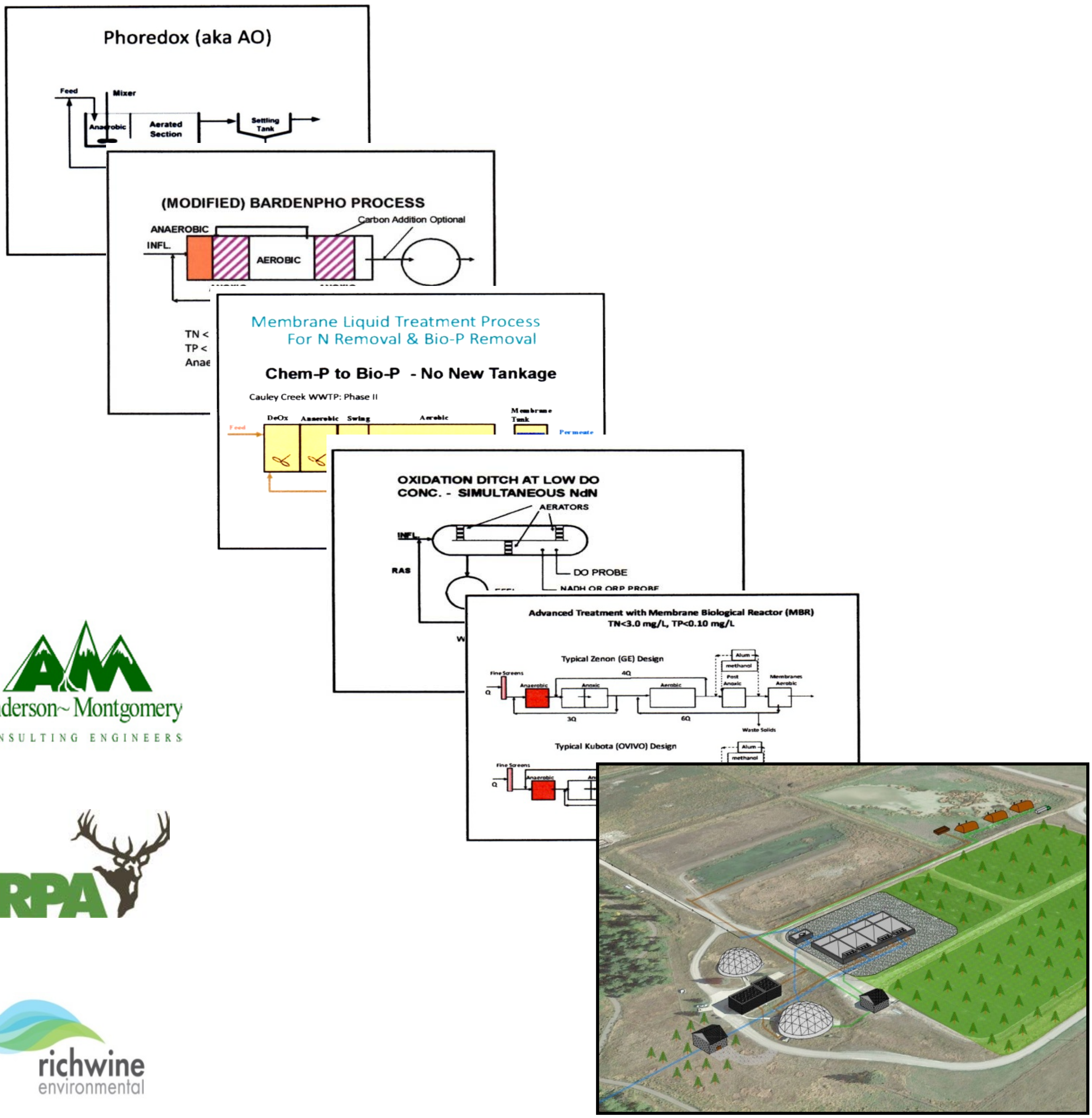
CITY OF WHITEFISH

2016 WASTEWATER SYSTEM IMPROVEMENTS PROJECT

PRELIMINARY ENGINEERING REPORT

OCTOBER 2016



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Chapter 1 Executive Summary

1.1 Introduction

This executive summary briefly describes the chapter contents for the *City of Whitefish 2016 Wastewater Systems Improvements Project - Preliminary Engineering Report (PER)*, conclusions and recommendations arising from this document. The primary impetus behind the project pertains to new wastewater treatment standards implemented by the Montana Department of Environmental Quality (DEQ) through the latest discharge permit issued to the City in 2015. New requirements for removal of ammonia, nitrogen and phosphorous were included in the new permit. The lagoon system, originally constructed in 1979, has served the City well but is approaching the end of its useful design life. The existing treatment facility cannot be made to meet the new standards without major reconstruction. This engineering study considered alternatives to address the existing permit as well as position the City for anticipated new limits that have been proposed by the DEQ for the next 5 and 10 years respectively, as the discharge permit is renewed. In development of treatment alternatives, the re-purposing of existing plant components that were constructed more recently than the lagoons was stressed to optimize the value of the earlier investment.

Outside of this planning document, a Nutrient Reduction and Trading Plan was recently prepared by Robert Peccia and Associates in conjunction with Anderson-Montgomery to consider non-plant options for nutrient reduction, such as storm water control or reduction of wastewater discharge volume through irrigation. These alternate measures for nutrient reduction were brought forth to this engineering report and are discussed in Chapter 5.

1.2 Basis of Planning

Determination of the usage of the wastewater system is dependent on land use, population density, the magnitude and type of commercial and industrial activity to be served, the condition of the existing system and regulatory requirements. The area studied in this document was established through meetings with the City Public Works and Planning Staff by examination of property ownership, zoning, planning jurisdiction and environmental conditions. The study area boundary, as decided by the planning team, is similar to the boundary used in a previous Wastewater PER prepared in 2008, with updates in 2014.

Estimates of population were developed using 2000 census data and 2010 census data and reflect a lower growth rate than that experienced in the area in earlier planning documents, when growth rates were high during the housing boom in early 2000. In reviewing the 2010 Census, it shows that the City of Whitefish's growth for the 2000-2010 period was 26.33% or a 2.37% average annual growth. Historically, the City has had an average annual growth of 1.75% over the last 40 years. Also, the 2010 Census projected an average annual growth rate of 1.9% between 2005 and 2025 for Flathead County. Based on review of a more current historical growth rate in the community plus consideration of the 2010 census data, it was decided to use an average <u>annual growth rate of 1.9% for the 20 year planning period</u>.

Theoretical build-out assumes that all developable land within the study area will be developed, giving a maximum density for the study area. **Table 1.1** summarizes the current and predicted study area population as well the population projected to be connected to the sewer utility in the same area.

Table 1.1 Predicted Study Area Population

	2015	2025	2035	Ultimate Build-out
Existing and Proposed Sewer Service Planning Area Population	11,661	14,076	16,992	36,929
Existing and Proposed Sewer Service Area **Connected** Population	8,033	9,697	11,705	36,929

The City of Whitefish had an estimated population of 6,984 in 2015, obviously less than the connected population identified in the table above. To effectively conduct facilities planning it is necessary to set a potential service area boundary, which may not reflect the boundaries of the City proper. The service area is the projected area in which municipal services can or may be extended depending upon needs and demand. Criteria examined in setting the potential service area boundary included environmental factors, public health protection, groundwater quality protection, surface water quality protection, land use planning and growth management, cost of service, the political environment and geophysical characteristics. The boundary for the proposed future wastewater service area was based on examination of the criteria described above, meetings and discussions with City staff, and comparison of predicted population growth with the capability of the proposed service area to accommodate the predicted growth.

These predictions are based on presumption that growth will occur in the Whitefish area at a relatively modest rate, similar to long-term community growth rates. These population values will be used in subsequent chapters of this report to predict demand on the wastewater system and to evaluate existing unit processes.

1.3 Wastewater Loads and Characteristics

Monthly flow and organic loading data was evaluated for a three year period, from 2012 through 2014. Based on this data, the average waste strength and flow is as follows:

BOD_5	**297 mg/l**
TSS	**239 mg/l**
Phosphorous	**6 mg/l**
Ammonia	**25 mg/l**
Average Daily Flow per capita	**128.7 gpcd**
Average Daily Flow per capita (wet weather)	**154.5 gpcd**

Earlier data was not used to prepare the estimates above in that a project was completed in 2012 to remove clear water from the sewer system, effectively resulting in a stronger waste strength.

Waste strength has increased significantly, almost 49% stronger in the concentration of BOD_5, since the last PER prepared in 2008. This increase in wastewater concentration reflects the ongoing efforts of the City to remove infiltration and inflow (I/I) of clear water from the collection system. The organic (BOD_5) and solids load is higher than is typically found at 0.32 lbs/capita for BOD_5 and 0.256 lbs/capita for TSS. The service area includes facilities that support the tourism trade with a relatively higher number of hotels and restaurants than is typical for a town of this population. The regional hospital also is a significant contributor to load. These facilities are not included in the connected population figure, so the use of higher per capita loads provide for the inclusion of these facilities in the treatment plant loads. Reduction of I/I allows for reduced sizing of new wastewater treatment unit processes and a corresponding savings in cost. Additionally, the biological treatment processes used in wastewater plants function more effectively if waste strength is not diluted with clear water.

Project Design Criteria are developed in a PER to evaluate treatment alternatives, size unit processes, prepare preliminary design drawings and prepare estimates of cost. The design criteria for this project are shown in the table below:

Table 1.2 CITY OF WHITEFISH WASTEWATER IMPROVEMENTS DESIGN CRITERIA

	2013	2015	2020	2025	2035
Planning Area	11,230	11,661	12,812	14,076	16,992
Connected Pop.	7,736	8,033	8,826	9,697	11,705
Q_{avg}	0.996	1.034	1.136	1.248	1.507
$Q_{\text{wet weather (6 month period)}}$	1.195	1.241	1.363	1.498	1.808
Q Max Day		4.266	4.342	4.355	4.530
AVG BOD (lbs/day)	2467.8	2562.5	2815.4	3093.3	3734.0
MAX BOD	3289.6	3415.8	3753.0	4123.4	4977.4
TSS (lbs/day)	1980.4	2056.4	2259.4	2482.4	2996.5
Ammonia (lbs/day) ***25.03 mg/l Avg Conc.***	208.9	216.9	238.3	261.8	316.0
Total P (lbs/day) ***6.0 mg/l Avg Conc.***	49.83	51.74	56.85	62.46	75.40
TKN Avg 41.4 mg/l					
Alkalinity 265.6 mg/l					
	Dec	Jan	Feb	Mar	Apr
Avg Influent Temp (*^oC*)	9.5	8.8	8.1	8.2	9.2

1.4 Existing Wastewater Treatment and Collection

1.4.1 Wastewater Treatment Plant

The existing wastewater treatment facilities consist of 3 partially mixed aerated lagoons for biological treatment with the discharge from the lagoon system flowing to a flocculating clarifier where alum and polymers are added to precipitate phosphorus. Flow to the lagoons is screened by a perforated mechanical screening system. Design capacity for the lagoons, built in 1979, is 1.25 MGD based on average daily flow. New pretreatment facilities and a second, redundant flocculating clarifier were constructed in 2008-09. A temporary disinfection system using sodium hypochlorite and chlorine neutralization was constructed in 2012. More specific design criteria for the existing facilities are as follows:

Pretreatment Facilities

Perforated Plate Mechanical Bar Screen	6.0 MGD Peak Capacity
Manual Bar Screen	9.0 MGD Peak Capacity
Screenings Washer/Compactor	6.0 MGD Peak Capacity
Odor Control Biofilter	1.4 CFM/SF
New Natural Gas Auxiliary Generator	150 KW
Bypass Pumping Capability for Existing Lift Station	

Aerated Lagoon System

	Cell #1	Cell#2	Cell#3
Volume (2' to 15' depth)	16.97 MG	8.52 MG	8.52 MG
Detention Time @ 1.25 MGD	13.6 days	6.8 days	6.8 days
Sludge Storage (0' to 2" depth)	260,200 cf	124,900 cf	124,900cf
Surface Area	4.93 acres	2.55 acres	2.55 acres

Advanced Treatment Facilities

Existing Flocculating Clarifier	1.8 MGD ADF Design Capacity
New Flocculating Clarifier	2.33 MGD ADF Design Capacity
New Mechanical Mixer for New Clarifier	
Redundant Alum and Polymer Feed Systems for Both Clarifiers	
New Natural Gas Auxiliary Generator	150 KW

The treatment system has consistently met the requirements of previous MPDES discharge permits regarding effluent quality. While the existing system is sized sufficiently to handle future growth, the age of the system and the inability of the treatment plant to remove nutrients and ammonia results in a need to look at a major upgrade or replacement of many of the existing facility's components.

1.5 Regulations

Water pollution degrades surface and ground waters, potentially making them unsafe for drinking, fishing, swimming, and other activities. Accordingly, the State and Federal regulatory agencies have passed statutes with the intent of maintaining and restoring the beneficial uses of State waters. As authorized by the Clean Water Act and the Montana Water Quality Act, the Montana Pollutant Discharge Elimination System (MPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the State. The Montana Department of Environmental Quality (MDEQ) has adopted water quality standards that govern the discharge of wastewater which would cause a new or increased source of pollution to state waters. The Department also administers the MPDES program which authorizes and regulates all discharges to State surface waters. The Department develops design standards applicable to the design and construction of public water supply and wastewater systems.

Presently the treated wastewater from the Whitefish wastewater system is discharged directly into the Whitefish River, via an effluent diffuser. The Whitefish River flows southerly from Whitefish Lake to join the Stillwater River near U.S. Highway 2 east of Kalispell. The river then flows a short distance to Flathead Lake. The MPDES discharge permit is the primary mechanism whereby the DEQ regulates the quality of the effluent discharge of wastewater from the wastewater system to the Whitefish River. The discharge permit established criteria for implementing the National Secondary Treatment Standards, Montana Water Quality Standards, the recently adopted numeric nutrient standards and Non-degradation based load limits.

Current Compliance - The existing facilities cannot consistently meet the new standards for ammonia and will have difficulty in meeting the limits for total nitrogen as the system adds additional users. In review of 6 years of monthly effluent data for 2010 through 2015 eighteen violations of the load limits in the current discharge permit for Total Nitrogen were noted. During the same period, several violations of the ammonia limit were shown for each year, primarily when the lagoons were not nitrifying. Ammonia values for the five year period are under the permit limit of 9.6 mg/l for a 1-2 month period, typically during July and August. Additionally, a number of exceedances of the *E. Coli* bacteria limits were noted in the period of record considered.

Total Nitrogen and Total Phosphorous – The current permit contains new limits for nutrients based on the numeric nutrient standards recently adopted by the DEQ. The DEQ anticipates a process that will “ratchet down” effluent standards via the variance process until the final water quality standards are met. The following schedule indicates the process contemplated by the DEQ to reduce nutrient concentrations in the discharge. The schedule for systems with flows greater than 1.0 MGD is applicable to Whitefish.

<u>Facilities > 1 MGD:</u>
A. Current general variance: 10 mg TN/L, 1.0 mg TP/L **-per statute**
B. Next permit (+5 years): 8 mg TN/L, 0.8 mg TP/L
C. Next permit: 8 mg TN/L, 0.5 mg TP/L
D. Next permit: *Under Development*

<u>2. Facilities < 1 MGD:</u>
A. Current general variance) 15 mg TN/L, 2.0 mg TP/L **-per statute**
B. Next permit (+5 years): 12 mg TN/L, 2.0 mg TP/L
C. Next permit: 10 mg TN/L, 1.0 mg TP/L
D. Next permit: 8 mg TN/L, 0.8 mg TP/L

Variances from Nutrient Standards – The numeric nutrient standards as described above are very low in comparison to conventional available treatment technologies and approach the limits of technology. While smaller systems can address the limits by curtailing their discharge through the use of land application of treated effluent, larger systems generally cannot install land application systems in a cost-effective manner. The DEQ concluded that treatment of wastewater to base numeric nutrient standards would result in substantial and widespread economic impacts on a statewide basis and developed a procedure to grant a variance from the criteria. A permittee who meets the end-of-pipe treatment requirements provided in the table below may apply for and the Department shall approve a general nutrient standards variance. The Department will process the general variance request through the discharge permit, and include information on the period of the variance and the interim requirements. The general variance may be established for a period not to exceed 20 years. A compliance schedule to meet the treatment requirements as shown may be granted on a case-by-case basis.

General Variance End-Of-Pipe Treatment Requirements

Discharger Category	Total P (mg/L)	Total N (mg/L)
≥ 1.0 million gallons per day	1	10
< 1.0 million gallons per day	2	15
Lagoons not designed to actively remove nutrients	Maintain current performance	

If a low-cost technological innovation for lowering nitrogen and phosphorus concentrations in effluent were to become widely available in the near future, the Department could make more stringent the concentrations shown in the Table above. Permittees receiving a general variance are required to evaluate current facility operations in order to optimize nutrient reduction with existing infrastructure and shall analyze cost-effective methods of reducing nutrient loading including nutrient trading, land application and improved facilities operation.

Whitefish received a General Variance in their latest discharge permit for the discharge category being greater than 1.0 MGD, resulting in a Total P limit of 1.0 mg/l and a Total N limit of 10 mg/l. These limits were used to calculate allowable loads of total nitrogen and phosphorous in the permit, effective July 1st through September 30th of each year.

1.6 Recommendations for Wastewater Improvements

A systematic analysis of the existing wastewater treatment facilities was completed in this planning document, considering waste loads from existing sources and anticipated loads for a 20 year planning period. In Chapter 4, several wastewater treatment alternatives were developed to address new regulatory standards as described in the previous section. The continued use or repurposing of existing plant facilities with remaining useful design life was stressed in the development of treatment alternatives. Sustainable treatment technologies are recommended for incorporation into the design and construction of new unit treatment processes. Energy efficiency should be prime consideration in the selection of specific pumping, mixing and aeration equipment. Treatment processes employing proven technologies capable of meeting existing and anticipated regulatory standards should be utilized. Both initial capital and long-term operating costs should be considered when identifying the apparent best treatment option for the City.

1.6.1 Summary Recommendations for Wastewater Improvements

The recommended project includes replacement of the existing secondary treatment plant with a Sequencing Batch Reactor (SBR) capable of removing ammonia, nitrogen and phosphorous to fully comply with the requirements of the current MPDES discharge permit. Furthermore, the plant will be capable of meeting anticipated more restrictive nutrient standards proposed by the DEQ in the next two discharge permit cycles (5 and 10 years hence). Pretreatment of the wastewater will be provided by the existing perforated screen plus grit removal capability added by a new unit process. A four cell sequencing batch reactor will be constructed within the third lagoon cell whereas the existing lagoon cells will be retained for treatment during construction. Use of 4 cells allows continuous discharge from the system, eliminating the need for a post treatment flow equalization basin. Biosolids from the SBR plant will be discharged to an aerobic digester for further stabilization. The existing flocculating clarifier will be converted to a covered aerobic digester. After stabilization, biosolids will be sent to the existing drying beds for further dewatering and long-term storage. Periodically the solids can be removed for disposal at the landfill or land application. While not an immediate plan (or need), a small composting operation could be constructed on site within one of the old treatment cells utilizing biosolids and wood waste to generate compost. Disinfection of the treated effluent would be provided by ultraviolet disinfection. Chapter 4 provides a complete description of the recommended alternative, including drawings.

The estimated costs for the project are $17,366,666 including costs for construction (with a 3% inflation factor for construction in 2019), engineering, administration and a 15% contingency. Annual costs for operating the entire facility are estimated to be $780,480, which roughly equates to a $440,000 cost increase over the current operational cost. Detailed cost estimates for this option are included in Appendix D.

1.6.2 Funding Strategy and User Costs

A project budget strategy has been prepared which anticipates grant funding from the TSEP and DNRC programs matched by a SRF loan, including forgiving principal of the loan in the amount of $500,000. An alternative or supplement to the SRF loan is being investigated utilizing a Rural Development Loan and Grant combination. Whitefish, primarily due to its population, is eligible for RD funding but is not a good candidate for the limited funds. Initial project planning is proceeding without an assumption of obtaining an RD grant.

Table 1.3 provides the project budget using the identified funding program sources, amounts applied for and the ultimate user rate impacts based on an "Equivalent Dwelling Unit" calculation. If grants are obtained for the amounts listed, the average residential wastewater user rate will increase to an estimated rate of $76.28.

It should be noted that the construction costs in the proposed project were inflated by a 3% annual inflationary increase for a three year period to reflect anticipated costs increases in the construction industry.

Project Phasing – Project phasing may be necessary due to the high cost of the project, limited grant assistance and the associated high user costs. However the compliance schedule with the regulatory agency requires compliance by 2021. It may be appropriate to phase components of the plant that could be deferred without impacting compliance with the mandated schedule.

1.6.3 Affordability Analysis

According to the 2010 Census data, the City of Whitefish has a Median Household Income (MHI) of $ 43,117 with 40.98% considered "low to moderate" income, and a 17.3% poverty rate. Using the "Target Rate" concept used by the funding agencies, the current procedure would use a multiplier of 2.3% x MHI to determine what is considered to be a target combined water/sewer rate. For Whitefish, the combined water/sewer target rate would be calculated as follows:

$43,117 x 0.023 ÷ 12 months = **$82.64/month**

Current average combined monthly water rates in Whitefish are $90.10, which is in excess of the target water/sewer rate. Estimated increase for the proposed project will equate to a $25 to $30/month per EDU, depending on the loan term and grant amount. The projected water and sewer rate when the project is implemented is estimated to be $127.03 which would be 154% of the target water and sewer rate. For the target sewer rate alone, currently $32.34, the new predicted sewer rate of $76.28 would be 236% of the target rate.

This affordability analysis indicates that increased costs, even with grants and low interest loans, are high and will impose a financial burden on wastewater system users in the City. Those families with incomes below the median household income, especially those with poverty status, will be particularly stressed by the increase in costs. The availability of low income housing has been demonstrated to be a significant problem in Whitefish and the raising of sewer rates will undoubtedly impact rental property and resultant rental rates, further affecting the affordability of housing.

Table 1.3 PROJECT BUDGET FORM

Preliminary Project Budget	**Whitefish 2016 Wastewater System Improvements**				**May 3, 2016**
Administrative/ Finance Costs	**Source: RRGL**	**Source: TSEP**	**SRF**	**SRF Forgiven Principal**	**Total:**
Professional Services-Project/Grant Administration	$5,000	$15,000	$48,000		$68,000
Legal Costs			$70,000		$70,000
Audit Fees					
Travel & Training			$5,000		$5,000
Loan Reserves			$520,000		$520,000
Interim Interest					
Bond Counsel & Related costs			$50,000		$50,000
ADMIN/FINANCE COSTS:	**$5,000**	**$15,000**	**$693,000**	**$0**	**$713,000**
Prel. Engineer (Geotech)			$35,000		$35,000
Engineering/Arch. Design		$485,000	$510,000		$995,000
Construction Engr. Services			$1,040,200		$1,040,200
Construction	$120,000	$250,000	$11,783,466	$500,000	$12,653,466
Contingency			$1,930,000		$1,930,000
ACTIVITY COSTS	**$120,000**	**$735,000**	**$15,298,666**	**$500,000**	**$16,653,666**
TOTAL PROJECT COSTS	**$125,000**	**$750,000**	**$15,991,666**	**$500,000**	**$17,366,666**
Completed by: Scott Anderson					
Construction Cost increased by 3.0% inflation, 3 years					

Determination of Estimated Debt Monthly Cost			
Estimated Loan Amount		$15,991,666	
CRF 2.5% Interest, 20 year term		0.0641	
# EDUs		4862	
EUAC		$1,025,066	
EUAC w 10% Coverage		$1,127,572	
Monthly Cost		$93,964.36	
Monthly Cost per EDU		$19.33	

1.7 Implementation Schedule

The following schedule provides an achievable timeline for implementation of the needed wastewater improvements, presuming that affordable project financing can be obtained. This schedule is required to be met as per a regulatory action issued by the DEQ.

Task	Date of Completion
Complete Facilities Planning (PER)	Oct 1 2016
Submit Design Plans to DEQ	February 1 2018
Construction Completion	May 1 2021
Achieve Compliance	Nov 1 2021
Annual Progress Reports	January 2016-2021

1.8 Public Participation

A project meeting was held with the City staff to discuss the project on September 23, 2015. A Whitefish Council work session, with the inclusion of the public, was held November 16, 2015 to discuss the planning process and potential treatment options. A public hearing was held April 18, 2016 to further discuss the project and associated environmental impacts identified through the public review. Notice of the hearing was included in the local paper. A copy of the slides presented at the presentation is included in the appendices of this document. A final decision regarding the environmental Assessment was made by the City Council on May 2, 2016. The City also participates with the Whitefish Community Wastewater Committee which discusses local wastewater issues pertaining primarily to Whitefish Lake. This discussion often incorporates comments regarding the City's wastewater treatment and collection system, system needs and regulatory requirements.

An additional public meeting was held August 29, 2016 to allow for further discussion and exchange of information regarding the proposed new wastewater treatment facilities recommended in the draft Preliminary Engineering Report (PER) prepared for the City of Whitefish.

Chapter 2 Basis of Planning

2.1 Introduction

To plan for future wastewater facility needs, it is necessary to estimate existing and future wastewater flows and loads. Determination of the hydraulic and organic loading to the wastewater system is dependent on several factors including land use, population density, the magnitude and type of commercial and industrial activity in the area to be served, visiting population and employment impacts, the condition of the existing system and regulatory requirements. Physical and environmental features of the study area will have an effect on where growth occurs within the planning area. The purpose of this chapter is to identify current wastewater system loads and project future conditions as defined by projected population growth and restrictive features of the planning area. Environmental conditions will be considered.

2.2 Study Area Description

2.2.1 Introduction

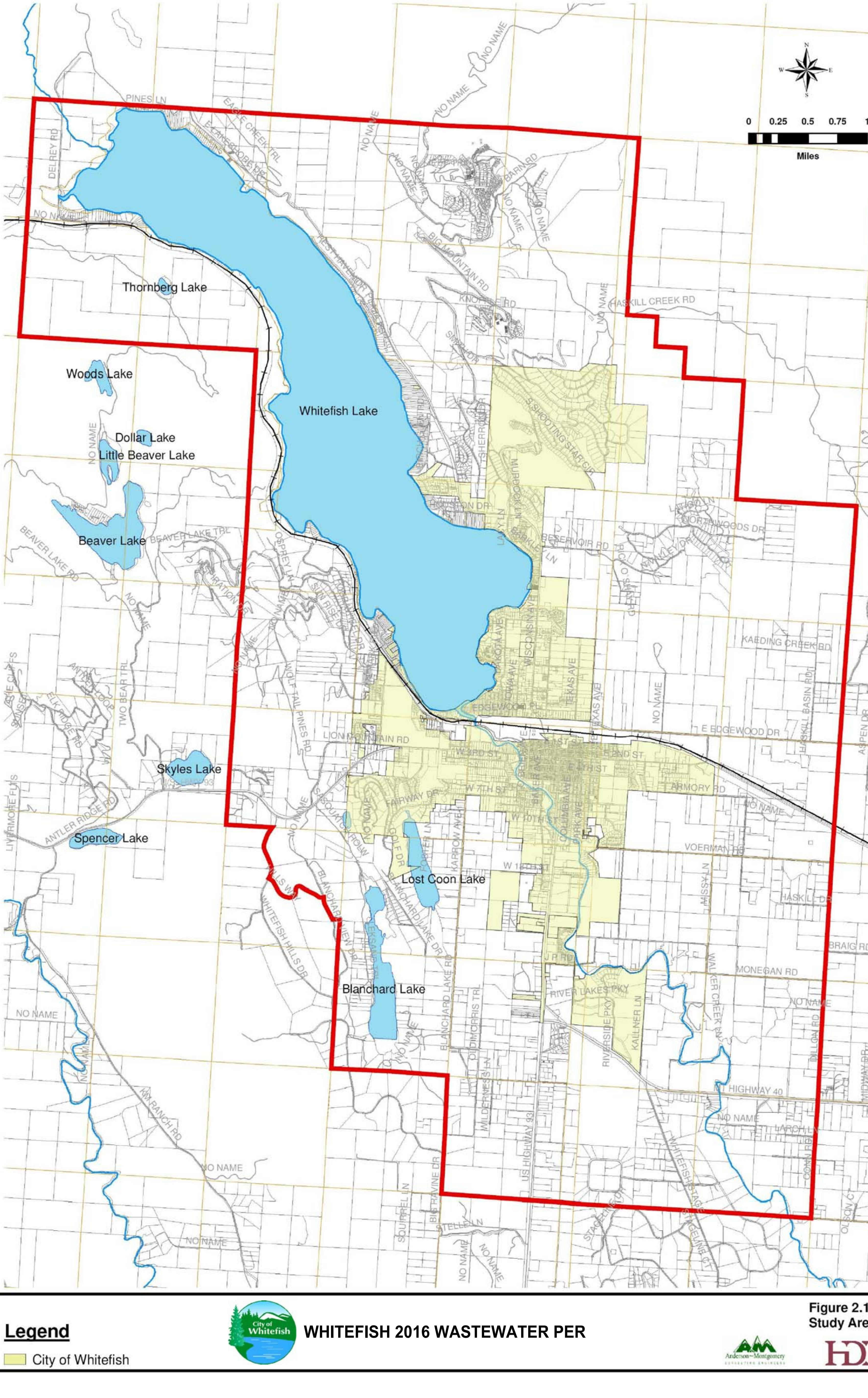
Wastewater flow generation for the future is determined, in part, by the size and the land use of the area to be served. The physical characteristics of the area to be served, such as topography, geology, and geographical location, greatly influence the type of land use and in turn the population density as well as commercial and industrial activity within the area. The planning investigation examines the physical characteristics of the study area, population densities, and land use that dictate water or wastewater service requirements in the future. The study area is then analyzed and a service area delineated based on the physical and economic feasibility of providing services.

2.2.2 Study Area Boundary Development

In development of wastewater planning documents in 2006 and 2008, meetings were held with staff from the city of Whitefish Public Works Department and the Tri-City Planning Office to discuss establishment of the study area boundary. Additional meetings were held between Whitefish Public Works and Planning Departments in 2013 to assess study and planning area boundaries as well as population projections. Property ownership, zoning, planning jurisdiction and environmental conditions were analyzed as well as development trends and a study area boundary established. The study area boundary, as decided by the planning team, follows the proposed Whitefish planning jurisdiction. **Figure 2.1** depicts the Whitefish Wastewater Facilities Plan Study Area including parcel information and City limits. **Figure 2.2** depicts the physical characteristics of the Whitefish area including topography, wetlands, and hydric soils.

2.2.3 Study Area Description

The study area is bounded by the north border of Sections 1, 2, 3, 4, and 5 of Township 31N, Range 22W; the west border of Sections 5, 8, 15, 22, 27, and 34 of Township 31N, Range 22W and Sections 11, 13, 24, 25, and 36 of Township 30N, Range 22W; the south border of



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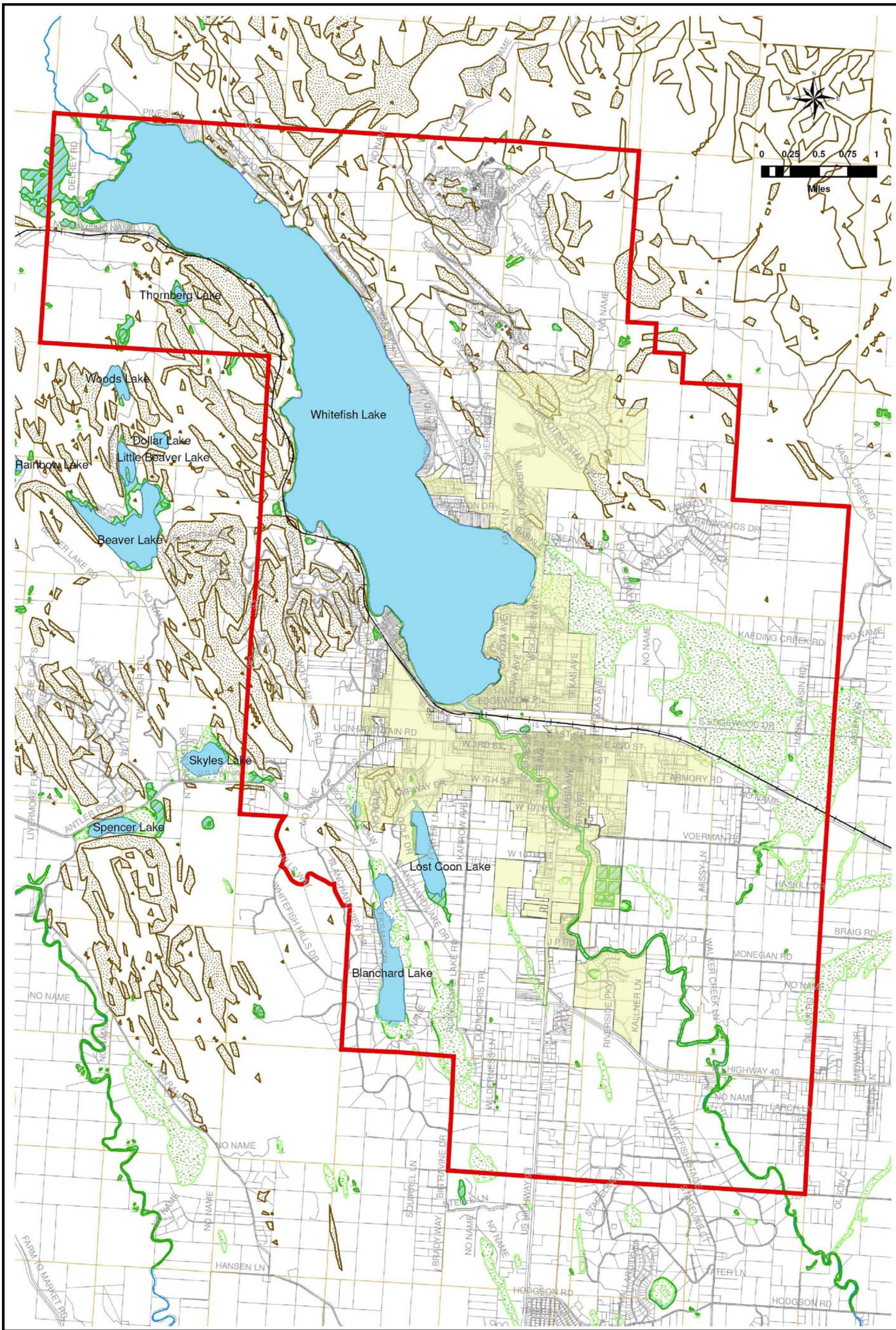
City of Whitefish

WHITEFISH 2016 WASTEWATER PER

Figure 2.1
Study Area



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- City of Whitefish
- Slopes > 30%
- Wetlands
- Hydric Soils

WHITEFISH 2016 WASTEWATER PER

Figure 2.2
Study Area Physical Characteristics

Sections 11 and 13 of Township 30N, Range 22W and Sections 16, 17, and 18 of Township 30N, Range 21W; and the east border of Sections 32, 29, 20, 16, 9, and 4 of Township 30N, Range 21W, and Sections 33, 28, 21, 17, 7 and 6 of Township 31N, Range 21W. The boundary of the study area follows the boundary of the proposed Whitefish planning jurisdiction.

The northwestern quadrant of the study area is comprised of Whitefish Lake and is characterized by steep forested hills. It is bounded in large part by state lands. The northeastern quadrant of the study area (north of the BNSF railroad tracks and east of Whitefish Lake) contains Big Mountain ski area, the Iron Horse and Northwoods Subdivisions and a nature conservancy. The area is characterized by forested hills to the north and swampy flat ground with some wetlands in the sections just north of the railroad tracks. There is a significant amount of developable property along the Big Mountain Road route. This area also contains part of the Haskill Creek drainage which is one of the main water supplies for the City of Whitefish. The southern half of the study area is dissected by the Whitefish River, with several small lakes and wetlands to the southeast. The southern half of the study area contains the majority of the developable property within the study area.

2.3 Environmental Attributes of the Study Area

The environmental features of the planning area impact the extension of infrastructure into undeveloped areas and can also affect the construction practices used to install new facilities. Sensitive environmental areas such as wetlands or open spaces will redirect development into areas more suitable for residential or commercial utilization. The following summary of the environmental characteristics of the planning area provides a general background on the natural features that exist in proximity to the City of Whitefish**.**

2.3.1 Geology and Soils

The geology of the Study Area is comprised of uplifted ancient sediments that created mountains, glacial deposits, and subsequently weather erosion of exposed materials. Materials likely to be encountered include glacial deposits, alluvium and Precambrian sedimentary rock of the Belt series.

Glacial deposits consisting of lacustrine silt, clay, gravel, glacial drift, and alluvial fan materials cover the majority of the Study Area. These materials may be found in the level to gently rolling terrain that exists across much of the upper Flathead Valley. Alluvium is found along streams and bordering the Whitefish River. The alluvium typically consists of silt, sand, gravel, and cobbles eroded from bedrock or glacial outwash deposits. The Belt series sedimentary rocks (typically limestones, dolomites, and argillites) underlie the Flathead Valley and form the mountains that surround the Study Area.

Several faults cross the planning area. The Whitefish and Stryker Faults are northwest to southeast trending faults that occur on the east and west sides, respectively, of Whitefish Lake. The Elk Divide Fault is southwest to northeast trending fault located south of Whitefish lake. The Study area is located in a relatively active seismic zone and has a moderate potential for experiencing a large damaging earthquake.

Several groups of soils dominate the planning area including the Whitefish association; Half Moon-Depew-Stryker association; Creston-Flathead-Blanchard, Mires-Blanchard association, and Half Moon-Haskill association. These soils are generally deep, well drained, and have textures ranging from loamy to sandy or gravelly. Soils in the planning area were developed in glacial till, outwash, or alluvium under forest or grass cover. With the exception of Whitefish soils, which are found on moderate to steep terrain, most soils occur on level to gently sloping lands.

Soils information suggests that a large portion of the planning area south and east of Whitefish Lake has soils with limitations for septic systems. The Half Moon silt loam soils, which cover most of the immediate Whitefish area, have severe restrictions for septic systems due to slow permeability. Excessive slopes, shallow bedrock, and shallow groundwater may limit the use of conventional septic systems on lands north of the City to the east and west of Whitefish Lake.

2.3.2 Surface Water

The Study Area is located in the Upper Flathead River Basin. Major surface waters include Whitefish Lake, Blanchard Lake, the Whitefish River and its tributaries. Whitefish Lake encompasses a surface area of five square miles and is up to 220 feet deep. It is 5.7 miles long and 1.4 miles wide and has approximately 15 miles of shoreline. It is used primarily for recreation and is a major source of drinking water for the City of Whitefish. Water quality in Whitefish Lake is characterized by low hardness and negligible iron, manganese, and dissolved minerals. It is consistent in seasonal water quality, other than potential algae blooms.

The Whitefish River flows southerly from Whitefish Lake to join the Stillwater River near U.S. Highway 2 east of Kalispell. The river then flows a short distance to Flathead Lake. The Whitefish River and Flathead Lake are both TMDL listed bodies of water. Major tributaries of the Whitefish River include Haskill Creek, Walker Creek, and Trumbull Creek. Haskill Creek is a major source of drinking water for the City of Whitefish. Water quality in Haskill Creek is generally quite high and is low in turbidity, hardness, and dissolved inorganics. Seasonal runoff, from snowmelt or thunderstorms, can increase turbidity temporarily.

2.3.2.1 Upper Whitefish River

<u>*Whitefish Area Water Resources Report: A Status of The Whitefish Lake Watershed and Surrounding Area, 2015*</u> published by the Whitefish Lake Institute provides the following information specific to the upper Whitefish River:

1. Background

"The uppermost reach of the Whitefish River flows from the Whitefish Lake outlet for approximately 2.5 miles through Whitefish City limits. After city limits, it transitions through a private property mix of residential and agricultural use until the Highway 40 Bridge. Beyond the Highway 40 Bridge is outside the scope of this study. Whitefish Lake buffers the discharge conveyed to the Whitefish River during the peak of the hydrograph and during storm events. Relyea (2005) reports that this buffering effect yields less erosional and depositional activity resulting in less floodplain development along the main channel. In other words, the water in the channel tends to stay in the channel with little lateral exchange. In addition, the buffering effect of Whitefish Lake and the low valley gradient make this river susceptible to impacts from increased sediment loading from its inability to transport material.

By 1987, the Landsat image shows that the upper Whitefish River had extensive urban and agriculture use, with an expansion of urban area and a decrease of agricultural area by 2011."

2. Biological Resources

Fisheries

"MFISH reports brook trout, bull trout, rainbow trout, westslope cutthroat trout, largescale sucker, longnose sucker, mountain whitefish, northern pike, northern pikeminnow, peamouth chub, redside shiner, and slimy sculpin in the Whitefish River based on professional judgment. A genetic sample targeting westslope cutthroat trout in 2001 showed 98.20% rainbow trout and 1.8% westslope cutthroat trout from a sample of 15 fish."

Macroinvertebrates

"In 2015, only 4 mayfly taxa, dominated by the baetid Acerpenna pygmaea (40 specimens, 8.1% of the assemblage) were found at this site. The biotic index value (7.02) was elevated above expectations and the highest of any site in this study. Tolerant organisms composed 40.2% of the assemblage and only 1 sensitive taxon, the chironomid, Heterotrissocladius sp., represented by 1 specimen, was collected. Collectors were 81.3% of the functional feeding composition of the assemblage. The dominance of the filterer and gatherer functional feeding groups and the elevated biotic index suggest that water quality is impaired at this site and the impairment may result from nutrient enrichment. The high relative abundance of hemoglobin-bearingorganisms (11.2%), including several hemoglobin-bearing midges (e.g., Microtendipes sp. (2.8%), Ablabesmyia sp. (2.4%)), suggests that hypoxic substrates may be present at this site.

There was no evidence of metals contamination. No cold stenotherm taxa were collected at this site. The temperature preference of the assemblage was 18.3 °C, the highest among all the sites. There were 3 caddisfly taxa and only 3 "clinger" taxa found in the sample, suggesting that fine sediment limits colonization in this reach. The FSBI (3.57) indicated an assemblage with moderate tolerance to fine sediment deposition. The data indicated that in-stream habitats were intact and probably diverse because taxa richness was moderately high (37). No stonefly taxa were found in this sample indicating impacts to channel morphology and stream banks. Only 1 long-lived taxon was collected, indicating that scour, toxic inputs, and thermal extremes could not be ruled out as impacts in this reach. The functional feeding groups were dominated by gatherers (62.9%) and filterers (18.7%) suggesting the importance of fine particulate organic matter to the energy flow of the system."

3. Habitat

"No habitat information exists for this stream. However, the river is low gradient with high amounts of fine sediment."

4. Water Chemistry

"From the lake outlet to the end of the project area, the Whitefish River is subject to inputs from groundwater, tributaries, storm water and the City of Whitefish Sewage Treatment Plant point discharge. This sampling site is near the outlet of Whitefish Lake, to account for lake export. WLI started collecting water chemistry information on Whitefish River in 2009. Whitefish River water chemistry summary figures for Total Phosphorus, Total Nitrogen, Total Organic Carbon, and Total Suspended Solids can be found in Chapter XXII Addendum C Water Chemistry and Temperature Information. Results for Total Phosphorus and Total Nitrogen fall within the Montana Wadeable Streams and Rivers Nutrient Criteria.

Downstream of the WLI sampling location on the Whitefish River, Relyea (2005) reported that the Whitefish Wastewater Treatment Plant during the 2003/4 water year discharged between 0.5 to 4% of the total discharge of the river. The report noted the disproportionately high degree of influence this effluent has on the river can be explained by the oligotrophic nature of the river source. The WWTP is a secondary treatment plant with a tertiary treatment process to remove phosphorus through the use of a flocculating clarifier. Some practical improvements are possible to upgrade the existing system to a tertiary treatment capable of removing both phosphorus and nitrogen. Land application of a portion of the plant's effluent flow may also be viable.

In 2007, WLI presented information to the Whitefish City Council from independent testing related to the release of petroleum products into the Whitefish River via a series of seeps along the shoreline near Town Pump. In that presentation, the chemical analysis of benzene leaking into the Whitefish River was shown to be 39 times the Maximum Contaminant Level for drinking water. That presentation prompted an August 13th, 2007 letter from the City Council to DEQ urging prompt attention to this issue. DEQ's response was that they have known about this problem since January 2003. The DEQ letter states that "although there have been delays in investigating the cause of the seep and designing corrective measures, this work is progressing at an acceptable rate." Full remediation is still pending for this site."

5. Water Temperature

"2014 continuous temperature data for the upper Whitefish River can be found in Chapter XXII Addendum C of the Water Resources Report. Water temperature for this year peaked on August 6-7th at 75°F. Water temperature data from 2009-2013 often show temperatures in the 70s°F which can stress salmonid species and life stages. The Upper Whitefish River temperature is affected by the release of warm epilimnetic water from Whitefish Lake."

6. Groundwater Resources and Quality

"The Flathead Valley is underlain by extensive groundwater aquifers which supply much of the water used by residences, agriculture, and industry. The aquifers can be categorized into three major types: shallow aquifers in sands and gravels (found at depths of less than 250 feet); deeper, artesian aquifers in unconsolidated sands and gravels (found at depths from 250 to 500 feet); and deep bedrock aquifers. The shallow and deeper sand and gravel aquifers have been widely tapped for domestic and agricultural uses. Precipitation, infiltration from streamflow during spring runoff, and percolation of irrigation water are the main sources of recharge for the shallow aquifers and deeper artesian aquifers. The bedrock aquifers are less important as water sources in the planning area since yields are not as significant as in shallower aquifers, and development of these sources has been less.

Groundwater chemistry varies in the aquifers but generally is of good quality. The groundwater in the planning area often has a tendency to be "hard" due to the limestone bedrock and glacial deposits derived from the similar bedrock materials. Groundwater in the planning area may also be relatively high in iron and/or manganese content.

In the immediate Whitefish area, several glacial moraines create significant variability in groundwater aquifers. Formations are discontinuous and convoluted in the shallower regions, based on well logs. Appreciable differences in types and extent of water bearing strata are encountered. Water quality in the sands and gravels is also sporadic, with hardness, iron, and/or manganese often present at nuisance levels. Contact with diverse mineral deposits is theorized as a cause for reduced quality.

Shallow groundwater within the municipal area is, at least seasonally, very close to the surface. The railroad tracks bisect a large, relatively flat, low lying area of the community, and groundwater depths there are only one to three feet. A perusal of well logs in and around Whitefish indicates considerable variability in groundwater depth. On higher land north of Woodland Place (two blocks north of the railroad) groundwater depths increase to 30 to 50 feet. In proximity to the lake, groundwater depths are predictably shallow and tied to the surface water elevation."

2.3.3 Groundwater

Groundwater in the Study Area often has a tendency to be "hard" due to limestone bedrock and glacial deposits and may also be relatively high in iron and/or manganese content. Groundwater aquifers in the immediate Whitefish area are significantly variable due to several glacial moraines. Formations are discontinuous in the shallower regions, based on well logs. A study of groundwater alternatives completed as part of the 1996 Water Master Plan Update concluded that an adequate supply of quality groundwater would be difficult to obtain for use in serving the City of Whitefish public water system. This study led to the construction of a surface water treatment plant to treat Whitefish Lake and Haskill Creek supplies.

2.3.4 Floodplains

Federal Emergency Management Agency (FEMA) floodplain maps show in the Study Area the existence of 100-year floodplain along the Whitefish River. This floodplain exists in a narrow band (100 – 200 feet wide) that parallel's the river channel. Floodplains associated with smaller tributary streams are restricted to or closely follow the permanent stream channel. Narrow floodplains also exist along the shores of Whitefish Lake. **Figure 2.3** provides a floodplain map developed by FEMA.

2.3.5 Biological Environment

Vegetation in the Study Area is categorized by agriculture, coniferous forest, deciduous woodlands, and riparian zone vegetation. Agricultural lands, located predominantly to the south and east of Whitefish, are used to grow wheat, barley, oats, rye, and hay. They are also used for pasture. Plants associated with pasture land are various clovers, timothy, fescue and bluegrass. Vegetation in riparian zones along the Whitefish River and in wetlands typically consists of cottonwoods, willows, alders, and dogwoods with an understory of numerous forbs and grasses. Deciduous woodlands may be found in upland and riparian areas and often contain vegetation similar to that found in riparian zones. Upland areas may contain aspen, larch and sometimes cottonwood. The understory vegetation in deciduous woodlands may also include various shrubs. Coniferous forest is scattered throughout the Study Area. Species common to these areas are white spruce, Douglas-fir, lodge pole pine, with an understory of grasses and shrubs.

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Floodway Data table shown on this FIRM.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

FEMA recommends that a Flood Insurance Policy be purchased for structures in areas where **levees** are shown as providing protection from the 1% annual chance flood. Flooding is not covered by standard property/fire/dwelling insurance policies nor is it covered by Homeowners Insurance, Renters Insurance, Condominium Owners Insurance, or Commercial Property Insurance. Contact your insurance agent and local floodplain administrator for further information.

Visit http://www.fema.gov/pdf/fhm/frm_gsah.pdf for information on levees and the risk of flooding in areas shown as being protected by levees.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey, NOAA
Silver Spring Metro Center
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from U.S. Geological Survey Digital Orthophoto Quadrangles produced at a scale of 1:12,000 from photography dated 1990 or later.

This map reflects more detailed up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

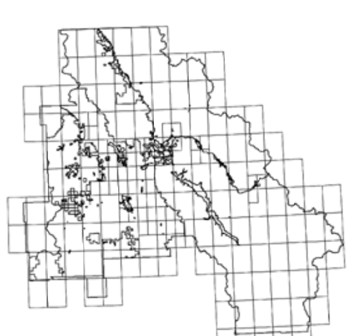
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1- 877- FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.

Flathead County Vertical Datum Offset Table

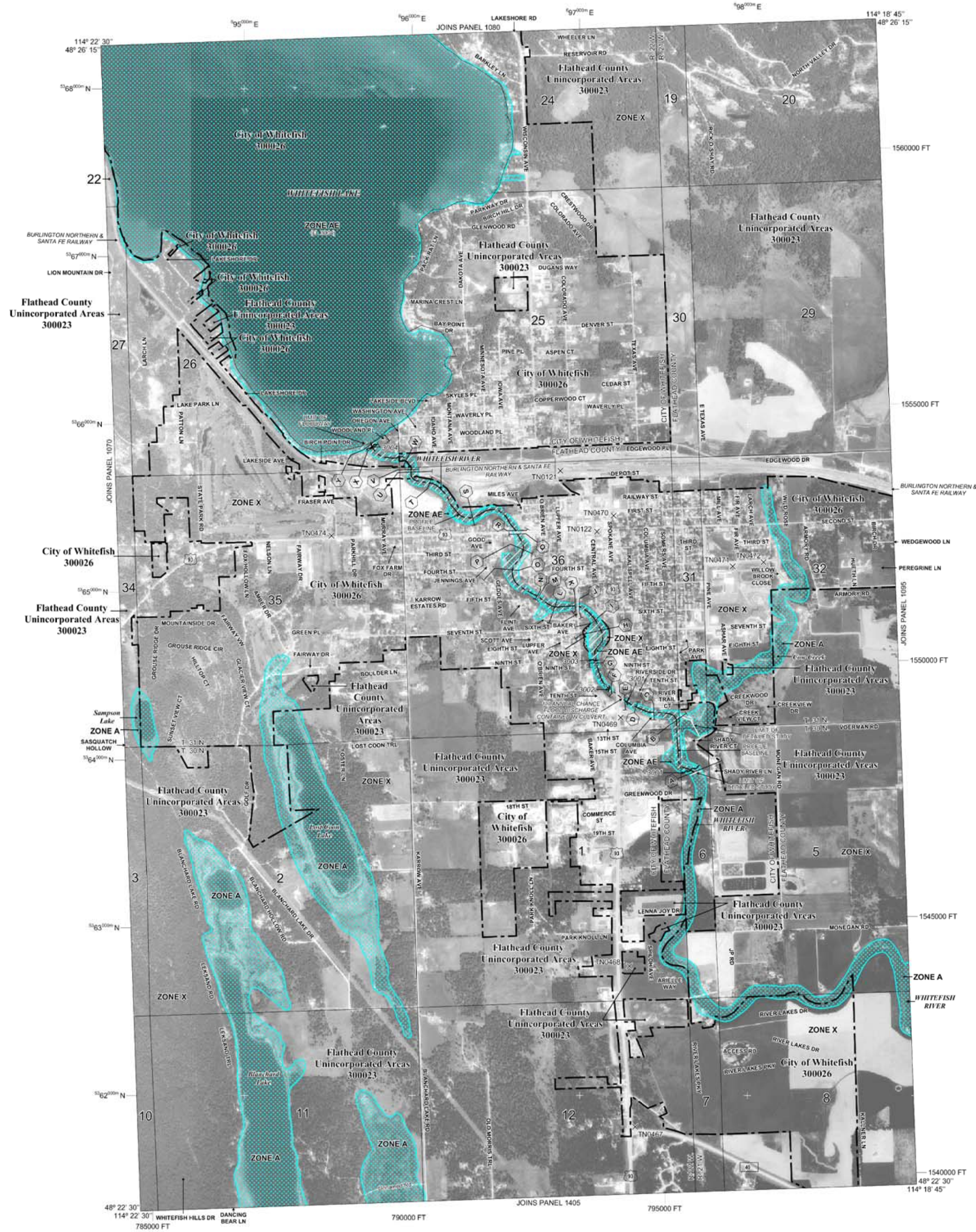
Flooding Source	Vertical Datum Offset (ft)	Flooding Source	Vertical Datum Offset (ft)
Whitefish River	3.8	Whitefish Lake	3.9

Example: To convert Whitefish River elevations to NAVD 88, 3.8 feet were added to the NGVD 29 elevations.

Panel Location Map



As per the Administrative Rules of Montana (ARM) 36.15.501(6), "The designated floodplain boundary is based on base flood elevations. The mapped floodplain boundary may be used as a guide for determining whether property is within the designated floodplain, but the exact boundary shall be determined according to the base flood elevation. If the local administrator determines it is unclear whether property is in or out of the floodplain, the local administrator shall require the applicant to provide additional information which may include elevations obtained through a level survey performed by a professional engineer or registered land surveyor."



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

~~513~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

(A)——(A)	Cross section line
(23)- - - - - -(23)	Transect line
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
4989000m N	1000-meter Universal Transverse Mercator grid values, zone 11
4989000 FT	5000-foot grid ticks: Montana State Plane coordinate system, (FIPS Zone 2500), Transverse Mercator
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1090G

FIRM
FLOOD INSURANCE RATE MAP
FLATHEAD COUNTY, MONTANA
AND INCORPORATED AREAS

PANEL 1090 OF 3525

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
FLATHEAD COUNTY	300023	1090	G
WHITEFISH, CITY OF	300026	1090	G

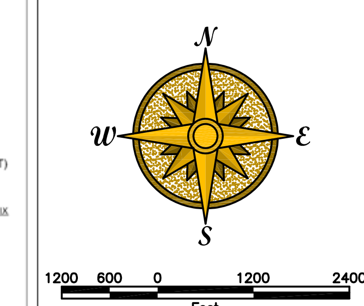
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
30029C1090G
EFFECTIVE DATE

Federal Emergency Management Agency

Anderson~Montgomery
CONSULTING ENGINEERS
1064 No. Warren
Helena, MT 59601
Phone: 406-449-3303
FAX: 406-449-3303

Figure 2.3
FEMA Flood Insurance Rate Map for the City of Whitefish, Montana



Project: Whitefish 2016 PER

Date: April 2016

File: FEMA Flood Map.dwg

2.3.6 Wildlife and Important Habitat

The Study Area supports a variety of wildlife species. Increased human development has placed considerable pressure on habitat in the Study Area. **Table 2-1** summarizes common wildlife resources and associated habitats in the Study Area. The Montana Department of Fish, Wildlife & Parks has mapped critical habitats for several wildlife species in the Whitefish Study Area. According to this mapping, winter range for White-tailed Deer, Mule Deer, and Elk exists along the south and west edges of the Study Area and north of the upper half of Whitefish Lake. Winter range is considered critical for these species.

Important habitats for terrestrial furbearers (Marten, Fisher, Wolverine, and Lynx) are located in the upland areas to the west, north and northeast of Whitefish Lake. These species make use of a variety of habitats during the year and are considered to be a sensitive wildlife species in the greater Whitefish area. The lakes and riparian areas found in the planning area provide potential nesting habitat for a wide variety of waterfowl.

Whitefish Lake contains six species of trout, kokanee salmon, and fifteen other species of fish. Swift Creek, a major tributary of Whitefish Lake, is rated as a high priority fishery resource according to a ranking system established by the Montana Department of Fish, Wildlife & Parks. Lazy Creek, Haskill Creek, and the Whitefish River are rated as moderate fishery resources. Use of the Whitefish River by fish is limited due to the high amount of sediment present in the stream. However, this stream serves as migration route for bull and west slope cutthroat trout moving between tributaries of the rivers and Flathead Lake.

Threatened or endangered species that would be expected to be encountered in the Study Area include the Bald Eagle and the Grizzly Bear. A travel corridor for the threatened grizzly bear is known to occur in the Haskill Basin area northeast of Whitefish. There have been increased sightings and encounters with grizzly bears in recent years. This increase is thought to be due to a combination of increased development in bear habitat, recent forest fires, and drought causing bears to look to lower lying lands and human resources such as garbage, pet food, and bird feeders for food.

Table 2.1 Wildlife Resources in the Whitefish Area

Wildlife Group	Common Representative Species	Associated Habitats
Large Mammals	White-tailed Deer Mule Deer Elk Moose	Coniferous forest Deciduous Woodlands Riparian Agricultural Lands
Small Mammals	Deer Mouse Skunk Raccoon Weasel	Coniferous forest Deciduous Woodlands Riparian Agricultural Lands Urban/developed Lands
Furbearers	Coyote Beaver Muskrat Marten Wolverine Fisher Lynx	Coniferous forest Deciduous Woodlands Riparian Agricultural Lands Urban/developed Lands

Waterfowl	Canada Goose Redheads Wood Duck Merganser Lesser Scaup Mallard Goldeneye Widgeon Teal Red-necked Grebe	Riparian Wetlands Aquatic
Upland Game Birds	Turkeys Ring-neck Pheasants Hungarian Partridge	Coniferous forest Riparian Agricultural Lands
Raptors	Osprey Red-tailed Hawk American Kestrel Swainson's Hawk	Deciduous Woodlands Riparian Agricultural Lands
Songbirds/passerine	Yellow Warbler Vesper Sparrow Meadowlark Eastern Kingbird Black-billed Magpie	Coniferous forest Deciduous Woodlands Riparian Agricultural Lands Urban/developed Lands Wetlands
Reptiles/Amphibians	Common Garter Snake Bull Snake Painted Turtle Leopard Frog	Deciduous Woodlands Riparian Agricultural Lands Wetlands Urban/developed Lands

2.3.7 Wetlands

Wetlands are protected by Section 404 of the Clean Water Act and work in wetlands may require coordination with both federal and state water quality agencies and the issuance of a permit by the U.S. Army Corps of Engineers. Wetlands are important and sensitive environmental areas that serve many beneficial functions including ground water recharge, flood control, filtering of surface water runoff, and providing essential wildlife habitat. **Figure 2.2** shows areas of known wetlands within the Study Area. It should be noted that there are likely other wetlands within the Study Area that are not necessarily identified on this planning-level figure. It is recommended that the City conduct a more detailed identification and mapping of wetland areas in and around Whitefish.

2.4 Land Use Planning

2.4.1 2007 Whitefish City County Growth Policy

The long range planning master document for the Whitefish area is the 2007 Whitefish City-County Growth Policy. This Growth Policy has been prepared and adopted under the authority of and in accordance with Part 6, Chapter 1, Title 76, Montana Code Annotated (MCA). A Growth Policy is required by Montana law for any local subdivision regulations. The purpose of this document is to set forth a broad body of public policy that is founded in a community vision, and that addresses growth and development issues through the various topic areas (elements) of natural resources, economic development, land use, community facilities, housing, and transportation. This document contains community goals, and policies and recommended actions for achieving those goals. The final element, Implementation/Intergovernmental Coordination, sets forth the manner in which the Growth Policy is to be implemented. While the Growth Policy itself does not enact regulations or establish programs, it provides the legal and rational basis, or "nexus" for regulatory or programmatic measures to implement the Growth Policy.

Wastewater Collection and Treatment - Chapter Four of the Growth Policy discusses wastewater treatment, with excerpts from this section as follows:

"The collection, treatment, and disposal of municipal wastewater is one of the most important and complex services that any city can provide. Protecting public health is the primary goal. Failing septic systems, or placing septic systems in areas unsuitable for their proper operation, can result in a public health risk through contamination of surface and groundwater. The Flathead County Health Department is responsible for issuing permits for septic systems. Permits are issued based on tests to determine suitable soils, appropriate lot size, and development density. Generally, a minimum lot size of one acre is required for a septic system. Contamination of Whitefish Lake from numerous older septic systems is a concern to the City of Whitefish and many area residents. This risk of contamination will only grow as more long vacant lots around the lake are built upon. On average, wastewater flows to the City of Whitefish system are .75 million gallons daily (mgd), with higher flow events in the spring due to infiltration of snowmelt into the system. The general trend since 1996 has been that wastewater flows are declining even as the population grows. This too is primarily due to better system maintenance and improvements that have reduced clear water flows to the system.

<u>Wastewater Collection and Treatment Goals:</u>

1. Continue to provide cost-effective and efficient wastewater collection, treatment, and disposal that protects the public health and does not compromise the environment.

<u>Wastewater Collection and Treatment Policies:</u>

1. Through the Land Use Element of this Growth Policy and land development regulations, direct growth to areas of the community already served by municipal sewers.
2. New sewer main extensions to serve new development shall be made in compliance with the City's Wastewater Utility Plan, including both location and routing of new mains and main line capacities to account for future development.

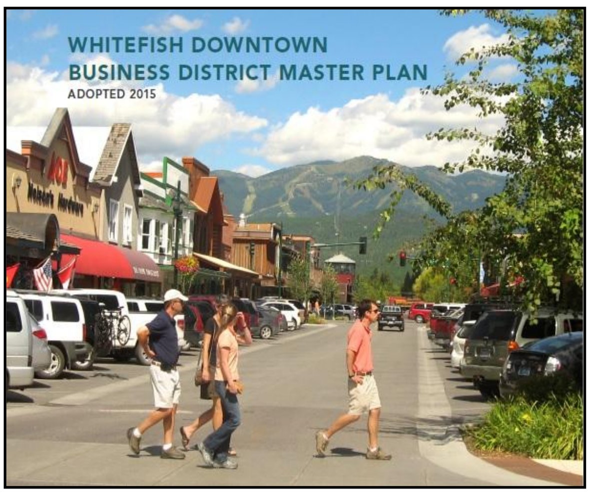
<u>Wastewater Collection and Treatment Recommended Actions:</u>

1. New developments within the Jurisdictional Area which propose on-site sewage disposal shall submit contingency plans for eventual connection to the municipal wastewater system.
2. Continue to work with the Whitefish County Water and Sewer District and the Big Mountain Sewer District to develop and implement long range wastewater management plans for the urbanizing areas of the Planning Jurisdictional Area, including those areas around Whitefish Lake where much of the new construction continues to rely on individual sewage disposal systems.

3. Work with the Flathead County Health Department to prepare a public education program on the proper operation, life expectancy, and potential pollution problems associated with individual on site disposal systems.
4. Work with the Flathead County Health Department and the Whitefish Lake Institute to monitor existing on-site sewage disposal systems around Whitefish lake to detect failed systems, and devise a plan for corrective action.
5. Study the feasibility of extending sewer mains to serve lakefront properties."

2.4.2 Whitefish 2015 Downtown Business District Master Plan

This Plan identifies opportunities to increase the vitality of the downtown business district. The plan outlines the components that will make this vision a reality. It builds upon existing assets and historic character, capitalizes on significant land uses and features the natural environment. It also sets out a realistic action plan for implementation that public officials, private investors and the community can follow. The 2015 Whitefish Downtown Business District Master Plan updates the adopted 2006 Whitefish Downtown Business District Master Plan. The intent of this plan is to:



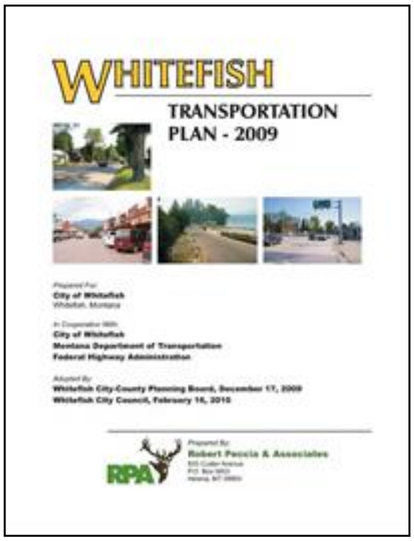
1. Build upon Central Avenue private development stimulated by considerable public investment that was prescribed in the 2006 plan
2. Set forth a new implementation strategy for public projects that will stimulate significant private investment and identify project phasing for priority projects
3. Emphasize the importance of providing essential retail parking
4. Ensure retail tenant recruitment within the City Hall parking structure
5. Address the Whitefish City-County Growth Policy and the State of Montana Growth Policy requirements
6. Strengthen the connection between commercial parcels along Wisconsin Avenue and north of the rail yard with the downtown core
7. Provide additional design detail for the Whitefish Promenade

2.4.3 2015 Highway 93 West Corridor Land Use Plan

The 2007 City of Whitefish Growth Policy recommends a corridor plan be formulated and adopted for US Highway 93 West with specific goals, policies, and recommended actions for the area that consider land use, scale, transportation function and modes, noise, screening, landscaping, and urban design. The corridor is the site of the Montana Department of Transportation US Highway 93 West three-phase road widening project to provide major infrastructure improvements. In addition to widening the road, the project includes curbs, sidewalks, trails, landscaping, and utility improvements dramatically affecting the corridor by improving traffic flow for auto, bike, and pedestrian access and improves landscaping in the corridor. These improvements also improve access and circulation. Construction of phase I began in the summer of 2013.

2.4.4 2009 Whitefish Transportation Plan

This Transportation Plan is intended to help guide decisions about the future of the Whitefish area transportation system. The Plan describes the existing system and identifies large and small improvements for the transportation network. The recommendations made in this document cover all modes of transportation, including travel by private vehicle, public transportation, pedestrian and bicycle modes. Recommended projects are intended to help relieve existing problems and prepare the Whitefish transportation system to meet future needs. The development and implementation of a Transportation Plan is a good tool for managing growth and accommodating development needs. Not only do Transportation Plans provide analysis and mitigation for the existing transportation system, it also provides an opportunity to "look into the crystal ball" to try and predict future growth – where it is likely to happen, when it is likely to happen, and how much of it is likely to occur. More importantly, by predicting this growth the community can be primed to deal with it before infrastructure problems become apparent. By identifying transportation system needs early on, planners and community leaders can begin to plan and implement infrastructure improvements important to the efficient operation and maintenance of the transportation system.



2.4.5 City of Whitefish 2009 Extension of Services Plan

This document is intended to be used as a guide for the provision of city services to those areas of the city not served at this time and for territories to be annexed into the city. This Plan satisfies the requirements of M.C.A. 7-2-4731 and 7-2-4732.

2.4.6 South Whitefish Transportation Planning Project

Adopted in October 1999, this plan addresses street realignment and planning in neighborhoods in the South Whitefish area.

2.5 Population, Growth and Service Area Delineation

2.5.1 Introduction

The Whitefish WWTP planning area consists of the City of Whitefish and Flathead County areas surrounding the City which fall within Whitefish's planning jurisdictional area. In 2010, the date of the most recent U.S. Census, the City of Whitefish had a population of 6,357. This made Whitefish the second largest city in Flathead County and accounted for about 7% of the total population of the county. The 2010 Median Household Income in Whitefish is $43,117, less than the state MHI of $46,230. Whitefish is located at 48°14′42″N 114°20′24″W at an altitude of 3,028 feet (923 m). The town is located on the western side of the continental divide, near Glacier National Park. According to the United States Census Bureau, the city has a total area of 11.80 square miles of which, 6.43 square miles is land and 5.37 square miles is water.

2.5.2 Existing Population and Current Trends

Current population data is required for analysis and modeling of the existing wastewater system. It is also important to understand trends in population for the study area in order to predict future population and its need for wastewater treatment. **Table 2.2** summarizes the trend in population growth for the City of Whitefish.

Table 2.2 – Whitefish Population Trends and Existing Population

	1990 [a]	2000 [b]	2010 [c]	2015 [d]
City of Whitefish Population	4,368	5,032	6,357	6,984

[a] 1990 Census Data
[b] 2000 Census Data
[c] 2010 Census Data
[d] Estimated 1.9 % Annual Growth Rate

The City of Whitefish population grew at a rate of 1.4% per year from 1990 to 2000 and approximately 2.37% from 2000 to 2010. The Study area population grew at a rate of 4% per year from 1990 to 2000. The data indicates that the City of Whitefish, through both infill and annexation, is capturing more of the Study Area population growth than it historically did from 1990 to 2000. In early 2013, AMCE/RPA met with John Wilson of the Whitefish Public Works Department and Dave Taylor of the Planning Department to prepare updated estimates of population growth that can be projected for the City of Whitefish planning area plus anticipated wastewater sewer service areas. The 2008 City of Whitefish Wastewater System PER was reviewed regarding the growth projections that were utilized in that planning document, noting that the City was experiencing a period of rapid growth at that time. Shortly thereafter growth rates rapidly declined with a flat or negative growth rate observed. In reviewing the 2010 Census, it shows that the City of Whitefish's growth for the 2000-2010 period was 26.33% or 2.37% average annual growth. Historically, the City has had an average annual growth of 1.75% over the last 40 years. Also, the Census projected an average annual growth rate of 1.9% between 2005 and 2025 for Flathead County. Based on review of a more current historical growth rate in the community plus consideration of the 2010 census data, it was decided to use an average annual growth rate of 1.9% for the 20 year planning period.

In order to accurately plan for future facilities and understand the condition of existing utilities quantifying total existing population is only the first step. It is also important to understand where that population resides today and where it is likely to reside in the future. To facilitate distribution of population, the study area was broken into sub-areas called analysis zones. Analysis zones are areas that have similar land use or are bordered by geophysical features that are likely to promote a certain type of land use. For previous plans, 2000 census data, data from the City of Whitefish Residential Construction, Land Subdivision and Annexation Report, and population distribution data developed in a workshop with the City of Whitefish, Tri-City Planning, WGM Group, County Planning, Montana Department of Transportation, and HDR staff were used to distribute population throughout the Study Area by analysis zone. Economic and population growth in the Whitefish area in the 1960's, 70's, 80's, and 90's was dependent on traditional industries like forestry, agriculture, and mining. During that period interest in recreation and retirement has steadily grown. Today the main drivers for economic growth in the Whitefish area are tourism, recreation, retirement, second home market, and some influx of people who telecommute or live in Whitefish and own business interests elsewhere.

The City of Whitefish is a resort community offering both summer and winter opportunity for recreation. This characteristic results in significant seasonal fluctuations in water demand due to fluctuations in visiting population. Some of this fluctuation is due to residences that are second homes and are not occupied year-round. Another component of this fluctuation is caused by seasonal fluctuations in tourism. These factors also result in some fluctuation in employment. It is important to understand the trend in this fluctuation in order to set per capita demand factors appropriately and in turn accurately predict future demand on the system. One method of gauging this trend is to examine the trend in resort taxes collected by the City of Whitefish. **Figure 2.4** is a graph of total resort tax revenue collected per month for motels, bars & restaurants, and retail for Fiscal years 2008 through 2015.

The trend in resort tax revenue shows that there is an increase in consumer use of motels, bars & restaurants, and retail in the summer months (June through September). It also shows that there has been a steady growth in resort tax revenue over time. In FY16, starting July 1, 2015, the City's Resort Tax increased from 2% to 3% with the additional 1% going to fund the debt service requirements for the acquisition of the Haskill Basin Conservation Easement. The seasonal variation in tax revenues will be taken into consideration when analyzing per capita usage and projecting future demand based on per capita demand factors.

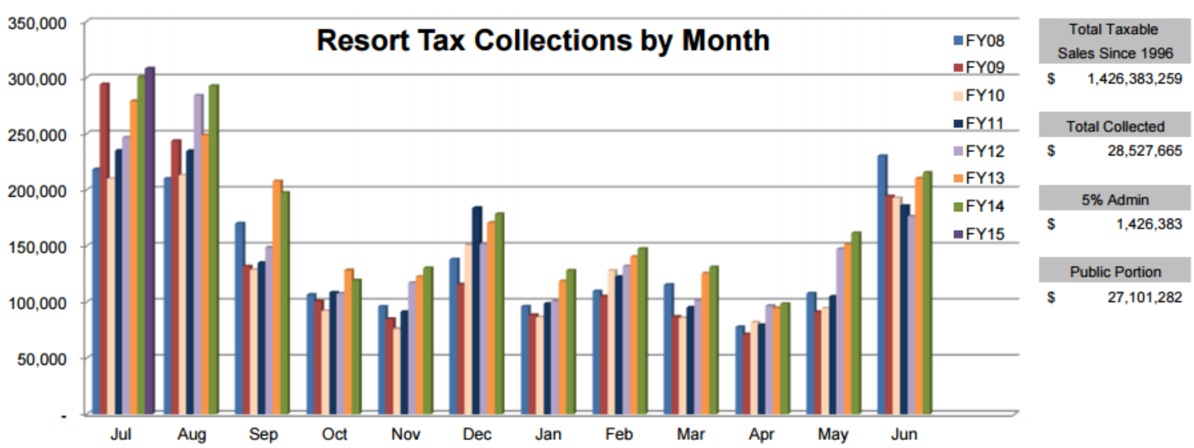


Figure 2.4 – Resort Tax Revenue

2.5.3 Service Area Delineation

Definition of the study area and in turn the potential service area is necessary so that utility planning can be conducted. Setting the potential service area boundary may be controversial because of implications of inclusion or exclusion. Inclusion may imply to some that utility services will be available. Other implications include annexation, cost of service, and configuration of infrastructure. Exclusion may have implications for the potential for service, and therefore, the viability of land for future development. The service area is the projected area in which municipal services can or may be extended depending upon needs and demand. In prior planning documents, the delineation of service area was looked at in great detail considering a logical extension of City services. This process was reviewed recently and it was concluded that the service area would be retained as it was depicted in the prior documents, shown as the attached **Figure 2.5** of the 2008 Wastewater PER. The table below shows the revised growth projections (1.9% annual) and how it impacts future estimated service area population. The second table which follows is excerpted from the 2008 PER and provides a comparison regarding the differences in growth (although the planning years are different).

Table 2.3 2016 Predicted Wastewater Service Area Population

	2015	2025	2035	Ultimate Build-out
Existing and Proposed Sewer Service Planning Area Population	11,661	14,076	16,992	36,929
Existing and Proposed Sewer Service Area **Connected** Population	8,033	9,697	11,705	36,929

Table 2.4 - Predicted Wastewater Service Area Population from 2008 PER

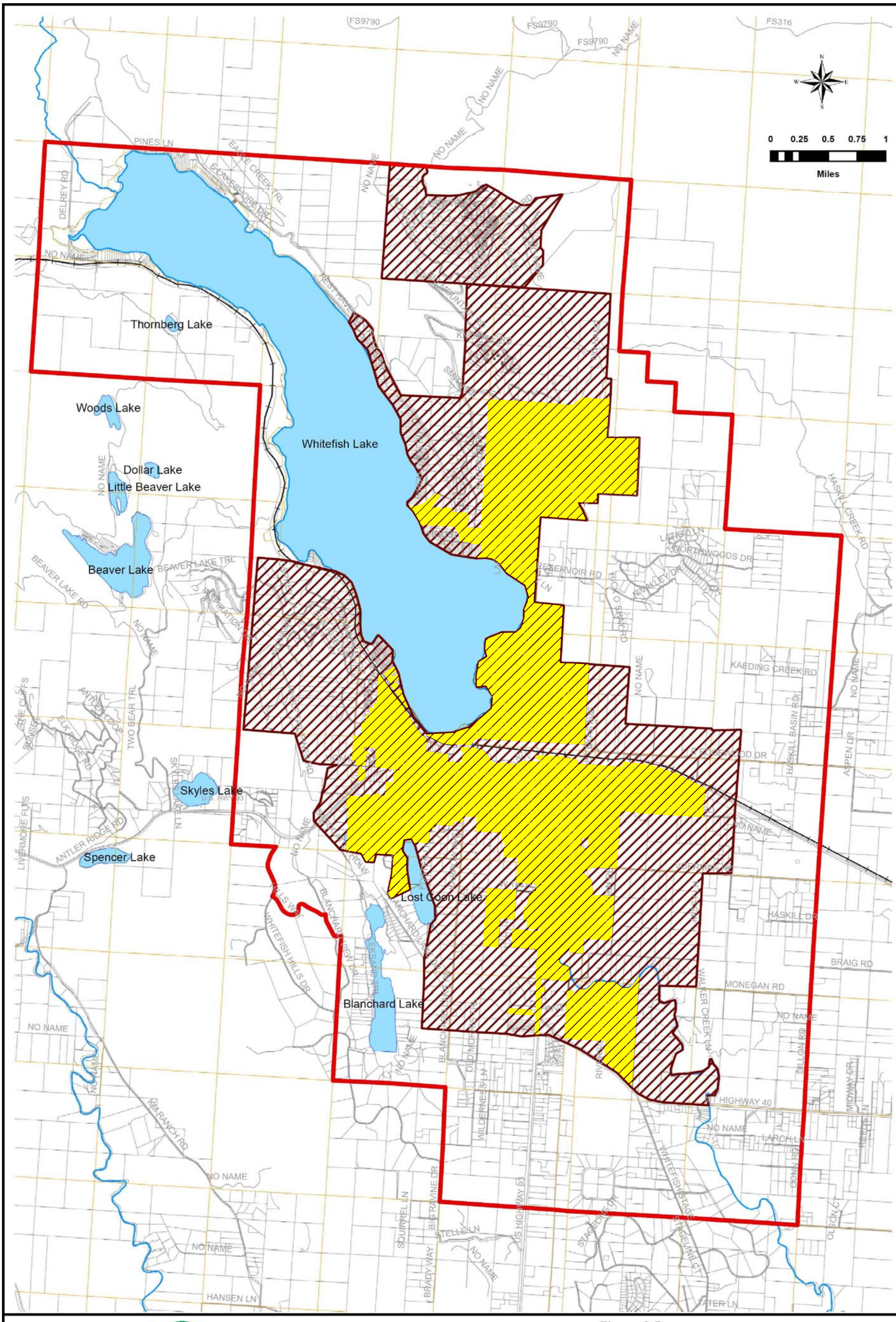
	2008	2018	2028	Ultimate Build-out
Proposed Sewer Service Planning Area Population	10,221	13,109	17,580	36,929
Proposed Sewer Service Area Connected Population	7,041	10,638	14,297	36,929

As shown, the lower rate of growth has a significant impact on the service area population in the later years of the 20 year planning period. The revised growth projections, plus a limited allowance for unplanned growth, will be utilized to develop flow and load projections for planning for new wastewater facilities in subsequent chapters of this document.

2.6 Wastewater Loads and Characteristics

2.6.1 Current Flow

Monthly flow data was evaluated for a five year period, from 2010 through 2015 which is depicted in **Figure 2.6** below, showing variation in monthly flow and the average for the year. It can be surmised that the high flows in March and April reflect influx of infiltration and inflow as clear water flows into the system through precipitation events and snow melt. High flows in June and July likely reflect an influx of tourists which peak in the summer months. An infiltration and inflow mitigation project is currently underway in Whitefish with construction planned for the summer and fall of 2016. The project will consist of the rehabilitation of approximately 6,960 lineal feet of 10", 8" and 6" sanitary sewer with the use of cured in place epoxy lining, replacement of 110 lineal feet of 8.0" sewer and rehabilitation of 39 manholes plus work on 39 manhole chimneys.



Legend

Project Study Area

City of Whitefish

Sewer Service Area

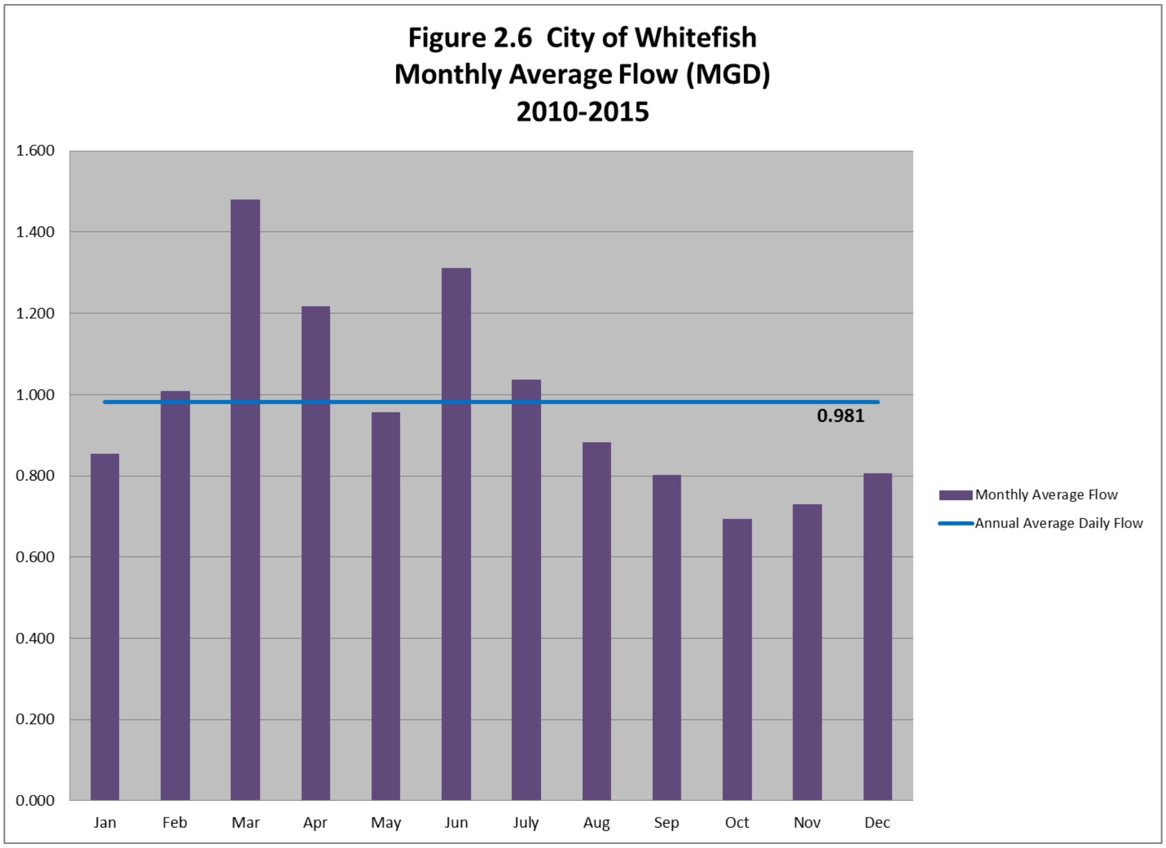
City of Whitefish

WHITEFISH 2016 WASTEWATER PER

Figure 2.5
Potential Future Wastewater Utility Service Area

Anderson~Montgomery

HDR



Upon completion of this project, flow and load conditions should be reassessed to determine the benefit of this project in reducing clear water flow to the sanitary sewer as well as a potential increase in waste strength.

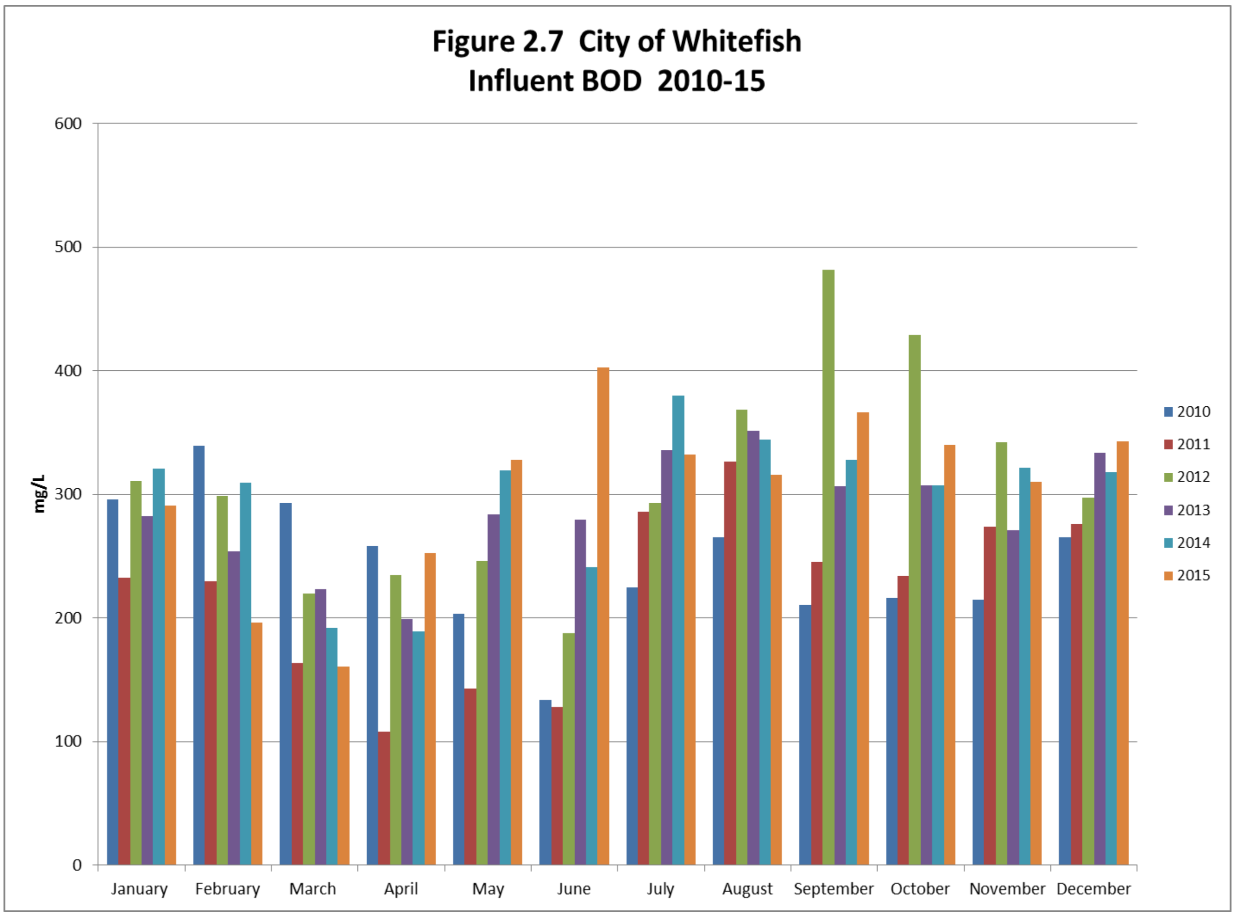
2.6.2 Existing Load to Plant

Monthly flow and organic loading data was evaluated for a three year period, from 2012 through 2014. Based on this data, the average waste strength and flow is as follows:

BOD_5	**297 mg/l**
TSS	**239 mg/l**
Phosphorous	**6 mg/l**
Ammonia	**25 mg/l**
Average Daily Flow per capita	**128.7 gpcd**
Average Daily Flow per capita (wet weather)	**154.5 gpcd**

An infiltration and inflow reduction project was completed in 2011; consequently data after this period was utilized. The organic loading in Whitefish continues to indicate increasing strength in the concentration of the waste. This may be due to infiltration and inflow reduction as well as possible higher strength waste originating from commercial/industrial users such as breweries, restaurants, hospitals and nursing homes. Additionally, another I/I project will be completed in 2016 which may further concentrate the waste. **Further analysis of waste loading should be completed before design work is initiated on new improvements**.

The following Figure 2.7 provides 6 years of data regarding influent loading. The graph indicates a general trend towards increasing waste concentration except possibly during the wetter months when weather conditions may have more influence on waste concentration.



2.6.3 Future Load Predictions and Project Design Criteria

Given the proposed growth in the sewer service area as well as the general population growth that is anticipated, flows and loads to the wastewater plant will increase significantly over the next 20 years. Utilizing the information presented above, the increase in flow and waste loads are predicted as follows to establish planning level design criteria. This information will be used to evaluate the existing facilities and plan for needed system improvements.

Table 2.5 CITY OF WHITEFISH WASTEWATER IMPROVEMENTS DESIGN CRITERIA

	2013	2015	2020	2025	2035
Planning Area	11,230	11,661	12,812	14,076	16,992
Connected Pop.	7,736	8,033	8,826	9,697	11,705
Qavg	0.996	1.034	1.136	1.248	1.507
Qwet weather (6 month period)	1.195	1.241	1.363	1.498	1.808
Q Max Day		4.266	4.342	4.355	4.530
AVG BOD (lbs/day)	2467.8	2562.5	2815.4	3093.3	3734.0
MAX BOD	3289.6	3415.8	3753.0	4123.4	4977.4
TSS (lbs/day)	1980.4	2056.4	2259.4	2482.4	2996.5
Ammonia (lbs/day) ***25.03 mg/l Avg Conc.***	208.9	216.9	238.3	261.8	316.0
Total P (lbs/day) ***6.0 mg/l Avg Conc.***	49.83	51.74	56.85	62.46	75.40
TKN Avg 41.4 mg/l					
Alkalinity 265.6 mg/l					
	Dec	Jan	Feb	Mar	Apr
Avg Influent Temp (*°C*)	9.5	8.8	8.1	8.2	9.2

2.7 Regulatory Considerations

2.7.1 General

This section of the report will consider regulatory factors that will govern the required treatment performance of improvements to the Whitefish wastewater treatment facilities including discharge to the receiving stream as well as disposal of produced biosolids. Background material on the development of water quality standards as incorporated into the City's discharge permit will be provided. Enforcement activities applicable to the City of Whitefish will be considered.

2.7.2 MPDES Discharge Permit

The Montana Pollutant Discharge Elimination System (MPDES) discharge permit is the primary mechanism whereby the MDEQ regulates the quality of the effluent discharge of wastewater from the City's wastewater system to the Whitefish River. The discharge permit establishes criteria for implementing the National Secondary Treatment Standards, Montana Water Quality Standards (WQS), including the numeric nutrient standards and non-degradation based load limits. The Federal Secondary Standards establish minimum levels of treatment based on available and achievable water treatment technologies. Levels of water quality that are required to maintain beneficial uses of state surface waters are set forth in the Water Quality Standards. The goal of the Permits program is to control point source discharges of wastewater such that water quality in state surface water is protected. Each MPDES permit issued is designed to protect the state surface water quality at the point of discharge as well as downstream or basin-wide pollution issues. Existing discharge permits are to be reissued on a five year cycle. The current discharge permit is included in **Appendix A.** The current permit, issued on June 9, 2015, established the following effluent standards shown in the table below. The standards in this permit are similar to those established in the previous discharge permit with the exception of new limits included for total nitrogen, ammonia and aluminum.

Table 2.6 CITY OF WHITEFISH MPDES EFFLUENT REQUIREMENTS
Effective August 1, 2015 Expires July 31, 2020

Parameter	Units	Average Monthly Limit	Average Weekly Limit	Maximum Daily Limit
5-Day Biochemical Oxygen Demand (BODs)	mg/L	30	45	
	lb/day	313	676	
	% Removal	85%		
Total Suspended Solids (TSS)	mg/L	30	45	
	lb/day	313	676	
	% Removal	85%		
pH	SU	6.0 -9.0		
***E. coli* Bacteria - summer**	cfu/100 mL	126		252
***E. coli* Bacteria -winter**	cfu/100 mL	630		1260
Total Residual Chlorine	mg/L	0.011		0.019
Ammonia, Total as N	mg/L	9.6		17.7
Total Nitrogen (TN) - summer	lb/day	176		
Total Nitrogen - non-summer		273		
Total Phosphorus (TP) -year-round	mg/L	1.0		
	lb/day	10.4		
Aluminum, dissolved	µg/L	113		325

Escherichia coli (E. coli) - winter is November 1 through March 31; summer is April 1 through October 31.
Report geometric mean if more than one sample is collected during the reporting period.
Analytical results less than 0.1 mg/l will be considered in compliance with the chlorine limit.
Nutrient summer limits effective July 1st - September 30th non-summer limits effective year round other than this timeframe.
Dissolved aluminum effluent limits take effect July1, 2017.

Current Compliance - The existing facilities cannot consistently meet the new standards for ammonia and will have difficulty in meeting the limits for total nitrogen as the system adds additional users. In review of 6 years of monthly effluent data for 2010 through 2015 (see **Appendix A**) eighteen violations of the load limits in the current discharge permit for Total Nitrogen were noted. During the same period, several violations of the ammonia limit were shown for each year, primarily when the lagoons were not nitrifying. Ammonia values for the period are only below the limit of 9.6 mg/l for a 1-2 month period typically during July and August. Additionally, a number of exceedances of the *E. Coli* bacteria limits were noted in the period of record considered.

Aluminum – The existing facilities should be able to meet the new aluminum standard, although high alum usage could potentially raise levels at or near the limit. Future treatment processes that employ biological nutrient removal should lower residual aluminum concentrations in the effluent.

2.7.3 Future Effluent Standards

Ammonia – Environmental Protection Agency (USEPA) has issued new aquatic life guidelines concerning the discharge of ammonia into waterbodies containing freshwater mussels (2013 US EPA Ammonia Criteria). Discussion with the DEQ has indicated that they have not yet adopted the new ammonia standards and had no immediate plans to do so. Nonetheless, these new standards will likely be adopted by DEQ at some point in the future. The state may be considering a variance process where compliance with the standard may pose an economic hardship. Additionally, the presence or absence of freshwater mussels may have some bearing on the application of the new criteria. Scientifically-defensible documentation of the presence or absence of mussel populations in a river system or stream reach could potentially save or cost a municipality or corporation millions of dollars in order for their effluent to achieve the more stringent 2013 ammonia standards.

Given this possibility, Anderson-Montgomery contracted with a statewide expert in the subject of aquatic habit for freshwater mussels to complete a survey of the Whitefish River, downstream from the discharge from the City's wastewater plant. The survey for freshwater mussels was completed in July 2014 by David Stagliano, an aquatic biologist with Morrison-Maierle, Inc. His conclusions are, as follows: "*Based on this biologist's professional experience of the habitat requirements of the western pearlshell mussel, pertinent database and literature searches, and findings from recent site surveys, the current condition of the Whitefish River above and below the WWTP project site lacks suitable habitat to support this species, and the proposed project area is determined to be absent of any mussel populations. Historical occurrences are equally unlikely.*"

The complete survey can be found in **Appendix B.** Consideration of treatment options should include review of capability to meet the more stringent ammonia standards.

Total Nitrogen and Total Phosphorous – The current permit contains new limits for nutrients based on the numeric nutrient standards recently adopted by the DEQ. These limits are based on a general variance to the standards, discussed in more detail in Section 2.7.5 below. The DEQ anticipates a process that will "ratchet down" effluent standards via the variance process until the final water quality standards are met. The following schedule indicates the process contemplated by the DEQ to reduce nutrient concentrations in the discharge. The schedule for systems with flows greater than 1.0 MGD is applicable to Whitefish.

Facilities > 1 MGD:

A. Current general variance: 10 mg TN/L, 1.0 mg TP/L **-per statute**
B. Next permit (+5 years): 8 mg TN/L, 0.8 mg TP/L
C. Next permit: 8 mg TN/L, 0.5 mg TP/L
D. Next permit: *Under Development*

2. Facilities < 1 MGD:

A. Current general variance) 15 mg TN/L, 2.0 mg TP/L **-per statute**
B. Next permit (+5 years): 12 mg TN/L, 2.0 mg TP/L
C. Next permit: 10 mg TN/L, 1.0 mg TP/L
D. Next permit: 8 mg TN/L, 0.8 mg TP/L

3. Lagoons not designed to actively remove nutrients:
A. Current general variance: Maintain current lagoon performance, start nutrient monitoring **- per statute**
B. Next permit (+5 years): Implement BMPs identified during optimization study

Treatment options to be evaluated will focus compliance with the nutrient standards for the next two permit cycles with the potential to add additional unit processes in the future to comply with more restrictive future standards.

2.7.4 Impairment of Beneficial Uses and the Restoration Process

The DEQ monitors water quality in the state's water bodies and prepares a biennial report indicating the status of water quality. The condition and trends of Montana's streams and lakes, contaminates found in groundwater and the safety of drinking water are considered. The report includes a listing of impaired waters and potential causes of impairment, referred to as the state's 303(d) list. A process is developed to reduce identified discharge of pollutants in a given stream with the intent of restoring beneficial uses. A calculation process called total maximum daily load (**TMDL**) is used to allocate pollutant discharge levels among the various dischargers. A TMDL is the maximum amount of a pollutant a waterbody can receive from all sources combined and still meet its water quality standards (i.e., support its beneficial uses). The extent of the allocation process is sufficiently large as required to restore a reach of stream, often looked at on a drainage-wide basin basis. The water quality planning process that includes TMDL development may take two to five years to complete and often will address multiple types of pollutant impairment, organized into groups. The most common pollutant groups in Montana are: sediment, nutrients, metals, temperature, pathogens, and salinity. Montana's *Draft 2016 Water Quality Integrated Report provides the following information regarding impairment of the Whitefish River:*

Flathead – Stillwater TMDL Planning Area

Whitefish River, Whitefish Lake to mouth (Stillwater River)

Cause of Impairment	**Potential Source**
Oil and Grease	Accidental release/Spill
PCB in Water Column	Industrial Point Source Discharge

Whitefish River Temperature TMDL - The Whitefish River was previously listed as impaired for temperature and a TMDL process was completed by the DEQ in 2014. DEQ determined that temperature impairs aquatic life in the Whitefish River. Historic removal of riparian vegetation, which is important for regulating stream temperature by providing shade, is the primary cause of impairment. Water quality restoration goals focus on improving riparian shade; however, maintaining stable stream channel morphology and instream flow conditions during the hottest months of the summer are also important for meeting the TMDLs. The *"Flathead - Stillwater Planning Area Nutrient, Sediment, and Temperature TMDLs and Water Quality Improvement Plan,"* approved by EPA on December 17, 2014, included an evaluation of temperature impacts from point and nonpoint sources on the Whitefish River, including the WWTP. Based on the treatment plant's maximum recorded effluent temperature of 74.8°F and average daily design flow of 1.8 mgd, the discharge was shown to cause temperature increases less than the 0.5°F allowed. The conclusion from the TMDL was that "maintaining operation of this facility at current levels would appear to cause no significant increase in Whitefish River temperatures."

Flathead Lake TMDL – The Whitefish River, via the Stillwater River, is a significant contributing stream to Flathead Lake and the discharge from the Whitefish wastewater plant ultimately enters the lake. Flathead Lake has long been considered an outstanding water resource of international importance. However, despite basin wide efforts to reduce nutrient loading (e.g., phosphate detergent ban, increased municipal sewerage treatment efficiency, etc.) there has been a downward trend in water quality since 1977. Flathead Lake is listed on historical 303(d) lists as impaired for the beneficial use of aquatic life support, with the nutrients nitrogen and phosphorous considered as the primary pollutant of concern.

The 2001 "*Nutrient Management Plan & Total Maximum Daily Load for Flathead Lake, Montana"* prepared by the DEQ established a TMDL seeking a15 percent reduction in man-caused nitrogen and phosphorus loads, plus a 10 percent margin of safety is proposed as the TMDL. The margin of safety has been included to account for projected future increases in point source loads attributable to increased wastewater flows and a continuing upward trend in population growth in the unincorporated areas of the basin. This initial allocation goal was considered to be **Phase I** of a two-step approach.

The Management Plan indicated that "*in 1983 the Water Quality Bureau of the Montana Department of Health and Environmental Sciences (the predecessor to DEQ) estimated that point sources were discharging 45,760 pounds of phosphorous into Flathead Lake each year. The bureau predicted that, unchecked, the load would increase to 91,740 pounds by 2000. Even with treatment, it was estimated that municipal sewage plants would discharge 15,400 pounds of phosphorous into the lake in 2000 (DHES, 1983). In 1984 the Water Quality Bureau established a 1.0 milligram per liter limit on phosphorous discharges from municipal point sources in the Flathead Basin. Between 1984 and 2000 all the municipalities in the watershed replaced or upgraded their sewage treatment facilities. All plants now have phosphorous removal systems. Local residents have also helped reduce loads by using low or no phosphate products.*

As a result of these efforts, the phosphorous load from permitted point sources in 2000 was just 2,329 pounds—15 percent of the most optimistic prediction 17 years earlier. No comparable limits were established for nitrogen discharges at that time. In the 1980s it was assumed that phosphorous availability was the determining factor in aquatic plant growth. Subsequent research has shown that nitrogen also plays an important role (Steg). The nitrogen limits contained in municipal permits are based on Montana's Non-degradation Rules (ARM 17.30.700). These limits are not tailored for Flathead Lake's specific water quality concerns. In 2000 municipal point sources discharged 56 metric tons of Total Nitrogen. Several of the treatment plants in the Flathead drainage basin have since installed nitrogen removal capacity in their treatment facilities."

Refinement of the waste load allocations for nutrients will be considered under **Phase II** of the Flathead Lake TMDL, which has not been completed. DEQ and EPA were under a court order to complete the TMDLs above before the end of calendar year 2014, as per an amended judgment to a TMDL lawsuit. Completing Phase II of the Flathead Lake nutrient TMDLs was not a requirement of the court order. In order to focus staff resources on those TMDLs that had to be completed by the end of 2014, DEQ and EPA decided to postpone the completion of the nutrient TMDLs for Flathead Lake until after 2014. Recent discussion with DEQ (Yashin) indicated that the Phase II Flathead Lake TMDL will now be postponed until new water quality standards are developed for the lake. The work on new standards is underway and should be completed within the year. **The impact of future waste load allocations of nutrients from point sources prescribed under the Phase II Flathead Lake TMDL is unknown at this time.**

2.7.5 Numeric Nutrient Standards

Most of Montana's water quality criteria are numeric which provide precise, measurable concentrations of pollutants that if exceeded would harm intended uses of the receiving stream. Montana's numeric water quality criteria are published in Circular DEQ-7 and Circular DEQ-12A. The nitrogen and phosphorus concentrations provided in Circular 12A, adopted in 2014, have been set at levels that will protect beneficial uses and prevent exceedance of other surface water quality standards which are commonly linked to nitrogen and phosphorus concentrations. The circular contains the base numeric nutrient standards for Montana's wadeable streams are grouped by ecoregion, with following standards applicable to Whitefish:

Ecoregion - Northern Rockies
Period When Criteria Apply - July 1 to September 3
Nutrient Limits - Total Phosphorus 25 µg/L   Total Nitrogen 275 µg/L

When a discharge permit is reissued, the permit writer considers if the authorized discharge creates a reasonable potential that the standards may be violated and, if so, sets criteria to insure that the standards will be met. When developing permit limits for base numeric nutrient standards for total nitrogen and total phosphorus, the critical low-flow for the design of disposal systems shall be based on the seasonal 14Q5 of the receiving water. The DEQ will use an average monthly limit (AML) only, using methods appropriate for criterion continuous concentrations (i.e., chronic concentrations). Permit limits will be established using a value corresponding to the 95th percentile probability distribution of the effluent. Nitrogen and phosphorus concentrations of the receiving waterbody upstream of the discharge may be characterized using other frequency distribution percentiles.

Variances from Nutrient Standards – The numeric nutrient standards as described above are very low in comparison to conventional available treatment technologies and approach the limits of technology. While smaller systems can address the limits by curtailing their discharge through the use of land application of treated effluent, most larger systems cannot install land application systems in a cost-effective manner. The DEQ concluded that treatment of wastewater to base numeric nutrient standards would result in substantial and widespread economic impacts on a statewide basis and developed a procedure, described in Circular 12 B, to grant a variance from the criteria. A permittee who meets the end-of-pipe treatment requirements provided in the table below may apply for and the Department shall approve a general nutrient standards variance. The Department will process the general variance request through the discharge permit, and include information on the period of the variance and the interim requirements. A person may apply for a general variance for either total phosphorus or total nitrogen, or both. The general variance may be established for a period not to exceed 20 years. A compliance schedule to meet the treatment requirements as shown may be granted on a case-by-case basis.

General Variance End-Of-Pipe Treatment Requirements

Discharger Category	Total P (mg/L)	Total N (mg/L)
≥ 1.0 million gallons per day	1	10
< 1.0 million gallons per day	2	15
Lagoons not designed to actively remove nutrients	Maintain current performance	

The Department must review the general variance treatment requirements every 3 years to assure that the justification for their adoption remains valid. The review may not take place before June 1, 2016, and must occur triennially thereafter. The purpose of the review is to determine whether there is new information that supports modifying (e.g., revising the interim effluent treatment requirements) or deleting terminating the variance. If a low-cost technological innovation for lowering nitrogen and phosphorus concentrations in effluent were to become widely available in the near future, the Department could make more stringent the concentrations shown in the Table above. Permittees receiving a general variance are required to evaluate current facility operations in order to optimize nutrient reduction with existing infrastructure and shall analyze cost-effective methods of reducing nutrient loading including nutrient trading, land application and improved facilities operation.

Whitefish received a General Variance in their latest discharge permit for the discharge category being greater than 1.0 MGD, resulting in a Total P limit of 1.0 mg/l and a Total N limit of 10 mg/l. These limits were used to calculate allowable loads of total nitrogen and phosphorous in the permit, effective July 1 through September 30 of each year.

Individual Variance Based on Substantial and Widespread Economic Impacts - Montana law allows for the granting of nutrient standards variances based on the particular economic and financial situation of a permittee (§75-5-313 [1], MCA). Individual nutrient standards variances (“individual variances”) may be granted on a case-by-case basis because the attainment of the base numeric nutrient standards is precluded due to economic impacts, limits of technology, or both. In general, individual variances are intended for permittees who would have financial difficulties meeting the general variance concentrations and are seeking individual nitrogen and phosphorus permit limits tailored to their specific economic situation. Individual variances may be established for a period not to exceed 20 years and must be reviewed by the Department every three years to ensure that their justification remains valid. Unlike the general variances discussed above, the DEQ will only grant an individual variance to a permittee after the permittee has shown the extent of the adverse economic impacts that would be incurred from meeting the standards. A permittee must also demonstrate that there are no reasonable alternatives (including but not limited to trading, compliance schedules, reuse, recharge, and land application) that would allow compliance with the base numeric nutrient standards.

If no reasonable alternatives exist, then an individual variance is justifiable and becomes effective and may be incorporated into a permit. Like any variance, individual variances must be adopted as revisions to Montana's standards and submitted to EPA for approval. This type of individual variance will often be based on the economic status of the community by demonstration of substantial and widespread economic impacts. At each triennial review the DEQ will consider if the basic economic status of a community granted an individual variance has changed. If new, low-cost nutrient removal technologies have become widely available, or if the economic status of the community has sharply improved, the basis of the variance may no longer be justified. In such cases the DEQ will discuss with the permittee the options going forward, including but not limited to a permit compliance schedule, trading, reuse, recharge, land application, or a general variance.

2.7.6 Non-degradation Based Limits

The previous permit for Whitefish included provisions for BOD_5, TSS, Total P and Total N average annual load limits imposed to implement the Non-degradation provisions of the Montana Water Quality Act. With the exception of Total N limit in the summertime, these non-degradation limits were carried over into the new permit. The intent of the non-degradation rules is to limit pollutant loads at a pre-existing level to maintain or improve the quality of Montana's waters. The Non-degradation Rules apply to new or increased sources of pollution. These rules prohibit significant increases in discharge of toxic and deleterious materials to state waters, unless it is affirmatively demonstrated to the DEQ that a change is justifiable as a result of necessary economic or social development and will not preclude present and anticipated use of these waters. Typically, loads in existence or the design capacity of the system in existence in April of 1993 are used as a baseline to establish the load limits. If water quality standards require pollutant loads to be less than the non-degradation based loads to maintain or restore an impaired water, the water quality based loads will preempt the non-degradation load limits. This will be the case with the numeric nutrient standards. As a facility grows beyond the non-degradation based design capacity of the plant, higher removal efficiencies will be needed to maintain compliance.

2.7.7 Municipal Sewage Sludge Disposal – 40 CFR Parts 503 and 257

Any sludge disposal program where the sludge is going to be land-filled, land applied or composted must meet the requirements found in Chapter 40 of the Code of Federal Regulations, Part 503 (land application and composting) or Part 257 (land-filling). The rules under Part 503 include specific limitations on the concentration of heavy metals and pathogens that sludge may contain in order to be beneficially reused. Part 503 also includes requirements for stabilizing or isolating the sludge in order to prevent odors and the spread of disease. For sludge that is to be disposed at a licensed landfill, Part 257 requires that it be a "non-liquid" and "non-hazardous" material. These characteristics are determined through physical and chemical testing procedures or, in some cases, by a "non-hazardous" certification. Sludge disposal alternatives considered in this plan will anticipate strict compliance with applicable regulations.

Whitefish currently generates a biological/chemical sludge mixture via wasting from the flocculating clarifier where alum is added to precipitate phosphorous. The solids are pumped to dewatering beds located north of the clarifier where additional reduction in water content and volume occurs. The beds are located in the old lagoon cells which have a clay liner. An underdrain is located in the center of the beds which returns filtrate to the raw wastewater pump station. In previous planning efforts, a need was identified for applying for and receiving a General Permit from the EPA for disposal of sludge. A "Notice of Intent" seeking to allow the City's disposal practices to be authorized under the General Sludge Disposal Permit was prepared by Anderson-Montgomery in 2006 and the General Permit was received by the City in 2007 authorizing the current method of sludge disposal. The permit expired in 2012. In discussion (3-29-16) with Bob Brobst of the EPA, it was learned that the EPA Region VIII no longer issues general permits and the rules are now "self-implementing". According to Mr. Brobst, as long as the solids remain on the drying beds they are considered to be in treatment and do not require a disposal permit. If and when the material is removed for final disposal, the Part 503 requirements for disposal of wastewater biosolids must be met.

2.7.8 DEQ Administrative Order on Consent

In October of 2012, the DEQ and the City agreed to conditions outlined in an Administrative Order on Consent (AOC), issued by the DEQ in response to wastewater system compliance issues associated with a series of effluent standards violations, failure of the required Whole Effluent Toxicity (WET) testing and minor occurrences of sewage overflows to state waters. The AOC is included in **Appendix C**. The AOC required several actions to be completed including the following:

- Submission of an Optimization Plan with the intent of improving treatment performance of existing facilities through improved aeration and mixing
- Submission of a Capacity, Management Operation Management Plan (CMOM) to address sewer overflows
- Within 90 days of renewal of the MPDES discharge permit, submit a Compliance Plan outlining steps to achieve compliance with the conditions of the permit
- Compliance Schedule for completion of key tasks as necessary to achieve compliance
- Annual progress reports

The Optimization Plan and CMOM were submitted to the DEQ as required. The MPDES discharge permit was renewed in August of 2015 and the Compliance Plan was prepared and submitted in October of 2015. The Compliance Plan included the following schedule as shown below.

COMPLIANCE PLAN

Required of the City of Whitefish under Administrative Order on Consent (Consent Order), Docket No. WQ-1 1-21 (MPDES Permit No.MT0020184, FID #2068)

Project Scope: Planning, design, construction and startup of the required improvements for the City of Whitefish wastewater treatment facilities that are necessary to bring the plant into compliance with the ammonia and whole effluent toxicity requirements in the MPDES Permit and applicable nutrient standards, including applicable general or individual variances as granted by the MDEQ.

Task	Date of Completion
Complete Facilities Planning (PER)	Oct 1 2016
Submit Design Plans to DEQ	February 1 2018
Construction Completion*	May 1 2021
Achieve Compliance	Nov 1 2021
Annual Progress Reports	January 2016-2021

** Note that some unit processes not directly related to compliance with the AOC may be phased for construction into 2022-23, potentially including long-term solids handling and UV disinfection*

2.7.9 Conclusions

Existing and new regulatory requirements will have a profound impact on capability of the existing Whitefish wastewater treatment plant to comply with the recently issued MPDES discharge permit and anticipated future requirements. A detailed assessment of each of the unit processes in the existing plant will be made in the next chapter to determine how they can be utilized or upgraded to meet the permit requirements. General conclusions regarding how current and potential regulatory issues might impact the City of Whitefish include the following:

- **Ammonia, nitrogen and *E. Coli* standards in the current discharge permit are frequently being violated**
- **Numeric nutrient standards will likely become more restrictive in the future. To the extent known, planning for the more restrictive permits limitations should be initiated.**
- **Ammonia standards will change and could become more restrictive in the future**
- **The impact of the Flathead Lake Phase II TMDL upon the City of Whitefish is unknown but could require further reduction of nutrients**
- **The TMDL for temperature in the Whitefish River does not appear to pertain to the Whitefish wastewater discharge**

- **The potential benefit of an individual variance from the numeric nutrient standards should be evaluated**
- **The DEQ Administrative Order on Consent requires compliance with the MPDES discharge permit by November 1, 2021.**

Chapter 3 Existing Wastewater Treatment Facilities

3.1 Introduction

This section of the Preliminary Engineering Report provides a systematic analysis of the existing Whitefish wastewater treatment system, giving consideration to existing and potential design flows and loads. Deficiencies will be identified with further analysis of alternatives provided in subsequent chapters. The ability of existing unit processes to comply with projected flows, loads and the recently issued MPDES discharge permit will be evaluated, including consideration of new wastewater effluent standards including the new numeric nutrient goals.

3.2 Evaluation Goals

An engineering evaluation of a wastewater treatment facility is generally recommended to identify the limitations of the existing system and identify approaches to correction, as well as define the capacity of the treatment facility. Regulatory action by the Montana Department of Environmental Quality has mandated that the City of Whitefish complete a planning process to develop viable options for upgrading the existing wastewater facilities to enable compliance with the discharge permit issued by the regulatory agency. This effort must be followed by project design and construction of facilities achieving compliance.

Limited funds are available for construction of additional facilities to accommodate new growth and development in the Whitefish area as well as comply with regulatory standards. Before making capital investments, it is worthwhile to fully define the capacity available in the existing treatment plant and develop a plan to maximize its use.

3.3 Existing Treatment Facilities, Loading and Regulatory Standards

3.3.1 General Description

The existing wastewater treatment facilities consist of 3 partially-mixed aerated lagoons for biological treatment with the discharge from the lagoon system flowing to a flocculating clarifier where alum and polymers are added to precipitate phosphorus. Raw wastewater passes through a perforated plate screen prior to pumping to the influent structure for the lagoon system. **Figure 3.1** provides a schematic view of the existing treatment facilities. Design capacity for the lagoons, built in 1979, is 1.25 MGD based on average daily flow. The original flocculating clarifier and ancillary equipment have a design capacity of 1.8 MGD. The lagoons were upgraded in 2002 with sludge removal from Cell #1, new aeration diffusers in all three cells, a fabric curtain in Cell #1, improved influent structure, new blowers and aeration piping. The facilities were again

MONTANA Scott Anderson 7978PE REGISTERED PROFESSIONAL ENGINEER

Revision	Date	By
Draft	4/2016	SA
Final		

Revision: Final
Plot Scale: 1:2
Drawn By: B.Nye
Approved By: S.Anderson, P.E.
Checked By: P.Montgomery, P.E.
Designed By: S.Anderson, P.E.
Project Number:

Engineer: Anderson~Montgomery Consulting Engineers
1064 N. Warren
Helena, Mt 59601
RPA

Owner: City of Whitefish, Montana

Project Title: Whitefish WWTP PER

Sheet Title: Existing Treatment Facility

Sheet: **Fig. 3.1** Of --

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upgraded in 2008-09 with construction of a new, redundant flocculating clarifier, a new headworks building with mechanical perforated plate screen, odor control biofilter, new polymer and alum feed equipment and improvements to the plant's electrical system including two new auxiliary generators. More specific design criteria for the existing unit processes at the plant are as follows:

Pretreatment Facilities

Perforated Plate Mechanical Bar Screen	6.0 MGD Peak Capacity 1.0 MGD ADF Capacity
Manual Bar Screen	9.0 MGD Peak Capacity
Screenings Washer/Compactor	6.0 MGD Peak Capacity
Odor Control Biofilter	1.4 CFM/SF
New Natural Gas Auxiliary Generator	150 KW
Bypass Pumping Capability for Existing Lift Station	

Aerated Lagoon System	**Cell #1**	**Cell#2**	**Cell#3**
Volume (2' to 15' depth)	16.97 MG	8.52 MG	8.52 MG
Detention Time @ 1.25 MGD	13.6 days	6.8 days	6.8 days
Sludge Storage (0' to 2' depth)	260,200 cf	124,900 cf	124,900cf
Surface Area	4.93 acres	2.55 acres	2.55 acres

Advanced Treatment Facilities

Original Flocculating Clarifier	1.8 MGD ADF Design Capacity
New Flocculating Clarifier	2.33 MGD ADF Design Capacity
New Mechanical Mixer for New Clarifier	
Redundant Alum and Polymer Feed Systems for Both Clarifiers	
New Natural Gas Auxiliary Generator	150 KW

3.3.2 Organic and Hydraulic System Loads

Current System Loading – Annual daily flows to the existing facility in 2015 averaged 0.956 MGD whereas the average daily maximum hydraulic loading for the year, occurring in March of 2015, was 3.839 MGD.

It should be noted that the higher flow events can be sustained for a number of days generally occurring in late spring and early summer. Infiltration and inflow associated with snowmelt, sump pumps, precipitation events and high groundwater have been identified as the cause of the sustained flows. The following Table 3.1 summarizes annual average and maximum organic and hydraulic loading to the plant for 2015. As noted in the table, the highest peak monthly sustained flow occurred in March, measured at 1.833 MGD.

Table 3.1 City of Whitefish Wastewater Treatment Plant Data

NPDES MT0020184		2015 WWTP Monthly Average Analytical Data												AVG 2015	
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Influent Flow	Avg.	0.888	1.611	1.833	1.016	0.738	0.879	0.865	0.843	0.762	0.637	0.640	0.760	0.956	*MGD*
	Max	1.265	2.676	3.839	1.492	1.024	1.334	0.991	1.002	1.009	0.724	0.878	0.973	3.839	*MGD*
	Total	27.52	45.11	56.83	30.48	22.87	26.37	26.82	26.15	22.86	19.74	19.20	23.57	347.5	*MG*
Effluent Flow	Avg.	0.917	1.718	1.766	1.007	0.681	0.841	0.823	0.773	0.728	0.588	0.668	0.722	0.936	*MGD*
	Max	1.095	2.688	2.795	1.483	0.750	1.317	0.899	0.870	0.751	1.044	0.811	0.957	2.795	*MGD*
	Total	28.43	48.12	54.75	30.21	21.11	25.24	25.50	23.97	21.84	18.24	20.04	22.39	339.8	*MG*
Influent Avg. Analysis (mg/L)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.	
	BOD5	291	196	161	253	328	403	332	316	366	340	310	343	303	*mg/L*
	TSS	208	112	86	201	241	351	309	259	314	281	298	282	245	*mg/L*
	Ammonia	*30*	*17*	*16*	*19*	*27*	*31*	*41*	*38*	*31*	*33*	*31*	*30*	*29*	*mg/L*
	TKN	*44*	*30*	*25*	*31*	*45*	*48.15*	*60.34*	*47.40*	*46.76*	*51.73*	*49.43*	*48.38*	*44*	*mg/L*
	Alkalinity	*284*	*306*	*306*	*300*	*276*	*288*	*296*	*268*	*265*	*258*	*262*	*269*	*281*	*mg/L*
Effluent Average Monthly Analysis (mg/L) *E-Coli = Maximum Monthly Analysis (mpn/100 ml)*		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.	
	pH	7.1	7.1	7.2	7.2	7.1	7.0	6.9	6.9	6.9	6.3	7.1	7.2	7	*mg/L*
	D.O.	1.4	3.5	6.1	5.6	3.5	2.0	1.8	1.9	2.7	5.6	8.5	6.8	4	*mg/L*
	Temp.	0.4	3.0	4.0	11.0	15.7	21.3	22.5	21.2	16.1	12.7	6.1	0.8	11	*mg/L*
	Chlorine	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	0.008	*mg/L*
	BOD5	44	15	9	7	6	9	8	8	8	4	5	8	11	*mg/L*
	TSS	32	9	5	6	8	6	9	9	7	5	7	10	9	*mg/L*
	E-Coli	12	579	435	18	1	2	6	19	14	110	21	2	102	*mg/L*
	Ammonia	18.4	14.0	12.9	13.0	12.3	22.8	24.8	19.2	20.2	0.8	14.7	17.9	16	*mg/L*
	#3 Ammonia	*26*	*23*	*20*	*14*	*26*	*38*	*23*	*19*	*21*	*2*	*16*	*28*	21	*mg/L*
	N+N	0.18	0.17	0.54	0.31	0.28	0.69	1.98	2.19	12.18	29.43	15.75	2.19	5	*mg/L*
	TKN	21.6	16.6	19.0	15.6	14.1	25.1	27.5	23.2	23.2	2.7	18.1	23.3	19	*mg/L*
	Total N	21.8	16.7	19.6	16.0	14.3	25.7	29.4	25.3	35.4	32.1	33.8	25.5	25	*mg/L*
	Lbs T N	166.9	240.2	288.5	134.1	81.5	180.8	202.3	163.6	215.2	157.7	188.6	153.6		
	Total P	1.46	0.68	0.50	0.55	0.59	0.63	0.72	0.74	0.63	0.30	0.59	0.85	1	*mg/L*
	Ortho P	1.05	0.60	0.62	0.60	1.02	0.87	0.55	0.67	0.44	0.24	0.50	0.93	1	*mg/L*
	Aluminum	50	60	50	90	60	50	40	30	40	<10	30	34	49	*mg/L*
	O&G	2	1	< 1	< 1	< 1	< 1	1	< 1					1	*mg/L*
	TDS	324			472			429						408	*mg/L*
Wk. Max. Loading	Weekly Maximum Loading in Pounds per Day														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.	
	BOD5	758	252	255	94	55	87	65	74	85	36	33	59	154	*Lbs*
	TSS	401	171	157	65	91	58	80	72	52	36	46	71	108	*Lbs*
Month Avg. Loading	Monthly Average Loading in Pounds per Day														
	BOD5	328	202	134	61	34	68	61	55	52	21	27	53	91	*Lbs*
	TSS	235	118	73	53	49	40	62	63	47	25	39	61	72	*Lbs*
	Total N	167	240	288	134	81	181	202	163	215	157	188	153	181	*Lbs*
	Total P	11.1	9.8	7.3	4.6	3.3	4.4	4.9	4.7	3.8	1.5	3.3	5.1	5	*Lbs*

Monthly flow and organic loading data was evaluated for a three year period, from 2012 through 2014. Based on this data, the average waste strength and flow is as follows:

BOD_5	**297 mg/l**
TSS	**239 mg/l**
Phosphorous	**6 mg/l**
Ammonia	**25 mg/l**
Average Daily Flow per capita	**128.7 gpcd**

Average Daily Flow per capita (wet weather)	**154.5 gpcd**

Design Loading for Existing Treatment System - The design capacity of the lagoon system was established during construction of the 1978 improvements at a design flow of 1.25 MGD with capacity to serve a population of 10,000 persons. The 1987 improvements to the system, including the construction of a flocculating clarifier for reduction of phosphorus, were built for a design capacity of 1.8 MGD. More recent improvements to the lagoon system including a new aeration system, hydraulic structures and the ability to store wastewater during high flow periods may bring the effective hydraulic design capacity of the lagoon system closer to the capacity of the flocculating clarifier. The following organic loads were utilized when designing the 2008 improvements:

BOD_5	2297 lbs/day
TSS	2447 lbs/day
Design Flow	1.8 MGD average daily flow

The existing facilities should have functional capacity to treat average daily flows up to 1.8 MGD with the capability to handle higher flows with the new clarifier, up to 2.3 MGD. The 2008 improvements removed a hydraulic restriction to the existing clarifier, allowing more flow through the unit process. If necessary, both clarifiers could be operated in parallel for a significantly higher flow handling capacity. However, at some elevated flow level, the aerated lagoons would limit the treatment capacity of the overall treatment system. Also regulatory standards may preclude sustained loads associated with a flow rate of 1.8 MGD, particularly given the fact that the non-degradation based load limits were calculated using a flow of 1.25 MGD. Note that the non-degradation regulatory standards apply to effluent loads. Anticipated influent loads must be considered for planning purposes with the understanding that regulatory standards will limit effluent loads thereby requiring additional levels of treatment and pollutant removal.

Year 2035 Design Loading – The following table, extracted from the previous chapter, indicates the projected hydraulic and organic loading for the wastewater treatment facility for the design year of 2035. This data will be used to evaluate existing facilities as well as proposed improvements that may be required for the future.

Table 3.2 CITY OF WHITEFISH WASTEWATER IMPROVEMENTS DESIGN CRITERIA

	2013	2015	2020	2025	2035
Planning Area	11,230	11,661	12,812	14,076	16,992
Connected Pop.	7,736	8,033	8,826	9,697	11,705
Q_{avg}	0.996	1.034	1.136	1.248	1.507
$Q_{wet\ weather\ (6\ month\ period)}$	1.195	1.241	1.363	1.498	1.808
Q Max Day		4.266	4.342	4.355	4.530
AVG BOD (lbs/day)	2467.8	2562.5	2815.4	3093.3	3734.0
MAX BOD	3289.6	3415.8	3753.0	4123.4	4977.4
TSS (lbs/day)	1980.4	2056.4	2259.4	2482.4	2996.5
Ammonia (lbs/day) ***25.03 mg/l Avg Conc.***	208.9	216.9	238.3	261.8	316.0
Total P (lbs/day) ***6.0 mg/l Avg Conc.***	49.83	51.74	56.85	62.46	75.40
TKN Avg 41.4 mg/l					
Alkalinity 265.6 mg/l					
	Dec	Jan	Feb	Mar	Apr
Avg Influent Temp	9.5	8.8	8.1	8.2	9.2

3.4 Unit Process Evaluation

3.4.1 General

This section of the PER provides a detailed process by process analysis of the existing wastewater treatment facilities from the plant's pretreatment facilities , main lift station, through the treatment plant to the effluent discharge structure located in the Whitefish River. Sidestream processes will also be evaluated. The basis for the information presented below is drawn from the prior engineering reports prepared by the consultant, site visits and interviews with the staff of the Public Works Department.

3.4.2 Lift Pumps and Pretreatment

Pretreatment - A new screening building was installed in the 2008-09 facilities upgrade, located on the northwest corner of the plant site. An Andritz Aqua-Screen Model 600x520x6 perforated plate screen with 6 mm openings (.25 inch) was installed, including a washer-compactor unit to handle removed screenings. The screen was located in a one room block building which includes an air collection system which draws air from the building and pumps it up to a biofilter located on the hilltop just east of the screen facility. Odors have not been a problem with the screening facility and the biofilter has not been used. The solids are then dewatered to a dryness suitable for disposal at a sanitary landfill, equivalent to the Paint Filter Test level of dryness (no free water). Screened material is removed to the landfill generally once per week. Screened solids are produced at a rate of about 3.5 to 6.0 cubic feet per day, generally increasing proportionately with flow volume. Flow to the screen building comes primarily from a 30" gravity line that flows along the Whitefish River southerly to the structure. Additionally, a forcemain from the River Lakes area was diverted from the lagoons to the screen building in 2015 to insure that all wastewater going to the plant has been screened.

A channel parallels the perforated screen installation where a manually cleaned bar screen is located. As needed, a second mechanical screen could be located in this channel. The discharge from the screen facility flows by gravity to the main pump station where it is pumped to the first cell of the treatment lagoons. A 3,000 gallon sump was constructed within the screen building adjacent to the gravity main flowing to the pump station. This sump was installed to allow use of a trash pump to pump around the main pump station into a connection port installed on the forcemain. Previous to installation of this bypass system, there was no means to isolate the pump station for maintenance or repair.

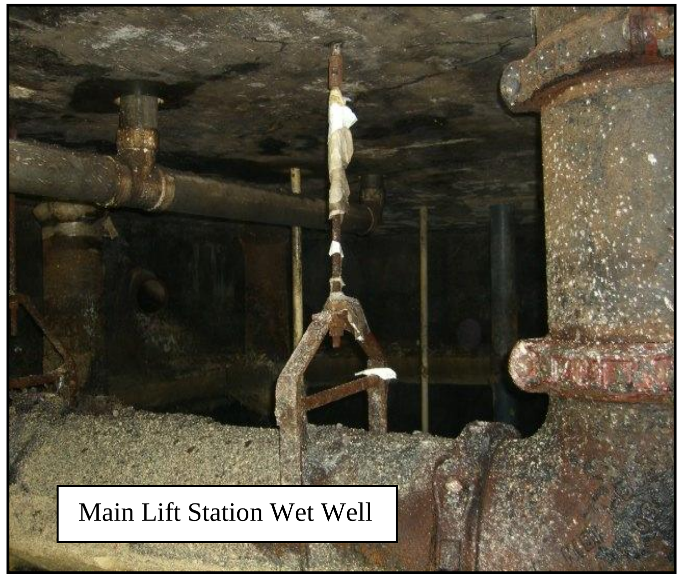
Headworks Screen, Washer & Compactor

Identified Deficiencies – There are no apparent deficiencies in the operation or performance of the screening facility. The system is rated for an average design flow of 1.0 MGD with a peak flow of 6.0 MGD. While peak flows have not reached 6.0 MGD in recent years, the system has experienced sustained peak flow events in excess of 1.0 MGD with no reduction in performance. Depending on the success of infiltration and inflow mitigation efforts, a reduction in peak flow events can be anticipated. Review of the system with the manufacturer of the perforated plate screen indicated that it was their belief that the system should function well within the anticipated design average daily and peak flows. A second screen can be installed in the future in the bypass channel.

Main Plant Lift Station- This lift station, constructed in 1987, pumps all of the City's wastewater into the treatment system. The lift station is located approximately 1,700' north of the lagoon inlet structure, along the east bank of the Whitefish River. A 30" RCP concrete pipe flows into the lift station from the screening building whereas the pumps discharge into a 16" force main, which directs flow into the lagoon system. The pump station has three 60-hp suction lift pumps with the original 1987 installation using Crown pumps. These have since been replaced by Gorman-Rupp Model T10A60-B 10" x 10" self-priming pumping units. The measured outputs (2005) of these pumps are as follows:

Pump #1 - 2500 gpm **Pump #2 - 2500 gpm** **Pump #3 - 2500 gpm**

Annual high flow events due to intense rains and/or rapid snowmelt have resulted in the need to operate two pumps in parallel, with the third pump as a backup. The current pumping arrangement appears to provide adequate redundancy, provision of handling peak flow with one pump on standby. Maximum daily flow during the period 2010 through 2015 was 4.029 MGD or 2800 gpm. With the City's ongoing efforts to reduce I/I in the system, peak flows have generally been diminishing.


Main Lift Station Wet Well

The Main Lift Station was constructed with three levels including the wetwell on the bottom, the middle level where the pumping units are located and the upper level which houses the controls and emergency generator set. The main 30" gravity sewage line enters the structure on the north side of the building. Wetwell access is provided via a covered hatch located in the lower level of the structure which enters the wetwell from the side. Due to the configuration of the wetwell, there is no safe access for cleaning, maintenance and repair of the interior structure during operation and the pump station would need to be bypassed to allow proper access. During the 2008-09 project, the pump station was taken out of service and the wetwell cleaned and inspected. No major concrete or metal corrosion was evident during the inspection and the facility was found to be in relatively good shape, given the age. The 2008-09 upgrades to the main lift station included removal of the old diesel generator and installation of a natural gas generator located outside of the pump station building, within a block enclosure for sound attenuation. A new roof for the lift station was included under the last project. Paving of the road to the lift station to facilitate year round access to the existing and new facilities was also constructed.

Identified Deficiencies – Plant staff have indicated that, given the age of much of the equipment in the pump station, partial renovation of pumping equipment, valves, electrical components, drives and controls is warranted. While almost 30 years old, the building's structural components should have useful life remaining.

3.4.3 Secondary and Advanced Treatment System

General Description - The existing wastewater treatment facilities consist of 3 aerated lagoon cells for biological treatment with the discharge from the lagoon system flowing to a flocculating clarifier where alum and polymers are added to precipitate phosphorus. A curtain was installed in Cell #1 to simulate division of the large lagoon cell into two cells, improve process treatment kinetics and performance. The lagoon system is a partially-mixed aerated lagoon with supplemental air provided to support the biological processes through the use of submerged fine bubble diffusers. Sufficient mixing energy is provided to disperse oxygen in the upper part of the lagoon as needed to support aerobic and facultative microorganisms. Solids enter the lagoon system through the deposition of settleable solids which are a component of the raw wastewater or through the settling of biomass which grows in the lagoon system. Previously, settled solids from the flocculating clarifier were returned to the lagoon system but this practice has been discontinued. A major upgrade to the lagoon system was completed in 2003 where sludge was removed from the first treatment cell, the aeration system replaced, improvements made to the lagoon influent structure and a new control system added to the main lift station located on site. The entire site was fenced with a secure chainlink fence. These improvements allow the effective treatment capacity of the lagoon system to exceed 1.25 MGD, approaching the greater capacity of the flocculating clarifier. The 2008-09 plant improvements included a second flocculating clarifier complete with an independent chemical feed system. An auxiliary generator was installed to insure reliable power is available for the phosphorous removal facilities. No improvements to the lagoon system were made during the last plant upgrade in 2008.

Influent Structures - Flow is pumped to the lagoon system, entering through a concrete discharge structure modified in 2003. A meter manhole was placed just ahead of the inlet structure where a magnetic flow meter measures influent flows to the lagoon. The flow transmitter is located in the blower building and a SCADA system allows flow data to be monitored on the computer located in the control building. A new bypass was installed to bypass flows around the influent structure to Cell #2. An older bypass line exists whereby flow can be diverted at the inlet structure to Cell #2, if necessary. The influent structure was constructed by modifying the original structure. Due to the difficulties in draining the existing lagoon to work on the influent structure, the underwater discharge ramp of the original system was left in place. The connection of the discharge ramp (or splash pad) to the portion of the concrete structure located on top of the dike is cracked and could potentially break off and slide into the bottom of the lagoon system.

Aerated Lagoon System – Tapered aeration is provided to the three lagoon cells through a submerged aeration system which discharges air at the bottom of the cell to submerged fine bubble diffusers. Air is supplied with three 60-hp Suterbuilt positive displacement blowers located in a separate blower building; each blower capable of provided 1210 scfm of air at 7.5 PSI. The aeration system utilizes new ductile iron piping with 10” air header to Cell #1 and 8” header to Cells #2 and #3. Valved 6” and 4” floating PE laterals provide air to the submerged diffuser units. Fine bubble Parkson Biolac Membrane Biofuser diffusers are used to disperse air to the lagoon contents. The number of diffuser units is as follows:

Cell #1 56 units   Cell #2 24 units   Cell #3 20 units

The variable speed drives allow the blowers to be turned down to better match oxygen demands. The system has been functioning well with the use of two blowers running at a reduced speed, requiring approximately 45 to 55 horsepower which is significantly less power than the previous aeration system required. Additionally, an air flow meter monitors air flow in the primary air header and this information can be used to control the blowers to optimize aeration. Noise attenuation materials were installed in the blower

Rags on Removed Diffuser

room during the 2003 project to reduce ambient noise levels. When operating, a harmonic oscillation of air passing through the blower intake filters has created a noise outside of the blower building that has led to complaints from nearby neighbors.

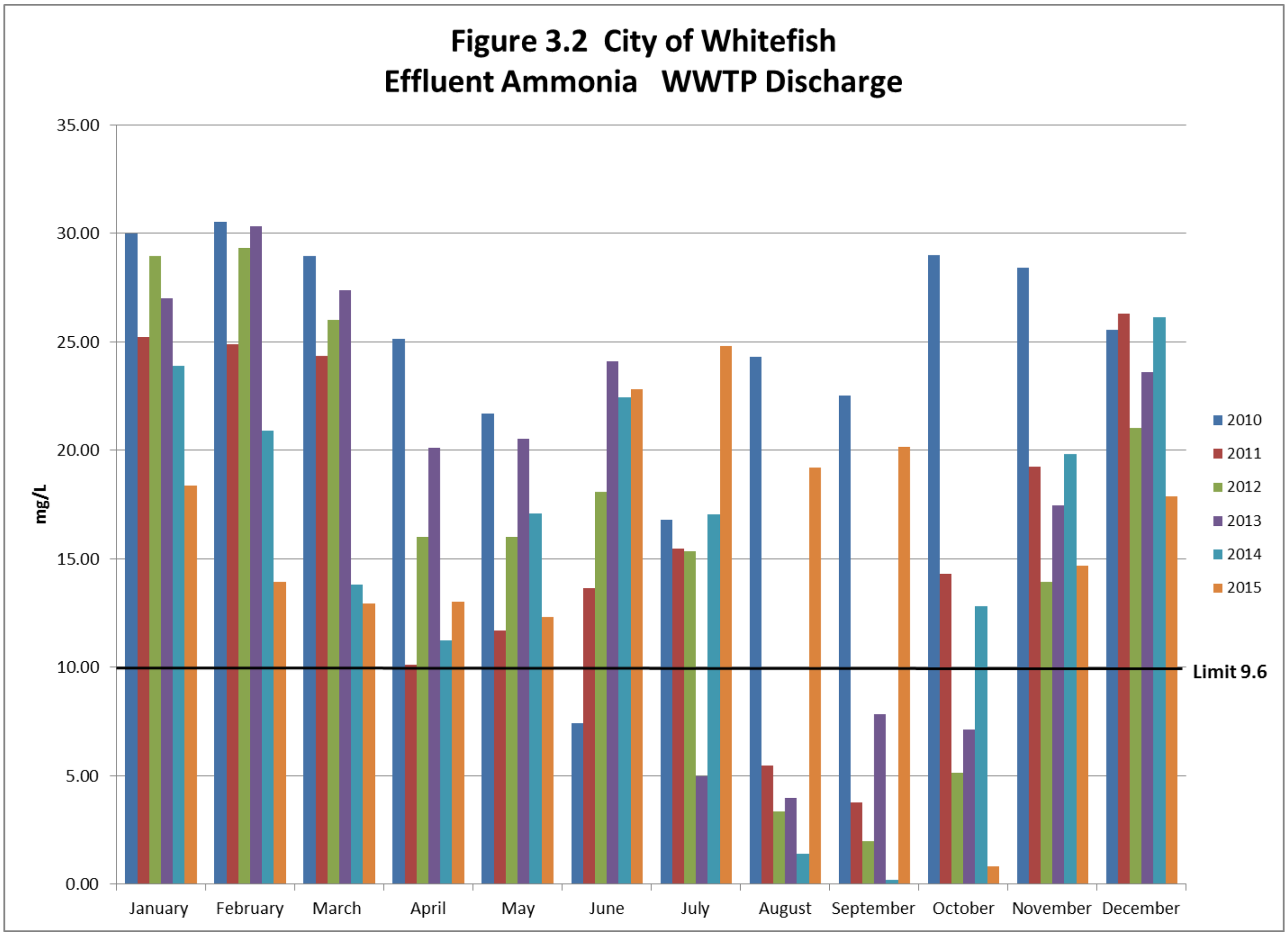
The lagoon piping allows for parallel and series operation as well as cell bypassing, if needed. Additionally, piping modifications were made in November of 1996 to allow the passage and/or retention of flows that exceed the design capacity of the existing piping, primarily the line feeding the flocculating clarifier. High flows, typically during storm events, can be diverted from the lagoon system into an existing phase isolation pond where it can be fed back into the raw sewage lift station. From this point, the stored flow will be returned for processing at the head end of the lagoon system. The 2008 project added additional hydraulic and treatment capacity in the advanced treatment system to handle flows greater than 1.8 MGD for limited periods, such as during the high flow events. It is estimated that about 2.88 MGD can now pass through the treatment system without diversion to the overflow ponds. It should be noted that a partial blockage has occurred in the hydraulic transfer structure between Cell #1 and Cell #2. Staff has attempted to eliminate the blockage with limited success.

Diffuser Problems – Since installation, the membrane diffusers have had ongoing problems with accumulation of rags on the diffuser units, allowing entrapment of air which then floats the diffuser to the water surface of the lagoon. The floating diffuser, without the water pressure head against the diffuser membrane, allows excess discharge of air. The plant operators have isolated banks of diffusers that have rag accumulation until the material could be removed. Removal requires accessing the diffuser with a floating platform and manually cleaning off the rags, generally a cumbersome and messy job. To address the problem, the perforated screen was installed in 2008 to remove the rags. This 2008 screening facility accepted flow from all of the City's users except an area south of the treatment plant (River Lakes) that pumped directly into the lagoons via a separate forcemain. This area serves a hospital and retirement homes and could be discharging a disproportionate amount of paper and cloth products that will eventually become rags. To address this problem, the River Lakes forcemain was diverted from the lagoon influent structure to the perforated screen facility in a project that was completed in 2015. While all of the incoming flow is now being screened, the residual accumulation of rags will continue to cause problems until the material is removed or breaks down. The malfunctioning aeration equipment limits the ability of the system to provide sufficient air for the biological demands of the system.

The membranes on the diffuser units have a 5 to 7 year estimated design life. Given their installation in 2003, the membranes should be replaced. This also requires use of the barge to pull each diffuser, disassembly and membrane replacement.

Performance – Since the upgrade of the lagoon aeration system in 2003, the performance of the system has improved and positive dissolved oxygen levels have generally been maintained. BOD_5 and TSS removal in the lagoon system plus polishing with the flocculating clarifier has been very good with only one excursion noted for the period from 2010 through 2015. Periodic odors have occurred, primarily in the spring during turnover. The lagoons are not effective for converting ammonia to nitrates.

Process Limitations – The existing lagoon system including earthwork, liner, discharge structures and piping which are 34 years old, are near the end of the typical design life for these components. Erosion of the riprap protecting the lagoon liner is becoming evident along the water line in the cells. The liner used in the lagoon would not meet current DEQ standards. The lagoons are not capable of meeting anticipated effluent standards for ammonia and nitrogen. The existing lagoon system cannot consistently remove ammonia on a year-round basis. The partially mixed aerated lagoon system, while effective for meeting secondary treatment standards, is limited in capability for provision of treatment performance considered as "advanced". Advanced treatment might include nutrient removal, reduction of ammonia and polishing of effluent BOD_5 or TSS concentrations below 20 mg/l. The aerated lagoon, with hydraulic detention times in the range of 30 to 40 days, experiences significant temperature losses in the winter time which reduce the performance of the biological processes. The nitrification process whereby ammonia is converted to nitrate nitrogen is typically present in aerated lagoons in the warmer months but will be lost in the wintertime. Nitrifying microorganisms, *nitrosomonas* and *nitrobacter*, are very sensitive to temperature and as the ambient heat is lost in an aerated lagoon system during Montana winters, these bacteria effectively cease to function. The inability to settle, recycle and concentrate solids in an aerated lagoon also limits the performance of the system, particularly in creating an environment which will support biological nitrogen or phosphorous removal. Longer detention times in aerated lagoons also encourage the growth of algae which can add to BOD_5 and TSS effluent concentrations. The Whitefish lagoon system, in combination with the flocculating clarifier, has consistently produced high quality effluent generally much better than "typical" lagoon effluent. Additionally, limited available oxygen in the lagoon system may reduce the rate of nitrification in the lagoon system. The following **Figure 3.2** shows the performance of the lagoon system in converting ammonia to nitrate over the last six years, with the current ammonia limit in the discharge permit noted. The graph demonstrates that ammonia removal is only achieved now in the plant during the summer months when water temperature favorably supports nitrifying bacteria.



Advanced Treatment -After receiving secondary treatment in the lagoon system, the wastewater is discharged to one of two flocculating clarifiers where alum and polymers are added to precipitate phosphorus. The older clarifier, not presently in service, is a covered 65’ diameter Westech concrete circular clarifier, 12’ sidewall depth with a volume of 318,000 gallons. The process is covered with an aluminum dome to allow for good performance during cold weather, without freezing. Design overflow rates at 1.8 MGD are 540 gallons per day per square foot. The process was installed in 1987 and included solids handling facilities and a control building. Alum and polymers are added to the effluent stream from the aerated lagoons by injection of the chemicals into a 12” flash mixer, prior to discharge to the flocculating clarifier. Typically, 200 to 250 mg/l alum is added to the flow stream, significantly greater than stoichiometric amounts. While the center well of the clarifier was designed to promote flocculation, the influent piping to the structure, just downstream of the flash mixer, may be detrimental to the formation of good floc structure. High velocities in the piping exceed recommended values and the turbulence may be shearing the floc.

A second redundant flocculating clarifier was constructed in 2008-09. This clarifier is rated for 2.3 MGD, is 75’ in diameter and is 14’ in depth. Similar to the existing clarifier, the new unit is covered with an aluminum dome. New chemical mixing and pumping equipment were included in the new clarifier project including a mechanical mixer rather than a static mixer. The new mixing equipment should allow more efficient use of alum, presuming better mixing. The alum and polymer feed pumps will be set up to be flow paced under the current project. The operators have been working to reduce alum usage and have been able to get successful phosphorous removal with alum dosages under 200 mg/l, except in cold weather where reduced water temperatures appears to inhibit the settling process.

Originally, the solids from the flocculating clarifier were to be dewatered through the use of a belt filter press located in the control building. The dewatered sludge would be land applied or hauled to a local compost facility. The unique biological-chemical sludge did not dewater well on the belt filter press, particularly in the winter. The poor dewatering characteristics of the sludge resulted in the need to rely on the return of alum sludge to the lagoon cells as an interim measure to maintain treatment performance. This practice resulted in a large build-up of sludge in the first aerated lagoon cell.

In 1998, improvements were made to allow the year-round pumping capability of alum sludge drawn from the flocculating clarifier (or storage) directly to augmented sand drying beds, located on site. This improvement has been successful in providing a reliable system for disposal and dewatering of the alum sludge. A sludge storage basin was located within the control building to store sludge if severe weather limits use of the drying beds. The belt filter press was removed. Solids from the new clarifier are periodically wasted to the sludge drying beds.

Performance- The flocculating clarifier has been very effective in removal of phosphorus from the effluent stream and the plant has shown consistent permit compliance. Prior to the 2003 plant upgrade, the effluent quality from the aerated lagoons was generally poor in terms of BOD_5 and TSS concentrations, in excess of the discharge permit. The flocculating clarifier is very effective in polishing the effluent from the secondary system, allowing compliance with the BOD_5 and TSS limits of the discharge permit. Effluent quality is assessed through samples which are collected from the outfall line that conveys treated effluent from the wastewater plant to the Whitefish River.

Process Limitations- With the duplicate clarifier and chemical feed equipment, the plant has significant capacity to treat flows with the addition of chemicals and clarification. Estimated physical treatment capacity up to 4 MGD should be possible for short periods although at some sustained flow condition above 1.8 MGD, the performance of the lagoon system will deteriorate, shifting more load to the flocculating clarifier system. The hydraulic capacity of the newer clarifier is 2.3 MGD. While the flocculating clarifiers have been proven to be effective for polishing the effluent BOD_5 and TSS as well as precipitation of phosphorous, the unit process provides little benefit for removal of nitrogen and ammonia.

3.4.4 Disinfection

The Whitefish treatment facility had what was considered to be temporary disinfection facilities installed in the main control building in 2011 utilizing sodium hypochlorite and sodium biosulfite for dechlorination. The equipment was considered to be temporary in the sense that a new treatment plant was anticipated for the future and permanent disinfection equipment would be a component of that project. Prior planning work recommended the use of ultraviolet disinfection equipment for the purpose of providing a long-term means of effluent disinfection.

At present, the chlorine solution is injected into the transfer line flowing from the lagoons into the flocculating clarifier, just ahead of the flow meter and chemical mixing equipment located on this conduit. The hydraulic residence time in the clarifier provides the contact time needed for the disinfection process. It was noted that the injection quill for the chlorine injection has created hydraulic anomalies which impact the flow meter located immediately downstream of the injection point. This flow meter is used for flow paced equipment such as the chemical feed pumps and the lack of stable flow measurement has adversely impacted this function. The City has been using an oxidation reduction potential (ORP) meter to assist with control of the chlorine disinfection system. ORP is an indicator of the ability of a solution to oxidize and is directly related to the concentration of the oxidizing agent, in this case free and combined chlorine. The city has had mixed success with chlorine effectiveness treating their effluent and purchased an ORP meter to help fine tune and optimize the disinfection process. The ORP of the effluent entering and leaving the clarifier is very low, < 300 millivolts and generally around 200-230 millivolts. Based on discussion with the plant operators, they had been utilizing about 7-9.5 gallons of sodium hypochlorite solution per 1 MGD of flow. Based on a 12.5% solution, this equates to a chlorine dosage of about 1.1 mg/l applied to the discharge from the aerated lagoon system to the flocculating clarifier, which is a low dosage rate. It was suggested that an increase in chlorine dosage may help get more reliable results in bacterial kill and allow for a better use of the ORP equipment. Peristaltic pumps (Thermo Scientific) are used to pump the chlorine solution from the solution tanks to the injection point.

Sodium biosulfite is pumped using Milton Roy positive displacement pumps, drawing solution from the solution tanks and discharging into a manhole downstream of the clarifier discharge. Staff checks chlorine levels in the next manhole downstream to monitor effectiveness of the dechlorination agent.

The current discharge permit also requires that *E.Coli* concentrations are reduced to 630 cfu/100ml for the average monthly limit and 1,260 for the maximum daily limit **during the winter** and 126 cfu/100ml for the average monthly limit and 252 for the maximum daily limit **during the summer**. Summer is April 1 through October 31. The previous permit required that these limits be met by **July1, 2011**. An analysis of the data since July 1, 2011 indicates that 15 excursions from the more restrictive standards have occurred and more can be anticipated in the future. As detention times in the lagoons decrease with additional flow and waste concentrations increase with I/I reduction, an increase in bacteria concentrations can be anticipated. Any changes in the secondary treatment process, such as a mechanical treatment plant, would impact bacteria concentrations, likely increasing the numbers that pass through the system. For these reasons, planning for construction of new disinfection facilities will be included in this planning document.

Process Limitations- The disinfection system was installed as a temporary system until the plant was upgraded and as such, should be replaced. Equipment should be reused were feasible.

Effluent Diffuser - Effluent from the plant is discharged to the Whitefish River via an 18 foot long - 12" diameter cast iron pipe installed along the bottom of the waterway, spanning just over ½ of the width of the stream. The diffuser has 1⅝" holes placed on alternating sides of the pipe, 90º off vertical, on 12" centers. The City staff has occasionally blown out the diffuser to reduce solids accumulation. The diffuser has been beneficial when calculating effluent standards in the discharge permit in that DEQ has acknowledged benefit of a diffuser in promoting good mixing through the entire width of the river.

3.4.5 Solids Handling

The Whitefish wastewater treatment facility presents a unique combination of an aerated lagoon system plus a flocculating clarifier, a collection of treatment processes not commonly used together. The generation of solids in the overall treatment system consists of incoming biological and inert solids, growth of biomass in the lagoons and the chemical-biological sludge that precipitates out of the flocculating clarifier. Sludge which is generated in the lagoon system is either stored on the bottom of the aerated cells or removed via suspended solids in the effluent. The sludge stored in the cells must eventually be removed. The removal of the large accumulation of biological and chemical sludge from the first aerated lagoon cell was a major component of the 2003 upgrade project. An estimated volume of 11 to 13 million gallons of sludge slurry was pumped from the cell and deposited in a sludge drying bed, constructed on site. Sludge was not removed from Cell #2 or #3 during the project. The need for future sludge removal can be anticipated in a 10 to 20 year time frame or during a project upgrade. Typically the removal of sludge from a lagoon system occurs in combination with other needed improvements, such as a major upgrade to the system.

Effluent from the lagoon system flows through the flocculating clarifier where alum and polymers are added to promote phosphorus removal. The chemicals aid in the coagulation of particles in the clarifier, helping to remove dissolved and suspended constituents. The solids stream from the flocculating clarifier is pumped to sand drying beds and retained in place. The liquid volume in 2004 was 1.29 million gallons with an average solids concentration of 2.3%. Sludge production in 2004 was 124.8 dry tons per year. The projected production in 2016 is estimated at 1.66 million gallons per year or about 160 tons on a dry weight basis. The sludge has not been analyzed recently for metals or pathogens. The sludge appears to dewater very well on the drying beds, leaving a dry and fine grained granulated material as the end product. Each of the three beds has an under drain which collects water which filters through the bed. The filtrate is returned to the raw sewage pump station which pumps the liquid back through the treatment system. Some "musty" odors occur during pumping to the beds which dissipate quickly.

Given the rate of accumulation on the drying beds, removal of dried solids will not be required for several years to come. The drying beds were designed to function year round. Solids can be retained within the flocculating clarifier for several days. Daily wasting is not needed in the manner required in a typical activated sludge system. The accumulation of sludge to date in the drying beds is minimal based on visual observation, estimated by City staff to be 6" to 1.0' at the most. The beds would appear to have significant volume to hold additional solids at the current rate of sludge generation. However, the City should strive to retain adequate space at the wastewater plant for future solids handling/disposal needs.

The sludge which was removed from Cell #1 during the 2003 construction project was left in the northernmost drying bed for long-term treatment. This bed could be reclaimed for use as a drying bed with removal and disposal of the dried sludge. Sufficient area is available nearby to allow for disposal. The accumulated solids could also be spread onsite and incorporated into the soil at an agronomic application rate, depending on the amount of nutrients and metals in the sludge. This sludge is similar in appearance to the sludge coming from the flocculating clarifier.

Process Limitations – The solids handling system associated with the existing treatment plant is functioning well and has ample capacity for additional sludge disposal, up to the design capacity of the existing treatment system. Eventually the accumulated solids must be removed from the system to maintain sufficient working volume in the beds to allow for solids dewatering. Similarly the lagoon solids placed in the third cell should be removed in the future to allow for additional capacity to handle waste solids from the flocculating clarifier. As noted in the previous chapter, final disposal of accumulated biosolids must be completed in accordance with the Federal Part 503 regulations. The probable final point would likely be the local landfill. The existing solids handling system will be considered for use with future plant improvements.

3.4.4 Summary of Wastewater Treatment Needs

The summary of needs identified in the evaluation of each unit process that is part of the existing Whitefish wastewater plant includes the following:

1. **In accordance with the Settlement Agreement between the City of Whitefish and the MDEQ, the City must initiate and complete construction of facilities to meet the standards of the recently issued discharge permit which include new limits for ammonia, total nitrogen and aluminum. Without major upgrades or replacement, the current secondary/advance treatment unit processes cannot comply with the effluent standards in the discharge permit.**
2. **The existing pretreatment screen has sufficient capacity for future design loads. Some treatment technologies may require fining screening.**

3. **The existing main pump station should be upgraded with new pumps, valves, controls, drives and electrical system improvements.**
4. **Disinfection facilities, currently installed on a temporary basis, should be upgraded.**
5. **The existing solids drying beds can be a viable component in plans for biosolids drying and disposal in the future. Accumulated solids should be periodically removed and disposed of in accordance with the Federal Part 503 Biosolids disposal regulations.**

3.5 Wastewater Collection System

This planning document is intended to focus on the Whitefish wastewater treatment plant. Separate studies, as recent as 2014, have been completed evaluating the City's wastewater collection system and lift station. Consequently, only limited information on the wastewater collection system is provided in this document, primarily for background.

3.5.1 Background

According to available documentation and City staff testimony, the City began collecting sanitary wastewater around 1911. At that time, the City passed an ordinance (Ord. 82, 12-7-1911) which required that there be constructed two sewer systems, one system for storm water runoff and one for sanitary sewage. The sanitary system that was constructed utilized 8" diameter clay tile pipe to collect wastewater from area residents and convey it to several large septic tanks located throughout town. Based on discussions with Public Works staff that are knowledgeable in system history, the City likely installed the early segments of sanitary sewer without the use of joint gasket material in order to intercept and lower the groundwater table. The additional clear water was also thought to be a benefit by enhancing solids flushing velocities. Closed circuit television (CCTV) inspection of some older portions of sanitary sewer indicates that either the gasket material is deteriorated or was never installed. Once the wastewater and groundwater was collected, it was directed to large concrete septic tanks for primary treatment and then discharged to drainfields on the banks of the Whitefish River. It is likely that these systems were hydrologically connected to the river itself.

In 1962, the City constructed the first centralized treatment system located at the current wastewater treatment plant site. Along with this treatment lagoon system, the City also constructed a 12" diameter interceptor along the northeast bank of the river to collect wastewater from the various cluster systems in town. At this point, the septic tanks and drainfields were abandoned in place. The collection system continued to grow with the community by extending clay pipe sewer mains into developing areas and upsizing existing interceptors to handle the added demand. In 1973, the City allowed the use of PVC pipe for sanitary sewer extensions and largely discontinued the use of clay pipe. However, over 12 miles of the original vitrified clay pipe system is still in use today.

The present-day wastewater collection system in Whitefish consists of approximately 45.7 miles of conventional gravity sewer mains, 16 raw wastewater lift stations and forcemains of various capacity, a series of 13 grinder pumps installations serving from 1 to 20 residences each and, four septic tank effluent pump or "STEP" systems serving individual areas on the east and west shores of Whitefish Lake. Due to historic and ongoing problems with maintenance and access, the City has dis-allowed the installation of any more of these grinder pump and STEP systems. The collection system delivers raw wastewater to the main sewage lift station and then on to the aerated lagoon treatment system with chemical phosphorous removal for discharge to the Whitefish River. Each of the collection system components was evaluated with respect to condition and dependability as well as capacity to handle existing and projected wastewater flows.

3.5.2 Regulatory Issues

The City has been required to address problems associated with sewer overflows, leading to enforcement activity put forth by the DEQ, as discussed in more detail in Chapter 2. These actions have led to a series of sewer system evaluations followed by construction projects. These projects have resulted in an investment of millions of dollars into the City's collection system and lift stations. A portion of this work is described below.

3.5.3 Collection System Infiltration and Inflow (I&I) Investigations

In 1999, the City continued its efforts to improve its wastewater system by completing the *Infiltration and Inflow Investigation for the City of Whitefish*. This document identified significant problems with specific portions of the City's sewage collection system including: direct inflow through numerous roof drains and catch basins, and significant infiltration.

In January 2006, the City completed a follow-up study of clear water inputs into the collection system titled *City of Whitefish – Sanitary Sewer Infiltration Mitigation Study, prepared by Anderson-Montgomery Consulting Engineers*. A project that evolved from this study included the rehabilitation of several downtown sanitary sewers that had problems with excessive infiltration and inflow as well as poor structural integrity. CIP liner was generally used for this project.

In April of 2014, the City prepared the *Preliminary Engineering Report - 2014 Infiltration & Inflow Mitigation Project authored by Anderson-Montgomery*. This report considered work completed in 2012 to reduce I/I and made further assessment of needs. Projects evolved which primarily looked at manhole work in known problem areas and continuation of sewer rehabilitation or replacement in priority areas. A project, funded with DNRC –RRGL and MDOC – TSEP grant funds with SRF loan funds is scheduled for the summer of 2016 to further address sources of clearwater entering the collection system.

3.5.4 Gravity Collection System

Whitefish's gravity sewer mains range in diameter from a minimum of 8" in the upper reaches of each drainage basin, to a maximum of 30" for the main trunk line along the east side of the Whitefish River. Total length of gravity collection sewer in Whitefish is approximately 45.7 miles with the following lengths for each diameter of pipe:

Pipe Diameter (in.)	Total Length (ft.)	(miles)	%-age of total system
30"	2,714	0.51	1.1%
27"	3,129	0.59	1.3%
18"	9,029	1.71	3.7%
15"	4,497	0.85	1.9%
12"	15,795	2.99	6.5%
10"	22,674	4.29	9.4%
8"	181,656	34.40	75.3%
6"	1,550	0.29	0.6%
4"	185	0.04	0.1%
TOTAL	**241,229 lineal feet**		

For the purposes of comparison between collection systems and federal guidelines for infiltration and inflow, it is typical practice to determine the total "inch-diameter-miles" of pipeline in the entire collection system. Using figures from the table immediately above, a total of 431 inch-diameter-miles of pipe can be derived. This is done by summating the products of all the various pipe diameters and their corresponding length in miles.

Materials of construction include clay tile in the older parts of town. Polyvinyl Chloride (PVC), cast iron and concrete have been used in more recent construction, and there is also some asbestos cement pipe primarily used for the larger diameter trunk lines and main line leading to the Main Lift Station. Of the estimated 45.7 total miles of pipe in the Whitefish system, the following list shows the estimated pipe lengths of each type of material.

Pipe Material	Total Length (ft.)	Percentage of total system
Clay tile	63,800	26%
PVC	172,453	71%
Cast Iron	220	<1%
Concrete	2929	1%
Asb. Cement	1,945	1%

As noted by the list, a significant amount of the gravity collection system is made up of vitrified clay pipe which was installed during construction of the original collection and discharge system in the early 1900's. Vitrified clay was the standard sewage piping material used until the early 1970's when PVC pipe began to be widely used. The clay pipe segments used in Whitefish's system are a nominal length of 3 feet including the bell, resulting in a pipe joint every 2.7 feet. This means the average block of clay pipe has over 140 joints. The total number of clay pipe joints in the Whitefish system is estimated at over 23,600. Clay pipe joint gasket material (if utilized) was typically a wax or petroleum-based mastic compound with adhesive and water sealing characteristics. With the average age of the clay pipe in Whitefish of approximately 60 years and the harsh environment, any joint sealing material that may have been used has likely experienced significant deterioration. This is evident from the television inspections that the City has conducted on approximately 23,000 lineal feet of clay pipe within the system (1998 through 2005). Some of the most pressing problems are: numerous crushed and collapsed sections, circumferential and longitudinal cracks, alignment and grade problems, root intrusions, infiltration and manhole defects. These problems are not uncommon in collections systems that are approaching 100 years of age.

Some of the *newer* sections of Whitefish's collection system also exhibit problems including offset joints, sags, infiltration and numerous protruding taps. These are typically from poor installation practices, inadequate bedding or possibly ground movement. There are several sewage collection systems in the northern part of the City (Cedar Estates, Mountain View, Sun Crest, Crestwood and Mountain Harbor) as well as numerous points in the Riverside development directly south and across the river from the wastewater plant, that exhibited significant infiltration through pipe joints, service taps and manholes. Once the sewer infrastructure is installed in new developments and is accepted by the City, it is very difficult to address defects and I&I issues. To preclude the acceptance of sub-standard sewer infrastructure, it is recommended that the City provide for vigorous inspection of construction as well as post-construction CCTV inspection of the piping and manholes to insure system integrity.

The main 30" outfall to the wastewater plant is located primarily along the banks of the Whitefish River. Access to this line is difficult and some sections of the line have been affected by unstable slope conditions, causing some movement of the outfall line. A trail has been proposed that will follow much of the outfall line. The City should make sure that this trail can be used for vehicular access to the outfall to allow for needed maintenance. Slope stability should be evaluated also when the trail is constructed to limit any further settlement problems. The City should pursue the acquisition of easements to access this sewer interceptor along its entire length for the purposes of maintenance and repair.

3.5.5 Lift Stations

The City of Whitefish has 20 raw wastewater lift stations, 71 individual and two centralized septic-tank-effluent-pump (STEP) or grinder pump stations and 73,136 lineal feet of forcemain ranging from 1½" to 16". Other than the lift station on the plant site, the lift stations on the collection system were not evaluated in this planning document and more information is available with earlier planning work as referenced earlier within this section.

Chapter 4 Wastewater System Needs, Alternative Analysis and Recommendations

4.1 Introduction

This chapter will identify feasible capital improvement projects to address Whitefish's wastewater system needs, provide preliminary cost estimates with descriptive drawings and recommend a prioritization strategy for those projects.

4.1 Public Health and Environmental Need of the Whitefish Treatment System

The Whitefish wastewater plant has satisfied the conditions of the previous wastewater discharge permits but is not able to comply with the conditions of the new permit. The ammonia standards included in the discharge permit are written to prevent toxicity to aquatic organisms in the Whitefish River. Indirectly, preventing toxicity in the river and the associated issues is of benefit to the health and welfare of the public as a whole particularly given the importance of water quality in the Flathead Basin. Additionally, the City must comply with numeric nutrient standards for total nitrogen and total phosphorous. While compliance with the phosphorous standards has been provided, the existing plant cannot meet the new standards for total nitrogen. The City of Whitefish and the Montana Department of Environmental Quality have agreed to implement improvements to the City's wastewater treatment plant as set forth in an Administrative Order on Consent (AOC), discussed in more detail in Chapter 2.

Failure to comply with the MPDES discharge permit or conditions established in the AOC will result in enforcement action by the DEQ, likely including monetary fines

4.2 Summary of Wastewater Treatment Plant Needs

The information below summarizes the identified needs for improvements to the Whitefish wastewater treatment facility, including the main lift station located at the treatment plant. The summary of needs identified in the evaluation of each unit process that is part of the existing Whitefish wastewater plant includes the following:

1. **In accordance with the Administrative Order on Consent WQ-11-21 (AOC) between the City of Whitefish and the MDEQ, the City must initiate and complete construction of facilities to meet the standards of the recently issued discharge permit which include new limits for ammonia, total nitrogen and aluminum. Without major upgrades or replacement, the current secondary/advance treatment unit processes cannot comply with the effluent standards in the discharge permit.**

2. **The existing pretreatment screen has sufficient capacity for future design loads. Some treatment technologies may require fine screening which would require a retrofit of the screen facility.**
3. **The existing main pump station should be upgraded with new pumps, valves, controls, drives and electrical system improvements.**
4. **Disinfection facilities, currently installed on a temporary basis, should be upgraded.**
5. **The existing solids drying beds can be a viable component in plans for biosolids drying and disposal in the future. Accumulated solids should be periodically removed and disposed of in accordance with the Federal Part 503 Biosolids disposal regulations.**
6. **Issues with odors and noise associated with the existing system should be addressed when considering new treatment technologies.**

The following analysis of major unit process summarizes deficiencies and identifies alternatives that will be evaluated. More detail on the unit processes was provided previously in Chapter 3.

4.2.1 Pretreatment and Pump Station

The existing pretreatment screening and dewatering facility are located on the northwest corner of the plant site and receive all of the community's wastewater. The main lift station is located just south of the pretreatment building, immediately adjacent to the banks of the Whitefish River. The pretreatment facility is relatively new and will function adequately with other improvements that will be evaluated for upgrading the Whitefish treatment system. The main lift station will require improvements including replacement of pumps, valves and controls. These improvements will be a common component of all treatment alternatives that will be considered.

4.2.2 Aerated Lagoons

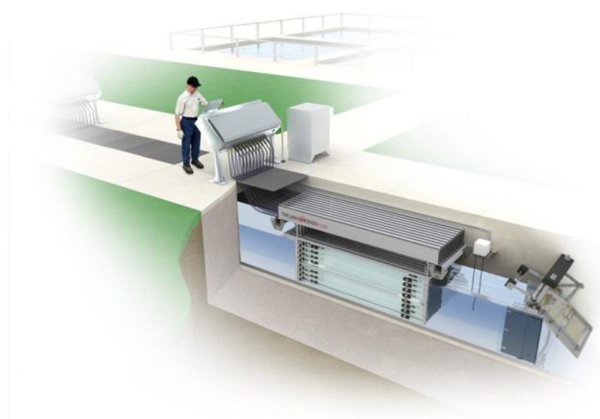
The existing 3-cell aerated lagoon system cannot meet the permit requirements for reduction of ammonia and total nitrogen. The existing lagoons are over 30 years old, are near the end of their useful life and do not meet current design standards. The option of continued use of the aerated lagoons for meeting the current and anticipated permit standards is not viable. Options to upgrade the system will be considered including advanced lagoon systems, oxidation ditch, sequencing batch reactor (SBR), membrane bioreactor (MBR) and a lagoon upgrade option that would remove ammonia but not total nitrogen. This last option would require an individual variance from the nutrient standards as described in Base Numeric Nutrient Standards Implementation Guidance, July 2014. These options will be developed and screened with the intent of eliminating those options not considered to be viable for detailed analysis.

4.2.3 Flocculating Clarifiers

These unit processes have been effective in reducing phosphorous levels in the effluent below the standard of 1.0 mg/l. The largest clarifier, built in 2008, is presently on line whereas the older clarifier would require renovation of the scraper and drive to use effectively. Both structures have inherent value and remaining useful life. The new clarifier was equipped with piping which was stubbed out past the foundation for the purpose of recycling mixed liquor, allowing conversion of the clarifier to a conventional secondary clarifier with return or wasting of activated sludge. In development of alternatives, these structures will be considered for use as secondary clarifiers, flocculating clarifiers, equalization basins or solids storage and stabilization.

4.2.4 Disinfection

Prior planning work completed in the 2008 Whitefish Wastewater System PER regarding installation of disinfection facilities recommended construction of a new ultraviolet disinfection system to enable compliance with new bacterial standards that was included in the previous MPDES discharge permit. As proposed, this system included a new building housing the disinfection facilities, located on the west side of the treatment plant grounds located along the outfall line to the river. This type of disinfection was previously selected due to costs and operational concerns regarding the safety of a chlorine disinfection process. UV disinfection works effectively on high quality effluent and allows use of a simple flow through channel rather than a much large contact basin as required for a chlorine-based system.
The City in 2012 elected to install temporary disinfection facilities with the thought that the new treatment system, when selected, may uniquely impact the design of UV system designed for a 20 year planning period. Additionally, chlorination equipment used in the temporary facilities could be "repurposed" in the new treatment plant, possibly for process control of adverse foaming or sludge bulking conditions.



UV disinfection unit processes will be included as a common component used in conjunction with the new treatment facilities.

4.2.5 Solids Handling

The existing solids handling system utilizing multiple biosolids dewatering beds is functioning well and has ample capacity for additional sludge disposal up to the design capacity of the existing treatment system. Eventually the accumulated solids must be removed from the system to maintain sufficient working volume in the beds to allow for solids dewatering. In the future, the lagoon solids previously placed in the third drying bed in 2004 should be removed to allow for additional capacity for new treatment facilities. Changes in the wastewater system to an activated sludge system would likely increase sludge production. Preliminary assessment of the sludge drying beds indicates that they will readily accept the anticipated sludge production from a mechanical wastewater treatment plant. More frequent removal of accumulated sludge would increase the handling capacity of the drying beds. Sludge stabilization would be required with an activated sludge treatment system. Decanting surface flow from the sludge storage basin would allow the thickening of the retained sludge volume. Any future designs utilizing the existing drying beds must be cognizant of odor potential.

The appropriate Biosolids Disposal General Permit, MTG-650059, was obtained from the EPA on February 22, 2008 with the permit remaining in effect until October 19, 2012. EPA has indicated that they no longer permit these types of disposal system and the rules governing disposal are self-implementing. The existing sludge drying process will be incorporated into treatment alternatives evaluated. The available methods for final disposal of dried solids as they are removed from the drying beds will be evaluated.

4.3 Screening of Wastewater Treatment Plant Alternatives

4.3.1 General Approach

Several treatment alternatives will initially be considered to insure that the most viable, cost-effective and environmentally sound options have been considered. The initial group of alternatives will be screened to eliminate those options which do not merit further evaluation. Lagoon-based options, similar to the existing plant, will be considered as will mechanical plants based on utilization of concrete basins and more complex unit processes. Screening these options for additional consideration or exclusion will be based on the following criteria, applied in an objective manner:

- **Capital and Operating Costs**
- **Mechanical and Operational Complexity**
- **Use of Proven Technology**
- **Future Expansion Capability**
- **Capacity to Remove Pollutants to Lower Levels**
- **Cold Weather Operation**
- **Odor Potential and Aesthetics**

4.3.2 Advanced Lagoon Options

Advanced Lagoon Systems – Two lagoon based options were evaluated, with each proposal capable of meeting the proposed effluent standards for Whitefish. Lagoon treatment technologies are evolving with capabilities for ammonia and nutrient removal. As these systems become more complex, they approach more traditional mechanical plants in complexity. A third option was considered which would not have capability for removal of nitrogen and would therefore require a variance from the regulatory standards. The third option was developed to determine the financial benefit, if any, of obtaining a variance from the DEQ base numeric nutrient standards. These options are described as follows:

LAGOON OPTION 1 - Parkson Biolac® Advanced Lagoon System

This alternative consists of a lagoon-based, quasi-activated sludge treatment system sized to treat the City's projected 2035 design average annual flowrate of 1.51 MGD and its maximum daily flowrate of 4.53 MGD with grit removal, solids handling and effluent disinfection. The system as proposed will remove ammonia down to permit limits and provide biological nutrient removal. The Parkson's Biolac® Wastewater Treatment System uses low-loaded activated sludge technology, moving aeration chains that suspend submerged fine-bubble diffusers, and a simple basin construction. The Biolac System features the BioFlex® Piping System and BioFuser® Aeration Units. The moving aeration chains improve mixing efficiency. The Biolac System mixes the aeration volumes associated with 30-70 day sludge age treatment. An aerobic selector basin and a fermenter are included with this option to create favorable conditions for biological removal of nutrients. The major treatment elements of the Biolac® Alternative include:

- Headworks – The existing screen system would be used, followed by upgraded raw sewage pumping and grit removal. Influent vortex-type grit system is proposed that will remove 90% of 200µm and larger grit. The grit system will wash and compact the material for auger-conveyance to a wheeled dumpster and landfill disposal.
- Bio-P Basin – Preceding the Biolac® treatment basin, a 52' square by 15' deep Bio-P basin will provide anaerobic selection of phosphorous-reducing microbes that will condition the influent wastewater for enhanced phosphorous removal.
- Biolac® Treatment Cell – The principal treatment component will be a single-basin, complete mix, quasi-activated sludge process using extended retention of biological solids to create well-stabilized solids and provide nutrient removal capability.
- Clarification – Secondary clarification will be accomplished through conversion of both existing flocculating clarifiers to secondary clarifiers. The Parkson company has an in basin clarifier which was considered but not selected due to concerns with clarifier performance. Additionally, utilizing the existing clarifiers provided a cost savings.
- Sludge Stabilization Basin – Sludge stabilization will be accomplished by construction of a 100'x75' basin with a membrane liner and aeration diffusers. The stabilized sludge will be discharged to the existing sludge drying beds.
- Fermenter Basin – A 100,000 gallon concrete tank will allow anaerobic fermentation of WAS and provide short-chain volatile fatty acids (SCVFA's) necessary for denitrification. Use of a fermenter is a new concept with Biolac.
- Aeration Equipment – The existing blower building will be expanded to house four new 100 HP blower assemblies for the Biolac® cell and three 150 HP

blowers for the sludge stabilization basin. High efficiency blowers will be utilized.

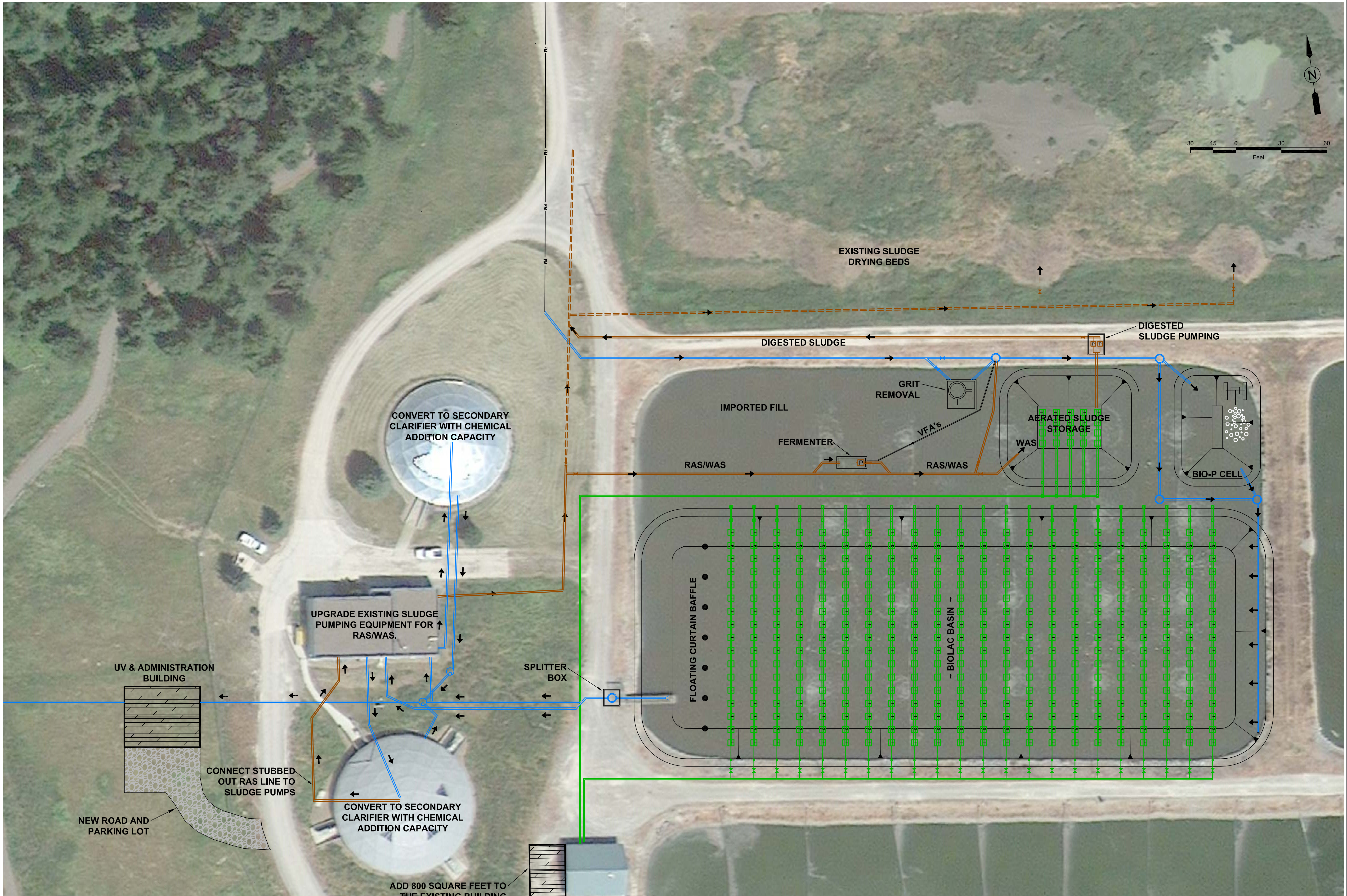
- UV Disinfection and Administration Building – A 4,000 ft^2 building will be constructed to house an open-channel ultra-violet disinfection unit, effluent magnetic flow meter, laboratory, auto-sampler, system controls and administration facilities.

Biolac systems have been constructed in Montana and have been effective for removal of ammonia, including good cold weather performance. The capability of the system to remove total nitrogen and total phosphorus is through the addition of relatively new technology in the fermenter and Bio-P cell, employing treatment technologies that have been proven to be effective. This system is not covered to minimize heat loss. Capability to optimize the operation to achieve lower pollutant levels is limited although filtration could be added in the future. It should be noted that the existing aerated lagoons utilize Parkson Biolac fine bubble aerators which have been problematic in regards to fouling with rags. Good pretreatment should address this problem. **Figure 4.1** provides a plan view of this alternative.

Estimated construction costs are $15,914,650 and annual operating costs are $642,400 with a net present worth of $23,512,010 utilizing a 4.0% present worth factor. **Appendix D provides detailed cost estimates for all treatment options.**

<u>LAGOON OPTION 2</u> - Environmental Dynamics International - Intermittently Decanted Extended Aeration Lagoon

The Intermittently Decanted Extended Aeration Lagoon, or IDEAL, consists of an EDI floating lateral aeration system with Magnum fine bubble diffusers, two chains of BioReef BioCurtain, a static decanter with flow control valves, an overflow pipe with Storm Mode™, process controls and a blower package. Two cells are provided for process redundancy. The system has a hydraulic detention time of 2 days and an estimated solids retention time of 50 days. The process, as originally presented, has no active sludge management. The "front-of-plant treatment" in the IDEAL system provides several benefits, as claimed by the manufacturer. First, the warmest water in the winter is found in the first cell where the bulk of treatment occurs. By performing treatment in the first cell the need for thermal covers is reduced. Second, by removing ammonia at the front of the plant the system can utilize the influent carbon for denitrification, which provides oxygen and alkalinity recovery. Lastly, because the sludge is retained in the first cell there is no need to operate and maintain sludge return pumps. The existing larger flocculating clarifier would be used with this system to provide further phosphorous removal. The older clarifier would be converted to a flow equalization basin. The unit processes for pretreatment and disinfection as proposed for the Biolac option would be utilized with this alternative also. **Figure 4.2** provides a plan view of this alternative. Note that AMCE added capability to remove and waste or recycle sludge from the system.



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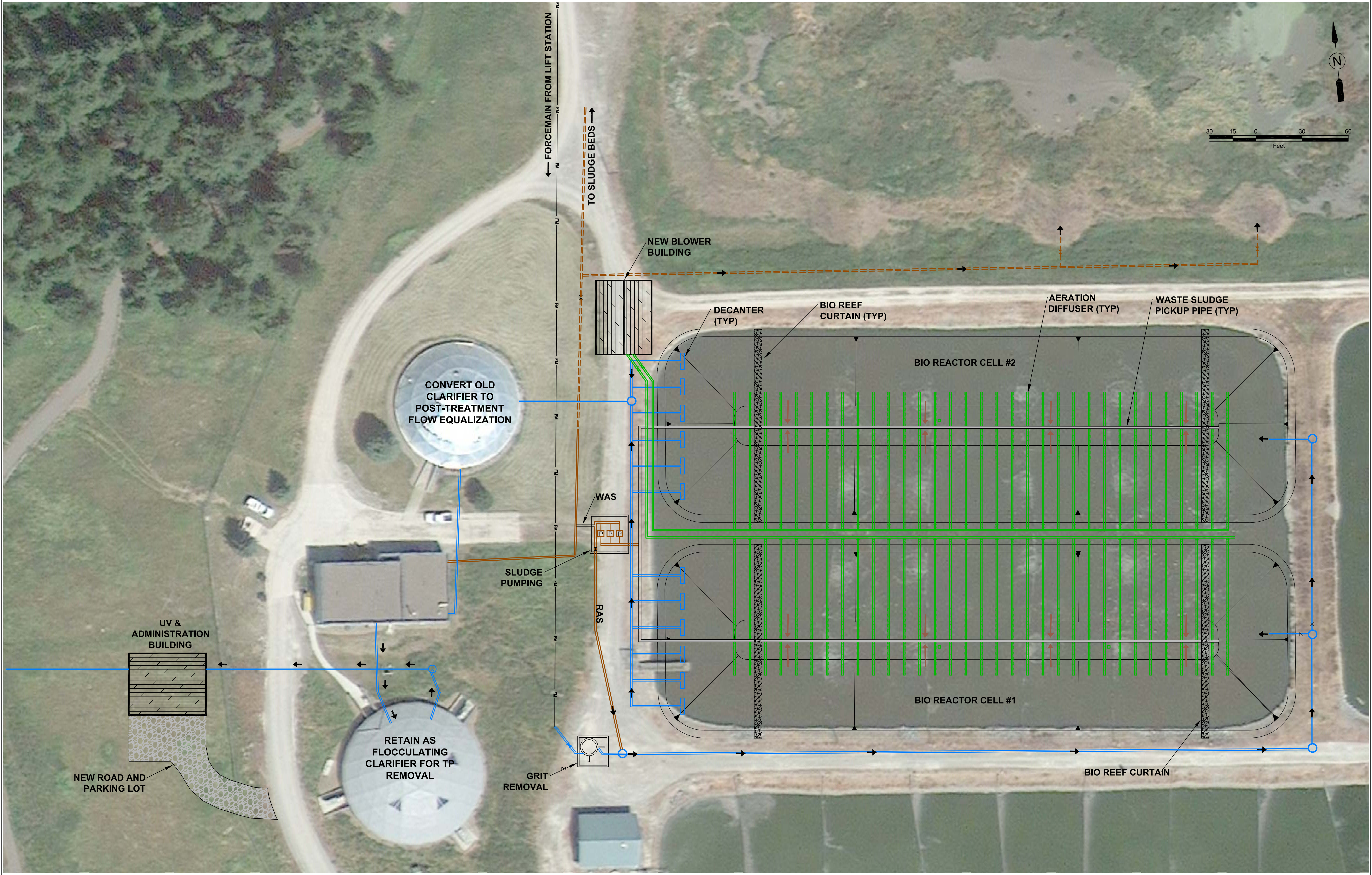

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EDI - Dual BioReactor IDEAL System with Existing Clarifier

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While EDI aeration systems have been used in Montana, the IDEAL system is a relatively new concept with limited operational experience throughout the US.

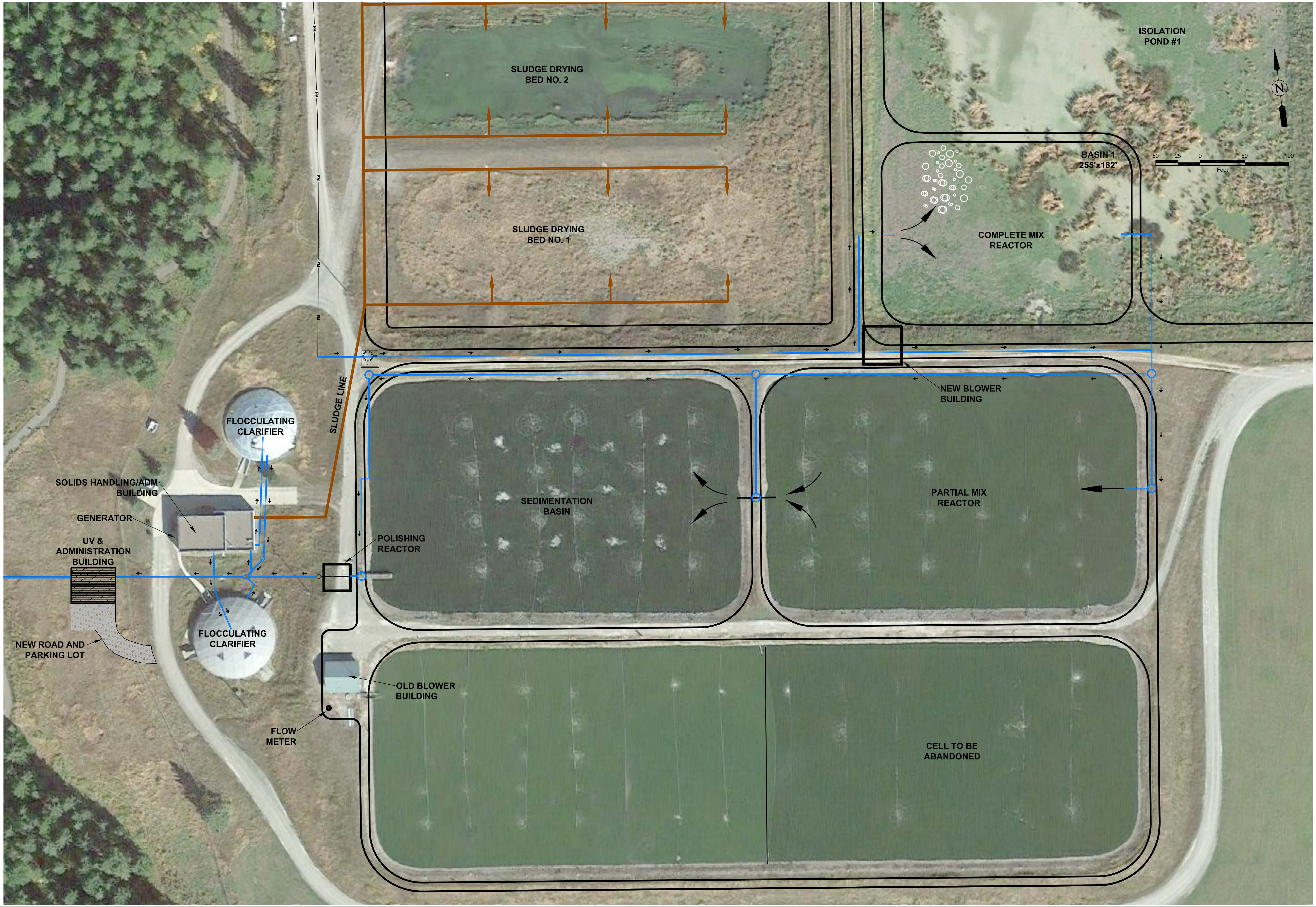
Estimated construction costs for this alternative are $ 12,477,180 and annual operating costs are $ 525,250 with a net present worth of $18,778,770, utilizing a 4.0% present worth factor.

LAGOON OPTION 3 – Aerated Lagoon, No Total N Removal

This option utilizes conventional technology to implement a three cell lagoon system which includes one complete mix cell followed by two partially mixed cells, with a quiescent zone prior to discharge, as shown on **Figure 4.3.** The secondary effluent passes through a nitrification cell to insure complete nitrification of ammonia, then flows into the existing flocculating clarifier for removal of phosphorous. To promote ammonia removal in cold weather, each cell will be covered to retain heat. Active sludge removal is not provided in the system thereby the periodic pumping of solids from Cells 2 and 3 will be required every 10 years or so. The unit processes for pretreatment, disinfection and pumping improvements as proposed for the other lagoon options would be utilized with this alternative also.

This option, as presented, does not have the capability to remove nitrogen as per the discharge permit. Limits for ammonia and total phosphorous can be met with this technology. An individual variance from the numeric nutrient standards as allowed in *DEQ Circular 12B, Nutrient Standards Variance*s, will be required. Language in the Circular states the following:

> *Montana law allows for the granting of nutrient standards variances based on the particular economic and financial situation of a permittee (§75-5-313(1), MCA). Individual nutrient standards variances ("individual variances") may be granted on a case-by-case basis because the attainment of the base numeric nutrient standards is precluded due to economic impacts, limits of technology, or both. Individual variances discussed in this section are generally intended for permittees who would have financial difficulties meeting the general variance concentrations and are seeking individual nitrogen and phosphorus permit limits tailored to their specific economic situation. Like the general variance in Section 2.0, individual variances may be established for a period not to exceed 20 years and must be reviewed by the Department every three years to ensure that their justification remains valid. Unlike the general variances discussed in Section 2.0, the Department will only grant an individual variance to a permittee after the permittee has made a demonstration to the Department that meeting the underlying standards would require water quality-based controls that result in substantial and widespread social and economic impacts. The variance application will identify the lowest effluent concentration that is feasible based on achieving the highest attainable condition. A permittee, using the assessment process referred to above, must also demonstrate to the Department that there are no reasonable alternatives including, but not limited to, trading, compliance schedules, reuse, recharge, and land application that would allow compliance*



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Sheet Title: Covered Aerated Lagoons With Nitrification

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> *with the base numeric nutrient standards. If no reasonable alternatives exist, then an individual variance is justifiable and becomes effective and may be incorporated into a permit following the Department's formal rulemaking process.*

The process for seeking a variance are included in the *Base Numeric Nutrient Standards Implementation Guidance, Version 1.0 2014*. The Guidance has been included in **Appendix E.** An initial analysis of the potential for obtaining the variance was completed by AMCE/RPA with the initial conclusions made that Whitefish **may** qualify. Consequently, to assess the financial benefit of not having to build facilities to remove Total Nitrogen, this Lagoon Option 3 was developed to determine the savings, if any, that could be obtained by building a less complex lagoon system. This option is similar to the existing system with upgrades using a complete mix cell and covers to promote ammonia removal. The new lagoon cells in this option would be lined with a synthetic liner.

Estimated construction costs for this alternative are $13,000,800 and annual operating costs are $ 493,100 with a net present worth of $19,034,042, utilizing a 4.0% present worth factor.

4.3.3 Screening of Advanced Lagoon Options

The three options were screened for further consideration. The first two options will meet the current permit requirements, with the general variance for Total Nitrogen. As limits become more restrictive in the future, lagoon based options may have difficulty in consistently achieving lower effluent standards primarily due to influences of temperature loss upon biological treatment processes as well as limits of process control. The third option cannot meet existing permit requirements unless an individual variance is granted by the DEQ. The process of determining eligibility for an individual variance could be costly and the outcome is unknown. More importantly, the costs for Option 3 remain high primarily because of the necessary improvements to meet the ammonia standard, which is not eligible for a variance. Consequently, there is no purpose in seeking an individual economic variance if there is no financial benefit.

The following Table 4.1 provides an analysis of the advanced lagoon options based on criteria set forth in Section 4.3.1, where the numeric point system used to evaluate options is based on a lower number indicating better attributes. This analysis indicates that the Biolac option is the best advanced lagoon option with the 3-Cell Lagoon system a close second.

Table 4.1 City of Whitefish PER
Screening of Advanced Lagoon Options

	Option 1 Biolac	Option 2 Ideal	Option 3 3-Cell
Capital and Operating Costs (NPW)	3	1	2
Mechanical and Operational Complexity	2	3	2
Use of Proven Technology	1	3	1
Future Expansion Capability	2	3	3
Capacity to Remove Pollutants to Lower Levels	1	3	3
Cold Weather Operation	2	3	1
Odor Potential and Aesthetics	2	3	2
Total	13	19	14
Rank	1	3	2

However, the second ranked option cannot meet the current permit requirements without the granting of a request for an individual economic variance. The primary concern with the IDEAL system is that the technology is not yet fully proven and the management of solids for removal or recycle not clearly defined by the manufacturer.

Given these conclusions, the Biolac Advanced Lagoon alternative (Option 1) will be further considered for comparison with mechanical treatment options.

4.3.4 Mechanical Treatment Plants

A mechanical treatment plant provides several advantages over a lagoon based system, which become more evident for communities with larger populations. Generally the expected performance capability of a mechanical plant will be better for reduction of conventional pollutants and nutrients. Given the projected regulatory goal of a staged reduction of effluent standards over time, a mechanical plant should be better suited to meet more restrictive regulatory standards as they are mandated. Closer control and automation of unit processes are possible. Because the hydraulic detention times are significantly less in a mechanical plant versus a lagoon, tanks are smaller and the overall facilities in a mechanical plant are smaller requiring less commitment of land. Mechanical plants may have a lower potential for odors primarily because of their relatively small size, allowing better collection and treatment of odors. A significant benefit in colder climates, mechanical plants are capable of retaining heat better than a lagoon system with a large surface area. All of the biological processes utilized in a wastewater plant for pollutant removal function better and more efficiently in warmer temperatures.

A mechanical plant will require more energy, operation and maintenance than a lagoon based system. The systems are significantly more mechanically complex and require a more knowledgeable operator with a higher degree of operator certification. Compliance monitoring and process control of mechanical plants requires more analytical capability and operator skill to complete. Typically a mechanical plant is more susceptible to upsets due to discharges of toxic compounds and is less capable of handling wide variations in flow.

Given the size of Whitefish, anticipated growth and projected regulatory standards, a mechanical plant may be a good solution for the City's need to upgrade existing plant facilities. The following three types of mechanical plants were initially considered, including several variations of each type.

- Sequencing Batch Reactor (SBR)
- Membrane Bioreactor (MBR)
- Oxidation Ditch

Sequencing Batch Reactor (SBR) – SBRs are a variation of the activated-sludge process. They differ from activated-sludge plants because they combine all of the treatment steps in a single basin, whereas conventional activated sludge facilities rely on multiple basins. According to a 1999 U.S. EPA report, an SBR is no more than an activated-sludge plant that operates in time rather than space. The operation of an SBR is based on a fill-and-draw principle, which generally consists of five steps: fill, react, settle, decant, and idle. These steps can be altered for different operational applications. SBR facilities commonly consist of two or more basins that operate in parallel. Systems that operate under continuous flow conditions are also utilized. In this modified version of the SBR, raw wastewater enters each basin on a continuous basis. The influent flows into the separate chamber, which has inlets to the react basin at the bottom of the tank to control the entrance speed so as not to agitate the settled solids. Continuous-flow systems are not true batch reactions because influent is constantly entering the basin. Multiple basins will reduce significant fluctuation in the discharge amount approaching continuous flow. This will benefit sizing of downstream processes such as disinfection.

Membrane Bioreactor – The term membrane bioreactor (MBR) is generally used to define wastewater treatment processes where a semi-permeable membrane is integrated with a biological process, typically an activated sludge system. While the activated sludge process uses a secondary clarifier for solid/liquid separation, an MBR uses a membrane for this function. This provides a number of advantages relating to process control and produced water quality. It is possible to operate MBR processes at higher mixed liquor suspended solids (MLSS) concentrations compared to conventional activated sludge systems, thus reducing the reactor volume to achieve the same loading rate. MBR plants can produce very high quality effluent. The MBR flow through the membrane inevitably decreases with filtration time. This is due to the deposition of soluble and particulate materials onto and into the membrane. MBR facilities are generally mechanically complex. Replacement of the membranes is a significant operational expense.

Oxidation Ditch – An oxidation ditch is a modified activated sludge biological treatment process utilizing long solids retention times (SRT) to remove biodegradable organics. Generally an oxidation ditch is a plug flow system operating in the extended aeration mode. Typical oxidation ditch treatment systems consist of a single or multichannel configuration within a ring, oval, or horseshoe-shaped basin, with the provision of horizontally or vertically mounted aerators. These aerators are responsible for facilitating circulation and aeration in the ditch, although aeration can be provided through other means. Through variation in aeration and mixing, environmental conditions can be created in a ditch that can nitrify ammonia and biologically remove nitrogen and phosphorous. This technology, though requiring more land compared with conventional treatment facilities, is shown to be highly effective in small to medium sized systems.

These three types of mechanical treatment plants are considered in detail for the City of Whitefish, with variations of each type considering specific site conditions, as follows:

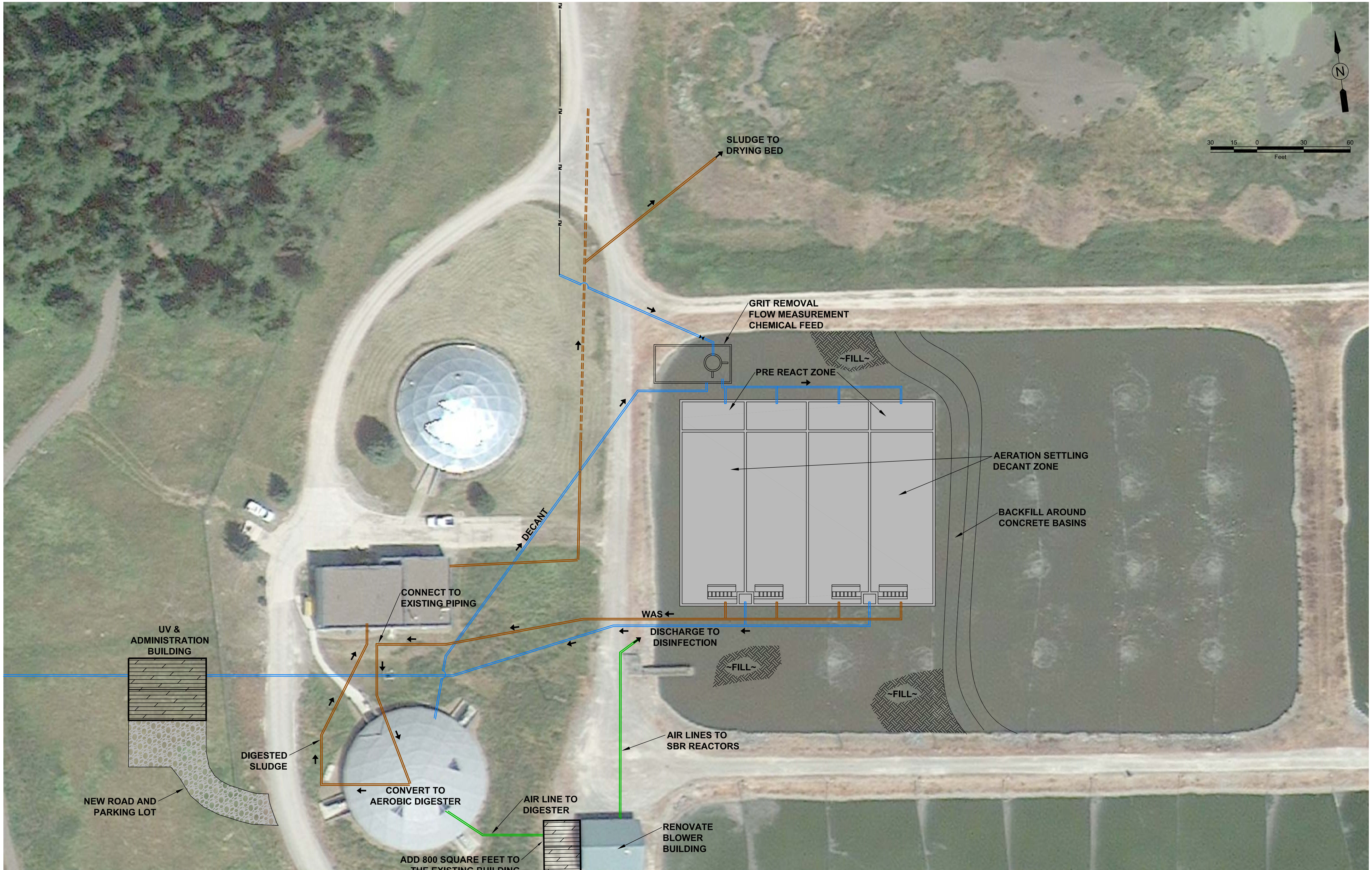
4.3.5 Mechanical Treatment Alternatives Considered

MECHANICAL TREATMENT OPTION 1 – Sequencing Batch Reactor with Aerobic Sludge Digestion and Drying Beds

This alternative consists of a four-basin sequencing batch reactor (SBR) sized to treat the City's projected 2035 design average annual flowrate of 1.51 MGD, wet weather flow of 1.8 MGD and its maximum daily flowrate of 4.53 MGD with grit removal, solids handling and effluent disinfection. The entire proposed SBR system could be fit within the footprint of existing treatment Cell #3. The sequencing batch reactor layout is shown in **Figure 4.4.**

The major treatment elements of the SBR Alternative include:

- Headworks – The existing screen system would be used, followed by upgraded raw sewage pumping and grit removal. Influent vortex-type grit system is proposed that will remove 90% of 200µm and larger grit. The grit system will wash and compact the material for auger-conveyance to a wheeled dumpster and landfill disposal.
- Chemical Feed System – A chemical feed system that will be capable of dosing the influent wastewater with alum (if necessary) in order to provide for enhanced phosphorous removal in the SBR basins.
- Sequencing Batch Reactor – The principal treatment component will be a four-basin sequencing batch reactor with BNR capability. Each basin will be approximately 5,800 ft^2 in surface area, 18' deep with a volume of 0.87 MG. Each basin will have five complete cycles per day at average daily flow (1.51 MGD) for a cycle time of 4.8 hours. Design will be based on peak month flow, estimated to be approximately the same as expected wet weather flow, 1.91 MGD. The entire facility will have a hydraulic detention time of 1.1 days, solids retention time of 17.7 days.
- Existing Clarifiers/Sludge Digestion – Sludge digestion will be accomplished by conversion of the existing 75' diameter flocculating clarifier to an aerobic digester. This existing circular concrete basin will provide 2.3 days of aerated retention time (without thickening) at ADF. After stabilization, the digested biosolids will be sent to the existing drying beds for extended treatment and drying.



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Project Title: Whitefish WWTP Alternatives

Sheet Title: Intermittent Cycle Extended Aeration System with SBR

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- Aeration and SBR Process Equipment – The existing blower building will be expanded to house four new 125 HP SBR blowers as well as adding three 75 HP blowers for the aerobic digester conversion.
- UV Disinfection and Administration Building – A 4,000 ft^2 building will be constructed to house: an open-channel ultra-violet disinfection unit; effluent magnetic flow meter; laboratory; auto-sampler; system controls and administration facilities.

Estimated construction costs for the SBR alternative are $15,984,739 and annual operating costs are $ 784,480 with a net present worth of $24,491,416 utilizing a 4.0% present worth factor. **Appendix D provides detailed cost estimates for all treatment options.**

MECHANICAL TREATMENT OPTION 2 -Membrane Bioreactor with Flow Equalization, Aerobic Sludge Digestion and Drying Beds

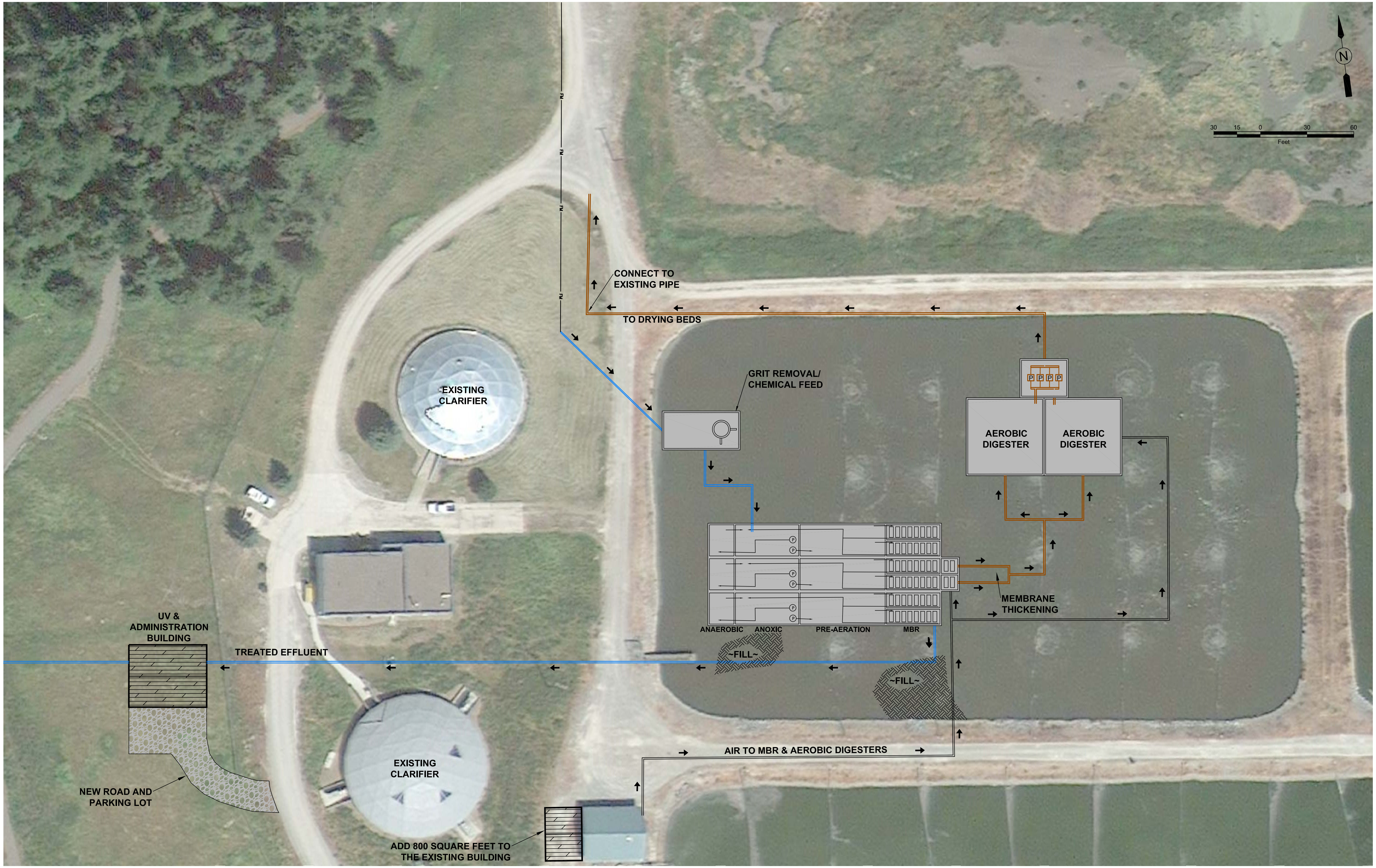
This alternative consists of a four-basin membrane bioreactor (MBR) with a membrane sludge thickening basin sized to treat the City's projected 2035 design average flowrate of 1.51 MGD, 1.8 MGD wet weather and its maximum daily flowrate of 4.53 MGD with grit removal, solids handling and effluent disinfection. The entire proposed MBR system could be fit within the footprint of existing treatment Cell #3. Flow equalization prior to the MBR would be accomplished by installing an earthen dike across the first 1/3 of aeration basin one and creating a 2 million gallon equalization basin. Various combinations of treatment equipment that could be paired with the MBR alternative were considered including:

1. MBR Treatment System with Aerobic Sludge Digesters, Mechanical Sludge Dewatering, and No Flow Equalization Basin
2. MBR Treatment System with Aerobic Sludge Digesters, Retaining the Existing Sludge Drying Beds for Sludge Dewatering, and No Flow Equalization
3. MBR Treatment System with Aerobic Sludge Digesters, Mechanical Sludge Dewatering, and Flow Equalization Basin
4. MBR Treatment System with Aerobic Sludge Digesters, Retaining the Existing Sludge Drying Beds for Sludge Dewatering, and Flow Equalization

The alternative that was selected for further evaluation was Number 4, MBR Treatment System with Aerobic Sludge Digesters, Retaining the Existing Sludge Drying Beds for Sludge Dewatering, and Flow Equalization. It was selected because:

- It had the lowest capital cost
- Allows the City to retain their investment in the existing drying beds
- The flow equalization basin will eliminate surges and reduce the cost of the MBR system. A portion of existing cell one can be re-used for the flow equalization basin.

The MBR layout is shown in **Figure 4.5**.



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Sheet Title: MBR

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The major treatment elements of the MBR Alternative include:

- Headworks. Influent vortex-type grit system that will remove 90% of 200μm and larger grit. The grit system will wash and compact the material for auger-conveyance to a wheeled dumpster and landfill disposal. The existing influent screens would have to be modified to reduce their opening size to 2-3 mm. A finer screen and grit removal is required to protect the membranes.
- Chemical Feed System. A chemical feed system that will be capable of dosing the influent wastewater with alum (if necessary) in order to provide for enhanced phosphorous removal in the MBR basins.
- Four-basin MBR. The MBR system will consist of four basins:
    - Anaerobic Basin – for biological phosphorus removal
    - Anoxic Basin – for biological nitrogen removal
    - Pre-Aeration Basin – for BOD removal, ammonia removal (nitrification) and biological phosphorus removal
    - MBR Basin – for BOD, TSS removal and chemical phosphorus removal if needed.

  Raw wastewater enters the anaerobic basin where mixers keep the wastewater in suspension. Oxygen levels drop in this basin causing the production of volatile fatty acids (VFA) and other fermentation products by facultative bacteria. The VFA's are taken up by phosphorus storing bacterial which break down the VFA's and release stored phosphorus to produce energy for metabolism. The anaerobic basin receives a recycle stream that is pumped from the anoxic basin at a flow rate equal to the influent flow rate. This recycle stream helps to maintain anaerobic conditions in the anaerobic basin.

  From the anaerobic basin the wastewater enters the anoxic basin where denitrifying bacteria convert nitrates in the wastewater to oxygen and nitrogen gas. The nitrogen gas is discharged to the atmosphere. Nitrate rich effluent is recycled from the aerobic basin into the anoxic basin by pumping at a flow rate of around three times the influent flow rate. Submersible mixers in the anoxic basin keep solids in the wastewater from settling out.

  From the anoxic basin the wastewater enters the pre-aeration basin where fine bubble diffusers aerate the wastewater supplying oxygen that allows aerobic bacteria to biodegrade organics (BOD) in the effluent and allows nitrifying bacteria to convert ammonia to nitrate. The nitrates are recycled to the anoxic basin for conversion to nitrogen gas and oxygen as described above. In the pre-aeration basin the phosphorus storing bacteria take up more phosphorus than what they excreted in the anoxic basin producing a net phosphorus removal from the wastewater.

  From the pre-aeration basin wastewater enters the membrane basin where banks of synthetic membranes filter the wastewater removing suspended solids and any remaining particulate material. Membrane diffusers provide additional oxygen, keep the wastewater in suspension, provide for additional BOD removal and are used to air scrub the membranes. If alum or other coagulants are fed ahead of the membrane basin, the membranes can provide for additional chemical phosphorus removal to very low levels. The membranes act like a physical strainer capable of removing very small particles including bacteria, some viruses, coagulated phosphorus and particulate material. Mixed liquor suspended solid (MLSSS) concentrations can vary from 5,000 to 13,000 mg/l providing the ability to withstand influent load fluctuations. Filtered effluent from the membrane basin will flow to the UV disinfection system and ultimately discharge to the Whitefish River.

- Membrane Sludge Thickening Basin. Mixed Liquor from the membrane basin will be periodically wasted to the Membrane Sludge Thickening Basin where the mixed liquor will be filtered and the solids thickened from a 1% solids concentration to 3% solids. This thickening process will significantly reduce the required aerobic digester volume saving capital cost.
- Aerobic Digesters. This alternative assumes that two new covered aerobic digesters would be constructed for sludge stabilization. The digesters will be equipped with: aeration diffusers for mixing and aeration; supernatant decant; scum/grease removal, and; high-level emergency overflow in accordance with DEQ-2 requirements.

Estimated construction costs for the MBR alternative are $ 22,392,080 and annual operating costs are $ 1,161,725 with a net present worth of $ 36,209,935, utilizing a 4.0% present worth factor.

MECHANICAL TREATMENT OPTION 3 - Oxidation Ditch with Sludge Thickening, Aerobic Sludge Digestion, Rehabilitation of the Existing Clarifiers and Drying Beds

This alternative consists of an oxidation ditch, sludge thickening, and aerobic digestion. The existing clarifiers would be rehabilitated and the existing sludge drying beds would be utilized. All components would be sized to treat the City's projected 2035 design average flowrate of 1.51 MGD, 1.8 MGD wet weather and its maximum daily flowrate of 4.53 MGD. Other system components would include grit removal, solids handling and effluent disinfection. Various combinations of treatment equipment that could be paired with the Oxidation Ditch were considered including:

1. Oxidation ditch with one new clarifier (replacing the old 65 ft clarifier), modifying the existing 75 ft clarifier, and mechanical dewatering.
2. Oxidation ditch with one new clarifier (replacing the old 65 ft clarifier), modifying the existing 75 ft clarifier, sludge thickening (to reduce digester size) and mechanical dewatering.
3. Oxidation ditch, rehabilitation of both existing clarifiers (no new clarifiers), no mechanical sludge thickening or dewatering (use existing drying beds).

4. Oxidation ditch, rehabilitation of both existing clarifiers, mechanical sludge thickening, and using the existing sludge drying beds for sludge dewatering.

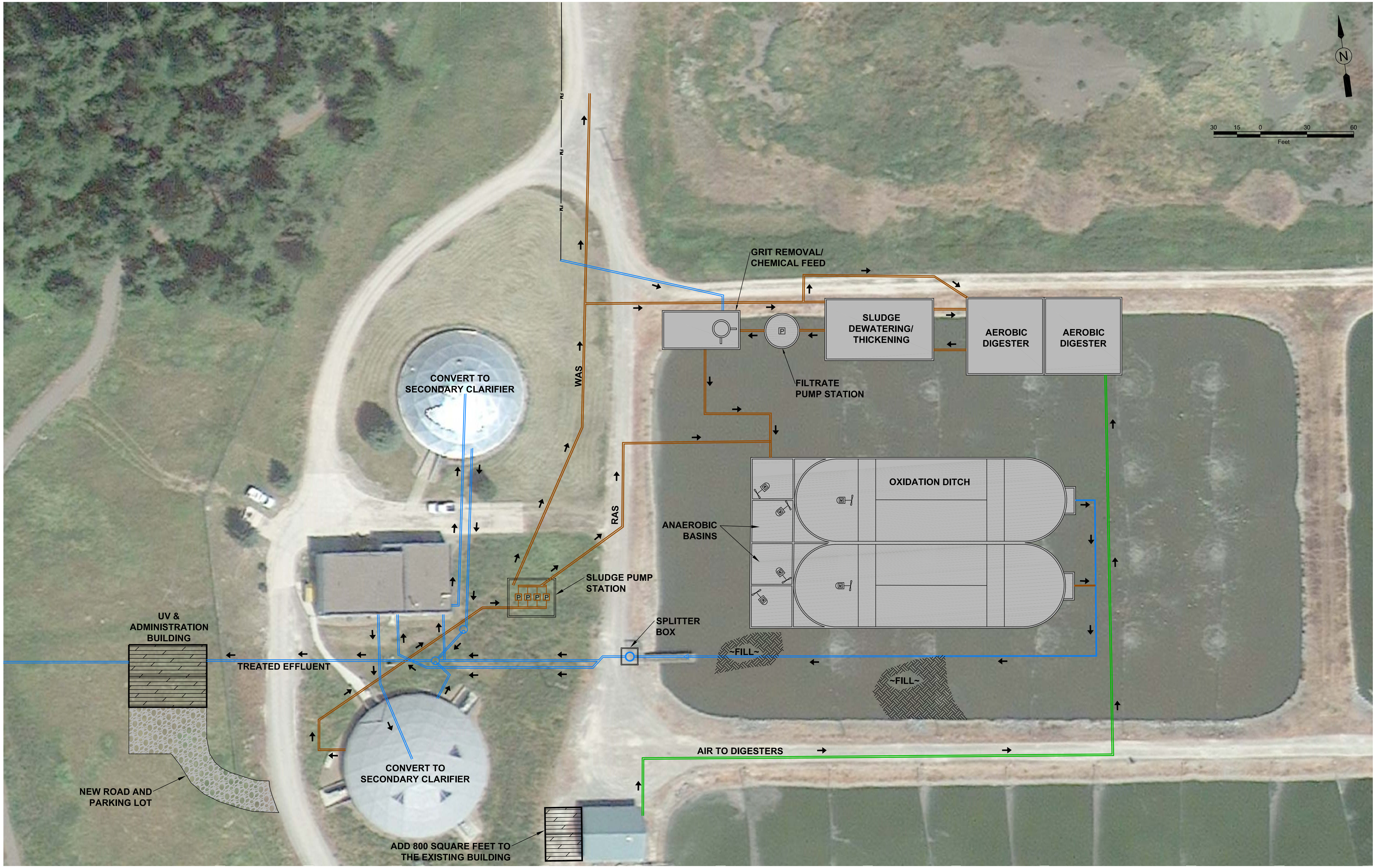
Number #4 was selected as the combination to evaluate in detail because it has the lowest capital cost and allows the City to retain the use and investment in the existing clarifiers and sludge drying beds.

The Oxidation Ditch layout is shown in **Figure 4.6.**

The major treatment elements of the Oxidation Ditch Alternative include:

- Headworks. Influent vortex-type grit system that will remove 90% of 200µm and larger grit. The grit system will wash and compact the material for auger-conveyance to a wheeled dumpster and landfill disposal. The existing influent screens would not have to be modified.
- Chemical Feed System. A chemical feed system that will be capable of dosing the influent wastewater with alum (if necessary) in order to provide for enhanced phosphorous removal in the clarifiers.
- Oxidation Ditch with BNR. The Oxidation Ditch system will consist of the following basins:
    - Four Anaerobic Basins – for biological phosphorus removal
    - Two Train Oxidation Ditch – for BOD removal, phosphorus removal, and nitrogen removal (anoxic zones created in the ditch).

  The system will consist of two oxidation ditches with external anaerobic tanks. The external anaerobic tanks will be equipped with submersible mixers that will operate continuously. The anaerobic tanks perform Bio-P functions (release of phosphorus as orthophosphate) and will also have the side benefit of acting as a selector tank (for inhibiting filament growth). The oxidation ditches will be equipped with horizontal rotor aerators and submersible mixers. The rotors and mixers alternate on and off through alternating timed cycles (aerobic/anoxic) to allow for nitrification and de-nitrification.
- Existing Clarifiers/Sludge Thickening. Mixed liquor from the oxidation ditches would flow to one of the two existing clarifiers. Clarified effluent will be disinfected with the UV disinfection system and discharged. Sludge from the clarifiers will be recycled back to the head end of the plant or wasted to the sludge thickener (disk thickening system) for further solids reduction and then to the aerobic digesters.
- Aerobic Digesters. This alternative assumes that two new covered aerobic digesters would be constructed for sludge stabilization. The digesters will be equipped with: aeration diffusers for mixing and aeration; supernatant decant; scum/grease removal, and; high-level emergency overflow in accordance with DEQ-2 requirements.
- UV Disinfection and Administration building. A 4,000 ft^2 building will be constructed to house: an open-channel ultra-violet disinfection unit; effluent



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MONTANA Scott Anderson 7978PE REGISTERED PROFESSIONAL ENGINEER

Revision	Date	By
Draft	4/2016	SA
Final		

Revision: Final
Plot Scale: 1:2
Drawn By: B.Nye
Approved By: S.Anderson, P.E.
Checked By: P.Montgomery, P.E.
Designed By: S.Anderson, P.E.
Project Number:

Engineer: Anderson~Montgomery Consulting Engineers, 1064 N. Warren, Helena, Mt 59601
RPA

Owner: City of Whitefish, Montana

Project Title: Whitefish WWTP Alternatives

Sheet Title: Oxidation Ditch

Sheet: Fig. 4.6

Of --

magnetic flow meter; laboratory; auto-sampler; system controls and administration facilities.

Estimated construction costs for the Oxidation Ditch alternative are $ 21,356,130 and annual operating costs are $ 927,990 with a net present worth of $ 31,023,170 utilizing a 4.0% present worth factor.

4.3.6 Screening of Mechanical Treatment Plant Options

The three options were screened for further consideration. Table 4.2 provides a summary of capital and operating costs for the alternatives. As shown, capital costs are significantly less for the SBR alternative, primarily due to capability of this option to best use existing site facilities, less concrete than the ditch option and less mechanical equipment than the MBR option. Operating costs are also less for the SBR generally because it uses less power than the other options. Staffing requirements for all three options are similar.

Table 4.2 Cost Summary Table for Mechanical Treatment Plants

Type of Mechanical Plant	Capital Cost	Annual O&M	Net Present Worth
Sequencing Batch Reactor	**$15,984,739**	**$784,485**	**$24,491,416**
MBR	**$22,392,082**	**$1,161,725**	**$36,209,935**
Oxidation Ditch	**$21,356,130**	**$927,990**	**$31,023,170**

To further evaluate the alternatives, the criteria used to review the lagoon alternatives was applied to the mechanical options, as shown below. The conclusions of this analysis, including the review of these options by the City Public Works staff, indicated that the SBR alternative and the Oxidation Ditch will be further reviewed in the final evaluation of alternatives. These options will also be compared against the Biolac Advanced Lagoon system for a complete analysis of alternatives.

Table 4.3 City of Whitefish PER
Screening of Mechanical Treatment Options

	Option 1 SBR	Option 2 MBR	Option 3 O-Ditch
Capital and Operating Costs (NPW)	1	3	2
Mechanical and Operational Complexity	2	3	2
Use of Proven Technology	1	2	1
Future Expansion Capability	1	2	3
Capacity to Remove Pollutants to Lower Levels	2	1	2
Cold Weather Operation	1	1	2
Odor Potential and Aesthetics	1	1	2
Total	9	13	14
Rank	1	2	3

The MBR plant, while capable of producing a high quality effluent, has greater capital and operating costs than the other options, resulting in a significantly greater present worth cost. Replacement of the membranes in the MBR option, as required on a periodic basis, can be quite expensive. Both the oxidation ditch and the SBR plant employ technologies with many years of operating experience, including good performance in cold climates.

4.4 Review of Screened Wastewater Treatment Plant Alternatives

4.4.1 Alternative Evaluation

After initial screening as previously discussed, the following alternatives will be further evaluated to determine the most cost-effective and environmentally sound treatment alternative.

- Biolac Advanced Lagoon System
- Sequencing Batch Reactor (SBR)
- Oxidation Ditch

This section of the PER will assess the alternatives identified previously, resulting in identification of the most cost-effective and environmentally sound option. Input from the City staff and City officials, the system users, the DEQ and funding agencies will all factor into final selection. This section will present an objective methodology for comparing the social-economic impacts of the treatment alternatives with each other to determine which will be recommended for implementation. This information coupled with the net present worth analysis will be utilized to make recommendations to the City, who will make the final decision regarding the selection of alternatives to implement. Where applicable, the “No Action” alternative was discussed for each system component. Generally the problems prompting the preparing of a PER and grant applications are severe enough the option of no action is not an acceptable approach.

Present Worth Analysis – In previous sections, estimated construction costs were developed including engineering, contingencies and salvage values. The salvage value reflects the estimated value of the facilities that have a usable life greater than twenty years. To perform a present worth analysis, the salvage value is brought back to "present" value using the appropriate economic calculations. For example, a water treatment system estimated to have a salvage value of $500,000 in the year 2036 is worth $155,900 in today's dollars utilizing a discount rate of 6.0%. In the cost analysis, salvage values are considered an asset rather than an expense; therefore, they are subtracted from the present worth cost of the project.

Operation and maintenance expenses are estimated on an annual basis. These annual costs are then brought back to a present worth using a capital recovery factor at a given interest rate and term. These costs are added to the capital costs of the project, allowing a comparison of total "present worth" of the alternatives to determine the least expensive alternative over the life of the facility. This approach addresses problems that might occur with an alternative that might have a low initial cost but high operational expense. The present worth analysis is meaningful when comparing alternatives which are similar in scope and function. Some project components have no alternatives that provide meaningful comparisons, such as replacement of existing water lines in the same available right of way. Either the line is replaced or the no action alternative selected for implementation.

4.4.2 Detailed Description of Alternatives

A complete description of the three screened alternatives is provided in the following section. Design criteria for these options are the same as previously discussed.

4.4.2.1 BioLac® Lagoon Treatment System Using Existing Clarifier with Aerated Sludge Storage and Drying Beds Description:

This alternative consists of a lagoon-based, quasi-activated sludge treatment system sized to treat the City's projected 2035 design average flowrate of 1.51 MGD, wet weather flow of 1.81 MGD and its maximum daily flowrate of 4.53 MGD including new grit removal, solids handling and effluent disinfection equipment. The entire proposed BioLac® system could be fit within the footprint of existing treatment Cell #3, excluding disinfection. The Biolac® Alternative layout was shown previously in **Figure 4.1**.
The major treatment elements of the Biolac® Alternative include:

- Influent Screening and Pumping - The existing influent screens (⅜") would not need to be modified.
- <u>Headworks</u> – Influent vortex-type grit system that will remove 90% of 200μm and larger grit. The grit system will wash and compact the material for auger-conveyance to a wheeled dumpster and landfill disposal.
- <u>Bio-P Basin</u> – Preceding the Biolac® treatment basin, a 52' square by 15' deep Bio-P basin will provide anaerobic selection of phosphorous-reducing microbes that will condition the influent wastewater for enhanced phosphorous removal. The Bio-P basin will have a single 10hp floating mixer to provide complete mixing without aeration.
- <u>Biolac® Treatment Cell</u> – The principal treatment component will be a single-basin, complete mix, quasi-activated sludge process using extended retention of biological solids to create well-stabilized solids and provide nutrient removal capability. The basin will be approximately 59,200 ft^2 in surface area, 10½' deep with a volume of 3.49 MG, providing an hydraulic retention time of 2.3 days and solids retention time of 60 days at average daily flow (1.51 MGD). Design F/M ratio is 0.0535 and MLSS is 3,200 mg/l. The Biolac® aeration system will be capable of delivering 5,403 lb.O_2 per day to remove an average of 4,828 lb/day of BOD_5, and 612 lb/day of ammonia. Equipment will include: 22 individually-controlled aeration headers with Wave Oxidation® capacity; 374 diffuser assemblies with 1,122 fine-bubble diffusers; a diffuser retrieval system; four 75 HP positive displacement blower assemblies; level sensors; dissolved oxygen

probes, and; a complete control system. The sinuous action of the aeration headers moving perpendicular to the flow path creates dynamic aerobic, anoxic and anaerobic zones within the Biolac® basin and allows for biological nitrification/denitrification and recovery of O_2 and alkalinity.

- Clarification – Secondary clarification will be accomplished through conversion of both existing flocculating clarifiers to secondary clarifiers. The older (65' diameter) clarifier would be re-furbished while Cell #3 is being drained and prepared for the Biolac® treatment cell. The newer (75' diameter) clarifier would be converted after the Biolac® treatment cell is operational. After conversion, the (75' diameter) clarifier would be utilized as the normal secondary clarifier and the other would act as a back-up when needed. The work will likely require use of a crane to remove the dome and access the equipment.
- Sludge Stabilization – Sludge stabilization will be accomplished by construction of a 100'x75' basin with membrane liner and aeration diffusers. This sludge stabilization basin will provide 11 days of aerated retention time (without thickening) at ADF. A single aerated sludge storage basin is adequate since the facility will have the option of conveying WAS directly to the sludge drying beds for dewatering. The aerated storage basin will be equipped with: aeration diffusers for mixing and aeration; supernatant decant; scum/grease removal, and; high-level emergency overflow in accordance with DEQ-2 requirements. Stabilized solids will be pumped to the existing drying beds (4.3 total acres) for further dewatering and volatile solids destruction. Ultimate sludge disposal will be either to the local land fill or possibly to the local composting facility in Olney, MT. A building would be constructed to house the digested sludge pumping equipment.
- Fermenter – A 100,000 gallon concrete tank will allow anaerobic fermentation of WAS and provide short-chain volatile fatty acids (SCVFA's) necessary for denitrification. The fermenter will include one 5 HP floating mixer, cover and pumps to move the SCVFA's to the de-gritted influent prior to introduction into the Bio-P basin. Note that fermenters typically are used to ferment primary solids rather than WAS.
- Aeration and Biolac® Process Equipment – The existing blower building will be expanded to house four new 100 HP blower assemblies for the Biolac® cell as well as adding three 150 HP blowers for the aerated sludge storage basin. Approximately 800 ft^2 of floor space will be added to the existing building to accommodate the additional blowers, piping, motor controls and appurtenant equipment.
- UV Disinfection and Administration Building – A 4,000 ft^2 building will be constructed to house: an open-channel ultra-violet disinfection unit; effluent magnetic flow meter; laboratory; auto-sampler; system controls and administration facilities. The disinfection unit will provide a minimum 15 mJ/cm^2 dose of 253.7 nm UV light to treated effluent and will be equipped with: 42 high intensity/low pressure lamps; dose-pacing controls; automated lamp wiping; module lifting system; transmittance monitor; UV intensity sensors, and; level control weir. UV energy required for Biolac® will be slightly higher than for mechanical treatment alternatives due to slightly higher TSS levels expected in

the effluent. The office and laboratory for the plant's operators will be relocated to the new administration building.

- Interim Treatment During Construction – Existing lagoon cells #1 and #2 and the newer flocculating clarifier will remain in operation during construction of the Biolac® lagoon and supporting unit processes. Once the Biolac® improvements are completed and on-line, cells #1 and #2 will be drained, undergo sludge removal and the dikes will be re-contoured to accommodate a new facility access road. Sludge from cells #1 and #2 will be pumped to the furthest north drying bed for dewatering.

Advantages of the Biolac Treatment Process:

- Footprint fits within that of existing treatment cell #3, allowing the City to maintain the maximum amount of treatment capability while the new improvements are being implemented.
- All aeration equipment is accessible for repair/maintenance without the need to drain the Biolac® treatment cell.
- Maximizing the use of existing infrastructure with the use of the main lift station and screen, both flocculating clarifier basins, blower building, sludge pumps and sludge drying beds.
- Good effluent quality:
  - BOD_5 < 10 mg/l
  - TSS < 15 mg/l
  - $NH_3 \leq 1$ mg/l
  - TN ≤ 8 mg/l
  - TP ≤ 1 mg/l. Can be enhanced with chemical addition.
- TN and TP removal through biological processes.
- Technology that has demonstrated performance in cold climates. Several installations in Montana providing good removal of ammonia and conventional pollutants. The additional of the biological nutrient removal processes does not have much actual operating experience.
- Capable of handling variable loadings and flows.
- Lagoon-based technology with long retention time can accommodate significant fluctuations in influent flowrate.
- Relatively low overall O&M costs compared to strictly mechanical treatment alternatives. O_2 recovered from de-nitrification can significantly reduce aeration power costs.
- Shallower basin depths will reduce groundwater issues during construction.

Disadvantages:

- Longer retention times coupled with seasonal infiltration & inflow results in low treatment temperatures in the winter/spring. This can inhibit nitrification and jeopardize compliance with the ammonia and TN limitations.
- Higher estimated capital costs than SBR.

- Not easily expandable – would require addition of more Biolac® cells. Not particularly adaptable to meet more stringent future nutrient regulations.
- Biological nutrient removal aspects are not well-proven.

Environmental Impacts: Anticipated long-term environmental impacts for the Biolac® with aerobic sludge stabilization and drying bed storage include:

Adverse:
- Fermentation of WAS has the potential to create odors.
- Increased overall O&M costs associated with more FTE's, maintenance, spare parts, etc.

Beneficial:
- Possibly lower power consumption than the current system. O_2 scavenged from de-nitrification could reduce overall oxygen demand.
- The City's effluent will receive a higher level of treatment prior to being discharged into the Whitefish River; reduced ammonia and nutrient levels in the treated effluent will result in enhanced instream water quality with a reduction in the incidence of nuisance algae growth.
- This alternative may also be coupled with controlled irrigation of adjacent areas, further reducing pollutant discharges to the Whitefish River and providing beneficial reuse of the City's treated effluent.
- Reduced chemical usage over current operation using alum and polymers for flocculating clarifier.

Operation and Maintenance – Operation of the pretreatment and pumping equipment will include daily checks on the equipment, adjustment as needed, scheduled and unscheduled maintenance, removal and disposal of accumulated materials to the landfill, lubrication, general cleaning, oversight of control system and emergency operations. While not utilized at present, the odor control biofilter, if used, requires operation of a blower, injection of supplemental water during dry weather and periodic replacement of the filter media. The secondary treatment process will require daily checks, adjustment of cycle times and aeration, process control testing, collection and testing (or delivery to lab) of compliance samples, adjustment of system controls, lubrication of blowers and miscellaneous equipment, adjustment of chemical feed rates, periodic replacement or cleaning of diffusers, general cleaning and system oversight. Solids handling equipment includes blowers that will require maintenance, scheduling of decant back to headworks, wasting of sludge to the sludge drying beds, general maintenance and cleaning of equipment and disposal to drying beds. Periodically, the drying beds will require removal of dried solids, testing and final disposal which could include onsite disposal, removal to the landfill, used for composting or as a general soil amendment. The detailed cost tables in the Appendices provide cost estimates for labor, power, chemicals and other operational costs.

UV Disinfection System Operation – This effort will include daily checks on the system, periodic replacement of the UV tubes, cleaning of the UV channels and general performance monitoring of the system. Most UV systems of this size utilize a mechanical cleaning system which utilizes a cleaning fluid and squeegees to keep the tubes clean. The cleaning system will require periodic servicing. The light sensor which measure UV transmittance will require cleaning. Alarms are provided on the system if a power failure occurs or if transmittance of light from the UV tubes drops below a specific set point. Lights must be replaced every 12,000 hours or when performance deteriorates. If a bank of lights is removed from a channel, a hoist system should be used or two operators and a support rack.

Land Requirements- All elements of the Biolac® system alternative can fit into the footprint of the existing lagoon system's Cell #3 as shown by the schematic, with the exception of disinfection, which is located on the west side of the site. This property is owned by the City and no additional land acquisition is necessary. With the Biolac® lagoon's relatively small footprint, the opportunities for on-site land application of treated effluent are possible.

Construction Issues – The primary construction issues involved with the Biolac® alternative are related to working within the footprint of the existing facility and also with groundwater. It is known that the existing lagoon cells are clay-lined over alluvial material. Draining Cell #3 while the other two cells are in operation will tend to create a hydraulic gradient toward the drained cell and increasing the volume of leakage from the operating cells #1 and #2. During construction of the Biolac® basins (including Bio-P), it will be necessary to provide adequate de-watering to allow installation of the membrane liner and subgrade cushion. Over-excavation and import of granular soils may be necessary if unsuitable soils are encountered below the Biolac® floor elevation.

Maintaining adequate treatment will be necessary during construction of the new facility. It is anticipated that Cell #3 would be isolated by directing Cell #2 effluent directly to the flocculating clarifier. Once isolated, Cell #3 liquid would be pumped to the beginning of Cell #1. Cell #3 solids would be pumped to the furthest north drying bed (similar to the operation conducted in 2002 for Cell #1). Once completely cleaned, work could then be undertaken in Cell #3 for construction of the grit removal, flow measurement, chemical feed, Biolac®, fermenter, blower building and site re-contouring. When these improvements are complete, the Biolac® could be put online and Cells #1 and #2 could be de-commissioned by pumping the liquids to the Biolac® treatment cell. Accumulated solids could be pumped to the existing drying beds or could wait for completion of the aerated sludge stabilization basin. While Cell #3 is being drained, the existing 65' diameter clarifier could be re-furbished for secondary clarification and then put on-line while the 75' diameter flocculating clarifier is being converted to a secondary clarifier. After Cells #1 and #2 are drained and cleaned, the dikes could be re-contoured to allow for expanded use of their footprint.

Sustainability Considerations- Energy efficient motors would be specified for high horsepower applications including the blowers, mixers, and high horsepower pumps. Ramped soft starters or variable speed drives will be specified for high horsepower pumps, mixers and blowers to maximize energy efficiency, prolong motor life and to minimize the costs due to high inrush power demand. Real-time DO probes and controls will be installed in the Biolac® basin to optimize oxygen concentrations and the BNR process which will allow for more efficient blower and equipment operation saving energy. Land application of a portion of the treatment plant's effluent could be accomplished on adjacent areas that are suitable for land application.

Estimated Costs- Engineer's unit price estimate of cost to implement the Biolac® alternative is provided in **Appendix D**. Table 4.4 below provides a summary of costs taken from the unit price cost estimate. This table provides the engineer's estimate of capital costs including contingency, design, engineer's bidding/construction inspection costs and estimated salvage value at the 20-year design life. Annual operation and maintenance costs include operational labor, electrical power; self-monitoring; chemicals, repair/replacement and spare parts. These estimates will be used to compare net-present worth of each alternative.

Table 4.4 Cost Summary for Biolac® Alternative

Total Capital Cost	**$15,914,648**
Total Annual O&M Cost	**$642,400**
20-Year Salvage Value	**$2,481,200**
Present Worth of Alternative	**$23,512,010**

4.4.2.2 Sequencing Batch Reactor with Aerobic Sludge Digestion and Drying Beds

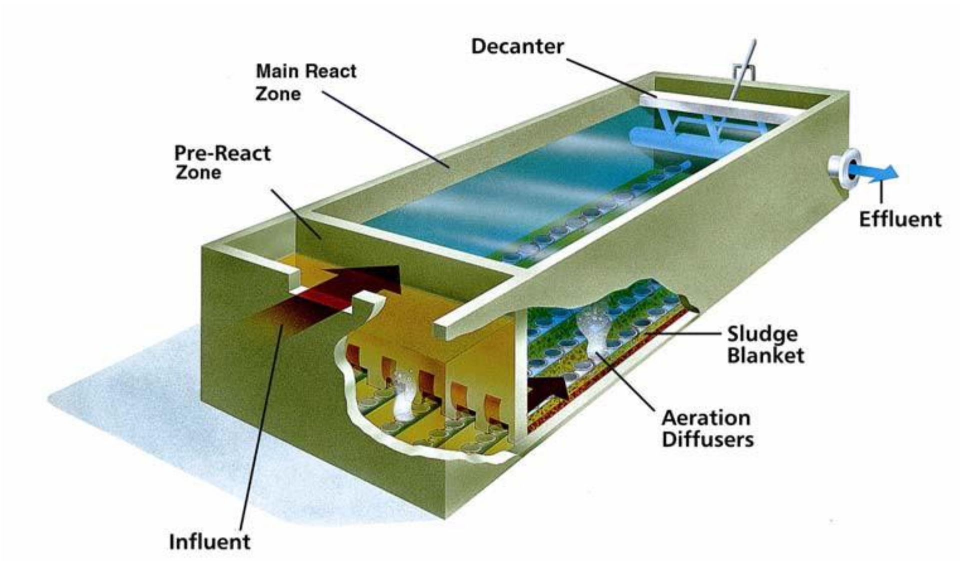
Description:

This alternative consists of a four-basin sequencing batch reactor (SBR) sized to treat the City's projected 2035 design average flowrate of 1.51 MGD, 1.81 MGD wet weather and its maximum daily flowrate of 4.53 MGD with grit removal, solids handling and effluent disinfection. The entire proposed SBR system could be fit within the footprint of existing treatment cell #3. The sequencing batch reactor layout was shown previously on **Figure 4.4**. The alternative shown reflects the Sanitaire layout, although basin/unit process sizing and equipment packages are similar with other SBR manufacturers'.

The major treatment elements of the SBR Alternative include:

- Headworks – Influent vortex-type grit system that will remove 90% of 200μm and larger grit. The grit system will wash and compact the material for auger-conveyance to a wheeled dumpster and landfill disposal. The existing influent screens (⅜") would not need to be modified
- Chemical Feed System – A chemical feed system that will be capable of dosing the influent wastewater with alum (if necessary) in order to provide for enhanced phosphorous removal in the SBR basins. This system will back up the biological nutrient removal process in the SBR.
- Sequencing Batch Reactor – The principal treatment component will be a four-basin sequencing batch reactor with BNR capability. Each basin will be

approximately 3,600 ft^2 in surface area, 15½' deep with a volume of 0.42 MG. Each basin will have five complete cycles per day at average daily flow (1.51 MGD) for a cycle time of 4.8 hours. The entire facility will have a hydraulic detention time of 1.1 days, solids retention time of 17.7 days. The SBR's aeration system will be capable of delivering 7,060 lb.O_2 per day to treat an average of 3,734 lb/day of BOD_5, and 316 lb/day of ammonia. Equipment will include: one electrically-actuated inlet valve, one 15 HP submersible mixer, one 3 HP submersible transfer pump, 25 fine-bubble diffusers and a floating decanter per basin; diffuser retrieval system; five 75 HP positive displacement blower assemblies; level sensors; dissolved oxygen probes, and; a complete control system. WAS will be predominantly pumped to aerobic digestion for further stabilization with the option of going to the existing sludge drying beds under exigent conditions. The equipment package provided is based on one specific manufacturer's design, other SBR designs are possible and should be considered in the design phase. An example of type of SBR design is shown below.



- Existing Clarifiers/Sludge Digestion – Sludge digestion will be accomplished by conversion of the existing 75' diameter flocculating clarifier to an aerobic digester. This existing circular concrete basin will provide 2.3 days of aerated retention time (without thickening) at ADF. A single aerobic digester is adequate since the facility will have the option of conveying WAS directly to the sludge drying beds for dewatering. The digester will be equipped with: aeration diffusers for mixing and aeration; supernatant decant; scum/grease removal, and; high-level emergency overflow in accordance with DEQ-2 requirements. Stabilized solids will be pumped to the existing drying beds (4.3 total acres) for further dewatering and volatile solids destruction. Ultimate sludge disposal will be either to the local land fill or possibly to the local composting facility in Olney, MT.

- Aeration and SBR Process Equipment – The existing blower building will be expanded to house four new 125 HP SBR blowers as well as adding three 75 HP blowers for the aerobic digester conversion. Approximately 800 ft^2 of floor space will be added to the existing building to accommodate the additional blowers, piping, motor controls and appurtenant equipment.
- UV Disinfection and Administration Building – A 4,000 ft^2 building will be constructed to house: an open-channel ultra-violet disinfection unit; effluent magnetic flow meter; laboratory; auto-sampler; system controls and administration facilities. The disinfection unit will provide a minimum 15 mJ/cm^2 dose of 253.7 nm UV light to treated effluent and will be equipped with: 36 high intensity/low pressure lamps; dose-pacing controls; automated lamp wiping; module lifting system; transmittance monitor; UV intensity sensors, and; level control weir.
- Interim Treatment – Existing lagoon cells #1 and #2 will remain in operation during construction of the SBR and supporting unit processes. Once the SBR improvements are completed and on-line, cells #1 and #2 will be drained, undergo sludge removal and the dikes will be re-contoured to accommodate a new facility access road. Sludge from cells #1 and #2 will be pumped to the furthest north drying bed for dewatering.

Advantages of SBR:

- Small footprint which can easily fit within that of existing treatment cell #3, allowing the City to maintain the maximum amount of treatment capability while the new improvements are being implemented.
- Maximizing the use of existing infrastructure with the use of the main lift station and screen, newer flocculating clarifier basin, blower building, sludge pumps and sludge drying beds.
- Excellent effluent quality:
    - BOD_5 < 10 mg/l
    - TSS < 10 mg/l
    - $NH_3 \leq 2$ mg/l
    - TN ≤ 10 mg/l
    - TP ≤ 1 mg/l. Can be enhanced with chemical addition.
- TN and TP removal through biological processes. Can be enhanced with filtration for future limitations.
- Reliable, proven technology that has demonstrated performance in cold climates. Several installations in Montana.
- Capable of handling variable loadings and flows.
- Overall Net Present Worth is among the lowest for all alternatives considered and Capital Costs are lowest for all the mechanical options.
- Easily expandable with the common-wall construction of additional basins and SBR assemblies. Adaptable to meet future nutrient regulations.

- SBR can be programmed to automatically advance the treatment cycles in response to flow fluctuations, I&I response and dry weather flows. Redundancy in treatment basins allows one basin to be taken out of service while still maintaining adequate treatment capacity with the remaining basins.

Dis-Advantages:

- Higher overall annual O&M costs than Biolac alternative.
- More complex mechanically than the existing system
- Will require more operator skill to operate

Environmental Impacts: Anticipated long-term environmental impacts for the SBR with aerobic sludge digestion and drying bed storage include:

Adverse:

- Higher power consumption than the current system.
- Increased overall O&M costs associated with more FTE's, power, maintenance, spare parts, etc.

Beneficial:

- The City's effluent will receive a higher level of treatment prior to being discharged into the Whitefish River; reduced ammonia and nutrient levels in the treated effluent will result in enhanced instream water quality with a reduction in the incidence of nuisance algae growth.
- This alternative may also be coupled with controlled irrigation of adjacent areas, further reducing pollutant discharges to the Whitefish River and providing beneficial reuse of the City's treated effluent.
- Reduced alum usage in order to achieve greater phosphorous removal.

Operation and Maintenance – Operation of the Pretreatment and Pumping equipment will include daily checks on the equipment, adjustment as needed, scheduled and unscheduled maintenance, removal and disposal of accumulated materials to the landfill, lubrication, general cleaning, oversight of control system and emergency operations. While not utilized at present, the odor control biofilter, if used, requires operation of a blower, injection of supplemental water during dry weather and periodic replacement of the filter media. The Secondary treatment process will require daily checks, adjustment of cycle times and aeration, process control testing, collection and testing (or delivery to lab) of compliance samples, adjustment of system controls, lubrication of blowers and miscellaneous equipment, adjustment of chemical feed rates, periodic replacement or cleaning of diffusers, general cleaning and system oversight. Solids handling equipment includes blowers that will require maintenance, scheduling of decant back to headworks, wasting of sludge to the sludge drying beds, general maintenance and cleaning of equipment and disposal to drying beds. Periodically, the drying beds will require removal of dried solids, testing and final disposal which could include onsite disposal, removal to the landfill, used for composting or as a general soil amendment. The detailed cost tables in the Appendices provide cost estimates for labor, power, chemicals and other operational costs.

UV Disinfection System Operation – This effort will include daily checks on the system, periodic replacement of the UV tubes, cleaning of the UV channels and general performance monitoring of the system. Most UV systems of this size utilize a mechanical cleaning system which utilizes a cleaning fluid and squeegees to keep the tubes clean. The cleaning system will require periodic servicing. The light sensor which measure UV transmittance will require cleaning. Alarms are provided on the system if a power failure occurs or if transmittance of light from the UV tubes drops below a specific set point. Lights must be replaced every 12,000 hours or when performance deteriorates. If a bank of lights is removed from a channel, a hoist system should be used or two operators and a support rack.

Land Requirements- All elements of the SBR system alternative, excluding disinfection, can easily fit into the footprint of the existing lagoons system's Cell #3 as shown by the schematic. This land is owned by the City and no additional land acquisition is necessary. With the SBR's relatively small footprint, the opportunities for on-site land application of treated effluent are maximized.

Construction Issues – The primary construction issues involved with the Sequencing Batch Reactor alternative are related to working within the footprint of the existing facility and also with groundwater. It is known that the existing lagoon cells are clay-lined over alluvial material. Draining Cell #3 while the other two cells are in operation will tend to create a hydraulic gradient toward the drained cell and increasing the volume of leakage from the operating cells #1 and #2. During construction of the SBR basins, it will be necessary to provide adequate de-watering to allow forming of the concrete sub-structure and assuring that soil bearing capacities are not exceeded. Over-excavation and import of granular soils may be necessary if unsuitable soils are encountered below the SBR.

Maintaining adequate treatment will be necessary during construction of the new facility. It is anticipated that Cell #3 would be isolated by directing Cell #2 effluent directly to the flocculating clarifier. Once isolated, Cell #3 liquid would be pumped to the beginning of Cell #1. Cell #3 solids would be pumped to the furthest north drying bed (similar to the operation conducted in 2002 for Cell #1). Once completely cleaned, work could then be undertaken in Cell #3 for construction of the grit removal, flow measurement, chemical feed, SBR, blower building and re-contouring. When these improvements are complete, the SBR could be put online and Cells #1 and #2 could be de-commissioned by pumping the liquids to the SBR. Solids could be pumped to the drying beds or could wait for completion of the digester. The flocculating clarifier could then be converted to an aerobic digester. After Cells #1 and #2 are drained and cleaned, the dikes could be re-contoured to allow for expanded use of their footprint.

Sustainability Considerations- Energy efficient motors would be specified for high horsepower applications including the blowers, mixers, and high horsepower pumps. Ramped soft starters or variable speed drives will be specified for high horsepower pumps, mixers and blowers to maximize energy efficiency, prolong motor life and to minimize the costs due to high inrush power demand. Real-time DO probes, pH sensors and controls will be installed in the reactor basins to optimize oxygen concentrations and the BNR process which will allow for more efficient blower and equipment operation saving energy. Land application of a portion of the treatment plant's effluent could be accomplished on adjacent areas that are suitable for land application.

Estimated Costs: Engineer's unit price estimate of cost to implement the Sequencing Batch Reactor alternative is provided in **Appendix D**. **Table 4.5** below provides a summary of the engineer's estimate of present-day capital costs including construction costs; contingency; design, bidding and construction inspection costs, and; estimated salvage value at the 20-year design life. Annual operation and maintenance costs include operational labor; electrical power; self-monitoring; chemicals; repair/replacement and spare parts. These estimates will be used to compare net-present worth of each alternative later in this chapter.

Table 4.5 Cost Summary for SBR Alternative

Total Capital Cost	**$15,984,740**
Total Annual O&M Cost	**$ 780,480**
20-Year Salvage Value	**$4,601,475**
Present Worth of Alternative	**$24,491,416**

4.4.2.3 Oxidation Ditch with Sludge Thickening, Aerobic Sludge Digestion, Rehabilitation of the Existing Clarifiers and Drying Beds

Description

This alternative consists of an oxidation ditch, sludge thickening, and aerobic digestion. The existing clarifiers would be rehabilitated and the existing sludge drying beds would be utilized. All components would be sized to treat the City's projected 2035 design average flowrate of 1.51 MGD, 1.81 MGD wet weather flow and its maximum daily flowrate of 4.53 MGD. Other system components would include grit removal, solids handling and effluent disinfection. Various combinations of treatment equipment that could be paired with the Oxidation Ditch were considered including:

1. Oxidation ditch with one new clarifier (replacing the old 65 ft clarifier), modifying the existing 75 ft clarifier, and mechanical dewatering.
2. Oxidation ditch with one new clarifier (replacing the old 65 ft clarifier), modifying the existing 75 ft clarifier, sludge thickening (to reduce digester size) and mechanical dewatering.
3. Oxidation ditch, rehabilitation of both existing clarifiers (no new clarifiers), no mechanical sludge thickening or dewatering (use existing drying beds).

4. Oxidation ditch, rehabilitation of both existing clarifiers, mechanical sludge thickening, and using the existing sludge drying beds for sludge dewatering.

The fourth option was selected as the combination to evaluate in detail because it has the lowest capital cost and allows the City to retain the use and investment in the existing clarifiers and sludge drying beds.

The Oxidation Ditch layout was shown previously in Figure 4.6.

The major treatment elements of the Oxidation Ditch Alternative include:

- Headworks. Influent vortex-type grit system that will remove 90% of 200μm and larger grit. The grit system will wash and compact the material for auger-conveyance to a wheeled dumpster and landfill disposal. The existing influent screens would not have to be modified.
- Chemical Feed System. A chemical feed system that will be capable of dosing the influent wastewater with alum (if necessary) in order to provide for enhanced phosphorous removal in the clarifiers.
- Oxidation Ditch with BNR. The Oxidation Ditch system will consist of the following basins:
  - Four Anaerobic Basins – for biological phosphorus removal
  - Two Train Oxidation Ditch – for BOD removal, phosphorus removal, and nitrogen removal (anoxic zones created in the ditch).
- The system will consist of two oxidation ditches with external anaerobic tanks. The external anaerobic tanks will be equipped with submersible mixers that will operate continuously. The anaerobic tanks perform Bio-P functions (release of phosphorus as orthophosphate) and will also have the side benefit of acting as a selector tank (for inhibiting filament growth). The oxidation ditches will be equipped with horizontal rotor aerators and submersible mixers. The rotors and mixers alternate on and off through alternating timed cycles (aerobic/anoxic) to allow for nitrification and de-nitrification. During the aerobic cycles the rotors will be in operation with the submersibles turned off. The rotors will provide the required oxygen transfer for BOD removal and for nitrification. The rotors will be controlled by VFDs in conjunction with a D.O. control loop for process optimization and energy efficiency. The uptake of excess orthophosphate will also occur during the aerobic cycle. The anoxic cycle will begin operation after the aerobic cycle based on timed sequence. During the anoxic cycle the rotors will turn off and the mixers will turn on. The mixers will provide complete mixing of the oxidation ditch during the anoxic cycle. As the D.O. depletes, the bacteria will begin to de-nitrify by using the nitrates produced from nitrification for BOD removal. De-nitrification is critical to the proper function of Bio-P removal (high nitrate levels will inhibit phosphorus release in the anaerobic tank). The contents of the oxidation ditches flow into the final clarifiers where the solids are allowed to settle and the clear liquid will flow over the effluent weirs. The settled solids in the bottom of the tank will be pumped back into the oxidation ditches as returned activated sludge (RAS) to maintain the population of bacteria. The return activated sludge can either be pumped into the anaerobic basins

(typical operation) or into the ditches. The orthophosphate taken up in the aerobic cycled is concentrated in the settled sludge as the clear liquid that overflows the weirs and will have a low concentration of phosphorus. Phosphorus is removed from the system in the waste activated sludge.

If alum or other coagulants are fed into the ditch, the clarifiers can provide additional chemical phosphorus removal. Treated effluent from the oxidation ditches will flow to the clarifiers. The settled sludge from the clarifiers will be returned to the ditch as activated sludge and typically enter the anaerobic basins with the raw influent wastewater. Periodically sludge will be wasted from the clarifiers to the aerobic digesters. Clarified effluent will flow to the UV disinfection system and ultimate discharge to the Whitefish River.

- Existing Clarifiers/Sludge Thickening. Mixed liquor from the oxidation ditches would flow to one of the two existing clarifiers. Clarified effluent will be disinfected with the UV disinfection system and discharged. Sludge from the clarifiers will be recycled back to the head end of the plant or wasted to the sludge thickener (disk thickening system) for further solids reduction and then to the aerobic digesters. The thickening system will dewater the sludge to a 4% solids concentration, reducing the size required for the aerobic digesters. A building to house the thickening equipment would be constructed next to the aerobic digesters. Minor modifications to the existing 75 ft. clarifier currently being used for phosphorus removal will have to be made to accommodate the increased volume of waste activated sludge. Modifications to the existing 65 ft. clarifier that is not currently in use will be more extensive including installing a new cover, drives, sweeps, electrical upgrades and HVAC upgrades. Splitting flow to clarifiers of two different sizes can be problematic.
- Aerobic Digesters. This alternative assumes that two new covered aerobic digesters would be constructed for sludge stabilization. The digesters will be equipped with: aeration diffusers for mixing and aeration; supernatant decant; scum/grease removal, and; high-level emergency overflow in accordance with DEQ-2 requirements. Stabilized solids will be pumped to the existing drying beds (4.3 total acres) for further dewatering and volatile solids destruction. Ultimate sludge disposal will be either to the local land fill or possibly to the local composting facility. A building would be constructed to house pumping equipment and possibly the blower equipment (costs assume reuse of the existing blower building).
- Process Equipment. Process equipment will include the items listed in the O&M Cost Estimate in **Appendix D.**
- UV Disinfection and Administration building. A 4,000 ft^2 building will be constructed to house: an open-channel ultra-violet disinfection unit; effluent magnetic flow meter; laboratory; auto-sampler; system controls and administration facilities. The disinfection unit will provide a minimum 15 mJ/cm^2 dose of 253.7 nm UV light to treated effluent and will be equipped with: 36 high intensity/low pressure lamps; dose-pacing controls; automated lamp wiping;

module lifting system; transmittance monitor; UV intensity sensors, and; level control weir.

Maintenance of Plant Operations – Once the Oxidation Ditch improvements are completed and on-line, cells #1 and #2 will be drained, undergo sludge removal and the dikes will be re-contoured to accommodate a new facility access road.

Advantages of Oxidation Ditch:

- Facilities can easily fit within that of existing treatment cell #3, allowing the City to maintain the maximum amount of treatment capability while the new improvements are being implemented.
- Making use of existing infrastructure with the use of the main lift station and screen, blower building, and sludge drying beds.
- Excellent effluent quality :
    - BOD_5 < 10 mg/l
    - TSS < 10 mg/l
    - $NH_3 \leq 1$ mg/l summer, 4 mg/l winter
    - TN ≤ 10 mg/l
    - TP ≤ 1 mg/l. Can be enhanced with chemical addition to < .3 mg/l.
- TN and TP removal through biological processes. Can be enhanced with filtration for future limitations.
- Reliable, proven technology that has demonstrated performance in cold climates. Several installations in Montana.
- Capable of handling variable loadings and flows.

Dis-Advantages:

- Higher overall annual O&M costs than the existing system, but comparable to other mechanical treatment alternatives.
- Capital cost and present worth higher than the other alternatives
- Physically, the largest mechanical system evaluated

Environmental Impacts - Anticipated long-term environmental impacts for the Oxidation Ditch with aerobic sludge digestion and drying bed storage include:

Adverse:
- Higher power consumption than the current system.
- Increased overall O&M costs associated with more FTE's, power, maintenance, spare parts, etc.

Beneficial:
- The City's effluent will receive a higher level of treatment prior to being discharged into the Whitefish River; reduced ammonia and nutrient levels in the treated effluent will result in enhanced instream water quality with a reduction in the incidence of nuisance algae growth.

- This alternative may also be coupled with controlled irrigation of adjacent areas suitable for land application, further reducing pollutant discharges to the Whitefish River and providing beneficial reuse of the City's treated effluent.
- Reduced alum usage in order to achieve greater phosphorous removal.

Operation and Maintenance – Operation of the Pretreatment and Pumping equipment will include daily checks on the equipment, adjustment as needed, scheduled and unscheduled maintenance, removal and disposal of accumulated materials to the landfill, lubrication, general cleaning, oversight of control system and emergency operations. While not utilized at present, the odor control biofilter, if used, requires operation of a blower, injection of supplemental water during dry weather and periodic replacement of the filter media. The Secondary treatment process will require daily checks, adjustment of cycle times and aeration, process control testing, collection and testing (or delivery to lab) of compliance samples, adjustment of system controls, lubrication of blowers and miscellaneous equipment, adjustment of chemical feed rates, periodic replacement or cleaning of diffusers, general cleaning and system oversight. Solids handling equipment includes blowers that will require maintenance, scheduling of decant back to headworks, wasting of sludge to the sludge drying beds, general maintenance and cleaning of equipment and disposal to drying beds. Periodically, the drying beds will require removal of dried solids, testing and final disposal which could include onsite disposal, removal to the landfill, used for composting or as a general soil amendment. The detailed cost tables in the Appendices provide cost estimates for labor, power, chemicals and other operational costs.

UV Disinfection System Operation – This effort will include daily checks on the system, periodic replacement of the UV tubes, cleaning of the UV channels and general performance monitoring of the system. Most UV systems of this size utilize a mechanical cleaning system which utilizes a cleaning fluid and squeegees to keep the tubes clean. The cleaning system will require periodic servicing. The light sensor which measure UV transmittance will require cleaning. Alarms are provided on the system if a power failure occurs or if transmittance of light from the UV tubes drops below a specific set point. Lights must be replaced every 12,000 hours or when performance deteriorates. If a bank of lights is removed from a channel, a hoist system should be used or two operators and a support rack.

Land Requirements- The Oxidation Ditch system can easily fit into the foot print of the existing lagoon system. This land is owned by the City and no additional land acquisition is required. The ditch system will take up less of the City owned property expanding the opportunity for on-site land application of some of the treated effluent.

Construction Issues – The primary construction issues involved with the ditch alternative are related to working within the footprint of the existing facility and also with groundwater. It is known that the existing lagoon cells are clay-lined over alluvial material. Draining Cell #3 while the other two cells are in operation will tend to create a hydraulic gradient toward the drained cell and increasing the volume of leakage from the operating cells #1 and #2. During construction of the ditch basins, it will be necessary to provide adequate de-watering to allow forming of the concrete sub-structure and assuring that soil bearing capacities are not exceeded. Over-excavation and import of granular soils may be necessary if unsuitable soils are encountered below the ditch basins.

Maintaining adequate treatment will be necessary during construction of the new facility. It is anticipated that Cell #3 would be isolated by directing Cell #2 effluent directly to the flocculating clarifier. Once isolated, Cell #3 liquid would be pumped to the beginning of Cell #1. Cell #3 solids would be pumped to the furthest north drying bed (similar to the operation conducted in 2002 for Cell #1). Once completely cleaned, work could then be undertaken in Cell #3 for construction of the grit removal, flow measurement, chemical feed, oxidation ditch, blower building and re-contouring. When these improvements are complete, the new oxidation ditch could be put online and Cells #1 and #2 could be de-commissioned by pumping the liquids to the oxidation ditch. Solids could be pumped to the drying beds or could wait for completion of the digester. After Cells #1 and #2 are drained and cleaned, the dikes could be re-contoured to allow for expanded use of their footprint.

Sustainability Considerations- Energy efficient motors would be specified for high horsepower motors including the blowers, ditch rotors, and high horsepower pumps. Ramp starters or variable speed drives will be specified for high horsepower pumps, ditch rotors and the blowers to maximize energy efficiency and to avoid the demand charges of starting high horsepower motors. Probes and controls will be installed in the reaction basins to optimize oxygen concentrations and the BNR process which will allow for more efficient blower and equipment operation saving energy. Land application of a portion of the treatment plant's effluent could be accomplished on adjacent areas that are suitable for land application.

Estimated Costs – Engineer's detailed unit price estimate of cost to implement the Oxidation Ditch alternative are provided in **Appendix D**. **Table 4.6** below provides a summary of the engineer's estimate of capital costs including contingency, design, bidding and construction inspection costs, and estimated salvage value at the 20-year design life. Annual operation and maintenance costs including operational labor, power, self-monitoring, chemicals, repair/replacement and spare parts are estimated as well. These estimates will be used to compare net-present worth of the alternatives.

Table 4.6 Cost Summary for Oxidation Ditch Alternative

Total Capital Cost	**$21,356,133**
Total Annual O&M Cost	**$928,000**
20 Year Salvage Value	**$6,451,440**
Present Worth of Alternative	**$31,023,170**

4.4.3 Evaluation of Alternatives

The following **Table 4.7** provides a comparison of capital and operating costs for the three final options considered. The present worth cost provides a summary of the capital costs, present value of operating costs with the present worth of the salvage value

Table 4-7 City of Whitefish Wastewater Treatment Alternatives
Net Present Worth Comparison Table

Alternative	Capital Cost	Annual O&M	20-Year NPW Annual O&M	Salvage Value	20-Year NPW Salvage Value	Overall 20-Year Net Present Worth
Biolac w/ Existing Clarifier	**$15,914,648**	$642,369	**$8,729,790**	$2,481,218	**$1,132,428**	**$23,512,010**
Sequencing Batch Reactor	**$15,984,739**	$780,485	**$10,606,791**	$4,601,475	**$2,100,113**	**$24,491,416**
Oxidation Ditch	**$21,356,133**	$927,996	**$12,611,472**	$6,451,438	**$2,944,436**	**$31,023,169**

deducted. Present worth can be considered as a more representative number of the true value of the costs of each alternative. As noted, the Biolac system and the SBR have similar capital costs whereas the Oxidation Ditch is significantly greater.

Table 4.8 City of Whitefish PER
Ranking of Three Screened Alternatives

	Option 1 Biolac	Option 2 SBR	Option 3 O-Ditch
Capital Costs	1	1	3
Operating Costs	1	2	3
Mechanical and Operational Complexity	1	1	1
Use of Proven Technology	2	1	1
Future Expansion Capability	3	1	2
Capacity to Remove Pollutants to Lower Levels	3	1	1
Cold Weather Operation	2	1	1
Odor Potential and Aesthetics	2	1	2
Environmental Impacts	1	1	1
Ease of Implementation	1	1	2
Public Acceptance	1	1	1
Total	**18**	**12**	**18**
Rank	**3**	**1**	**2**

Similar comparisons can be made for the present worth values for each alternative with some variation in the present values of the Biolac system and the SBR due to the lower operating costs of the SBR.

The treatment alternatives were ranked utilizing the criteria used in the earlier screening process, with the addition of three additional factors, as described in **Table 4.8** below.

Discussion – The first two factors reflect the capital and operating costs for each option, with the oxidation ditch reflecting the highest capital and operating costs. Complexity of the treatment alternatives is relatively similar. The Biolac option was scored lower for proven technology primarily due to the use of a fermenter, a process that can be problematic with odors and has not be fully tested with the lagoon based system. The Biolac system is also more difficult to expand with an earthen structure. Lack of close operational control, limited solids management and the limits of proven technology also result in a reduced score for the Biolac in the system's capacity to reduce pollutants to a lower level. Cold weather operation is similar for the three options although the large surface area of the Biolac reduced the score on this item. The SBR was scored better for aesthetics, primarily due to the systems relatively small size. Environmental impacts of each alternative are similar as is the ease of implementation. A Public Meeting was held to discuss the treatment options and the draft PER made available to the public. No adverse comments were received by the public. One city councilman indicated that the carbon footprint of the treatment alternatives should be a factor in the selection process. The Mayor further indicated that odor potential of treatment options should be a consideration. The process indicates that the SBR facility is the best alternative for the City of Whitefish.

The SBR plant, with good operation, can meet existing and the proposed permit limits suggested for the next permitting cycle. Use of chemicals will allow for improved phosphorous removal required for the more restrictive permit standards. Ultimately, filtration of the treated effluent may be necessary to meet more restrictive standards in the future.

4.6 Recommended Wastewater Treatment Plant Improvements

4.6.1 Summary of Recommendations

After review of the planning document by the Whitefish Public Works Department, the City Council and the Public, it was concluded that the Sequencing Batch Reactor was the most cost-effective and environmentally sound treatment alternative. The proposed project includes replacement of the existing secondary treatment plant with a Sequencing Batch Reactor (SBR) capable of removing ammonia, nitrogen and phosphorous to fully comply with the requirements of the current MPDES discharge permit. Furthermore, the plant will be capable of meeting anticipated more restrictive nutrient standards proposed by the DEQ in the next two discharge permit cycles (5 and 10 years hence).

The estimated costs for the project are $17,366,666 including costs for construction (with a 3% inflation factor presuming construction in 2019), engineering, administration and a 15% contingency. Annual costs for operating the entire facility are estimated to be $780,480, which roughly equates to a $440,000 cost increase over the current operational cost. Detailed cost estimates for this option are included in Appendix D. Chapter 6 will consider an implementation strategy to develop this option.

Chapter 5 Other Nutrient Reduction Options

5.1 Introduction

5.1.1 Nutrient Reduction Outside of the Treatment Plant

The City of Whitefish is currently investigating means to reduce nutrients through methods other than removal in a centralized wastewater treatment plant. Nutrient reduction could include reduction at the source, removal of alternate sources such as stormwater, agricultural runoff or wood smoke, land application of wastewater in lieu of discharge, upstream controls such as improved management (or elimination) of septic systems and other options involving the concept of nutrient trading. The City of Whitefish has obtained a grant from the Montana DNRC to prepare a Nutrient Reduction Plan which is being prepared by Robert Peccia & Associates in conjunction with Anderson-Montgomery Consulting Engineers. The *Executive Summary* from this plan is included below.

5.1.2 Executive Summary for City of Whitefish Nutrient Trading Plan

The Montana Department of Environmental Quality (MDEQ) defines nutrient trading as a market-based approach to achieving water quality standards in which a point source (such as the Whitefish Wastewater Treatment Plant) purchases pollutant reduction credits from another point source or a nonpoint source in the applicable trading region that are then used to meet the source's pollutant discharge obligations. To be creditable to the source purchaser, the credits must reflect an actual, pollutant load differential below the credit seller's baseline. Under certain circumstances, a point source buyer may have to purchase more than one pound of pollutant reduction to equal a pound discharged at its outfall. In simpler terms, if the City can find means to reduce nutrient loading (nitrogen and phosphorus) from other sources they can obtain a "nutrient credit" that in effect increases the nutrient loading limits for nitrogen and phosphorus in the City's current discharge permit. Potential nutrient trading sources in the Whitefish Area include:

- Land application of effluent from the existing wastewater treatment plant.
- Residential on-site septic systems.
- Runoff from agricultural land
- Stormwater runoff from the City's stormwater collection system.
- Golf course runoff.
- Smoke from woodstoves.

5.1.3 Initial Investigative and Sampling Efforts

In order to make an initial determination as to whether or not there are potential nutrient trading sources near the Whitefish Wastewater Treatment Plant (WWTP), an initial sampling plan was developed to screen for the presence of nutrients in the City's stormwater discharges and at or near the mouth of nearby tributary streams that flow into the Whitefish River. The table below taken from Chapter 1 of the Plan summarizes the sampling points.

TABLE 5.1 Sampling Points	
Sample Location	Sample Type
Whitefish River Outfall	Storm Water
Riverside Pond	Storm Water
Hamilton/Baker Outfall	Storm Water
Spruce Court Outfall	Storm Water
Mouth of Cow Creek	Surface Water
Swift Creek at Delrey	Surface Water
Swift Creek at Olney	Surface Water
Haskill Creek Near Mouth	Surface Water
Viking Creek Near Mouth	Surface Water
Walker Creek Near Mouth	Surface Water
Whitefish River at Columbia Bridge	Surface Water
Whitefish River at JP Road	Surface Water
Whitefish River at Highway 40	Surface Water
Whitefish River at Lake Outlet	Surface Water

The current in-stream nutrient standards for the Northern Rockies Ecoregion (as defined in Circular DEQ 12-A) are 0.275 mg/l TN and 0.025 mg/l TP. These standards are in effect from July 1st to September 30th of each year and were used as an initial gauge for the significance of the initial sampling results. The limited sampling that was completed in 2014 indicated three areas or sources where nutrient concentrations exceeded the numeric nutrient instream standards for the Northern Rockies Ecoregion. They were Cow Creek, Walker Creek and stormwater runoff from the City of Whitefish. Cow Creek receives multiple discharges from the City's storm drainage system and livestock are wintered just to the east of the creek in the Creek View Drive area. Livestock (cattle) were noted on Walker Creek near the Dillon Road Crossing and could be contributing to the nutrient loading in the creek. Nutrients detected in the urban stormwater runoff can be attributed to sources such as lawn fertilizer, pet waste, and particulate material. Based on the sampling results and on the ground investigations the conclusion was made that the Cow and Walker Creek drainages and the City's stormwater effluent have a potential for generating nutrient trading credits.

In addition to the above sources other potential sources of nutrient credits were investigated in the nutrient trading plan including:

- Golf Course Runoff
- Agricultural Runoff
- Lawn Fertilizers
- Areas with onsite septic tanks
- Smoke from woodstoves

- Land Application (irrigation) of the Effluent from the Whitefish Wastewater Treatment Plant (WWTP)

5.1.4 EVALUATION OF POTENTIAL NUTRIENT TRADING SOURCES

The table below taken from Chapter 3 summarizes the advantages and disadvantages of potential nutrient trading sources:

TABLE 5.2 Advantages and Disadvantages Of Nutrient Trading Sources

Potential Trading Source	Advantages	Disadvantages or Issues
Land Application of WWTP Effluent	• Long-term source of credits. • Most credits available of any of the sources. • City would have direct control of the irrigation system. • Quantity of available credits easy to document • Amount of credit will not vary unless irrigated volume reduced or increased.	• Cost to implement is very high with the exception of irrigating on City property around the plant. • Multiple irrigation sites would be needed. Would have purchase multiple sites or enter into multiple lease agreements. • Clay soils in the area may pose challenges. • Extensive piping system is required to serve multiple irrigation sites. • Credits available only during irrigation season unless total retention/storage is provided.
Residential On-Site Septic Systems	• Moderate amount of potential credits available. • Long-term source of credits. • Amount of credit will not vary.	• Cost per pound of credit is very high. • Septic systems that connect to the City's collection system will increase the lbs/day loading to the WWTP by at least twice the lbs/day of credits generated. • Converting septic systems to a central or individual level two advanced treatment systems would require a significant monitoring effort by the City to validate and maintain the credits.
Runoff from Agricultural Land	• Moderate to low amount of potential credits available • Cost per pound of credit generated is reasonable	• Not a long-term source of trading credits (land use or ownership can change). • Requires landowner cooperation. • BMP's will require a management and maintenance effort by the City to document and validate credits.
Storm water	• Cost per pound of credit generated is reasonable	• Amount of potential credits available is low.
Golf Courses		• Not likely to provide a significant amount of trading credits. • Would have to enter into an agreement with the golf course owners for management of BMP's • May not be a long term source if golf course closes, changes ownership or management practices.
Urban Runoff (Lawn Fertilizer)	• Cost to implement fertilizer management programs and/or implementing ordinances to require fertilizers with slow release nitrogen and low or zero phosphorus should be reasonable.	• May be difficult to document the effect of implementing management BMP's and fertilizer ordinances. • Depends upon public participation and results may vary from year to year. • Would have to document by sampling runoff on a yearly basis. • Magnitude of trading credits unknown. Other states have not noticed marked decrease in nutrient pollution.

Smoke from Woodstoves		• Likely not a significant source of trading credits • Would be hard to manage and document. • Pollution control devices on woodstoves don't typically target nutrients.

The table below also taken from Chapter 3 of the Nutrient Plan summarizes an estimate of potential trading credits that may be available from the various sources that were evaluated in this document. Sources that did not show initial promise are not included in this table. These estimates are very preliminary and are subject to many factors as discussed in this document. The table also provides a range of estimated costs to generate the estimated nitrogen trading credits based on the preliminary analyses provided in Chapter 2 of the Plan. These cost estimates are provided in dollars/pound/day, in other words the cost to produce a pound per day of nitrogen credit. The costs to produce a pound per day of phosphorus credit are not provided but would be significantly higher because the number of phosphorus credits generated from each source is much lower than the pounds per day of nitrogen credit generated. The estimates are provided are preliminary and would have to be fined tuned for each actual trading source that is pursued. For comparison purposes the cost and amount of credits that would be generated by adding nutrient removal to a new mechanical treatment plant is included in the table.

TABLE 5.3 Estimate of Nutrient Credits Generated From Various Sources and Cost/Day/Lb of Credit Generated

Trading Source	**Estimate of Total Available TN Credits (lbs/day)**	**Estimate of Total Available TP Credits (lbs/day)**	**Estimated Capital Cost for BMP or Credit Generation**	**Cost per One Pound of TN Credit Generated per Day**	**Notes**
Onsite Land Application at the WWTP Property	Up to **22**	Up to **0.5**	$1.0 million	$45,000	Assumes 20 Acres Available for Irrigation at WWTP Site. Available credits will decrease and cost per credit will increase if a mechanical plant with BNR is constructed, due to lower nutrient concentration in the effluent.
Land Application Offsite from the WWTP	Up to **192** currently Up to **276** by end of 20-yr planning period	Up to **4.2** currently Up to **6** by end of planning period	$10 million - $73 million	$36,000-$237,000	Cost and credits dependent upon volume of wastewater land applied.
Connect on-site septic systems to City collection system or convert to advanced treatment	**14-24** (Potential for area around Whitefish lake and upper Whitefish River.)	**0.6-1.8** (Potential for area around Whitefish lake and upper Whitefish River.)	Varies	Varies	Capital costs and cost per pound per day of credit for site specific examples are provided in table 2-13.
Connect 100 generic lots with on-site septic systems to City collection system or convert to advanced treatment	**3.8 to 6.3**	**0-0.5**	$4.1million - $5.3 million for 100 generic lots	$650,000 to 1.4 million for 100 generic lots	Range of costs and generated credits based on either connecting to sewer system or installing advanced treatment. Less credits are generated for advanced treatment.
Agricultural Runoff	**8** (Based on three areas with significant concentrations of livestock.)	**2** (Based on three areas with significant concentrations of livestock.)	Varies with BMP implemented. $90,000 to $108,000 (For three site specific examples evaluated.)	Varies with BMP implemented. $ 34,000 to $38,000 (Based on three areas with significant concentrations of livestock)	Total available credits may increase if other areas are identified.
Stormwater	**0.4 to 4.0**	**0.08 to 0.80**	Varies with BMP implemented and drainage area.	Varies with BMP implemented and drainage area.	
Stormwater estimates for generic 5 acre drainage area	**0.003 to 0.007**	**0.0009 to 0.002**	$25,000 to $ 223,000	$3.8 million - $42 million	Costs vary with type of BMP implemented. See Table 2021
Install Mechanical Treatment with Biological Nutrient Removal at the Whitefish WWTP	**109** Based on current flow (1.0 MGD). **163** Based on 20-yr planning period flow	**2.1** Based on current flow. **3.1** Based on 20-yr flow	$1,600,000 To add BNR to Mechanical Treatment Plant	$14,700 (current) $ 9.815 (20-yr)	Assumes BNR would increase current TP removal rate by 50% and produce 10 mg/l TN in WWTP effluent.

5.1.5 Need for Nutrient Trading Credits

The table below summarizes the current nitrogen and phosphorus loading limits in the City's discharge permit that expires in July of 2020. The table also includes the current and projected 20-year nutrient effluent loadings with an estimate of the credits that will be needed over the planning period in order to comply with the current discharge permit.

TABLE 5.4 Current Nutrient Loading Limits with Current and 20-Year Estimated WWTP Effluent Nutrient Loads

Nutrient	Current Permit Effluent Limit (lbs/day)	Current WWTP Average Effluent Load (lbs/day)	Estimated 20-yr WWTP Average Effluent Load (at 1.5 MGD) (lbs/day)	Current Credits Needed (Average) (lbs/day)	Credits Needed at End of 20-Year Planning Period (Avg. (lbs/day)
Nitrogen					
Summer	176	184	276	8	100
Non-Summer	273	184	276	0	3
Phosphorus					
Year Around	10.4	4.5	6.75	0	0

The treatment plant effluent loadings in the above table are based on the performance of the City's existing aerated lagoons. <u>At current treatment levels, there will be no need to obtain phosphorus credits during the planning period unless the effluent limits in the City's discharge permit are lowered during the 20-year planning period.</u> The existing WWTP will not be able to meet the current and 20-year summertime permit effluent limit of 176 lbs per day for total nitrogen and it will not be able to meet the non-summertime permit effluent limit by the end of the 20-year planning period. Currently, the existing treatment plant will exceed the nitrogen loading limit in its discharge permit by up to 8 lbs per day and this number will increase to 100 lbs per day by the end of the planning period. The estimated credits that will be needed at the end of the planning period will likely decrease or may not be needed if the City constructs a treatment process that is more efficient at removing nitrogen (and phosphorus) than the existing aerated lagoons. If nutrient trading is implemented, the first order of priority would be to obtain nitrogen trading credits in the summer months.

5.1.6 Feasible Options for Nutrient Trading

There is one trading option that would be able to provide the 100 lbs/day of nitrogen credits needed at the end to the planning period; land application of a significant portion of the treated wastewater effluent from the WWTP. The construction of a mechanical plant with nutrient removal would also allow the City to meet the requirements of its discharge permit. Constructing a new WWTP is not nutrient trading. Although, there is a limited potential that the City could sell credits to another entity in the future if a new WWTP is constructed that removes more lbs/day of nitrogen and phosphorus than is required by the discharge permit for the plant.

The remaining sources listed in Table 5.2 (stormwater, septic tanks and agricultural runoff) even if combined would likely not be able to generate the needed 100 lbs/day of nitrogen credits in the summer months at the end of the planning period without upgrading City's WWTP. In the short-term installing an irrigation system to irrigate effluent on the City's property combined with trading credits from other sources would allow the City to meet the nitrogen effluent limits for a portion of the planning period (5-10 years). Other options include:

- Credits from recent and future stormwater improvements. The amount of potential credits from stormwater improvements is limited (estimated at 0.4 to 4 lbs/day of total nitrogen). However, it may be possible to obtain credits for recently completed and future stormwater improvements such as detention basins and groundwater infiltrators. These credits could be documented by sampling and banked for future use. It is likely not cost effective to install stormwater treatment just for obtaining nutrient credits because of the small amount of credits available, but credits should be documented and banked for improvements that are being completed for other reasons. These credits could be used if future discharge permit nutrient limits become more stringent in the future.
- Credits from On-Site Septic Systems. In general it would not be cost effective to obtain nutrient trading credits by sewering areas with on-site septic systems and connecting to the City's sewer system or by providing some type of advanced treatment system for the on-site systems. The costs are very high for obtaining the credits from septic systems as illustrated in Table 5.3. Also, if the on-site systems are connected to the City sewer system the additional nutrient load in lbs/day to the City's treatment system would be at least twice the amount of nutrient credits in lbs/day that could be generated (due to the trading ratios that de-rate the credits as discussed later in this document). However, if there are areas adjacent to the City's collection system that are going to be connected for other reasons, the credits should be documented and banked for future use in case future discharge permits tighten the effluent limits for nitrogen and phosphorus.

5.1.7 Viable Nutrient Trading or Reduction Options

In order to determine if a particular method of reduction is viable for nutrient trading the following criteria should be examined:

- Capital cost for implementing BMP's or improvements to generate credits.
- Cost per pound per day of nutrient credit generated.
- Quantity of credits available from the source.

- Practicality of maintaining and documenting the quantity of credits generated.
- Whether the credits are long or short term.
- Manpower effort and cost required to maintain and operate BMP's.

Based on these criteria and the analysis in this document the most cost effective and practical options for generating nutrient credits or meeting the requirements of the City's discharge permit would be:

1. Adding nutrient removal to the proposed mechanical treatment plant.
2. Installing BMP's to reduce nutrients in agricultural runoff.
3. Irrigation of WWTP effluent.

These options are discussed in more detail below.

1. Adding BNR to the Proposed Mechanical Treatment Plant - This source does not generate credits by "trading" in the traditional manner with other sources of nutrient pollution. It consists of constructing a new treatment plant with nutrient removal capability. The cost per pound per day of credit that is presented in Table 3-2 of the Nutrient Plan was based on the cost to add nutrient removal to some type of mechanical treatment plant such as a traditional activated sludge plant, oxidation ditch, MBR or SBR. It assumes that the plant is going to be constructed as a replacement to the existing aerated lagoons. This source of "credits" is discussed here because it appears to be the most cost effective means of meeting the current discharge permit's nitrogen and phosphorus limits. Also, it is capable of generating trading credits in excess of what is required to meet the current discharge permit which could be sold to other point source dischargers if they exist. In-plant nutrient removal options are discussed in detail in the prior chapter of this document.

2. Installing BMP's to Reduce Nutrients in Agricultural Runoff - This source would not likely generate a significant quantity of credits. However the cost to implement BMP's to remove nutrients from agricultural runoff is lower than most of the other options. This may not be a reliable long-term source of nutrient trading credits if land ownership changes or if land management practices change. Therefore, this may be a good option if the nutrient limits in future discharge permits are lowered further and credits are needed to comply with the permit in the short-term until treatment upgrades can be completed.

Other sources that were evaluated that were not as cost effective, posed management or documentation problems or that did not generate a significant number of credits included:

- Connecting on-site septic systems to the City's collection system or converting them to advanced treatment.

- Adding BMP's for nutrient removal to existing stormwater discharges (unless they are being done for other reasons then the credits should be banked for future use).
- Off-site land application of large volumes of wastewater effluent.
- Runoff from golf courses.
- Runoff from urban lawns.
- Woodsmoke.

3. Irrigation of WWTP Effluent - Land application can be used to reduce the nutrient loading from the existing or new wastewater treatment plant. A nutrient credit would be applied to the City's nitrogen and phosphorus loading limits in its wastewater discharge permit. One pound per day of nitrogen and phosphorus credit would be given for each pound per day of credit that was land applied. Credits would only be given for the months that irrigation occurs (May-Sept.) unless a large storage lagoon is constructed to store wastewater that is discharged during the remainder of the year. Land applying a portion or all of the effluent from the City's wastewater treatment system could partially or totally eliminate the need to construct a treatment system with nutrient removal. In order to land apply wastewater effluent it must be treated to meet at least secondary effluent standards for BOD, and TSS and must meet total coliform limits. The degree of treatment required and the coliform limits that must be met are based on the crop that is irrigated with the treated wastewater. The table in the design criteria section summarizes MDEQ's land application requirements for various types of crops.

The City's current discharge permit has nutrient loading limits for nitrogen and phosphorous. The limits for nitrogen are more stringent in the summer months from July 1st to September 30th of each year as summarized in the table below. The table also includes current and projected design loadings in the wastewater treatment plant effluent (assuming treatment efficiency does not change):

TABLE 5.5 Permit Nutrient Limits and Current WWTP Nutrient Loadings

NUTRIENT	SUMMER LOADING LIMITS (July 1st To Sept. 30th)	NON SUMMER LOADING LIMITS	CURRENT AVERAGE LOAD (From Discharge Permit Fact Sheet)	ESTIMATED AVERAGE LOAD IN 2035 (Assuming current effluent TN & TP concentrations)
Nitrogen	176 lbs./day	273 lbs./day	184 lbs./day	276 lbs./day
Phosphorus	10.4 lbs./day	10.4 lbs./day	4.5 lbs./day	6.75 lbs./day

A number of conclusions can be made from the above table:

- Based on current and estimated design phosphorus loads in the treatment plant effluent, phosphorus effluent loads will not exceed discharge permit loading limits over the 20-year planning period.

- The average current effluent nitrogen load (184 lbs. /day) will exceed the new summertime nitrogen loading limit of 176 lbs. /day by an average of 8 lbs. /day.
- The average effluent nitrogen load will exceed the new non-summertime nitrogen loading limit of 273 lbs./day near the end of the 20-year planning period by an estimated average of 3 lbs./day (unless a new treatment plant with nutrient removal is constructed).
- The effluent nitrogen load will have to be reduced by 100 lbs./day to meet the summertime nitrogen loading limits and by 3 lbs./day to meet the non-summertime nitrogen loading limits near the end of the 20-year planning period

The Nutrient Trading Plan evaluates land application as a source of nutrient trading credits in detail. In this document four alternatives were considered for land application:

1. Alternative One: Land Apply a Portion of the Wastewater Treatment Plant (WWTP) Effluent on City Owned Property at the WWTP (see limitations discussed below).
2. Alternative Two: Land Apply All of the WWTP Effluent During the Summer Months (Mid-May to Mid-September; approx. 120 days), Continue Discharging the Remainder of the Year.
3. Alternative Three: Construct a Storage Lagoon and Land Apply All of the WWTP Effluent During the Summer Months, Totally Eliminating the Discharge From the WWTP.
4. Alternative Four: Land Apply to Meet Summer Nitrogen Limits for 20-year Planning Period (100 lbs. of credit required by end of planning period).

Out of these four alternatives only Alternative One was deemed a viable alternative for nutrient trading. The other alternatives were eliminated at this point in time for the following reasons:

- Based on NRCS soils data ⅓ to ½ of the area in the Whitefish Valley is rated as “very limited” for the disposal of wastewater by irrigation, the remainder of the area is ranked as “somewhat limited”. This is due to a number of factors including high clay content, high water table, and slopes too steep for irrigation. The most significant factor is the clay content of the local soils. Clay soils can become impermeable after extended periods of irrigation due to sodium and other dissolved solids in the wastewater. Much of the land in the Whitefish near the Whitefish WWTP is classified by the NRCS as unsuitable for the land application of wastewater due the high clay content of the soil and high groundwater in certain areas.
- The area around the WWTP is heavily populated and large blocks of suitable land for irrigation are limited. It would likely not be possible to find enough suitable land for the alternatives with the higher acreage requirements.

- Required buffer zones around irrigation sites further complicate finding large blocks of suitable land.
- Alternatives Two, Three and Four would require 130 to 1200 acres of land for irrigation and off season storage to be viable.
- Due to the lack of large blocks of suitable land, multiple irrigation sites and a complex piping system would be required.
- The clay content of the soils could cause a site to fail over time if the soils is not periodically conditioned and maintained.
- Capital costs ranged from $5.7 million for Alternative Four to $72.8 million for alternative Three.   Construction of a new WWTP for ammonia removal would still be required for Alternatives Two and Four.

Figure 5.1 shows potential sites with suitable soils for land application (per the NRCS soils maps) of wastewater. This figure illustrates problem of finding large blocks of suitable land. Alternative One was deemed viable for the following reasons:

- The City already owns the land and can manage it properly for land application.
- The soils appear to be somewhat suitable for land application, although a thorough soils investigation would be required to determine its actual suitability.
- Could be used in the future if nutrient limits in the City's discharge permit are reduced further supplementing the treatment efficiency of a new WWTP during the summer months when the nitrogen loading limits are the most stringent.
- It is the least costly of all of the land application alternatives that were evaluated.

The City owns approximately 40 acres of land around the wastewater treatment plant. This alternative consists of the construction of a land application system that would land apply treated effluent on suitable ground owned by the City at and adjacent to the existing wastewater treatment plant. This alternative would be utilized to supplement the disposal of treated effluent from either the existing aerated lagoon system or the preferred mechanical treatment plant alternative (the SBR system).   Approximately half of this area (20 +/- acres) is covered by a dense growth of various types of trees and shrubs including Engelmann Spruce, Douglas Fir, Western Larch, Lodgepole Pine and Sub-Alpine Fir. This area also contains a popular public walking/biking trail.   A preliminary site survey of this area estimated approximately 292 trees per acre of the various types listed above, with the predominate species being Engelmann Spruce (152 trees per acre) and Douglas Fir (81 trees per acre). Discussions with a local landscaping firm and RPA's Landscape Architecture Division staff indicated that irrigation of this heavily forested area may be detrimental to the existing trees and in fact may kill the trees, especially if drip or subsurface irrigation is used. The potential issue is the clay content of the local soils.   If the clays are prone to swelling when they become saturated, the soil permeability will decrease preventing enough water from reaching the root zone of the trees.

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Revision	Date	By
Draft	4/2014	SA
Final		

Revision: Final

Plot Scale: 1:2

Drawn By: H.Simpkins

Approved By: G.Swanson, P.E.

Checked By: S.Anderson, P.E.

Designed By: G.Swanson, P.E.

Project Number:

Engineer: Anderson-Montgomery Consulting Engineers, 1064 N. Warren, Helena, Mt 59601

RPA

Owner: City of Whitefish, Montana

Project Title: Whitefish WWTP Alternatives

Sheet Title: Land Application Acreages

Sheet: Fig. 5.1

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For the forested 20 acres, further study will be required to determine if any irrigation can occur without harming the existing tree growth. It may be possible to install some type of limited irrigation system, however a detailed soil study should be completed and an agronomist or forestry expert should be consulted before any irrigation is attempted in this area. The density of the existing trees and vegetation would also make installing an irrigation system a challenge and add to installation costs. If spray irrigation is used to irrigate this area the effluent would have to be filtered to meet Class A requirements due to public accessibility.

Therefore, from a practical standpoint only 20 (+/-) acres may be available for irrigation which would limit the irrigation volume to approximately 0.12 MGD. This area lies adjacent to the existing sludge drying beds and aerated lagoons. See **Figure 5.2.** This area could be irrigated with hand lines or wheel lines. A center pivot is probably not suitable because of the shape and size of the remaining areas. The effluent would have to meet at least Class C or D requirements (If public access is not allowed). However, the current WWTP effluent should meet Class B requirements because it is oxidized, settled

TABLE 5.6 MDEQ Land Application Requirements

Class of Reclaimed Wastewater	**Requirements and Treatment Standards**	**Allowable Uses**	**Notes**
A	Must be oxidized, coagulated, filtered and disinfected. BOD and TSS ≤ 10 mg/l. Median number of total coliforms ≤ 2.2 CFU/100 mls	Spray, drip or subsurface irrigation of nonfood crops and food crops. Landscape irrigation of restricted and unrestricted access areas	
B	Must be oxidized, settled, and disinfected. BOD and TSS ≤ 10 mg/l. Median number of total coliforms ≤ 2.2 CFU/100 mls	Same as Class A except not allowed for food root crops or landscape irrigation of unrestricted areas.	
C	Must be oxidized, settled and disinfected. Median number of total coliforms ≤ 23 CFU/100 mls	Spray, drip or subsurface irrigation of nonfood crops. Only spray irrigation of food crops. Only landscape Irrigation of restricted access areas	
D	Must be oxidized and settled.	Spray irrigation of tress and fodder, fiber and seed crops. Drip or subsurface irrigation of nonfood crops.	Disinfection not generally required unless in close proximity to public access or habitation.

and disinfected (see Table 5.6) A pump station will have to be constructed to pump the treated effluent through the irrigation system. A small surge/storage basin may be warranted to even out peaks in the effluent flow and because continuous and/or daily irrigation may not be possible. MDEQ requires a minimum resting period of 3 days for

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Final		

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Drawn By: H.Simpkins
Approved By: G.Swanson, P.E.
Checked By: S.Anderson, P.E.
Designed By: G.Swanson, P.E.
Project Number:

Engineer: Anderson–Montgomery Consulting Engineers, 1064 N. Warren, Helena, Mt 59601

RPA

Owner: City of Whitefish, Montana

Project Title: Whitefish WWTP Alternatives

Sheet Title: Proposed Irrigation System Map

Sheet: **Fig. 5.2**

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X:\Barbara\AMCE Project Files\Whitefish WWTP Alternatives 2015\DWGs\Figures From Gary\WhitefishWW_RPA_DWGs\IRRIGATION_AMCEborder.dwg SAVED:5/4/16 PRINTED:5/4/16 BY:ADAM every one day of irrigation. The existing lagoons would serve this purpose at present. However, if a new mechanical plant is constructed, a small surge/storage basin will have to be included with this alternative. The clay soils also pose a challenge for this area and the soils may have to be periodically amended with gypsum to maintain the permeability of the soils. A detailed soils evaluation should be completed prior to designing and implementing this alternative to insure that it is viable. The cost estimate for this alternative assumes that only 20 acres of the existing WWTP site is suitable for irrigation.

Design Criteria. Design criteria for determining application rates for this alternative are provided in the Appendix F. MDEQ Circular 2 requirements for land application of wastewater effluent will be followed as applicable.

Appendix F, taken from the Nutrient Reduction Plan (copy available upon request) contains land application design criteria for two crops; alfalfa and poplar trees. Poplar trees were evaluated because they have a much higher evapotranspiration rate than other crops. Currently the City of Missoula Montana is using poplar trees to dispose of a portion of its wastewater effluent. DEQ Circular 2 requires that two land application rates be calculated using soil permeability as one parameter and nitrogen loading (based on crop nitrogen uptake) as the other parameter.

The allowable application rate is the lower of the two calculated rates. The rate calculated by soil permeability is directly affected by the soils infiltration rate at the irrigation site(s). The Nitrogen loading rate must be calculated to insure that all of the applied nitrogen is taken up by the crop to prevent groundwater contamination. The soils in the Whitefish area and near the existing wastewater treatment plant typically have a high clay content and low infiltration rate. As can be seen from the calculations in Appendix A (available on request), the estimated hydraulic loading rate of 26.7 inches per year is significantly less than the nitrogen irrigation loading rates calculated for alfalfa (38.16 inches) and poplar trees (170 inches per year). Therefore, the hydraulic loading rate controls. Because of the low hydraulic loading rate, the high evapotranspiration (ET) rate of poplars and other crops with high ET rates cannot be taken advantage of.

Environmental Impacts- There are no adverse long-term environmental impacts associated with this alternative. The degree of treatment that will be provided to the wastewater should minimize odors and pathogens will be inactivated with disinfection. There are long-term benefits associated with this alternative. A portion of the treated wastewater from the WWTP will be re-used for the production of a crop (likely hay) and will not be discharged into the Whitefish River. The required buffer zones will be implemented protecting public health and safety. Periodic conditioning of the clay soils may be required to maintain their permeability.

Land Requirements- The land that will be irrigated is already owned by the City. No additional land will have to be purchased. The land will be put to beneficial use by raising some type of crop.

Construction Issues- There are no significant construction issues associated with this alternative.

Sustainability Considerations -Energy efficient motors would be specified for the pumps for the irrigation system. Land application provides for beneficial re-use of the treated wastewater to raise a marketable crop.

Estimated Costs - Engineer's unit price estimate of cost to implement this land application alternative are provided in **Appendix F.** The Summary Table 5.7 provides the engineer's estimate of: construction costs; contingency; design, bidding and construction inspection costs, and; estimated salvage value at the 20-year design life. Operation and maintenance costs including: operational labor; power; repair/replacement, and; spare parts are estimated as well.

Table 5.7 Cost Summary for On-Site Land Application Alternative	
Total Capital Cost	$ 969,700
Total Annual O&M Cost	$ 15,890
Present Worth of Alternative	$1,159,000

Cost-Effectiveness of Land Application – As noted in Table 5.3, the cost for land application of wastewater on the treatment plant site, while significantly less than off-site land application, is still significantly greater than nutrient removal utilizing the BNR capacity of the wastewater treatment plant. However, in the future, more restrictive standards may require a tertiary treatment process be installed at the plant to meet lower nutrient effluent criteria. At this juncture, land application may become cost-effective. Additionally the concept of land application allows for nutrient reuse rather than nutrient disposal, presenting an environmental benefit not available from the option of stream discharge. The growth of trees on site would also serve to tie up CO2, potentially off-setting the carbon production associated with the wastewater treatment plant.

Chapter 6 Project Implementation

6.1 Institutional Responsibility

6.1.1 Introduction

The City of Whitefish has the necessary legal authority and financial capability to construct and operate the existing and proposed wastewater facilities. The City officials recognize the need to upgrade and expand the wastewater system as regulatory standards require new or more stringent levels of treatment. This engineering report identified needed wastewater treatment facilities and developed treatment alternatives, leading to a recommended option. The wastewater collection system was not evaluated but was previously considered in a similar planning document prepared in 2014. This chapter of the report will evaluate the financial impacts of the proposed project and identify methods to finance needed improvements. A proposed project budget was provided. Project sustainability is considered in this section.

6.1.2 Financial Status

The wastewater system is an enterprise fund operated by the City of Whitefish with a substantial operating budget for revenues and expenditures. Current annual revenues are estimated to be $2,421,500 for 2016 and O&M costs are budgeted at $ 1,887,877. There are 3,880 equivalent resident dwelling units providing approximately 73% of the annual revenue. The City has eight existing loans with Montana State Revolving Loan (SRF) and enjoys a good status with this funding agency.

A rate study for the Whitefish water and wastewater system was completed in March 2016 by AE2S/Nexus. While the study was completed prior to the completion of this PER, preliminary results for project costs were factored into the rate analysis. The Executive Summary from the Wastewater Utility Financial Plan and Rate Study is included in **Appendix G**. It should be noted that the Whitefish City Council is still reviewing the rate study and should adopt the document in the near future.

6.2 Project Recommendations

6.2.1 Project Description

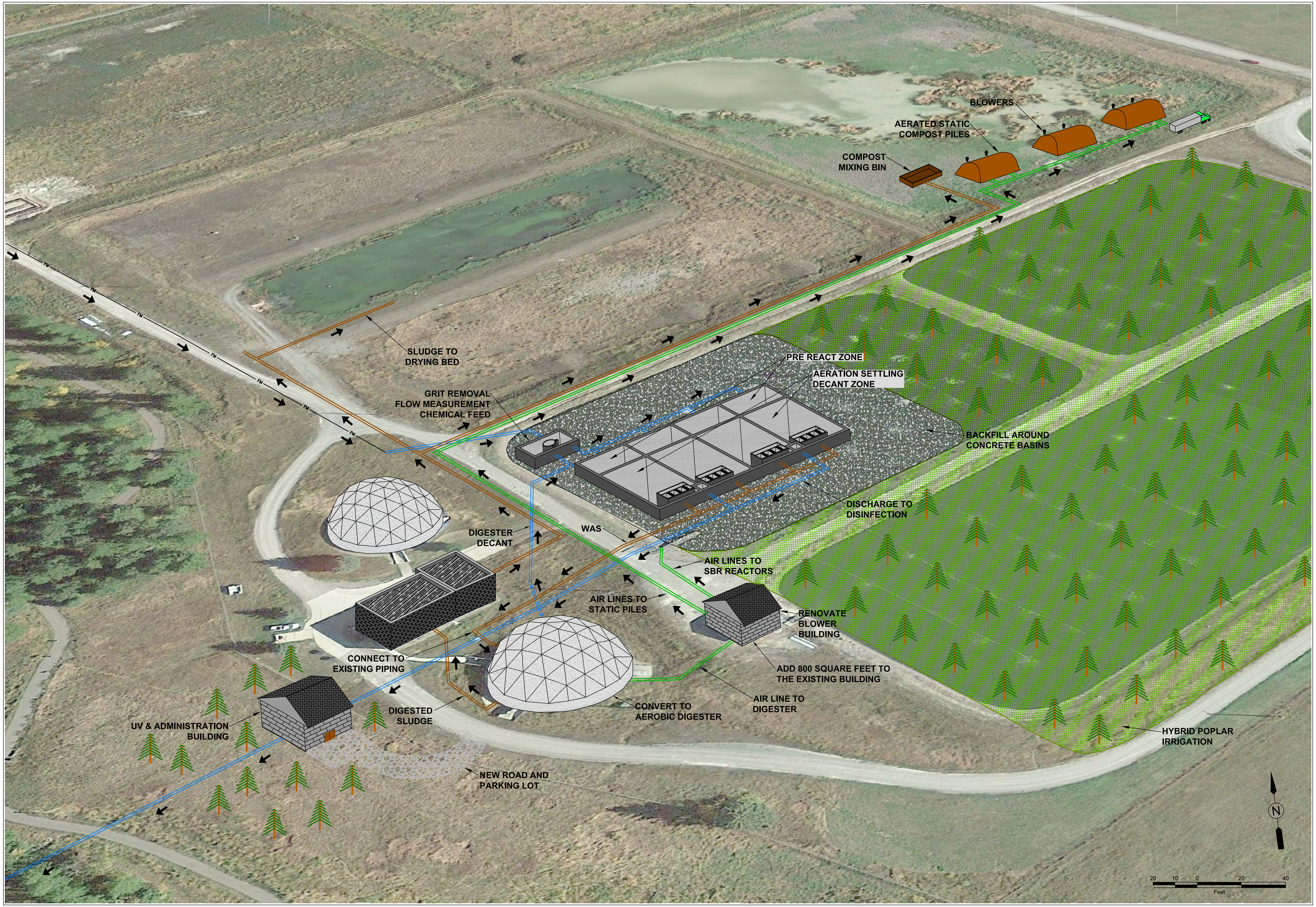
The proposed project includes replacement of the existing secondary treatment plant with a Sequencing Batch Reactor (SBR) capable of removing ammonia, nitrogen and phosphorous to fully comply with the requirements of the current MPDES discharge permit. Furthermore, the plant should be capable of meeting anticipated more restrictive nutrient standards proposed by the DEQ in the next two discharge permit cycles (5 and 10 years hence). Pretreatment of the wastewater will be provided by the existing perforated screen plus grit removal capability added by a new unit process. A four cell sequencing batch reactor will be constructed within the third lagoon cell whereas the existing lagoon cells will be retained for treatment during construction. Use of 4 cells allows continuous discharge from the system, eliminating the need for a post treatment flow equalization basin. Biosolids from the SBR plant will be discharged to an aerobic digester for further stabilization. The existing flocculating clarifier will be converted to a covered aerobic digester. After stabilization, biosolids will be sent to the existing drying beds for further dewatering and long-term storage. Periodically the solids can be removed for disposal at the landfill or land application. While not an immediate plan (or need), a small composting operation could be constructed on site within one of the old treatment cells utilizing biosolids and wood waste to generate compost. Disinfection of the treated effluent would be provided by ultraviolet disinfection. Chapter 4 provides a complete description of the recommended alternative, including drawings. **Figure 6.1** provides a perspective drawing of how the new treatment plant would appear on the site.

Variations of SBR facilities are available from manufacturers with the primary differences related to the decanter, type of aeration device and control system. The aeration systems can range to fine bubble diffusers to coarse bubble jet aeration, each with unique characteristics in energy efficiency and O&M requirements. **Appendix J** contains design reports from four different types of manufacturers typifying the how each company designs and assembles their equipment packages. Cost estimates in this report were based on the Sanitaire ICEAS SBR system utilizing 4 basins. However, this should not be construed as a recommendation for this type of system. The procurement process used to select an equipment package should include consideration of energy efficiency, O&M requirements, availability of support, references, number of operational systems, etc. to insure that the optimal facility is built addressing the needs for the City of Whitefish. Often equipment will be pre-purchased with a separate procurement process with the final plant design then based on the specific installation requirements for the selected supplier. After equipment selection and final design, the project would be bid to obtain a General Contractor to complete site work and install the equipment. Pre-purchase equipment could include the grit removal system, the SBR equipment, aerobic digester aeration and the UV disinfection equipment.

The estimated costs for the project are $17,366,666 including costs for construction (with a 3% inflation factor for construction in 2019), engineering, administration and a 15% contingency. Annual costs for operating the entire facility are estimated to be $780,480, which roughly equates to a $440,000 cost increase over the current operational cost. Detailed cost estimates for this option are included in Appendix D.

6.2.2 Environmental Impacts

Environmental impacts associated with this alternative are expected to be positive. An environmental review of the alternative using the environmental checklist was completed and is included in **Appendix H.** Comments from agencies with environmental authority will be included in the appendix also, when received. The project will fit entirely within the constraints of the existing treatment site thereby limiting new land resource utilization. Odor potential for this system should be less than the existing lagoon system, which has had periodic odor problems. Of the three primary alternatives reviewed, the SBR option has the least power requirement and carbon footprint. Construction related impacts such as noise, dust, runoff, etc. will be controlled by specifications in the contract documents, including use of the appropriate construction permits.



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Project Title
Whitefish WWTP Alternatives

Sheet Title
Sequencing Batch Reactor with Potential Upgrades

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Of --

6.2.3 Sustainability Considerations

Greenhouse Gases - Wastewater treatment plants generate greenhouse gases in the biological treatment processes including production of N_20, CH_3 and CO_2. The relative amounts of these gasses are a function of the type of treatment process utilized and the degree of pollutant removal whereby higher removal rates generally equate to a high gas production rate. Additionally, the input of energy and chemicals as required to operate unit processes in a treatment plant add to the overall carbon footprint of the facility. Mechanical wastewater plants require relatively high amounts of energy to function and this component of the operating process will usually be the primary contributor of greenhouse gasses. Evaluations of wastewater plants have concluded that of the overall emissions from a SBR treatment plant, almost 95% of the greenhouse gas produced in the treatment process is derived from the generation of energy used to power the treatment plant unit processes.

The City of Whitefish obtains power from the Flathead Electric Coop who derives their electrical energy from the Bonneville Power Administration (BPA). BPA indicates on their website that 83% of their energy is derived from hydropower sources. The generation of electricity from hydropower has a very low carbon footprint relative to the other sources of power generation, consequently, this will reduce the carbon footprint of the Whitefish wastewater treatment plant. The use of high efficiency blowers and aeration equipment will also reduce the generation of greenhouse gases. If the City elects to land apply treated effluent or set up a modest biosolids composting operation, a reduction of greenhouse gas emissions can be anticipated.

The current Whitefish treatment system uses a significant amount of alum and polymers for the removal of phosphorous through precipitation in the flocculating clarifier. The proposed treatment facilities will utilize a biological nutrient removal process for removal of nitrogen and phosphorous, obviating the need to use chemicals. The carbon requirement for the production and delivery of chemicals will be significantly reduced with the new treatment plant. Of the three treatment alternatives evaluated, the selected SBR option utilizes the least amount of energy on an annual basis, further reducing the carbon footprint of this option.

Energy Efficiency – The design of the plant will include the consideration of high efficiency blowers and aeration devices with good oxygen transfer efficiency. The plant will be well insulated to reduce heat loss and promote optimal performance of the biological treatment processes. Good control capacity and variable speed drives are effective in effectively utilizing aeration and pumping devices without overuse. The BNR process is inherently efficient in that the generation of nitrates can provide a source of oxygen for microorganisms through denitrification, in lieu of supplemental aeration. The process of biological nutrient removal will also greatly reduce the use of alum and polymers to precipitate phosphorous from the plant flow stream. Production of these chemicals can be energy intensive.

6.3 Financial Assistance Programs and Funding Strategy

6.3.1 Local Revenues

Local revenues that support capital improvements generally come in the form of user charges associated with rates assessed for use of the water and sewer system or general funds. General funds revenues include taxes, special fees, grants, interest earnings and other sources of assistance. System reserves should be generated from user charges to replace or offset the costs of water or sewer system components, particularly equipment items with limited design life. Revenues should also be adequate to support a sound maintenance program sufficient to optimize the design life of existing capital improvements and defer the need for premature replacement. Local revenues in the form of user charges, assessments or special fees can be used to support the incurrence of debt as required to pay for capital improvements with significant cost. System development, connection or impact fees are often charged by communities for new users of an existing capital improvement. The fees are based on the proportionate share of the "general benefit" of facilities that are utilized by the new user. It should be noted that the 2005 Legislature passed SB 185 which defined criteria for assessment and use of impact fees. Impact fees cannot be used for replacement of existing structures unless portions of the replacement facilities are also required to serve new development. The legislation calls for defined procedure that must be established by the local government for assessment of impact fees.

In order to insure that local revenues are spent on the highest priority infrastructure needs, the City undertook a utility master planning effort in 2005 which concluded in 2006. The City's water, wastewater and storm water systems were evaluated and a Capital Improvements Plan was established based on the findings of the Utility Master Plan(s). The City of Whitefish engages in regular capital improvement planning for their utilities. A copy of the current Wastewater System CIP is included in **Appendix G** with the Rate Study excerpt**.**

6.3.2 Financing with Loan Funds

Although grant assistance is generally sought, very rarely does a municipality implement significant improvements to their infrastructure systems without borrowing some portion of the project costs. Most financial assistance programs require some type of local match for grant funds. Communities have three primary mechanisms by which Montana Statutes allow the incurrence of and securing of debt, with the fourth being the resort tax which is utilized by the City of Whitefish. The SRF program and a more traditional issuance of debt through the public bond markets both rely on the following methods to secure debt:

GO Bonds - This type of debt requires an election and approval by 60% or more if 30% turnout and approval by 50% or more if 40% turnout of the electorate. There is a debt limitation based on taxable value of property. This type of financing does not require a debt reserve placed on deposit or the collection of debt coverage. The rate of charges is based on taxable value of the property and all property owners would pay the tax, whether connected to the new utility or not.

Revenue Bonds - This type of debt is secured by the pledging of user charges. This type of debt generally requires the collection of coverage which means that 10-25% of the annual debt service must be collected and that one principal and interest payment must be placed in reserve. The rates and charges for revenue bonds would apply only to connected users and would be based on actual use although recent legislation allowed revenue bonds to be supported by an assessment placed upon measurable property values such as square footage. These bonds, in some cases, can be backed by the general obligation of the taxpayers (i.e. "double barreled bonds).

Special Improvement Districts - Available to cities, districts and counties, this type of financial district can be created by a local government for the purpose of building a water, sewer or road systems within the community. A specific process must be followed to create the district and the process can be stopped by a protest of 75% or more of the property owners, unless overridden by the majority of the council. All properties in the district benefited by the improvements will be assessed for costs. Portions of the assessment go into a revolving fund to act as security for the debt.

Resort Tax- The City of Whitefish is presently collecting a local option resort tax, as allowed by Montana statute. While this tax could be used to help finance water or wastewater system improvements, the local authorities have indicated that the primary use of the tax revenues will be for replacement of City streets. When replacing a City street, the project scope often includes upgrades to water, sewer or storm drain systems located beneath the roadway, as needed prior to replacement of the street surface. It is not likely that Whitefish's resort tax revenues would be utilized for the capital improvements projects anticipated in this PER.

6.3.3 Financial Assistance with Federal & State Grants or Low Interest Loans

Montana Treasure State Endowment Program - The Treasure State Endowment Program is a state-funded grant and loan program designed to assist cities, districts, and counties in financing wastewater systems, drinking water systems, sanitary or storm sewer systems, solid waste disposal and separation systems, and bridges. The MDOC has estimated between $3M and $17M dollars will be available for public facility projects in 2017, depending upon the legislative budgetary process. Individual grant amounts from this program are capped at $750,000 and generally require a 50% match. Projects submitted for assistance by this program would be due in May of 2016 and require legislative approval, the earliest coming in spring of 2009. Grant funds would not be available until July of 2017 **at the earliest.** The City of Whitefish is preparing to submit a TSEP application in May 2016 for this project.

DNRC Water Development Grant and Loan Program - This grant and loan program is administered by the Montana Department of Natural Resources and Conservation. The DNRC grants are limited to $125,000. Projects that conserve or reuse natural resources or promote the sound use of water tend to do well in competing for these grant funds. Applications to this program will not be received until May of 2016, on the same schedule as TSEP grants. The City of Whitefish is preparing to submit a DNRC application on that schedule.

USDA Rural Development Program (RD) -The RD loan and grant program is administered by the Rural Utilities Services of the US Department of Agriculture, formerly known as the Farmers Home Administration (FmHA). RD has grants and loans available with the mixture of the two dependent on the community's residential income and target user rates. Loan terms for as much as 40 years are possible. Water and sewer systems in smaller communities often are funded with financial assistance from this program. At this point, the City of Whitefish has contacted the RD program and has received an initial determination that the project would be eligible for financial assistance, primarily in the form of loan funding. The population size of Whitefish reduces the benefit available from the RD program, which focuses on small communities.

Montana Wastewater and Drinking Water State Revolving Loan Programs - These funding sources can provide low interest loans generally below market rates. Effectively the reduced interest cost equates to a grant component in a combined funding package. Loan rates are as low as 2.5% for needy communities and terms can be as long as 30 years for qualifying "hardship" communities. These two programs can loan money for drinking water and wastewater improvement projects. Other types of water pollution control projects have been funded with the wastewater SRF program. For high cost projects in needy communities, the SRF program can forgive principal on some loans, essentially equating to a grant. Forgiven principal can be in an amount up to $500,000.

CDBG (Community Development Block Grant Program) -This grant program is administered by the Montana Department of Commerce. All CDBG applications must document that at least 51 percent of the non-administrative funds requested for a CDBG project are clearly designed to meet the needs for low and moderate-income families. The CDBG program estimates that they will have $3.0 to $3.4 million available in 2016 for public facility projects with a maximum of $500,000 per project. Having a high percentage of low and moderate-income people in the community and the presence of a high potential health threat helps a community compete for a CDBG grant. Good local involvement in the planning process also helps grant competitiveness. Applications are made to this program on an annual basis. Planning grants for engineering and grant preparation expenses are also available from the CDBG Program. The City of Whitefish does not anticipate submitting a CDBG application due to candidacy concerns.

Intercap Loan Program - The Montana Board of Investments of the MDOC administers this loan program which is available to communities for paying for capital improvements. The INTERCAP Program is a low cost, variable-rate program that lends money to Montana local governments, state agencies and the university system for the purpose of financing or refinancing the acquisition and installation of equipment or personal and real property and infrastructure improvements. The Board of Investments issues tax-exempt bonds and loans the proceeds to eligible borrowers. In addition to long-term financing, INTERCAP is an excellent source for interim financing. The loan term is up to 10 years or the useful life of the project. The funding is always available and is not subject to a funding cycle. Maximum loan amount per project depends on the borrower's legal debt authority. The City may utilize INTERCAP funds in the event that TSEP and/or DNRC funds are received in order to expedite design on the wastewater improvements under this Facilities Plan. Project Eligibility includes the following:

Real property improvements
New and used equipment of all kinds
New and used vehicles of all kinds
Water, wastewater, and solid waste projects
Preliminary engineering and grant writing work
Interim financing for construction or cash-flow loans
Energy retrofit projects
100% financing acceptable, equity or matching money not required

6.3.4 Funding Strategy and User Costs

A project budget strategy has been prepared which anticipates grant funding from the TSEP and DNRC programs matched by a SRF loan, including forgiving principal of the loan in the amount of $500,000. An alternative or supplement to the SRF loan is being investigated utilizing a Rural Development Loan and Grant combination. Whitefish, primarily due to its population is eligible for RD funding but is not a good candidate for the limited funds. Initial project planning is proceeding without an assumption of obtaining an RD grant. **Table 6.1** provides the project budget using the identified funding program sources, amounts applied for and the ultimate user rate impacts based on an “Equivalent Dwelling Unit” calculation. If grants are obtained for the amounts listed, the average residential wastewater user rate will increase an estimated $19.33 for debt and $7.53 for O&M cost above the current charges. It should be noted that the **construction costs** in the proposed project were inflated by a 3% annual inflationary increase for a three year period to reflect anticipated costs increases in the construction industry.

Project Phasing – Project phasing may be necessary due to the high cost of the project, limited grant assistance and the associated high user costs. However the compliance schedule with the regulatory agency requires compliance by 2021. It may be appropriate to phase components of the plant that could be deferred without impacting compliance with the mandated schedule. Items that could be deferred include construction of the Disinfection/Administration building and the upgrading of the raw sewage lift pumps. This work is estimated to cost about $2,062,000 and could be deferred until additional TSEP or DNRC grant funding became available in a future grant cycle where application is made in 2018 with funds available in 2019.

Table 6.1 PROJECT BUDGET

Preliminary Project Budget	Whitefish 2016 Wastewater System Improvements				May 3, 2016
Administrative/ Finance Costs	**Source: RRGL**	**Source: TSEP**	**SRF**	**SRF Forgiven Principal**	**Total:**
Professional Services- Project/Grant Administration	$5,000	$15,000	$48,000		$68,000
Legal Costs			$70,000		$70,000
Audit Fees					
Travel & Training			$5,000		$5,000
Loan Reserves			$520,000		$520,000
Interim Interest					
Bond Counsel & Related costs			$50,000		$50,000
ADMIN/FINANCE COSTS:	**$5,000**	**$15,000**	**$693,000**	**$0**	**$713,000**
Prel. Engineer (Geotech)			$35,000		$35,000
Engineering/Arch. Design		$485,000	$510,000		$995,000
Construction Engr. Services			$1,040,200		$1,040,200
Construction	$120,000	$250,000	$11,783,466	$500,000	$12,653,466
Contingency			$1,930,000		$1,930,000
ACTIVITY COSTS	**$120,000**	**$735,000**	**$15,298,666**	**$500,000**	**$16,653,666**
TOTAL PROJECT COSTS	**$125,000**	**$750,000**	**$15,991,666**	**$500,000**	**$17,366,666**
Completed by: Scott Anderson					
Construction Cost increased by 3.0% inflation, 3 years					

Determination of Estimated Debt Monthly Cost			
Estimated Loan Amount		$15,991,666	
CRF 2.5% Interest, 20 year term		0.0641	
# EDUs		4862	
EUAC		$1,025,066	
EUAC w 10% Coverage		$1,127,572	
Monthly Cost		$93,964.36	
Monthly Cost per EDU		$19.33	

6.3.5 Short-lived Assets

Project funding agencies are asking that potential grantees and loan recipients develop reserve/replacement funds to address equipment that has a limited life and would require replacement through a means other than long-term capital financing. The specific item, design life and replacement cost should be identified to determine annual cost to collect to fund the replacement of the asset. The following table was developed for the new components proposed under this project and do not include existing equipment. Annual cost is the cost total divided by the anticipated design life.

Table 6.2
WHITEFISH WASTEWATER SYSTEM
SCHEDULE OF SHORT LIVED ASSETS
Budget-15 year Period

Period	Annual Contribution
1 - 5 Years	$2,080.00
5 - 10 Years	$9,100.00
10 - 15 Years	$7,200.00
Total Annual Contribution	**$18,400.00**

1 to 5 Years	Total Contributions
UV Lamps	$10,400.00
Total	**$10,400.00**
6-10 Years	
Diffuser Replacement with Rings	$21,000.00
Blowers	$50,000.00
Instrumentation	$20,000.00
Total	**$91,000.00**
11-15 Years	
Grit Pumps	$20,000.00
Chemical Feed	$20,000.00
SBR Pumping	$30,000.00
SBR Mixers	$18,000.00
Control Upgrade	$20,000.00
Total	**$108,000.00**

6.3.6 Affordability Analysis

According to the 2010 Census data, the City of Whitefish has a Median Household Income (MHI) of $ 43,117 with 40.98% considered “low to moderate” income, and a 17.3% poverty rate. Using the “Target Rate” concept used by the funding agencies, the current procedure would use a multiplier of 2.3% x MHI to determine what is considered to be a target combined water/sewer rate.

For Whitefish, the combined water/sewer target rate would be calculated as follows:

$43,117 x 0.023 ÷ 12 months = **$82.64/month**

Current average combined monthly water rates in Whitefish are $90.10, which is in excess of the target water/sewer rate. Estimated increase for the proposed project will equate to a $25 to $30/month per EDU, depending on the loan term and grant amount. It is estimated that the final water and sewer cost, when the project is complete, will be 153% of the target rate.

This affordability analysis indicates that increased costs, even with grants and low interest loans, are high and will impose a financial burden on wastewater system users in the City. Those families with incomes below the median household income, especially those with poverty status, will be particularly stressed by the increase costs. The availability of low income housing has been demonstrated to be a significant problem in Whitefish and the raising of sewer rates will undoubtedly impact rental property and resultant rental rates, further affecting the affordability of housing.

6.4 Implementation Schedule

The following schedule provides an achievable timeline for implementation of the needed wastewater improvements, presuming that affordable project financing can be obtained. This schedule is required to be met as per a regulatory action issued by the DEQ.

Task	Date of Completion
Complete Facilities Planning (PER)	Oct 1 2016
Submit Design Plans to DEQ	February 1 2018
Construction Completion	May 1 2021
Achieve Compliance	Nov 1 2021
Annual Progress Reports	January 2016-2021

6.5 Public Participation

A project meeting was held with the City staff to discuss the project on September 23, 2015. A Whitefish Council work session, with the inclusion of the public, was held November 16, 2015 to discuss the planning process and potential treatment options. A public hearing was held April 18, 2016 to further discuss the project and associated environmental impacts identified through the public review. Notice of the hearing was included in the local paper. A copy of the slides presented at the City Wastewater Workshop and the Wastewater System Public Hearing are included in **Appendix I**. A final decision regarding approval of the environmental Assessment was made by City Council on May 2, 2016. An additional public meeting was held August 29, 2016 to allow for further discussion and exchange of information regarding the proposed new wastewater treatment facilities recommended in the draft Preliminary Engineering Report

(PER) prepared for the City of Whitefish.

The City also participates with the Whitefish Community Wastewater Committee which discusses local wastewater issues pertaining primarily to Whitefish Lake. This discussion often incorporates comments regarding the City's wastewater treatment and collection system, system needs and regulatory requirements. The City has also supported the Whitefish Lake Institute including recent completion of the Whitefish Lake Watershed Restoration Plan, sponsored by the City with financial assistance from the DNRC-RRGL grant program. This study allowed for additional public input into wastewater issues in the community.

Council Approval of PER – On October 3, 2016 the City Public Works Director Craig Workman, P.E., made a presentation to the City Council on the Wastewater PER. The City passed a motion unanimously to accept the PER and authorize submission of the report to the Montana DEQ. The presentation made to the Council and the minutes documenting the acceptance of the document are included in **Appendix I**.

APPENDIX A

MPDES DISCHARGE PERMIT

Major Lagoon
Permit No.: MT0020184

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

AUTHORIZATION TO DISCHARGE UNDER THE MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with Montana Water Quality Act, Title 75, Chapter 5, Montana Code Annotated (MCA) and the Federal Water Pollution Control Act (the "Clean Water Act"), 33 U.S.C. § 1251 *et seq.*,

City of Whitefish

is authorized to discharge from its **domestic wastewater treatment plant**

located at **300 Monegan Road in Whitefish, MT,**

to receiving waters named, **Whitefish River,**

in accordance with discharge point(s), effluent limitations, monitoring requirements and other conditions set forth herein. Authorization for discharge is limited to those outfalls specifically listed in the permit.

This permit shall become effective: **August 1, 2015.**

This permit and the authorization to discharge shall expire at midnight, **July 31, 2020.**

FOR THE MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

Jon Kenning, Chief
Water Protection Bureau
Permitting & Compliance Division

Issuance Date: June 9, 2015

MPDES500

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I. EFFLUENT LIMITATIONS, MONITORING REQUIREMENTS & OTHER CONDITIONS

A. Description of Discharge Points and Mixing Zone

The authorization to discharge provided under this permit is limited to those outfalls specially designated below as discharge locations. Discharges at any location not authorized under an MPDES permit is a violation of the Montana Water Quality Act and could subject the person(s) responsible for such discharge to penalties under the Act. Knowingly discharging from an unauthorized location or failing to report an unauthorized discharge within a reasonable time from first learning of an unauthorized discharge could subject such person to criminal penalties as provided under Section 75-5-632 of the Montana Water Quality Act.

Outfall	Description
001	**Location:** A diffuser discharging into Whitefish River, located at 48.39194 N latitude, -114.32991 W longitude. **Mixing Zone:** The maximum extent of the chronic and acute mixing zones in the named receiving waters are: 100 feet downstream and 50 feet in width for the following parameters: ammonia, nitrate-nitrite, total nitrogen, total phosphorus, total residual chlorine (TRC), and metals. **Treatment Works**: Major aerated lagoon with mechanical phosphorus removal and disinfection through chlorination. 1.8 million gallons per day (mgd) average daily design flow.

B. Effluent Limitations

Outfall 001

Effective immediately and lasting through the term of the permit, the quality of effluent discharged by the facility shall, as a minimum, meet the limitations as set forth below:

Outfall 001 Effluent Limits [1]				
Parameter	Units	Average Monthly Limit	Average Weekly Limit	Maximum Daily Limit
5-Day Biochemical Oxygen Demand (BOD_5)	mg/L	30	45	--
	lb/day	313	676	--
	% Removal	85%	--	--
Total Suspended Solids (TSS)	mg/L	30	45	--
	lb/day	313	676	--
	% Removal	85%	--	--
pH	su	6.0 – 9.0		
E. coli Bacteria – summer [2, 3]	cfu/100 mL	126	--	252
E. coli Bacteria – winter [2, 3]	cfu/100 mL	630	--	1260
Total Residual Chlorine [4]	mg/L	0.011	--	0.019
Ammonia, Total as N	mg/L	9.6	--	17.7
Total Nitrogen (TN) – summer [5,6]	lb/day	176	--	
TN – non-summer [5,6]	lb/day	273		
Total Phosphorus (TP) – year-round	mg/L	1.0		
	lb/day	10.4		
Aluminum, dissolved [7]	µg/L	113	--	325

Footnotes: NA means not applicable.

(1) See Definition section at end of permit for explanation of terms.
(2) *Escherichia coli (E. coli)* - winter is November 1 through March 31; summer is April 1 through October 31.
(3) Report geometric mean if more than one sample is collected during the reporting period.
(4) Analytical results less than 0.1 mg/L will be considered in compliance with the chlorine limit.
(5) Total Nitrogen (TN) calculated as the sum of Nitrate + Nitrite as N and Total Kjeldahl Nitrogen concentrations.
(6) Nutrient summer limits effective July 1st – September 30th, non-summer limits effective year round other than this timeframe.
(7) Dissolved aluminum effluent limits take effect **July 1, 2017.**

There shall be no chronic toxicity in the effluent.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

C. Monitoring Requirements

Outfall 001

As a minimum, upon the effective date of this permit, the following constituents shall be monitored at the frequency and with the type of measurement indicated; samples or measurements shall be representative of the volume and nature of the monitored discharge. If no discharge occurs during the entire monitoring period, it shall be stated on the Discharge Monitoring Report Form (EPA No. 3320-1) that no discharge or overflow occurred.

Monitoring Requirements (1)

Parameter	Unit	Sample Location	Sample Frequency	Sample Type
Flow	mgd	Effluent	Continuous	Instantaneous (2)
5-Day Biochemical Oxygen Demand (BOD_5)	mg/L	Influent (3)	1/Week	Composite
	mg/L	Effluent	2/Week	Composite
	lb/day	Effluent	1/Month	Calculated
	% Removal	Effluent	1/Month	Calculated
Total Suspended Solids (TSS)	mg/L	Influent (3)	1/Week	Composite
	mg/L	Effluent	2/Week	Composite
	lb/day	Effluent	1/Month	Calculated
	% Removal	Effluent	1/Month	Calculated
pH	s.u.	Effluent	2/Week	Instantaneous
Temperature – summer (4)	°F	Effluent	Continuous	Instantaneous
		Upstream	Continuous	Instantaneous
E. coli Bacteria	cfu/100 mL	Effluent	2/Week	Grab
Total Residual Chlorine (5)	mg/L	Effluent	Daily	Grab
Total Ammonia as N	mg/L	Effluent	1/Week	Composite
Nitrate + Nitrite as N	mg/L	Effluent	1/Week	Composite
Total Kjeldahl Nitrogen	mg/L	Effluent	1/Week	Composite
Total Nitrogen as N (6)	mg/L	Effluent	1/Week	Calculated
	lb/day	Effluent	1/Month	Calculated
Total Phosphorus as P	mg/L	Effluent	1/Week	Composite
	lb/day	Effluent	1/Month	Calculated
Dissolved Aluminum	µg/L	Effluent	1/Week	Composite
Dissolved Oxygen	mg/L	Effluent	1/Month	Grab
Oil & Grease (7)	mg/L	Effluent	Semi-annual	Grab
Whole Effluent Toxicity, Chronic	% Effluent	Effluent	1/Quarter (8)	Composite

Footnotes:
(1) See Definitions section at end of permit for explanation of terms.
(2) Requires recording device or totalizer; permittee shall report daily maximum and daily average flow on DMR.
(3) Influent BOD_5 and TSS samples shall be collected only if effluent discharge occurs in the monitoring period.
(4) Temperature monitoring by continuous data logger is required during the summer period of July 1 – September 30th.
(5) The permittee is only required to sample for total residual chlorine if chlorine is used as a disinfectant in the treatment process. If chlorine is *not* used, write "NA" on the DMR for this parameter.
(6) Calculated as the sum of Nitrate + Nitrite as N and Total Kjeldahl Nitrogen concentrations.
(7) Use EPA Method 1664, Revision A: N-Hexane Extractable Material (HEM), or equivalent.
(8) WET Testing may be reduced to two species semi-annually (twice per year) after Whitefish passes eight quarters of WET tests.

All analytical procedures must comply with the specifications of 40 CFR Part 136 and the analyses must meet any Required Reporting Values (RRVs) listed in Circular DEQ-7 unless otherwise specified. Samples shall be collected, preserved and analyzed in accordance with approved procedures listed in 40 CFR Part 136.

Reporting Requirements

Load Calculations

Effluent limitations or monitoring requirements that are expressed in terms of load (lb/day), must be based on total mass of the discharge in accordance with the definition of daily discharge in Part V of this permit. If the permit specifies that the effluent flow rate be monitored on a continuous basis, the total mass shall be calculated using the following equations:

$$\text{Load (lb/day)} = \text{Daily Discharge (mg/L)} \times \text{Daily Flow (MGD)} \times 8.34$$

If the permit specifies that the effluent flow rate be measured on an instantaneous basis, the total mass shall be estimated using the following equation:

$$\text{Load (lb/day)} = \text{Daily Discharge (mg/L)} \times \text{Daily Flow (GPM)} \times 0.012$$

The daily flow used to calculate the load must be measured in the same calendar day or 24-hour period in which the effluent sample is collected for either method.

Percent (%) Removal

The percent removal shall be calculated using the following formula:

$$\%\ \text{Removal} = \frac{[\textit{Influent Concentration}]-[\textit{Effluent Concentration}]}{[\textit{Influent Concentration}]} \times 100\%$$

Where:

Influent Concentration = Corresponding 30-day average influent concentration based on the analytical results of the reporting period.

Effluent Concentration = Corresponding 30-day average effluent concentration based on the analytical results of the reporting period.

Composite Samples

Composite samples shall, as a minimum, be composed of four or more discrete aliquots (samples) of equal volume and time collected in a 24 hour period. The aliquots shall be combined in a single container for analysis (simple composite). The time between the collection of the first sample and the last sample shall not be less than six (6) hours nor more than 24 hours.

Whole Effluent Toxicity Testing – Chronic Toxicity

Starting in the first calendar quarter following the effective date of the permit, the permittee shall, at least once each calendar quarter, conduct a chronic static renewal toxicity test on a composite sample of the effluent. Testing will employ two species per quarter and will consist of 5 effluent concentrations (3, 6, 12, 56, and 100 percent effluent) and a control. Dilution water and the control shall consist of the receiving water and must be collected upstream of the discharge. A minimum of three effluent samples are required for chronic toxicity tests. These samples must be collected on days 1, 3, and 5, and be shipped to the testing laboratory. The first sample is used for test initiation and for renewal on test day 2. The second sample is used for test renewal on test days 3 and 4. The third sample is used for renewal on test days 5, 6, and 7.

The static renewal toxicity tests shall be conducted in general accordance with the procedures set out in the latest revision of Short Term Methods for Estimating the Chronic Toxicity of Effluent and Receiving Waters to Freshwater Organisms, EPA-821-R-02-013 (October 2002) and the "Region VIII NPDES Whole Effluent Toxics Control Program, August 1997." The permittee shall conduct a three-brood (seven day) survival and reproduction static renewal toxicity test using Ceriodaphnia dubia (test method 1002.0) and a seven day growth and survival static renewal toxicity test using Pimephales promelas (test method 1000.0). The control of pH in the toxicity test utilizing CO_2 enriched atmospheres is allowed to prevent rising pH drift. The target pH selected must represent the pH value of the receiving water at the time of sample collection. The use of CO_2 to control pH drift must be in accordance with the requirements of sections 12.3.5, 12.3.5.1 through 4, and 12.3.5.2, and all other test requirements, in the chronic methods manual (EPA-821-R-02-013).

Chronic toxicity occurs when the inhibition concentration to 25% of the test population (IC_{25}) is less than or equal to the 12% effluent concentration. Control survival and growth or reproduction must meet the requirements specified in the method.

If chronic toxicity occurs in a routine test, an additional test shall be conducted within 14 days of the date of the initial sample. Should chronic toxicity occur in the second test, testing shall occur once a month until further notified by the Department and a TIE-TRE shall be initiated as required in Part I.D.2. In all cases, the results of all toxicity tests must be submitted to the Department in accordance with Part II of this permit.

The quarterly results from the laboratory shall be reported along with the Discharge Monitoring Report (DMR) form submitted for the end of the reporting calendar quarter (e.g., whole effluent results for the reporting quarter ending March 31 shall be reported with the March DMR due April 28th with the remaining quarterly reports submitted with the June, September, and December DMR's). The format for the laboratory report shall be consistent with the latest revision of Region VIII Guidance for Whole Effluent Reporting, and shall include all chemical and physical data as specified.

If the results for eight consecutive quarters of testing indicate no toxicity, the permittee may request a reduction to semi-annual (twice per year) chronic toxicity testing on two species. The Department may approve or deny the request based on the results and other available information without an additional public notice. If the request is approved, the test procedures are to be the same as specified above. One semi-annual test must be conducted in the second calendar quarter and one in the fourth quarter, each year.

D. Special Conditions

1. Toxicity Identification Evaluation (TIE) / Toxicity Reduction Evaluation (TRE):

Should toxicity be detected in the required WET resample, a TIE/TRE shall be undertaken by the Permittee to establish the cause of the toxicity, locate the source(s) of the toxicity, and develop control or treatment for the toxicity. Failure to initiate or conduct an adequate TIE/TRE, or delays in the conduct of such tests, shall not be considered a justification for noncompliance with any whole effluent toxicity limitations contained in Part I.B of this permit. A TRE plan shall be submitted to the Department within 45 days after confirmation of the continuance of effluent toxicity (resample).

2. Effluent Diffuser Maintenance

Whitefish will develop a periodic maintenance program to ensure that the effluent diffuser is operating as designed. A summary of the program and its implementation during this permit cycle will be submitted 180 days prior to the expiration date of this permit renewal.

3. Infiltration/Inflow

The City of Whitefish shall summarize the influences from infiltration/inflow (I/I) to their treatment works. The summary shall provide an estimate of the amount and sources of I/I into the collection system and a summary of work accomplished and additional work planned to reduce this I/I. A summary of the program shall be submitted 180 days prior to the expiration date of this permit renewal.

4. Nutrient Variance – Facility Optimization Study

The permittee must complete a Facility Optimization Study and Nutrient Reduction Analysis. The Study must include an analysis of nutrient trading feasibility within the watershed. Written notification indicating completion and availability of the Study results must be submitted to the Department as described in Part I.F. of this permit.

5. Dissolved Aluminum

Whitefish shall meet the dissolved aluminum effluent limits by July 1, 2017. Whitefish shall submit an annual summary of what actions have been taken and what are planned to be taken by no later than January 28th of each year until July 1, 2017.

6. Sewage Sludge:

The use or disposal of sewage sludge must be in conformance with 40 CFR 503.

E. Pretreatment Requirements

1. The Permittee shall not allow any user to introduce into a POTW any pollutants which cause Pass Through or Interference. These general prohibitions and the specific prohibitions in Part I.E.2 of this rule apply to all non-domestic sources introducing pollutants into a POTW whether or not the source is subject to other national pretreatment standards or any national, state or local pretreatment requirements.

2. In addition, the following pollutants may not be introduced into a POTW:

   a. Pollutants which create a fire or explosion hazard in the POTW, including waste streams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Celsius using the test methods specified in 40 CFR 261.21;

   b. Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, unless the works is specifically designed to accommodate such discharges;

   c. Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW resulting in interference;

   d. Any pollutant, including oxygen-demanding pollutants (BOD, etc.), released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the POTW;

   e. Heat in amounts which will inhibit biological activity in the POTW resulting in interference, but in no case heat in such quantities that the temperature at the POTW treatment plant exceeds 40 degrees Celsius (104 degrees Fahrenheit) unless the department, upon request of the POTW, approves alternative temperature limits;

   f. Petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause Interference or Pass Through;

g. Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems; and

h. Any trucked or hauled pollutants, except at discharge points designated by the POTW.

3. Publicly Owned Treatment Works. All POTWs must provide adequate notice to the Department of the following:

a. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to federal effluent guidelines and standards [40CFR Subchapter N] if it were directly discharging those pollutants; and

b. Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

c. For the purposes of this paragraph, adequate notice shall include information on:

1) the quality and quantity of effluent introduced into the POTW, and

2) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

F. Compliance Schedule

The actions listed below must be completed on or before the respective scheduled completion dates. The completion of all actions or deliverables must be reported to the Department at the address listed in Part II.D. of the permit and in accordance with the signatory requirements of Part IV.G. of the permit.

Compliance Schedule

Action	Frequency	Scheduled Completion Date of Action[(1)]	Report Due Date[(2)]
Complete a Facility Optimization Study and Nutrient Reduction Analysis	Single Event	August 1, 2017	NA
Submit Notification that the Facility Optimization Study and Nutrient Reduction Analysis is Complete	Single Event	August 1, 2017	August 28, 2017

Footnotes: NA = Not Applicable
(1) The actions must be completed on or before the scheduled completion dates.
(2) This notification must be received by the Department on or before the scheduled due date.

II. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling

Samples taken in compliance with the monitoring requirements established under Part I of the permit shall be collected from the effluent stream prior to discharge into the receiving waters. Samples and measurements shall be representative of the volume and nature of the monitored discharge. Sludge samples shall be collected at a location representative of the quality of sludge immediately prior to use-disposal practice.

B. Monitoring Procedures

Monitoring must be conducted according to test procedures approved under Part 136, Title 40 of the Code of Federal Regulations, unless other test procedures have been specified in this permit. See Part I.C of this permit for any applicable sludge monitoring procedures. All flow-measuring and flow-recording devices used in obtaining data submitted in self-monitoring reports must indicate values within 10 percent of the actual flow being measured.

C. Penalties for Tampering

The Montana Water Quality Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $25,000, or by imprisonment for not more than six months, or by both.

D. Reporting of Monitoring Results

Monitoring results must be reported on a Discharge Monitoring Report (DMR) EPA form 3320-1. Monitoring results must be submitted in either electronic or paper format and be postmarked no later than the 28th day of the month following the end of the monitoring period. Whole effluent toxicity (biomonitoring) results must be reported with copies of the laboratory analysis report on forms from the most recent version of EPA Region VIII's "Guidance for Whole Effluent Reporting". If no discharge occurs during the reporting period, "no discharge" must be reported on the report form. Legible copies of these, and all other reports required herein, must be signed and certified in accordance with Part IV.G 'Signatory Requirements' of this permit and submitted to DEQ at the following address:

Montana Department of Environmental Quality
Water Protection Bureau
PO Box 200901
Helena, Montana 59620-0901
Phone: (406) 444-3080

E. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of the permit must be submitted to DEQ in either electronic or paper format and be postmarked no later than 14 days following each schedule date unless otherwise specified in the permit.

F. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using approved analytical methods as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report. Such increased frequency shall also be indicated.

G. Records Contents

Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements;
2. The initials or name(s) of the individual(s) who performed the sampling or measurements;
3. The date(s) analyses were performed;
4. The time analyses were initiated;
5. The initials or name(s) of individual(s) who performed the analyses;
6. References and written procedures, when available, for the analytical techniques or methods used; and
7. The results of such analyses, including the bench sheets, instrument readouts, computer disks or tapes, etc., used to determine these results.

H. Retention of Records

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time. Data collected on site, copies of Discharge Monitoring Reports, and a copy of this MPDES permit must be maintained on site during the duration of activity at the permitted location.

I. Twenty-four Hour Notice of Noncompliance Reporting

1. The permittee shall report any serious incidents of noncompliance affecting the environment as soon as possible, but no later than twenty-four (24) hours from the time the permittee first became aware of the circumstances. The report shall be made to the Water Protection Bureau at (406) 444-3080 or the Office of Disaster and Emergency Services at (406) 324-4777. The following examples are considered serious incidents:

   a. Any noncompliance which may seriously endanger health or the environment;

   b. Any unanticipated bypass which exceeds any effluent limitation in the permit (See Part III.G of this permit, "Bypass of Treatment Facilities");

   c. Any upset which exceeds any effluent limitation in the permit (See Part III.H of this permit, "Upset Conditions").

2. A written submission shall also be provided within five days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected; and

   d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

3. The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the Water Protection Bureau, by phone, at (406) 444-3080.

4. Reports shall be submitted to the addresses in Part II.D of this permit, "Reporting of Monitoring Results".

J. Other Noncompliance Reporting

Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for Part II.D of this permit are submitted. The reports shall contain the information listed in Part II.I.2 of this permit.

K. Inspection and Entry

The permittee shall allow the head of the Department or the Director, or an authorized representative thereof, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

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

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance, any substances or parameters at any location.

III. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give the Department and the Regional Administrator advance notice of any planned changes at the permitted facility or of an activity which may result in permit noncompliance.

B. Penalties for Violations of Permit Conditions

The Montana Water Quality Act provides that any person who violates a permit condition of the Act is subject to civil or criminal penalties not to exceed $25,000 per day or one year in prison, or both, for the first conviction, and $50,000 per day of violation or by imprisonment for not more than two years, or both, for subsequent convictions. MCA 75-5-611(a) also provides for administrative penalties not to exceed $10,000 for each day of violation and up to a maximum not to exceed $100,000 for any related series of violations. Except as provided in permit conditions on Part III.G of this permit, "Bypass of Treatment Facilities" and Part III.H of this permit, "Upset Conditions", nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense

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.

D. Duty to Mitigate

The permittee 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.

E. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit. However, the permittee shall operate, as a minimum, one complete set of each main line unit treatment process whether or not this process is needed to achieve permit effluent compliance.

F. Removed Substances

Collected screenings, grit, solids, sludges, or other pollutants removed in the course of treatment shall be disposed of in such a manner so as to prevent any pollutant from entering any waters of the state or creating a health hazard. Sludge shall not be directly blended with or enter either the final plant discharge and/or waters of the United States. Any sludges removed from the facility shall be disposed of in accordance with 40 CFR 503, 258 or other applicable rule.

G. Bypass of Treatment Facilities

1. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Parts III.G.2 and III.G.3 of this permit.

2. Notice:

   a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least 60 days before the date of the bypass.

   b. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required under Part II.I of this permit, "Twenty-four Hour Reporting".

3. Prohibition of bypass:

   a. Bypass is prohibited and the Department may take enforcement action against a permittee for a bypass, unless:

      1) The 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 back-up 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; and

      3) The permittee submitted notices as required under Part III.G.2 of this permit.

   b. The Department may approve an anticipated bypass, after considering its adverse effects, if the Department determines that it will meet the three conditions listed above in Part III.G.3.a of this permit.

H. Upset Conditions

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with technology based permit effluent limitations if the requirements of Part III.H.2 of this permit 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 (i.e., Permittees will have the opportunity for a judicial determination on any claim of upset only in an enforcement action brought for noncompliance with technology-based permit effluent limitations).

2. Conditions necessary for a demonstration of 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:

   a. An upset occurred and that the permittee can identify the cause(s) of the upset;

   b. The permitted facility was at the time being properly operated;

   c. The permittee submitted notice of the upset as required under Part II.I of this permit, "Twenty-four Hour Notice of Noncompliance Reporting"; and

   d. The permittee complied with any remedial measures required under Part III.D of this permit, "Duty to Mitigate".

3. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

IV. GENERAL REQUIREMENTS

A. Planned Changes

The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

1. The alteration or addition could significantly change the nature or increase the quantity of pollutant discharged. This notification applies to pollutants which are not subject to effluent limitations in the permit; or

2. There are any planned substantial changes to the existing sewage sludge management practices of storage and disposal. The permittee shall give the Department notice of any planned changes at least 180 days prior to their implementation.

B. Anticipated Noncompliance

The permittee shall give advance notice to the Department of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

C. Permit Actions

This permit may be revoked, modified and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The application must be submitted at least 180 days before the expiration date of this permit.

E. Duty to Provide Information

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

F. Other Information

When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Department, it shall promptly submit such facts or information with a narrative explanation of the circumstances of the omission or incorrect submittal and why they weren't supplied earlier.

G. Signatory Requirements

All applications, reports or information submitted to the Department shall be signed and certified.

1. All permit applications shall be signed by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Department shall be signed by a person described above or by a duly authorized representative of that person. A person is considered a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to the Department; and

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or an individual occupying a named position.)

3. Changes to authorization. If an authorization under Part IV.G.2 of this permit is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part IV.G.2 of this permit must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section shall make the following certification:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. Penalties for Falsification of Reports

The Montana Water Quality Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more that $25,000 per violation, or by imprisonment for not more than six months per violation, or by both.

I. Availability of Reports

Except for data determined to be confidential under 40 CFR Part 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department and the EPA. As required by the Clean Water Act, permit applications, permits and effluent data shall not be considered confidential.

J. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

K. Property or Water Rights

The issuance of this permit does not convey any property or water rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

L. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

M. Transfers

This permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Department at least 30 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them;

3. The Department does not notify the existing permittee and the proposed new permittee of an intent to revoke or modify and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in Part IV.M.2 of this permit; and

4. Required annual and application fees have been paid.

N. Fees

The permittee is required to submit payment of an annual fee as set forth in ARM 17.30.201. If the permittee fails to pay the annual fee within 90 days after the due date for the payment, the Department may:

1. Impose an additional fee assessment computed at the rates established under ARM 17.30.210; and,

2. Suspend the processing of the application for a permit or authorization or, if the nonpayment involves an annual permit fee, suspend the permit, certificate or authorization for which the fee is required. The Department may lift suspension at any time up to one year after the suspension occurs if the holder has paid all outstanding fees, including all penalties, assessments and interest imposed under this sub-section. Suspensions are limited to one year, after which the permit will be terminated.

O. Reopener Provisions

This permit may be reopened and modified (following proper administrative procedures) to include the appropriate effluent limitations (and compliance schedule, if necessary), or other appropriate requirements if one or more of the following events occurs:

1. Water Quality Standards: The water quality standards of the receiving water(s) to which the permittee discharges are modified in such a manner as to require different effluent limits than contained in this permit.

2. Water Quality Standards are Exceeded: If it is found that water quality standards or trigger values in the receiving stream are exceeded either for parameters included in the permit or others, the department may modify the effluent limits or water management plan.

3. TMDL or Wasteload Allocation: TMDL requirements or a wasteload allocation is developed and approved by the Department and/or EPA for incorporation in this permit.

4. Water Quality Management Plan: A revision to the current water quality management plan is approved and adopted which calls for different effluent limitations than contained in this permit.

5. Sewage Sludge: There have been substantial changes (or such changes are planned) in sludge use or disposal practices; applicable management practices or numerical limitations for pollutants in sludge have been promulgated which are more stringent than the requirements in this permit; and/or it has been determined that the permittee's sludge use or disposal practices do not comply with existing applicable state or federal regulations.

6. Toxic Pollutants: A toxic standard or prohibition is established under Section 307(a) of the Clean Water Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit.

V. DEFINITIONS

1. **"Act"** means the Montana Water Quality Act, Title 75, chapter 5, MCA.

2. **"Administrator"** means the administrator of the United States Environmental Protection Agency.

3. **"Acute Toxicity"** occurs when 50 percent or more mortality is observed for either species (See Part I.C of this permit) at any effluent concentration. Mortality in the control must simultaneously be 10 percent or less for the effluent results to be considered valid.

4. **"Annual Average Load"** means the arithmetic mean of all 30-day or monthly average loads reported during the calendar year for a monitored parameter.

5. **"Arithmetic Mean" or "Arithmetic Average"** for any set of related values means the summation of the individual values divided by the number of individual values.

6. **"Average monthly limitation"** means the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

7. **"Average weekly limitation"** means the highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week.

8. **"BOD_5"** means the five-day measure of pollutant parameter biochemical oxygen demand.

9. **"Bypass"** means the intentional diversion of waste streams from any portion of a treatment facility.

10. **"$CBOD_5$"** means the five-day measure of pollutant parameter carbonaceous biochemical oxygen demand.

11. **"Composite samples"** means a sample composed of two or more discrete aliquots (samples). The aggregate sample will reflect the average quality of the water or wastewater in the compositing or sample period. Composite sample may be composed of constant volume aliquots collected at regular intervals (simple composite) or flow proportioned.

12. **"Daily Discharge"** means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the daily discharge is calculated as the average measurement of the pollutant over the day.

13. **"Daily Maximum Limit"** means the maximum allowable discharge of a pollutant during a calendar day. Expressed as units of mass, the daily discharge is cumulative mass discharged over the course of the day. Expressed as a concentration, it is the arithmetic average of all measurements taken that day.

14. **"Department"** means the Montana Department of Environmental Quality (MDEQ). Established by 2-15-3501, MCA.

15. **"Director"** means the Director of the Montana Department of Environmental Quality.

16. **"Discharge"** means the injection, deposit, dumping, spilling, leaking, placing, or failing to remove any pollutant so that it or any constituent thereof may enter into state waters, including ground water.

17. **"EPA"** means the United States Environmental Protection Agency.

18. **"Federal Clean Water Act"** means the federal legislation at 33 USC 1251, *et seq.*

19. **"Geometric Mean"** means the value obtained by taking the Nth root of the product of the measured values.

20. **"Grab Sample"** means a sample which is taken from a waste stream on a one-time basis without consideration of flow rate of the effluent or without consideration for time.

21. **"Indirect discharger"** means a non-domestic discharger introducing pollutants to a publicly owned treatment works.

22. **"Instantaneous Maximum Limit"** means the maximum allowable concentration of a pollutant determined from the analysis of any discrete or composite sample collected, independent of the flow rate and the duration of the sampling event.

23. **"Instantaneous Measurement"**, for monitoring requirements, means a single reading, observation, or measurement.

24. **"Interference"** means a discharge which, alone or in conjunction with other contributing discharges

    a. Inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and

    b. Therefore causes a violation of any requirement of the POTW's MPDES permit (including an increase in the magnitude or duration of a violation) or causes the prevention of sewage sludge use or disposal in compliance with the following statutes and regulations: Section 405 of the Clean Water Act; 40 CFR Part 503 - Standards for the Use and Disposal of Sewage Sludge; Resource Conservation and Recovery Act (RCRA); 40 CFR Part 258 - Criteria for Municipal Solid Waste Landfills; and/or any State regulations regarding the disposal of sewage sludge.

25. **"Maximum daily discharge limitation"** means the highest allowable daily discharge.

26. **"Minimum Level"** (ML) of quantitation means the lowest level at which the entire analytical system gives a recognizable signal and acceptable calibration point for the analyte, as determined by the procedure set forth at 40 CFR 136. In most cases the ML is equivalent to the Required Reporting Value (RRV) unless other wise specified in the permit. (ARM 17.30.702(22))

27. **"Mixing zone"** means a limited area of a surface water body or aquifer where initial dilution of a discharge takes place and where certain water quality standards may be exceeded.

28. **"Nondegradation"** means the prevention of a significant change in water quality that lowers the quality of high-quality water for one or more parameters. Also, the prohibition of any increase in discharge that exceeds the limits established under or determined from a permit or approval issued by the Department prior to April 29, 1993.

29. **"Pass through"** means a discharge which exits the POTW into waters of the State of Montana in quantities or concentrations which, alone or in conjunction with other discharges, is a cause of a violation of any requirement of the POTW's MPDES permit (including an increase in the magnitude or duration of a violation).

30. **"POTW"** means a publicly owned treatment works.

31. **"Regional Administrator"** means the administrator of Region VIII of EPA, which has jurisdiction over federal water pollution control activities in the state of Montana.

32. **"Severe property damage"** means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

33. **"Sewage Sludge"** means any solid, semi-solid or liquid residue generated during the treatment of domestic sewage and/or a combination of domestic sewage and industrial waste of a liquid nature in a treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment processes; and a material derived from sewage sludge. Sewage sludge does not include ash generated during the incineration of sewage sludge or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works.

34. **"TIE"** means a toxicity identification evaluation.

35. **"TMDL"** means the total maximum daily load limitation of a parameter, representing the estimated assimilative capacity for a water body before other designated uses are adversely affected. Mathematically, it is the sum of wasteload allocations for point sources, load allocations for non-point and natural background sources, and a margin of safety.

36. **"TRE"** means a toxicity reduction evaluation.

37. **"TSS"** means the pollutant parameter total suspended solids.

38. **"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.

DEPARTMENT OF ENVIRONMENTAL QUALITY
PERMITTING and COMPLIANCE DIVISION
MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM (MPDES)

Fact Sheet

PERMITTEE:	City of Whitefish
PERMIT NUMBER:	MT0020184
RECEIVING WATER:	Whitefish River
FACILITY INFORMATION:	
Name:	City of Whitefish Wastewater Treatment Facility
Location:	300 Monegan Road Whitefish, MT 59937 Flathead County 48°23'31"N, -114°19'41"W
Mailing Address:	P.O. Box 158 Whitefish, MT 59937-0158
Contact: Telephone: Email:	Greg Acton, Utility Operations Supervisor (406) 863-2451 gacton@cityofwhitefish.org
FEE INFORMATION:	
Number of Outfalls:	1 (for fee determination purposes)
Type of Outfall:	001 – Major POTW Aerated Lagoon followed by Mechanical Phosphorus-Removal Treatment and Chlorination/De-chlorination, no Pretreatment Program, Continuous Discharge to Surface Water

I. Permit Status

The City of Whitefish (Whitefish) Wastewater Treatment Facility (WWTF) MPDES permit became effective July 1, 2008 ('2008 Permit"). The permit was modified on March 30, 2012, to remove the requirement for an engineering report detailing how effluent ammonia limits would be achieved, in conformance with a joint settlement agreement between Whitefish and the Department of Environmental Quality (DEQ). The 2008 Permit expired at midnight, June 30, 2013.

Whitefish submitted a complete renewal application on February 15, 2013. DEQ issued a Notice of Completeness on February 21, 2013. In accordance with ARM 17.30.1313, the 2008 Permit was administratively extended.

II. Facility Information

A. Facility Description

The Whitefish WWTF serves the residents and businesses of the City of Whitefish and Big Mountain Sewer District, with a current service area population of approximately 6,922 (renewal application, 2013). Secondary treatment for the facility consists of a three-celled, aerated, bentonite-lined lagoon system built in 1979 with an average daily design flow of 1.25 million gallons per day (mgd). Whitefish has made the following major WWTF improvements over the years:

- 1979 – Aerated basin, secondary treatment average daily design flow of 1.25 mgd with peak design flow of 2.6 mgd [Whitefish O&M Manual, Morrison-Maierle, Inc., February 1981].
- 1988 – WWTF system secondary treatment remains at average daily design flow of 1.25 mgd. Tertiary treatment added (a phosphorus removal clarifier designed for average daily design flow of 1.25 mgd) with aluminum flocculant dosed at 185 mg/L [O&M Manual – Whitefish Phosphorus Removal Facility, Carver Engineering, Inc. October 1988].
- 2003 – Upgraded lift stations and lagoon aeration (included the addition of a baffle to divide cell 1 into cells 1A and 1B). Secondary treatment average daily design flow increased to 1.8 mgd [Whitefish Wastewater Facility Improvements O&M Manual, Anderson-Montgomery, September 2003].
- 2009 – Tertiary treatment upgraded (second flocculating clarifier added to increase the facility's phosphorus treatment capacity to 2.33 mgd) with aluminum flocculant dosed at 250 mg/L. WWTF system remains limited to secondary treatment average daily design flow of 1.8 mgd. [Whitefish Wastewater Treatment Plants Improvements 2008 – 2009 O&M Manual, Anderson-Montgomery].
- 2011 – Added chlorine disinfection /de-chlorination.

The effluent is continuously discharged to the Whitefish River at Outfall 001. The effluent pipe is equipped with a ductile iron, multi-port diffuser (15 ports on alternate sides with one foot centers) that extends 18 feet (approximately 2/3) across the river bed.

Solids are removed from the phosphorus removal clarifier on a monthly basis and stored in a constructed sludge drying bed. Whitefish was previously covered by EPA Region VIII Permit Number MTG650000, *General Permit for Facilities/Operations that Generate, Treat, and/or Use/Dispose of Sewage Sludge by Means of Land Application, Landfill, and Surface Disposal Under the National Pollutant Discharge Elimination System*. However, EPA did not renew the Biosolids General Permit, opting for direct enforceability of the rule. The use or disposal of biosolids generated by the Whitefish WWTF is required to meet the applicable requirements of 40 Code of Federal Regulations (CFR) Part 503 *Standards of the Use or Disposal of Sewage Sludge*.

Table 1 is a summary of the City of Whitefish WWTF design criteria from the Morrison-Maierle, Inc. 1981 *O&M Manual*; and Anderson/Montgomery Consulting Engineers *Wastewater Treatment Plant Improvements 2008 – 2009 O&M Manual*.

Table 1. Current Design Criteria Summary – Whitefish WWTP

Facility Description: Continuous discharge lagoon facility with three aerated cells, two phosphorus removal clarifiers, and chlorination/de-chlorination disinfection.	
Construction Date: 1979	Modification Dates: 1987, 2003, 2009, 2011
1979 Design Population: 10,000	2013 Population Served: 6,922
Design Flow, Average (mgd): 1.8	Design Flow, Peak (mgd): 2.6
Design BOD Removal (%): 85	Design BOD Load (lb/day): 3,880
Design SS Removal (%): 85	Design TSS Load (lb/day): 3,328
Design TN Removal (%): NA	Design TN Load (lb/day): NA
Design TP Removal (%): 90	Design TP Load (lb/day): 116
Collection System: Combined [ ] Separate [X]	
SSO Events (Y/N): Y	Number: 5 (between 2010 – 2012)
Bypass Events(Y/N): N	Number: NA
Inflow and Infiltration contribution (mgd): 0.28 mgd (application)	Source: storm water, subdivision hook ups, sump pumps, failing lift stations and sewer lines, shore line sewer pipes below the level of the lake.
Disinfection: Yes	Type: Chlorination/De-chlorination
Discharge Method: Continuous	
Effluent Flow Primary Device: Parshall flume	
Effluent Secondary Flow Device: Magmeter with totalizer	
Sludge Storage: Physical (alum) sludge stored in phase isolation basin. Disposed by land application.	

The collection system was built as a combined sewer; however, separation of the combined sewers was undertaken by the City in the late 1990's and the system is now considered a separate sanitary sewer system.

Inflow and Infiltration (I/I) flows are reported on the updated application to be 0.28 mgd. Whitefish reported that they lined/replaced 17,845 feet of sewer lines and two leaking lift station wet wells on the 2013 renewal application.

B. Effluent Characteristics

A summary of the City of Whitefish effluent data from the facility Discharge Monitoring Reports (DMRs) for the Period of Record (POR) of January 1, 2011, through November 30, 2014, are summarized in Table 2.

Table 2: Effluent Characteristics for Outfall 001: January 1, 2011 through November 30, 2014

Parameter	Location	Units	Previous Permit Limit	Min. 30-Day	Avg. 30-Day	Max. 30-Day	No. of Samples (1)
Flow, Monthly Average	Effluent	mgd	NA (2)	0.62	1.0	2.1	47
Biochemical Oxygen Demand (BOD_5)	Influent	mg/L	NA (2)	125	278	482	47
	Effluent	mg/L	45/30 (3)	3	8	15	47
	NA	% removal	85	93	97	99	47
	Effluent	lb/day	382/255 (3)	19	69	177	47
Total Suspended Solids (TSS)	Influent	mg/L	NA (2)	101	231	543	47
	Effluent	mg/L	45/30 (3)	4	12	46	47
	NA	% removal	85	74	94	98	47
	Effluent	lb/day	469/313 (3)	25	108	500	47
pH	Effluent	s.u.	6.0 to 9.0	6.2	--	7.6	47
E. coli Bacteria – winter (4,5)	Effluent	cfu/100 mL	1260/630 (3)	1	48	218	16
E. coli Bacteria – summer (4,5)	Effluent	cfu/100 mL	252/126 (3)	2	13	65	25
Total Residual Chlorine (5)	Effluent	mg/L	0.019/0.011 (3)	<0.005	--	0.01	41
Total Ammonia as N	Effluent	mg/L	NA (2)	0.2	16.3	30.3	47
Nitrate + Nitrite as N	Effluent	mg/L	NA (2)	0.1	4.8	24.7	47
Total Kjeldahl Nitrogen (TKN)	Effluent	mg/L	NA (2)	2.2	18.6	32.7	47
Total Nitrogen as N (6)	Effluent	mg/L	NA (2)	13	23	33	47
		lb/day	426/273 (3)	87	184	301	41
Total Phosphorus as P	Effluent	mg/L	1.0	0.2	0.5	1.7	47
		lb/day	10.4	1.6	4.5	18	47
Temperature	Effluent	°C	NA (2)	0.1	10.8	23.2	47
Dissolved Oxygen	Effluent	mg/L	NA (2)	2.2	6.8	13.3	47
Oil and Grease	Effluent	mg/L	10	<1	--	2	46
Aluminum, Dissolved	Effluent	µg/L	NA (2)	20	164	1160	40
Copper, Total Recoverable	Effluent	µg/L	NA (2,7)	<0.01	9	15	4
Lead, Total Recoverable	Effluent	µg/L	NA (2,7)	<0.01	--	1.0	5
Total Dissolved Solids	Effluent	mg/L	NA (2)	385	437	550	15

Footnotes: NA means not available/not applicable
(1) No. of samples is the number of monthly DMRs submitted; there may be numerous readings during the month. Values provided are monthly averages.
(2) No effluent limit in previous permit, monitoring requirement only.
(3) Either max daily or average weekly / average monthly.
(4) *Escherichia coli (E. coli)* bacteria - winter period November 1 through March 31, summer period April 1 through October 31.
(5) Period of record began July 1, 2011.
(6) Calculated as the sum of TKN and Nitrite + Nitrate as N concentrations.
(7) Total recoverable copper and lead monitoring required semi-annually in 2010 & 2011.

C. Compliance History

In the previous fact sheet, DEQ discussed that the diffuser had not been maintained and plugging caused all of the discharge to exit at the end of the pipe (2008 Permit Fact Sheet & Response to Comments). Since then, Whitefish cleaned the diffuser, removed the blockage, and screened off access to the diffuser to prevent future problems. However, Whitefish has not provided any indication that maintenance of the discharge diffuser is included as part of an on-going maintenance program. A requirement for a five-year maintenance report will be included in this permit renewal as a Special Condition.

Another previous concern was that the Whitefish WWTF collections system has had numerous Sanitary Sewer Overflow events (SSOs) since initial construction. This was one of the issues addressed in the Administrative Order on Consent (AOC) which Whitefish entered with DEQ in October 2012 (WQ-11-21, FID #2068). The AOC was in response to 11 failed Whole Effluent Toxicity (WET) tests between June 2008 and June 2012; 15 exceedances of permit limits for *Escherichia coli (E. coli)* bacteria, Total Nitrogen (TN), Total Phosphorus (TP), Total Suspended Solids (TSS), and TSS percent removal between March 2011 and June 2012; and five SSOs between July 2010 and June 2012. The AOC remains in force, and includes the requirement for Whitefish to submit a plan to come into compliance with new permit limits within 90 days from the effective date of this renewed MPDES permit.

III. Proposed Technology-based Effluent Limits (TBELs)

A. Applicability

B. The Board of Environmental Review (BER) has adopted by reference 40 CFR Part 133 which sets minimum treatment requirements for secondary treatment or equivalent for publicly-owned treatment works (POTW) [ARM 17.30.1203]. National Secondary Standards (NSS) as described in 40 CFR Part 133 are incorporated into all municipal permits. Secondary treatment is defined in terms of effluent quality as measured by BOD_5, TSS, percent removal of BOD_5 and TSS, and pH.

The regulations in 40 CFR 133.105 allow for the application of treatment equivalent-to-secondary effluent limitations (TES). However, facilities are only eligible for TES if, with proper operation and maintenance, the 95th percentile of the effluent concentration cannot meet the 30-day average effluent limit of 30 mg/L BOD_5 or TSS [40 CFR 133.101(g)(1)]. Whitefish had a 95th percentile 30-day average concentration of 14 mg/L BOD_5 and 21 mg/L TSS; both of which demonstrate compliance with NSS and makes the facility ineligible for TES. The 2008 Permit applied the NSS limitations for both BOD_5 and TSS. These limits will be maintained in this permit.

C. Mass-based Limitations

ARM 17.30.1345(8) requires that all effluent limits be expressed in terms of mass. The following equation was used to calculate the BOD_5 and TSS load limitations using the current design flow of 1.8 mgd and the TBELs limitations as proposed above:

$$\text{Load (lb/day)} = \text{Design Flow} \times \text{Concentration Limit (mg/L)} \times 8.34\ (\text{lb}\cdot\text{L})/(\text{mg}\cdot\text{gal})$$

BOD$_5$ and TSS:

30-day average loads = (1.8 mgd)(30 mg/L)(8.34) = 450 lb/day

7-day average loads = (1.8 mgd)(45 mg/L)(8.34) = 676 lb/day

Load limits (lb/day) for BOD$_5$ and TSS will apply to the effluent and will be maintained at the more stringent of the nondegradation load, water-quality-based effluent limitations, and/or load limits calculated in this permit renewal.

D. Nondegradation Loads

The provisions of ARM 17.30.701 - 718 (Nondegradation of Water Quality) apply to new or increased sources of pollution [ARM 17.30.705(1)]. Sources that are in compliance with the conditions of their permit and do not exceed the limits established in the permit or determined from a permit previously issued by DEQ are not considered new or increased sources.

The WWTF was built in 1979 with an average daily design flow of 1.25 mgd, and remained limited by this secondary treatment average daily flow until the 2003 facility upgrade. Therefore, nondegradation load allocations are based on the facility design rate in 1993 of 1.25 mgd, in order for the WWTF to avoid being considered a new or increased source (ARM 17.30.702). Nondegradation load values were calculated for BOD$_5$, TSS, TN and TP as part of the renewal of the permit in 1995 and maintained in the 2008 Permit. During this renewal, DEQ proposes the following:

- BOD$_5$ – 313 lb/day monthly average load allocation (based on 1.25 mgd and 30 mg/L monthly average concentration limit). The previous method for developing the BOD$_5$ load allocation based on percent removal was not based on the criteria in ARM 17.30.715, technology-based standards, or water quality standards and has been replaced with an enforceable BOD$_5$ load allocation per current policy.
- TSS – 313 lb/day monthly average load allocation (remains the same, based on 1.25 mgd and 30 mg/L monthly average concentration limits).
- TN – no nondegradation load allocation. The TN load allocation presented in the previous fact sheets do not apply because it was calculated using the Department of Health and Environmental Sciences memorandum (DHES, October 1994), and was not based on the criteria in ARM 17.30.715 or water quality standards.
- TP – 10.4 lb/day monthly average load allocation (remains the same, based on 1.25 mgd and an enforceable TP concentration-based limit of 1.0 mg/L).

The nondegradation and actual annual average loads for the POR January 2010 through December 2014 are presented below. These data indicate that the WWTF did not exceed nondegradation load values and is not considered a new or increased source.

Table 3. Nondegradation and Actual Loads for POR							
Parameter	Units	Nondegradation Allocated Loads	Actual 30-Day Average Loads				
		Annual Average	2010	2011	2012	2013	2014
BOD_5	lb/day	313	61	57	82	58	77
TSS	lb/day	313	65	94	142	96	98
TP	lb/day	10.4	3.0	3.7	5.0	4.2	5.3

E. Proposed TBELs

Table 4 presents the proposed TBELs for Whitefish:

Table 4. Outfall 001 Proposed TBELs (1)				
Parameter	Concentration (mg/L)		Load (lb/day)	
	Average Monthly	Average Weekly	Average Monthly (2)	Average Weekly
BOD_5	30	45	313	676
TSS	30	45	313	676
pH	Within the range of 6.0 to 9.0 s.u. (instantaneous)			
BOD_5 Percent Removal	85 %			
TSS Percent Removal	85 %			

Footnotes:
(1) See Definition section at end of permit for explanation of terms.
(2) Based on nondegradation allocated loads.

IV. Water-Quality Based Effluent Limits (WQBELs)

A. Scope and Authority

The Montana Water Quality Act (Act) states that a permit may only be issued if DEQ finds that the issuance or continuance of the permit will not result in pollution of any state waters [75-5-401(2), Montana Code Annotated (MCA)]. Montana water quality standards at ARM 17.30.637(2) require that no wastes may be discharged such that the waste either alone or in combination with other wastes will violate or can reasonably be expected to violate any standard. ARM 17.30.1344(2) adopts by reference 40 CFR 122.44 which states that MPDES permits shall include limits on all pollutants which will cause, or have a reasonable potential to cause an excursion above any water quality standard, including narrative standards. The purpose of this section is to provide a basis and rationale for establishing effluent limits based on Montana water quality standards that will protect designated uses of the receiving stream.

B. Receiving Water

The Whitefish WWTF discharges to the Whitefish River identified as USGS Hydrologic Unit Code (HUC) 17010210, and Montana stream assessment unit MT76P003_010, WHITEFISH RIVER, Whitefish Lake to mouth (Stillwater River). The WWTF discharge location is approximately 2.5 miles below the outlet from Whitefish Lake, and more than 20 miles above the confluence with the Stillwater River.

The Whitefish River is classified B-2 [ARM 17.30.608(1)(a)(iv)]. Class B-2 waters are to be maintained suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming, and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply [ARM 17.30.624(1)]. Degradation that will impact established beneficial uses is not allowed.

Impairments

The Whitefish River is listed on the 2014 303(d) List as fully supporting drinking water, primary contact recreation, and agricultural uses, but not supporting aquatic life. The list cites the following causes and sources for impairment:

- oil and grease (O&G): accidental spill/release;
- temperature: site clearance (land development or redevelopment), wet weather discharges, and silviculture activities; and
- PCBs in the water column: industrial point source discharge and silviculture activities.

Whitefish River was included in the temperature Total Maximum Daily Load (TMDL) for Flathead Lake, *Flathead - Stillwater Planning Area Nutrient, Sediment, and Temperature TMDLs and Water Quality Improvement Plan*, approved by EPA in December 2014 (see below, Part IV.E.2). In addition, TMDLs for Whitefish River are required for oil & grease and PCBs in water column impairments but have not been completed; however, the WWTF is not listed as a cause of these impairments.

Critical Flow

The United States Geological Service (USGS) collected flow and other data for the Whitefish River at gauging station 12366000 approximately 10 miles below the WWTF. In order to obtain a seven-day, ten-year low flow (7Q10) value for the Whitefish River at the point of discharge, the 7Q10 value from the downstream gauging station needs to be corrected by subtracting a calculated contribution from the WWTF.

The USGS released a draft of their updated statistical summaries of stream flow in January 2015. The new 7Q10 at gauging station 12366000 is 23.3 cubic feet per second (cfs) or 15.1 mgd, which is a significant increase from the previous 7Q10 of 13 cfs (8.4 mgd) as listed in the 2004 USGS *Statistical Summaries of Streamflow in Montana and Adjacent Areas,* Water Years 1900 through 2002.

During the last renewal, in order to obtain a calculated 7Q10 value for the Whitefish River upstream from the point of discharge, the 7Q10 value from the gauging station was corrected by subtracting the maximum average monthly discharge flow rate (*i.e.*, 8.4 mgd 7Q10 minus 1.14 mgd discharge flow equaled a calculated 7Q10 of 7.26 mgd). Whitefish provided arguments against the use of the *maximum* of the monthly average discharge rates. DEQ responded to these arguments in the Response to Comments issued as part of the final determination and maintained the use of the maximum average monthly discharge flow rate.

For this renewal, the maximum of the monthly average discharge rates for the period of record (2.1 mgd) is subtracted from the new 7Q10 (15.1 mgd) to provide the updated calculated 7Q10 (13.0 mgd).

In addition, for nutrient determinations, the seasonal 14-day, five-year low flow (14Q5, July through October) was calculated by subtracting the maximum seasonal discharge rate (calculated to be 1.4 mgd) from the seasonal 14Q5 value for the gauging station of 28.4 cfs (18.4 mgd), for a updated calculated 14Q5 (17.0 mgd).

Ambient Water Quality Data

Ambient water quality data for the Whitefish River in the 2.5-mile upstream stretch between Whitefish Lake and the outfall location is presented in Table 5 for the POR. DEQ obtained the ambient data from the City of Whitefish; the Whitefish Lake Institute; and STORET (stations C09WHTFR08 and WFROUTLET).

Table 5. Whitefish River - Ambient Water Quality Monitoring Data

Parameter	Units	No. of Samples	CV	Minimum	Average	75th Percentile	Maximum
Hardness	mg/L	11	0.04	82	88	87 (1)	92
pH	s.u.	146	0.04	5.6	8.1	8.3	8.7
Temperature	°C	145	0.6	0.6	10.8	16.4	24.4
Total Ammonia as N	mg/L	19	1.1	0.003	<0.02 (2)	<0.04 (2)	0.07
$NO_3 + NO_2$	mg/L	21	1.8	0.001	<0.012 (2)	<0.01 (2)	0.10
Total Nitrogen as N	mg/L	33	0.3	0.06	0.10	0.11	0.24
Total Phosphorus as P	mg/L	32	0.5	<0.001	0.006	0.008	0.016

Footnote:
(1) Hardness is the 25th percentile.
(2) Cannot determine exact average or 75th percentile due to several analyses with "nondetect" at various detection limits.

C. Applicable Water Quality Standards

Discharges to surface waters classified B-2 are subject to the specific water quality standards of ARM 17.30.624, Department Circular DEQ-7 (October 2012), as well as the general provision of ARM 17.30.635 through 637, 641, 645, and 646. In addition to these standards, dischargers are also subject to mixing zone rules (ARM 17.30 Subchapter 5); Nondegradation (Subchapter 7); and the Base Numeric Nutrients Standards and Variances (Department Circulars DEQ-12A and DEQ-12B).

D. Mixing Zone

ARM 17.30.635(2) requires that the design condition for disposal systems must be based on the 7Q10. More restrictive requirements may be necessary due to specific mixing zone requirements. A mixing zone is an area where the effluent mixes with the receiving water and certain water quality standards may be exceeded [ARM 17.30.502(6)]. DEQ must determine the applicability of currently granted mixing zones [ARM 17.30.505(1)]. Mixing zones allowed under a permit issued prior to April 29, 1993 will remain in effect unless there is evidence that previously allowed mixing zones will impair existing or anticipated uses [ARM 17.30.505(1)(c)].

The discharge must also comply with the general prohibitions of ARM 17.30.637(1) which require that state waters, including mixing zones, must be free from substances which will:

(1) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines;

(2) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials;

(3) produce odors, colors or other conditions as to which create a nuisance or render undesirable tastes to fish flesh or make fish inedible;

(4) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; and

(5) create conditions which produce undesirable aquatic life.

No mixing zone will be granted that will impair beneficial uses [ARM 17.30.506(1)]. Aquatic life-chronic, aquatic life-acute, human health, and nutrient standards may not be exceeded outside of the mixing zone [ARM 17.30.507(1)(a)]. Acute standards may not be exceeded in any part of the mixing zone unless DEQ finds that minimal initial dilution will not threaten or impair beneficial uses [ARM 17.30.507(1)(b)].

A standard mixing zone may be granted for facilities when mixing is nearly instantaneous [ARM 17.30.516(3)(d)]. Nearly instantaneous mixing is assumed if the discharge is through an effluent diffuser. The Whitefish effluent pipe is equipped with a diffuser. The 2008 Permit granted 100% dilution for both chronic and acute calculations, which will remain with this permit renewal.

Therefore, Whitefish will be granted the full calculated 7Q10 dilution flow of 13.0 mgd to evaluate RP and develop chronic and acute effluent limits for ammonia, nitrate-nitrite, TRC, and metals, and the full calculated 14Q5 dilution flow of 17.0 mgd to evaluate RP and develop nutrient limits [ARM 17.30.516(3)(e)].

ARM 17.30.516(3)(d) states that a nearly instantaneous mixing zone may not extend downstream more than two (2) river widths. During the 2008 Permit renewal, the length of the chronic mixing zone was reduced to 100 feet from 200 feet downstream from the point of discharge, since the river width was estimated to be 50 feet at 7Q10. The mixing zone will be maintained at 100 feet downstream for chronic, acute, and nutrient mixing.

E. Basis for Proposed Water Quality-Based Effluent Limits

Parameters typically present in municipal wastewater that may cause or contribute to a violation of water quality standards include the conventional pollutants such as biological material (as measured by BOD_5), TSS, oil & grease, pathogenic bacteria, and pH; and non-conventional pollutants such as temperature, total residual chlorine, total ammonia, total nitrogen, and total phosphorus.

ARM 17.30.1345 requires WQBELs to be developed for any pollutant for which there is reasonable potential (RP) for discharges to cause or contribute to exceedances of instream numeric or narrative water quality standards. RP calculations utilize the receiving water concentration, the maximum projected effluent concentration, the design flow of the wastewater treatment facility, and the applicable receiving water flow. DEQ uses a mass balance equation to determine RP (*Equation 1*).

$$C_{RP} = \frac{C_d Q_d + C_s Q_s}{Q_d + Q_s} \qquad (Eq.\ 1)$$

Where:

C_{RP} = calculated receiving water concentration after mixing, mg/L
C_d = critical effluent concentration, mg/L
C_s = critical upstream concentration, mg/L
Q_d = facility average daily design flow rate, mgd
Q_s = critical receiving water flow, mgd

1. Conventional Pollutants

TSS and BOD_5 - The facility provides a significant reduction in biological material and solids through secondary treatment (Section III). No additional WQBELs will be required for these parameters.

pH - Pursuant to ARM 17.30.624(2)(c), the induced variation of hydrogen ion concentration within the range of 6.5 to 8.5 must be less than 0.5 pH units. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0. The previous permit limited the WWTF effluent to a pH range of 6.0 – 9.0 s.u. based on TBELs. This effluent limit will be maintained with this permit renewal.

Oil and Grease (O&G) –The 2008 Permit added an O&G effluent limit of 10 mg/L due to the inclusion of O&G on the 2006 303(d) List, with a cause of industrial point sources. Although the Whitefish River remains on the 2014 303(d) List as impaired for O&G, the cause was clarified as accidental spill/releases and the WWTF is not listed as a cause of the impairment.

The maximum concentration for 46 O&G samples taken during the POR was 2.0 mg/L. Based on the method developed in the EPA's 1991 *Technical Support Document for Water Quality-based Toxics Control* (TSD), the maximum projected concentration of O&G in the effluent is 2.0 mg/L, based on 2.0 mg/L x TSD multiplier of 1.0. Since this is less than the 10 mg/L standard, there is not RP and the limit will be removed.

***Escherichia coli (E. coli)* Bacteria** - The applicable standards for *E. coli* are:

a. April 1 through October 31, of each year, the geometric mean number of the microbial species *E. coli* must not exceed 126 colony forming units (cfu) per 100 milliliters (mL), nor are 10% of the total samples during any 30-day period to exceed 252 cfu per 100 mL [ARM 17.30.624(2)(a)(i)]; and

b. November 1 through March 31, of each year, the geometric mean number of *E. coli* shall not exceed 630 cfu per 100 mL and 10% of the samples during any 30-day period may not exceed 1,260 cfu per 100 mL [ARM 17.30.624(2)(a)(ii)].

DEQ is not granting a mixing zone for *E. coli* bacteria. These standards were applied as final effluent limitations at end-of-pipe, effective July 1, 2011, and will remain in effect for this renewal cycle.

2. *Nonconventional Pollutants*

Temperature – Circular DEQ-7 lists temperature as a harmful parameter, with a reference to the temperature water quality standards, which is the following for B-2 classification waters under ARM 17.30.624(2)(e):

Table 6. Applicable Water Temperature Standards for B-2 Classified Waters

Parameter	Units	Ambient Temperature	Maximum Increase	Maximum Decrease
Temperature Change	°F	32-55	Ambient + 1°F	Ambient –2°F
		55- 66		Ambient –2°F/hour
		66-66.5 (1)	Maintain <67°F	
		>66.5	Ambient + 0.5°F	

Footnotes:
(1) Between 66 °F to 66.5 °F, no discharge is allowed to cause the water temperature to exceed 67 °F.

Whitefish River is listed as impaired for temperature. The "*Flathead - Stillwater Planning Area Nutrient, Sediment, and Temperature TMDLs and Water Quality Improvement Plan,*" approved by EPA on December 17, 2014, included an evaluation of temperature impacts from point and nonpoint sources on the Whitefish River, including the WWTF. Based on the WWTF's maximum recorded effluent temperature of 74.8°F and average daily design flow of 1.8 mgd, the WWTF was shown to cause temperature increases less than the 0.5°F allowed. The WWTF heat contribution was calculated at 1,877 kcal/second.

The conclusion from the TMDL was that 'maintaining operation of this facility at current levels would appear to cause no significant increase in Whitefish River temperatures.' To ensure the baseline is maintained, and provide additional information for the future, Whitefish will be required to monitor both effluent and upstream for temperature during the summer months of July through September.

Ammonia, Total as Nitrogen - Ammonia limits are developed based on standards that account for a combination of pH and temperature of the receiving stream, the presence or absence of salmonid species, and the presence or absence of fish in early life stages. Salmonid fishes and their early life stages are presumed present year-round, based on the waterbody classification of B-2. Table 7 presents the ammonia water quality standards for the Whitefish River using the ambient river water quality data in Table 5 (Circular DEQ-7).

Table 7. Ammonia- Water Quality Standards for Whitefish River

Condition	Salmonids Present	Early Life Stages Present	Ambient Condition [1]		Water Quality Standard [2] mg/L
			pH s.u.	Temperature °C	
Acute	Yes	NA	8.3	NA	3.15
Chronic	NA	Yes	8.3	16.4	1.36

Footnotes: NA – Not Applicable
(1) Based on 75th percentile of annual data.
(2) Acute - maximum daily; Chronic - 30-day average concentration.

Because of the additional upstream data gathered during this POR, and a change in DEQ policy to use the 75th percentile of the annual data for both acute and chronic determinations, the ammonia water quality standards for Whitefish River have changed. The acute ammonia standard is 3.15 mg/L and the chronic standard is 1.36 mg/L year round. DEQ assessed RP for Whitefish to cause or contribute to the exceedance of these ammonia water quality standards in the Whitefish River using *Equation 1*,

$$C_{RP} = \frac{(1.8 \times 34.1) + (13.0 \times 0.04)}{(1.8 + 13.0)} = 4.2 \text{ mg/L}$$

Where:

- C_{RP} =calculated receiving water concentration after mixing, mg/L
- C_d = maximum projected effluent concentration of 34.1 mg/L (32.6 mg/L max observed during POR x multiplier from TSD Table 3-2)
- C_s = 75th percentile of ammonia concentration upstream of discharge, 0.04 mg/L
- Q_s = critical receiving water flow, 7Q10 of 13.0 mgd – 100% available dilution
- Q_d = facility design flow rate, 1.8 mgd

The calculated C_{RP} of 4.2 mg/L is greater than the calculated ammonia standards, therefore, RP exists for this parameter and effluent limits are necessary.

For most parameters with RP, to establish WQBELs for an existing discharger DEQ first calculates Wasteload Allocations (WLAs) from the numeric water quality standards. These WLAs are then translated into maximum daily limitations (MDLs) and average monthly limitations (AMLs) using TSD multipliers. As shown in *Equation 2* below, the mass-balance equation given in the previous section can be arranged to calculate the WLA (C_d) so that the discharge does not cause or contribute to an exceedance of the applicable water quality standard under critical conditions.

$$C_d = WLA = \frac{Q_r C_r - Q_s C_s}{Q_d} \quad (\textit{Eq. 2})$$

Given:

C_d = Effluent Pollutant Concentration (WLA)

Q_s = critical receiving water flow, 7Q10 of 13.0 mgd – 100% available dilution

Q_d = facility design flow rate, 1.8 mgd

$Q_r = Q_s + Q_d$

C_s = 75th percentile of ammonia concentration upstream of discharge, 0.04 mg/L

C_r = the resulting receiving water concentration (ammonia water quality standards for Whitefish River, see Table 7)

The WLA and end-of-pipe ammonia limits are calculated and presented in Attachment A. These proposed limits are 9.2 mg/L AML and 17.0 mg/L MDL.

Nitrate+Nitrite (N+N) – The human health standard for N+N is 10 mg/L (Circular DEQ-7). The maximum observed effluent concentration during the POR was 27 mg/L. DEQ assessed RP for Whitefish to cause or contribute to the exceedance of the N+N water quality standard in the Whitefish River using *Equation 1*,

$$C_{RP} = \frac{(1.8 \times 29.5) + (13.0 \times 0.01)}{(1.8 + 13.0)} = 3.6 \text{ mg/L}$$

Where:

C_{RP} =calculated receiving water concentration after mixing, mg/L

C_d = maximum projected effluent concentration of 29.5 mg/L (27 mg/L max observed during POR x multiplier from TSD Table 3-2)

C_s = 75th percentile of N+N concentration upstream of discharge, 0.01 mg/L

Q_s = critical receiving water flow, 7Q10 of 13.0 mgd – 100% available dilution

Q_d = facility design flow rate, 1.8 mgd

The calculated C_{RP} of 3.6 mg/L is less than the N+N standard of 10 mg/L, therefore, RP does not exist for this parameter and effluent limits are not necessary at this time. Monitoring will continue to be required.

Nutrients [Total Nitrogen (TN) and Total Phosphorus as P (TP)] - Historically there were no numeric water quality standards for TN and TP, and DEQ based nutrient limits on the narrative standard "State surface waters must be free from substances attributable to discharges that will create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; and create conditions which produce undesirable aquatic life" [ARM 17.30.637(1)(d) and (e)].

Whitefish River was included as part of the "*Flathead - Stillwater Planning Area Nutrient, Sediment, and Temperature TMDLs and Water Quality Improvement Plan*" approved by EPA on December 17, 2014. Most of the nutrient planning was ultimately removed from the scope of this TMDL and DEQ plans to address nutrients in Flathead-Stillwater Planning Area as a future (Phase II) TMDL.

On July 25, 2014, the BER and DEQ approved Circular DEQ-12A (Base Numeric Nutrient Standards, July 2014 edition) and Circular DEQ-12B (Nutrient Standard Variances, July 2014 edition). EPA approved these standards on February 26, 2015. The standards in

Circular DEQ-12A that apply to the Whitefish River, located within the Northern Rockies ecoregion, are 0.275 mg/L TN and 0.025 mg/L TP, from July 1st through September 30th. Circular DEQ-12A states that the seasonal 14Q5 should be used for RP and limit development. DEQ calculated the seasonal 14Q5 for Whitefish River to be 17.0 mgd (see Part IV.B).

Total Nitrogen

At the time of the 2008 Permit development, nitrogen was listed as the nutrient of concern for impairment of the Whitefish River but there was no TMDL. DEQ limited the WWTF to current performance, which resulted in mass-based TN limits of 273 lb/day AML and 426 lb/day MDL, effective July 1, 2011. These limits were year-round to be protective of both the immediate receiving water (Whitefish River) and downstream, including Flathead Lake.

For this renewal, DEQ has implemented the Department Circular DEQ-12A standard for Whitefish River of 0.275 mg/L TN from July 1st – September 30th. DEQ assessed RP for the WWTF to cause or contribute to the exceedance of this new TN water quality standard in the Whitefish River using *Equation 1*,

$$C_{RP} = \frac{(1.8 \times 38.7) + (17.0 \times 0.11)}{(1.8 + 17.0)} = 3.8 \text{ mg/L}$$

Where:

C_{RP} = calculated receiving water concentration after mixing, mg/L
C_d = maximum projected effluent concentration of 38.7 mg/L (38 mg/L max observed during POR x multiplier from TSD Table 3-2)
C_s = 75th percentile of TN concentration upstream of discharge, 0.11 mg/L
Q_s = critical receiving water flow, seasonal 14Q5 of 17.0 mgd
Q_d = facility design flow rate, 1.8 mgd

The calculated C_{RP} of 3.8 mg/L is greater than the TN standard of 0.275 mg/L, therefore, RP exists for the WWTF to cause or contribute to an exceedence of the TN standard. DEQ calculated the WLA of 1.83 mg/L and an end-of-pipe TN effluent limit of 1.7 mg/L, which are presented in Attachment A.

Whitefish cannot currently meet this calculated TN effluent limit. If a facility cannot meet a calculated TN effluent limit, Montana State Law (75-5-103(22) and 75-5-313, MCA) allows for variances for up to 20 years, at which time the effluent limits based on the water quality standards will be final and effective.

Whitefish is eligible to pursue a general variance from the nitrogen standards as presented in Circular DEQ-12B, which was requested in correspondence dated March 19, 2015. DEQ finds the variance category in Table 12B-1 applicable to Whitefish is the discharger category "> 1.0 mgd" for a facility designed to remove nutrients. A variance is designed to be a technically-achievable level, which DEQ will express as a monthly average mass-based limit. In cases where the facility cannot comply with the base numeric standards, but the current performance of the facility is better than the general variance limits, Circular DEQ-12B allows for general variance limits based on the facility's current performance.

DEQ reviewed the TN variance, existing permit limits, and current performance in order to determine the most stringent of the following applicable to Whitefish:

(a) TSD-method using the Department Circular DEQ-12B general variance 'long-term average' (LTA) of 10.0 mg/L x multiplier in TSD Table 5-2 (1.17 based on CV of 0.2) x average daily design flow (1.8 mgd) x 8.34 = 176 lb/day TN during the summer months of July 1st – September 30th,

(b) TSD-method using Department Circular DEQ-12B variance limits based on the WWTF current performance LTA (21.8 mg/L seasonal average) x AML multiplier in TSD Table 5-2 (1.17) x average daily design flow (1.8 mgd) x 8.34 = 382.9 lb/day to compare to the general variance for the summer months, or

(c) Current year-round AML of 273 lb/day.

In summary, DEQ is proposing TN mass-based effluent limits as a summertime AML of 176 lb/day (July 1st – September 30th) based on the Circular DEQ-12B general variance, and a non-summertime AML of 273 lb/day based on the current year-round limit.

Total Phosphorus

Whitefish has had a 1.0 mg/L TP effluent limit since the early 1980's. The 1996 Permit developed an annual average nondegradation load limit of 10.4 lb/day TP based on the existing 1.0 mg/L TP limit and average daily design flow of 1.25 mgd. The 2008 Permit maintained the TP concentration-based effluent limit of 1.0 mg/L, and changed the 10.4 lb/day nondegradation load to an average monthly limit year-round to be protective of both the immediate receiving water (Whitefish River) and downstream, including Flathead Lake.

For this renewal, DEQ has implemented the Circular DEQ-12A standard for Whitefish River of 0.025 mg/L TP from July 1st – September 30th. DEQ assessed RP for the WWTF to cause or contribute to the exceedance of this new TP standard in the Whitefish River using *Equation 1*,

$$C_{RP} = \frac{(1.8 \times 5.2) + (17.0 \times 0.008)}{(1.8 + 17.0)} = 0.5 \text{ mg/L}$$

Where:

C_{RP} =calculated receiving water concentration after mixing, mg/L
C_d = maximum projected effluent concentration of 5.2 mg/L (4.8 mg/L max observed during POR x multiplier from TSD Table 3-2)
C_s = 75th percentile of TP concentration upstream of discharge, 0.008 mg/L
Q_s = critical receiving water flow, seasonal 14Q5 of 17.0 mgd
Q_d = facility design flow rate, 1.8 mgd

The calculated C_{RP} of 0.5 mg/L is greater than the TP water quality standard of 0.025 mg/L, therefore, RP exists for this parameter. DEQ calculated the WLA of 0.186 mg/L and an end-of-pipe TP effluent limit of 0.14 mg/L, which are presented in Attachment A.

Whitefish cannot currently meet this calculated TP effluent limit. If a facility cannot meet a calculated TP effluent limit, Montana State Law (75-5-103(22) and 75-5-313, MCA) allows for variances for up to 20 years, at which time the effluent limits based on the water quality standards will be final and effective.

Whitefish is eligible to pursue a general variance from the phosphorus standards as presented in Circular DEQ-12B, which was requested in correspondence dated March 19, 2015. DEQ finds the variance category in Table 12B-1 applicable to Whitefish is the discharger category "> 1.0 mgd" for a facility designed to remove nutrients. A variance is designed to be a technically-achievable level, which DEQ will express as a monthly average mass-based limit. In cases where the facility cannot comply with the base numeric standards, but the current performance of the facility is better than the general variance limits, Circular DEQ-12B allows for general variance limits based on the facility's current performance.

DEQ reviewed the TP variance, existing permit limits, and current performance in order to determine the most stringent of the following applicable to Whitefish:

(a) TSD-method using the Department Circular DEQ-12B general variance 'long-term average' (LTA) of 1.0 mg/L TP x TSD Table 5-2 multiplier (1.17 based on CV of 0.2) x average daily design flow (1.8 mgd) x 8.34 = 17.6 lb/day during the summer months of July 1st – September 30th,

(b) TSD-method using Department Circular DEQ-12B variance limits based on the WWTF current performance LTA (0.42 mg/L seasonal average) x TSD Table 5-2 multiplier (1.17) x average daily design flow (1.8 mgd) x 8.34 = 7.4 lb/day to compare against the general variance for the summer months, or

(c) Current year-round AML of 10.4 lb/day.

In summary, DEQ is proposing TP mass-based effluent limits as a summertime AML of 7.4 lb/day (July 1st – September 30th) based on Circular DEQ-12B current performance, and a non-summertime AML of 10.4 lb/day based on the current permit limit. In addition, DEQ is maintaining the current year-round TP concentration limit of 1.0 mg/L.

Table 8 provides a summary of the current, proposed, and future TN and TP permit limits based on the above evaluation. The proposed limits for this renewal are based on the current Circular DEQ-12B variance levels; DEQ is responsible for conducting a triennial review to determine whether these variance concentrations are sufficient and the concentrations may change in future years.

Table 8. Outfall 001 TN and TP Effluent Limits (Monthly Average) (1)

Parameter	Concentration (mg/L)			Load (lb/day)	
	Current	Proposed	2034 (*est*)	Current	Proposed
TN – summer (2, 3)	NA	NA	1.7	273	176
TN – non-summer (2, 3)			NA		273
TP – summer (3)	1.0	1.0	0.14	10.4	7.4
TP – non-summer (3)			1.0		10.4

Footnotes: NA = Not Applicable
(1) See Definition section at end of permit for explanation of terms.
(2) Calculated as the sum of Nitrate + Nitrite and TKN concentrations.
(3) Summer limit is effective July 1st – September 30th and non-summer limit is effective year-round other than applicable summer limit.

Dissolved Oxygen (DO) – Freshwater aquatic life standards are characterized by the fishery (cold- or warm-water) and by the presence or absence of fish in early life stages (DEQ Circular DEQ-7). They are presented in Table 9, below. Standards are further defined based on a specific period of time and required in-stream DO levels. Classification states this waterbody is a cold-water fishery (salmonid and associated aquatic life) and all life stages are assumed to be present.

Table 9. DO Standards For Waters Classified B-2 (DEQ Circular-7).

Condition	30-Day Mean (mg/L)	7-Day Mean (mg/L)	7-Day Mean Minimum (1) (mg/L)	1-Day Minimum (1) (mg/L)
Early Life Stages (2,3)	NA	9.5 (6.5)	NA	8.0 (5.0)
Other Life Stages	6.5	NA	5.0	4.0

Footnotes:
(1) All minima should be considered as instantaneous concentrations to be achieved at all times. These are water column concentrations recommended to achieve the required inter-gravel DO concentrations shown in parentheses.
(2) For species that have early life stages exposed directly to the water column, the figures in parentheses apply.
(3) Includes all embryonic and larval stages and all juvenile forms of fish to 30-days following hatching.

Dissolved oxygen is a parameter of concern for the WWTF. The 2008 Permit required Whitefish to monitor DO levels in the effluent. The effluent DO concentration ranged from 2.2 mg/L to 13.3 mg/L, with the average at 6.8 mg/L. The City of Whitefish provided DO monitoring data for upstream, for 140 data points from April 2012 through December 2014. The 25th percentile of upstream DO concentration, which is used as the statistical worst-case background concentration, was 9.0 mg/L; the upstream DO concentration ranged from 7.3 to 13.7 mg/L.

Whitefish River is not listed as impaired for DO. In addition, DEQ typically concludes that concentration- and mass-based BOD_5 limits are adequate to protect DO levels in the receiving water; moreover, the WWTF discharges through a diffuser which should increase oxygen at the point of discharge. Lastly, the WWTF has continually met the maximum weekly and monthly average BOD_5 effluent limits. No DO limit is necessary. Monthly DO effluent monitoring is required during this permit cycle.

Total Residual Chlorine (TRC) – In 2011, Whitefish installed chlorination/de-chlorination at the WWTF as a method of disinfection. The 2008 Permit incorporated a TRC chronic effluent limit of 0.011 mg/L AML and an acute TRC limitation of 0.019 mg/L MDL. These limits will be maintained in this permit renewal.

Approved analytical methods require TRC samples to be analyzed immediately (40 CFR 136). The method must achieve a minimum detection level of 0.1 mg/L. The discharge will be considered to be in compliance with permit limits if the analytical result of the chlorine sample is less than 0.1 mg/L.

3. *Toxic Pollutants*

ARM 17.30.623(2)(h) states that concentrations of carcinogenic, bio-concentrating, toxic, or harmful parameters which would remain in the water after conventional treatment may not exceed the applicable standards specified in Department Circular DEQ-7.

Metals – During the last permit cycle, Whitefish was required to monitor for dissolved aluminum, total recoverable copper, and total recoverable lead. The standards for these metals are summarized below:

Table 10: Metals Standards for Whitefish River (Circular DEQ-7)

Metal	Water Quality Standard (μg/L)		
	Acute	Chronic	Human Health
Aluminum, Dissolved	750	87	--
Copper, Total Recoverable (1)	12.3	8.3	1,300
Lead, Total Recoverable (1)	68.4	2.7	15

Footnote:
(1) Acute and chronic standards based on Whitefish River 25th percentile hardness of 87 mg/L.

The following RP analysis was conducted based on data for the POR.

- *Aluminum, dissolved*: the WWTF has not previously had an aluminum effluent limit, but monitoring was required due to the use of aluminum as a raw material. During the POR, the dissolved aluminum concentration in 40 effluent samples reported on monthly DMRs ranged between 20 μg/L and 1,160 μg/L. In addition, the City of Whitefish monitored the dissolved aluminum concentration in seven upstream samples during 2013, with concentrations ranging between 12 μg/L and 130 μg/L.

  Based on this data, DEQ assessed RP for the WWTF to cause or contribute to the exceedance of the aluminum water quality standards in the Whitefish River using *Equation 1*,

$$C_{RP} = \frac{(1.8 \times 1{,}401) + (13.0 \times 90)}{(1.8 + 13.0)} = 249\ \mu g/L$$

Where:

C_{RP} = calculated receiving water concentration after mixing, µg/L
C_d = maximum projected effluent concentration of 1,401 µg/L (1,160 µg/L max observed during POR x multiplier from TSD Table 3-2)
C_s = 75th percentile concentration upstream of discharge, 90 µg/L
Q_s = critical receiving water flow, 7Q10 of 13.0 mgd – 100% available dilution
Q_d = facility design flow rate, 1.8 mgd

Since 249 µg/L > 87 µg/L (dissolved aluminum chronic water quality standard), there is RP and a dissolved aluminum effluent limit is required. See Appendix A for the development of the WQBEL. With this renewal, DEQ proposes new effluent limits for dissolved aluminum: an MDL of 120 µg/L and AML of 41 µg/L.

The dissolved aluminum effluent concentration averaged 164 µg/L during the POR, which indicates that the WWTF cannot currently meet the proposed limits. A compliance schedule will be included to allow Whitefish time to adjust their process to reduce the aluminum concentrations in the effluent (see Part VIII. Special Conditions).

- *Copper, Total Recoverable*: the WWTF has not previously had a copper effluent limit, but monitoring was required due to the inclusion of copper on previous 303(d) lists for Whitefish River. During the POR, Whitefish analyzed four copper effluent samples. One sample showed nondetect at <0.01 µg/L. The other three samples ranged from 7 to 15 µg/L total recoverable copper. Similarly, four of the seven upstream samples were nondetect (three were <1 µg/L and one was <0.1 µg/L). The other three upstream samples were between 0.2 µg/L and 0.3 µg/L.

  Based on this data, DEQ assessed RP for Whitefish to cause or contribute to the exceedance of a copper water quality standard in the Whitefish River using *Equation 1*,

$$C_{RP} = \frac{(1.8 \times 48) + (13.0 \times 1.0)}{(1.8 + 13.0)} = 6.7\ \mu g/L$$

  Where:

  C_{RP} = calculated receiving water concentration after mixing, µg/L
  C_d = maximum projected effluent concentration of 48 µg/L (15 µg/L max observed during POR x multiplier from TSD Table 3-2)
  C_s = 75th percentile concentration upstream of discharge < 1.0 µg/L
  Q_s = critical receiving water flow, 7Q10 of 13.0 mgd – 100% available dilution
  Q_d = facility design flow rate, 1.8 mgd

  Since 6.7 µg/L < 8.3 µg/L (total recoverable copper chronic water quality standard), the WWTF does not have RP to exceed the copper standards. Furthermore, DEQ removed copper as a cause of impairment for Whitefish River in 2014. No copper limits or monitoring will be required.

- *Lead, Total Recoverable:* the WWTF has not previously had a lead effluent limit, but monitoring was required due to the inclusion of lead on previous 303(d) lists for Whitefish River. Of the five effluent samples taken during the POR, one sample was 1 µg/L and the other four samples were nondetect (three at <0.5 µg/L and one at <0.01

µg/L). Similarly, all seven upstream samples were nondetect (three were <0.001 µg/L and four were <0.00005 µg/L).

Based on this data, DEQ assessed RP for the WWTF to cause or contribute to the exceedance of the lead water quality standards in the Whitefish River using *Equation 1*,

$$C_{RP} = \frac{(1.8 \times 2.5) + (13.0 \times 0.001)}{(1.8 + 13.0)} = 0.3 \ \mu g/L$$

Where:

C_{RP} = calculated receiving water concentration after mixing, µg/L
C_d = maximum projected effluent concentration of 2.5 µg/L (1 µg/L max observed during POR x multiplier from TSD Table 3-2)
C_s = 75th percentile concentration upstream of discharge < 0.001 µg/L
Q_s = critical receiving water flow, 7Q10 of 13.0 mgd – available dilution
Q_d = facility design flow rate, 1.8 mgd

Since 0.3 µg/L < 2.7 µg/L (total recoverable lead chronic water quality standard), the WWTF does not have RP to exceed the lead standards. Furthermore, DEQ removed lead as a cause of impairment in 2014. No lead limits or monitoring will be required.

Organic Substances - The Whitefish River in the area of discharge is on the 2014 303(d) List for PCBs in the water column due to industrial point sources; the WWTF is not identified as a source. As part of the renewal application, Whitefish conducted three sets of analyses of the effluent for volatile organic compounds, acid-extractable compounds, and base-neutral compounds: all results were nondetect other than chloroform, with a maximum concentration of 1.1 µg/L. The Circular DEQ-7 human health standard for chloroform is 57 µg/L; even without dilution there is no RP to exceed this standard. No limits are required.

Whole Effluent Toxicity (WET) Testing – The 2008 Permit included the narrative limitation that the effluent shall be free of any acute toxicity. ARM 17.30.637(1)(d) requires that state waters be free from substances attributable to municipal waste that create conditions which are harmful or toxic to human, animal, plant or aquatic life; except DEQ may allow limited toxicity in a mixing zone provided that there is no acute lethality to organisms. The 2008 Permit required quarterly two-species WET tests, with the allowance that if no acute toxicity was observed for four consecutive calendar quarters, WET testing could be reduced to alternating one species each quarter.

In a WET test, acute toxicity occurs when 50 percent or more mortality is observed for a test species at any effluent concentration. Based on information provided in the renewal application, the WWTF's effluent passed all of the *Ceriodaphnia* acute WET tests but failed 19 *Pimephales promelas* acute WET tests since the 2008 Permit's effective date of July 1, 2008. DEQ recognized that ammonia may be the primary cause of the WET test failures. Table 11 summarizes the ammonia levels for each WET test failed, as provided on the renewal application form (WET monitoring ceased as of October 2012 based on the AOC):

Table 11: WET Test Failures *Pimephales promelas*	
Failure Months	Ammonia (mg/L)
February 2009	34.8
March 2009	31.1
August 2009	12.3
October 2009	30.3
November 2009	34.5
February 2010	34.0
March 2010	33.5
July 2010	23.3
September 2010	35.1
October 2010	30.4
November 2010	32.9
December 2010	29.9
February 2011	29.0
July 2011	21.6
December 2011	27.2
March 2012	28.0
April 2012	16.3
June 2012	17.0
July 2012	18.9

This renewal will require quarterly two-species WET testing, with the allowance that if no acute toxicity was observed for four (4) consecutive calendar quarters, Whitefish could request in writing that DEQ reduce WET testing to one species quarterly.

V. Proposed Effluent Limits

Section 402(o) of the CWA and 40 CFR 122.44(l) require that effluent limitations or conditions in reissued permits be at least as stringent as those in the existing permit, with certain exceptions. Also, regulations at 40 CFR 122.44 require that permits contain the more stringent TBEL or WQBEL limitation applicable to an individual pollutant. In addition, DEQ considered the proposed permit limits to ensure that they were as stringent as previous limits, or met the anti-backsliding requirements.

Beginning on the effective date and lasting through the term of the permit, the discharge from Outfall 001 shall, at a minimum, meet the effluent limits presented in Table 12:

Table 12: Outfall 001 Proposed Effluent Limits (1)				
Parameter	Units	Average Monthly Limit	Average Weekly Limit	Maximum Daily Limit
BOD_5	mg/L	30	45	--
	lb/day	313	676	--
	% Removal	85%	--	--
TSS	mg/L	30	45	--
	lb/day	313	676	--
	% Removal	85%	--	--
pH	su	6.0 – 9.0		
E. coli Bacteria – summer (2, 3)	cfu/100 mL	126	--	252
E. coli Bacteria – winter (2, 3)	cfu/100 mL	630	--	1260
Total Residual Chlorine (4)	mg/L	0.011	--	0.019
Ammonia, Total as N	mg/L	9.2	--	17.0
TN – summer (5,6)	lb/day	176	--	--
TN – non-summer (5,6)		273	--	--
TP – year round	mg/L	1.0	--	--
TP – summer (6)	lb/day	7.4	--	--
TP – non-summer (6)		10.4	--	--
Aluminum, dissolved (7)	µg/L	41	--	120

Footnotes: NA means not applicable.
(1) See Definition section at end of permit for explanation of terms.
(2) Winter is November 1 through March 31; summer is April 1 through October 31.
(3) Report geometric mean if more than one sample is collected during the reporting period.
(4) Analytical results less than 0.1 mg/L will be considered in compliance with the chlorine limit.
(5) Calculated as the sum of Nitrate + Nitrite as N and Total Kjeldahl Nitrogen concentrations.
(6) Summer limits effective July 1st – September 30th, non-summer limits effective year round other than this timeframe.
(7) Dissolved aluminum effluent limits take effect July 1, 2016.

There shall be no acute toxicity in the effluent.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

VI. Self-Monitoring Requirements

Regulations requiring the establishment of monitoring and reporting conditions in MPDES permits are found in 40 CFR 122.44(i) and 122.48, and ARM 17.30.1351. All analytical procedures must comply with the specifications of 40 CFR Part 136 and the analyses must meet any Required Reporting Values (RRVs) listed in Circular DEQ-7 unless otherwise specified. Samples shall be collected, preserved and analyzed in accordance with approved procedures listed in 40 CFR Part 136.

The influent monitoring frequency is reduced from three times per week to once per week for a number of reasons: low variability of the influent water quality (CV 0.3 for BOD_5 and 0.4 for TSS); the secondary treatment is an aerated lagoon system with a relatively long holding time compared with mechanical plants; the facility collects the influent samples via composite sampler to dampen any variability; and the percent removal has not been a problem for BOD_5 (lowest observed was 93% removal) and is seldom a problem for TSS (out of 47 monthly reports, only two samples were below 85% removal – the lowest of which was 74% removal in March 2012 during a period with elevated TSS effluent concentrations).

At the same time, the BOD_5 and TSS effluent monitoring has been increased from once per week to twice per week (samples at least one day apart), to reflect the fact that this lagoon system is classified as a major source, with an average daily design flow rate over 1 mgd. DEQ believes that analysis twice per week for BOD_5 and TSS is sufficient, based on the fact that for BOD_5 the CV is < 0.5 which is lower than the statistically 'expected' value of 0.6 and for TSS the CV is at the statistically 'expected' CV of 0.6. Also, other than TSS excursions in March and April 2012, the WWTF met all BOD_5 and TSS concentration limits during the POR.

Also, the other significant monitoring change with this permit is that monitoring for dissolved aluminum will increase from monthly to weekly. There is high variability in the dissolved aluminum effluent concentration, with a CV of 1.5 for the POR, and the facility will be required to meet new effluent limits during this permit cycle.

Starting with the effective date of the permit and lasting for the duration of the permit cycle, self-monitoring of effluent discharged at Outfall 001 shall be conducted at the discharge structure and samples will reflect the nature and effect of the discharge as presented in Table 13.

Table 13: Outfall 001 Monitoring Requirements (1)

Parameter	Unit	Sample Location	Sample Frequency	Sample Type
Flow	mgd	Effluent	Continuous	Instantaneous (2)
5-Day Biochemical Oxygen Demand (BOD_5)	mg/L	Influent (3)	1/Week	Composite
	mg/L	Effluent	2/Week	Composite
	lb/day	Effluent	1/Month	Calculated
	% Removal	Effluent	1/Month	Calculated
Total Suspended Solids (TSS)	mg/L	Influent (3)	1/Week	Composite
	mg/L	Effluent	2/Week	Composite
	lb/day	Effluent	1/Month	Calculated
	% Removal	Effluent	1/Month	Calculated
pH	s.u.	Effluent	2/Week	Instantaneous
Temperature – summer (4)	°F	Effluent	Continuous	Instantaneous
		Upstream	Continuous	Instantaneous
E. coli Bacteria	cfu/100 mL	Effluent	2/Week	Grab
Total Residual Chlorine (5)	mg/L	Effluent	Daily	Grab
Total Ammonia as N	mg/L	Effluent	1/Week	Composite
Nitrate + Nitrite as N	mg/L	Effluent	1/Week	Composite
Total Kjeldahl Nitrogen	mg/L	Effluent	1/Week	Composite
Total Nitrogen as N (6)	mg/L	Effluent	1/Week	Calculated
	lb/day	Effluent	1/Month	Calculated
Total Phosphorus as P	mg/L	Effluent	1/Week	Composite
	lb/day	Effluent	1/Month	Calculated
Dissolved Aluminum	µg/L	Effluent	1/Week	Composite
Dissolved Oxygen	mg/L	Effluent	1/Month	Grab
Oil & Grease (7)	mg/L	Effluent	Semi-annual	Grab
Whole Effluent Toxicity, Acute	% Effluent	Effluent	1/Quarter (8)	Composite

Footnotes:

(1) See Definitions section at end of permit for explanation of terms.
(2) Requires recording device or totalizer; permittee shall report daily maximum and daily average flow on DMR.
(3) Influent BOD_5 and TSS samples shall be collected only if effluent discharge occurs in the monitoring period.
(4) Temperature monitoring by continuous data logger is required during the summer period of July 1 – September 30th.
(5) The permittee is only required to sample for total residual chlorine if chlorine is used as a disinfectant in the treatment process. If chlorine is *not* used, write "NA" on the DMR for this parameter.
(6) Calculated as the sum of Nitrate + Nitrite as N and Total Kjeldahl Nitrogen concentrations.
(7) Use EPA Method 1664, Revision A: N-Hexane Extractable Material (HEM), or equivalent.
(8) WET Testing may be reduced to one species quarterly after Whitefish passes four (4) quarters of WET testing.

VII. Nonsignificance Determination

The proposed effluent limits and discharge flows for the Whitefish WWTF do not constitute a new or increased source of pollutants pursuant to ARM 17.30.702. Therefore, a nonsignificance analysis is not required [ARM 17.30.705(1)].

VIII. Special Conditions/Compliance Schedule

(1) Effluent Diffuser Maintenance

Whitefish will develop a periodic maintenance program to ensure that the effluent diffuser is operating as designed. A summary of the program and its implementation during this permit cycle will be submitted 180 days prior to the expiration date of this permit renewal.

(2) Infiltration/Inflow

Facilities with a design average discharge rate at or above 0.1 mgd are required to summarize the influences from infiltration/inflow (I/I) to their treatment works as part of MPDES permit renewal. The summary shall provide an estimate of the amount and sources of I/I into the collection system and a summary of work accomplished and additional work planned to reduce this I/I. A summary of the program will be submitted 180 days prior to the expiration date of this permit renewal.

(3) Nutrient Variance – Optimization Study

Facilities that receive a nutrient variance must evaluate current facility operations to optimize nutrient reduction with existing infrastructure and analyze other cost-effective methods of nutrient load reductions. DEQ-12B allows for flexibility regarding the scope and content of the study but requires that the optimization study includes, but is not limited to, an assessment of nutrient trading feasibility within the watershed without substantial investment in new infrastructure. DEQ may request the permittee provide the results of the optimization study/nutrient reduction analysis within two years of receiving the variance.

This permit requires the completion of an optimization study/nutrient reduction analysis including an assessment of trading with a two year compliance schedule, as summarized in Table 14 below.

Table 14: Compliance Schedule

Action	Frequency	Scheduled Completion Date of Action(1)	Report Due Date(2)
Complete a Facility Optimization Study	Single Event	No Later than Two Years from the Effective Date of the Permit	NA
Submit Notification that the Facility Optimization Study is Complete	Single Event	No Later than Two Years from the Effective Date of the Permit	No Later than the 28th of the Month Two Years from the Effective Date of the Permit

Footnotes:
NA = Not Applicable
(1) The actions must be completed on or before the scheduled completion dates.
(2) This notification must be received by DEQ on or before the scheduled due date.

DEQ-12B encourages optimization studies that include, but are not limited to, facility operations and maintenance, reuse, recharge, and land application. However, DEQ-12B clarifies that the changes to facility operations resulting from the analysis carried out are only intended to be refinements to the wastewater treatment system already in place, addressing changes to facility operation and maintenance. Optimizations are not intended to include changes to the facility resulting in structural modification, user rate increases, or substantial capital investment.

(4) Dissolved Aluminum

Whitefish does not currently meet the proposed dissolved aluminum effluent limits. Whitefish shall meet the dissolved aluminum effluent limits by July 1, 2016.

The addition of aluminum is part of the phosphorus removal system; however, there may be operational changes that could reduce the amount of aluminum. For instance, a 2008 technical report by Anderson and Montgomery has indicated that Whitefish may be able to reduce the amount of aluminum added to the clarifier by modifying the pH.

Whitefish shall submit an annual summary of what actions have been taken and what are planned to be taken by no later than January 28, 2016.

IX. Information Sources

1. Administrative Rules of Montana Title 17 Chapter 30 - Water Quality
   - Subchapter 2 - Water Quality Permit and Application Fees,
   - Subchapter 5 - Mixing Zones in Surface and Ground Water
   - Subchapter 6 - Montana Surface Water Quality Standards and Procedures
   - Subchapter 7 - Nondegradation of Water Quality
   - Subchapter 12 - Montana Pollutant Discharge Elimination System (MPDES) Standards
   - Subchapter 13 - Montana Pollutant Discharge Elimination System (MPDES) Permits.

2. Montana Code Annotated Title 75 - Environmental Protection Chapter 5 - Water Quality.

3. Montana Department of Environmental Quality Circular DEQ-7, Montana Numeric Water Quality Standards, October 2012

4. Montana Department of Environmental Quality Circular DEQ-12A and -12B, Nutrient Standards and Nutrient Standard Variances, August 2014.

5. 40 CFR Parts 122-125, 130-133, & 136.

6. 40 CFR Part 503 – Standards for the Use or Disposal of Sewage Sludge.

7. Federal Water Pollution Control Act (Clean Water Act), 33 U.S.C. §§ 1251-1387, October 18, 1972, as amended 1973-1983, 1987, 1988, 1990-1992, 1994, 1995 and 1996.

8. Federal Water Pollution Control Act (Clean Water Act), § 303(d), 33 USC 1313(d) Montana List of Waterbodies in Need of Total Maximum Daily Load Development, 1996 and 2014.

9. MPDES Permit Number MT0020184:

    a. Administrative Record.
    b. Renewal Application DEQ Form 1 and EPA Form 2A, 2013.

10. US Department of the Interior US Geological Survey, Statistical Summaries of Streamflow in Montana and Adjacent Areas, Water Years 1900 through 2002, Scientific Investigations Report 2004-5266, 2004 (site 12366000); also Updated Electronic Records - Period of record 1929–1950; 1973–2006.

11. US EPA Technical Support Document for Water Quality-Based Toxics Control (TSD), EPA/505/2-30-001, March 1991. [TSD Tables 3-2 and 5-2]

12. US EPA NPDES Permit Writers' Manual, EPA 833-K – 10-001, September 2010.

13. US EPA Ref. 8EPR-EP, Flathead Lake (nutrients) Total Maximum Daily Load, March 2002; and "Flathead - Stillwater Planning Area Nutrient, Sediment, and Temperature TMDLs and Water Quality Improvement Plan" approved by EPA on December 17, 2014.

14. Whitefish WWTF Operations and Maintenance (O&M) Manuals:

    - City of Whitefish Wastewater Treatment Facility Plans Design Criteria Operations and Maintenance (O&M) Manual, Morrison-Maierle, Inc., 1979.
    - City of Whitefish Phosphorus Removal Clarifier Design Criteria O&M Manual Carver Engineering, 1987.
    - City of Whitefish Facilities Upgrades Design Criteria O&M Manual Anderson/Montgomery, 2003.
    - City of Whitefish Wastewater Treatment Plant Improvements 2008 – 2009 O&M Manual, Anderson/Montgomery, 2008.

Completed: Christine Weaver, March 2015

Attachment A: Whitefish WWTF – WQBEL Calculations

			Ammonia acute	Ammonia chronic		Aluminum acute	Aluminum chronic
7Q10		mgd	13	13		13	13
% of 7Q10 to use			100	100		100	100
instream flow (% of 7Q10)	Qs	mgd	13.0	13		13	13
instream concentration	Cs	mg/L	0.04	0.04	ug/L	90	90
design flow (POTW)	Qd	mgd	1.8	1.8		1.8	1.8
downstream flow (Qs + Qd)	Qr		14.8	14.8		14.8	14.8
downstream concentration or water quality standard	Cr	mg/L	3.15	1.36	ug/L	750	87
effluent concentration or WLA ((Qr*Cr) - (Qs*Cs))/Qd)	**Cd or WLA**	mg/L	**25.6**	**10.9**	ug/L	**5517**	**65**
number of samples per month (if = 1, enter 4)	N		4	4		4	4
CV (if sample set >= 10, then SD/mean, else 0.6)	CV		0.5	0.5		1.5	1.5
acute and chronic long term average (99 %tile)	LTAa LTAc		9.54	**6.33**		796	**17.3**
most conservative LTA	MIN (LTAa, LTAc)		**6.33**			**17.3**	
maximum daily limit (99 %tile)	MDL	mg/L	**17.0**		ug/L	**120**	
average monthly limit (95 %tile)	AML	mg/L	**9.2**		ug/L	**41**	

			TN chronic	TP chronic
14Q5		mgd	17	17
% of 14Q5 to use			100	100
instream flow (% of 14Q5)	Qs	mgd	17	17
instream concentration	Cs	mg/L	0.11	0.008
design flow (POTW)	Qd	mgd	1.8	1.8
downstream flow (Qs + Qd)	Qr	mgd	18.8	18.8
downstream concentration or water quality standard	Cr	mg/L	0.275	0.025
effluent concentration or WLA ((Qr*Cr) - (Qs*Cs))/Qd)	**Cd or WLA**	mg/L	**1.83**	**0.186**
number of samples per month (if = 1, enter 4)	N		4	4
CV (if sample set >= 10, then SD/mean, else 0.6)	CV		0.2	0.9
LTA	LTA		**1.46**	**0.07**
average monthly limit (95 %tile)	AML	mg/L	**1.7**	**0.14**

APPENDIX B

WHITEFISH FRESHWATER MUSSEL SURVEY

Attachment A: Whitefish WWTF – WQBEL Calculations

			Ammonia acute	Ammonia chronic		Aluminum acute	Aluminum chronic
7Q10		mgd	13	13		13	13
% of 7Q10 to use			100	100		100	100
instream flow (% of 7Q10)	Qs	mgd	13.0	13		13	13
instream concentration	Cs	mg/L	0.04	0.04	ug/L	90	90
design flow (POTW)	Qd	mgd	1.8	1.8		1.8	1.8
downstream flow (Qs + Qd)	Qr		14.8	14.8		14.8	14.8
downstream concentration or water quality standard	Cr	mg/L	3.15	1.36	ug/L	750	87
effluent concentration or WLA ((Qr*Cr) - (Qs*Cs))/Qd)	**Cd or WLA**	mg/L	**25.6**	**10.9**	ug/L	**5517**	**65**
number of samples per month (if = 1, enter 4)	N		4	4		4	4
CV (if sample set >= 10, then SD/mean, else 0.6)	CV		0.5	0.5		1.5	1.5
acute and chronic long term average (99 %tile)	LTAa LTAc		9.54	**6.33**		796	**17.3**
most conservative LTA	MIN (LTAa, LTAc)		**6.33**			**17.3**	
maximum daily limit (99 %tile)	MDL	mg/L	**17.0**		ug/L	**120**	
average monthly limit (95 %tile)	AML	mg/L	**9.2**		ug/L	**41**	

			TN	TN chronic		TP	TP chronic
14Q5		mgd		17			17
% of 14Q5 to use				100			100
instream flow (% of 14Q5)	Qs	mgd		17			17
instream concentration	Cs	mg/L		0.11			0.008
design flow (POTW)	Qd	mgd		1.8			1.8
downstream flow (Qs + Qd)	Qr	mgd		18.8			18.8
downstream concentration or water quality standard	Cr	mg/L		0.275			0.025
effluent concentration or WLA ((Qr*Cr) - (Qs*Cs))/Qd)	**Cd or WLA**	mg/L		**1.83**			**0.186**
number of samples per month (if = 1, enter 4)	N			4			4
CV (if sample set >= 10, then SD/mean, else 0.6)	CV			0.2			0.9
LTA	LTA			**1.46**			**0.07**
average monthly limit (95 %tile)	AML	mg/L	**1.7**			**0.14**	

Technical Memo

MORRISON MAIERLE, INC.

TO: Scott Anderson, P.E. Anderson-Montgomery Consulting Engineers Inc.

FROM: David Stagliano, Senior Aquatic Biologist, MMI dstagliano@m-m.net

DATE: 7/30/2014

JOB: City of Whitefish WWTP Mussel Surveys

RE: **EPA MUSSEL SPECIES ASSESSMENT BELOW WHITEFISH WWTP**

CC: Mark Brooke, P.E. MMI

☐**Urgent** ☐**For Review** ☐**Please Comment** ☐**Please Reply** ☐**For Your Use**

The City of Whitefish is upgrading their wastewater treatment facility (WWTP) and wanted to determine if freshwater mussels are (or potentially were) present in the Whitefish River near its discharge point. The Environmental Protection Agency (USEPA) has issued new aquatic life guidelines concerning the discharge of ammonia into waterbodies containing freshwater mussels (USEPA 2013a). Thus, it is incumbent upon state environmental quality agencies (MT DEQ) to know the most current distribution of freshwater mussel populations in its watersheds. The western pearlshell mussel, a Montana species of concern (SOC), is the only native mussel species potentially occurring in the Whitefish River watershed (Stagliano 2010). By evaluating the presence / absence of mussel occurrence data, the state may determine that the pursuit of site-specific ammonia criteria using the EPA Recalculation Procedure is or is not warranted (USEPA 2013b). Scientifically-defensible documentation of the presence or absence of mussel populations in a river system or stream reach could potentially save or cost a municipality or corporation millions of dollars in order for their effluent to achieve the more stringent 2013 ammonia standards. Although statewide watershed data exists for Montana's mussel species, there has been no documented pearlshell populations in the Whitefish River watershed (see Stagliano 2010).

Project Description

Morrison Maierle, Inc. was contracted to perform scientifically-defensible mussel surveys following EPA technical guidance (USEPA 2013c) in this Whitefish River reach to determine the presence or absence of mussel populations for the WWTP upgrade project. On-site surveys were performed by a qualified, professional mussel biologist with appropriate state permits necessary for this determination, where no current or historical data exist. If existing mussel survey data exists for the stream section of interest (presence or absence), it should not be over 10 years old or a re-evaluation may be needed (USEPA 2013c).

The method sections are requirements of the EPA guidance document (USEPA 2013c):

1.1 METHODS

1) Search for potential mussel occurrence records in the MT Heritage Program database (MNHP 2014), MT DEQ water quality field studies (MTDEQ 2014), FWP fisheries reports

(MFWP 2014), etc. that may have existed for this particular watershed prior to the on-site visit. These are included in the results.

2) Map the river study area within 1 km downstream of the effluent area showing aspects of the stream channel area of interest, such as study boundaries, in-stream, suitable mussel habitat features, geomorphic habitat classifications (Rosgen 1996), as well as mussel survey transects, quadrats and cells sampled, etc.
3) If the survey area does not encompass the entire site for which site-specific exemptions are ruled, provide detailed documentation how the survey can be extrapolated to the entire site.
4) Mussels surveys are performed within the appropriate time-frame (April-October) with a survey method appropriate for the waterbody being evaluated and the mussel fauna present. Relevant research studies are cited to support the sampling approach, design, and method.

1.2 RESULTS

1) There were no previously reported mussel surveys or specimen collections in the Whitefish River (MNHP 2014). The Whitefish River is currently listed on Montana's 303 (d) list as threatened for partial support for aquatic life and cold water fisheries (MDEQ 2014). Mussel surveys performed in the Stillwater River (4 sites, upstream of the City of Whitefish), an adjacent tributary river with downstream connections to the Flathead River, reported no mussels (MNHP 2014).

2) The Whitefish River was mapped for in-stream habitat and eight mussel transects (averaging 120m each) were sampled 1 km downstream of the WWTP effluent area to JP Road, and two transects 300 m upstream of the discharge point (see Map 1). Discharge reported during our survey was 308 cfs as measured at the USGS gaging station (#12366080). This river reach is dominated by run / glide geomorphology with no riffle areas, and some deep pools (Figure 1). Stream channel bankfull width in the reach averaged 35 meters (117 feet, n= 8), is moderately entrenched with an entrenchment ratio of 1.5, a width to depth ratio of 18, gradient of <1% and a moderate sinuosity of 1.2 with bottom substrate dominated by silt / clay (Table 1). These characteristics classify this stream reach as a Rosgen B6c (Rosgen 1996). Rooted aquatic macrophytes and filamentous algae comprised large portions of the stream channel, averaging 32% coverage across all transects, and occupying as much as 50% of the wetted stream width (Figure 1, 3). Aquatic vegetation had substantially less coverage in transects above the WWTP than below (Figure 3). Shading of the stream channel by riparian trees increased as we proceeded upstream to the WWTP and above.

3) Based on the known preferred habitat of the western pearlshell mussel (Rosgen C3-C4 stable, gravel-bottomed streams), and the minimal or nearly lack of this habitat mapped in the study reach (see Map 1, Figure 4), it is highly unlikely that channel benthic areas outside the specifically surveyed areas contain any mussel populations.

Table 1. *Habitat and Water Quality Parameters measured at Whitefish River transects. Transect number corresponds to Map 1. CHD= channels depths. na = not able to field measure.*

7/22/2014	Whitefish River below WWTP						Whitefish River above WWTP	
Transect	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Water Temp °C	20.4	20.5	20.5	20.5	20.6	20.6	20.5	20.5
Conductivity (µs/cm)	155	160	165	168	164	158	157	157
pH	7.85	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Bankfull width (m)	28	29	33	40	42	43	35	37
Avg. Left CHD (cm)	75	85	90	55	60	70	65	60
Avg. Center CHD (cm)	140	150	na	133	130	140	135	120
Avg. Right CHD (cm)	70	90	95	70	66	70	95	92
% Fines (Clay / Silt)	60	100	100	92	98	100	99	99
% Gravel (4-32 mm)	15	0	0	6	2	0	1	1
% Cobble (>64 mm)	25	0	0	2	0	0	0	0
% Aquatic Veg. / Algae	25	30	40	33	40	50	20	25
% Riparian Shading	10	5	10	30	40	40	50	30

4) Mussels surveys were performed on July 22nd and 23rd, 2014 within the appropriate time-frame (April-October) along longitudinal transects using both snorkeling (in depths > 1m) and aquascopes for shallower water depths in a time and distance based sampling effort (CPUE). We cumulatively sampled approximately 900 meters of stream length x 2 m search width. These sampling methods are approved methods for state-wide mussel studies and are more suited to find rare species and small populations than quadrant or cell sampling methods (Vaughn et al. 1996, Young et al. 2001).

1.3 OCCURRENCE IN THE PROJECT AREA

Based on this biologist's professional experience of the habitat requirements of the western pearlshell mussel, pertinent database and literature searches, and findings from recent site surveys, the current condition of the Whitefish River above and below the WWTP project site lacks suitable habitat to support this species, and the proposed project area is determined to be absent of any mussel populations. Historical occurrences are equally unlikely. In fact, the only mollusk species identified during the extensive surveys was the water-quality tolerant and ubiquitous, pond/marsh snail, *Stagnicola elodes* (Figure 2). Additionally, our nearly 1800 m^2 of underwater surveys recorded only one fish species present, the introduced northern pike (2 juvenile individuals).

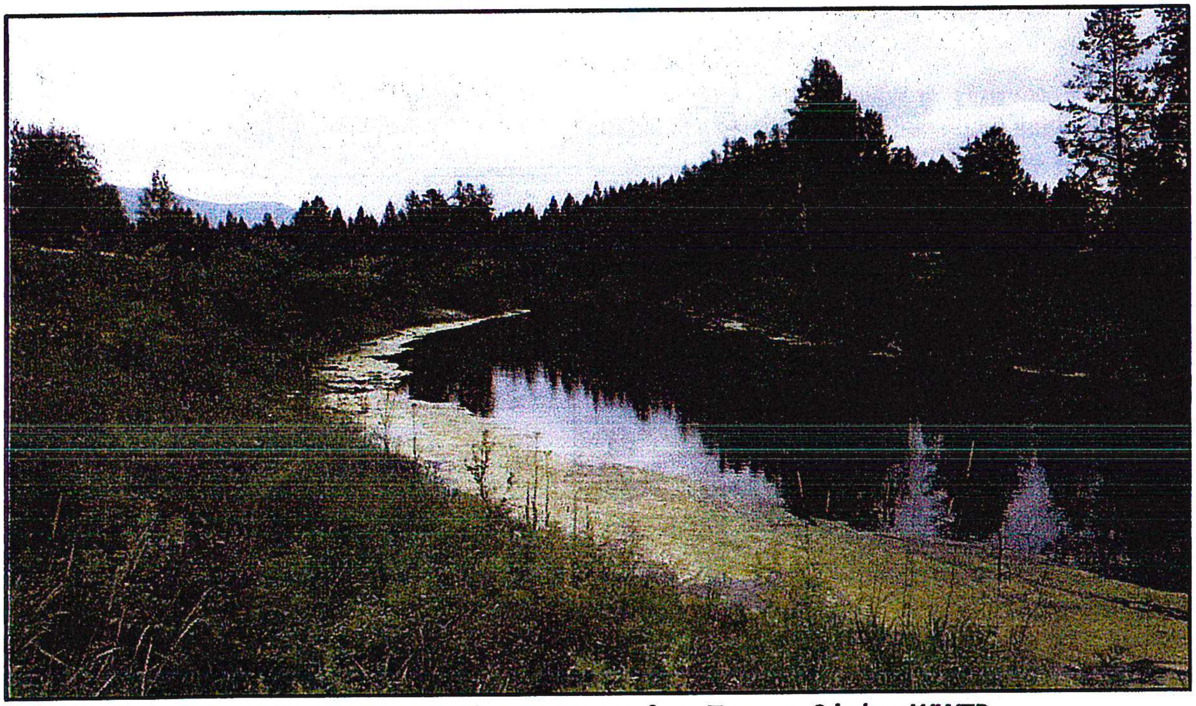
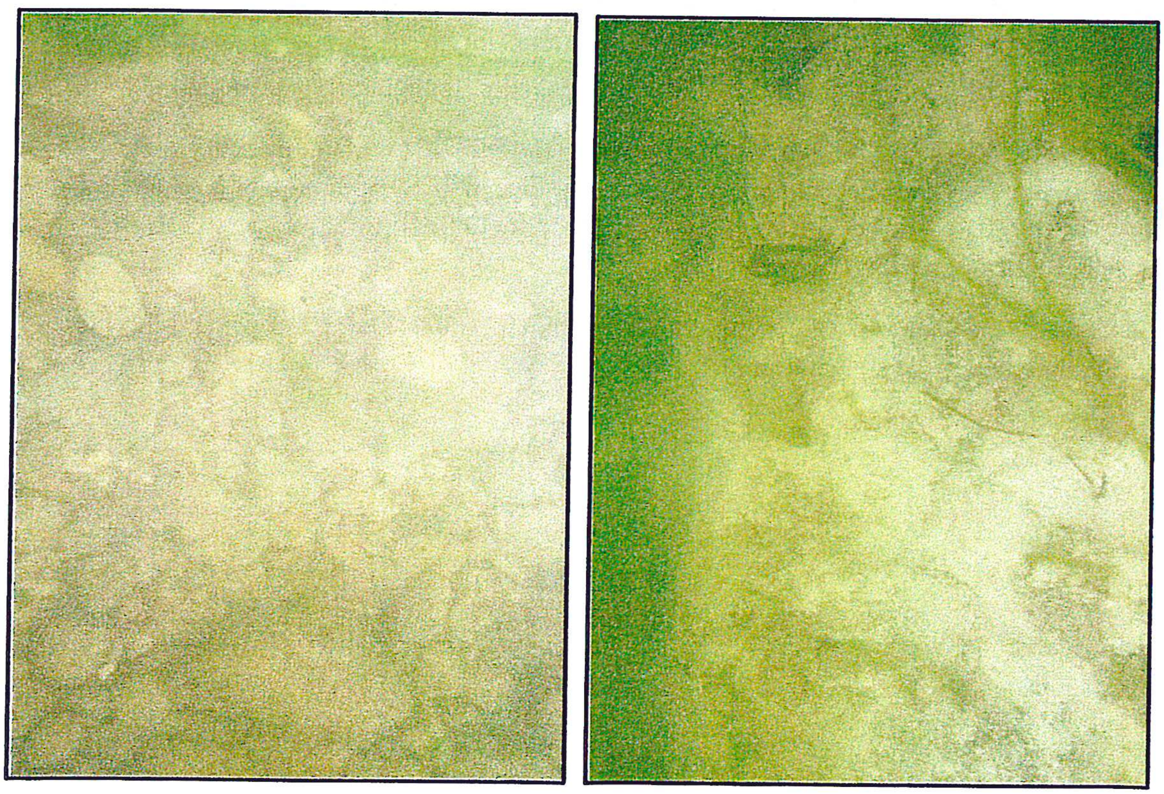


Figure 1. View of the Whitefish River looking upstream from Transect 3 below WWTP.

Figure 2. Marsh snails (Stagnicola elodes) observed during the mussel surveys.

Figure 3. View of the Whitefish River from above (left) and below (right) the WWTP.

Figure 4. Suitable (left) and non-suitable (right) benthic substrate for pearlshell mussels.



Literature Cited

Montana Bull Trout Scientific Group 1995. Flathead River Drainage Bull Trout Status Report (Including Flathead Lake, the North and Middle Forks of the Flathead River and the Stillwater and Whitefish rivers). 46 pp.

Montana Department of Environemntal Quality (MDEQ) 2014. Water Quality Standards Attainment Record. Whitefish River, Whitefish Lake to mouth (Stillwater River). 26 pp.

Montana Fish, Wildlife and Parks (MFWP). 2014. Montana Fisheries Information System (MFISH) – Whitefish River (Lake County).

Montana Natural Heritage Program (MNHP). 2014. Animal Species of Concern Reports. Western Pearlshell Mussel, NHP Database http://mtnhp.org/SpeciesOfConcern/ [Accessed: July 10, 2014).]

Rosgen, D. 1996. Applied river morphology manual. Wildlands Hydrology, Pagosa Springs, CO.

Stagliano, D. 2010. Freshwater Mussels in Montana: Comprehensive Results from 3 years of SWG Funded Surveys. Report to MT Fish Wildlife and Parks, Helena, MT 41 pp. + appendices

United States Environmental Protection Agency (USEPA). 2013a. Aquatic life ambient water quality criteria for ammonia – freshwater. EPA-822-R-13-001. National Technical Information Service, Springfield, VA.

United States Environmental Protection Agency (USEPA). 2013b. Revised deletion process for the site-specific recalculation procedure for aquatic life criteria. EPA-823-R-13-001. National Technical Information Service, Springfield, VA.

United States Environmental Protection Agency (USEPA). 2013c. Technical Support Document for Conducting and Reviewing Freshwater Mussel Studies for the Development of Site-specific Water Quality Criteria for Ammonia. National Technical Information Service, Springfield, VA.

Vaughn, C.C., C.M. Taylor and K.J. Eberhard. 1996. A Comparison of the Effectiveness of Timed Searches vs. Quadrat Sampling in Mussel Surveys. In K.S. Cummins, A.C. Buchanan, and L.M. Koch (eds.). The conservation and management of freshwater mussels II. Upper Mississippi River Cons. Rock Island Illinois.

Young, M.R., P.J. Cosgrove, L.C. Hastie and B. Henniger. 2001. A standardised method for assessing the status of freshwater mussels in shallow water. J. Moll. Stud. 67: 395-396.

APPENDIX C

DEQ ADMINISTRATIVE ORDER

cc: John W.
Greg H
Sherri B
CS
original to Necile

Montana Department of
ENVIRONMENTAL QUALITY

Brian Schweitzer, Governor
Richard H. Opper, Director

P.O. Box 200901 • Helena, MT 59620-0901 • (406) 444-2544 • www.deq.mt.gov

received
10/9/12 CS

October 5, 2012

Charles Stearns, City Manager
City of Whitefish
P.O. Box 158
Whitefish, MT 59937

RE: Administrative Order on Consent (Consent Order), Docket No. WQ-11-21 (MPDES Permit No. MT0020184, FID #2068)

Dear Mr. Stearns:

Enclosed is an executed copy of the above-referenced Consent Order. John Wilson's helpful participation was instrumental in arriving at a successful agreement. If you have any questions or comments, please feel free to contact me or Tom Bovington at (406) 444-2711. Tom is the case manager and will be tracking compliance with the Consent Order.

Sincerely,

John L. Arrigo

John L. Arrigo, Administrator
DEQ Enforcement Division
P.O. Box 200901
Helena, MT 59620-0901
(406) 444-5327; fax (406) 444-1923
email: jarrigo@mt.gov

Enclosure

cc via email: John Wilson, Public Works Director, City of Whitefish
Tom Bovington, Enforcement Division
Kari Smith, Water Protection Bureau
Jim Madden, Legal

BEFORE THE DEPARTMENT OF ENVIRONMENTAL QUALITY

OF THE STATE OF MONTANA

IN THE MATTER OF: VIOLATIONS OF THE WATER QUALITY ACT BY THE CITY OF WHITEFISH AT THE WHITEFISH WASTEWATER TREATMENT SYSTEM, FLATHEAD COUNTY, MONTANA. (MPDES PERMIT NO. MT0020184, FID #2068)	ADMINISTRATIVE ORDER ON CONSENT Docket No. WQ-11-21

I. NOTICE OF VIOLATION

Pursuant to the authority of Section 75-5-611, Montana Code Annotated (MCA), the Department of Environmental Quality (Department) hereby gives notice to the City of Whitefish (Respondent) of the following Findings of Fact and Conclusions of Law with respect to violations of the Montana Water Quality Act (WQA) (Title 75, chapter 5, part 6, MCA) and the Administrative Rules of Montana (ARM) (Title 17, chapter 30, sub-chapters 1 through 20) adopted there under.

II. FINDINGS OF FACT AND CONCLUSIONS OF LAW

The Department hereby makes the following Findings of Fact and Conclusions of Law:

1. The Department is an agency of the executive branch of government of the State of Montana, created and existing under the authority of Section 2-15-3501, MCA.

2. The Department administers the WQA.

3. Respondent is a "person" as defined in Section 75-5-103(28), MCA.

4. Section 75-5-605(1)(b), MCA, states that it is unlawful for any person to violate any provision set forth in a permit or stipulation, including but not limited to limitations and conditions contained in the permit.

5. Pursuant to Section 75-5-611, MCA, the Department may issue an order that requires corrective action and assesses an administrative penalty. The administrative penalty

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may not exceed $10,000 for each day of each violation and $100,000 for any related series of violations.

6. Respondent owns and operates a public wastewater treatment system (WWTS) to provide treatment and disposal of domestic sewage. Respondent discharges treated wastewater from its WWTS into the Whitefish River as authorized by Montana Pollutant Discharge Elimination System (MPDES) Permit No. MT0020184 (Permit). The Permit authorizes Respondent to discharge treated wastewater from its WWTS to one outfall: Outfall 001 - at the end of the pipe/ditch, discharging into the Whitefish River, located at approximately 48°23'15"N latitude, 114°20'01" W longitude.

7. On March 17, 2006, the Department received from the Respondent an application to renew the Permit.

8. On September 28, 2007, the Department notified the Respondent of the decision to issue a renewed Permit and provided Respondent a copy of the proposed permit. The proposed Permit was effective July 1, 2008 through June 30, 2013. The notification stated the Permit would become final unless an appeal was submitted to the Board of Environmental Review (BER) within 30 days.

9. On October 25, 2007, the BER received an appeal from the Respondent. The point of the appeal was to request a reasonable compliance schedule in the Permit for an engineering evaluation and implementation plan to ensure compliance with the Permit ammonia effluent limits.

10. To resolve the appeal, on April 18, 2008, the Department and the Respondent signed a Settlement Agreement (Agreement) and a Stipulation and Request for Dismissal. On May 30, 2008, the BER issued an Order of Dismissal.

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11. The Agreement provided a schedule for Respondent to comply with the Permit ammonia and nutrient limits. The schedule is dependent upon the Department's completion of the Total Maximum Daily Load (TMDL) analysis and waste load allocation by December 2011. As of the effective date of this Administrative Order on Consent (Consent Order), the TMDL has not been completed. In accordance with the Agreement, Respondent requested and the Department granted an extension for the compliance schedule, providing a maximum of one year from the date on which approved waste load allocations are received to prepare the Engineering Report and allowing all other deadlines to be adjusted accordingly.

Whole effluent toxicity Permit violations

12. Part I.B. of the Permit states: "There shall be no acute toxicity in the effluent." Acute toxicity is measured by a Whole Effluent Toxicity (WET) test.

13. Part I.C. of the Permit specifies WET monitoring requirements and states: "If acute toxicity occurs in a routine test, an additional test shall be conducted within 14 days of the date of the initial sample. Should acute toxicity occur in the second test, testing shall occur once a month until further notified by the Department."

14. Discharge Monitoring Reports (DMRs) submitted by Respondent document that the results of WET monitoring showed the effluent failed to meet the Permit prohibition of no acute toxicity in the discharge at Outfall 001 on 11 occasions. A list of the dates the effluent failed the WET test are shown on Attachment A and incorporated herein.

15. The Department sent Violation Letters to notify Respondent of the acute toxicity violations on the dates shown on Attachment B.

16. Respondent violated Part I.B. of the Permit 11 times by failing to comply with the prohibition of acute toxicity in the discharge.

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17. Respondent violated Section 75-5-605(1)(b), MCA, 11 times by failing to comply with the Permit provision that prohibits acute toxicity in the discharge.

Exceeding Permit effluent limits

18. ARM 17.30.2001 defines classes of WQA violations. Appendix A to 40 CFR 123.45 lists Group I and Group II pollutants. The Department considers Class I violations, a 40% or greater exceedance of an MPDES permit effluent limit for a Group I pollutant or a 20% or greater exceedance of a Group II effluent limit, to be significant noncompliances (SNCs).

19. Part I.B. of the Permit establishes interim and final effluent limits for Outfall 001. Interim effluent limits were in effect from July 1 2008 through June 30, 2011. Final effluent limits became effective July 1, 2011.

20. DMRs submitted by Respondent indicate the WWTP discharge exceeded Permit effluent limits for *E. coli*, Total Nitrogen (TN), Total Phosphorus (TP), Total Suspended Solids (TSS), or TSS percent removal 15 times from March 2011 through June 2012. Of those 15 exceedances, ten are considered SNCs. Attachment A lists the violations and identifies which violations are SNCs.

21. The Department sent Violation Letters to notify Respondent of the violations on the dates listed on Attachment B.

22. Respondent violated Part I.B. of the Permit by exceeding the Permit effluent limits for *E. coli*, TN, TP, TSS, or TSS percent removal from March 2011 through June 2012.

23. Respondent violated Section 75-5-605(1)(b), MCA, 14 times by exceeding Permit effluent limits from March 2011 through March 2012.

Sanitary sewer overflows (SSO) violation

24. Part I.A. of the Permit states that the authorization to discharge is limited to Outfall 001.

25. The Department received 24-hour and corresponding five-day SSO reports from Respondent for SSOs that occurred on July 21, 2010, October 20, 2010, September 19, 2011, April 12, 2012, and June 6, 2012.

26. The discharge of sewage from any location other than Outfall 001 is not authorized by the Permit. Therefore, the SSOs were discharges of sewage from locations not authorized in the Permit.

27. The Department sent violation letters on August 5, 2010, November 8, 2010, October 13, 2011, April 25, 2012, and June 18, 2012 to notify Respondent that the SSOs were unauthorized discharges and considered Permit violations.

28. Respondent violated Part I.B of the Permit five times by discharging from unauthorized locations.

29. Respondent violated Section 75-5-605(1)(b), MCA, five times by discharging from locations not authorized in the Permit.

III. ADMINISTRATIVE ORDER ON CONSENT

This Administrative Order on Consent (Consent Order) is issued to Respondent pursuant to the authority vested in the State of Montana, acting by and through the Department under the WQA and the rules adopted under the Act. NOW, THEREFORE, THE DEPARTMENT ORDERS AND RESPONDENT AGREES AS FOLLOWS:

30. Respondent shall comply with all provisions of the Permit, except the following permit requirements are stayed until notified otherwise in writing by the Department:

a. WET testing required in Part I.C.,

b. The prohibition of acute toxicity in the effluent required in Part I.B.,

c. Part I.D.2. of the Permit regarding Toxicity Reduction / Toxicity Identification Evaluation and Part I.D.3. regarding Total Ammonia – Nitrogen Effluent

Limitations, including "Compliance Schedule for Special Conditions," and

d. Any ammonia or nutrient limits established in any modified or renewed permit.

31. The Agreement described in Paragraphs 10 and 11 is hereby terminated.

32. Within 90 days of the effective date of this Consent Order, Respondent shall submit a detailed description of how and when the facility will provide optimum effluent treatment by ensuring maximum aeration and mixing within the treatment system (Optimization Plan). The Optimization Plan shall be submitted to the Department at the address in Paragraph 36.

Capacity, Management Operation and Maintenance Study (CMOM Study)

33. Within 90 days of the effective date of this Consent Order, Respondent shall submit a written plan for a CMOM Study (CMOM Plan). The goal of the CMOM Study is to identify all corrective actions needed to eliminate preventable SSOs. The CMOM Plan shall be submitted to the Department at the address in Paragraph 36.

34. The CMOM Study must be completed within 15 months of the effective date of this Consent Order. Within 45 days following completion of the CMOM Study, a CMOM Report must be submitted that summarizes the findings, conclusions and recommended corrective actions to eliminate preventable SSOs, along with a proposed schedule for implementation of the actions. Respondent shall implement the corrective actions in accordance with the Department's written approval of the report. The CMOM Report shall be submitted to the Department at the address in Paragraph 36.

Compliance with Permit acute toxicity prohibition and effluent limits for ammonia and nutrients

35. Within 90 days from the effective date of the renewed Permit, Respondent shall submit to the Department for its review a plan and schedule (Plan) to come into compliance with the renewed

Permit. The Plan must identify compliance dates for:

a. Completion of a Preliminary Engineering Review;

b. Submittal of plans and specifications to the Department in accordance with ARM 17.38.101, *ET seq*;

c. Completion of construction;

d. The final date Respondent will be in full compliance with ammonia and whole effluent toxicity requirements in the Permit or any modified or renewed permit;

e. Submittal of annual progress reports, and

f. The Plan should include a plan and schedule for addressing nutrient standards, which may include application for an individual or a general variance from nutrient standards.

36. The Optimization Plan, CMOM Plan and Report, and the Plan shall be sent to:

John L. Arrigo, Administrator
Enforcement Division
Department of Environmental Quality
1520 East Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

37. The Department will review the Plan and will notify the Respondent in writing if the Plan is approved or disapproved. If disapproved, the letter will request the Respondent to modify the Plan in accordance with the review comments and resubmit the Plan within a defined timeframe. If the resubmitted Plan is not approvable, Respondent agrees to meet with the Department as soon as is possible to discuss an approvable Plan. Approved compliance actions and dates will be incorporated by reference into this Consent Order as enforceable requirements upon written notification to Respondent by the Department.

38. Respondent may not commence or continue the construction, alteration, or extension of the WWTS prior to Department approval of plans and specifications submitted pursuant to ARM

17.38.101 *et seq.* If deficiencies are found in the plans and specifications, Respondent shall respond to any Department request for additional information and remedy any deficiency noted by the Department within 60 days after the request for information or notice of deficiency is mailed. Respondent may not commence or continue operation of the WWTS prior to certifying by letter that the modification or upgrades were completed in accordance with the approved plans and specifications, and Respondent must submit certified as-built drawings within 90 days of completion of construction as required by ARM 17.30.101(12) and (13).

39. Respondent shall submit an application for renewal of the Permit at least 180 days prior the Permit expiration date. An application for an individual or general variance from numeric nutrient standards, if applicable, must be included in the Permit renewal application or submitted as an application for a permit amendment.

40. Respondent must achieve and maintain compliance with the Permit by the final date specified in the approved compliance date incorporated into this Consent Order pursuant to Paragraph 37. If implementation of the Plan fails to achieve permanent compliance, the Department may order further steps and/or seek penalties for noncompliance.

Stipulated penalties

41. In the interest of settlement and to avoid litigation, the Department will exercise its enforcement discretion to not calculate or assess an administrative penalty for the violations alleged in this Consent Order. In lieu of an assessed penalty, Respondent agrees to pay stipulated penalties as described in Paragraph 42.

42. After the effective date of this Consent Order, Respondent shall pay to the Department the following stipulated penalties:

a. A $50 stipulated penalty for each day the Optimization Plan, CMOM Plan and Report, and the Plan required in Paragraphs 33, 34, and 35 are submitted late; and for each day a Plan deadline incorporated by reference into this Consent Order is missed;

b. A $50 stipulated penalty for future late or incomplete DMRs, or a failure to monitor for required parameters;

c. A $100 stipulated penalty for each exceedence of one or more effluent limits for a particular parameter in a month, exclusive of those permit requirements stayed under Paragraph 30; and

d. A $500 stipulated penalty for each failure to comply with the notification requirements specified in Parts II.I and II.J of the Permit.

43. The Department will send a written notice to notify the Respondent of the reason for the stipulated penalties and the amount that is due. Within 30 days after receipt of a written notice, Respondent shall pay to the Department the full amount of any stipulated penalty that is due. Stipulated penalties must be paid by check or money order, made payable to the "Montana Department of Environmental Quality," and must be sent to the Department at the address in Paragraph 36.

44. If the Department assesses stipulated penalties under this Consent Order, notifies Respondent of the reason for, and amount of the stipulated penalty and Respondent refuses to pay the amount assessed, the Department is entitled to a judgment in district court for the stipulated penalty. In such an action, Respondent may dispute the occurrence of the violation before the court; however, if the court determines that a violation has occurred, Respondent is precluded from challenging the amount of the stipulated penalty.

45. The Department acknowledges that Respondent's implementation of a capitol project of the scope that may be required by the conditions of the Permit involves coordination of planning, design, financing and construction. The Department also acknowledges that the Respondent may need accommodations to conduct simultaneous and cost-efficient planning for

Permit effluent limits for ammonia and nutrients. Thus reasonable adjustments to the approved compliance actions and dates incorporated by reference into this Consent Order as enforceable requirements pursuant to Paragraph 37 may be necessary due to factors beyond the Respondent's control.

46. If any event occurs that may result in the exceedance of an effluent limit or an enforcement limit or that may delay completion of corrective actions and cause a failure to meet a compliance deadline, Respondent shall notify the Department in writing within ten (10) days after it becomes aware of the event. The notice must be sent to the address listed in Paragraph 36. The notice of delay must include: (a) an explanation of the reasons for the delay; (b) the expected duration of the delay; (c) a description of all actions taken or planned to prevent or minimize the delay and a schedule for implementation of those actions, and (d) a request for a modification of the corrective actions and compliance dates incorporated by reference into this Consent Order pursuant to Paragraph 37, if necessary.

47. The Department will review the notice submitted by Respondent under Paragraph 46 and will exercise its enforcement discretion to determine if it is appropriate to modify the corrective actions and compliance dates and/or waive all or a portion of any stipulated penalties that may be due.

48. Failure to fulfill the requirements of this Consent Order by the specified timeframes, as ordered herein, constitutes a violation of Title 75, chapter 5, part 6, MCA, and may result in the Department seeking a court order requiring additional corrective action and assessing additional civil penalties.

IV. CONSENT TO ADMINISTRATIVE ORDER

49. Respondent waives its right to administrative appeal or judicial review of the Findings of Fact and Conclusions of Law and Administrative Order on Consent set forth herein

and agrees that this Consent Order is the final and binding resolution of the issues raised.

50. The terms of this Consent Order constitute the entire agreement between the Department and Respondent with respect to the issues addressed herein notwithstanding any other oral or written agreements and understandings made and entered into between the Department and Respondent prior to the effective date of this Consent Order.

51. Except as herein provided, no amendment, alteration, or addition to this Consent Order shall be binding unless reduced to writing and signed by both parties.

52. Each of the signatories to this Consent Order represents that he or she is authorized to enter into this Consent Order and to bind the parties represented by him or her to the terms of this Consent Order.

53. Except as provided in Paragraph 30, none of the requirements in this Consent Order are intended to relieve Respondent from its obligation to comply with all applicable state, federal, and local statutes, rules, ordinances, orders, and permit conditions.

54. This Consent Order terminates upon determination by the Department and written notification to Respondent that it has fully complied with its requirements.

55. This Consent Order becomes effective upon signature of the Director of the Department or his designee.

IT IS SO ORDERED:	IT IS SO AGREED:
STATE OF MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY	CITY OF WHITEFISH
John L. Arrigo	Charles C. Stearns
JOHN L. ARRIGO, Administrator Enforcement Division	CHARLES C. STEARNS, City Manager
10/5/12 Date	10/2/12 Date

RESPONDENT: CITY OF WHITEFISH WWTF
ATTACHMENT A : Effluent Limitation Exceedance Violations

2012

Outfall	Parameter Desc	Monitoring Period End Date	Permit Limits		DMR VALUE	Percent Exceedence		SNC
001-A	Nitrogen, total	03/31/2012	273	lb/d	289.	6		
001-A	Phosphorus, total (as P)	03/31/2012	1	mg/L	1.69	69	I	Yes
001-A	Phosphorus, total (as P)	03/31/2012	10.4	lb/d	18.4	77	I	Yes
001-A	Solids, suspended percent removal	03/31/2012	85	%	74.	73	I	Yes
001-A	Solids, total suspended	03/31/2012	30	mg/L	46.	53	I	Yes
001-A	Solids, total suspended	03/31/2012	45	mg/L	71.	58	I	Yes
001-A	Solids, total suspended	03/31/2012	313	lb/d	500.	60	I	Yes
001-A	Solids, total suspended	03/31/2012	469	lb/d	764.	63	I	Yes
001-W	Pass/Fail Static Renewal 96Hr Acute	03/31/2012	0	pass=0/fail=1	1.			
001-A	E. coli, MTEC-MF	04/30/2012	252	CFU/100mL	365.	45	II	Yes
001-A	Solids, total suspended	04/30/2012	45	mg/L	100.	122	I	Yes
001-A	Solids, total suspended	04/30/2012	469	lb/d	791.	69	I	Yes
001-A	Nitrogen, total	06/30/2012	273	lb/d	287.	5		
001-W	Pass/Fail Static Renewal 96Hr Acute	06/30/2012	0	pass=0/fail=1	1.			

2011

Outfall	Parameter Desc	Monitoring Period End Date	Permit Limits		DMR VALUE			SNC
001-A	Phosphorus, total (as P)	03/31/2011	10.4	lb/d	12.2	17		
001-A	Solids, total suspended	03/31/2011	469	lb/d	502.	7		
001-W	Pass/Fail Static Renewal 96Hr Acute	03/31/2011	0	pass=0/fail=1	1.			
001-A	Solids, suspended percent removal	06/30/2011	85	%	84.	7		
001-W	Pass/Fail Static Renewal 96Hr Acute	12/31/2011	0	pass=0/fail=1	1.			

2010

Outfall	Parameter Desc	Monitoring Period End Date	Permit Limits		DMR VALUE	Percent Exceedence		SNC
001-W	Pass/Fail Static Renewal 96Hr Acute	03/31/2010	0	pass=0/fail=1	1.			
001-W	Pass/Fail Static Renewal 96Hr Acute	09/30/2010	0	pass=0/fail=1	1.			
001-W	Pass/Fail Static Renewal 96Hr Acute	12/31/2010	0	pass=0/fail=1	1.			

2009

Outfall	Parameter Desc	Monitoring Period End Date	Permit Limits		DMR VALUE	Percent Exceedence	SNC
001-W	Pass/Fail Static Renewal 96Hr Acute	03/31/2009	0	pass=0/fail=1	1.		
001-W	Pass/Fail Static Renewal 96Hr Acute	09/30/2009	0	pass=0/fail=1	1.		
001-W	Pass/Fail Static Renewal 96Hr Acute	12/31/2009	0	pass=0/fail=1	1.		

2008

Outfall	Parameter Desc	Monitoring Period End Date	Permit Limits		DMR VALUE	Percent Exceedence	SNC
001-W	Pass/Fail Statre 48Hr Acute Ceriodaj	06/30/2008	0	pass=0/fail=1	1.		

(1) Average Monthly Limit	**Significant Non-compliance**
(2) Average Weekly Limit	
(3) Average Daily Limit	(pH of 0.5 SU above or below permit limit is a Group I Pollutant SN
(4) Instantaneous	II - Group II Pollutant Exceeds Limit by 20% or more

ATTACHMENT B

FID #2068 - City of Whitefish WWTP, MPDES Permit MT0020184
Whole Effluent Toxicity (WET) Violations and Violation Letter Dates

Monitoring Period End	Parameter	Violation Letter Date
June 30, 3008	WET test	October 17, 2008
March 31, 2009	WET test	June 3, 2009
September 30, 2009	WET test	February 11, 2010
December 31, 2009	WET test	February 11, 2010
March 31, 2010	WET test	May 18, 2010
September 30, 2010	WET test	November 19, 2010
December 31, 2010	WET test	February 7, 2011
March 31, 2011	WET test, TSS, TP	May 20, 2011
June 30, 2011	TSS%	August 19, 2011
December 31, 2011	WET test	February 15, 2012
March 31, 2012	WET test, TSS, TSS%, TP, TN	May 16, 2012
April 30, 2012	TSS, E coli	June 16, 2012
June 30, 2012	WET test, TN	August 8, 2012

APPENDIX D

COST TABLES

LAGOON OPTION 1 - BIOLAC TREATMENT LAGOON USING EXISTING CLARIFIER SYSTEM

COST ESTIMATE

Standard cost used throughout spreadsheet

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr.
Grit Removal					
Lift Station Upgrade	LS	1	$300,000	$300,000	
Imported Fill (grit and sludge pump platform)	CY	2,500	$14.25	$35,625	$35,625
Eutek Equipment (Headcell and Teacup)	LS	1	$230,000	$230,000	
Equipment Mark-up & Install	%	40%	$230,000	$92,000	
Grit Pumps & Installation	LS	1	$50,000	$50,000	
Bypass and Grit Piping	LF	80	$75	$6,000	
Non-Potable Water System	LS	1	$18,500	$18,500	$9,250.0
Non-Potable Piping	LF	440	$12	$5,280	$5,280
Grit Handling (washing & dumpsters)	LS	1	$85,000	$85,000	
Equipment Electrical & Controls	LS	1	$75,000	$75,000	
Magnetic Flow Meter	LS	1	$15,000	$15,000	
Mag Meter Structure	LS	1	$12,000	$12,000	$12,000
Building Structure	SF	400	$150	$60,000	$30,000
Electrical	%	20%	$509,500	$101,900	$50,950
HVAC	LS	1	$25,000	$25,000	
Building Finish & Painting	%	25%	$60,000	$15,000	
Building Flat Concrete	CY	40	$900	$36,000	$36,000
Subtotal:				**$1,162,305**	

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr.
Bio-P Pond (60'x45')					
Liner	SF	5,300	$3.25	$17,225	
Imported Fill (elevate floor)	CY	200	$14.25	$2,850	$2,850
Imported Fill (common dike)	CY	1,750	$14.25	$24,938	$24,938
Select backfill - liner cushion	CY	130	$32	$4,160	$4,160
Flow Control Structure	Each	2	$15,500	$31,000	$31,000
Control Valves	Each	4	$4,000	$16,000	
Influent Piping	LF	520	$75	$39,000	$39,000
Insulated Cover	SF	5,000	$11.50	$57,500	
Emergency Overflow Piping	LF	130	$75	$9,750	$9,750
Floating Mixer (Parkson)	LS	1	$20,000	$20,000	
Equipment Mark-up & Install	%	40%	$20,000	$8,000	
Subtotal:				**$230,423**	

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr.
Fermenter					
Vertical Concrete	CY	42	$1,200	$50,400	$50,400
Flat Concrete	CT	25	$900	$22,500	$22,500
Lid	LS	1	$22,500	$22,500	$22,500
Penetrations	Each	12	$425	$5,100	$5,100
Handrail	LF	150	$28	$4,200	
Floor Grating	SF	1,800	$18	$32,400	
FVA Pump & Piping	LS	1	$15,500	$15,500	
In-Vessel Pump	Each	1	$7,500	$7,500	
V-Notch Weir Plate	LF	360	$51	$18,360	
Floating Mixer (Parkson)	LS	1	$125,000	$125,000	
Equipment Mark-up & Install	%	40%	$125,000	$50,000	
Odor-Control Biofilter Vertical Concrete	CY	18	$1,200	$21,600	$21,600
Odor-Control Biofilter Flat Concrete	CY	18	$900	$16,200	$16,200
Odor-Control Biofilter Piping	LF	40	$75	$3,000	$3,000
Odor-Control Biofilter Ex. Fan & Controls	LS	1	$15,000	$15,000	
Subtotal				**$409,260**	

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr.
Treatment Pond (390'x170')					
Liner	SF	69,500	$3.25	$225,875	
Imported Fill (elevate floor)	CY	3,500	$14.25	$49,875	$20,000
Imported Fill (common dike)	CY	8,700	$14.25	$123,975	$123,975
Select backfill - liner cushion	CY	1,850	$32	$59,200	$59,200
RAS Piping	LF	450	$75	$33,750	$33,750
Control Valves	Each	5	$4,000	$20,000	
Treatment Piping	LF	180	$75	$13,500	$13,500
Aeration Header	LF	480	$75	$36,000	$36,000
Aeration Piping	LF	3520	$60	$211,200	$105,600
Equipment (Parkson)	LS	1	$1,000,000	$1,000,000	
Equipment Mark-up & Install	%	40%	$1,000,000	$400,000	
Subtotal:				**$2,173,375**	

Blower Building and Equipment					
100-Hp Blowers (Parkson)	Each	4	$25,000	$100,000	
Blower Installation	%	40%	$100,000	$40,000	
Equipment Electrical & Controls	LS	1	$75,000	$75,000	
Building Structure	SF	1,730	$150	$259,500	$129,750
Electrical	%	20%	$517,500	$103,500	$51,750
HVAC	LS	1	$29,000	$29,000	
Building Finish & Painting	%	25%	$259,500	$64,875	
Building Concrete	CY	60	$900	$54,000	$54,000
Subtotal:				**$725,875**	

Existing Clarifier (75'Dia, 14' SWD)					
12" Influent Piping	LF	100	$112.50	$11,250	$11,250
10" RAS Piping	LF	350	$112.50	$39,375	$39,375
Equipment Modifications	LS	1	$55,000	$55,000	
10" WAS Piping to Aerated Sludge Storage	LF	400	$112.50	$45,000	$45,000
Floor Grating	SF		$18	$0	
V-Notch Weir Plate	LF		$51	$0	
Equipment (WesTech)	LS		$125,000	$0	
Equipment Mark-up & Install	%		$0	$0	
Subtotal				**$150,625**	

Existing Clarifier (65'Dia, 12' SWD)					
Remove & Reinstall Dome	LS	1	$40,000	$40,000	
Remove & Scrap Existing Equipment	LS	1	$19,000	$19,000	
New Secondary Clarifier Equipment	LS	1	$220,000	$220,000	
Clarifier Equip Installation	%	30%	$220,000	$66,000	
Upgrade HVAC	LS	1	$55,000	$55,000	
Renovate Power Vents & Dampers	EA	4	$8,200	$32,800	
Renovate Deteriorated Concrete	LS	1	$55,000	$55,000	$55,000
Upgrade Electrical	LS	1	$25,000	$25,000	
Subtotal				**$512,800**	

RAS/WAS Sludge Pumping					
15 Hp WAS/RAS Sludge Pumps & VFD's	Each	3	$25,000	$75,000	
Equipment Mark-up & Install	%	40%	$75,000	$30,000	
WAS Sludge Piping	LF	480	$100	$48,000	$48,000
RAS Sludge Piping	LF	80	$200	$16,000	$16,000
Digested Sludge Line to Drying Beds	LF	310	$100	$31,000	$31,000
RAS/WAS Equipment Electrical & Controls	LS	1	$12,000	$12,000	
Building Concrete	CY	30	$1,200	$36,000	$36,000
Imported Fill	CY	700	$14.25	$9,975	$9,975
Building Structure	SF	300	$150	$45,000	$22,500.0
Electrical	%	25%	$263,000	$65,750	$32,875
HVAC	LS	1	$20,000	$20,000	
Building Finish & Painting	%	25%	$45,000	$11,250	
10 Hp Pump to Drying Beds	Each	2	$37,500	$75,000	
Equipment Mark-up & Install	%	40%	$75,000	$30,000	
Subtotal:	RAS/WAS Sludge Pumping			**$504,975**	

Digested Sludge Pumping					
10 Hp Sludge Pumps	Each	2	$15,500	$31,000	
Equipment Mark-up & Install	%	40%	$31,000	$12,400	
Equipment Electrical & Controls	LS	1	$32,000	$32,000	
Building Concrete	CY	30	$1,200	$36,000	$36,000
Imported Fill	CY	700	$14.25	$9,975	$9,975
Digested Sludge Piping	LF	380	$75	$28,500	$28,500
Building Structure	SF	300	$150	$45,000	$22,500
Electrical	%	25%	$132,000	$33,000	$16,500
HVAC	LS	1	$20,000	$20,000	
Building Finish & Painting	%	25%	$45,000	$11,250	
Subtotal:	Digested Sludge Pumping			**$259,125**	

Aerated Sludge Storage Pond					
Liner	SF	8,500	$3.25	$27,625	
Imported Fill (elevate floor)	CY	300	$14.25	$4,275	$4,275
Imported Fill (common dike)	CY	1,300	$14.25	$18,525	$18,525
Select backfill - liner cushion	CY	220	$32	$7,040	$7,040
Influent Structure	LS	1	$15,500	$15,500	$15,500
Piping WAS pump to digester	LF	100	$37	$3,700	$3,700
Aeration Diffuser & Mixing Package	LS	1	$350,000	$350,000	

Aeration/Mixing Equipment Mark-up & Install	%	40%	$350,000	$140,000	
Piping Storage to Drying Bed Pipe	LF	100	$75	$7,500	$7,500
Insulated Cover	SF	7400	$11.50	$85,100	
Supernatant/Scum Draw-Off	LS	1	$13,800	$13,800	
Supernatant Piping to Influent Line	LF	110	$75	$8,250	$8,250
Buried Control Valves	Each	13	$4,000	$52,000	
Aeration Control Valves	Each	22	$3,000	$66,000	
Aeration Header	LF	400	$175	$70,000	$35,000
Aeration Piping	LF	840	$140	$117,600	
250 Hp Blower	Each	3	$120,000	$360,000	
Blower Equipment Mark-up & Install	%	40%	$360,000	$144,000	
Equipment Electrical & Controls	LS	1	$35,000	$35,000	
Subtotal:				**$1,525,915**	

UV/Mechanical/Admin Bldg					
UV Disinfection Equipment	LS	1	$300,000	$300,000	
Install UV Equipment	%	30%	$300,000	$90,000	
UV Piping and Valves	LS	1	$132,000	$132,000	$132,000
Magnetic Flow Meter	LS	1	$25,000	$25,000	
Concrete UV Channel (30'x24'x5.5')	CY	19	$1,200	$22,800	$22,800
Imported Fill	CY	1,000	$14.25	$14,250	$14,250
Building	SF	4,000	$150	$600,000	$300,000
Non-potable Water System	LS	1	$84,600	$84,600	$42,300
Laboratory Equipment & Furnishings	LS	1	$60,000	$60,000	
HVAC	LS	1	$20,000	$20,000	
Drainage	LS	1	$10,000	$10,000	
UV Equipment Crane	Each	1	$12,000	$12,000	
Electrical/Controls	%	20%	$1,041,600	$208,320	
Effluent Piping	LF	170	$75	$12,750	
Building Finish & Painting	LS	25%	$600,000	$150,000	
Auto-Sampler	Each	1	$20,000	$20,000	
Subtotal:				**$1,761,720**	

Site Work and Misc					
Access Road/Sidewalks/Parking	LS	1	$200,000	$200,000	$200,000
Site Dewatering	LS	1	$150,000	$150,000	
Fencing	LF	4,000	$20	$80,000	
Misc. Site Grading and Earthwork	LS	1	$150,000	$150,000	$150,000
Landscaping/Irrigation	LS	1	$75,000	$75,000	
Standby Generator, pad, security	LS	1	$75,000	$75,000	
Protective Gear & Equipment	LS	1	$18,000	$18,000	
Subtotal				**$748,000**	

SUMMARY:	
Mobilization & Bonding	$752,794
Grit Removal and Lift Station Upgrade	$1,162,305
Bio-P Pond (60'x45')	$230,423
Fermenter	$409,260
Treatment Pond (390'x170')	$2,173,375
Blower Building and Equipment	$725,875
Existing Clarifier (75'Dia, 14' SWD)	$150,625
Existing Clarifier (65'Dia, 12' SWD)	$512,800
RAS/WAS Sludge Pumping	$504,975
Digested Sludge Pumping	$259,125
Aerated Sludge Storage Pond	$1,525,915
UV/Mechanical/Admin Bldg	$1,761,720
Emergency Generation (Critical Processes	$89,800
Site Work and Misc	$748,000
De-Commission & Sludge Removal Cells #1 - #3	$500,000
Total Estimated Construction Cost:	**$11,506,991**
Admin	$575,349.57
Contingency	$1,726,048.70
Engineering	$2,071,258.44
Geotechnical Investigation	$35,000
ESTIMATED CONSTRUCTION COST:	**$15,914,648**

TOTAL Salvage Value
$2,481,218

				$0.10	($/KWh)
POWER Cost Estimate	HP	% Running	HP·hr/month	KWh/yr	Power Cost/yr
Grit Removal	10	50%	3,600	32,220	$3,222
Bio-P Pond			0	0	$0
Fermenter	5	85%	3,060	27,387	$2,739
Treatment Pond			0	0	$0
Blower Building & Equipment	200	80%	115,200	1,031,040	$103,104
75' Clarifier	15	90%	9,720	86,994	$8,699
65' Clarifier	10	10%	720	6,444	$644
RAS/WAS Pumping	7.5	15%	810	7,250	$725
Digested Sludge Pumping	10	10%	720	6,444	$644
Aerated Sludge Storage Pond	250	40%	72,000	644,400	$64,440
UV/Mechanical Building	7	100%	5,040	45,108	$4,511
				1,887,287	188728.65
				Annual Power:	**$377,457**

Equipment Maint. & Materials	No.	Unit	Unit Cost	Subtotal
Headworks/Grit	1	LS	$11,500	$11,500
Fermenter	1	LS	$7,500	$7,500
Diffuser Membranes (5 yr life)	235	Each	$40	$9,400
Blower	1	LS	$8,000	$8,000
Clarifier	1	LS	$22,000	$22,000
Sludge Pumping	1	LS	$13,000	$13,000
UV Lamps (3 yr life)	24	Each	$260	$6,240
Generator	1	LS	$4,000	$4,000
Misc. (HVAC, controls, sensors, valves)	1	LS	$20,000	$20,000
Chemicals	1	LS	$40,000	$40,000
			Annual Maint.	**$141,640**

	# FTE's	#hr/yr		
	3	6240	$50.00	Labor $/hr
LABOR Cost Estimate	% Time	hr/yr	$ Labor	
Grit Removal	9%	561.6	$28,080	
Bio-P Pond	2%	124.8	$6,240	
Fermenter	5%	312	$15,600	
Treatment Pond	15%	936	$46,800	
Blower Building & Equipment	15%	936	$46,800	
Clarifiers	10%	624	$31,200	
RAS/WAS Pumping	15%	936	$46,800	
Digested Sludge Pumping	7%	436.8	$21,840	
Aerated Sludge Storage Pond	3%	187.2	$9,360	
UV/Mechanical Building	19%	1185.6	$59,280	
	100%		**$312,000**	**Annual Labor**

NET PRESENT WORTH - Biolac & Existing Clarifiers					
Interest Rate	4%		*$15,914,648*	$15,914,648	Capital Cost
			$11,294,612	$831,097	Annual O&M
			$1,132,428	$2,481,218	Salvage Value
			$26,076,833	**TOTAL NET PRESENT WORTH**	

LAGOON OPTION 2 - EDI - Intermittantly Decanted Extended Aeration Lagoon (IDEAL)

COST ESTIMATE

Standard cost used throughout spreadsheet - linked to the Biolac & New Clarifier worksheet. Changing those standard values in yellow, will change these

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr. Salvage Value
Grit Removal					
Lift Station Upgrade	LS	1	$300,000	$300,000	
Imported Fill (grit and sludge pump platform)	CY	2,500	$14.25	$35,625	$35,625
Eutek Equipment (Headcell and Teacup)	LS	1	$230,000	$230,000	
Equipment Mark-up & Install	%	40%	$230,000	$92,000	
Grit Pumps & Installation	LS	1	$50,000	$50,000	
Bypass and Grit Piping	LF	80	$75	$6,000	
Non-Potable Water System	LS	1	$18,500	$18,500	
Non-Potable Piping	LF	280	$12	$3,360	$3,360
Grit Handling (washing & dumpsters)	LS	1	$85,000	$85,000	
Equipment Electrical & Controls	LS	1	$75,000	$75,000	
Magnetic Flow Meter	LS	1	$15,000	$15,000	
Mag Meter Structure	LS	1	$12,000	$12,000	$12,000
Building Structure	SF	400	$150	$60,000	$30,000
Electrical	%	20%	$509,500	$101,900	
HVAC	LS	1	$25,000	$25,000	
Building Finish & Painting	%	25%	$60,000	$15,000	
Building Concrete	CY	40	$900	$36,000	$36,000
Subtotal:				**$1,160,385**	
Bio-Reactor Pond Two @ (400'x120')					
Liner	SF	118,000	$3.25	$383,500	
Imported Fill (elevate floor)	CY	4,300	$14.25	$61,275	$61,275
Imported Fill (common dike)	CY	15,500	$14.25	$220,875	$220,875
Select backfill - liner cushion	CY	3,300	$32	$105,600	$105,600
Influent Structure	LS	3	$15,500	$46,500	$46,500
Electrically-Actuated Control Valves	Each	4	$12,000	$48,000	
E-Activated Valve Vault	Each	4	$12,000	$48,000	
Influent Piping	LF	785	$75	$58,875	$58,875
Aeration Header	LF	580	$75	$43,500	$43,500
Air Valves (not EDI)	Each	2	$12,000	$24,000	
EDI Equipment	LS	1	$970,000	$970,000	
Equipment Mark-up & Install	%	40%	$970,000	$388,000	
Insulating Cover	SF	78,000	$5.90	$460,200	
WAS Piping	LF	800	$65	$52,000	$52,000
Subtotal:				**$2,910,325**	
Blower Building and Equipment					
100-Hp Blowers (EDI)	Each	4	$25,000	$100,000	
Blower Installation	%	40%	$100,000	$40,000	
Equipment Electrical & Controls	LS	1	$75,000	$75,000	
Building Structure	SF	1,730	$150	$259,500	$129,750
Electrical	%	20%	$517,500	$103,500	
HVAC	LS	1	$29,000	$29,000	
Building Finish & Painting	%	25%	$259,500	$64,875	
Building Concrete	CY	60	$900	$54,000	$54,000
Subtotal:				**$725,875**	
Sludge Pumping					
7.5 Hp WAS/RAS Sludge Pumps	Each	3	$13,600	$40,800	
Equipment Mark-up & Install	%	40%	$40,800	$16,320	
WAS Piping	LF	370	$55	$20,350	$20,350
RAS Piping	LF	170	$55	$9,350	$9,350
WAS Equipment Electrical & Controls	LS	1	$22,000	$22,000	
Building Concrete	CY	35	$1,200	$42,000	$42,000
Imported Fill	CY	700	$14.25	$9,975	$9,975
Building Structure	SF	400	$150	$60,000	$30,000
Electrical	%	25%	$203,600	$50,900	
HVAC	LS	1	$20,000	$20,000	
Building Finish & Painting	%	25%	$60,000	$15,000	
10 Hp Pump to Drying Beds	Each	2	$20,400	$40,800	
Equipment Mark-up & Install	%	40%	$40,800	$16,320	
Subtotal:				**$363,815**	

Post-Treatment Equalization Basin (Old N. Clarifier)					
Influent Structure	LS		$15,500	$0	
IDEAL effluent piping to EQ	LF	160	$37	$5,920	
EQ effluent piping to discharge	LF	150	$37	$5,550	
Automated fill/draw control system	LS	1	$21,000	$21,000	
Insulate Existing Cover	SF	3,350	$12.30	$41,205	
Buried Control Valves	Each	2	$12,000	$24,000	
EQ Pump	Each	3	$24,480	$73,440	
EQ Pump Controls	LS	1	$25,000	$25,000	
EQ Pump Enclosure	SF	400	$150	$60,000	
Subtotal:				**$256,115**	
UV/Mechanical/Admin Bldg					
UV Disinfection Equipment	LS	1	$300,000	$300,000	
Install UV Equipment	%	30%	$300,000	$90,000	
UV Piping and Valves	LS	1	$132,000	$132,000	$132,000
Magnetic Flow Meter	LS	1	$25,000	$25,000	
Concrete UV Channel (30'x24'x5.5')	CY	19	$1,200	$22,800	$22,800
Imported Fill	CY	1,000	$14.25	$14,250	$14,250
Building	SF	4,000	$150	$600,000	$300,000
Non-potable Water System	LS	1	$84,600	$84,600	
Laboratory Equipment & Furnishings	LS	1	$60,000	$60,000	
HVAC	LS	1	$20,000	$20,000	
Drainage	LS	1	$10,000	$10,000	
UV Equipment Crane	Each	1	$12,000	$12,000	
Electrical/Controls	%	20%	$1,041,600	$208,320	
Effluent Piping	LF	170	$75	$12,750	$12,750
Building Finish & Painting	LS	25%	$600,000	$150,000	
Auto-Sampler	Each	1	$20,000	$20,000	
Subtotal:				**$1,761,720**	

Site Work and Misc					
Access Road/Sidewalks/Parking	LS	1	$200,000	$200,000	$200,000
Site Dewatering	LS	1	$150,000	$150,000	
Fencing	LF	4,000	$20	$80,000	
Misc. Site Grading and Earthwork	LS	1	$150,000	$150,000	$150,000
Landscaping/Irrigation	LS	1	$75,000	$75,000	
Standby Generator, pad, security	LS	1	$75,000	$75,000	
Protective Gear & Equipment	LS	1	$18,000	$18,000	
Subtotal				**$748,000**	

TOTAL Salvage Value
$1,832,835

SUMMARY:	
Mobilization & Bonding	$589,836
Grit Removal	$1,160,385
Bio-Reactor Pond Two @ (400'x120')	$2,910,325
Blower Building and Equipment	$725,875
Sludge Pumping	$363,815
Post-Treatment Equalization Basin (Old N. Clarifier)	$256,115
UV/Mechanical/Admin Bldg	$1,761,720
Site Work and Misc	$748,000
De-Commission & Sludge Removal Cells #1 - #3	$500,000
Total Estimated Construction Cost:	**$9,016,071**
Admin	$450,803.57
Contingency	$1,352,410.72
Engineering	$1,622,892.86
Geotechnical Investigation	$35,000
ESTIMATED CONSTRUCTION COST:	**$12,477,179**

This alternative presumes continued use of the existing (new) flocculating clarifier for TP polishing. Existing (old) flocculating clarifier to be converted to post-treatment EQ - to meter effluent flow to UV. Sludge removal capabilities with a perforated center take-off pipe in each bioreactor cell. No aerated sludge storage. Includes new grit removal, Two EDI BioReactor Cells, renovated/expanded blower building, new UV & Administration Building.

POWER Cost Estimate	HP	% Running	HP·hr/month	KWh/yr	Power Cost/yr
				$0.10	($/KWh)
Grit Removal	10	50%	3,600	32,220	$3,222
Bio-Reactor Pond Two @ (400'x120')			0	0	$0
Blower Building and Equipment	250	90%	162,000	1,449,900	$144,990
Sludge Pumping	5	15%	540	4,833	$483
Post-Treatment Equalization Basin (Old N. Clarifier)			0	0	$0
UV/Mechanical/Admin Bldg	7	100%	5,040	45,108	$4,511
				Annual Power:	$153,206

Equipment Maint. & Materials	No.	Unit	Unit Cost	Subtotal
Headworks/Grit	1	LS	$11,500	$11,500
BioReactor Pond	1	LS	$7,500	$7,500
Diffuser Membranes (5 yr life)	145	Each	$40	$5,800
Blower	1	LS	$8,000	$8,000
Sludge Pumping	1	LS	$13,000	$13,000
UV Lamps (3 yr life)	24	Each	$260	$6,240
Generator	1	LS	$4,000	$4,000
Misc. (HVAC, controls, sensors, valves)	1	LS	$20,000	$20,000
Chemicals	1	LS	$10,000	$10,000
			Annual Maint.	$86,040

	# FTE's	#hr/yr		
	2.75	5720	$50.00	Labor $/hr
LABOR Cost Estimate	% Time	hr/yr	$ Labor	
Grit Removal	10%	572	$28,600	
Bio-Reactor Pond Two @ (400'x120')	45%	2574	$128,700	
Blower Building and Equipment	5%	286	$14,300	
Sludge Pumping	15%	858	$42,900	
Post-Treatment Equalization Basin (Old N. Clarifier)	15%	858	$42,900	
UV/Mechanical/Admin Bldg	10%	572	$28,600	
	100%		$286,000	Annual Labor

NET PRESENT WORTH - EDI/IDEAL					
Interest Rate	4%		*$12,477,179*	$12,477,179	Capital Cost
			$7,138,094	$525,246	Annual O&M
			$836,506	$1,832,835	Salvage Value
			$18,778,767	**TOTAL NET PRESENT WORTH**	

LAGOON OPTION 3 - THREE CELL COVERED LAGOONS WITH NITRIFICATION + VARIANCE FOR N

COST ESTIMATE

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr. Salvage Value
Grit Removal					
Imported Fill (grit and sludge pump platform)	CY	2,500	$14.25	$35,625	$35,625
Eutek Equipment (Headcell and Teacup)	LS	1	$230,000	$230,000	
Equipment Installation	%	40%	$230,000.00	$92,000	
Grit Pumps & Installation	LS	1	$50,000	$50,000	
Bypass and Grit Piping	LF	80	$75.00	$6,000	
Non-Potable Water System	LS	1	$18,500	$18,500	
Non-Potable Piping	LF	440	$12.00	$5,280	$5,280
Grit Handling (washing & dumpsters)	LS	1	$85,000	$85,000	
Equipment Electrical & Controls	LS	1	$75,000	$75,000	
Magnetic Flow Meter	LS	1	$15,000	$15,000	
Mag Meter Structure	LS	1	$12,000	$12,000	$12,000
Building Structure	SF	400	$150.00	$60,000	$30,000
Electrical	%	20%	$509,500.00	$101,900	
HVAC	LS	1	$25,000.00	$25,000	
Building Finish & Painting	%	25%	$60,000.00	$15,000	
Building Flat Concrete	CY	40	$900.00	$36,000	$36,000
Subtotal:				**$862,305**	

Blower Building and Equipment					
150-Hp Blowers	Each	4	$50,000	$200,000	
Blower Installation	%	40%	$200,000.00	$80,000	
Equipment Electrical & Controls	LS	1	$120,000	$120,000	
Building Structure	SF	1,730	$150.00	$259,500	$129,750.0
Electrical	%	20%	$662,500.00	$132,500	
HVAC	LS	1	$29,000.00	$29,000	
Building Finish & Painting	%	25%	$259,500.00	$64,875	
Building Concrete	CY	60	$900.00	$54,000	$27,000.0
Subtotal:				**$939,875**	

Covered Three Cell Lagoon System					
10" Forcemain	LF	780	$78.00	$60,840.00	$60,840.00
18" DIP Gravity Main	LF	1600	90	$144,000.00	$144,000.00
Control Manholes	EA	5	8500	$42,500.00	$42,500.00
Liquid Control Valves	EA	8	10000	$80,000.00	$80,000.00
Cover for Basin #1	SF	46410	$4.50	$208,845.00	
Cover for Basin #2	SF	99450	$4.50	$447,525.00	
Cover for Basin #3	SF	99450	$4.50	$447,525.00	
Dike for Basin #1 (2 sides)	CY	13355	$12.50	$166,937.50	$166,937.50
Excavation in Basin #1 (Removing 6')	CY	3375	$12.50	$42,187.50	$42,187.50
Liner Basin #1	SF	56635	$3.00	$169,905.00	
Liner Basin #2	SF	115885	$3.00	$347,655.00	
Liner Basin #3	SF	115885	$3.00	$347,655.00	
Select Backfill for Liner	LS	7100	$32.00	$227,200.00	
Aeration Piping and Control Valves	LF	4400	$60.00	$264,000.00	$132,000.00
Equipment Package	LS	1	$1,250,000.00	$1,250,000.00	
Fixed-Film Nitrification System	LS	1	$275,000.00	$275,000.00	
Subtotal				**$4,521,775.00**	

UV/Mechanical					
UV Disinfection Equipment	LS	1	$300,000.00	$300,000	
Install UV Equipment	%	30%	$300,000.00	$90,000	
UV Piping and Valves	LS	1	$132,000.00	$132,000	$132,000
Magnetic Flow Meter	LS	1	$25,000.00	$25,000	
Concrete UV Channel (30'x24'x5.5')	CY	19	$1,200.00	$22,800	$22,800
Imported Fill	CY	1,000	$14.25	$14,250	$14,250
Building	SF	2,000	$150.00	$300,000	$150,000.0
Non-potable Water System	LS	1	$84,600.00	$84,600	
Laboratory Equipment & Furnishings	LS	1	$60,000.00	$60,000	
HVAC	LS	1	$20,000.00	$20,000	
Drainage	LS	1	$10,000.00	$10,000	
UV Equipment Crane	Each	1	$12,000.00	$12,000	
Electrical/Controls	%	20%	$741,600.00	$148,320	
Effluent Piping	LF	170	$75.00	$12,750	
Building Finish & Painting	LS	25%	$300,000.00	$75,000	
Auto-Sampler	Each	1	$20,000.00	$20,000	
Subtotal:				**$1,326,720**	

Site Work and Misc					
Access Road/Sidewalks/Parking	LS	1	$100,000.00	$100,000	$100,000
Side Dewatering	LS	1	$150,000.00	$150,000	
Fencing	LF	4,000	$20.00	$80,000	
Misc. Site Grading and Earthwork	LS	1	$100,000.00	$100,000	$100,000
Landscaping/Irrigation	LS	1	$75,000.00	$75,000	
Standby Generator, pad, security	LS	1	$75,000.00	$75,000	
Protective Gear & Equipment	LS	1	$18,000.00	$18,000	
Subtotal				$598,000	

TOTAL SALVAGE VALUE
$1,463,170

SUMMARY:	
Contractor Mobilization, Insurance, Bonds	$520,000
Grit Removal	$862,305
Blower Building and Equipment	$939,875
Covered Three Cell Lagoon System	$4,521,775
UV/Mechanical	$1,326,720
Emergency Generation (Critical Processes	$126,800
Site Work and Misc	$598,000
De-Commission & Sludge Removal Cells #1 - #3	$500,000
Total Estimated Construction Cost:	**$9,395,475**
Admin	$469,773.75
Contingency	$1,409,321.25
Engineering	$1,691,185.50
Geotechnical Investigation	$35,000
ESTIMATED CONSTRUCTION COST:	**$13,000,756**

				$0.10	($/KWh)
POWER Cost Estimate	HP	% Running	HP·hr/month	KWh/yr	Power Cost/yr
Grit Removal	10	50%	3,600	32,220	$3,222
Blower Building & Aeration Equipment	300	80%	172,800	1,546,560	$154,656
UV/Mechanical Building	7	100%	5,040	45,108	$4,511
	317				
				Annual Power:	**$162,389**

Equipment Maint. & Materials	No.	Unit	Unit Cost	Subtotal
Grit Removal	1	LS	$11,500	$11,500
Diffuser Membranes (5 yr life)	300	Each	$40	$12,000
Blower	1	LS	$8,000	$8,000
UV Lamps (3 yr life)	24	Each	$260	$6,240
Nitrification				
Generator	1	LS	$4,000	$4,000
Misc. (HVAC, controls, sensors, valves)	1	LS	$20,000	$20,000
Chemicals	1	LS	$10,000	$10,000
			Annual Maint.	**$71,740**

	# FTE's	#hr/yr		
	3	6240	$50.00	Labor $/hr
LABOR Cost Estimate	% Time	hr/yr	$ Labor	
Grit Removal	9%	561.6	$28,080	
Treatment Pond	35%	2184	$109,200	
Blower Building & Equipment	20%	1248	$62,400	
UV/Mechanical Building	19%	1185.6	$59,280	
	83%		**$258,960**	**Annual Labor**

NET PRESENT WORTH - 3 Cell Lagoon w Nitrification					
Interest Rate	4%		*$13,000,756*	$13,000,756	Capital Cost
			$6,701,077	$493,089	Annual O&M
			$667,791	$1,463,170	Salvage Value
			$19,034,042	**TOTAL NET PRESENT WORTH**	

COST ESTIMATE

Mechanical Treatment Option 1 - Sequencing Batch Reactor (SBR - Sanitaire)

[ ] standard cost used throughout spreadsheet - linked to the Biolac & New Clarifier worksheet. Changing those standard values in yellow, will change these

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr. Salvage Value
Grit Removal & Chemical Feed					
Lift Station Upgrade	LS	1	$300,000	$300,000	
Imported Fill (grit and sludge pump platform)	CY	3,100	$14.25	$44,175	$44,175
Eutek Equipment (Headcell and Teacup)	LS	1	$230,000	$230,000	
Equipment Mark-up & Install	%	40%	$230,000	$92,000	
Grit Pumps & Installation	LS	1	$50,000	$50,000	
Bypass and Grit Piping	LF	80	$75	$6,000	
Non-Potable Water System	LS	1	$18,500	$18,500	
Non-Potable Piping	LF	280	$12	$3,360	$3,360
Grit Handling (washing & dumpsters)	LS	1	$85,000	$85,000	
Chemical Tankage	LS	1	$21,000	$21,000	
Chemical Feed	LS	1	$33,000	$33,000	
Equipment Electrical & Controls	LS	1	$8,100	$8,100	
Magnetic Flow Meter	LS	1	$15,000	$15,000	
Mag Meter Structure	LS	1	$12,000	$12,000	$12,000
Building Structure	SF	1,152	$150	$172,800	$86,400
Electrical	%	20%	$611,100	$122,220	
HVAC	%	25%	$172,800	$43,200	
Building Finish & Painting	%	25%	$172,800	$43,200	
Building Concrete	CY	45	$900	$40,500	$40,500
Subtotal:				**$1,340,055**	

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr. Salvage Value
Sequencing Batch Reactor					
Excavation/Backfill/Subgrade Stabilization	SF	24,900	$15	$373,500	$373,500
Subgrade Drainage	SF	24,900	$6.50	$161,850	$161,850
Imported Fill	CY	23,400	$14.25	$333,450	$333,450
Flat Concrete	CY	1,260	$900	$1,134,000	$1,134,000
Vertical Concrete	CY	960	$1,200	$1,152,000	$1,152,000
Sanitaire Equipment	LS	1	$1,303,300	$1,303,300	
Equipment Mark-up & Install	%	40%	$1,303,300	$521,320	
Influent Piping	LF	280	$75	$21,000	$21,000
Aeration Header	LF	300	$175	$52,500	$52,500
Air Valves (not Sanitaire)	Each	4	$12,000	$48,000	
Concrete Penetrations	LS	32	$1,200	$38,400	
Subgrade Gravel	CY	1,130	$38	$42,940	$42,940
Insulating Cover	SF		$5.80	$0	
WAS Piping	LF	380	$65	$24,700	$24,700
Subtotal:				**$5,206,960**	

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr. Salvage Value
Blower Building and Equipment					
125-Hp Blowers (PD from Sanitaire)	Each	4	$25,000	$100,000	
Blower Installation	%	40%	$100,000	$40,000	
Equipment Electrical & Controls	LS	1	$75,000	$75,000	
Building Renovation	SF	960	$110	$105,600	$52,800
Building Addition	SF	800	$180	$144,000	$72,000
Electrical	%	20%	$518,500	$103,700	
HVAC	%	25%	$249,600	$62,400	
Building Finish & Painting	%	25%	$249,600	$62,400	
Building Concrete	CY	35	$900	$31,500	$31,500
Subtotal:				**$724,600**	

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr. Salvage Value
Sludge Pumping					
7.5 Hp Digested Sludge Pumps	Each	3	$13,600	$40,800	
Equipment Mark-up & Install	%	40%	$40,800	$16,320	
Digested Sludge piping	LF		$55	$0	
RAS Piping	LF		$55	$0	
WAS Equipment Electrical & Controls	LS		$22,000	$0	
Building Concrete	CY		$1,200	$0	
Imported Fill	CY		$14.25	$0	
Building Structure	SF		$150	$0	
Electrical	%	25%	$81,600	$20,400	$10,200
HVAC	LS		$20,000	$0	
Building Finish & Painting	%		$0	$0	
10 Hp Pump to Drying Beds	Each	2	$20,400	$40,800	
Equipment Mark-up & Install	%	40%	$40,800	$16,320	
Subtotal:				**$134,640**	

Convert Flocculating Clarifier to Aerobic Digester					
Remove existing equipment	LS	1	$22,000	$22,000	
Coat concrete tank interior	SF	7,720	$3.25	$25,090	
Aeration Diffuser & Lateral Package	LS	1	$110,000	$110,000	
Automated Fill/Decant Control System	LS	1	$21,000	$21,000	
New Scum Draw-Off	LS	1	$13,800	$13,800	
Supernatant Piping to Influent Line	LF	300	$75	$22,500	$22,500
Buried Control Valves	Each	3	$4,000	$12,000	
Aeration Control Valves	Each	2	$12,000	$24,000	
Aeration Header	LF	100	$75	$7,500	$7,500
Aeration Manifold and Distribution Piping	LF	100	$60	$6,000	$6,000
75 Hp Blower	Each	3	$24,000	$72,000	
Blower Equipment Mark-up & Install	%	40%	$72,000	$28,800	
Blower Electrical & Controls	LS	1	$21,000	$21,000	
Subtotal:				**$385,690**	

UV/Mechanical/Admin Bldg					
UV Disinfection Equipment	LS	1	$300,000	$300,000	
Install UV Equipment	%	30%	$300,000	$90,000	
UV Piping and Valves	LS	1	$132,000	$132,000	$132,000
Magnetic Flow Meter	LS	1	$25,000	$25,000	
Concrete UV Channel (30'x24'x5.5')	CY	19	$1,200	$22,800	$22,800
Imported Fill	CY	1,000	$14.25	$14,250	$14,250
Building	SF	4,000	$150	$600,000	$300,000
Non-potable Water System	LS	1	$84,600	$84,600	$42,300
Laboratory Equipment & Furnishings	LS	1	$60,000	$60,000	
HVAC	LS	1	$20,000	$20,000	
Drainage	LS	1	$10,000	$10,000	$5,000
UV Equipment Crane	Each	1	$12,000	$12,000	
Electrical/Controls	%	20%	$1,041,600	$208,320	
Effluent Piping	LF	170	$75	$12,750	$12,750
Building Finish & Painting	LS	25%	$600,000	$150,000	
Auto-Sampler	Each	1	$20,000	$20,000	
Subtotal:				**$1,761,720**	

Site Work and Misc					
Access Road/Sidewalks/Parking	LS	1	$200,000	$200,000	$200,000
Site Dewatering	LS	1	$150,000	$150,000	
Fencing	LF	4,000	$20	$80,000	
Misc. Site Grading and Earthwork	LS	1	$150,000	$150,000	$150,000
Landscaping/Irrigation	LS	1	$75,000	$75,000	$37,500
Standby Generator, pad, security	LS	1	$75,000	$75,000	
Protective Gear & Equipment	LS	1	$18,000	$18,000	
Subtotal				**$748,000**	

TOTAL Salvage Value

$4,601,475

SUMMARY:	
Mobilization & Bonding	$756,117
Grit Removal & Chemical Feed	$1,340,055
Sequencing Batch Reactor	$5,206,960
Blower Building and Equipment	$724,600
Sludge Pumping	$134,640
Convert Flocculating Clarifier to Aerobic Digester	$385,690
UV/Mechanical/Admin Bldg	$1,761,720
Site Work and Misc	$748,000
De-Commission & Sludge Removal Cells #1 - #3	$500,000
Total Estimated Construction Cost:	**$11,557,782**
Admin	$577,889.08
Contingency	$1,733,667.23
Engineering	$2,080,400.68
Geotechnical Investigation	$35,000
ESTIMATED CONSTRUCTION COST:	**$15,984,739**

$12,629,188

This alternative presumes existing (new) flocculating clarifier will be used as aerobic sludge digester. Old flocculating clarifier will be abandoned. Post-Treatment EQ not required with Sanitaire since one basin will be decanting/discharging throughout cycle of all four basins. No need to oversize the UV capabilities. Renovated/expanded blower building, new grit removal, new admin/laboratory/UV building.

POWER Cost Estimate	HP	% Running	HP·hr/month	KWh/yr	Power Cost/yr
				$0.10	($/KWh)
Grit Removal & Chemical Feed	10	50%	3,600	32,220	$3,222
SBR Decant Pump	10	20%	1,440	12,888	$1,289
Blower Building and Equipment	150	100%	108,000	966,600	$96,660
Sludge Pumping	2.5	15%	270	2,417	$242
SBR Submersible Mixers	12	100%	8,640	77,328	$7,733
Aerobic Digester	200	50%	72,000	644,400	$64,440
UV/Mechanical/Admin Bldg	7	90%	4,536	40,597	$4,060
			Total	1,776,450	
				Annual Power:	**$177,645**

Equipment Maint. & Materials	No.	Unit	Unit Cost	Subtotal	
Headworks/Grit	1	LS	$11,500	$11,500	
SBR	1	LS	$52,500	$52,500	
Diffuser Membranes (5 yr life)	160	Each	$60	$9,600	4 headers, 200 diffusers/header. Replace 5 years.
Blower	1	LS	$8,000	$8,000	
Digester	1	LS	$22,000	$22,000	
Sludge Pumping	1	LS	$13,000	$13,000	
UV Lamps (3 yr life)	24	Each	$260	$6,240	72 total lamps - replace 24/year
Generator	1	LS	$4,000	$4,000	
Misc. (HVAC, controls, sensors, valves)	1	LS	$20,000	$20,000	
Chemicals	1	LS	$40,000	$40,000	Alum feed and polymer for sludge conditioning
			Annual Maint.	**$186,840**	

	# FTE's	#hr/yr		
	4	8320	$50.00	
LABOR Cost Estimate	% Time	hr/yr	$ Labor	
Grit Removal & Chemical Feed	10%	832	$41,600	
Sequencing Batch Reactor	50%	4160	$208,000	
Blower Building and Equipment	15%	1248	$62,400	
Sludge Pumping	3%	249.6	$12,480	
Aerobic Digester	12%	998.4	$49,920	
UV/Mechanical/Admin Bldg	10%	832	$41,600	
	100%		**$416,000**	**Annual Labor**

NET PRESENT WORTH - Sanitaire SBR					
Interest Rate	4%		*$15,984,739*	$15,984,739	Capital Cost
			$10,606,791	$780,485	Annual O&M
			$2,100,113	$4,601,475	Salvage Value
			$24,491,416	**TOTAL NET PRESENT WORTH**	

Mechanical Treatment Option 2 - Membrane Bioreactor

COST ESTIMATE

[ ] standard cost used throughout spreadsheet - linked to the Biolac & New Clarifier worksheet. Changing those standard values in yellow, will change these

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr. Salvage Value
Grit Removal & Chemical Feed					
Lift Station Upgrade	LS	1	$300,000	$300,000	
Manufacturer Equipment Package (Headcell and Teacup)	LS	1	$230,000	$230,000	
Installation of Equipment	LS	1	$60,000	$60,000	
Purchase Grit Pumps	EA	2	$25,000	$50,000	
Bypass Piping and Grit Piping	LS	1	$60,000	$60,000	
Magnetic Flow Meter	LS	1	$15,000	$15,000	
Drainage Piping	LS	1	$5,000	$5,000	
Non-Potable Water Piping	LS	1	$12,000	$12,000	
Electrical and Controls	LS	1	$75,000	$75,000	
Structure and Building				$0	
Grit Tank Wall (52 LF x 12' x 12")	CY	23	$1,200	$27,600	$27,600.00
Grit Tank Slab (13'x13'x12")	CY	7	$900	$6,300	$6,300.00
Tank Cover (Fiberglass Plank)	LS	1	$7,500	$7,500	
Open Channel Construction (Tank Entrance)	LS	1	$12,000	$12,000	$12,000.00
Building (25' x 30') CMU	SF	1500	$150	$225,000	$112,500.00
Ventilation / Odor Control	LS	1	$30,000	$30,000	
Painting	LS	1	$25,000	$25,000	
Building Electrical	LS	1	$120,000	$120,000	
ions to Existing Screens to Reduce Opening Size to 2-3 mm	LS	1	$300,000	$300,000	
Subtotal:				**$1,560,400**	

MBR Including Membrane Sludge Thickening					
Excavation/Backfill/Disposal for MBR	CY	15000	$18	$270,000	$270,000
Structural Fill	CY	3000	$25	$75,000	$75,000
MBR Control Building	SF	1600	$150	$240,000	$240,000
Concrete (basin size incr. w/ Flow Eq. Alt.)					$0
Walls	CY	891	$1,200	$1,069,200	$1,069,200
Floor/Footings	CY	660	$900	$594,000	$594,000
Subgrade Drainage	SQ FT	15000	$6	$93,750	$93,750
Equipment	LS	1	$3,552,350	$3,552,350	
Equipment Installation	LS	1	$250,000	$250,000	
Basin Covers	SQ FT	9000	$50	$450,000	
RAS/WAS Pump Station (included in MBR Package)	LS	1	$0		
Electrical	LS	1	$250,000	$250,000	
Plant Piping					
Influent Piping	FT	250	$100	$25,000	$25,000
MBR Effluent	FT	700	$100	$70,000	$70,000
Sludge Piping	FT	300	$75	$22,500	$22,500
Misc.	FT	200	$75	$15,000	
Coagulant Feed System	LS	1	$50,000	$50,000	
Valves/Misc Piping & Fittings	LS	1	$100,000	$100,000	
Subtotal:				**$7,126,800**	

Flow Equalization Basin					
Regrade Existing Lagoon	LS	1	$20,000	$20,000	$20,000
Install Dike Across Existing Aeration Basin To Create 2 MG Equalizatin Basin (260'x70'x15'swd)	CY	5000	$18	$90,000	$90,000
Line Flow Equalizaiton Basin	SF	28000	$1.25	$35,000	
Basin Piping	LF	300	$75	$22,500	
Upgrade Aeration/Mixing System	LS	1	$100,000	$100,000	
Flow Equalization Pumping System	LS	1	$200,000	$200,000	
Subtotal:				**$467,500**	

Aerobic Digestors					
DIGESTER CONSTRUCTION (2 TANKS)					
Concrete Walls	CY	131	$1,200	$157,200	$157,200.00
Concrete Floor Slab	CY	220	$900	$198,000	$198,000.00
Excavation / Backfill / Disposal	CY	10,000	$18	$180,000	$180,000.00
Structural Fill	CY	2,000	$25	$50,000	$50,000.00
Catwalks for Access	LS	1	$60,000	$60,000	
Cover	SQ FT	6,000	$50	$300,000	
Subgrade Drainage	SQ FT	6,000	$6.25	$37,500	
SITE / PROCESS PIPING					
Buried Plug Valves	EA	5	$4,000	$20,000	$10,000.00
Supernatant Withdrawal	EA	3	$1,500	$4,500	$2,250.00
Supernatant to Headworks (8-inch)	LF	150	$75	$11,250	$5,625.00
Sludge Withdrawal Piping (8-Inch to Dewatering)	LF	150	$75	$11,250	$5,625.00
Overflow Piping (8-inch)	LF	150	$75	$11,250	$5,625.00
AERATION and MIXING					
Buried 14-Inch Aeration Header	LF	770	$150	$115,500	$57,750.00
Exposed Aearation Header (14-inch SS)	LF	154	$200	$30,800	$15,400.00
Submerged Aeration Piping	LS	1	$80,000	$80,000	$12,000.00
Diffuser & Mixing Equipment Package (excludes blowers)	LS	1	$350,000	$350,000	$52,500.00
x 175 HP), Turn Down Capable, Good Eff (Equipment Only)	EA	3	$80,000	$240,000	
Installation of Mfr Equipment Package	LS	1	$125,000	$125,000	
Instrumentation	LS	1	$10,000	$10,000	$1,500.00
Rehab Existing Blower Building	LS	1	$400,000	$400,000	
Electrical	LS	1	$100,000	$100,000	$15,000.00
DIGESTER BLDG					
New Building (CMU) (40 x40)	SF	1600	$150	$240,000	$36,000.00
HVAC	LS	1	$30,000	$30,000	
Sludge and Supernatant Pumps	LS	1	$100,000	$100,000	
Digester Building Electrical	LS	1	$75,000	$75,000	$11,250.00
Building Drainage System	LS	1	$25,000	$25,000	$3,750.00
Painting	LS	1	$45,000	$45,000	
Subtotal:				**$3,007,250**	

UV/Mechanical/Admin Bldg					
UV Disinfection Equipment	LS	1	$300,000	$300,000	
Install UV Equipment	%	30%	$300,000	$90,000	
UV Piping and Valves	LS	1	$132,000	$132,000	$132,000
Magnetic Flow Meter	LS	1	$25,000	$25,000	
Concrete UV Channel (30'x24'x5.5')	CY	19	$1,200	$22,800	$22,800
Imported Fill	CY	1,000	$14.25	$14,250	$14,250
Building	SF	4,000	$150	$600,000	$300,000
Non-potable Water System	LS	1	$84,600	$84,600	
Laboratory Equipment & Furnishings	LS	1	$60,000	$60,000	
HVAC	LS	1	$20,000	$20,000	
Drainage	LS	1	$10,000	$10,000	
UV Equipment Crane	Each	1	$12,000	$12,000	
Electrical/Controls	%	20%	$1,041,600	$208,320	
Effluent Piping	LF	170	$100	$17,000	
Building Finish & Painting	LS	25%	$600,000	$150,000	
Auto-Sampler	Each	1	$20,000	$20,000	
Subtotal:				**$1,765,970**	

Site Work and Misc					
Access Road/Sidewalks/Parking	LS	1	$150,000	$150,000	$150,000
Site Dewatering	LS	1	$150,000	$150,000	
Fencing	LF	4,000	$20	$80,000	
Misc. Site Grading and Earthwork	LS	1	$150,000	$150,000	$150,000
Landscaping/Irrigation	LS	1	$75,000	$75,000	
Standby Generator, pad, security	LS	1	$90,000	$90,000	
Protective Gear & Equipment	LS	1	$18,000	$18,000	
Subtotal				**$713,000**	
					TOTAL Salvage Value
					$4,316,375

SUMMARY:	
Mobilization & Bonding	$1,059,864
Grit Removal & Chemical Feed	$1,560,400
MBR Including Membrane Sludge Thickening	$7,126,800
Flow Equalization Basin	$467,500
Aerobic Digestors	$3,007,250
UV/Mechanical/Admin Bldg	$1,765,970
Site Work and Misc	$713,000
De-Commission & Sludge Removal Cells #1 - #3	$500,000
Total Estimated Construction Cost:	**$16,200,784**
Admin	$810,039.22
Contingency	$2,430,117.66
Engineering	$2,916,141.19
Geotechnical Investigation	$35,000
ESTIMATED CONSTRUCTION COST:	**$22,392,082**

				$0.10	($/KWh)
POWER Cost Estimate	HP	% Running	HP·hr/month	KWh/yr	Power Cost/yr
Submersible Recycle Pumps for Anoxic Basin (3) - 2.3 hp	6.9	100%	4,968	44,474	$4,447
Anoxic Basin Mixers (3) - 6 hp	18	100%	12,960	116,018	$11,602
Anoxi Basin Feed Forward Pumps (3) - 6.4 hp	19.2	100%	13,824	123,752	$12,375
Pre-Aeration Blowers (3) - 50.7 hp	152.1	100%	109,512	980,351	$98,035
Membrane Permeate Pumps (6) - 3.5 hp	21	100%	15,120	135,354	$13,535
Membrane Blowers (6) - 18.8 hp	112.8	100%	81,216	727,046	$72,705
MBT Permeate Pumps (1) - 0.2 hp	0.2	100%	144	1,289	$129
MBT Blowers (1) - 5.6 hp	5.6	100%	4,032	36,094	$3,609
Grit Pumps	10	50%	3,600	32,227	$3,223
Clarifier	15	90%	9,720	87,013	$8,701
RAS/WAS Pumping	7.5	15%	810	7,251	$725
Digested Sludge/Supernatant Pumping	7.5	15%	810	7,251	$725
Dewatering Equipment	0	15%	0	0	$0
Thickening Equipment	0	15%	0	0	$0
Filtrate Pumps	2.5	15%	270	2,417	$242
Digester Blowers; (2) - 175 hp	350	90%	226,800	2,030,314	$203,031
UV Disinfection System - 5 kW	*5*	*100%*	3,600	43,200	$4,320
Flow Equalization Basin Aeration	25	25%	4,500	54,000	$5,400
Flow Equalization Basin Pumps	10	25%	1,800	21,600	$2,160
Misc. electrical cost (HVAC, lights etc)			0	0	$15,000
				Annual Power:	**$459,965**

Equipment Maint. & Materials	No.	Unit	Unit Cost	Subtotal	
UV Lamp Replacement; Based on 3 yr lamp life	24	EA	$260	$6,240	72 total lamps - replace 24/year
Msc. UV Equipment Maintenance	1	LS	$1,000	$1,000	
Ditch Equipment Maintenance	1	LS	$35,250	$35,250	
Blower Maintenance	1	LS	$10,000	$10,000	
Pump Maintenance	1	LS	$3,000	$3,000	
Headworks Equipment Maintenance	1	LS	$11,500	$11,500	
Clarifier Equipment Maintenance	1	LS	$25,000	$25,000	
Dewatering Equipment Maintenance	0	LS	$10,000		
Thickening Equipment Maintenance	0	LS	$10,000		
Chemicals	1	LS	$50,000	$50,000	
Flow Equalization Basin Pumps and Aeration	1	LS	$1,000	$1,000	
quipment Maintenance (piping, valves, HVAC, controls etc)	1	LS	$20,000	$20,000	
Annualized Cost for Membrane Replacement *	1	LS	$118,770	$118,770	
Generator Maintenance	1	LS	$4,000	$4,000	
			Annual Maint.	**$285,760**	

	# FTE's	#hr/yr		
	4	8320	$50.00	
LABOR Cost Estimate	% Time	hr/yr	$ Labor	
Grit Removal & Chemical Feed	10%	832	$41,600	
MBR Including Membrane Sludge Thickening	50%	4160	$208,000	
#REF!	15%	1248	$62,400	
#REF!	3%	249.6	$12,480	
Aerobic Digester	12%	998.4	$49,920	
UV/Mechanical/Admin Bldg	10%	832	$41,600	
	100%		**$416,000**	**Annual Labor**

NET PRESENT WORTH - Sanitaire SBR					
Interest Rate	4%		*$22,392,082*	$22,392,082	Capital Cost
			$15,787,846	$1,161,725	Annual O&M
			$1,969,994	$4,316,375	Salvage Value
			$36,209,935	**TOTAL NET PRESENT WORTH**	

Mechanical Treatment Option 3 - Oxidation Ditch (Lakeside)

COST ESTIMATE

[ ] standard cost used throughout spreadsheet - linked to the Biolac & New Clarifier worksheet. Changing those standard values in yellow, will change these

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr. Salvage Value
Grit Removal & Chemical Feed					
Lift Station Upgrade	LS	1	$300,000	$300,000	
Imported Fill (grit and sludge pump platform)	CY	3,100	$14.25	$44,175	$44,175
Eutek Equipment (Headcell and Teacup)	LS	1	$230,000	$230,000	
Equipment Mark-up & Install	%	40%	$230,000	$92,000	
Grit Pumps & Installation	LS	1	$50,000	$50,000	
Bypass and Grit Piping	LF	80	$100	$8,000	
Non-Potable Water System	LS	1	$18,500	$18,500	$9,250
Non-Potable Piping	LF	280	$12	$3,360	$3,360
Grit Handling (washing & dumpsters)	LS	1	$85,000	$85,000	
Chemical Tankage	LS	1	$21,000	$21,000	
Chemical Feed	LS	1	$33,000	$33,000	
Equipment Electrical & Controls	LS	1	$8,100	$8,100	
Magnetic Flow Meter	LS	1	$15,000	$15,000	
Mag Meter Structure	LS	1	$12,000	$12,000	$12,000
Building Structure	SF	1,152	$150	$172,800	$86,400
Electrical	%	20%	$611,100	$122,220	$61,110
HVAC	%	25%	$172,800	$43,200	
Building Finish & Painting	%	25%	$172,800	$43,200	
Building Concrete	CY	45	$900	$40,500	$40,500
Subtotal:				**$1,342,055**	

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr. Salvage Value
Oxidation Ditch					
Excavation/Backfill/Subgrade Stabilization	CY	30,000	$18	$540,000	$540,000
Subgrade Drainage	SF	24,000	$6.50	$156,000	$156,000
Structural Fill	CY	7,000	$25	$175,000	$175,000
Flat Concrete	CY	1,500	$900	$1,350,000	$1,350,000
Vertical Concrete	CY	1,100	$1,200	$1,320,000	$1,320,000
Lakeside Equipment	LS	1	$810,750	$810,750	
Equipment Mark-up & Install	%	40%	$810,750	$324,300	
Influent Piping	LF	250	$100	$25,000	$25,000
Ditch Effluent Piping	LF	560	$100	$56,000	$56,000
Clarifier Effluent Piping	LF	300	$100	$30,000	$30,000
RAS Piping	LF	400	$100	$40,000	$40,000
Miscellaneous Piping	LF	200	$75	$15,000	$15,000
WAS Piping	LF	500	$75	$37,500	$37,500
Electrical	LS	1	$200,000	$200,000	$100,000
Coagulant Feed System	LS	1	$50,000	$50,000	
Valves/Misc Fittings	LS	1	$100,000	$100,000	$50,000
Subtotal:				**$5,229,550**	

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr. Salvage Value
Sludge Thickening System					
Building	SF	3600	$150	$540,000	$270,000
Painting	LS	1	$50,000	$50,000	
Dewatering Equipment and installation	EA	1	$350,000	$350,000	
Polymer Systems	LS	1	$35,000	$35,000	$5,250
Percolate Pumping System	LS	1	$60,000	$60,000	$9,000
Sludge Feed Pump Station	LS	1	$75,000	$75,000	$11,250
Misc. Equipment & Piping	LS	1	$60,000	$60,000	$30,000
Electrical and Controls	LS	1	$150,000	$150,000	$22,500
Subtotal:				**$1,320,000**	

ITEM	Unit	Quantity	Unit Price	Unit Subtotal	20-Yr. Salvage Value
RAS/WAS Pump Station					
7.5 Hp WAS Sludge Pumps	Each	4	$18,000	$72,000	
Equipment Mark-up & Install	%	40%	$72,000	$28,800	
WAS Piping	LF	80	$55	$4,400	$4,400
RAS Piping	LF	80	$55	$4,400	$4,400
WAS Equipment Electrical & Controls	LS	1	$22,000	$22,000	
Building Concrete	CY	65	$1,200	$78,000	$78,000
Imported Fill	CY	110	$14.25	$1,568	$1,568
Building Structure	SF	600	$150	$90,000	$45,000
Electrical	%	15%	$72,000	$10,800	$5,400
HVAC	LS	1	$20,000	$20,000	
Building Finish & Painting	%	15%	$90,000	$13,500	
10 Hp Pump to Drying Beds	Each		$27,000	$0	
Equipment Mark-up & Install	%	40%	$0	$0	
Subtotal:				**$345,468**	

Re-Build/Modify Existing Flocculating Clarifiers					
75' Clarifier - Equipment Modifications	LS	1	$55,000	$55,000	
65' Clarifier					
Remove & Reinstall Dome	LS	1	$40,000	$40,000	
Remove & Scrap Existing Equipment	LS	1	$19,000	$19,000	
New Secondary Clarifier Equipment	LS	1	$220,000	$220,000	
Clarifier Equip Installation	%	30%	$220,000	$66,000	
Upgrade HVAC	LS	1	$55,000	$55,000	
Renovate Power Vents & Dampers	EA	4	$8,200	$32,800	
Renovate Deteriorated Concrete	LS	1	$55,000	$55,000	$55,000
Upgrade Electrical	LS	1%	$25,000	$250	
Subtotal:				**$543,050**	

Aerobic Digestors					
DIGESTER CONSTRUCTION (2 TANKS)					
Concrete Walls	CY	131	$1,200	$157,200	$157,200.00
Concrete Floor Slab	CY	220	$900	$198,000	$198,000.00
Excavation / Backfill / Disposal	CY	10,000	$18	$180,000	$180,000.00
Structural Fill	CY	2,000	$25	$50,000	$50,000.00
Catwalks for Access	LS	1	$60,000	$60,000	
Cover	SQ FT	6,000	$50	$300,000	
Subgrade Drainage	SQ FT	6,000	$6.25	$37,500	$37,500.00
SITE / PROCESS PIPING					
Buried Plug Valves	EA	5	$4,000	$20,000	
Supernatant Withdrawal	EA	3	$1,500	$4,500	
Supernatant to Headworks (8-inch)	LF	150	$75	$11,250	$5,625.00
Sludge Withdrawal Piping (8-Inch to Dewatering)	LF	150	$75	$11,250	$5,625.00
Overflow Piping (8-inch)	LF	150	$75	$11,250	$5,625.00
AERATION and MIXING					
Buried 14-Inch Aeration Header	LF	590	$150	$88,500	$44,250.00
Exposed Aearation Header (14-inch SS)	LF	154	$200	$30,800	$7,700.00
Submerged Aeration Piping	LS	1	$80,000	$80,000	$12,000.00
Diffuser & Mixing Equipment Package (excludes blowers	LS	1	$350,000	$350,000	
Blowers (3 x 175 HP), Turn Down Capable, Good Eff (Equ	EA	3	$80,000	$240,000	
Installation of Mfr Equipment Package	LS	1	$125,000	$125,000	
Instrumentation	LS	1	$10,000	$10,000	$1,500.00
Rehab Existing Blower Building	LS	1	$100,000	$100,000	
Electrical	LS	1	$100,000	$100,000	$50,000.00
DIGESTER BLDG					
New Building (CMU) (40 x40)	SF	1600	$150	$240,000	$120,000.00
HVAC	LS	1	$30,000	$30,000	
Sludge and Supernatant Pumps	LS	1	$100,000	$100,000	
Digester Building Electrical	LS	1	$75,000	$75,000	$37,500.00
Building Drainage System	LS	1	$25,000	$25,000	$12,500.00
Painting	LS	1	$45,000	$45,000	
Subtotal:				**$2,680,250**	

UV/Mechanical/Admin Bldg					
UV Disinfection Equipment	LS	1	$300,000	$300,000	
Install UV Equipment	%	30%	$300,000	$90,000	
UV Piping and Valves	LS	1	$132,000	$132,000	$132,000
Magnetic Flow Meter	LS	1	$25,000	$25,000	
Concrete UV Channel (30'x24'x5.5')	CY	19	$1,200	$22,800	$22,800
Imported Fill	CY	1,000	$14.25	$14,250	$14,250
Building	SF	4,000	$150	$600,000	$300,000
Non-potable Water System	LS	1	$84,600	$84,600	$42,300
Laboratory Equipment & Furnishings	LS	1	$60,000	$60,000	
HVAC	LS	1	$20,000	$20,000	
Drainage	LS	1	$10,000	$10,000	$5,000
UV Equipment Crane	Each	1	$12,000	$12,000	
Electrical/Controls	%	20%	$1,041,600	$208,320	
Effluent Piping	LF	170	$100	$17,000	$17,000
Building Finish & Painting	LS	25%	$600,000	$150,000	
Auto-Sampler	Each	1	$20,000	$20,000	
Subtotal:				**$1,765,970**	

Site Work and Misc					
Access Road/Sidewalks/Parking	LS	1	$150,000	$150,000	$150,000
Site Dewatering	LS	1	$150,000	$150,000	
Fencing	LF	4,000	$20	$80,000	
Misc. Site Grading and Earthwork	LS	1	$150,000	$150,000	$150,000
Landscaping/Irrigation	LS	1	$75,000	$75,000	
Standby Generator, pad, security	LS	1	$90,000	$90,000	
Protective Gear & Equipment	LS	1	$18,000	$18,000	
Subtotal				**$713,000**	
					TOTAL Salvage Value
					$6,451,438

SUMMARY:	
Mobilization & Bonding	$1,010,754
Grit Removal & Chemical Feed	$1,342,055
Oxidation Ditch	$5,229,550
Sludge Thickening System	$1,320,000
RAS/WAS Pump Station	$345,468
Re-Build/Modify Existing Flocculating Clarifiers	$543,050
Aerobic Digestors	$2,680,250
UV/Mechanical/Admin Bldg	$1,765,970
Site Work and Misc	$713,000
De-Commission & Sludge Removal Cells #1 - #3	$500,000
Total Estimated Construction Cost:	**$15,450,096**
Admin	$772,504.82
Contingency	$2,317,514.47
Engineering	$2,781,017.37
Geotechnical Investigation	$35,000
ESTIMATED CONSTRUCTION COST:	**$21,356,133**

				$0.10	($/KWh)
POWER Cost Estimate	HP	% Running	HP·hr/month	KWh/yr	Power Cost/yr
Ditch Rotors 90 min on/60 min off; (4)-40 hp	160	60%	69,120	618,762	$61,876
Ditch Submersible Mixers; (4) - 9 hp	36	40%	10,368	92,814	$9,281
Anaerobic Basin Submersible Mixers; (4) - 1.8 hp	8	100%	5,760	51,564	$5,156
Grit Pumps	10	50%	3,600	32,227	$3,223
Clarifier	15	90%	9,720	87,013	$8,701
RAS/WAS Pumping	7.5	15%	810	7,251	$725
Digested Sludge/Supernatant Pumping	7.5	15%	810	7,251	$725
Dewatering Equipment	0	15%	0	0	$0
Thickening Equipment	7.5	15%	810	7,251	$725
Filtrate Pumps	2.5	15%	270	2,417	$242
Blowers; (2) - 175 hp	350	90%	226,800	2,030,314	$203,031
UV Disinfection System - 5 kW	*5*	*100%*	*3,600*	43,200	$4,320
Misc. electrical cost (HVAC, lights etc)				2,980,065	$15,000
				Annual Power:	**$313,006**

Equipment Maint. & Materials	No.	Unit	Unit Cost	Subtotal	
UV Lamp Replacement; Based on 3 yr lamp life	24	EA	$260.00	$6,240	
Msc. UV Equipment Maintenance	1	LS	$1,000.00	$1,000	
Ditch Equipment Maintenance	1	LS	$35,250.00	$35,250	4 headers, 200 diffusers/header. Replace 5 years.
Blower Maintenance	1	LS	$8,000.00	$8,000	
Pump Maintenance	1	LS	$3,000.00	$3,000	
Headworks Equipment Maintenance	1	LS	$11,500.00	$11,500	
Clarifier Equipment Maintenance	1	LS	$25,000.00	$25,000	72 total lamps - replace 24/year
Dewatering Equipment Maintenance	0	LS	$10,000.00		
Thickening Equipment Maintenance	1	LS	$10,000.00	$10,000	
Chemicals	1	LS	$75,000.00	$75,000	
Msc . Equipment Maintenance (piping, valves, HVAC, controls etc)	1	LS	$20,000.00	$20,000	
Generator Maintenance	1	LS	$4,000	$4,000	Alum feed and polymer for sludge conditioning
			Annual Maint.	**$198,990**	

	# FTE's	#hr/yr		
	4	8320	$50.00	
LABOR Cost Estimate	% Time	hr/yr	$ Labor	
Grit Removal & Chemical Feed	10%	832	$41,600	
Oxidation Ditch	50%	4160	$208,000	
Sludge Thickening System	15%	1248	$62,400	
RAS/WAS Pump Station	3%	249.6	$12,480	
Aerobic Digester	12%	998.4	$49,920	
UV/Mechanical/Admin Bldg	10%	832	$41,600	
	100%		**$416,000**	**Annual Labor**

NET PRESENT WORTH - Oxidation Ditch					
Interest Rate	4%		*$21,356,133*	$21,356,133	Capital Cost
			$12,611,472	$927,996	Annual O&M
			$2,944,436	$6,451,438	Salvage Value
			$31,023,169	**TOTAL NET PRESENT WORTH**	

APPENDIX E

DEQ BASE NUMERIC STANDARDS IMPLEMENTATION GUILDANCE

cc: John W.
Greg A
Sherri B
CS
original to Necile

Montana Department of
ENVIRONMENTAL QUALITY

Brian Schweitzer, Governor
Richard H. Opper, Director

P.O. Box 200901 • Helena, MT 59620-0901 • (406) 444-2544 • www.deq.mt.gov

received
10/9/12 CS

October 5, 2012

Charles Stearns, City Manager
City of Whitefish
P.O. Box 158
Whitefish, MT 59937

RE: Administrative Order on Consent (Consent Order), Docket No. WQ-11-21 (MPDES Permit No. MT0020184, FID #2068)

Dear Mr. Stearns:

Enclosed is an executed copy of the above-referenced Consent Order. John Wilson's helpful participation was instrumental in arriving at a successful agreement. If you have any questions or comments, please feel free to contact me or Tom Bovington at (406) 444-2711. Tom is the case manager and will be tracking compliance with the Consent Order.

Sincerely,

John L. Arrigo

John L. Arrigo, Administrator
DEQ Enforcement Division
P.O. Box 200901
Helena, MT 59620-0901
(406) 444-5327; fax (406) 444-1923
email: jarrigo@mt.gov

Enclosure

cc via email: John Wilson, Public Works Director, City of Whitefish
Tom Bovington, Enforcement Division
Kari Smith, Water Protection Bureau
Jim Madden, Legal

BEFORE THE DEPARTMENT OF ENVIRONMENTAL QUALITY

OF THE STATE OF MONTANA

IN THE MATTER OF: VIOLATIONS OF THE WATER QUALITY ACT BY THE CITY OF WHITEFISH AT THE WHITEFISH WASTEWATER TREATMENT SYSTEM, FLATHEAD COUNTY, MONTANA. (MPDES PERMIT NO. MT0020184, FID #2068)	ADMINISTRATIVE ORDER ON CONSENT Docket No. WQ-11-21

I. NOTICE OF VIOLATION

Pursuant to the authority of Section 75-5-611, Montana Code Annotated (MCA), the Department of Environmental Quality (Department) hereby gives notice to the City of Whitefish (Respondent) of the following Findings of Fact and Conclusions of Law with respect to violations of the Montana Water Quality Act (WQA) (Title 75, chapter 5, part 6, MCA) and the Administrative Rules of Montana (ARM) (Title 17, chapter 30, sub-chapters 1 through 20) adopted there under.

II. FINDINGS OF FACT AND CONCLUSIONS OF LAW

The Department hereby makes the following Findings of Fact and Conclusions of Law:

1. The Department is an agency of the executive branch of government of the State of Montana, created and existing under the authority of Section 2-15-3501, MCA.

2. The Department administers the WQA.

3. Respondent is a "person" as defined in Section 75-5-103(28), MCA.

4. Section 75-5-605(1)(b), MCA, states that it is unlawful for any person to violate any provision set forth in a permit or stipulation, including but not limited to limitations and conditions contained in the permit.

5. Pursuant to Section 75-5-611, MCA, the Department may issue an order that requires corrective action and assesses an administrative penalty. The administrative penalty

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may not exceed $10,000 for each day of each violation and $100,000 for any related series of violations.

6. Respondent owns and operates a public wastewater treatment system (WWTS) to provide treatment and disposal of domestic sewage. Respondent discharges treated wastewater from its WWTS into the Whitefish River as authorized by Montana Pollutant Discharge Elimination System (MPDES) Permit No. MT0020184 (Permit). The Permit authorizes Respondent to discharge treated wastewater from its WWTS to one outfall: Outfall 001 - at the end of the pipe/ditch, discharging into the Whitefish River, located at approximately 48°23'15"N latitude, 114°20'01" W longitude.

7. On March 17, 2006, the Department received from the Respondent an application to renew the Permit.

8. On September 28, 2007, the Department notified the Respondent of the decision to issue a renewed Permit and provided Respondent a copy of the proposed permit. The proposed Permit was effective July 1, 2008 through June 30, 2013. The notification stated the Permit would become final unless an appeal was submitted to the Board of Environmental Review (BER) within 30 days.

9. On October 25, 2007, the BER received an appeal from the Respondent. The point of the appeal was to request a reasonable compliance schedule in the Permit for an engineering evaluation and implementation plan to ensure compliance with the Permit ammonia effluent limits.

10. To resolve the appeal, on April 18, 2008, the Department and the Respondent signed a Settlement Agreement (Agreement) and a Stipulation and Request for Dismissal. On May 30, 2008, the BER issued an Order of Dismissal.

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11. The Agreement provided a schedule for Respondent to comply with the Permit ammonia and nutrient limits. The schedule is dependent upon the Department's completion of the Total Maximum Daily Load (TMDL) analysis and waste load allocation by December 2011. As of the effective date of this Administrative Order on Consent (Consent Order), the TMDL has not been completed. In accordance with the Agreement, Respondent requested and the Department granted an extension for the compliance schedule, providing a maximum of one year from the date on which approved waste load allocations are received to prepare the Engineering Report and allowing all other deadlines to be adjusted accordingly.

Whole effluent toxicity Permit violations

12. Part I.B. of the Permit states: "There shall be no acute toxicity in the effluent." Acute toxicity is measured by a Whole Effluent Toxicity (WET) test.

13. Part I.C. of the Permit specifies WET monitoring requirements and states: "If acute toxicity occurs in a routine test, an additional test shall be conducted within 14 days of the date of the initial sample. Should acute toxicity occur in the second test, testing shall occur once a month until further notified by the Department."

14. Discharge Monitoring Reports (DMRs) submitted by Respondent document that the results of WET monitoring showed the effluent failed to meet the Permit prohibition of no acute toxicity in the discharge at Outfall 001 on 11 occasions. A list of the dates the effluent failed the WET test are shown on Attachment A and incorporated herein.

15. The Department sent Violation Letters to notify Respondent of the acute toxicity violations on the dates shown on Attachment B.

16. Respondent violated Part I.B. of the Permit 11 times by failing to comply with the prohibition of acute toxicity in the discharge.

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17. Respondent violated Section 75-5-605(1)(b), MCA, 11 times by failing to comply with the Permit provision that prohibits acute toxicity in the discharge.

Exceeding Permit effluent limits

18. ARM 17.30.2001 defines classes of WQA violations. Appendix A to 40 CFR 123.45 lists Group I and Group II pollutants. The Department considers Class I violations, a 40% or greater exceedance of an MPDES permit effluent limit for a Group I pollutant or a 20% or greater exceedance of a Group II effluent limit, to be significant noncompliances (SNCs).

19. Part I.B. of the Permit establishes interim and final effluent limits for Outfall 001. Interim effluent limits were in effect from July 1 2008 through June 30, 2011. Final effluent limits became effective July 1, 2011.

20. DMRs submitted by Respondent indicate the WWTP discharge exceeded Permit effluent limits for *E. coli*, Total Nitrogen (TN), Total Phosphorus (TP), Total Suspended Solids (TSS), or TSS percent removal 15 times from March 2011 through June 2012. Of those 15 exceedances, ten are considered SNCs. Attachment A lists the violations and identifies which violations are SNCs.

21. The Department sent Violation Letters to notify Respondent of the violations on the dates listed on Attachment B.

22. Respondent violated Part I.B. of the Permit by exceeding the Permit effluent limits for *E. coli*, TN, TP, TSS, or TSS percent removal from March 2011 through June 2012.

23. Respondent violated Section 75-5-605(1)(b), MCA, 14 times by exceeding Permit effluent limits from March 2011 through March 2012.

Sanitary sewer overflows (SSO) violation

24. Part I.A. of the Permit states that the authorization to discharge is limited to Outfall 001.

25. The Department received 24-hour and corresponding five-day SSO reports from Respondent for SSOs that occurred on July 21, 2010, October 20, 2010, September 19, 2011, April 12, 2012, and June 6, 2012.

26. The discharge of sewage from any location other than Outfall 001 is not authorized by the Permit. Therefore, the SSOs were discharges of sewage from locations not authorized in the Permit.

27. The Department sent violation letters on August 5, 2010, November 8, 2010, October 13, 2011, April 25, 2012, and June 18, 2012 to notify Respondent that the SSOs were unauthorized discharges and considered Permit violations.

28. Respondent violated Part I.B of the Permit five times by discharging from unauthorized locations.

29. Respondent violated Section 75-5-605(1)(b), MCA, five times by discharging from locations not authorized in the Permit.

III. ADMINISTRATIVE ORDER ON CONSENT

This Administrative Order on Consent (Consent Order) is issued to Respondent pursuant to the authority vested in the State of Montana, acting by and through the Department under the WQA and the rules adopted under the Act. NOW, THEREFORE, THE DEPARTMENT ORDERS AND RESPONDENT AGREES AS FOLLOWS:

30. Respondent shall comply with all provisions of the Permit, except the following permit requirements are stayed until notified otherwise in writing by the Department:

a. WET testing required in Part I.C.,

b. The prohibition of acute toxicity in the effluent required in Part I.B.,

c. Part I.D.2. of the Permit regarding Toxicity Reduction / Toxicity Identification Evaluation and Part I.D.3. regarding Total Ammonia – Nitrogen Effluent

Limitations, including "Compliance Schedule for Special Conditions," and

d. Any ammonia or nutrient limits established in any modified or renewed permit.

31. The Agreement described in Paragraphs 10 and 11 is hereby terminated.

32. Within 90 days of the effective date of this Consent Order, Respondent shall submit a detailed description of how and when the facility will provide optimum effluent treatment by ensuring maximum aeration and mixing within the treatment system (Optimization Plan). The Optimization Plan shall be submitted to the Department at the address in Paragraph 36.

Capacity, Management Operation and Maintenance Study (CMOM Study)

33. Within 90 days of the effective date of this Consent Order, Respondent shall submit a written plan for a CMOM Study (CMOM Plan). The goal of the CMOM Study is to identify all corrective actions needed to eliminate preventable SSOs. The CMOM Plan shall be submitted to the Department at the address in Paragraph 36.

34. The CMOM Study must be completed within 15 months of the effective date of this Consent Order. Within 45 days following completion of the CMOM Study, a CMOM Report must be submitted that summarizes the findings, conclusions and recommended corrective actions to eliminate preventable SSOs, along with a proposed schedule for implementation of the actions. Respondent shall implement the corrective actions in accordance with the Department's written approval of the report. The CMOM Report shall be submitted to the Department at the address in Paragraph 36.

Compliance with Permit acute toxicity prohibition and effluent limits for ammonia and nutrients

35. Within 90 days from the effective date of the renewed Permit, Respondent shall submit to the Department for its review a plan and schedule (Plan) to come into compliance with the renewed

Permit. The Plan must identify compliance dates for:

a. Completion of a Preliminary Engineering Review;

b. Submittal of plans and specifications to the Department in accordance with ARM 17.38.101, *ET seq*;

c. Completion of construction;

d. The final date Respondent will be in full compliance with ammonia and whole effluent toxicity requirements in the Permit or any modified or renewed permit;

e. Submittal of annual progress reports, and

f. The Plan should include a plan and schedule for addressing nutrient standards, which may include application for an individual or a general variance from nutrient standards.

36. The Optimization Plan, CMOM Plan and Report, and the Plan shall be sent to:

John L. Arrigo, Administrator
Enforcement Division
Department of Environmental Quality
1520 East Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

37. The Department will review the Plan and will notify the Respondent in writing if the Plan is approved or disapproved. If disapproved, the letter will request the Respondent to modify the Plan in accordance with the review comments and resubmit the Plan within a defined timeframe. If the resubmitted Plan is not approvable, Respondent agrees to meet with the Department as soon as is possible to discuss an approvable Plan. Approved compliance actions and dates will be incorporated by reference into this Consent Order as enforceable requirements upon written notification to Respondent by the Department.

38. Respondent may not commence or continue the construction, alteration, or extension of the WWTS prior to Department approval of plans and specifications submitted pursuant to ARM

17.38.101 *et seq.* If deficiencies are found in the plans and specifications, Respondent shall respond to any Department request for additional information and remedy any deficiency noted by the Department within 60 days after the request for information or notice of deficiency is mailed. Respondent may not commence or continue operation of the WWTS prior to certifying by letter that the modification or upgrades were completed in accordance with the approved plans and specifications, and Respondent must submit certified as-built drawings within 90 days of completion of construction as required by ARM 17.30.101(12) and (13).

39. Respondent shall submit an application for renewal of the Permit at least 180 days prior the Permit expiration date. An application for an individual or general variance from numeric nutrient standards, if applicable, must be included in the Permit renewal application or submitted as an application for a permit amendment.

40. Respondent must achieve and maintain compliance with the Permit by the final date specified in the approved compliance date incorporated into this Consent Order pursuant to Paragraph 37. If implementation of the Plan fails to achieve permanent compliance, the Department may order further steps and/or seek penalties for noncompliance.

Stipulated penalties

41. In the interest of settlement and to avoid litigation, the Department will exercise its enforcement discretion to not calculate or assess an administrative penalty for the violations alleged in this Consent Order. In lieu of an assessed penalty, Respondent agrees to pay stipulated penalties as described in Paragraph 42.

42. After the effective date of this Consent Order, Respondent shall pay to the Department the following stipulated penalties:

a. A $50 stipulated penalty for each day the Optimization Plan, CMOM Plan and Report, and the Plan required in Paragraphs 33, 34, and 35 are submitted late; and for each day a Plan deadline incorporated by reference into this Consent Order is missed;

b. A $50 stipulated penalty for future late or incomplete DMRs, or a failure to monitor for required parameters;

c. A $100 stipulated penalty for each exceedence of one or more effluent limits for a particular parameter in a month, exclusive of those permit requirements stayed under Paragraph 30; and

d. A $500 stipulated penalty for each failure to comply with the notification requirements specified in Parts II.I and II.J of the Permit.

43. The Department will send a written notice to notify the Respondent of the reason for the stipulated penalties and the amount that is due. Within 30 days after receipt of a written notice, Respondent shall pay to the Department the full amount of any stipulated penalty that is due. Stipulated penalties must be paid by check or money order, made payable to the "Montana Department of Environmental Quality," and must be sent to the Department at the address in Paragraph 36.

44. If the Department assesses stipulated penalties under this Consent Order, notifies Respondent of the reason for, and amount of the stipulated penalty and Respondent refuses to pay the amount assessed, the Department is entitled to a judgment in district court for the stipulated penalty. In such an action, Respondent may dispute the occurrence of the violation before the court; however, if the court determines that a violation has occurred, Respondent is precluded from challenging the amount of the stipulated penalty.

45. The Department acknowledges that Respondent's implementation of a capitol project of the scope that may be required by the conditions of the Permit involves coordination of planning, design, financing and construction. The Department also acknowledges that the Respondent may need accommodations to conduct simultaneous and cost-efficient planning for

Permit effluent limits for ammonia and nutrients. Thus reasonable adjustments to the approved compliance actions and dates incorporated by reference into this Consent Order as enforceable requirements pursuant to Paragraph 37 may be necessary due to factors beyond the Respondent's control.

46. If any event occurs that may result in the exceedance of an effluent limit or an enforcement limit or that may delay completion of corrective actions and cause a failure to meet a compliance deadline, Respondent shall notify the Department in writing within ten (10) days after it becomes aware of the event. The notice must be sent to the address listed in Paragraph 36. The notice of delay must include: (a) an explanation of the reasons for the delay; (b) the expected duration of the delay; (c) a description of all actions taken or planned to prevent or minimize the delay and a schedule for implementation of those actions, and (d) a request for a modification of the corrective actions and compliance dates incorporated by reference into this Consent Order pursuant to Paragraph 37, if necessary.

47. The Department will review the notice submitted by Respondent under Paragraph 46 and will exercise its enforcement discretion to determine if it is appropriate to modify the corrective actions and compliance dates and/or waive all or a portion of any stipulated penalties that may be due.

48. Failure to fulfill the requirements of this Consent Order by the specified timeframes, as ordered herein, constitutes a violation of Title 75, chapter 5, part 6, MCA, and may result in the Department seeking a court order requiring additional corrective action and assessing additional civil penalties.

IV. CONSENT TO ADMINISTRATIVE ORDER

49. Respondent waives its right to administrative appeal or judicial review of the Findings of Fact and Conclusions of Law and Administrative Order on Consent set forth herein

and agrees that this Consent Order is the final and binding resolution of the issues raised.

50. The terms of this Consent Order constitute the entire agreement between the Department and Respondent with respect to the issues addressed herein notwithstanding any other oral or written agreements and understandings made and entered into between the Department and Respondent prior to the effective date of this Consent Order.

51. Except as herein provided, no amendment, alteration, or addition to this Consent Order shall be binding unless reduced to writing and signed by both parties.

52. Each of the signatories to this Consent Order represents that he or she is authorized to enter into this Consent Order and to bind the parties represented by him or her to the terms of this Consent Order.

53. Except as provided in Paragraph 30, none of the requirements in this Consent Order are intended to relieve Respondent from its obligation to comply with all applicable state, federal, and local statutes, rules, ordinances, orders, and permit conditions.

54. This Consent Order terminates upon determination by the Department and written notification to Respondent that it has fully complied with its requirements.

55. This Consent Order becomes effective upon signature of the Director of the Department or his designee.

IT IS SO ORDERED:

STATE OF MONTANA
DEPARTMENT OF ENVIRONMENTAL QUALITY

John L. Arrigo

JOHN L. ARRIGO, Administrator
Enforcement Division

10/5/12
Date

IT IS SO AGREED:

CITY OF WHITEFISH

Charles C. Stearns

CHARLES C. STEARNS, City Manager

10/2/12
Date

RESPONDENT: CITY OF WHITEFISH WWTF
ATTACHMENT A : Effluent Limitation Exceedance Violations

2012

Outfall	Parameter Desc	Monitoring Period End Date	Permit Limits		DMR VALUE	Percent Exceedence		SNC
001-A	Nitrogen, total	03/31/2012	273	lb/d	289.	6		
001-A	Phosphorus, total (as P)	03/31/2012	1	mg/L	1.69	69	I	Yes
001-A	Phosphorus, total (as P)	03/31/2012	10.4	lb/d	18.4	77	I	Yes
001-A	Solids, suspended percent removal	03/31/2012	85	%	74.	73	I	Yes
001-A	Solids, total suspended	03/31/2012	30	mg/L	46.	53	I	Yes
001-A	Solids, total suspended	03/31/2012	45	mg/L	71.	58	I	Yes
001-A	Solids, total suspended	03/31/2012	313	lb/d	500.	60	I	Yes
001-A	Solids, total suspended	03/31/2012	469	lb/d	764.	63	I	Yes
001-W	Pass/Fail Static Renewal 96Hr Acute	03/31/2012	0	pass=0/fail=1	1.			
001-A	E. coli, MTEC-MF	04/30/2012	252	CFU/100mL	365.	45	II	Yes
001-A	Solids, total suspended	04/30/2012	45	mg/L	100.	122	I	Yes
001-A	Solids, total suspended	04/30/2012	469	lb/d	791.	69	I	Yes
001-A	Nitrogen, total	06/30/2012	273	lb/d	287.	5		
001-W	Pass/Fail Static Renewal 96Hr Acute	06/30/2012	0	pass=0/fail=1	1.			

2011

Outfall	Parameter Desc	Monitoring Period End Date	Permit Limits		DMR VALUE	Percent Exceedence		SNC
001-A	Phosphorus, total (as P)	03/31/2011	10.4	lb/d	12.2	17		
001-A	Solids, total suspended	03/31/2011	469	lb/d	502.	7		
001-W	Pass/Fail Static Renewal 96Hr Acute	03/31/2011	0	pass=0/fail=1	1.			
001-A	Solids, suspended percent removal	06/30/2011	85	%	84.	7		
001-W	Pass/Fail Static Renewal 96Hr Acute	12/31/2011	0	pass=0/fail=1	1.			

2010

Outfall	Parameter Desc	Monitoring Period End Date	Permit Limits		DMR VALUE	Percent Exceedence		SNC
001-W	Pass/Fail Static Renewal 96Hr Acute	03/31/2010	0	pass=0/fail=1	1.			
001-W	Pass/Fail Static Renewal 96Hr Acute	09/30/2010	0	pass=0/fail=1	1.			
001-W	Pass/Fail Static Renewal 96Hr Acute	12/31/2010	0	pass=0/fail=1	1.			

2009

Outfall	Parameter Desc	Monitoring Period End Date	Permit Limits		DMR VALUE	Percent Exceedance	SNC
001-W	Pass/Fail Static Renewal 96Hr Acute	03/31/2009	0	pass=0/fail=1	1.		
001-W	Pass/Fail Static Renewal 96Hr Acute	09/30/2009	0	pass=0/fail=1	1.		
001-W	Pass/Fail Static Renewal 96Hr Acute	12/31/2009	0	pass=0/fail=1	1.		

2008

Outfall	Parameter Desc	Monitoring Period End Date	Permit Limits		DMR VALUE	Percent Exceedance	SNC
001-W	Pass/Fail Statre 48Hr Acute Cerioda	06/30/2008	0	pass=0/fail=1	1.		

(1) Average Monthly Limit	**Significant Non-compliance**
(2) Average Weekly Limit	
(3) Average Daily Limit	(pH of 0.5 SU above or below permit limit is a Group I Pollutant SN
(4) Instantaneous	II - Group II Pollutant Exceeds Limit by 20% or more

ATTACHMENT B

FID #2068 - City of Whitefish WWTP, MPDES Permit MT0020184
Whole Effluent Toxicity (WET) Violations and Violation Letter Dates

Monitoring Period End	Parameter	Violation Letter Date
June 30, 3008	WET test	October 17, 2008
March 31, 2009	WET test	June 3, 2009
September 30, 2009	WET test	February 11, 2010
December 31, 2009	WET test	February 11, 2010
March 31, 2010	WET test	May 18, 2010
September 30, 2010	WET test	November 19, 2010
December 31, 2010	WET test	February 7, 2011
March 31, 2011	WET test, TSS, TP	May 20, 2011
June 30, 2011	TSS%	August 19, 2011
December 31, 2011	WET test	February 15, 2012
March 31, 2012	WET test, TSS, TSS%, TP, TN	May 16, 2012
April 30, 2012	TSS, E coli	June 16, 2012
June 30, 2012	WET test, TN	August 8, 2012

Montana Department of ENVIRONMENTAL QUALITY

Base Numeric Nutrient Standards Implementation Guidance

Version 1.0

JULY 2014

Prepared by:
Water Quality Planning Bureau, Water Quality Standards Section
Montana Department of Environmental Quality
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

WQPBWQSTR-002

Acronyms

Acronym	Definition
AFDM	Ash Free Dry Mass
$CBOD_{20}$	Carbonaceous Biochemical Oxygen Demand, run for 20 consecutive days
DEQ	Department of Environmental Quality (Montana)
DO	Dissolved Oxygen
EMAP	Environmental Monitoring and Assessment Program
EPA	Environmental Protection Agency (U.S.)
EPT	Ephemeroptera, Plecoptera, and Trichoptera
HBI	Hilsenhoff Biotic Index
ISS	Inorganic Suspended Sediment
LMI	Low to Moderate Income
MCA	Montana Code Annotated
MHI	Median Household Income
PAR	Photosynthetically Active Radiation
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorus
TSS	Total Suspended Solids
USGS	United States Geological Survey
WRF	Water Reclamation Facility
WWTP	Wastewater Treatment Plant

1.0 Introduction

This document was developed through the collective efforts of the Nutrient Work Group and the Department. It provides guidance pertaining to the implementation of Montana's base numeric nutrient standards and variances from those standards. The remaining sections address the following topics:

Section 2.0: For permittees operating under a general nutrient standards variance, this section provides the defined effluent limits (i.e., nutrient reduction steps) to be met over several permit cycles of the general variance.

Section 3.0: Provides guidance for the development of individual nutrient standards variances for public- and private-sector entities, based on economic factors and the limits of technology.

Section 4.0: Provides detailed, data-intensive modeling approaches for developing site-specific numeric nutrient criteria. This approach lends itself to the development of model-based individual variances for dischargers.

Section 5.0: Provides guidance for the development of alternative nutrient standards variances for public- and private-sector entities.

Section 6.0: Outlines a streamlined approach for developing site-specific numeric nutrient criteria for streams or rivers where full biological support is demonstrated but where the existing nutrient concentrations exceed applicable base numeric nutrient standards.

1.1 Scope

The provisions for general, individual, and alternative variances in section 75-5-313, Montana Code Annotated (MCA), are available to all discharge permit holders and are not limited to dischargers under permit on the effective dates of Department of Environmental Quality (DEQ) Circular DEQ-12A or DEQ Circular DEQ-12B.

1.2 Definitions

1. Limits of technology means treatment for the removal of nitrogen and phosphorus compounds from wastewater that meets the more stringent of the following: (a) ability to consistently achieve a concentration of 70 µg Total Phosphorus (TP)/L and 4,000 µg Total Nitrogen (TN)/L, or (b) the best demonstrated control technology, processes, or operating methods available at the time the Department evaluates a permittee's application for a limits of technology variance.
2. Pollution control project means an upgrade to a wastewater treatment facility and all directly relevant infrastructure.

2.0 Defined Nutrient-reduction Steps for Permittees Operating under a General Nutrient Standards Variance

The Department and the Nutrient Work Group developed a series of defined nutrient-reduction steps to be taken over time and that are specific to recipients of general nutrient standards variances. Per §75-5-

313 [8], MCA, general nutrient standards variance may be established for no more than 20 years. The intent of establishing nutrient reduction steps upfront for most of the 20 year period is to provide permittees regulatory certainty well out into the future. This in turn allows for better facility planning and financing. State law still requires the Department to review triennially the general variance concentrations, and to lower them conforming with technological advancements and improvements in cost (Montana Code Annotated (MCA) 75-5-313[7][b]). However, the Department will only supersede the reduction steps defined here if substantial cost reductions for existing technology have occurred, or technological innovations have allowed for nutrient reductions well beyond the defined steps and those technologies can be readily implemented on wastewater facilities in Montana.

For the purposes of permit development, the values provided below apply to recipients of general nutrient standards variances and the concentrations should be viewed as monthly averages applicable during the time period the base numeric nutrient standards are in effect.

1. **For facilities > 1 million gallons per day:**
   A. By 2016 (or first receipt of general nutrient standards variance): 10 mg TN/L, 1.0 mg TP/L
   B. Next permit cycle (5 year later): 8 mg TN/L, 0.8 mg TP/L
   C. Next permit cycle (5 years later): 8 mg TN/L, 0.5 mg TP/L
   D. Next permit cycle (5 years later): Under Development

2. **For facilities < 1 million gallons per day:**
   A. By 2016 (or first receipt of general nutrient standards variance): 15 mg TN/L, 2.0 mg TP/L
   B. Next permit cycle (5 year later): 12 mg TN/L, 2.0 mg TP/L
   C. Next permit cycle (5 years later): 10 mg TN/L, 1.0 mg TP/L
   D. Next permit cycle (5 years later): 8 mg TN/L, 0.8 mg TP/L

3. **For lagoons not designed to actively remove nutrients:**
   A. By 2016 (or first receipt of general nutrient standards variance): Maintain current lagoon performance and commence nutrient monitoring in the effluent
   B. Next permit cycles (5 years later): Implement BMPs identified during optimization study

3.0 Guidance Pertaining to the Evaluation Process for Individual Variances

Section 3.0 provides guidance on applying for an individual variance based on the direct evaluation of economic factors. **Section 3.1** applies to the public sector, while **Section 3.2** applies to the private sector.

3.1 Public-sector Permittees

Montana law allows for the granting of nutrient standards variances based on the specific economic and financial conditions of a permittee (§75-5-313 (1), MCA). These variances, referred to as individual nutrient standards variances ("individual variances"), may be granted on a case-by-case basis because the attainment of the base numeric nutrient standards is precluded due to economic impacts, limits of technology, or both. Individual variances may only be granted to a permittee after the permittee has made a demonstration to the Department that adverse, significant economic impacts would occur, the limits of technology have been reached, or both, and that there are no reasonable alternatives to discharging into state waters. The processes by which the demonstration is made are provided here, and were developed in conjunction with Montana Nutrient Work Group.

Methods outlined below in **Section 3.1.1** are Montana's modifications to methods presented in U.S. Environmental Protection Agency (1995; Montana Code Annotated (MCA) 75-5-513[7][b]) and pertain to the economic impacts rationale for an individual variance. If adverse, substantial and widespread economic impacts to a community trying to comply with base numeric nutrient standards can be demonstrated, the facility interim effluent limit will be determined via a sliding scale as proposed by Environmental Protection Agency (EPA) in its September 10, 2010 memo to the Department entitled "EPA Guidance on Variances".

Permittees applying for an individual variance based on discharging at the limits of technology do not have to prepare the economic analysis presented below in **Section 3.1.1.** Rather, they should demonstrate to the Department that the waste treatment system they are proposing can achieve, at a minimum, the nitrogen and phosphorus concentrations described in **Section 1.2** of this document, and that achieving those concentrations still will not enable them to attain the base numeric nutrient standards at a 14Q5 flow. Various factors will have a bearing on the final effluent concentrations approved by the Department for individual variances discussed in this paragraph.

3.1.1 Substantial and Widespread Economic Impacts: Process Overview

The Department has assumed that most permittees who cannot comply with the base numeric nutrient standards (Montana Department of Environmental Quality, 2014a) would pursue a general variance (Montana Department of Environmental Quality, 2014b). Therefore, individual variances discussed here are generally for permittees for whom significant economic impacts would occur even at the general variance treatment levels. As noted above, the Department will assess economic impacts using a modified version of EPA's economic-impact guidance. For communities with secondary scores (discussed further below) of 1.5 or lower, the cost cap for the upgrade would be set at 1.0% or lower of the median household income (MHI) for a community, including existing wastewater fees. If the cost cap were below existing wastewater rates, then no further action would be required. Higher Secondary scores would to a higher MHI cost cap. See **Figure 3-1** for a small flow chart of the overall process.

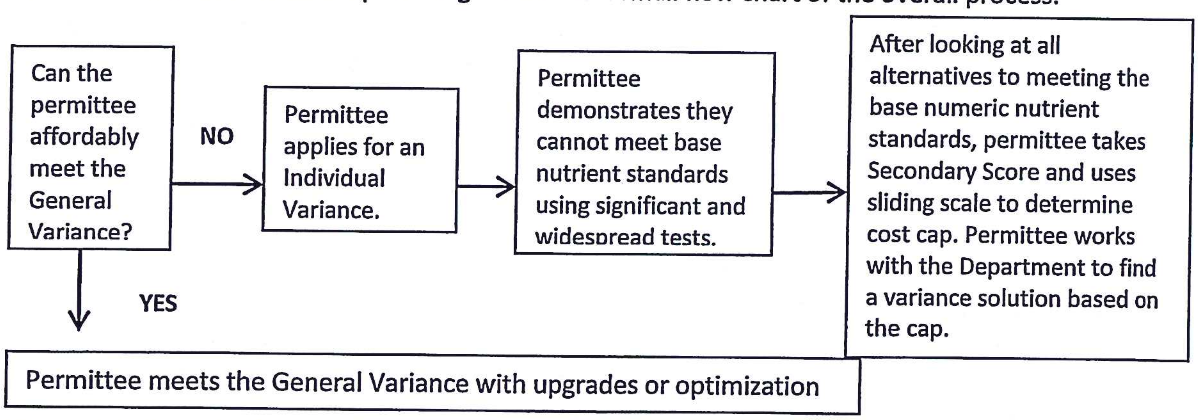


Figure 3-1. Flow chart for evaluation of substantial and widespread economic impacts

The following is an overview of the steps required to carry out a substantial and widespread economic analysis for a public-sector permittee. The evaluation can be undertaken directly in an Excel spreadsheet template which contains instructions. The template is called "PublicEntity_Worksheet_EPACostModel_2014.xlsx", and is available from the Department.

Step 1: Verify project costs that would occur from meeting the base numeric nutrient standards and calculate the annual cost of the new pollution control project.

Step 2: Calculate total annualized pollution control cost per household including existing wastewater fees and the new pollution control project (manifested as an increase in the household wastewater bill).

Steps 3-5: The Substantial Test

Step 3: Calculate and evaluate the Municipal Preliminary Screener score based on the new wastewater fees and the town's Median Household Income. This step identifies communities that can readily pay for the pollution control project vs. those that cannot.

Note: If the public entity passes a significant portion of the pollution control costs along to private facilities or firms, then the review procedures outlined in Chapter 3 of U.S. Environmental Protection Agency 1995 (EPA, (1995) for 'Private Entities' should also be consulted to determine the impact on the private entities.

Step 4: Calculate the Secondary Test to get a secondary score. This measurement incorporates a characterization of the socio-economic and financial well-being of households in the community where the wastewater plant is located. It comprises five evaluation parameters which are then compared against state averages for a score. The scores of the five parameters are averaged to provide the secondary test score for a given community. A secondary score can range from 1.0 to 3.0. A value of 3.0 is a strong score and 1.0 is a weak score.

Note: The Secondary Score is based on the assumption that the ability of a community to finance a project may be dependent upon existing household financial conditions within that community.

Step 5: Assess where the community falls in the substantial impacts matrix. This matrix evaluates whether or not a given community is expected to incur substantial economic impacts due to the implementation of the pollution control costs. If the applicant can demonstrate substantial impacts, then the applicant moves on to the widespread test. If the applicant cannot demonstrate substantial impacts, then they will not perform the widespread test; they will be required to meet the base numeric nutrient standards.

Note: The evaluation of substantial impacts resulting from compliance with base numeric nutrient standards includes two elements; (1) financial impacts to the public entity as measured in **Step 3** (reflected in increased household wastewater fees), and (2) current socio-economic conditions of the community as measured in **Step 4**. Governments have the authority to levy taxes and distribute pollution control costs among households and businesses according to the tax base. Similarly, sewage authorities charge for services, and thus can recover pollution control costs through user's fees. In both cases, a substantial impact will usually affect the wider community. Whether or not the community faces substantial impacts depends on both the cost of the pollution control and the general financial and economic health of the community.

Step 6: The Widespread Test

Step 6: If impacts from meeting the base numeric nutrient standards are expected to be substantial, then the applicant goes on to demonstrate whether or not the impacts are expected to be widespread. The Widespread test consists of questions that ask the permittee about current economic, social and population trends in the affected area (usually the community and possibly outlying areas tied to the community). The permittee is then asked to estimate the effects of higher wastewater costs on each of these trends. Further optional questions are asked about the effects of higher wastewater costs on things like city debt limits, improved water quality, future development patterns, and other factors that the applicant may want to add.

Note: Estimated changes in socio-economic indicators of the community and other geographical areas tied to the community as a result of pollution control costs will be used to determine whether widespread impacts would occur.

Step 7: Final Determination of Substantial and Widespread Economic Impacts

Step 7: If widespread impacts are also demonstrated, then a permittee is eligible for an individual variance after having demonstrated to the Department that they considered alternatives to discharging (including but not limited to trading, land application, and permit compliance schedules). If widespread impacts have not been demonstrated, then the permittee is not eligible for an individual variance based on these methods.

3.1.2 Completing the Substantial and Widespread Assessment Spreadsheet

Detailed steps for completing the substantial and widespread cost assessment are found in the spreadsheet template "PublicEntity_Worksheet_EPACostModel_2014.xlsx" available from the Department and on the Nutrient Workgroup website. Readers should refer to that spreadsheet, as it is self-explanatory and instructions are found throughout. Below are a few additional details which may help clarify some of the steps:

1. Start at the far left tab of the spreadsheet ("Instructions [Steps to be Taken]") and review the instructions. They are the same steps outlined in **Section 3.1.1** above, but in more detail. Proceed to subsequent tabs to the right, making sure not to skip any of worksheets A through F.
2. Summarize the project on Worksheet A.
3. Detail the costs of the project on Worksheet B.
4. Calculated the annual cost per household of existing and expected new water treatment costs on Worksheet C.
5. On Worksheet D, carefully read the text in blue and compare it to the results from the MHI test and the community's Low to Moderate Income (LMI) level. Based on this screener, the evaluation will either terminate (i.e., it has been shown that the water pollution control is clearly affordable), or will continue to the secondary tests on the next tab which is Worksheet E[1].

[1] The Department appended the LMI test to EPA's Municipal Preliminary Screener at this step in the process. This was done in order to address communities in which the income distribution is skewed such that there is a large proportion of high- and low-income individuals, but less in the middle near the median household income. As modified, the test should assure that such communities will move on to the more detailed secondary tests.

6. On Worksheet E, note the linkages to websites and phone numbers where the information requested can be obtained. Then use this information to fill in Worksheet F where a secondary score is calculated.
7. The next tab, 'Substantial Impacts Matrix', shows if the community has demonstrated substantial impacts (or not). Those that have clearly demonstrated substantial impacts as well as those that are 'borderline' move on to the widespread tests.
8. On the 'DEQ Widespread Criteria' tab, complete the four descriptive questions. Then, complete the six primary questions and determine the outcome as to whether impacts are widespread. If still unclear, complete the additional secondary questions and again evaluate.
9. In order to be eligible for an individual variance, both substantial and widespread tests must be satisfied.
10. If substantial and widespread impacts are demonstrated, then the permittee moves on to the next tab, Worksheet I, Remedy. In this step, the permittee examines and reports whether there are "reasonable alternatives" to the individual variance that preclude the need for an individual variance. If not, then then the cost the permittee will need to expend towards the pollution control project will be based on the sliding scale (see below). The cost cap is determined as a percentage of the community's MHI, and the key driver of the required cost cap is the Secondary Score.

The difference between the cost cap MHI from the sliding scale and what is currently being paid (also in MHI) is the additional money that can go towards the pollution control project. Once the amount of money available is determined, the Department and the applicant will look at both capital and O&M investments that could be used to craft an individual variance, given what money is available. Refer to **Section 3.1.3** below for more details on the remedy process.

3.1.3 The Remedy: Determining the Target Cost of the Pollution Control Project

If a permittee has demonstrated that substantial and widespread economic impacts would occur if they were to comply with the base numeric nutrient standards, and there are no reasonable alternatives to discharging (including trading, permit compliance schedules, general variances, alternative variances, or alternative effluent management loading reduction methods such as reuse, recharge, or land application), then the cost the permittee will need to expend towards the pollution control project will be based on a sliding scale (**Figure 3-2**). The cost cap is determined as a percentage of the community's MHI, and the key driver of the cost cap is the secondary test (secondary score) calculated in **step 4** of **Section 3.1.1.**

For example, a community has demonstrated that substantial and widespread economic impacts would occur from trying to comply with the base numeric nutrient standards, and there were no reasonable alternatives to discharging. If the permittee's average secondary score from the secondary tests was 1.5, then the annual cost cap for the pollution control project (including current wastewater fees) would be the dollar value equal to 1.0% of the community's MHI at the time that the analysis was undertaken (see blue line, **Figure 3-2**). This 1.0% would include existing wastewater costs plus the new, hypothetical upgrades.

If this community was already paying ≥ 1.0% of community MHI for its wastewater bill, then no additional monies would be spent on capital or O&M costs (and no additional upgrades would occur). Still, additional improvements may still be expected. The facility's current discharge nutrient concentrations might become the basis of the community's individual variance but the community must

APPENDIX F

LAND APPLICATION DESIGN CRITERIA AND COST TABLES

Annual Hydraulic Loading Rate for Alfalfa

The design maximum irrigation application rates must be calculated for each month using hydraulic loading rates based on soil permeability (Lp) and nitrogen loading (Ln). The corresponding monthly value for Lp and Ln must be compared, with the lower of the two values used for design. The monthly hydraulic loading rates must be summed to yield the annual hydraulic loading rate (Lh).

Soil Data – Web Soil Survey

A review of the Web Soil Survey data set shows that the area of interest consists of Ha (Half Moon silt loam, o to 3 percent slopes), Rb (Radnor silty clay loam, 0 to 3 percent slopes) and De (Depew silty clay loam, o to 3 percent slopes). The Ha and De soils are a Hydrologic Soil Group C. The Rb soil is a Hydrologic Soil Group C/D. Group C soils have slow infiltration rate when thoroughly wet. Group D soils have a verly slow infiltration rate (high runoff potential) when thoroughly wet. In looking at the soils ability of disposal of wastewater by irrigation, the USDA Web Soil Survey classifies all soils in the vicinity of the WWTP as Very Limited. Below is a summary of each soils capacity to transmit water (most limiting layer):

De = 0.06 to 0.20 in/hr

Ha = 0.20 to 0.57 in/hr

Rb = 0.06 to 0.20 in/hr

We will use 0.20 in/hr as a percolation rate for these calculations. This may change based on actual field testing of the soils.

Precipitation

A review of the National Oceanic and Atmospheric Administration (NOAA) data for Station USC00248902, Whitefish, MT showed that 2006 was the wettest year in the last 10 years. Precipitation data for the station during 2006 is summarized below:

Month - 2006	Total Precipitation (inches)
January	3.93
February	1.31
March	0.60
April	2.28
May	1.47
June	5.53
July	1.69
August	1.22
September	1.53
October	1.14
November	4.08
December	2.50
Total	**27.28**

Crop Evapotranspiration (ETc)

Crop evapotranspiration, or consumptive water use, must be based on average regional values for the selected crop(s). This data was retrieved from Agrimet, for the Creston, Montana Station (CRSM). Unfortunately, the station does not show ETc values for Poplar trees. However, studies indicate that poplar trees can consume 1 MG per acre of trees per growing season, which equates to about 36-inches per growing season. Below are the ETc monthly values for Alfalfa (mean):

Month – 2006	ETc (inches) - Alfalfa
January	0.00
February	0.00
March	0.00
April	1.18
May	4.58
June	5.30
July	7.83
August	6.07
September	3.24
October	0.00
November	0.00
December	0.00
Total	**28.2**

Soil Permeability Calculations:

The hydraulic loading based on soil permeability (Lp) is determined as:

$$Lp = (ETc - P + Pw)/SE$$

where, Lp = Hydraulic Loading Rate, in/month

ETc = Crop Evapotranspiration, in/month

P = Precipitation, in/month

Pw = Percolation Rate, in/month

SE = Distribution system efficiency, fraction (0.70 to 0.85 for sprinklers)

Month	Maximum Operating Days per Month	P (in)	ETc (in)	Pw (in)	SE	Lp (in)
January	0	3.93	0	0	0.8	0.00
February	0	1.31	0	0	0.8	0.00
March	0	0.60	0	0	0.8	0.00
April	0	2.28	1.18	0	0.8	0.00
May	6	1.47	4.58	1.15	0.8	5.33
June	6	5.53	5.3	1.15	0.8	1.15
July	6	1.69	7.83	1.15	0.8	9.12
August	6	1.22	6.07	1.15	0.8	7.50
September	6	1.53	3.24	1.15	0.8	3.58
October	0	1.14	0	0	0.8	0.00
November	0	4.08	0	0	0.8	0.00
December	0	2.50	0	0	0.8	0.00
Total =		**27.3**	**28.2**	**5.8**	**9.6**	**26.7**

The table above shows the months for which irrigation could be applied and the hydraulic loading rates based on Soil Permeability (Lp).

Nitrogen Calculations:

The hydraulic loading based on nitrogen limits (Ln) is determined as:

Ln = (U * C) / [Cn(1-f)]

where,

Ln = Hydraulic loading, in/month

U = Crop updated as a function of yield, lb/acre*month

C = Conversion constant, 4.41

Cn = Applied total nitrogen concentration, mg/L

f = Nitrogen loss factor

Month	Typical Yield acre-yr (Alfalfa, tons)	ETc	ETc ratio	N (%)	U (lbs)	Cn (mg/L)	f	(U*C)	(Cn(1-f))	Ln (in)
January	4	0	0	2.25	0	26	0.20	0	20.8	0
February	4	0	0	2.25	0	26	0.20	0	20.8	0
March	4	0	0	2.25	0	26	0.20	0	20.8	0
April	4	1.18	0.04	2.25	7.53	26	0.20	33.22	20.8	1.60
May	4	4.58	0.16	2.25	29.23	26	0.20	128.92	20.8	6.20
June	4	5.3	0.19	2.25	33.83	26	0.20	149.19	20.8	7.17
July	4	7.83	0.28	2.25	49.98	26	0.20	220.41	20.8	10.60
August	4	6.07	0.22	2.25	38.74	26	0.20	170.86	20.8	8.21
September	4	3.24	0.11	2.25	20.68	26	0.20	91.20	20.8	4.38
October	4	0	0	2.25%	0	26	0.20	0	20.8	0
November	4	0	0	2.25%	0	26	0.20	0	20.8	0
December	4	0	0	2.25	0	26	0.20	0	20.8	0
Total =	**48**	**28.2**	**1**		**180.00**					**38.16**

Annual Hydraulic Loading Rate

The design maximum irrigation application rate must be calculated for each month using hydraulic loading rates based on soil permeability (Lp) and nitrogen loading (Ln). The corresponding values for Lp and Ln must be compared, with the lower of the two values used for design. The monthly hydraulic loading rates must be summed to yield the annual hydraulic loading rate (Lh).

Month	Lp (in)	Ln (in)	Lh (in)
January	0.00	0	0
February	0.00	0	0
March	0.00	0	0
April	0.00	1.60	0.00
May	5.33	6.20	5.33
June	1.15	7.17	1.15
July	9.12	10.60	9.12
August	7.50	8.21	7.50
September	3.58	4.38	3.58
October	0.00	0	0
November	0.00	0	0
December	0.00	0	0
Total =	**26.7**	**38.16**	**26.7**

For all months, the hydraulic loading rate, based on soil permeability (Lp) is lower and thus controls the annual hydraulic loading rate. The above design criteria are preliminary, site specific soils analysis along with evapotranspiration adjustments for different crops will need to be made for each specific site that would be utilized for land application.

Annual Hydraulic Loading Rate for Poplar Trees

The design maximum irrigation application rates must be calculated for each month using hydraulic loading rates based on soil permeability (Lp) and nitrogen loading (Ln). The corresponding monthly value for Lp and Ln must be compared, with the lower of the two values used for design. The monthly hydraulic loading rates must be summed to yield the annual hydraulic loading rate (Lh).

Soil Data – Web Soil Survey

A review of the Web Soil Survey data set shows that the area of interest consists of Ha (Half Moon silt loam, o to 3 percent slopes), Rb (Radnor silty clay loam, 0 to 3 percent slopes) and De (Depew silty clay loam, o to 3 percent slopes). The Ha and De soils are a Hydrologic Soil Group C. The Rb soil is a Hydrologic Soil Group C/D. Group C soils have slow infiltration rate when thoroughly wet. Group D soils have a verly slow infiltration rate (high runoff potential) when thoroughly wet. In looking at the soils ability of disposal of wastewater by irrigation, the USDA Web Soil Survey classifies all soils in the vicinity of the WWTP as Very Limited. Below is a summary of each soils capacity to transmit water (most limiting layer):

De = 0.06 to 0.20 in/hr

Ha = 0.20 to 0.57 in/hr

Rb = 0.06 to 0.20 in/hr

We will use 0.20 in/hr as a percolation rate for these calculations. This may change based on actual field testing of the soils.

Precipitation

A review of the National Oceanic and Atmospheric Administration (NOAA) data for Station USC00248902, Whitefish, MT showed that 2006 was the wettest year in the last 10 years. Precipitation data for the station during 2006 is summarized below:

Month - 2006	Total Precipitation (inches)
January	3.93
February	1.31
March	0.60
April	2.28
May	1.47
June	5.53
July	1.69
August	1.22
September	1.53
October	1.14
November	4.08
December	2.50
Total	**27.28**

Crop Evapotranspiration (ETc)

Crop evapotranspiration, or consumptive water use, must be based on average regional values for the selected crop(s). For Alfalfa, this data was retrieved from Agrimet, for the Creston, Montana Station (CRSM). Unfortunately, the station does not show ETc values for Poplar trees. However, according to *Forest Crop Irrigation with Wastewater Effluent from the Helena Wastewater Treatment Plant; City of Helena Feasibility Study,* April 2007, poplar trees can consume 1 MG per acre of trees per 120 day growing season, which equates to about 36-inches per growing season. Using 36-inches of evapotranspiration per growing season the table below is an estimate of the ETc monthly values for Poplar Trees (mean):

Month – 2006	ETc (inches) - Alfalfa
January	0.00
February	0.00
March	0.00
April	0.00
May	3.0
June	7.0
July	10.0
August	12.0
September	4.0
October	0.00
November	0.00
December	0.00
Total	**36.0**

Soil Permeability Calculations:

The hydraulic loading based on soil permeability (Lp) is determined as:

$$Lp = (ETc - P + Pw)/SE$$

where, Lp = Hydraulic Loading Rate, in/month

ETc = Crop Evapotranspiration, in/month

P = Precipitation, in/month

Pw = Percolation Rate, in/month

SE = Distribution system efficiency, fraction (0.70 to 0.85 for sprinklers)

Month	Maximum Operating Days per Month	P (in)	ETc (in)	Pw (in)	SE	Lp (in)
January	0	3.93	0	0	0.8	0.00
February	0	1.31	0	0	0.8	0.00
March	0	0.60	0	0	0.8	0.00
April	0	2.28	0	0	0.8	0.00
May	6	1.47	3.0	1.15	0.8	3.35
June	6	5.53	7.0	1.15	0.8	3.28
July	6	1.69	10.0	1.15	0.8	11.82
August	6	1.22	12.0	1.15	0.8	14.91
September	6	1.53	4.0	1.15	0.8	4.52
October	0	1.14	0	0	0.8	0.00
November	0	4.08	0	0	0.8	0.00
December	0	2.50	0	0	0.8	0.00
Total =		**27.3**	**36**	**5.8**	**9.6**	**37.88**

The table above shows the months for which irrigation could be applied and the hydraulic loading rates based on Soil Permeability (Lp).

Nitrogen Calculations:

The hydraulic loading based on nitrogen limits (Ln) is determined as:

Ln = (U * C) / [Cn(1-f)]

where,

Ln = Hydraulic loading, in/month

U = Crop updated as a function of yield, lb/acre*month; for poplar trees a rate of 135 lbs/acre per 120 day growing season from the above referenced City of Helena Report. (equates to 34 lbs/acre/month)

C = Conversion constant, 4.41

Cn = Applied total nitrogen concentration, mg/L

f = Nitrogen loss factor

Month	Typical Yield acre-yr	ETc	ETc ratio	N (%)	U (lbs)	Cn (mg/L)	f	(U*C)	(Cn(1-f))	Ln (in)
January	N/A	0	0	N/A	0	26	0.20	0	20.8	0
February		0	0		0	26	0.20	0	20.8	0
March		0	0		0	26	0.20	0	20.8	0
April		0	0		0	26	0.20	0	20.8	0
May		3.0	.125		17	26	0.20	442	20.8	21.25
June		7.0	0.25		34	26	0.20	884	20.8	42.5
July		10.0	0.25		34	26	0.20	884	20.8	42.5
August		12.0	0.25		34	26	0.20	884	20.8	42.5

September		4.0	0.125		17	26	0.20	442	20.8	21.25
October		0	0		0	26	0.20	0	20.8	0
November		0	0		0	26	0.20	0	20.8	0
December		0	0		0	26	0.20	0	20.8	0
Total =		**36**	**1**		**136**					**170**

Annual Hydraulic Loading Rate

The design maximum irrigation application rate must be calculated for each month using hydraulic loading rates based on soil permeability (Lp) and nitrogen loading (Ln). The corresponding values for Lp and Ln must be compared, with the lower of the two values used for design. The monthly hydraulic loading rates must be summed to yield the annual hydraulic loading rate (Lh).

Month	**Lp (in)**	**Ln (in)**	**Lh (in)**
January	0.00	0	0
February	0.00	0	0
March	0.00	0	0
April	0.00	1.60	0.00
May	5.33	6.20	21.25
June	1.15	7.17	42.5
July	9.12	10.60	42.5
August	7.50	8.21	42.5
September	3.58	4.38	21.25
October	0.00	0	0
November	0.00	0	0
December	0.00	0	0
Total =	**26.7**	**38.16**	**170**

For all months, the hydraulic loading rate, based on soil permeability (Lp) is lower and thus controls the annual hydraulic loading rate. The above design criteria are preliminary, site specific soils analysis along with evapotranspiration adjustments for different crops will need to be made for each specific site that would be utilized for land application.

WHITEFISH WASTEWATER - 2015

Engineer's Opinion of Probable Construction Cost
11/13/2015

Onsite Irrigation

OPERATION AND MAINTENANCE COSTS AND PRESENT WORTH OF ALTERNATIVE

Item	Description	Units	Quantity	Unit Price	TOTAL
1	Electrical Cost	KwHr	12,891	$0.10	$1,289
2	Labor	Hours	192	$50.00	$9,600
3	Msc. Parts and Repairs	LS	1	$5,000.00	$5,000
			TOTAL ESTIMATED ANNUAL O&M COST		**$15,889**

Annual Equivalent Cost (Capital plus O&M) [i=3%, 20yr, 1 pmt/yr] **$81,068**

Item	Description	TOTAL
1	Capital Cost	$969,700
2	Present Worth of Annual O&M Cost (P/A, 3%, 20 years)	$236,390
3	Salvage Value in 20 years (estimate)	-$85,000
4	Net Present Worth of Salvage Value (P/F, 3%, 20 years)	-$47,062
	TOTAL PRESENT WORTH	**$1,159,000**

* assumes 50 yr. life, straight line depreciation.

Short Lived Assets	(assumes 50% of line item cost is equip. requiring replacement) No Equipment			
0 to 5 Year Assets	%	20%	$ -	$ -
5 to 10 Year Assets	%	10%	$ -	$ -
10 to 15 Year Assets	%	6.67%	$ -	$ -
Total SLA				**$0.00**

WHITEFISH WASTEWATER - 2015

Engineer's Opinion of Probable Construction Cost

12/1/2015

Item #	Onsite Irrigation System DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	TOTAL PRICE	SALVAGE VALUE
1	Geotechnical Investigation	LS	1	$10,000	$10,000	
2	Permits	LS	1	$5,000	$5,000	
3	Pump Station	LS	1	$90,000	$90,000	
4	15 HP 460Volt 3 Phase Motor, Vertical Turbine Pump w/ VFD	EA	4	$14,000	$56,000	
5	Field Forcemain Trunk Line	LF	2,000	$50	$100,000	$ 50,000.00
6	Field Branch Lines	LF	500	$50	$25,000	
7	Irrigation Equipment	LS	1	$100,000	$100,000	
8	Fencing	LF	3,000	$12	$36,000	
9	Signs and Misc.	LS	1	$800	$800	
10	Seeding, Fertilizing & Mulching	AC	20.0	$3,500	$70,000	$ 35,000.00
11	Concrete Surge Basin 40'x40'x12'					
	Excavation / Backfill /Disposal	CY	1,300.0	$18	$23,400	
	Walls	CY	59.0	$1,200	$70,800	
	Floor	CY	65.3	$900	$58,800	
				Subtotal	$645,800	
		Mobilization, Bonding, & Submittals (5%)			$32,300	
		Total Estimated Construction Cost			**$678,100**	
		Engineering @ 18% of Construction			$122,100	
		Administrative/Financial @ 10% of Construction			$67,800	
		Contingency @ 15% of Construction			$101,700	
		TOTAL ESTIMATED IMPROVEMENT COST			**$969,700**	**$85,000**

WHITEFISH WASTEWATER - 2015

Engineer's Opinion of Probable Construction Cost

12/1/2015

Onsite Irrigation System to Irrigate July1 through Sept 30 to Meet Summer Nutrient Limits

DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	TOTAL PRICE
Geotechnical Investigation	LS	1	$50,000	$50,000
Permits	LS	1	$5,000	$5,000
Pump Station	LS	1	$150,000	$150,000
30 HP 460Volt 3 Phase Motor, Vertical Turbine Pump w/ VFD	EA	3	$18,000	$54,000
Forcemain Trunk Line	LF	8,000	$50	$400,000
Field Branch Lines	LF	2,000	$50	$100,000
Irrigation Equipment	LS	1	$250,000	$250,000
Fencing	LF	5,000	$12	$60,000
Signs and Misc.	LS	1	$800	$800
Seeding, Fertilizing & Mulching	AC	20.0	$3,500	$70,000
Purchase Land	AC	130.0	$15,000	$1,950,000
Storage Basin*	AC	3		
Excavation / Backfill /Disposal	CY	29,040.0	$18	$522,700
Liner and Liner Cusion Material	SQFT	143,748	$0.9	$129,400
Misc. Piping	LS	1.0	$30,000	$30,000
			Subtotal	$3,771,900
			Mobilization, Bonding, & Submittals (5%)	$188,600
			Total Estimated Construction Cost	**$3,960,500**
			Engineering @ 18% of Construction	$712,900
			Administrative/Financial @ 10% of Construction	$396,100
			Contingency @ 15% of Construction	$594,100
			TOTAL ESTIMATED IMPROVEMENT COST	**$5,663,600**

*Based on 90 day Irrigation Season (July 1 - Sept. 30)

WHITEFISH WASTEWATER - 2015

Engineer's Opinion of Probable Construction Cost

12/14/2015

Onsite Irrigation System to Irrigate July1 through Sept 30 to Meet Summer Nutrient Limits

Description	Units	Quantity	Unit Price	TOTAL
Electrical Cost	KwHr	9,668	$0.10	$967
Labor	Hours	128	$50.00	$6,400
Msc. Parts and Repairs	LS	1	$5,000.00	$5,000
		TOTAL ESTIMATED ANNUAL O&M COST		**$12,367**
nnual Equivalent Cost (Capital plus O&M)		[i=3%, 20yr, 1 pmt/yr]		**$393,050**

Description	TOTAL
Capital Cost	$5,663,600
Present Worth of Annual O&M Cost (P/A, 3%, 20 years)	$183,987
Salvage Value in 20 years (estimate)	-$3,398,160.00
Net Present Worth of Salvage Value (P/F, 3%, 20 years)	-$1,881,479
TOTAL PRESENT WORTH	**$3,966,100**

* assumes 50 yr. life, straight line depreciation.

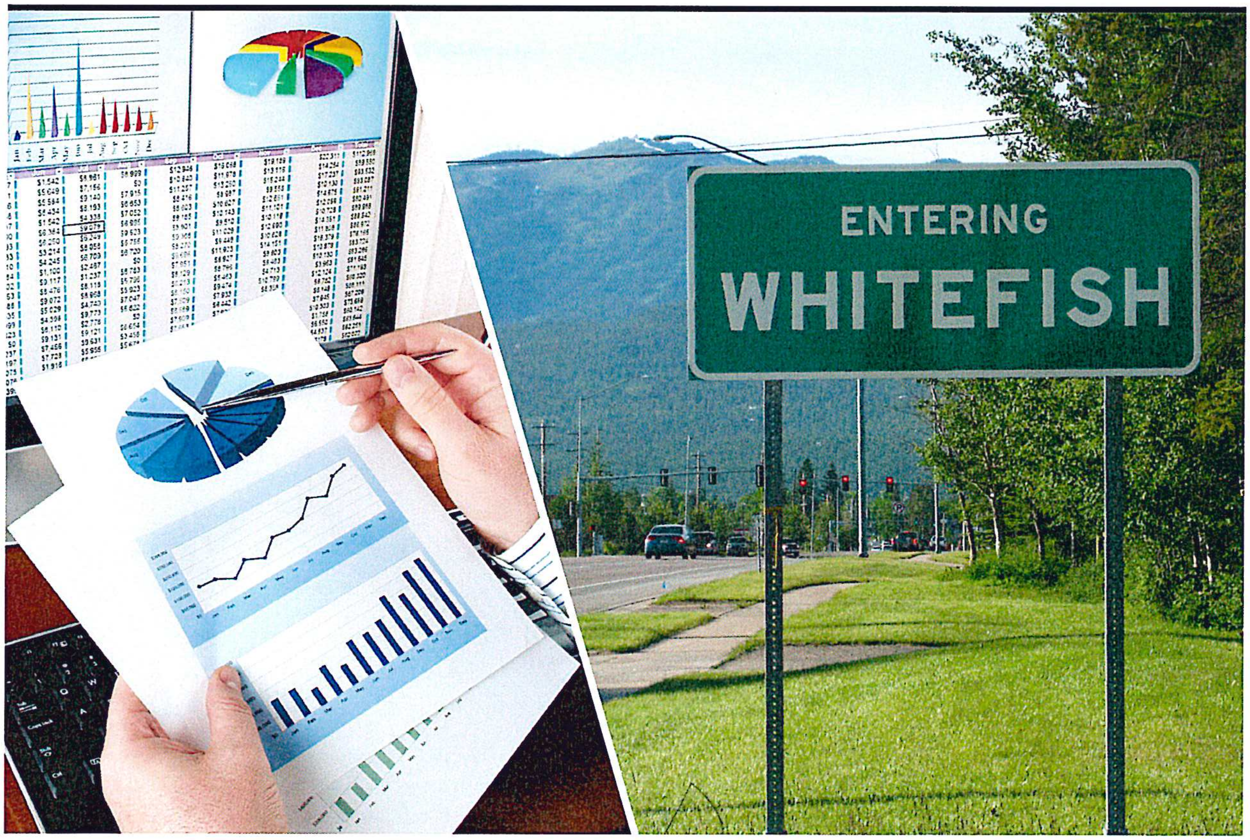
Short Lived Assets	(assumes 50% of line item cost is equip. requiring replacement)			No Equipment
0 to 5 Year Assets	%	20%	$ -	$ -
5 to 10 Year Assets	%	10%	$ -	$ -
10 to 15 Year Assets	%	6.67%	$ -	$ -
Total SLA				**$0.00**

APPENDIX G

EXECUTIVE SUMMARY
FINANCIAL PLAN AND RATE STUDY
CITY CAPITAL IMPROVEMENT PLAN

WASTEWATER UTILITY FINANCIAL PLAN AND RATE STUDY

CITY OF WHITEFISH, MT | MARCH 2016



AE2S Think Big. Go Beyond.

AE2S NEXUS The Financial Link

City of Whitefish

Executive Summary – Wastewater

In May 2015, the City of Whitefish (City) retained AE2S to complete a Water and Wastewater Financial Plan and Rate Structure Study (Study). The completion of a comprehensive rate study is typically recommended every three (3) to five (5) years unless triggered by a major change to Utility operations or if significant capital improvements are planned. In line with these recommendations, the City initiated this Study for the following reasons:

- Greater than 10 years have passed since a comprehensive review of the water rates was completed and greater than 5 years have passed since wastewater rates were last comprehensively evaluated. The wastewater rates were last reviewed in 2009.
- The City desired a review of the equitability associated with current rates charged to different water service and wastewater service zones.
- The City is in the process of planning for a new wastewater treatment plant, which is expected to be commissioned in 2021. Based on preliminary engineering estimates for the facility, new debt associated with this facility is anticipated to be in the range of $15 million to $20 million.

The City of Whitefish provides wastewater service to approximately 3,530 customer accounts within City limits and 106 customer accounts located outside of City limits. Current policy requires that new users located outside of City limits are not eligible for connection unless annexation occurs. The City operates an extensive network of collection system gravity mains, forcemains, and lift stations. In addition, the City receives wastewater from areas with centralized septic-tank-effluent-pump (STEP) systems and Grinder systems that have additional service requirements. Certain areas within the collection system require significant pumping to convey the wastewater across the City to the wastewater treatment plant (WWTP). To address costs attributable to the various user types and service zones, the City's Wastewater rate schedule distinguishes between three different service classes in addition to the dedicated rates associated with providing service to Grinder and STEP users:

- Service Class 1 (SC-1): areas in which wastewater is conveyed by gravity pipelines to the main lift station, and is then pumped to the WWTP. Wastewater associated with users in SC-1 is pumped one time (1X);
- Service Class 2 (SC-2): areas in which wastewater is pumped by an intermediate pump station prior to the main lift station, where it is then pumped to the WWTP. In general, wastewater associated with users in SC-2 is pumped two times (2X);
- Service Class 3 (SC-3): areas in which wastewater is pumped either once or twice by an intermediate pump station prior to get to the main lift station, where it is then pumped to the WWTP. In general, wastewater associated with users in SC-3 is pumped a minimum of two times, and sometimes three times (2-3X) depending upon location.

The Wastewater rate schedule includes a monthly fixed component based on location and service type (i.e. SC1, SC2, SC3, Grinder, or STEP) and a volumetric component also based on location and service type that is charged per 1,000 gallons of winter water use. Tables ES.1 and ES.2 summarize the current volumetric and base rate structures, respectively, for the Wastewater Utility. In 2007, the City adopted a policy whereby the Wastewater rates can be increased annually, if necessary, by the US Department of Labor's Water, Sewer and Trash Collection Services Consumer Price Index for All Urban Consumers. For Fiscal Year 2016 (FY16), the Wastewater rates were increased by 2.3 percent.

User Class	2016 Rate $/thousand gallons
Inside City Users	
SC-1	$3.55
SC-2	$6.31
SC-3	$8.86
Grinder	$13.47
STEP	$16.65
Outside City Users	
SC-1	$5.46
SC-2	$8.71
SC-3	$10.54
Resthaven	$21.47
Big Mountain	$8.71

Table ES.1: 2016 Volumetric Wastewater Rate Structure

User Class	2016 Monthly Base Rate	2016 Monthly Base Rate - Discounted
Inside City Users		
SC-1	$21.17	$5.29
SC-2	$37.02	$9.27
SC-3	$43.17	$10.79
Grinder	$53.94	$13.49
STEP	$56.07	$14.03
Outside City Users		
SC-1	$24.73	--
SC-2	$41.48	--
SC-3	$47.58	--
Resthaven	$60.18	--
Big Mountain	$72.58	--

Table ES.2: 2016 Monthly Wastewater Base Rate Structure

The City of Whitefish adopted a policy in 2006 that provides a 75 percent discount on the base (fixed) portion of the wastewater bill to low income customers that receive assistance from the Montana Department of Public Health and Human Services, and also to Senior Citizens age 65 and over.

Cost of Service Analysis

To evaluate the equitability of the existing rate structure, a Cost of Service Analysis (COSA) was completed to measure the cost attributable to each user class against the amount of revenue provided by each user class. The COSA comparison is made based on cost and revenue percentages calculated for a representative Test Year. For the purpose of this analysis, FY16 budget and capital expenditures were used as the basis for the Test Year. To develop Test Year revenue projections, the number of accounts and billed flow for calendar year 2014 were escalated to 2016. The FY16 Wastewater rates were then applied to the account and flow figures to develop Test Year revenues. Total Test Year 2016 revenue requirements are shown in Table ES.3.

Revenue Requirement	Test Year 2016
O&M-Related	$1,887,877
Capital-Related	$1,005,865
Total Revenue Requirements	**$2,893,742**

Table ES.3: Summary of Test Year 2016 Revenue Requirements

During the development of the COSA assumptions, significant effort was spent evaluating the service zone classifications. Input from City staff indicated that the SC-3 areas were primarily associated with high-cost pumping facilities with a small user base. It was further noted that some of these facilities are in developing areas that with growth, will more closely resemble an SC-2 service area in the future. Based on this discussion and input from Council members in a Study Work Session, a revision to the approach to the Service Classes was made as part of the COSA, shown in Figure ES.1. The COSA results, which reflect the revised approach, are shown in Table ES.4. The COSA results were used to develop a recommended rate approach that would work to bring COSA percent difference percentages in line through the 2017 to 2026 planning period.

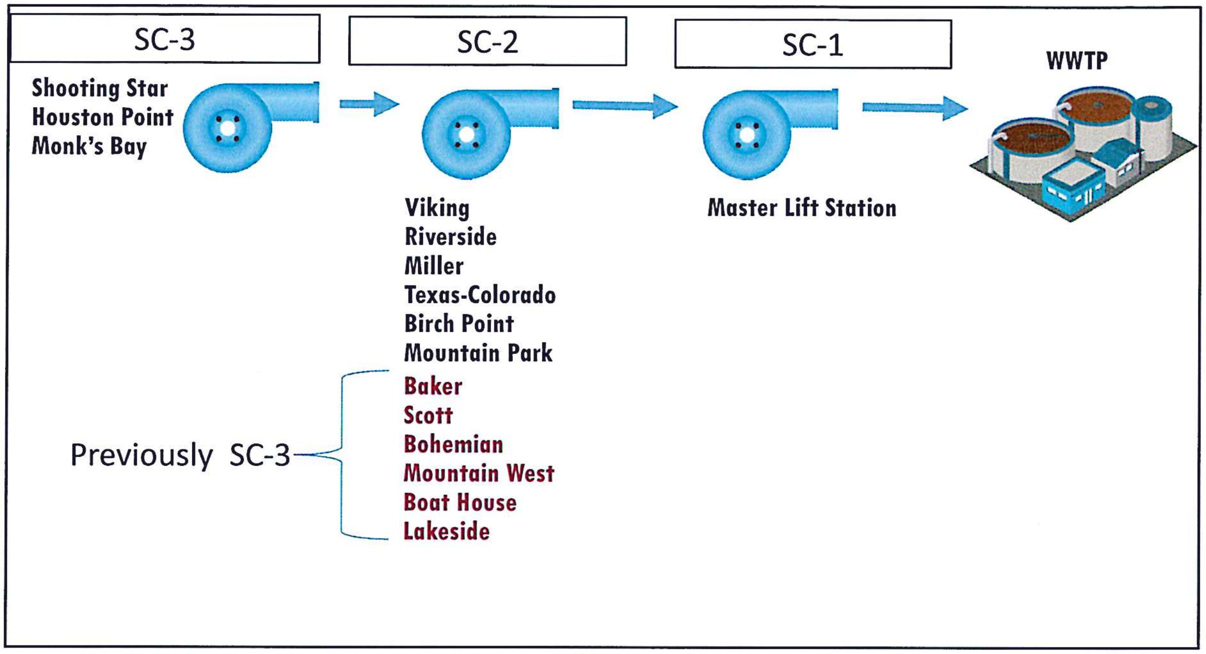


Figure ES.1: Revised Service Class Approach

User Class	Test Year 2016		
	Cost Percentage	Revenue Percentage	% Difference
Inside City Users			
SC-1	48.5%	43.7%	-9.9%
SC-2	35.3%	40.1%	13.7%
SC-3	2.9%	3.0%	5.7%
Grinder	1.4%	1.5%	3.7%
STEP	1.0%	0.9%	-9.1%
Outside City Users			
SC-1	0.6%	0.6%	-1.2%
SC-2	0.9%	1.2%	26.0%
SC-3	--	--	--
Resthaven	3.1%	2.8%	-9.3%
Big Mountain	6.5%	2.4%	-1.3%
Total	100%	100%	

Table ES.4: Test Year 2016 Cost of Service Analysis Results

Given a typically recommended COSA target difference of ±10%, the detailed COSA results generally showed that based on the assumptions utilized, the revenues associated with each user class are generally in line with the cost. It does appear that the SC-2 user class is generating revenue at a higher percentage than its associated cost, and that the SC-1, STEP, and Resthaven user classes are generating revenue at a percentage less than the associated cost.

Correction of potential cost of service disparities were addressed in the rate design and revenue adequacy portions of the Study. It should be noted that Montana Law specifies that rate increases applied to users outside of City limits cannot exceed those applied to similar users located within City limits. As a result, the City has limited ability to correct cost of service disparities associated with outside users.

Findings and Recommendations

The COSA results identified potential slight inequities within the existing rate structure. Because the City will be bringing on a significant new facility within the planning period, it is important to note that the COSA relationships will change when the rate base changes. As a result, recommended rate adjustments throughout the planning period take into account anticipated annual shifts in the COSA across the evaluated period.

To address cost of service inequities, support the funding of target reserve levels, and achieve overall revenue adequacy for the Wastewater Utility, rate adjustments for the period of 2017 through 2026 were projected. Using the Test Year 2016 as the basis, revenue requirements were indexed to reflect inflationary effects and billed wastewater volumes and accounts were adjusted to reflect average increase in the user base over the past five years. Tables ES.5/ES.6 and ES.7/ES.8 summarize the projected monthly base and volumetric rates, respectively, for 2017 through 2026. Tables ES.9 and ES.10 summarize the projected revenue requirements, revenues, and overall revenue adequacy for the study period. Figure ES.2 projects the future cash balances associated with the information presented in Tables ES.5 through ES.10.

User Class	2016 Rates	2017 Recommended	2018 Projected	2019 Projected	2020 Projected	2021 Projected
Inside City Users						
SC-1	$21.17	$21.81	$22.46	$23.13	$23.82	$24.53
SC-2	$37.02	$38.13	$39.27	$40.45	$41.66	$42.91
SC-3	$43.17	$44.47	$45.80	$47.17	$48.59	$50.05
Grinder	$53.94	$55.56	$57.23	$58.95	$60.72	$62.54
STEP	$56.07	$57.75	$59.48	$61.26	$63.10	$64.99
Outside City Users						
SC-1	$24.73	$25.47	$26.23	$27.02	$27.83	$28.66
SC-2	$41.48	$42.72	$44.00	$45.32	$46.68	$48.08
SC-3	$47.58	$49.01	$50.48	$51.99	$53.55	$55.16
Resthaven	$60.18	$61.99	$63.85	$65.77	$67.74	$69.77
Big Mountain	$72.58	$74.76	$77.00	$79.31	$81.69	$84.14

Table ES.5: Wastewater Utility Monthly Base Rate Projections – 2017-2021

User Class	2022 Projected	2023 Projected	2024 Projected	2025 Projected	2026 Projected
Inside City Users					
SC-1	$25.27	$26.03	$26.81	$27.61	$28.44
SC-2	$44.20	$45.53	$46.90	$48.31	$49.76
SC-3	$51.55	$53.10	$54.69	$56.33	$58.02
Grinder	$64.42	$66.35	$68.34	$70.39	$72.50
STEP	$66.94	$68.95	$71.02	$73.15	$75.34
Outside City Users					
SC-1	$29.52	$30.41	$31.32	$32.26	$33.23
SC-2	$49.52	$51.01	$52.54	$54.12	$55.74
SC-3	$56.81	$58.51	$60.27	$62.08	$63.94
Resthaven	$71.86	$74.02	$76.24	$78.53	$80.89
Big Mountain	$86.66	$89.26	$91.94	$94.70	$97.54

Table ES.6: Wastewater Utility Monthly Base Rate Projections – 2022-2026

User Class	2016 Rates	2017 Recommended	2018 Projected	2019 Projected	2020 Projected	2021 Projected
Inside City Users						
SC-1	$3.55	$4.44	$5.55	$6.94	$8.40	$10.16
SC-2	$6.31	$7.07	$7.92	$8.87	$9.93	$11.12
SC-3	$8.86	$9.92	$10.91	$12.00	$13.20	$14.52
Grinder	$13.47	$14.55	$15.71	$16.97	$18.33	$19.80
STEP	$16.65	$18.32	$20.15	$21.36	$22.64	$24.00
Outside City Users						
SC-1	$5.46	$6.83	$8.54	$10.68	$12.92	$15.63
SC-2	$8.71	$9.76	$10.93	$12.24	$13.71	$15.36
SC-3	$10.54	$11.80	$12.98	$14.28	$15.71	$17.28
Resthaven	$21.47	$23.62	$25.98	$27.54	$29.19	$30.94
Big Mountain	$8.71	$9.76	$10.93	$12.02	$13.22	$14.54

Table ES.7: Wastewater Utility Volumetric Rate Projections – 2017-2021

User Class	2022 Projected	2023 Projected	2024 Projected	2025 Projected	2026 Projected
Inside City Users					
SC-1	$10.36	$10.57	$10.78	$11.00	$11.22
SC-2	$11.34	$11.57	$11.80	$12.04	$12.28
SC-3	$15.39	$16.01	$16.65	$17.32	$18.01
Grinder	$20.99	$21.62	$22.27	$22.94	$23.63
STEP	$25.44	$26.97	$28.59	$28.59	$28.59
Outside City Users					
SC-1	$15.63	$15.63	$15.63	$15.63	$15.63
SC-2	$15.67	$15.98	$16.30	$16.63	$16.96
SC-3	$18.32	$19.05	$19.81	$20.60	$21.42
Resthaven	$32.80	$34.77	$36.86	$36.86	$36.86
Big Mountain	$15.41	$16.03	$16.67	$16.67	$16.67

Table ES.8: Wastewater Utility Volumetric Rate Projections – 2022-2026

	2016	2017	2018	2019	2020	2021
Projected Revenue Requirements						
O&M	$1,887,877	$1,945,860	$2,005,873	$2,067,994	$2,132,301	$2,673,253
Capital (Cash-Funded)	$1,190,250	$775,000	$429,000	$138,500	$180,900	$400,000
Capital (Debt-Funded)	$2,190,527	$0	$0	$19,587,500	$0	$0
Debt Service	$250,541	$338,976	$333,017	$336,197	$1,678,455	$1,679,249
Future WWTP Capital Reserve	$0	$335,324	$670,649	$1,005,973	$0	$0
Total Revenue Requirements	**$5,519,195**	**$3,395,160**	**$3,438,539**	**$23,136,163**	**$3,991,656**	**$4,752,502**
Projected Income and Funds from Other Sources						
Loan Proceeds	$2,190,527	$0	$0	$19,587,500	$0	$0
Other Revenue	$498,000	$560,500	$220,500	$220,500	$220,500	$220,500
Net Revenue Requirements	$2,830,668	$2,834,660	$3,218,039	$3,328,163	$3,771,156	$4,532,002
Projected Revenue from Rates	**$2,436,156**	**$2,714,483**	**$3,041,090**	**$3,422,787**	**$3,831,790**	**$4,308,042**
Revenue Surplus/(Deficiency)	($394,511)	($120,178)	($176,948)	$94,624	$60,634	($223,960)

Table ES.9: Projected Wastewater Utility Revenue Adequacy – 2017-2021

	2022	2023	2024	2025	2026
Projected Revenue Requirements					
O&M	$2,760,137	$2,850,007	$2,942,974	$3,039,154	$3,138,666
Capital (Cash-Funded)	$400,000	$400,000	$400,000	$400,000	$400,000
Capital (Debt-Funded)	$0	$0	$0	$0	$0
Debt Service	$1,674,901	$1,668,177	$1,664,930	$1,663,373	$1,665,700
Future WWTP Capital Reserve	$0	$0	$0	$0	$0
Total Revenue Requirements	**$4,835,038**	**$4,918,184**	**$5,007,904**	**$5,102,527**	**$5,204,366**
Projected Income and Funds from Other Sources					
Loan Proceeds	$0	$0	$0	$0	$0
Other Revenue	$220,500	$220,500	$220,500	$220,500	$220,500
Net Revenue Requirements	$4,614,538	$4,697,684	$4,787,404	$4,882,027	$4,983,866
Projected Revenue from Rates	**$4,452,243**	**$4,595,802**	**$4,743,134**	**$4,880,527**	**$5,021,372**
Revenue Surplus/(Deficiency)	($162,294)	($101,882)	($44,270)	($1,501)	$37,506

Table ES.10: Projected Wastewater Utility Revenue Adequacy – 2022-2026

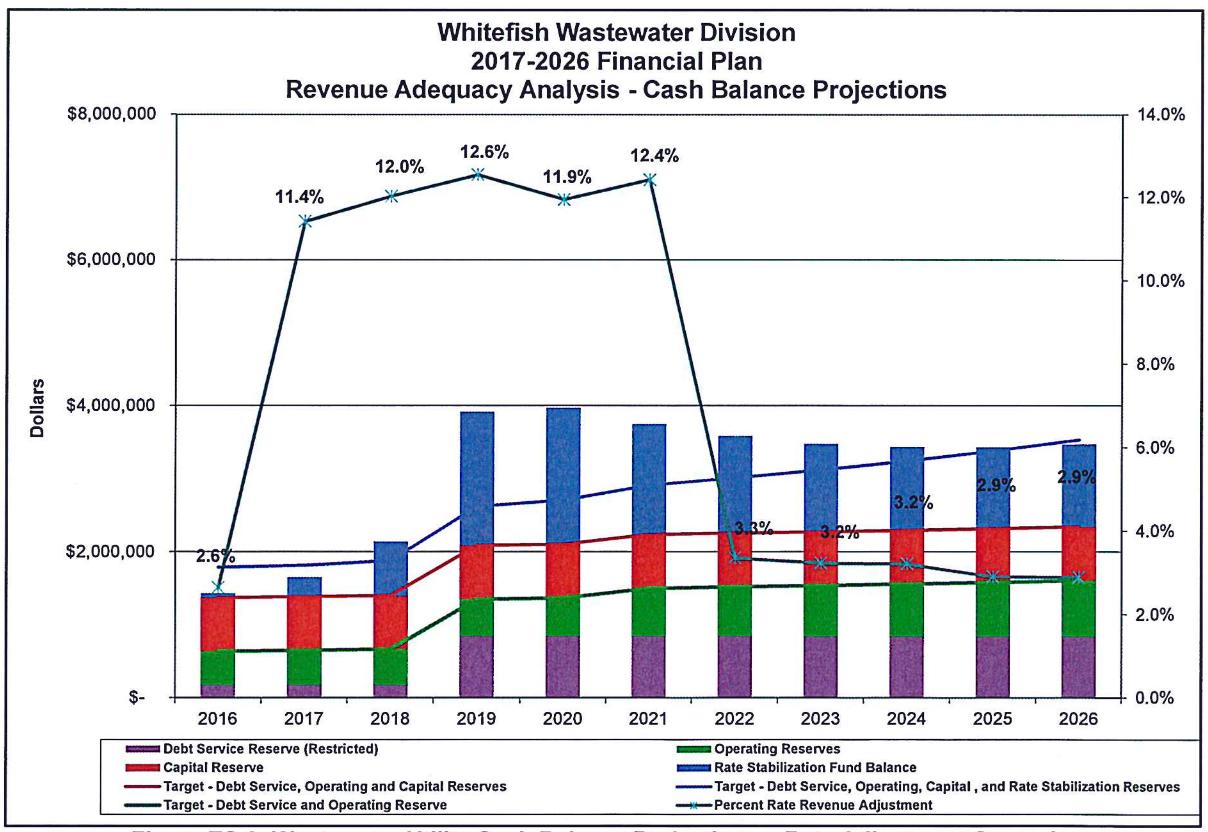


Figure ES.2: Wastewater Utility Cash Balance Projections – Rate Adjustment Scenario

Based on the COSA, rate design, and revenue adequacy analyses completed within this project, the following recommendations are offered for the Wastewater Utility:

- **Adopt a revised approach to the Service Classes.** Based on discussions with City Staff and Council Members, it is recommended that the City revise the lift station classifications as shown in Figure ES.1. The COSA completed as part of this study followed this approach.
- **Implement near-term adjustments to prepare the Utility for debt associated with the new WWTP.** By gradually increasing revenue requirements with the goal of generating adequate revenue to meet debt service and coverage requirements by 2020, the City can show a proactive approach to managing Utility finances. In the interim, reserve funds can be built that can potentially minimize necessary future rate increase, provided that coverage can be met at that time.
- **Closely monitor coverage as the new debt service comes online.** The required coverage associated with debt for the new WWTP will require rate increases beyond what is necessary to simply meet the debt payment.
- **Strive to correct cost of service inequities as adjustments are made to meet annual revenue requirements.** By implementing the recommended changes to the wastewater rates, the City will be making an effort to rectify any existing cost of service inequities. By updating usage characteristics, revenue requirements, and asset values on an annual basis, the model will make adjustments to the COSA relationships. This will be important when the new WWTP facility comes online. The model is currently set up based on projected asset values.
- **Link annual Outside user rate adjustments to adjustments to Inside user rates.** It is recommended that City continue to adjust rates to Outside users consistent with those to Inside users. Due to the relatively small number of Outside users, it is very difficult to correct any cost of service disparity.
- **Review Wastewater Revenue Adequacy annually.** The City of Whitefish has undertaken this project to develop a financial tool to assist in managing the financial health of the Wastewater Utility. Although the projections herein contain proposed rate adjustments through 2026, a change in actual revenues or expenses from those projected could significantly impact the Utility. As a result, it is strongly recommended that the City closely monitor revenues and expenses as compared to those projected in the rate model, making adjustments as necessary, and update the projected rate adjustments based on the desired objective of achieving consistent revenue adequacy and meeting cash reserve target balances.

- **Continue pursuit of grant dollars for construction of the new WWTP.** The City is actively exploring potential grant funds for the WWTP construction. As grant dollars are acquired, future projections can be adjusted to reflect reduced revenue requirements.
- **Monitor near-term revenue stability.** As the City implements rate increases designed to meet future debt service requirements, there is the potential for some users to decrease water use in an overall effort to lower the utility bill. Therefore, the City should closely monitor revenue stability associated with these multi-year changes.
- **Establish Target Levels and Fund Operating Reserves.** In addition to Debt Service reserves required by bond covenants, it is recommended that the City strive to achieve and maintain the following reserve levels:
    - Operating Reserves: Target = 90 days of operating expenses
    - Capital Reserve: Target = 15 percent of average annual cash-funded capital expenditures
    - Rate Stabilization: Target = 15 percent of annual rate revenue.
- **Continue the policy of rate indexing as a minimum annual adjustment.** Although future rate adjustment projections contained herein are, for some user classes, less than average inflation, it is recommended that the City maintain its rate indexing policy, even though it is likely with an up-to-date financial model that in most years the City will be able to specifically dial in the necessary percentage.
- **Revise the existing Low Income/Senior Discount Policy.** It is recommended that the City revise its policy to require income-based qualification through the LIEAP to receive the discounted Utility rates.
- **Proactively communicate changes to the rate structure and increases to the periodic utility bills to the public.** It is recommended that once the City has approved Utility rates for 2017, it continue its proactive community outreach program to educate customers as to the new rates and rate impacts. It is suggested that outreach efforts involve information on the City website, press releases, and mailings. Table ES.11 presents the monthly change in dollar amount associated with wastewater rate projections. The change is compared to the monthly charge for the amount of wastewater listed in the second column. The calculation has been completed for each year, with reference back to FY16 charges for service. Therefore, the monthly increase in the last column represents the projected monthly increase in

2026 as compared to the monthly charge in 2016. Table ES.12 presents the same information in percentage format.

It is important to remember that the cost of service is a one-time snapshot of cost causation associated with users of the Utility. Setting rates for one to five years based on a cost of service analysis utilizing a Test Year costs and usage characteristics is a generally accepted practice. Corrections are then made periodically as COSA assumptions are updated. It is becoming more common to incorporate COSA into annual rate setting, which has been done for this project. This approach should help the City to adjust more quickly to changes in how the Utility is operated and how users are driving cost, thereby managing rate equitability on an on-going basis.

	Avg Monthly Gallons	Existing Bill FY16	2017 Monthly Increase from 2016	2018 Monthly Increase from 2016	2019 Monthly Increase from 2016	2020 Monthly Increase from 2016	2021 Monthly Increase from 2016	2022 Monthly Increase from 2016	2023 Monthly Increase from 2016	2024 Monthly Increase from 2016	2025 Monthly Increase from 2016	2026 Monthly Increase from 2016
SC-1												
Inside	3,000	$ 31.82	$ 3.31	$ 7.29	$ 12.13	$ 17.20	$ 23.19	$ 24.53	$ 25.92	$ 27.33	$ 28.79	$ 30.28
Inside Low Income	3,000	$ 15.94	$ 2.83	$ 6.32	$ 10.66	$ 15.21	$ 20.67	$ 21.45	$ 22.27	$ 23.10	$ 23.96	$ 24.83
Outside	3,000	$ 41.11	$ 4.85	$ 10.74	$ 17.95	$ 25.48	$ 34.44	$ 35.30	$ 36.19	$ 37.10	$ 38.04	$ 39.01
Inside	6,000	$ 42.47	$ 5.98	$ 13.29	$ 22.30	$ 31.75	$ 43.02	$ 44.96	$ 46.98	$ 49.02	$ 51.14	$ 53.29
Inside Low Income	6,000	$ 26.59	$ 5.50	$ 12.32	$ 20.83	$ 29.76	$ 40.50	$ 41.88	$ 43.33	$ 44.79	$ 46.31	$ 47.84
Outside	6,000	$ 57.49	$ 8.96	$ 19.98	$ 33.61	$ 47.86	$ 64.95	$ 65.81	$ 66.70	$ 67.61	$ 68.55	$ 69.52
SC-2												
Inside	3,000	$ 55.95	$ 3.39	$ 7.08	$ 11.11	$ 15.50	$ 20.32	$ 22.27	$ 24.29	$ 26.35	$ 28.48	$ 30.65
Inside Low Income	3,000	$ 28.20	$ 2.56	$ 5.40	$ 8.55	$ 12.03	$ 15.91	$ 16.89	$ 17.91	$ 18.94	$ 20.01	$ 21.09
Outside	3,000	$ 67.61	$ 4.39	$ 9.18	$ 14.43	$ 20.20	$ 26.55	$ 28.92	$ 31.34	$ 33.83	$ 36.40	$ 39.01
Inside	6,000	$ 74.88	$ 5.67	$ 11.91	$ 18.79	$ 26.36	$ 34.75	$ 37.36	$ 40.07	$ 42.82	$ 45.67	$ 48.56
Inside Low Income	6,000	$ 47.13	$ 4.84	$ 10.23	$ 16.23	$ 22.89	$ 30.34	$ 31.98	$ 33.69	$ 35.41	$ 37.20	$ 39.00
Outside	6,000	$ 93.74	$ 7.54	$ 15.84	$ 25.02	$ 35.20	$ 46.50	$ 49.80	$ 53.15	$ 56.60	$ 60.16	$ 63.76
SC-3												
Inside	3,000	$ 69.75	$ 4.48	$ 8.78	$ 13.42	$ 18.44	$ 23.86	$ 27.97	$ 31.38	$ 34.89	$ 38.54	$ 42.30
Inside Low Income	3,000	$ 37.37	$ 3.50	$ 6.80	$ 10.41	$ 14.36	$ 18.68	$ 21.66	$ 23.91	$ 26.23	$ 28.65	$ 31.14
Inside	6,000	$ 96.33	$ 7.66	$ 14.93	$ 22.84	$ 31.46	$ 40.84	$ 47.56	$ 52.83	$ 58.26	$ 63.92	$ 69.75
Inside Low Income	6,000	$ 63.95	$ 6.68	$ 12.95	$ 19.83	$ 27.38	$ 35.66	$ 41.25	$ 45.36	$ 49.60	$ 54.03	$ 58.59
Grinder												
Inside	3,000	$ 94.35	$ 4.86	$ 10.01	$ 15.51	$ 21.36	$ 27.59	$ 33.04	$ 36.86	$ 40.80	$ 44.86	$ 49.04
Inside Low Income	3,000	$ 53.90	$ 3.64	$ 7.54	$ 11.75	$ 16.27	$ 21.14	$ 25.18	$ 27.55	$ 30.00	$ 32.52	$ 35.12
Inside	6,000	$ 134.76	$ 8.10	$ 16.73	$ 26.01	$ 35.94	$ 46.58	$ 55.60	$ 61.31	$ 67.20	$ 73.27	$ 79.52
Inside Low Income	6,000	$ 94.31	$ 6.88	$ 14.26	$ 22.25	$ 30.85	$ 40.13	$ 47.74	$ 52.00	$ 56.40	$ 60.93	$ 65.60
STEP												
Inside	3,000	$ 106.02	$ 6.69	$ 13.91	$ 19.32	$ 25.00	$ 30.97	$ 37.24	$ 43.84	$ 50.77	$ 52.90	$ 55.09
Resthaven	3,000	$ 124.59	$ 8.26	$ 17.20	$ 23.80	$ 30.72	$ 38.00	$ 45.67	$ 53.74	$ 62.23	$ 64.52	$ 66.88
Inside	6,000	$ 155.97	$ 11.70	$ 24.41	$ 33.45	$ 42.97	$ 53.02	$ 63.61	$ 74.80	$ 86.59	$ 88.72	$ 90.91
Resthaven	6,000	$ 189.00	$ 14.71	$ 30.73	$ 42.01	$ 53.88	$ 66.41	$ 79.66	$ 93.64	$ 108.40	$ 110.69	$ 113.05
Big Mountain												
Big Mountain	1,470,000	$ 12,876.28	$ 1,545.68	$ 3,267.82	$ 4,872.43	$ 6,638.81	$ 8,581.66	$ 9,863.08	$ 10,777.08	$ 11,720.56	$ 11,723.32	$ 11,726.16

Table ES.11: Monthly Wastewater Rate Increases Associated with Projected Rate Adjustments – Referenced to FY16

	Avg Monthly Gallons	Existing Bill FY16	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
			% Increase from 2016	% Increase from 2016	% Increase from 2016	% Increase from 2016	% Increase from 2016	% Increase from 2016	% Increase from 2016	% Increase from 2016	% Increase from 2016	% Increase from 2016
SC-1												
Inside	3,000	$ 31.82	10.4%	22.9%	38.1%	54.1%	72.9%	77.1%	81.5%	85.9%	90.5%	95.2%
Inside Low Income	3,000	$ 15.94	17.8%	39.6%	66.9%	95.4%	129.7%	134.6%	139.7%	144.9%	150.3%	155.8%
Outside	3,000	$ 41.11	11.8%	26.1%	43.7%	62.0%	83.8%	85.9%	88.0%	90.2%	92.5%	94.9%
Inside	6,000	$ 42.47	14.1%	31.3%	52.5%	74.8%	101.3%	105.9%	110.6%	115.4%	120.4%	125.5%
Inside Low Income	6,000	$ 26.59	20.7%	46.3%	78.3%	111.9%	152.3%	157.5%	163.0%	168.4%	174.2%	179.9%
Outside	6,000	$ 57.49	15.6%	34.8%	58.5%	83.2%	113.0%	114.5%	116.0%	117.6%	119.2%	120.9%
SC-2												
Inside	3,000	$ 55.95	6.1%	12.7%	19.9%	27.7%	36.3%	39.8%	43.4%	47.1%	50.9%	54.8%
Inside Low Income	3,000	$ 28.20	9.1%	19.1%	30.3%	42.7%	56.4%	59.9%	63.5%	67.2%	71.0%	74.8%
Outside	3,000	$ 67.61	6.5%	13.6%	21.3%	29.9%	39.3%	42.8%	46.4%	50.0%	53.8%	57.7%
Inside	6,000	$ 74.88	7.6%	15.9%	25.1%	35.2%	46.4%	49.9%	53.5%	57.2%	61.0%	64.9%
Inside Low Income	6,000	$ 47.13	10.3%	21.7%	34.4%	48.6%	64.4%	67.9%	71.5%	75.1%	78.9%	82.7%
Outside	6,000	$ 93.74	8.0%	16.9%	26.7%	37.6%	49.6%	53.1%	56.7%	60.4%	64.2%	68.0%
SC-3												
Inside	3,000	$ 69.75	6.4%	12.6%	19.2%	26.4%	34.2%	40.1%	45.0%	50.0%	55.3%	60.6%
Inside Low Income	3,000	$ 37.37	9.4%	18.2%	27.9%	38.4%	50.0%	58.0%	64.0%	70.2%	76.7%	83.3%
Inside	6,000	$ 96.33	8.0%	15.5%	23.7%	32.7%	42.4%	49.4%	54.8%	60.5%	66.4%	72.4%
Inside Low Income	6,000	$ 63.95	10.4%	20.3%	31.0%	42.8%	55.8%	64.5%	70.9%	77.6%	84.5%	91.6%
Grinder												
Inside	3,000	$ 94.35	5.2%	10.6%	16.4%	22.6%	29.2%	35.0%	39.1%	43.2%	47.5%	52.0%
Inside Low Income	3,000	$ 53.90	6.8%	14.0%	21.8%	30.2%	39.2%	46.7%	51.1%	55.7%	60.3%	65.2%
Inside	6,000	$ 134.76	6.0%	12.4%	19.3%	26.7%	34.6%	41.3%	45.5%	49.9%	54.4%	59.0%
Inside Low Income	6,000	$ 94.31	7.3%	15.1%	23.6%	32.7%	42.6%	50.6%	55.1%	59.8%	64.6%	69.6%
STEP												
Inside	3,000	$ 106.02	6.3%	13.1%	18.2%	23.6%	29.2%	35.1%	41.4%	47.9%	49.9%	52.0%
Resthaven	3,000	$ 124.59	6.6%	13.8%	19.1%	24.7%	30.5%	36.7%	43.1%	49.9%	51.8%	53.7%
Inside	6,000	$ 155.97	7.5%	15.7%	21.4%	27.6%	34.0%	40.8%	48.0%	55.5%	56.9%	58.3%
Resthaven	6,000	$ 189.00	7.8%	16.3%	22.2%	28.5%	35.1%	42.1%	49.5%	57.4%	58.6%	59.8%
Big Mountain												
Big Mountain	1,470,000	$ 12,876.28	12.0%	25.4%	37.8%	51.6%	66.6%	76.6%	83.7%	91.0%	91.0%	91.1%

Table ES.12: Monthly Wastewater Rate Percentage Increase Associated with Projected Rate Adjustments – Referenced to FY16

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Projected Wastewater Capital Needs FY 2016 - FY 2020

	Project	Project Number	Description & Justification	Year	Cost	Funding Source (s) Impact Fees	WRDA	TESP	RRGL	Cash	Grant	Other	Debt
	Treatment												
1	Equipment Storage Building/Shed		Cold storage for parts/equip. @ WWTP (930)	FY16	$ 25,000					$ 25,000			
2	Wastewater Treatment Facility Improvement Project - Mitigate impacts from Riverside sewage pu		Engineering and Construction	FY16	$ 100,000								
3	Wastewater Treatment Facility Improvement Project - Waste receiving station		Engineering and Construction	FY16	$ 60,000								
4	Wastewater Treatment Facility Improvement Project - Site Irrigation		Engineering and Construction	FY16	$ 50,000								
5	I&I Mitigation - Field Data Acquisition/Analysis & TSEP Grant Application			FY16	$ 60,000								
6	I&I Mitigation - CIPP & Manhole Repairs		Engineering and Construction	FY16	$ 1,500,000								
8	Activated Sludge Plant-Design		Major plant upgrade	FY16	$ 700,000	$ 490,000							$ 210,000
8	Whitefish Lake Septic Leachate Mitigation - Engineering & Construction		Engineering and Construction	FY16	$ 250,000								
9	Activated Sludge Plant-Construction		Major plant upgrade	FY17	$ 5,300,000	$ 3,710,000							$ 1,590,000
	Collection												
	Sewer Main Upgrade N of Hospital - Greenwood to Columbia		Upgrade under-sized sewer mains to maintain	FY16	$ 250,000	$ 75,000							$ 175,000
	Upgrade Birch Point Gravity Sewer			FY16	$ 100,000								$ 100,000
	Piping - Future Capacity Enhancements		Upgrade 1730 LF of collection mains to enhan	FY16	$ 455,000	$ 364,000							$ 91,000
	Cow Creek Sewer Extension		Engineering & Construction - Extension to Edg	FY16	$ 800,000	$ 800,000							$ -
	Whitefish West Project-US93 - Phase II - Karrow Ave - State Park Road		Water & sewer improvements in conjunction v	FY16	$ 743,000	$ 148,600							$ 594,400
	Whitefish Urban Project-US93 - Design & Construct		Upgrade gravity sewer system in conjunction v	Future	$ 500,000	$ 100,000							$ 400,000
	Manhole Rehab		Various locations - Wait for I&I ??	Future									
	Sewer Main to City Shop		Needed facility upgrade sanitation concerns	Future									
	Pumping Stations												
	Generator (Emergency Power)		Miller Liftstation Standby Power	FY16	$ 75,000					$ 75,000			
	Generator (Emergency Power)		Birch Point Liftstation Standby Power	FY16	$ 50,000					$ 50,000			
	Bohemian Lift Station			FY16	$ 15,000					$ 15,000			
	Birch Point Lift Station - Phase I Pump Station Upgrades		New wet well, valve pit & pipe extensions in cc	FY16	$ 250,000					$ 250,000			
	Generator (Emergency Power) & Access Improvements		City Beach Sewage Pump Station - Engineering	FY16	$ 75,000					$ 75,000			
	Birch Point Lift Station - Phase II Pump Station Upgrades		New pumps, controls and force main	FY16	$ 200,000					$ 200,000			
	Riverside Lift Station Capacity Enhancement			FY16	$ 145,000	$ 116,000							$ 29,000
	Upgrade Pumps at Main Lift Station			FY16	$ 75,000	$ 75,000							$ -
	Texas-Colorado Lift Station Capacity Enhancement			FY16	$ 101,000	$ 30,300							$ 70,700
	Mountain Park Lift Station			Future	$ 98,500	$ 49,250				$ 49,250			
	Equipment												
	Manhole Chimney Repair Equipment			FY16	$ 35,000					$ 35,000			
	Chlorine Analyzer		Replacement	FY16	$ 5,500					$ 5,500			
	Ammonium, PH ORP, LDO, Temp.			FY16	$ 11,000					$ 11,000			
	Portable PH, DO, Temp, River Monitoring			FY16	$ 5,000					$ 5,000			
	Slurry Pump w/VFD & Alum Recycle			FY16	$ 19,000					$ 19,000			
	Optimization Strategies DO Control, Recycle Heat Retention			FY16	$ 40,000					$ 40,000			
	Locator		Replacement - Total $6,000, split $3,000 each	FY16	$ 3,000					$ 3,000			
	Handheld Meter Reader		Replacement - Total $5,500 split $2,750 each v	FY16	$ 2,750					$ 2,750			
	Mobile Drive Unit		Replacement - Total $6,500 split $3,250 each v	FY16	$ 3,250					$ 3,250			
	Hydraulic Power Unit - Replace 2005 Lynx LPU18HO2		Replacement for unit #95 - Total $7,000, Split	FY16	$ 2,250					$ 2,250			
	Pickup Truck, 4x4 (service body) - Replace 2007 Ford F250		Replacement for unit #4	FY17	$ 35,000					$ 35,000			
	Excavator - Replace 1987 J.Deere 595		Replacement for unit #43 - Total $150,000, spl	FY17	$ 50,000					$ 50,000			
	Pickup, 4x4 (Flatbed) - Replace 2002 Ford F350 XL		Replacement for unit #8 - Total $26,000, split	FY18	$ 9,000					$ 9,000			
	Pickup, 4x4 - Replace 2002 Ford F150		Replacement for unit #14	FY18	$ 22,000					$ 22,000			

Project	Project Number	Description & Justification	Year	Cost	Funding Source (s)							
					Impact Fees	WRDA	TESP	RRGL	Cash	Grant	Other	Debt
SUV - Replace 2006 Ford Freestyle		Replacement for unit #5 - Total $24,000, split $	FY18	$ 8,000					$ 8,000			
Pickup, 4x4 - Replace 2003 Ford F150 XL		Replacement for unit #16 - Total $25,000, split	FY18	$ 8,000					$ 8,000			
Vactor Truck - Replace 2002 Strlng 2110		Replacement for unit #36	FY18	$ 225,000					$ 225,000			
Pressure Washer - Replace 2008 Landa OHWA-18024A		Replacement for unit #85 - Total $6,000, split $	FY18	$ 2,000					$ 2,000			
6" Pump, Trailer Mounted - Replace GR 16A2-F3L		Replacement for unit #169	FY18	$ 55,000					$ 55,000			
SUV - Replace 2006 Ford Escape		Replacement for unit #1 - Total $25,000, split $	FY19	$ 8,500					$ 8,500			
Pressure Washer - Replace 2001 Landa MHP4-3000		Replacement for unit #84 - Total $6,000, split $	FY19	$ 2,000								
Pickup, 4x4 - Replace 2004 Ford F150 XL		Replacement for unit #18 - Total $25,000, split	FY19	$ 8,000								
Dump Truck, 12 Yard - 1994 Kenw. T-450		Replacement for unit #27 - Total $110,000, spl	FY19	$ 35,000								
Dump Truck – Replace 2004 FRTLNR FL112		Replacement unit #29 - Total $110,000, split $	FY19	$ 35,000								
Generator - Replace 1996 MQ DCA60SSIT		Replacement for unit #92	FY19	$ 40,000								
Loader - Replace 1998 Case 621BXT		Replacement for unit #42 - Total $150,000, Spl	FY20	$ 50,000								
Van - Replace 2008 Chevy Express		Replacement for unit #20 - Total $30,000, split	FY20	$ 10,000								
Dump Truck - Replace 2005 Ford F750		Replacement for unit #24 - Total $35,000, split	FY20	$ 11,500								
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Jet-Away - Replace 2000 JetAway JAJ-600R		Replacement for unit #37	FY20	$ 24,000								
Backhoe - Replace 2001 Cat 430D		Replacement for unit #44 - Total $80,000, split	FY20	$ 27,500								
Snow Plow, 8' - Replace 20013 Blzzrd Speedwing		Replacement for unit #147	FY20	$ 6,900								
Shoring - Replace 1994 GME		Replacement for unit #312 - Total $12,000, spl	FY20	$ 6,000								
Other												
Infrastructure Management Software -		Information management system to inventory	FY16	$ 7,500					$ 7,500			
GIS Software		ArcGIS, Maint on standard, SA & NA, ESRI GPS	FY16	$ 4,000								
Generator for Public Works Shop		Total cost $26,000 (Split $8,000 Street, $9,000	FY16	$ 9,000					$ 9,000			
Wireless Mesh & Expansion of Backup Equipment		Mobile nodes, stationary nodes (Total $150,0C	FY16	$ 50,000					$ 9,000			
Sludge Removal		Maintenance	Future	$ 250,000					$ 250,000			
GIS Software		SGELA License Agreement - total $30,000 split	FY17	$ 10,000					$ 10,000			
GIS Software		SGELA License Agreement & ESRI GPS Analyst	FY18	$ 10,000					$ 10,000			
GIS Software		SGELA License Agreement - total $30,000 split	FY19	$ 10,000					$ 10,000			
GIS Software		License Agreement and updates - total $30,00	FY20	$ 10,000					$ 10,000			
									$ -			
			Totals	$ 13,178,150	$ 5,958,150	$ -	$ -	$ -	$ 1,604,000	$ -	$ -	$ 3,260,100

	Cost	Impact Fees	WRDA	TESP	RRGL	Cash	Grant	Other	Debt
Beginning Available	$ 941,000	$ 425,000		$ -		$ 516,000			
Projected over 5 years	$ 1,950,000	$ 375,000		$ -		$ 1,575,000	$ -		
Total Available	$ 2,891,000	$ 800,000	$ -	$ -	$ -	$ 2,091,000	$ -	$ -	$ -
Total FY 2016	$ 6,276,250	$ 2,098,900	$ -	$ -	$ -	$ 842,250	$ -	$ -	$ 1,270,100
Total FY 2017	$ 5,395,000	$ 3,710,000	$ -	$ -	$ -	$ 95,000	$ -	$ -	$ 1,590,000
Total FY 2018	$ 338,500	$ -	$ -	$ -	$ -	$ 338,500	$ -	$ -	$ -
Total FY 2019	$ 138,500	$ -	$ -	$ -	$ -	$ 18,500	$ -	$ -	$ -
Total FY 2020	$ 180,900	$ -	$ -	$ -	$ -	$ 10,000	$ -	$ -	$ -
Future	$ 848,500	$ 149,250	$ -	$ -	$ -	$ 299,250	$ -	$ -	$ 400,000
Total Required	$ 13,177,650	$ 5,958,150	$ -	$ -	$ -	$ 1,603,500	$ -	$ -	$ 3,260,100
Net Deficiency	($10,286,650)	($5,158,150)	$0	$0	$0	$487,500	$0	$0	($3,260,100)

Projected Wastewater Capital Needs FY 2016 - FY 202

	Project	Project Number	Description & Justification	Year	Cost	Impact Fees	WRDA	TESP	RRGL	Cash	Grant	Other	Debt
						Funding Source (s)							
	Treatment												
1	Equipment Storage Building/Shed		Cold storage for parts/equip. @ WWTP (930)	FY16	$ 25,000					$ 25,000			
2	Wastewater Treatment Facility Improvement Project - Mitigate impacts from Riverside sewage pu		Engineering and Construction	FY16	$ 100,000								
3	Wastewater Treatment Facility Improvement Project - Waste receiving station		Engineering and Construction	FY16	$ 60,000								
4	Wastewater Treatment Facility Improvement Project - Site Irrigation		Engineering and Construction	FY16	$ 50,000								
5	I&I Mitigation - Field Data Acquisition/Analysis & TSEP Grant Application			FY16	$ 60,000								
6	I&I Mitigation - CIPP & Manhole Repairs		Engineering and Construction	FY16	$ 1,500,000								
8	Activated Sludge Plant-Design		Major plant upgrade	FY16	$ 700,000	$ 490,000							$ 210,000
8	Whitefish Lake Septic Leachate Mitigation - Engineering & Construction		Engineering and Construction	FY16	$ 250,000								
9	Activated Sludge Plant-Construction		Major plant upgrade	FY17	$ 5,300,000	$ 3,710,000							$ 1,590,000
	Collection												
	Sewer Main Upgrade N of Hospital - Greenwood to Columbia		Upgrade under-sized sewer mains to maintain	FY16	$ 250,000	$ 75,000							$ 175,000
	Upgrade Birch Point Gravity Sewer			FY16	$ 100,000								$ 100,000
	Piping - Future Capacity Enhancements		Upgrade 1730 LF of collection mains to enhan	FY16	$ 455,000	$ 364,000							$ 91,000
	Cow Creek Sewer Extension		Engineering & Construction - Extension to Edg	FY16	$ 800,000	$ 800,000							$ -
	Whitefish West Project-US93 - Phase II - Karrow Ave - State Park Road		Water & sewer improvements in conjunction v	FY16	$ 743,000	$ 148,600							$ 594,400
	Whitefish Urban Project-US93 - Design & Construct		Upgrade gravity sewer system in conjunction v	Future	$ 500,000	$ 100,000							$ 400,000
	Manhole Rehab		Various locations - Wait for I&I ??	Future									
	Sewer Main to City Shop		Needed facility upgrade sanitation concerns	Future									
	Pumping Stations												
	Generator (Emergency Power)		Miller Liftstation Standby Power	FY16	$ 75,000					$ 75,000			
	Generator (Emergency Power)		Birch Point Liftstation Standby Power	FY16	$ 50,000					$ 50,000			
	Bohemian Lift Station			FY16	$ 15,000					$ 15,000			
	Birch Point Lift Station - Phase I Pump Station Upgrades		New wet well, valve pit & pipe extensions in cc	FY16	$ 250,000					$ 250,000			
	Generator (Emergency Power) & Access Improvements		City Beach Sewage Pump Station - Engineering	FY16	$ 75,000					$ 75,000			
	Birch Point Lift Station - Phase II Pump Station Upgrades		New pumps, controls and force main	FY16	$ 200,000					$ 200,000			
	Riverside Lift Station Capacity Enhancement			FY16	$ 145,000	$ 116,000							$ 29,000
	Upgrade Pumps at Main Lift Station			FY16	$ 75,000	$ 75,000							$ -
	Texas-Colorado Lift Station Capacity Enhancement			FY16	$ 101,000	$ 30,300							$ 70,700
	Mountain Park Lift Station			Future	$ 98,500	$ 49,250				$ 49,250			
	Equipment												
	Manhole Chimney Repair Equipment			FY16	$ 35,000					$ 35,000			
	Chlorine Analyzer		Replacement	FY16	$ 5,500					$ 5,500			
	Ammonium, PH ORP, LDO, Temp.			FY16	$ 11,000					$ 11,000			
	Portable PH, DO, Temp, River Monitoring			FY16	$ 5,000					$ 5,000			
	Slurry Pump w/VFD & Alum Recycle			FY16	$ 19,000					$ 19,000			
	Optimization Strategies DO Control, Recycle Heat Retention			FY16	$ 40,000					$ 40,000			
	Locator		Replacement - Total $6,000, split $3,000 each	FY16	$ 3,000					$ 3,000			
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Project	Project umber	Description & Justification	Year	Cost	Imp ees	VRDA	TESP	RRGL	Cash	Grant	Other	D
					Funding Source (s)							
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Sludge Removal		Maintenance	Future	$ 250,000					$ 250,000			
GIS Software		SGELA License Agreement - total $30,000 split	FY17	$ 10,000					$ 10,000			
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GIS Software		License Agreement and updates - total $30,00	FY20	$ 10,000					$ 10,000			
									$ -			
			Totals	$ 13,178,150	$ 5,958,150	$ -	$ -	$ -	$ 1,604,000	$ -	$ -	$ 3,260,100
			Beginning Available	$ 941,000	$ 425,000		$ -		$ 516,000			
			Projected over 5 years	$ 1,950,000	$ 375,000		$ -		$ 1,575,000	$ -		
			Total Available	$ 2,891,000	$ 800,000	$ -	$ -	$ -	$ 2,091,000	$ -	$ -	$ -
			Total FY 2016	$ 6,276,250	$ 2,098,900	$ -	$ -	$ -	$ 842,250	$ -	$ -	$ 1,270,100
			Total FY 2017	$ 5,395,000	$ 3,710,000	$ -	$ -	$ -	$ 95,000	$ -	$ -	$ 1,590,000
			Total FY 2018	$ 338,500	$ -	$ -	$ -	$ -	$ 338,500	$ -	$ -	$ -
			Total FY 2019	$ 138,500	$ -	$ -	$ -	$ -	$ 18,500	$ -	$ -	$ -
			Total FY 2020	$ 180,900	$ -	$ -	$ -	$ -	$ 10,000	$ -	$ -	$ -
			Future	$ 848,500	$ 149,250	$ -	$ -	$ -	$ 299,250	$ -	$ -	$ 400,000
			Total Required	$ 13,177,650	$ 5,958,150	$ -	$ -	$ -	$ 1,603,500	$ -	$ -	$ 3,260,100
			Net Deficiency	($10,286,650)	($5,158,150)	$0	$0	$0	$487,500	$0	$0	($3,260,100)

APPENDIX H

ENVIRONMENTAL ASSESSMENT DOCUMENTATION

RESOLUTION NO. 16-17

A Resolution of the City Council of the City of Whitefish, Montana, adopting the final Environmental Assessment for the Wastewater Treatment Plant Improvements Project.

WHEREAS, the City of Whitefish has completed an assessment to identify potential environmental impacts associated with improvements to the Whitefish wastewater treatment plant; and

WHEREAS, at a lawfully noticed public hearing on April 8, 2016, the Whitefish City Council reviewed the draft Environmental Assessment, received written and oral reports from Public Works staff, and received public comment; and

WHEREAS, the City of Whitefish has determined that the Wastewater Treatment Plant Improvements Project will not significantly affect the quality of the human environment and accordingly the City of Whitefish has determined an Environmental Impact Statement is not necessary.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Whitefish, Montana, as follows:

Section 1: The City of Whitefish hereby approves the final Environmental Assessment for the Wastewater Treatment Plant Improvements Project, a copy of which is attached as Exhibit "A" and incorporated herein by reference.

Section 3: This Resolution shall take effect immediately upon its adoption by the City Council, and signing by the Mayor thereof.

PASSED AND ADOPTED BY THE CITY COUNCIL OF THE CITY OF WHITEFISH, MONTANA, ON THIS 2ND DAY OF MAY, 2016.

John M. Muhlfeld, Mayor

ATTEST:

Michelle Howke, City Clerk

EXHIBIT A

CITY OF WHITEFISH
2016 WASTEWATER SYSTEM IMPROVEMENTS PROJECT

Environmental Review Form

1. **Alternatives: Describe Reasonable Alternatives To The Project.**

   The proposed project is to upgrade the City of Whitefish wastewater treatment plant as needed to comply with regulatory requirements regarding discharges to state waters. Initial alternatives considered include the No-Action alternative, lagoon based options and mechanical treatment plants including the following:

   - Parkson Biolac Advanced Lagoon System
   - EDI IDEAL Advance Lagoon System
   - Three Cell Lagoon System with ammonia Removal
   - Sequencing Batch Reactor (SBR)
   - Membrane Bioreactor (MBR)
   - Oxidation Ditch

   These options were further screened with a full evaluation of the following three wastewater treatment plant alternatives:

   - Parkson Biolac Advanced Lagoon System
   - Sequencing Batch Reactor (SBR)
   - Oxidation Ditch

   Pending staff and public review, the Sequencing Batch Reactor has been identified as the most cost-effective and environmentally sound treatment alternative.

2. **Mitigation: Identify Any Enforceable Measures Necessary To Reduce Any Impacts To An Insignificant Level.**

   Measures to mitigate construction related impacts will be required of the construction contractor by specification including dust control, noise limitations, control of runoff and erosion and obtaining all required construction permits related to mitigation of potential environmental impacts.

3. **Is an EA or Environmental Impact Statement (EIS) required?** Describe whether or not an EA or EIS is required, and explain in detail why or why not.

   The decision was made that the Environmental Assessment Process, including completion of the environmental checklist and public review of the proposed project, sufficiently addresses environmental impacts associated with the proposed work. The project does not qualify for a Categorical Exclusion as allowed under the Montana Environmental Policy Act. The project was determined to not adversely affect the quality of the human environment and a full EIS is not necessary.

4. **Public Involvement:** A project meeting was held with the City staff to discuss the project on September 23, 2015. A Whitefish Council work session, with the inclusion of the public, was held November 16, 2015 to discuss the planning process and potential treatment options. A public hearing was held April 18, 2016 to further discuss the project and associated environmental impacts identified through the public review. A final decision regarding the environmental Assessment was made by City Council on May 2, 2016.

5. **Person Responsible for Preparing:** Scott Anderson, P.E., President of Anderson-Montgomery Consulting Engineers, prepared the Environmental Checklist.

6. **Other Agencies:** List any state, local, or federal agencies that have over-lapping or additional jurisdiction or environmental review responsibility for the proposed action and the permits, licenses, and other authorizations required; and list any agencies or groups that were contacted or contributed information to this Environmental Assessment (EA).

   Agencies contacted or that will be contacted include the Montana Department of Environmental Quality, Montana Department of Natural Resources and Conservation, the State Historical Society, the Montana Department of Fish, Wildlife and Parks, the US Fish and Wildlife Service and the US Army Corps of Engineers.

Charles C. Stearns — 5/3/16

Charles C. Stearns, City Manager — Date

City of Whitefish

ENVIRONMENTAL REVIEW CHECKLIST

Form Prepared by Scott Anderson, P.E. , Anderson-Montgomery Consulting Engineers

NAME OF PROJECT:	Whitefish 2016 Wastewater System Improvements Project
PROPOSED ACTION:	Upgrade Wastewater Treatment System
LOCATION:	Whitefish, Montana

Key Letter:

N: No Impact; **B:** Potentially Beneficial; **A:** Potentially Adverse; **P:** Approval/Permits Required; **M:** Mitigation Required

PHYSICAL ENVIRONMENT

Key	#	Item
N	1	Soil Suitability, Topographic and/or Geologic Constraints (e.g., soil slump, steep slopes, subsidence, seismic activity)
		Response and source of information: Previous AMCE geotechnical reports
		Poor soil conditions on site will require removal and replacement with structural fill.
N	2	Hazardous Facilities (e.g., power lines, hazardous waste sites, acceptable distance from explosive and flammable hazards including chemical/petrochemical storage tanks, underground fuel storage tanks, and related facilities such as natural gas storage facilities & propane storage tanks)
		Response and source of information: Prior work on site
		No adverse impacts anticipated.
B	3	Effects of Project on Surrounding Air Quality or Any Kind of Effects of Existing Air Quality on Project (e.g., dust, odors, emissions)
		Response and source of information: City staff, prior experience on site.
		Work proposed is to upgrade an existing wastewater plant, which has had periodic odor problems in the past. The new system should be less prone to generating odors and appropriate odor control mechanisms will be employed in the design of new facilities. Construction dust will be control the contract specification and contractor oversight.
	4	Groundwater Resources & Aquifers (e.g., quantity, quality, distribution, depth to groundwater, sole

Key Letter:		
N: No Impact; **B:** Potentially Beneficial; **A:** Potentially Adverse; **P:** Approval/Permits Required; **M:** Mitigation Required		
N		No impact to farmlands, forestlands, etc is anticipated. All work within site of existing wastewater treatment plant.
Key	9	Vegetation & Wildlife Species & Habitats, including Fish and Sage Grouse (e.g., terrestrial, avian and aquatic life and habitats)
N		*Response and source of information:* Prior correspondence with FWP, Fish and Wildlife Service
		No impacts anticipated, FWP, Fish and Wildlife Service has been contacted on previous work on site and will be allowed to comment on this project.
Key	10	Unique, Endangered, Fragile, or Limited Environmental Resources, Including Endangered Species (e.g., plants, fish or wildlife)
N		*Response and source of information:* Montana FWP, 2008
		No significant impacts anticipated. FWP did mention that grizzly bears frequent the Whitefish area and that construction activities should be conducted to avoid negative impacts - proper food storage, etc.
Key	11	Unique Natural Features (e.g., geologic features)
N		*Response and source of information:* Prior technical studies on site
		No impacts anticipated
Key	12	Access to, and Quality of, Recreational & Wilderness Activities, Public Lands and Waterways, and Public Open Space
		Response and source of information: City staff

Key Letter:		
N: No Impact; **B:** Potentially Beneficial; **A:** Potentially Adverse; **P:** Approval/Permits Required; **M:** Mitigation Required		
N		Public walking path currently exists through site. Proposed project will have not impact on this trail. New plant could improve general aesthetics in area.
HUMAN ENVIRONMENT		
Key	1	Visual Quality – Coherence, Diversity, Compatibility of Use and Scale, Aesthetics
		Response and source of information: Prior engineering experience with site
N		New facilities located within confines of existing treatment plant site, located at present site for many years. Aesthetics of site should improve with decommissioning of old lagoon system.
Key	2	Nuisances (e.g., glare, fumes)
		Response and source of information: Prior engineering experience with site
B		Some concern/complaints raised in past with odors from lagoon system. The proposed project should reduce potential for odors.
Key	3	Noise -- suitable separation between noise sensitive activities (such as residential areas) and major noise sources (aircraft, highways & railroads)
		Response and source of information: Prior engineering experience with site
B		Noise has been a problem with some nearby residents in the past due to blower noise. The new project will allow resolution of this problem by use of low noise blowers and mitigation of sources of noise.
Key	4	Historic Properties, Cultural, and Archaeological Resources
		Response and source of information: MT Historical Society, 2008 comments

Key Letter:		
N: No Impact; **B:** Potentially Beneficial; **A:** Potentially Adverse; **P:** Approval/Permits Required; **M:** Mitigation Required		
N		The Montana Historical Society has indicated that the proposed project site has been previously disturbed and their records indicate that no recorded historic or archaeological sites are known to exist within the project area.
Key	5	Changes in Demographic (population) Characteristics (e.g., quantity, distribution, density)
		Response and source of information: City staff
N		No impacts anticipated, new facilities are being sized for projected population growth.
Key	6	General Housing Conditions - Quality, Quantity, Affordability
		Response and source of information: Prior engineering experience with site
M		No direct impacts anticipated. However, the cost of the new treatment facilities is significant and housing affordability may be impacted as rates increase. Financial assistance is being pursued to mitigate financial impacts.
Key	7	Displacement or Relocation of Businesses or Residents
		Response and source of information:
N		No long-term impacts anticipated.
Key	8	Public Health and Safety
		Response and source of information: DEQ MPDES discharge permit

Key Letter:		
N: No Impact; **B:** Potentially Beneficial; **A:** Potentially Adverse; **P:** Approval/Permits Required; **M:** Mitigation Required		
N		The regulatory discharge permit for wastewater treatment facilities is written to protect the health and safety of the public. The new facilities will allow full compliance with the discharge permit thereby assuring protection of the public.
Key	9	Lead Based Paint and/or Asbestos
		Response and source of information: Prior engineering experience with site
N		No adverse impact anticipated
Key	10	Local Employment & Income Patterns - Quantity and Distribution of Employment, Economic Impact
		Response and source of information: City staff, Whitefish Growth Policy
N		No adverse impacts anticipated. City's Growth Policy advocates use of compliant wastewater treatment facilities.
Key	11	Local & State Tax Base & Revenues
		Response and source of information: City Staff, City Planning Documents
B		Appropriate wastewater treatment facilities which protect water quality and the local environment will serve to enhance the tourist and recreational industries, which support the tax base within the community.
Key	12	Educational Facilities - Schools, Colleges, Universities
		Response and source of information:
N		No adverse impact anticipated
Key	13	Commercial and Industrial Facilities - Production & Activity, Growth or Decline.

Key Letter:		
N: No Impact; **B:** Potentially Beneficial; **A:** Potentially Adverse; **P:** Approval/Permits Required; **M:** Mitigation Required		
		Response and source of information: City Staff, Local Planning Documents
		Appropriate wastewater treatment facilities which protect water quality and the local environment will serve to enhance the tourist and recreational industries allowing growth and prosperity.
Key	14	Health Care – Medical Services
		Response and source of information:
N		No adverse impacts anticipated
Key	15	Social Services – Governmental Services (e.g., demand on)
		Response and source of information:
N		No adverse impact anticipated.
Key	16	Social Structures & Mores (Standards of Social Conduct/Social Conventions)
		Response and source of information:
N		No adverse impact anticipated.
Key	17	Land Use Compatibility (e.g., growth, land use change, development activity, adjacent land uses and potential conflicts)
		Response and source of information: Prior engineering experience with site

Key Letter:		
N: No Impact; **B:** Potentially Beneficial; **A:** Potentially Adverse; **P:** Approval/Permits Required; **M:** Mitigation Required		
N		The proposed facilities fall within the confines of the existing site, which has been used for wastewater treatment facilities for many years. Generally this would continue to be the best use of the land for this site. Land development around the site is occurring and the new plant, with improved aesthetics, could create a more compatible condition.
Key	18	Energy Resources - Consumption and Conservation
		Response and source of information: Engineering experience
M		The new facilities will increase energy use over the current plant's demand. Use of improved energy efficient blowers will mitigate this increase in energy use. The plant will allow for better control of the treatment process which will enable more effective use of energy. The new plant should allow for a significant reduction in chemical use which requires energy resources to produce.
Key	19	Solid Waste Management
		Response and source of information: Engineering experience
N		The new plant may increase production of biosolids. Adequate facilities are available on site to allow for proper treatment and drying of biosolids. With a reduction in chemical use, the biosolids will be more suitable as a soil amendment or for use in a compost generating plant.
Key	20	Wastewater Treatment - Sewage System
		Response and source of information: Engineering experience
B		The project is being proposed to upgrade the existing treatment allowing for full compliance with regulatory standards. Measurable beneficial impacts are anticipated.
Key	21	Storm Water – Surface Drainage
		Response and source of information: DEQ Permits
N		A stormwater permit will be required by the regulatory agency for construction. The permit will require proper control of stormwater to preclude runoff and erosion.
Key	22	Community Water Supply
		Response and source of information: Engineering experience, compliance with regulatory standards

Key Letter:		
N: No Impact; **B:** Potentially Beneficial; **A:** Potentially Adverse; **P:** Approval/Permits Required; **M:** Mitigation Required		
B		Further treatment of the Whitefish wastewater, discharged into the Whitefish River, could potentially improve this source of water for downstream uses, including water supply.
Key	23	Public Safety – Police
		Response and source of information:
N		No adverse impacts anticipated.
Key	24	Fire Protection – Hazards
		Response and source of information:
N		No adverse impacts anticipated.
Key	25	Emergency Medical Services
		Response and source of information:
N		No adverse impacts anticipated.
Key	26	Parks, Playgrounds, & Open Space
		Response and source of information:
N		No adverse impacts anticipated.

Key Letter:

N: No Impact; **B:** Potentially Beneficial; **A:** Potentially Adverse; **P:** Approval/Permits Required; **M:** Mitigation Required

Key	#	Item
Key	27	Cultural Facilities, Cultural Uniqueness & Diversity
		Response and source of information:
N		No adverse impacts anticipated.
Key	28	Transportation Networks and Traffic Flow Conflicts (e.g., rail; auto including local traffic; airport runway clear zones - avoidance of incompatible land use in airport runway clear zones)
		Response and source of information: Engineering experience with site
N		No adverse impacts anticipated. Project site is not located near airports or major transportion routes.
Key	29	Consistency with Local Ordinances, Resolutions, or Plans (e.g., conformance with local comprehensive plans, zoning, or capital improvement plans)
		Response and source of information: City Staff, Local Planning Documents
N		Compliance with local ordinance will be reviewed during project design phase.
Key	30	Is There a Regulatory Action on Private Property Rights as a Result of this Project? (consider options that reduce, minimize, or eliminate the regulation of private property rights.)
		Response and source of information: City Staff
N		No known impact or regulatory action associated with private property rights.

Anderson~Montgomery
CONSULTING ENGINEERS

1064 N. Warren
Helena, MT 59601
phone (406) 449-3303
fax (406) 449-3304

May 3, 2016

Damon Murdo
Cultural Records Mgr.
Montana Historical Society
P.O. Box 201202
Helena, MT 59620-1202

RE: City of Whitefish Wastewater System Improvements Project – Flathead County.

Dear Mr. Murdo,

The City of Whitefish is in the process of planning for improvements to its community wastewater system facilities. Potential projects considered for implementation include improvements to the City's Wastewater Treatment Plant. Legal location of the proposed improvements is Township 30N, Range 21W6.

The wastewater treatment plant improvements consist of the installation of a new Sequencing Batch Reactor and all appurtenant piping and equipment and the construction of a new UV and Administration Building. A map showing the proposed improvements is attached. All construction work will occur on land owned by the City of Whitefish where the existing wastewater treatment plant is located. A map showing the planning area for this study and general location of proposed improvements is attached.

The success of this project is dependent upon receiving comments from applicable state and federal agencies. Therefore, we would greatly appreciate any comments you might have on this project regarding known or potential historical, archeological or cultural resources.

Thank you for your help. Please call me at 449-3303 if you have any questions. Comments can be directed to me at 1064 N. Warren Street, Helena, MT 59601.

Sincerely,

Scott Anderson

Scott Anderson P.E.
Anderson-Montgomery Consulting Engineers

Attachment: Figure 3.1 Planning Area (Existing Treatment Facility)
Attachment: Figure 4.4 Sequencing Batch Reactor

Anderson~Montgomery
CONSULTING ENGINEERS

1064 N. Warren
Helena, MT 59601
phone (406) 449-3303
fax (406) 449-3304

May 3, 2016

Mike Knutson
Montana DNRC – Floodplain Management
P.O. Box 201601
Helena, MT 59620-1601

RE: City of Whitefish Wastewater System Improvements Project – Flathead County.

Dear Mr. Knutson,

The City of Whitefish is in the process of planning for improvements to its community wastewater system facilities. Potential projects considered for implementation include improvements to the City's Wastewater Treatment Plant. Legal location of the proposed improvements is Township 30N, Range 21W6.

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1064 N. Warren
Helena, MT 59601
phone (406) 449-3303
fax (406) 449-3304

May 3, 2016

Allen Steinle – MT Program Manager
U.S. Army Corps of Engineers
10 W. 15th St.
Helena, MT 59601

RE: City of Whitefish Wastewater System Improvements Project – Flathead County.

Dear Mr. Steinle,

The City of Whitefish is in the process of planning for improvements to its community wastewater system facilities. Potential projects considered for implementation include improvements to the City's Wastewater Treatment Plant. Legal location of the proposed improvements is Township 30N, Range 21W6.

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1064 N. Warren
Helena, MT 59601
phone (406) 449-3303
fax (406) 449-3304

May 3, 2016

Mark Wilson
Field Supervisor
U.S. Fish and Wildlife Service
Ecological Services – Montana Field Office
585 Shepard Way
Helena, MT 59601

RE: City of Whitefish Wastewater System Improvements Project – Flathead County.

Dear Mr. Wilson,

The City of Whitefish is in the process of planning for improvements to its community wastewater system facilities. Potential projects considered for implementation include improvements to the City's Wastewater Treatment Plant. Legal location of the proposed improvements is Township 30N, Range 21W6.

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Sincerely,

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Helena, MT 59601
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fax (406) 449-3304

May 3, 2016

Lauri Hanauska-Brown
Nongame/T&E Section Manager
MDFWP
PO Box 200701
Helena, MT 59620

RE: City of Whitefish Wastewater System Improvements Project – Flathead County.

Dear Mrs. Hanauska-Brown,

The City of Whitefish is in the process of planning for improvements to its community wastewater system facilities. Potential projects considered for implementation include improvements to the City's Wastewater Treatment Plant. Legal location of the proposed improvements is Township 30N, Range 21W6.

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Sincerely,

Scott Anderson

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Anderson-Montgomery Consulting Engineers

Attachment: Figure 3.1 Planning Area (Existing Treatment Facility)
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MONTANA HISTORICAL SOCIETY
225 North Roberts ✣ P.O. Box 201201 ✣ Helena, MT 59620-1201
✣ (406) 444-2694 ✣ FAX (406) 444-2696 ✣ www.montanahistoricalsociety.org ✣

April 28, 2008

Paul W. Montgomery
Anderson~Montgomery
1064 N. Warren
Helena MT 59601

RE: CITY OF WHITEFISH WASTEWATER PROJECT. SHPO Project #: 2008042507

Dear Mr. Montgomery:

I have conducted a cultural resource file search for the above-cited project located in Section 25, T31N R22W. According to our records there have been a few previously recorded sites within the designated search locale. In addition to the sites there have been a few previously conducted cultural resource inventories done in the area. If you would like any further information regarding these sites or reports you may contact me at the number listed below.

We feel that because the project will be occurring within previously disturbed ground there is a low likelihood cultural properties will be impacted. We, therefore, feel that a recommendation for a cultural resource inventory is unwarranted at this time. However, should cultural materials be inadvertently discovered during this project we would ask that our office be contacted and the site investigated.

If you have any further questions or comments you may contact me at (406) 444-7767 or by e-mail at dmurdo@mt.gov. Thank you for consulting with us.

Sincerely,

Damon Murdo
Cultural Records Manager

File: DEQ/AIR&WATER WASTE MNG/2008

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
HELENA REGULATORY OFFICE
10 WEST 15TH STREET, SUITE 2200
HELENA MT 59626

REPLY TO
ATTENTION OF

May 6, 2008

Helena Regulatory Office
Phone (406) 441-1375
Fax (406) 441-1380

RE: **Corps File No.** 2006-9-0256
Request for input for Whitefish Wastewater Project-Impacts-UV Disinfection Facility

Anderson-Montgomery
Attn: Paul W. Montgomery, P.E.
1064 North Warren
Helena, Montana 59601

Dear Mr. Montgomery:

We have reviewed your information regarding the above referenced subject matter. The potential site is located in Section 25, Township 31 North, Range 22 West, Flathead County, Montana.

Under the authority of Section 404 of the Clean Water Act, Department of the Army permits are required for the discharge of fill material into waters of the United States. Waters of the U. S. include the area below the ordinary high water mark of stream channels and lakes or ponds connected to the tributary system, and wetlands adjacent to these waters. Isolated waters and wetlands, as well as man-made channels and ditches, may be waters of the U. S. in certain circumstances, which must be determined on a case-by-case basis.

Based on the information provided, this office is unable to ascertain jurisdictional authority at this time. Please be advised that if no fill material will be placed either temporarily or permanently in a water of the United States, no Department of the Army permit is required for this project. However, this does not eliminate the requirement to obtain other applicable federal, state, tribal and local permits.

Upon review of the proposed site map, any work requiring fills below the ordinary high water mark of the Whitefish River would require permit authorization from the Corps.

If you have any questions, please call Vicki Sullivan of this office at (406) 441-1375, and reference Corps File No. 2006-9-0256.

Sincerely,

Allan Steinle
Montana Program Manager

Montana Fish, Wildlife & Parks

1400 South 19th
Bozeman, MT 59718

May 7, 2008

Paul Montgomery
Anderson – Montgomery
1064 North Warren
Helena, MT 59601

Dear Paul,

I have reviewed the proposed city of Whitefish Wastewater Project. Based on the materials you provided, I would not anticipate significant negative impacts on listed threatened or endangered species.

The city of Whitefish and its immediate environs are frequently accessed by the grizzly bear. I would ask that you contact our grizzly bear management specialist, (Tim Manley, 490 North Meridian, Kalispell, MT 59001 – Phone: 406-892-0802 or Cell: 406-250-1265), to ensure that any construction activities are conducted in a way to avoid any negative impacts on grizzlies, such as possible worker food storage issues, construction timing, etc.

Please feel free to contact me at 406-994-6437 if you need further instruction.

Sincerely,

Arnold Dood
Endangered Species Coordinator

APPENDIX I

PUBLIC INVOLVEMENT

WHITEFISH CITY COUNCIL
April 18, 2016
7:10 P.M.

1) CALL TO ORDER

Mayor Muhlfeld called the meeting to order. Councilors present were Hildner, Barberis, Frandsen, and Williams, Feury and Sweeney were absent. City Staff present were City Manager Stearns, City Clerk Howke, City Attorney Jacobs, Finance Director Smith, Planning and Building Director Taylor, Public Works Director Workman, Parks and Recreation Director Butts, Senior Planner Compton-Ring. Approximately 35 people were in the audience.

2) PLEDGE OF ALLEGIANCE

Mayor Muhlfeld asked Leo Keane to lead the audience in the Pledge of Allegiance.

3) COMMUNICATIONS FROM THE PUBLIC – **(This time is set aside for the public to comment on items that are either on the agenda, but not a public hearing or on items not on the agenda. City officials do not respond during these comments, but may respond or follow-up later on the agenda or at another time. The Mayor has the option of limiting such communications to three minutes depending on the number of citizens who want to comment and the length of the meeting agenda)**

Leo Keane, 514 Pine Place, asked the City Council to consider a problem of over population of deer in town. He suggested eliminating the deer to a sustainable population by either live capture and relocate or provide food for the food bank.

Judy Spivey, 117 Park Knoll Lane, complimented the Planning Board for turning down the Marriott Motel project. If the project is presented again, the Council should ask if Whitefish needs it, and if Whitefish wants it. She doesn't want Whitefish to become America Town USA.

4) COMMUNICATIONS FROM VOLUNTEER BOARDS

Councilor Hildner reported the Bicycle and Pedestrian Committee had a special meeting this morning to review with WGM Group and BJ Greive the status of the Bike/Ped Master Plan update. A few things of interest for the community is on April 29 there is a community bike ride starting at 10:00 from the temporary City Hall location to look at the bicycle and pedestrian system. There will also be two community forums on May 19th and May 23rd at the Whitefish High School Cafeteria from 7:00 p.m. to 8:00 p.m. He encourages all the members of the public to attend.

5) CONSENT AGENDA

a) Minutes from the April 4, 2016 Council regular meeting (p.19)

Councilor Hildner had a correction to the minutes on page 22 of the packet, last paragraph, instead of "goal revenue' change to "revenue goal".

Councilor Hildner made a motion, second by Councilor Frandsen to approve the Consent Agenda. The motion passed unanimously.

6) PUBLIC HEARINGS **(Items will be considered for action after public hearings) (Resolution No. 07-33 establishes a 30-minute time limit for applicant's land use presentations. Ordinances require 4 votes for passage – Section 1-6-2 (E)(3) WCC))**

a) ~~Ordinance No. 16-___; A request by Whitefish TP LLC for a Conditional Use Permit and a Planned Unit Development to construct a 111-room hotel. The property is zoned WB-2 (Secondary Business District). It is located at 6405 Highway 93 S (proposed Marriott Hotel)~~ **(Withdrawn and to be re-submitted)**

b) **Consideration of authorizing grant applications for the Montana DNRC Renewable Resource Grant and Loan Program and the Montana Department of Commerce Treasure State Endowment Program for a proposed project that will install significant improvements to the City's wastewater treatment facilities (p. 26) (CD1 10:27)**

Director Workman gave his staff report that is provided in the packet and also introduced Scott Anderson with Anderson Montgomery Consulting Engineers (AMC). The materials from Scott Anderson's presentation along with a copy of the Environmental Review Checklist is appended to the end of the packet.

Councilor Hildner asked and Scott stated the two 40-year old lagoon areas located at the northern most point of the property is no longer active and could be repurposed for other use such as a tree nursery.

Councilor Hildner asked and Scott said around 1,200 acres would be required to land apply all of the wastewater. A large storage cell is also required. Currently there is 20 acres available for land application, which would be about 10% of the flow in the summer time. The land application systems, in order to function, it has to be an agricultural operation.

Councilor Hildner stated the City is actively pursuing a Climate Action Plan, he asked Scott how this fits in with the Plan in terms of reducing not only carbon footprints but perhaps an alternative that actually generates energy, rather than consumes energy? Scott said there are some new technologies out there that allow better use of energy, such as more efficient aeration devises and more efficient blower devises. Councilor Hildner mentioned he would like to see some additional information on energy conservation pursuant to our search for a Climate Action Plan. Scott stated they do an energy analysis of all the alternatives, it would be easy for AMC to do that. Councilor Hildner also stated he did not see odor reduction in the analysis. Scott reported they included that into the aesthetics, and it is a consideration in all of the processes, that is one benefit of a mechanical plant over a lagoon system, is the ability to collect and treat odors because it is smaller.

Mayor Muhlfeld mentioned that the City is the first community to develop a nutrient trading plan for the State of Montana, he is curious on how much value that's informing the design of the plant, meaning are we marrying the two projects and how? Scott said there is a chapter in the plan, they are going to look at two alternatives for land application. It is definitely a component in the development process. It will be most effective in supplementing a treatment plant.

Mayor Muhlfeld opened the public hearing.

There being no comment, Mayor Muhlfeld closed the public comment and turned it over to the Council for their consideration. No formal action is needed.

c) Ordinance No. 16-___; An Ordinance approving the Mkay Enterprises Preliminary Plat and Planned Unit Development, to develop 18 lots located at 6361 and 6365 Highway 93 South, Whitefish (WPP 15-07/WPUD 15-01) (First Reading) (p.35) (CD 1 48:04)

Senior Planner Compton-Ring gave her staff report that is provided in the packet on the website. The applicant is proposing to develop the plan in three phases; single family detached lots, apartments, townhouses. The developer is proposing to an east to west right-of-way on the north side of the property, and extend Whitefish Avenue south to JP Road. A variety of open space areas for the residents in the multifamily portion of the development, along Whitefish River and a pedestrian connection from Whitefish Avenue to the river. The applicant is extending the paved public trail from the north property line to the south property line. Within the 18-unit apartment building 4-units will be provided to the Housing Authority for affordable housing. The Fire Marshal is requesting full fire suppression sprinkler and alarm systems on structures built on lots 4,7,11,14,15,16. Staff is satisfied with the zoning deviation to the smaller lot sizes and width, and feel it is complimentary to the subdivision to the north. The Planning Board approved the project with 28 conditions, staff recommended amendments to Condition #19 and #20 and added Condition #28.

Senior Planner Compton-Ring responded to a few public comments that townhouses are not a permitted use in the PUD, she stated that in the PUD Chapter multifamily is listed as a permitted residential use. The definition of multifamily, is a building or buildings that is attached to each other and containing three or more dwelling units. This is intended to apply to types such as triplexes, four-plexes or apartments. The definition of townhouses or condos is how the unit is constructed. The benefits being provided by the project is up to the Council to decide. The Citizens for a Better Flathead handed a letter to the Planning Board, with questions regarding to the location and legal description of WB-2, it was s 1965 description and reflects the zoning north of the Whitefish River along Spokane Avenue, it doesn't pertain to this particular area. Multifamily is a commercial use because it can potentially be rented, therefor it is not permitted within the PUD. Tom Tornow had emailed Senior Planner Compton-Ring comments that were handed to the Council and also appended to the packet.

Councilor Hildner mentioned in Condition 17, during the planning board discussion on refuse disposal areas, the need or desire for containers that can be used particularly for cardboard and plastic.

Mayor Muhlfeld opened the Public Hearing.

Michael Morton, 101 Lakeside Boulevard, is the managing general partner for Mkay Enterprises. Michael stated he is offering to the City in exchange of the PUD; to build Akers Lane that will connect Highway 93 with Whitefish Avenue, the extension of Whitefish Avenue to JP Road, extend the Whitefish River Trail from the northern boundary to the southern boundary of the project property, and agreed to 4 units of the 18-unit apartment building to be assigned to the Whitefish Housing Authority for rental. When the project was started there was some substantial objection from the Rivers Edge Subdivision, they have amended the plan and addressed their issues and at the Planning Board the president of the Rivers Edge HOA supported the project. Michael has marked every tree on the property and will put forth their very best efforts to save the large trees on the property, and added a strong covenant to require written approval for cutting any tree on the project.

Councilor Hildner mentioned at the Planning Board meeting of some discussion about waiving the HOA dues for the affordable housing, Michael said the dues are paid by the owner not by the tenants, it will not be a part of any rental agreement.

Bruce Booty, 301 Second Street, Landscape Architect, responded to the letter Tom Tornow addressed. The first half of Condition # 10 is almost an exact copy of what is written in Senior Planner Compton-Ring's conditions. Bruce feels that "not shine directly on or into neighboring properties" should be included in Condition #10. Condition #20 is there to make sure that there are four affordable housing units, the additional language seems this condition is going to control all the other market rate units the developer is creating. Units can't be added in a subdivision but you can reduce the number of units. Bruce thinks Condition #20 is good as is. Condition #26 needs to stay, because Lot 17 is still a part of a plat but is removed from the PUD. Condition #29, are townhomes on sub-lots and are available for sale; if the owner wants to keep some of those lots, he can. The developer is fine with Condition #30 if they want to add another condition to further substantiate the drawings. Bruce stated they have worked with staff real hard to make peace and provide assurances to the neighbors.

Don Spivey, 117 Park Knoll Lane, he is representing two parties. He received a call from the Rivers Edge Home Owners Association, in regards to Condition #29, with the sale of the townhouses. He will report back to the Rivers Edge HOA. Don did decide the project has done some good things in terms of the single family homes near the river, eliminated the ingress and egress from the townhouses onto the Whitefish Avenue, which reduces congestion and contamination. He thinks it is a good thing and we get 4 more affordable houses. Lot 17 is the lot against Highway 93, subject potential of a variety of sorts, not necessarily another PUD but it could be anything. He mentioned we have to be careful with Lot 17 and what happens to it. He is delighted the City is working with the Department of Transportation to mitigate some of the traffic challenges that are occurring between the signal at JP Road and the Mountain Mall signal.

Leo Keene, 514 Pine Place, is pleased the developer is recognizing and acknowledging the trees on the property. It is a nice entry into Whitefish, it is important the developer is taking responsibility in preserving the trees. He wished the City would acknowledge the importance as well by codifying tree retention in developments.

Hunter Holmes, 216 Midway Drive, works in the real estate community, he has seen numerous residential communities developed and he thinks this is one of the best developments presented that preserves the trees, the setback off the highway and improving the access for not only this development but also for Rivers Edge, and building a section of trails to get the community to the Rocksund Bridge is very important. It will improve the housing demand in town as well the employee housing.

There being no further comment Mayor Muhlfeld closed the public comment and turned it over to the Council for their consideration.

Councilor Frandsen made a motion, second by Councilor Hildner to approve the staff report (WPP 15-07/WPUD 15-01), and the findings of fact, and approve the first reading of Ordinance No. 16-08; approving the Mkay Enterprises Preliminary Plat and Planned Unit Development, to develop 18 lots located at 6361 and 6365 Highway 93 South.

Councilor Hildner made an amendment, second by Councilor Barberis to include an addition to Condition #17 to include facilities for recycling of cardboard and plastics. The motion passed unanimously.

Councilor Frandsen made an amendment, second by Councilor Hildner to add Condition #29, the twenty-foot access trail and landscape buffer easement on the north edge of the property shall be substantially as depicted in the plan in section elevation presented by the developer during the public hearing. The motion passed unanimously.

Councilor Frandsen stated she is very pleased with how the plan worked out, but is concerned of the congestion on Highway 93 as a result of additional development coming along. She hopes to continue along and build alternate access ways keeping in mind there is going to be more congestion. She would hate to see stop light after stop light on Highway 93. The only thing that concern her is Lot 14, 15, 16 areas, the entire middle of that section is all parking access. It would have been nice to a little more people interaction space, where kids are playing and neighbors are interacting through sidewalks and walking dogs. As moving along maybe some more opportunity for landscaping to enhance the neighbor's interaction.

Councilor Hildner wanted to applaud everyone, just based on what he heard at the Planning Board level and what he heard tonight. The cooperative effort between the developers and the neighbors and everybody involved. He thinks this is a nice blue print on how we move forward with these sorts of things. He is also glad to see at least 4 affordable units.

The original motion with amendments adding Condition #17 and #29 passed unanimously.

7) **COMMUNICATIONS FROM CITY MANAGER (CD 1 01:37:31)**
   a) **Written report enclosed with the packet. Questions from Mayor or Council? (p.334)** None
   b) **Other items arising between April 13th and April 18th** - None
   c) **Discussion and possible authorization to proceed with a "wholly surrounded" annexation process for the area around West Lakeshore Drive (Lake Park Addition) (p. 348)**

City Manager Stearns gave his staff report that is provided in the packet on the website. The Council originally met in a work session on March 3, 2014 to discuss properties outside the City that have utility connections and look for areas of annexation. At the time the first priority was the Houston Drive area on East Lakeshore Drive, the second priority is the West Lakeshore

Drive. The East Lakeshore Drive annexation effort stalled and a lawsuit was filed trying to prevent from annexing with a "wholly surrounded" method. The City won that lawsuit at the District Court level, March 21, 2016, by that time staff had begun working on the West Lakeshore annex proposal.

Councilor Frandsen asked and City Manager Stearns said we currently do not have any volunteer petitions to annex. There are a number of waivers signed by property owners saying they won't protest the annexation. If we have a waiver on hand, we don't have to count their protest. Councilor Frandsen also asked and City Manager Stearns stated the rest of the properties south on West Lakeshore are annexed until closer to Ramsey Avenue. City Manager Stearns stated State Park would likely remain outside city limits, which was a condition of a sewer line easement agreement.

Discussion between City Manager Stearns, Councilor Hildner and Mayor Muhlfeld confirmed 11 properties are on sanitary sewer.

Councilor Hildner made a motion, second by Councilor Frandsen to authorize the City Manager to proceed with a "wholly surrounded" annexation process for the area around West Lakeshore Drive (Lake Park Addition) including adopting the schedule. The motion passed unanimously.

d) Discuss request for renewal or extension of lease of Cemetery land for Veteran's Peace Park (p.357)

City Manager Stearns stated the term ends on August 1, 2016, the Great Northern Veterans Peace Park Foundation has the option to renew this lease from year to year. City Manager Stearns received an email from Ryan Zinke earlier this year requesting to renew for a ten-year lease. This is currently known as the sledding hill, and is planning on having parking at the Peace Park and the western part of his parcel for sledding.

Councilor Frandsen asked and City Manager Stearns stated the topography of the property is not viable to extend the Cemetery usage, it was looked into but it would require a lot of fill and a retaining wall and would not be cost effective for a cemetery.

Councilor Hildner asked if there has been any further discussion with Ryan as to developing the entire area as an event area? City Manager Stearns was not sure of Ryan's development plans. Planning and Building Director Taylor mentioned he thought maybe one event a year. He has used it as a staging area for the highway construction company. The property is in the county, tract 4c+ is inside city limits.

Councilor Hildner would like to know Ryan's plans for the property which could have a bearing on the length of lease.

Councilor Frandsen agrees, the use for the particular lot that would be leased specifically says it should be open to the public without charge for no other purpose without the written consent of the City. She suggests shortening the term of the lease if there is concern of the development of the property.

Mayor Muhlfeld stated Ryan would have to come to the Council if it were to be converted from an open space to another use. He suggests going back to Ryan and stating the Council is open to a one-year lease, or a five-year lease, if he presents an overall plan of his vision for the park.

Council unanimously agreed to have City Manager Stearns contact Ryan with his intentions of the property.

8) COMMUNICATIONS FROM MAYOR AND CITY COUNCILORS (CD 2 09:35)

a) Consideration of an email from Justin Lawrence of Lakestream Outfitters and Fly Shop for the City to initiate a text amendment to the WB-2 zoning district (p. 367)

Councilor Hildner hopes in the communication with Justin Lawrence the angst the City went through to come up with the zoning for the WB2 with regards to the WB3.

Mayor Muhlfeld will contact Justin Lawrence.

b) Discuss and set dates for budget work sessions for FY17 budget and set date for the preliminary public hearing on the budget for the June 20th meeting (p.368)

City Manager Stearns stated May 31 and June 13 are tentative dates for the budget meetings. Councilor Frandsen will not be available for May 31, she prefers the Council to proceed if she is the only one missing. Councilor Feury and Councilor Sweeney are not present to confirm their schedule.

Councilor Frandsen made a motion, second by Councilor Barberis to postpone until May 2, 2016. The motion passed unanimously.

c) Resolution No. 16-___; A Resolution establishing the Wisconsin Avenue Corridor Plan Steering Committee (p.369)

Planning and Building Director Taylor stated the Council authorized to proceed with the Wisconsin Avenue Plan. Councilor Hildner wanted to avoid any criticism as such as the Highway 93 Neighborhood Plan. Director Taylor stated this has more residential property owners than members at large.

Councilor Frandsen made a motion, second by Councilor Williams to approve Resolution No. 16-16, a Resolution establishing the Wisconsin Avenue Corridor Plan Steering Committee. The motion passed unanimously.

d) Consideration of appointing an additional representative to Whitefish Legacy Partners committees (p. 373)

Parks and Recreation Director Butts stated it would be the City's best interest to have two members on the Legacy Lands Advisory Committee. Currently Councilor Williams is serving on both committees.

Councilor Frandsen made a motion, second by Councilor Hildner to appoint Councilor Williams to the Whitefish Trail Operations Committee and the Legacy Lands Advisory Committee and Councilor Barberis to the Legacy Lands Advisory Committee. The motion passed unanimously.

Communications from the Council

Councilor Hildner will be absent at the May 2nd meeting.

Councilor Frandsen would like to find a way to work towards bringing something to the Council for a deer relocating program for review. She thought a few of the Council could get together. Councilor Hildner agreed.

Public Works Director Workman reiterated the public outreach program regarding the Bicycle Pedestrian Master Plan. He encourages the community to visit the City's website to participate in the survey. The bike ride on May 29th is at 10am at the temporary City Hall.

9) ADJOURNMENT (Resolution 08-10 establishes 11:00 p.m. as end of meeting unless extended to 11:30 by majority)

Mayor Muhlfeld adjourned the meeting at 9:51 p.m.

____
Mayor Muhlfeld

Attest:

____
Michelle Howke, Whitefish City Clerk

LEGALS

No. 2324

NOTICE FOR PUBLIC HEARING

The City of Whitefish will hold a public hearing on Monday, April 18, 2016, at 7:10 p.m., in the Whitefish City Council Chambers at 1005 Baker Avenue, Whitefish MT 59937 for the purpose of obtaining public comments regarding proposed Montana DNRC Renewable Resource and MDOC Treasure State Endowment Program grant applications for a proposed project that will consider significant improvements to the City's wastewater treatment facilities. At the public hearing, the proposed project will be explained, including the purpose and proposed location of the project, activities, budget, possible sources of funding, and potential costs to City ratepayers. As required by the MEPA and MDOC regulations, the City of Whitefish has prepared an Environmental Assessment (EA) that evaluates the potential environmental effects and consequences of the proposed project. This notice announces the availability of the EA for public review and comments. All interested persons will be given the opportunity to ask questions and to express their opinions regarding this proposed project. Comments may be given orally at the hearing or submitted in writing. After the hearing, all comments will be reviewed and considered and the City of Whitefish will decide that either:

1.An Environmental Impact Statement (EIS) is necessary;
2.The Environmental Assessment did not adequately reflect the issues raised by the proposed action and must be revised; or
3.An EIS is not necessary and make a final decision on the proposed action

Anyone who would like more information or who wants to submit suggestions should Contact Craig Workman P.E., Whitefish Director of Public Works @ 863-2455 or Anderson-Montgomery Consulting Engineers @ 449-3303.

April 6, 13, 2016
MNAXLP

STATE OF MONTANA

FLATHEAD COUNTY

AFFIDAVIT OF PUBLICATION

RICHELLE ROONEY BEING DULY SWORN, DEPOSES AND SAYS: THAT SHE IS THE LEGAL CLERK OF THE **WHITEFISH PILOT** A WEEKLY NEWSPAPER OF GENERAL CIRCULATION, PRINTED AND PUBLISHED IN THE CITY OF COLUMBIA FALLS, IN THE COUNTY OF FLATHEAD, STATE OF MONTANA, AND THAT **NO. 2324**

LEGAL ADVERTISMENT WAS PRINTED AND PUBLISHED IN THE REGULAR AND ENTIRE ISSUE OF SAID PAPER, AND IN EACH AND EVERY COPY THEREOF ON THE DATES Of April 6, 13, 2016.

AND THE RATE CHARGED FOR THE ABOVE PRINTING DOES NOT EXCEED THE MINIMUM GOING RATE CHARGED TO ANY OTHER ADVERTISER FOR THE SAME PUBLICATION, SET IN THE SAME SIZE TYPE AND PUBLISHED FOR THE SAME NUMBER OF INSERTIONS.

Richelle Rooney

Subscribed and sworn to
Before me this May 3, 2016

Dorothy I. Glencross

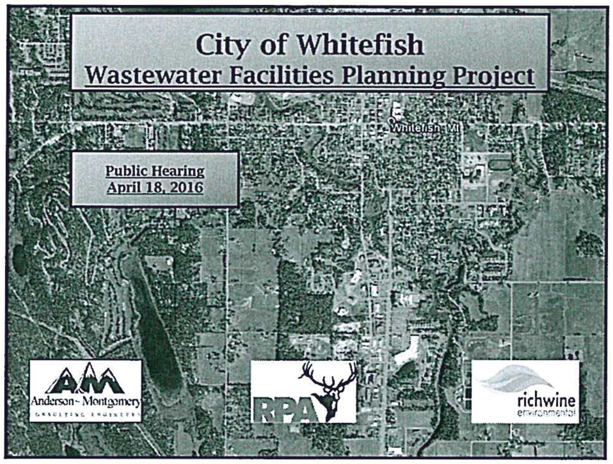
Dorothy I. Glencross

Notary Public for the State of Montana
Residing in Kalispell
My commission expires 9/11/2017

DOROTHY I. GLENCROSS NOTARIAL SEAL State of Montana

DOROTHY I. GLENCROSS
NOTARY PUBLIC for the
State of Montana
Residing at Kalispell, Montana
My Commission Expires
September 11, 2017

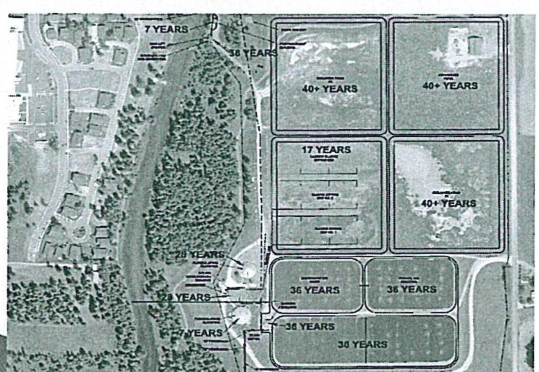
Public Hearing



Why is a New Wastewater Treatment Plant Needed??

- REQUIREMENTS OF MPDES DISCHARGE PERMIT
- NEW REGULATORY STANDARDS RECENTLY ADOPTED BY THE DEQ
- AGING PLANT FACILITIES
- NONCOMPLIANCE WITH DEQ DESIGN STANDARDS
- *THE WHITEFISH LAGOON SYSTEM IS OLD, EQUIPMENT IS WEARING OUT AND THE TECHNOLOGY CANNOT MEET CURRENT OR FUTURE REGULATORY STANDARDS*

Age Of Existing Unit Processes



What Work Is Being Done To Address Wastewater System Deficiencies?

City Hired Consultant Team to Perform Several Tasks

Infiltration and Inflow Mitigation Project to Reduce Clearwater

Nutrient Reduction Plan funded by DNRC

Whitefish Lake Watershed Management Plan

Facilities Planning for Wastewater Treatment Facilities

Application for Grant Assistance

Regulatory Requirements Addressed
- New Discharge Permit
- Optimization of Existing Treatment Processes – River Lakes Forcemain Extension
- Compliance Plan Approved by DEQ

Administrative Order of Compliance

COMPLIANCE PLAN:

Task	Date of Completion
Complete Facilities Planning (PER)	October 1, 2016
Submit Design Plans to DEQ	February 1, 2018
Construction Completion	May 1, 2021
Achieve Compliance	November 1, 2021

MPDES Discharge Permit

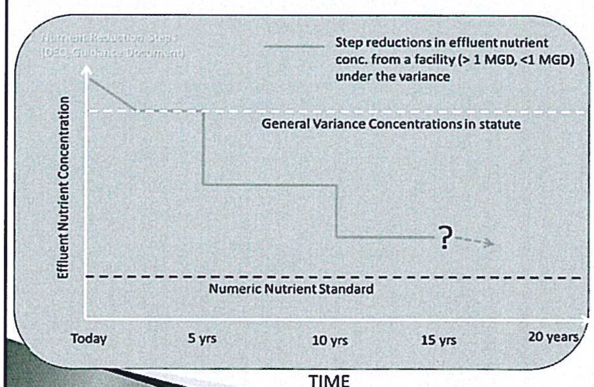
- License to Discharge to State Waters, Contains both Federal and State Water Quality Standards
- Renewed Every 5 Years, Last Done in August 2015
- Contains Limits for Organic Wastes, Bacteria, Toxic Compounds and Nutrients
- Most Recent Permit Contains Several New Effluent Standards not Previously Required
- Compliance Requirements for Whitefish Permit Established Under the AOC

MPDES Permit Limitations

CITY OF WHITEFISH
MPDES Permit MT #0020184
Wastewater Effluent Standards (effective Aug 1, 2015)

Parameter	Units	Avg. Month	Avg. Week	Max Day
5-Day Biochemical Oxygen Demand (BOD_5)	*mg/L*	30	45	--
	lb/day	313	676	--
	% Removal	85%	--	--
Total Suspended Solids (TSS)	*mg/L*	30	45	--
	lb/day	313	676	--
	% Removal	85%	--	--
pH	*SU*	6.0-9.0		
E. coli Bacteria-summer	*cfu/100 mL*	126	--	252
E. coli Bacteria -winter	*cfu/100 mL*	630	--	1260
Total Residual Chlorine	*mg/L*	0.011	--	0.019
Ammonia, Total as N	*mg/L*	9.6	--	17.7
Total Nitrogen- summer	*lb/day*	176	--	--
Total Nitrogen- winter	*lb/day*	273	--	--
Total Phosphorus (TP) -year-round	*mg/L*	1.0	--	--
	lb/day	10.4	--	--
Aluminum, dissolved	*µg/L*	113	--	325

Numeric Nutrient Standards – Reduction over Time



Compliance with Numeric Nutrient Standards

-Invest in New Treatment Technology $$$
-Variances from Numeric Nutrient Standards
-Combination of Both

- General Variances
- Individual Variances
- Economic Variances - Options available for communities to receive temporary relief from the standards based on:
  - Inability to pay for treatment/economics
  - Limits of technology

Facilities Planning Process

GENERAL OUTLINE FOR FACILITIES PLAN

- ASSESSMENT OF THE STUDY AREA
  - Population Projections
  - Loading Criteria
  - Environmental Assessment
  - Regulatory Considerations
- EVALUATION OF EXISTING TREATMENT FACILITIES
  - Condition, Age
  - Compliance with DEQ Design Standards
  - Capacity to Meet Regulatory Treatment Performance Criteria
  - Identification of Unit Process Limitations
- ANALYSIS OF TREATMENT ALTERNATIVES
  - Consider All Viable Alternatives
  - Develop Preliminary Design and Estimate of Costs
  - Screen Options
  - Complete a Present Worth Cost Analysis which Considers Capital and Operating Costs
  - Consider Non-monetary Factors
  - Identify Most Cost-effective and Environmentally Sound Alternative

Service Area and Connected Population Projections

City of Whitefish
Wastewater Facilities Planning Design Criteria

	2013	2015	2020	2025	2035
Planning Area	11,230	11,661	12,812	14,076	16,992
Connected Pop.	7,736	8,033	8,826	9,697	11,705
Ultimate Buildout - 36,929					

Alternative Considerations

- Future Application of More Restrictive Standards
  - Nutrients
  - Ammonia
  - Non-Degradation
- Expansion Capability
- Operating Cost and Complexity
- Capital Cost
- Proven Technology
- Ability to Process Variable Flows and Loads
- Benefits of Nutrient Reduction and Nutrient Trading
  - On-site Land Application of Treated Effluent

Initial Alternatives Screened

Lagoon:
- 3-Cell, Covered Aerated Lagoon with Nitrification. (*Pursue Economic Variance for Nutrient Removal)*

Advanced Lagoon:
- Biolac with Existing Clarifier
- Biolac with New Clarifier
- EDI - Intermittently Decanted Extended Aeration Lagoon (IDEAL)

Mechanical
- Sequencing Batch Reactor
- Oxidation Ditch
- Membrane Bio-Reactor

Lagoons vs Mechanical Plants

Lagoons
- Simple to Operate, Less Costly O&M
- Significant Commitment of Land
- Limited Treatment Performance
- Subject to Cold Weather Impact on the Biological Treatment Process

Mechanical Treatment Plants
- Small Footprint
- Requires Advanced Operational Skills
- Energy and Chemical Intensive
- Conducive to Expansion, Addition of Advanced Treatment Processes

Alternatives Selected for Full Evaluation

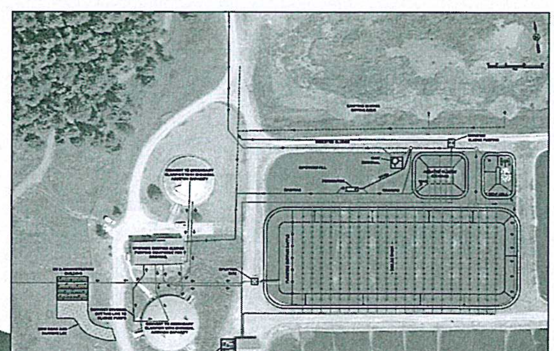
Screening Criteria

Aesthetics
Expansion Capability
Ability to Remove Pollutants to Lower Level
Operational Complexity
Proven Technology
Cold Weather Operation
Reuse of Existing Plant Components

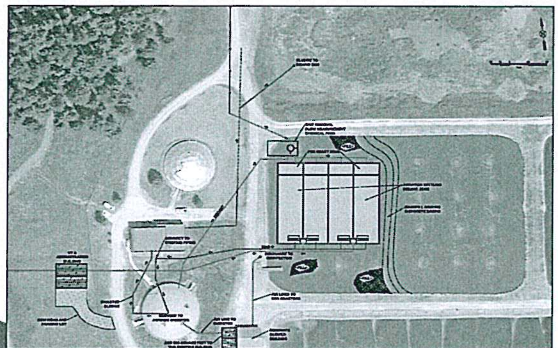
→ Selected Alternatives

Biolac Advanced Lagoon System
Sequencing Batch Reactor
Oxidation Ditch

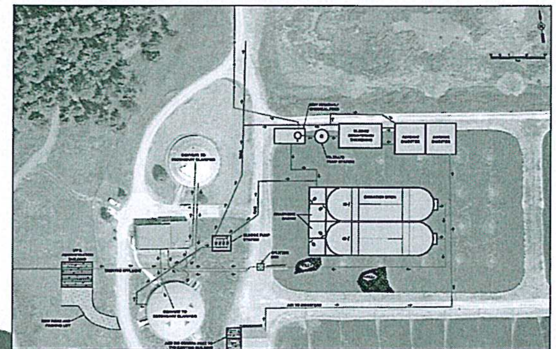
Biolac with Existing Clarifiers



Sequencing Batch Reactor



Oxidation Ditch



Net Present Worth Comparison

Table 4-7 City of Whitefish Wastewater Treatment Alternatives

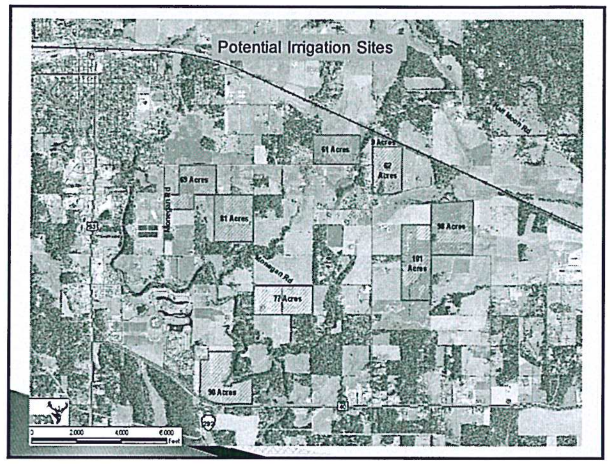
Net Present Worth Comparison Table

Alternative	Capital Cost	Annual O&M	20-Year NPW Annual O&M	Salvage Value	20-Year NPW Salvage Value	Overall 20-Year Net Present Worth
Biolac w/ Existing Clarifier	$15,914,648	$642,369	$8,729,790	$2,481,218	$1,132,428	$23,512,010
Sequencing Batch Reactor	$15,984,739	$780,485	$10,606,791	$4,601,475	$2,100,113	$24,491,416
Oxidation Ditch	$21,356,133	$927,996	$12,611,472	$6,451,438	$2,944,436	$31,023,169

Estimated Costs - $10 to $15/month Increase

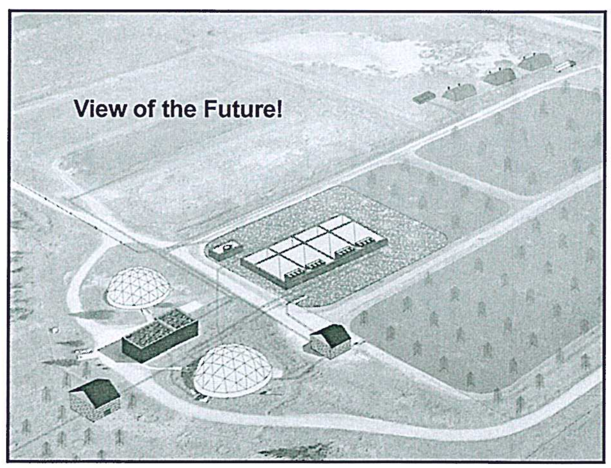
Other Nutrient Reduction Measures

- Land Application
  - On Plant Site
  - In Vicinity of Plant
  - Soil, Groundwater Constraints
- Nutrient Trading
  - Stormwater
  - Agricultural
  - Septic Systems
- Good Options for Future Regulatory Restrictions!



Financial Planning

- Grants
  - DNRC Renewable Resources $125,000
  - TSEP - $750,000
  - Rural Development Grant 25% Of Costs
- Low Interest Loans
  - Typically 2%-3% Interest, 20 to 40 year term
  - Montana State Revolving Loan Fund
  - Rural Development



QUESTIONS?

THANK YOU!

Scott Anderson
Gary Swanson
406-449-3303
Scott@a-mce.com
garys@rpa-hln.com

Anderson~Montgomery
CONSULTING ENGINEERS

RPA

Preliminary Project Budget	Whitefish 2016 Wastewater System Improvements				April 15, 2016
Administrative/ Finance Costs	Source: RRGL	Source: TSEP	RD Loan	RD Grant	Total:
Professional Services- Project/Grant Administration	5,000	15,000	33,000	15,000	68,000
Legal Costs			70,000		70,000
Audit Fees					-
Travel & Training			5,000		5,000
Loan Reserves	-		550,000		550,000
Interim Interest					-
Bond Counsel & Related cost	-		50,000		50,000
ADMIN/FINANCE COSTS:	5,000	15,000	708,000	15,000	743,000
Prel. Engineer (Geotech)			40,000		40,000
Engineering/Arch. Design		485,000	510,000		995,000
Construction Engr. Services			1,040,200		1,040,200
Construction	120,000	250,000	8,010,000	3,200,000	11,580,000
Contingency			1,600,000		1,600,000
ACTIVITY COSTS	120,000	735,000	11,200,200	3,200,000	15,255,200
TOTAL PROJECT COSTS	125,000	750,000	11,908,200	3,215,000	15,998,200

Nutrient Reduction Steps in DEQ Guidance

1. Facilities > 1 MGD:
- A. 1st general variance: 10 mg TN/L, 1.0 mg TP/L - per statute
- B. Next permit (+5 years): 8 mg TN/L, 0.8 mg TP/L
- C. Next permit: 8 mg TN/L, 0.5 mg TP/L
- D. Next permit: *Under Development*

2. Facilities < 1 MGD:
- A. 1st general variance) 15 mg TN/L, 2.0 mg TP/L - per statute
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- D. Next permit: 8 mg TN/L, 0.8 mg TP/L

3. Lagoons not designed to actively remove nutrients:
- A. 1st general variance: Maintain current lagoon performance, start nutrient monitoring - per statute
- B. Next permit (+5 years): Implement BMPs identified during optimization study

Assumptions in Alternative Analysis:

- Stay Within Existing Site, Locate System in Cells 2 and 3
- Maintain Operation of Cell 1 and Flocculating Clarifier Throughout Construction
- Retain Existing Facilities Where Practical
  - Screen
  - New Flocculating Clarifier
  - Chemical Feed Equipment
  - Raw Lift Pumps??
- Effect of Cold Wastewater
- Replace Temporary Disinfection with UV System
- Convert Administrative Offices to Maintenance Building
- Address Known Public Concerns - Noise, Odors, Aesthetics, Trail, Cemetery, Cost, ……

Numeric Nutrient Standards

Nutrient Trading

- 2013: Board of Environmental Review adopted rules allowing dischargers to use nutrient trading to help comply with numeric nutrient standards and variances
  - Found in Department Circular DEQ-13

Land Application

- Onsite & Offsite Opportunities
- 1:1 Benefit vs. Trading
- May Replace Future Enhanced Treatment Needs
- Aesthetics, Perception, Environmental Benefits

Land Application and Nutrient Trading are being evaluated in the Planning Process

Current and Future Activities (Next 12 Months)

City Officials

Decide Upon the Environmental Assessment Process for Alternatives

Make Decision Regarding Pending Grant Applications

City Staff/Consultant Team

Refine Alternative Analysis with City Input

Site Visits of Applicable Systems

Arrange Public Involvement Activities

Develop Financial Plan

Submit Grant Applications (May 2016)

Complete Planning Process by October 2016

Initiate Project Design Next Fall

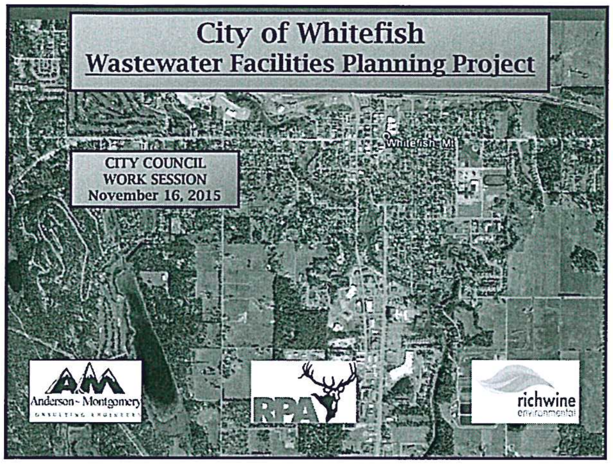
History of Whitefish WWTP

CITY OF WHITEFISH

WASTEWATER TREATMENT PLANT HISTORY

Phase Isolation Ponds	70's
Three Cell Partially Mixed Aerated Lagoons	1979
Flocculating Clarifier, Chemical Addition, Belt Filter Press	1988
Eliminated BFP, Added Drying Beds for Alum Sludge	1999
Upgraded Aeration System, New Blowers, VFD, Clean Lagoon Cell #1, Added Curtain	2002
New Perforated Screen, Flocculating Clarifier, Chemical Feed Equipment	2008
Temporary Chlorination/Dechlorination Facilities	2011

Work Session



Why is a New Wastewater Treatment Plant Needed??

- REQUIREMENTS OF MPDES DISCHARGE PERMIT
- NEW REGULATORY STANDARDS RECENTLY ADOPTED BY THE DEQ
- AGING PLANT FACILITIES
- NONCOMPLIANCE WITH DEQ DESIGN STANDARDS
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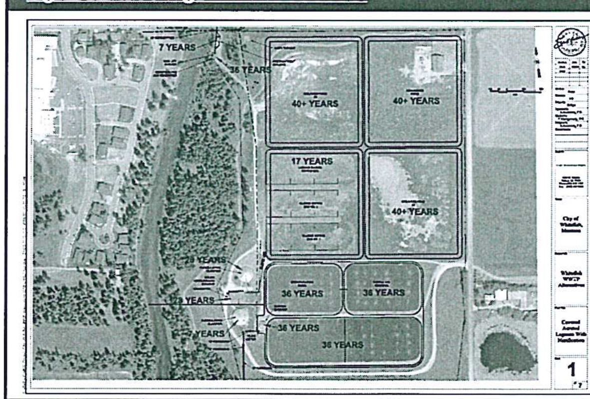
Age Of Existing Unit Processes



What Work Is Being Done To Address Wastewater System Deficiencies?

- AMCE/RPA/REI TEAM HIRED IN 2012 TO PERFORM SEVERAL TASKS
  - Address Regulatory Requirements
    - Discharge Permit Application and Review
    - Assistance with Compliance with Administrative Order of Compliance (AOC)
    - Optimization of Existing Treatment Processes (required by AOC)
  - Infiltration and Inflow Mitigation
  - Nutrient Reduction and Watershed Plans (DNRC Grant Funded)
  - Monitoring of New Regulatory Requirements
  - Financial Planning – Grant and Low Interest Loan Applications
  - Facilities Planning for Wastewater Treatment Facilities
  - General Technical Assistance

Regulatory Considerations

- ADMINISTRATIVE ORDER OF COMPLIANCE
  - Interim Improvements in Treatment and Collection System Operation
    - Infiltration and Inflow Mitigation
  - Development of a Compliance Plan – Triggered by Renewal of Discharge Permit in August 2015
  - Compliance Plan – Schedule of Activities for Complying with Standards Imposed in Discharge Permit
- MPDES DISCHARGE PERMIT
  - Requires Removal Of Ammonia Year Round
  - New Numeric Criteria for Nitrogen and Phosphorous Removal
  - Elimination of Toxicity
  - Application of Montana's Non-Degradation Policy
- DEQ WASTEWATER DESIGN STANDARDS (DEQ-2)
  - System Design Standards Applicable to the Design and Construction of New Facilities

Administrative Order of Compliance

COMPLIANCE PLAN:

Task	Date of Completion
Complete Facilities Planning (PER)	October 1, 2016
Submit Design Plans to DEQ	February 1, 2018
Construction Completion	May 1, 2021
Achieve Compliance	November 1, 2021

MPDES Permit Limitations

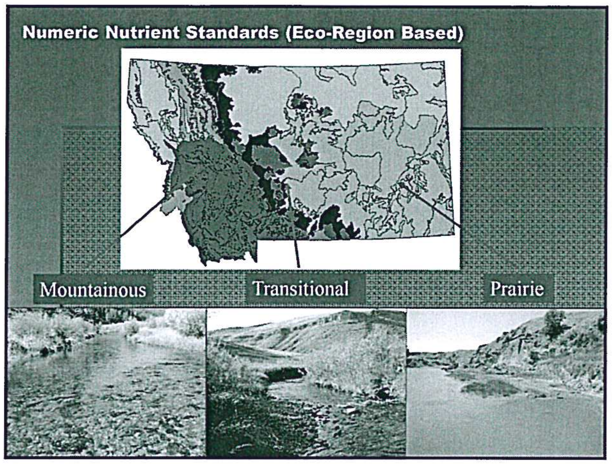
MPDES EFFLUENT STANDARDS APPLICABLE TO THE WHITEFISH WWTP

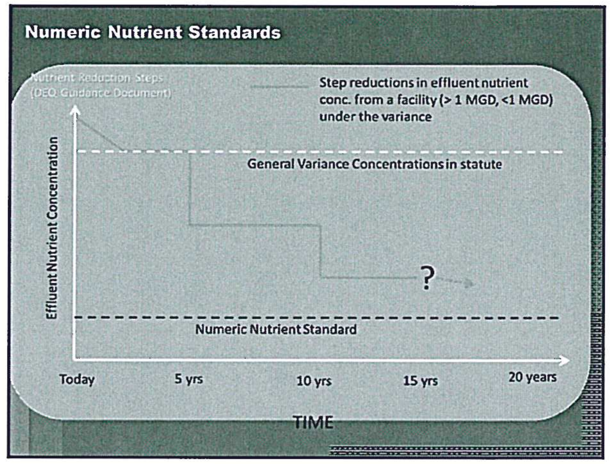
National Secondary Standards – BOD_5, TSS, % Removal, pH

Nondegradation Based Standards - The provisions of ARM 17.30.701 - 718 apply to new or increased sources of pollution. Sources that are in compliance with the conditions of their permit and do not exceed the limits established in the permit or determined from a permit previously issued by DEQ are not considered new or increased sources. The nondegradation rules only apply to "new or increased sources" as of April 29, 1993. This clause exempts discharges that were existing or permitted, authorized or approved by the Department (or its predecessor) prior to April 29, 1993.

Water Quality Based Effluent Standards

- Conventional Pollutants
- Ammonia
- Total Nitrogen and Total Phosphorous - Circular DEQ-12A standards that apply to the Whitefish River, located within the Northern Rockies ecoregion, are 0.275 mg/L TN and 0.025 mg/L TP from July 1st through September 30th.
- Total Residual Chlorine
- Aluminum (toxic pollutant)
- Whole Effluent Toxicity





Numeric Nutrient Standards

Nutrient Reduction Steps in DEQ Guidance

1. Facilities > 1 MGD:

- A. 1st general variance: 10 mg TN/L, 1.0 mg TP/L -per statute
- B. Next permit (+5 years): 8 mg TN/L, 0.8 mg TP/L
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Numeric Nutrient Standards

Variances from Numeric Nutrient Standards:

- General Variances
- Individual Variances
- Economic Variances - Options available for communities to receive temporary relief from the standards based on:
  - Inability to pay for treatment/economics
  - Limits of technology

Numeric Nutrient Standards

GENERAL VARIANCE

Because the treatment of wastewater to base numeric nutrient standards in 2011 would have resulted in substantial and widespread economic impacts on a statewide basis a permittee who meets the end-of-pipe treatment requirements may apply for and DEQ shall approve and grant a general nutrient standards variance . The Department will process the general variance request through the discharge permit, and include information on the period of the variance and the interim requirements. A person may apply for a general variance for either total phosphorus or total nitrogen, or both. The general variance may be established for a period not to exceed 20 years.

Numeric Nutrient Standards

INDIVIDUAL VARIANCES

Montana law allows for the granting of nutrient standards variances based on the particular economic and financial situation of a permittee. Individual nutrient standards variances may be granted on a case-by-case basis because the attainment of the base numeric nutrient standards is precluded due to economic impacts, limits of technology, or both. In general, individual variances are intended for permittees who would have financial difficulties meeting even the general variance concentrations, and are seeking individual N and P permit limits tailored to their specific economic situation.

Numeric Nutrient Standards

Nutrient Trading

- 2013: Board of Environmental Review adopted rules allowing dischargers to use nutrient trading to help comply with numeric nutrient standards and variances
  - Found in Department Circular DEQ-13

Land Application

- Onsite & Offsite Opportunities
- 1:1 Benefit vs. Trading
- May Replace Future Enhanced Treatment Needs
- Aesthetics, Perception, Environmental Benefits

Land Application and Nutrient Trading are being evaluated in the Planning Process

MPDES Discharge Permit

- License to Discharge to State Waters. Contains both Federal and State Water Quality Standards
- Renewed Every 5 Years, Last Done in August 2015
- Contains Limits for Organic Wastes, Bacteria, Toxic Compounds and Nutrients
- Most Recent Permit Contains Several New Effluent Standards not Previously Required
- Compliance Requirements for Whitefish Permit Established Under the AOC

MPDES Permit Limitations

CITY OF WHITEFISH MPDES Permit MT #0020184 Wastewater Effluent Standards (effective Aug 1, 2015)				
Parameter	Units	Avg. Month	Avg. Week	Max Day
5-Day Biochemical Oxygen Demand (BOD_5)	mg/L	30	45	--
	lb/day	313	676	--
	% Removal	85%	--	--
Total Suspended Solids (TSS)	mg/L	30	45	--
	lb/day	313	676	--
	% Removal	85%	--	--
pH	SU	6.0-9.0		
E. coli Bacteria-summer	cfu/100mL	126	--	252
E. coli Bacteria-winter	cfu/100mL	630	--	1260
Total Residual Chlorine	mg/L	0.011	--	0.019
Ammonia, Total as N	mg/L	9.6	--	17.7
Total Nitrogen- summer	lb/day	176	--	--
Total Nitrogen- winter	lb/day	273	--	--
Total Phosphorus (TP) -year-round	mg/L	1.0	--	--
	lb/day	10.4	--	--
Aluminum, dissolved	µg/L	113	--	325

Facilities Planning Process

GENERAL OUTLINE FOR FACILITIES PLAN

- ASSESSMENT OF THE STUDY AREA
  - Population Projections
  - Loading Criteria
  - Environmental Assessment
  - Regulatory Considerations
- EVALUATION OF EXISTING TREATMENT FACILITIES
  - Condition, Age
  - Compliance with DEQ Design Standards
  - Capacity to Meet Regulatory Treatment Performance Criteria
  - Identification of Unit Process Limitations
- ANALYSIS OF TREATMENT ALTERNATIVES
  - Consider All Viable Alternatives
  - Develop Preliminary Design and Estimate of Costs
  - Screen Options
  - Complete a Present Worth Cost Analysis which Considers Capital and Operating Costs
  - Consider Non-monetary Factors
  - Identify Most Cost-effective and Environmentally Sound Alternative

Facilities Planning Process

- PROJECT IMPLEMENTATION
  - Schedule for Construction
  - Assess Environmental Impacts
  - Develop Financial Plan – Grants, Low Interest Loans
  - User Impacts – Low Income Residents
  - Consider Project Phasing
  - Allow for Public Involvement
  - Prepare Workable Implementation Plan
  - Final Recommendations

ANALYSIS OF TREATMENT ALTERNATIVES
Design Criteria (20-Years)

City of Whitefish

Wastewater Facilities Planning Design Criteria

	2013	2015	2020	2025	2035
Planning Area	11,230	11,661	12,812	14,076	16,992
Connected Pop.	7,736	8,033	8,826	9,697	11,705
Ultimate Buildout - 36,929					
Qavg (mgd)	0.996	1.034	1.136	1.248	1.507
Qwet weather	1.195	1.241	1.363	1.498	1.808
Qmax day		4.266	4.342	4.355	4.63
AVG BOD (lbs/day)	2468	2563	2815	3093	3734
MAX BOD	3289.6	3415.8	3753.0	4123.4	4977
TSS (lbs/day)	1980	2056	2259	2482	2996
Ammonia (lbs/day)	209	217	238	261	316
NO2 + NO3 (lbs/day)	263	273	300	330	398
Phosphorous (lbs/day)	49.83	51.74	56.85	62.46	75.40
	Dec	Jan	Feb	Mar	Apr
Avg Influent Temp	9.5	8.8	8.1	8.2	9.2
Avg Alkalinity	266 mg/l				

Assumptions in Alternative Analysis:

- Stay Within Existing Site, Locate System in Cells 2 and 3
- Maintain Operation of Cell 1 and Flocculating Clarifier Throughout Construction
- Retain Existing Facilities Where Practical
  - Screen
  - New Flocculating Clarifier
  - Chemical Feed Equipment
  - Raw Lift Pumps??
- Effect of Cold Wastewater
- Replace Temporary Disinfection with UV System
- Convert Administrative Offices to Maintenance Building
- Address Known Public Concerns – Noise, Odors, Aesthetics, Trail, Cemetery, Cost, ……

Alternative Considerations

- Future Application of More Restrictive Standards
  - Nutrients
  - Ammonia
  - Non-Degradation
- Expansion Capability
- Operating Cost and Complexity
- Capital Cost
- Proven Technology
- Ability to Process Variable Flows and Loads
- Benefits of Nutrient Reduction and Nutrient Trading
  - On-site Land Application of Treated Effluent

Alternatives Evaluated:

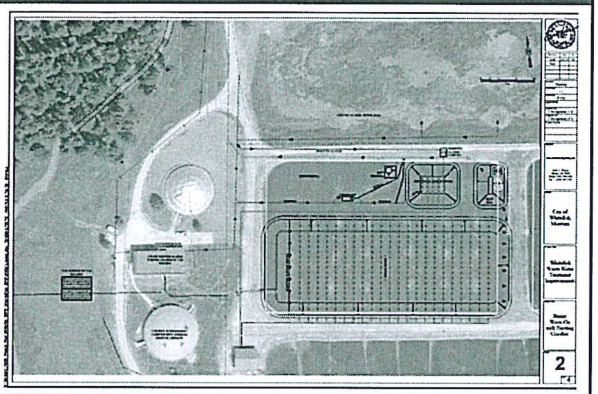
<u>Lagoon:</u>
- 3-Cell, Covered Aerated Lagoon with Nitrification. *(Pursue Economic Variance for Nutrient Removal)*

<u>Advanced Lagoon:</u>
- Biolac with Existing Clarifier
- Biolac with New Clarifier
- EDI – Intermittantly Decanted Extended Aeration Lagoon (IDEAL)

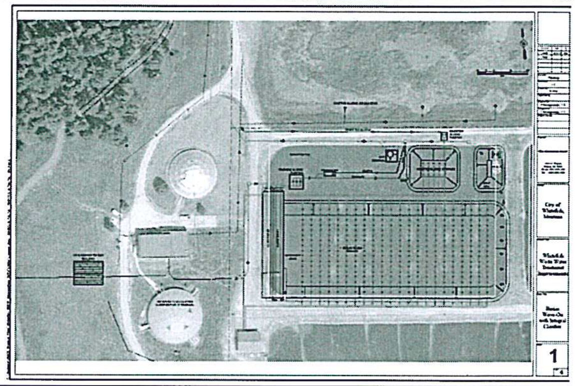
<u>Mechanical</u>
- Sequencing Batch Reactor
- Oxidation Ditch
- Membrane Bio-Reactor

Covered Aerated Lagoon (Ammonia Removal & Variance)

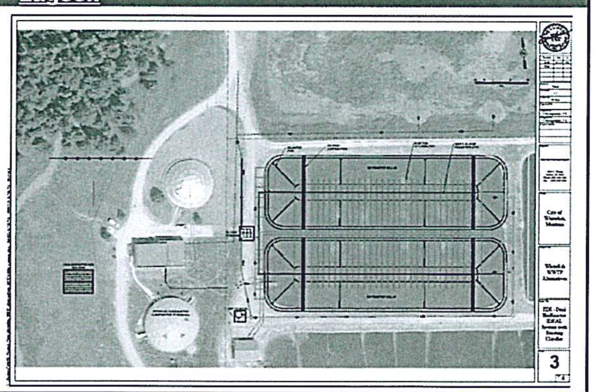
Biolac with Existing Clarifiers



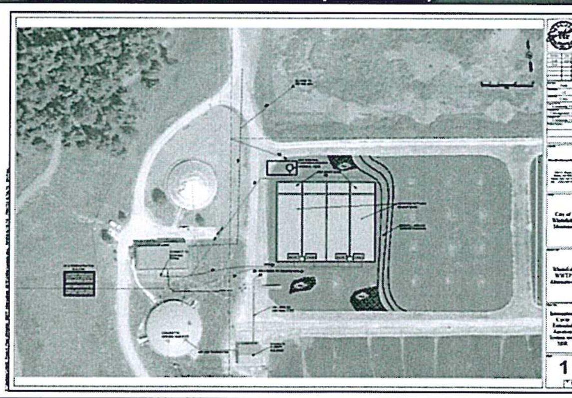
Biolac with New Clarifier



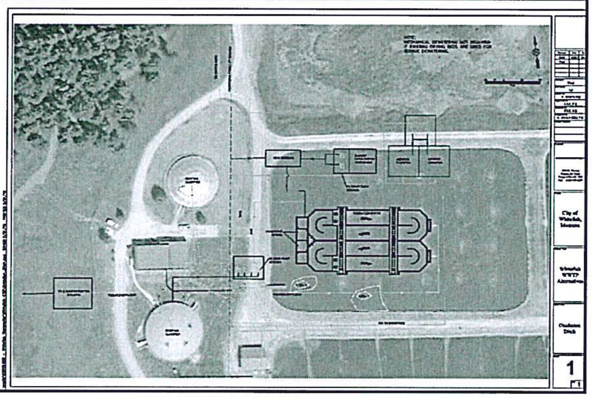
EDI – Intermittantly Decanted Extended Aeration Lagoon



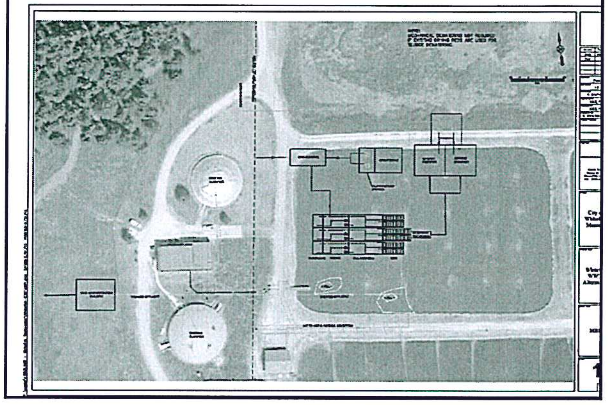
Sequencing Batch Reactor (Sanitaire)



Oxidation Ditch (Lakeside)



Membrane Bio-Reactor



Net Present Worth Comparison

Alternative	Capital Cost	Annual O&M	20-Yr. Salvage Value	Total Net Present Worth
EDI-IDEAL Lagoon	$12,034,200	$525,250 ($7,138,100)	$1,832,800 ($836,500)	$18,335,800
Covered Aerated Lagoon w/ Nitrification	$13,000,800	$493,100 ($6,701,100)	$1,463,200 ($667,800)	$19,034,000
Biolac & Existing Clarifier	$15,175,800	$642,370 ($8,729,800)	$2,151,500 ($982,000)	$22,923,700
Sequencing Batch Reactor	$14,355,500	$780,500 ($10,606,800)	$4,115,000 ($1,878,100)	$23,084,200
Biolac & New Clarifier	$16,092,500	$644,724 ($8,762,000)	$2,833,000 ($1,293,000)	$23,561,200
Oxidation Ditch (Lakeside)	$19,587,500	$928,000 ($12,611,500)	$5,727,500 ($2,614,000)	$29,585,300
Membrane Bio-Reactor	$20,473,600	$1,025,200 ($13,932,500)	$4,069,550 ($1,857,300)	$32,549,200

Lagoons vs Mechanical Plants

Lagoons

- Simple to Operate, Less Costly O&M
- Significant Commitment of Land
- Limited Treatment Performance
- Subject to Cold Weather Impact on the Biological Treatment Process

Mechanical Treatment Plants

- Small Footprint
- Requires Advanced Operational Skills
- Energy and Chemical Intensive
- Conducive to Expansion, Addition of Advanced Treatment Processes

Current and Future Activities (Next 12 Months):

- Submit Compliance Plan, Meet with DEQ
- Refine Alternative Analysis with City Input
- Site Visits of Applicable Systems
- Arrange Public Involvement Activities
- Develop Financial Plan
- Submit Grant Applications (April-May 2016)
- Complete Planning Process by October 2016
- Initiate Project Design

Future Activities:

QUESTIONS?

THANK YOU!

Scott Anderson
Paul Montgomery
406-449-3303
Scott@a-mce.com

Things to Resolve:

Net Present Worth Comparison

Alternative	Capital Cost	Annual O&M	20-Yr. Salvage Value	Total Net Present Worth
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550 East 1st St #103
Whitefish MT 59937

Voice:406.862.4327
Fax:406.862.0686

www.whitefishlake.org
info@whitefishlake.org

Whitefish Lake
INSTITUTE

501 (c)(3) Non-Profit Corporation

1 May 2016

We are writing this letter in support of the proposed project: *City of Whitefish Wastewater Systems Improvement Project.*

The Whitefish Lake Institute (WLI) has worked in concert with the City of Whitefish on several collaborative projects to protect the health and safety of the community of Whitefish.

WLI recently published its *Whitefish Area Water Resources Report: A Status of the Whitefish Lake Watershed and Surrounding Area.* This first ever watershed assessment and restoration plan—developed on behalf of the City of Whitefish as a deliverable to the Department of Natural Resources and Conservation—provides baseline scientific and historical knowledge, identifies known and potential concerns, and offers recommendations to the conservation management organizations responsible for the health of the watershed. Peer reviewed by scientists, resource managers and policy makers, the report increases the collective understanding of our resources and allows us to make more informed resource management decisions.

Based on our research and analysis for this report, we believe the actions to be taken in this wastewater systems improvement project are in keeping with our mutual goal of protecting water quality and the health of our community. We hope the City of Whitefish is afforded the opportunity to bring this project to fruition.

Sincerely,

Lori S. Curtis

Lori S. Curtis
Science & Education Director
Whitefish Lake Institute

9) COMMUNICATIONS FROM PUBLIC WORKS DIRECTOR (CD 52:34)

a) Consideration of accepting Preliminary Engineering Report for the Wastewater Treatment Plant improvements design and authorizing its submittal to the Montana Department of Environmental Quality (p. 76)

Public Works Director Workman gave his staff report that is provided in the packet on the website. Councilor Frandsen asked and Director Workman said as we move from a lagoon system to a mechanical plant, there is a number of different areas that we can control odors much more readily. With a mechanical plant, we have a variety of different aeration techniques, pumping techniques, returning techniques and ways to control odors. Some of the area in this new plant where the more odiferous processes will take place will uncovered cells. There is the same probability of odors but much more operator control. Mayor Muhlfeld asked and Director Workman assumes there will be a pretty quick turn around on this report, he anticipates we will hear by the end of the year. Councilor Hildner asked and Director Workman said part of the PER does incorporate a nutrient trading plan that is associated with it for possible nutrient credits. Nutrient trading down the road will give us flexibility as we go to deal with future permits, and Burlington Northern (BN) will be the first place we look. Councilor Hildner also did not want to lose sight about the composting plant, as well as the possibility to convert a lagoon into a nursery that can be fertilized and watered from the waste water treatment plant.

Councilor Frandsen made a motion, second by Councilor Sweeney to accept the Preliminary Engineering Report for the Wastewater Treatment Plant improvements design and authorizing its submittal to the Montana Department of Environmental Quality. The motion passed unanimously.

10) COMMUNICATIONS FROM CITY MANAGER (CD 1:04:49)

a) Written report enclosed with the packet. Questions from Mayor or Council? (p. 92)

b) Other items arising between September 28th and October 3rd

City Manager Stearns wanted to make sure the Council saw the City Hall Parking Structure budget update that in his manager report. This afternoon he received the August Resort Tax Report. August was up 27.7% or $120,000 increase from last year, most of that being in Lodging which was up 78%.

c) Resolution No. 16-54; A Resolution indicating its intent to consider annexing approximately 82.7 acres of wholly surrounded land into the City of Whitefish, Montana, describing the land to be so considered, providing for notice and publication as provided by law, providing for a date of hearing such proposed annexation, and approving the Report on Extension of Services (p. 97)

City Manager Stearns gave his staff report that is provided in the packet on the website. Councilor Sweeney asked and Manager Stearns said at the time of the Public Hearing the Council can decide to remove properties, or delay properties for annexation. The decisions would need to be supported by findings or rational. Mayor Muhlfeld asked and Director Taylor said there will be a work session regarding the extension of services before the end of the year.

City of Whitefish
Department of Public Works
1005 W. 10^{TH} Street, PO Box 158
Whitefish, MT 59937
(406) 863-2460 Fax (406) 863-2419

September 27, 2016

Mayor Muhlfeld and City Councilors
City of Whitefish
Whitefish, Montana

Mayor Muhlfeld and Councilors

Approval of Preliminary Engineering Report for the Wastewater Systems Improvements Project

Introduction/History

The City was issued an Administrative Order of Consent (AOC) by the Montana Department of Environmental Quality (DEQ) on October 5, 2012. Late last year the AOC was updated to incorporate a Compliance Plan detailing the completion dates that must be met in order to bring the WWTP into compliance. The first milestone of the Compliance Plan requires that a Preliminary Engineering Report (PER) be approved by Council and submitted to DEQ.

Current Report

The primary impetus behind the project pertains to new wastewater treatment standards implemented by DEQ through the latest discharge permit, issued to the City in 2015. New requirements for removal of ammonia, nitrogen and phosphorous were included in this permit. The City's lagoon system was originally constructed in 1979, and has served the residents well. However, the existing treatment facility has reached the end of its useful design life and cannot be made to meet the new standards without major reconstruction.

The PER considered alternatives to address the existing permit, and will position the City to meet new limits in future permits. In development of treatment alternatives, the re-use of newer plant components was stressed in order to optimize the value of the City's earlier investments. In addition, sustainable treatment technologies were considered for incorporation into the design of the new plant. Although treatment processes employing proven technologies, capable of meeting existing and anticipated regulatory standards, should be utilized, energy efficiency will be a prime consideration in the selection of specific pumping, mixing and aeration equipment.

The following is a brief summary of the three treatment alternatives that were analyzed in the report.

BioLac Lagoon Treatment System – This alternative consists of a lagoon-based, quasi-activated sludge treatment system. The system would include new grit removal, solids handling, and effluent disinfection equipment. The entire proposed BioLac system could be fit within the footprint of existing treatment cell #3, excluding disinfection.

Oxidation Ditch – The oxidation ditch is a variation of the activated sludge process. The system consists of a closed-loop aeration channel through which mixed wastewater is continuously recirculated. The heart of the oxidation ditch technology is the aeration system. The aerator provides for oxygen transfer, mixing, and recirculation of the wastewater. Through the proper design of the aeration system, it is possible to achieve organic removal, ammonia removal (nitrification), and nitrate removal (denitrification) in a single sludge system. The oxidation ditch concept also has the potential for phosphorus removal.

Sequencing Batch Reactor – This alternative consists of a multi basin system sized to treat the City's projected 2035 design flow. The Sequencing Batch Reactor (SBR) is an activated sludge process designed to operate under variable conditions. An SBR operates in a true batch mode with aeration and sludge settlement both occurring in the same tank. The major differences between SBR and conventional continuous-flow, activated sludge system is that the SBR tank carries out the functions of aeration and sedimentation in a time sequence, rather than in the conventional space sequence of continuous-flow systems. In addition, the SBR system can be designed with the ability to treat a wide range of influent volumes whereas the continuous system is based upon a fixed influent flowrate. Thus, there is a degree of flexibility associated with working in a time rather than in a space sequence.

The following table provides a comparison of the capital and operating costs for the three final options considered:

Table 4-7 City of Whitefish Wastewater Treatment Alternatives

Net Present Worth Comparison Table

Alternative	Capital Cost	Annual O&M	20-Year NPW Annual O&M	Salvage Value	20-Year NPW Salvage Value	Overall 20-Year Net Present Worth
Biolac w/ Existing Clarifier	$15,914,648	$642,369	$8,729,790	$2,481,218	$1,132,428	$23,512,010
Sequencing Batch Reactor	$15,984,739	$780,485	$10,606,791	$4,601,475	$2,100,113	$24,491,416
Oxidation Ditch	$21,356,133	$927,996	$12,611,472	$6,451,438	$2,944,436	$31,023,169

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The treatment alternatives were ranked as follows, with 1 being the most desirable, and 3 being the least:

Table 4.8 City of Whitefish PER Ranking of Three Screened Alternatives			
	Option 1 Biolac	Option 2 SBR	Option 3 O-Ditch
Capital Costs	1	1	3
Operating Costs	1	2	3
Mechanical and Operational Complexity	1	1	1
Use of Proven Technology	2	1	1
Future Expansion Capability	3	1	2
Capacity to Remove Pollutants to Lower Levels	3	1	1
Cold Weather Operation	2	1	1
Odor Potential and Aesthetics	2	1	2
Environmental Impacts	1	1	1
Ease of Implementation	1	1	2
Public Acceptance	1	1	1
Total	18	12	18
Rank	3	1	2

The recommended project includes replacement of the existing treatment plant with a SBR. This system will be capable of removing ammonia, nitrogen and phosphorous to fully comply with the requirements of the current MPDES discharge permit. Furthermore, the SBR plant will be capable of meeting anticipated nutrient standards proposed by the DEQ in the next two discharge permit cycles (5 and 10 years hence).

Pretreatment of the wastewater will be provided by the existing perforated screen plus grit removal capability added by a new unit process. A four cell sequencing batch reactor is proposed within the third lagoon cell whereas the existing lagoon cells will be retained for treatment during construction. Use of 4 cells allows continuous discharge from the system, eliminating the need for a post treatment flow equalization basin. BioSolids from the SBR plant will be discharged to an aerobic digester for further stabilization. The existing flocculating clarifier will be converted to a covered aerobic digester. After stabilization, BioSolids will be sent to the existing drying beds for further dewatering and long-term storage. Periodically the solids can be removed for disposal at the landfill or land application. While not an immediate plan (or need), a small composting operation could be constructed on site within one of the old treatment cells utilizing BioSolids and wood waste to generate compost. Disinfection of the treated effluent would be provided by ultraviolet disinfection.

Financial Requirement

The estimated capital costs for the project are $17,500,000. This includes construction, engineering, administration and a 15% contingency. Annual costs for operating the entire facility are estimated to be $780,480, which roughly equates to a $440,000 cost increase over the current operational cost. Detailed cost estimates for this option are included in PER.

A project budget strategy has been prepared which anticipates grant funding from the TSEP and DRNC programs matched by a SRF loan, including forgiving principal of the loan in the amount of $500,000. An alternative or supplement to the SRF loan is being investigated utilizing a Rural Development Loan and Grant combination. Whitefish, primarily due to its population, is eligible for RD funding but is not a good candidate for the limited funds. Initial project planning is proceeding without an assumption of obtaining an RD grant.

Recommendation

A copy of the Executive summary of the PER is included with this report, along with a schematic of the proposed SBR treatment technology. The entire PER is available for review or download at the Public Works Department.

It is the opinion of the Public Works Department that this PER provides a comprehensive review of the alternatives to address the AOC and bring the City into compliance with our discharge permit. It is our further opinion that the SBR is the best alternative to proceed with.

Based on these factors, it is the recommendation of the Public Works Department that Council approve the PER and authorize its submittal to DEQ

Sincerely,

Craig Workman, P.E.
Director of Public Works

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Sincerely,

Craig Workman, P.E.
Director of Public Works

APPENDIX J

SBR DESIGN REPORTS

AQUA AEROBICS

FLUIDYNE

SANITAIRE ICEAS

PARKSON

Preliminary Manufacturer's

Design Report

Aqua A SBR

Anderson~Montgomery

CONSULTING ENGINEERS

PROCESS DESIGN REPORT

AQUA-AEROBIC SYSTEMS, INC.

WHITEFISH MT

Design#: 141346

Option: Preliminary Design SBR

Designed By: Aaron Xu on Friday, August 14, 2015

Design Notes

Pre-SBR

- Neutralization is recommended/required ahead of the SBR if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Coarse solids removal/reduction is recommended prior to the SBR.

- Elevated concentration of Hydrogen Sulfide can be detrimental to both civil and mechanical structures. If anaerobic conditions exist in the collection system, steps should be taken to eliminate Hydrogen Sulfide prior to the treatment system.

SBR

- The maximum flow, as shown on the design, has been assumed as a hydraulic maximum and does not represent an additional organic load.

- The decanter performance is based upon a free-air discharge following the valve and immediately adjacent to the basin. Actual decanter performance depends upon the complete installation including specific liquid and piping elevations and any associated field piping losses to the final point of discharge. Modification of the high water level, low water level, centerline of discharge, and / or cycle structure may be required to achieve discharge of full batch volume based on actual site installation specifics.

Aeration

- The aeration system has been designed to provide 1.25 lbs. O2/lb. BOD5 applied and 4.6 lbs. O2/lb. TKN applied at the design average loading conditions.

Digester

- A supernatant return device is recommended in the digester, and shall be provided by others.

- The digester will share a common standby blower with the SBR.

Process/Site

- An elevation of 3,000 ft has been assumed, as displayed on the design.

- The winter wastewater temperature has been given, and summer wastewater and ambient temperatures have been assumed, as displayed on the design.

- The anticipated effluent total nitrogen requirement is predicated upon an influent waste temperature of 10° C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification and denitrification below 10° C can be unpredictable, requiring special operator attention.

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as CaCO3) is required for every mg of NH3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- To achieve the effluent monthly average total phosphorus limit, the biological process and chemical feed systems need to be designed to facilitate optimum performance.

- A minimum of twelve (12) daily composite samples per month (both influent and effluent) shall be obtained for total phosphorus analysis.

- Chemical feed lines (i.e. metal salts) shall be furnished to each reactor, aerobic digester and dewatering supernatant streams as necessary.

- pH monitoring of the upstream biological reactor is required when adding metal salts.

Anticipated

- The effluent Total Nitrogen (TN) limit of 10 mg/l is assumed to be comprised of 2 mg/l organic nitrogen, 6 mg/l Nox-N, and 2 mg/l NH3-N.

- In order to meet the required Total Nitrogen limit, strict operator attention will be necessary for process and operational control. It is also recommended that provisions be made for supplemental carbon source addition in order to facilitate denitrification. (by others)

Post-SBR

- Post-Equalization basin, by others, follows the AquaSBR.

Equipment

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square, rectangular or sloped with construction materials including concrete, steel or earthen.

- Rectangular or sloped basin construction with length to width ratios greater than 1.5:1 may require alterations in the equipment recommendation.

- The basins are not included. Basins and basin modification shall be provided by others.

- Influent is assumed to enter the reactor above the waterline, located appropriately to avoid proximity to the decanter, splashing or direct discharge in the immediate vicinity of other equipment.

- If the influent is to be located submerged below the waterline, adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- A minimum freeboard of 2.0 ft. is recommended for diffused aeration.

- Aqua-Aerobic Systems, Inc. is familiar with various “Buy American” Acts (i.e. AIS, ARRA, Federal FAR 52.225, EXIM Bank, USAid, PA Steel Products Act, etc.). As the project develops Aqua-Aerobic Systems can work with you to ensure full compliance of our goods with various Buy American provisions if they are applicable/required for the project. When applicable, please provide us with the specifics of the project’s “Buy American” provisions.

AquaSBR - Sequencing Batch Reactor - Design Summary

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 1.507 MGD	= 5705 m3/day
Max Design Flow	= 4.53 MGD	= 17148 m3/day

DESIGN PARAMETERS	Influent	mg/l	Effluent Required	<= mg/l	Effluent Anticipated	<= mg/l
Bio/Chem Oxygen Demand:	BOD5	297	BOD5	30	BOD5	30
Total Suspended Solids:	TSS	239	TSS	30	TSS	30
Total Kjeldahl Nitrogen:	TKN	41.40	--	--	--	--
Total Nitrogen:	--	--	TN	10	TN	10
Phosphorus:	Total P	6	Total P	1	Total P	1

SITE CONDITIONS	Maximum		Minimum		Design		Elevation (MSL)
Ambient Air Temperatures:	75 F	23.9 C	20 F	-6.7 C	75 F	23.9 C	3,000 ft
Influent Waste Temperatures:	68 F	20.0 C	48 F	9.0 C	68 F	20.0 C	914.4 m

SBR BASIN DESIGN VALUES

			Water Depth			Basin Vol./Basin		
No./Basin Geometry:	= 2 Square Basin(s)		**Min**	= 12.6 ft	= (3.8 m)	**Min**	= 0.682 MG	= (2,581.5 m³)
Freeboard:	= 2.0 ft	= (0.6 m)	**Avg**	= 15.4 ft	= (4.7 m)	**Avg**	= 0.833 MG	= (3,152.0 m³)
Length of Basin:	= 85.0 ft	= (25.9 m)	**Max**	= 21.0 ft	= (6.4 m)	**Max**	= 1.135 MG	= (4,296.4 m³)
Width of Basin:	= 85.0 ft	= (25.9 m)						

Number of Cycles:	= 5 per Day/Basin (advances cycles beyond MDF)	
Cycle Duration:	= 4.8 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.073 lbs. BOD5/lb. MLSS-Day	
MLSS Concentration:	= 4500 mg/l @ Min. Water Depth	
Hydraulic Retention Time:	= 1.105 Days @ Avg. Water Depth	
Solids Retention Time:	= 17.8 Days	
Est. Net Sludge Yield:	= 0.670 lbs. WAS/lb. BOD5	
Est. Dry Solids Produced:	= 2502.6 lbs. WAS/Day	= (1135.2 kg/Day)
Est. Solids Flow Rate:	= 300 GPM (30008 GAL/Day)	= (113.6 m³/Day)
Decant Flow Rate @ MDF:	= 8389.0 GPM (as avg. from high to low water level)	= (529.2 l/sec)
LWL to CenterLine Discharge:	= 3.3 ft	= (1.0 m)
Lbs. O2/lb. BOD5	= 1.25	
Lbs. O2/lb. TKN	= 4.60	
Actual Oxygen Required:	= 7060 lbs./Day	= (3202.2 kg/Day)
Air Flowrate/Basin:	= 2555 SCFM	= (72.4 Sm3/min)
Max. Discharge Pressure:	= 10.7 PSIG	= (74 KPA)
Avg. Power Required:	= 2240.8 KW-Hrs/Day	

Aerobic Digester - Design Summary

AEROBIC DIGESTER DESIGN PARAMETERS

Sludge Flowrate to the Digester	= 29,987.7 gal/day	= (113.5 m³/day)
Inlet Sludge Concentration	= 1.00%	
Solids Loading to the Digester	= 2,501.0 lb/day	= (1,134.4 kg/day)
Inlet Volatile Solids Fraction	= 75.0%	

AEROBIC DIGESTER BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 85 ft	= (25.9 m)			
Width of Basin:	= 30 ft	= (9.1 m)			
Min. Water Depth:	= 14.7 ft	= (4.5 m)	**Min. Basin Vol. Basin:**	= 280,387.8 gal	= (1,061.5 m³)
Max. Water Depth:	= 21 ft	= (6.4 m)	**Max. Basin Vol. Basin:**	= 400,553.9 gal	= (1,516.4 m³)

AEROBIC DIGESTER PROCESS DESIGN PARAMETERS

Solids Retention Time:	= 26.7 days	
Digester Design Temperature:	= 20 C	
Volatile Solids Destruction:	= 40%	
Digester Solids Concentration:	= 2%	
Oxygen Supplied for Digestion:	= 2.00 lbs O2 per lb VSS Destroyed	
Oxygen Distribution Per Basin:	= 100.0%	
Actual Oxygen Required:	= 1,500.1 lb/day	= (680.4 kg/day)
Volatile Percentage After Digestion:	= 64.3%	
Estimated Dry Solids to be Removed:	= 1,750.9 lb/day	= (794.2 kg/day)
Volume of Solids to be Removed:	= 10,497.0 gal/day	= (39.74 m³/day)
Estimated Supernatant Volume:	= 120,166.2 gal/basin	= (454.88 m³/basin)
Assumed Supernatant Duration:	= 180 minutes	
Calculated Supernatant Flow:	= 667.6 gpm	= (42.1 l/sec)

1. The Volatile Solids Destruction listed above shall be used for determination of the oxygen demand during summer conditions. It should be noted that the actual VSS destruction will be dependant upon digester inlet condition, temperature, and operating conditions.
2. The Digester Solids Concentration is reflected as an average concentration, assuming the operations include frequent settling and supernating practices.

AEROBIC DIGESTER EQUIPMENT CRITERIA

SCFM Required for O2 Demand:	= 740/basin	= (1,257 m³/hr/basin)
Mixing Energy with Diffusers (Coarse):	= 30 SCFM/1000 ft³	
SCFM Required to Mix:	= 1,607 SCFM/basin	= (2,729 Nm³/hr/basin)
Max. Discharge Pressure:	= 9.67 PSIG	= (66.70 KPA)
Max. Flow Rate Required Basin:	= 300 gpm	= (1.136 m³/min)
Avg. Power Required:	= 1,346.75 kW-hr/day	

AquaSBR

Influent Valves

2 Influent Valve(s) will be provided as follows:

- 16 inch electrically operated plug valve(s).

Mixers

2 AquaDDM Direct Drive Mixer(s) will be provided as follows:

- 30 HP Aqua-Aerobic Systems Endura Series Model FSS DDM Mixer(s).

Mixer Mooring

2 Mixer Cable Mooring System(s) consisting of:

- #6 AWG-four conductor electrical service cable(s).
- Aerial support tie(s).
- Electrical cable strain relief grip(s), 2 eye, wire mesh.
- 304 stainless steel cable.
- Maintenance mooring cable loop(s).
- Stainless steel mooring spring(s).

Decanters

2 Decanter Assembly(ies) consisting of:

- 16X12 Decanter(s) with fiberglass float, 304 stainless steel weir, galvanized restrained mooring frame, and painted steel power section with #14-10 conductor power cable and #16-9 conductor signal cable.
- Decant pipe(s).
- Galvanized mooring post(s).
- Galvanized steel dewatering support post(s).
- Galvanized steel top mooring post supports.
- Galvanized steel bottom mooring post supports.
- 20 inch electrically operated butterfly valve(s).

Transfer Pumps/Valves

2 Submersible Pump Assembly(ies) consisting of the following items:

- 3 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- Manual plug valve(s).
- 3 inch diameter swing check valve.
- Galvanized steel slide rail assembly(ies).
- 304 stainless steel intermediate support(s).

Retrievable Fine Bubble Diffusers

18 Retrievable Fine Bubble Diffuser Assembly(ies) consisting of:

- 25 diffuser tubes consisting of two flexible EPDM porous membrane sheaths mounted on a rigid support pipe with 304 stainless steel band clamps.
- 304 stainless steel manifold weldment.
- 304 stainless steel leveling angles.
- 304 stainless steel leveling studs.
- Galvanized vertical support beam.
- Galvanized vertical air column assembly.
- Galvanized upper vertical beam and pulley assembly.
- Galvanized top support bracket.
- 3" EPDM flexible air line with ny-glass quick disconnect end fittings.
- Galvanized threaded flange.

- 3" manual isolation butterfly valve with cast iron body, EPDM seat, aluminum bronze disk and one-piece steel shaft.
- Ny-glass quick disconnect cam lock adapter.
- 304 stainless steel adhesive anchors.
- Brace angles.

1 Diffuser Electric Winch(es) will be provided as follows:

- Portable electric winch.

Positive Displacement Blowers

2 Positive Displacement Blower Package(s), with each package consisting of:

- ROOTS 616 Positive Displacement Blower Package with common base, V-belt drive, enclosed drive guard, pressure gauge, pressure relief valve, and vibration pads.
- 304 stainless steel anchors.
- 125 HP motor with slide base.
- Blower startup by the blower packager is included.
- Inlet filter and inlet silencer.
- Discharge silencer, check valve, manual butterfly isolation valve, and flexible discharge connector.

Air Valves

2 Air Control Valve(s) will be provided as follows:

- 10 inch electrically operated butterfly valve(s) with actuator.

Level Sensor Assemblies

2 Pressure Transducer Assembly(ies) each consisting of:

- Submersible pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).
- 304 stainless steel anchors.

2 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- 304 stainless steel anchors.

Instrumentation

2 Dissolved Oxygen Assembly(ies) consisting of:

- Thermo Fisher RDO dissolved oxygen probe with electric cable. Probe includes stainless steel stationary bracket and retrievable pole probe mounting assembly. One (1) probe per basin.
- Thermo Fisher AV38 controller and display module(s).

AquaSBR: Aerobic Digester

Transfer Pumps/Valves

1 Submersible Pump Assembly(ies) consisting of the following items:

- 3 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- Manual plug valve(s).
- 3 inch diameter swing check valve.
- Galvanized steel slide rail assembly(ies).
- 304 stainless steel intermediate support(s).

Fixed Coarse Bubble Diffusers

1 Aqua-Aerobic's Fixed Coarse Bubble Diffuser System(s) consisting of the following components:

- PVC diffuser(s).
- 10" Schedule 40 galvanized steel riser pipe(s).

- 304 stainless steel anchors.

Positive Displacement Blowers

2 Positive Displacement Blower Package(s), with each package consisting of:

- ROOTS 715J Positive Displacement Blower Package with common base, V-belt drive, enclosed drive guard, pressure gauge, pressure relief valve, and vibration pads.
- 304 stainless steel anchors.
- 125 HP motor with slide base.
- Blower startup by the blower packager is included.
- Inlet filter and inlet silencer.
- Discharge silencer, check valve, manual butterfly isolation valve, and flexible discharge connector.

Level Sensor Assemblies

1 Sensor installation(s) consisting of:

- Submersible pressure transducer(s).
- Stainless steel sensor guide rail weldment(s).
- PVC sensor mounting pipe(s).
- Top support(s).
- Stainless steel anchor kit(s).

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- 304 stainless steel anchors.

Controls

Controls wo/Starters

1 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuse(s) and fuse block(s).
- Allen Bradley 1769-L30ER Compactlogix integral programmable controller.
- Operator interface(s).
- Remote Access Ethernet Modem.

AquaSBR® Sequencing Batch Reactor
Operational Description

Phase Descriptions for Diffused Aeration

Mix Fill Phase

Prior to the start of the Mix Fill phase, the reactor contents exist in a stratified condition. The bottom portion of the reactor consists of settled sludge, and the top portion consists of a clear supernatant. At this point in time, the reactor has recently completed a Decant cycle, and the overall water depth is equal to the minimum side water depth (SWD).

The reactor environment has been "conditioned" by events that occurred during the prior cycle. First, the reactor environment has been conditioned by the termination of flow (and associated organic loading) to the reactor as the React Fill phase was completed. Second, the completion of the React phase provided the opportunity for the wastewater contaminants in the reactor to be "polished off". Third, the absence of mixing and aeration during the Settle, Decant, Idle and Waste Sludge phases further conditioned the reactor environment.

Typically, the settled sludge zone will contain the majority of the microbial life. This microbial life continues a certain level of respiration and effectively depletes this settled sludge zone of any dissolved oxygen (D.O.).

The supernatant layer above the settled sludge zone represents a significant fraction (typically 50 % to 70 %) of the reactor volume. Since the majority of the microbial life has settled to the bottom of the reactor, the relative effect of microbial respiration in the supernatant layer (compared to the sludge mass layer) is generally reduced. Therefore, the D.O. concentration in the supernatant layer typically ranges from 0.50 to 1.5 mg/l prior to the start of the Mix Fill phase.

The water in the supernatant layer is generally of reasonably good quality with respect to the concentration of specific wastewater parameters. Residual soluble levels of organic material (as determined by a BOD_5 measurement) are present in concentrations at or below the anticipated effluent value. Total suspended solids (TSS), total nitrogen (Tot-N) and total phosphorus (Total P) are also present in concentrations at or below the anticipated effluent concentrations.

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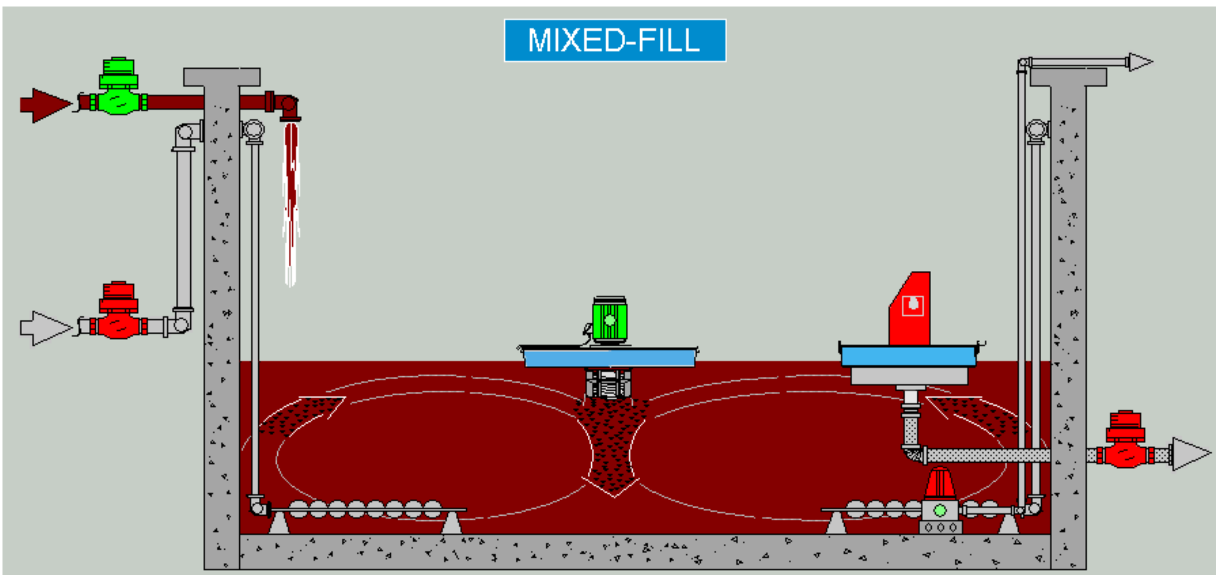
As the Mix Fill phase of operation begins, wastewater flow is initiated to the reactor and the AquaDDM mixer is turned on. At this point, the AquaDDM begins mixing the reactor while the air supply system remains off and is not providing oxygen to the reactor. The stratified condition of the reactor that existed in the preceding phases is now converted to a completely mixed condition. The settled biomass is now resuspended and combined with the previously isolated supernatant layer and the raw wastewater entering the reactor. A schematic of this phase of operation, along with its associated process and mechanical considerations, is shown in Figure 1.

Mix Fill Phase (Figure 1)



Process Considerations	Mechanical Considerations
Zero or Near Zero D.O.	Mixer Operating
Complete Mix Conditions	Influent Valve Open/Transfer Pump Operating
Denitrification	Aeration System Off
Phosphorus Release	Sludge Pump Off
Sludge Conditioning	Decant Weir Closed
Filamentous Control	

As raw wastewater continues to flow into the reactor, the completely mixed condition results in the dispersal of the microbial life and incoming wastewater throughout the reactor. The residual level of D.O. that existed in the supernatant layer is rapidly depleted as a result of microbial respiration being effective throughout the entire reactor volume.

As raw wastewater enters the reactor, the amount of organic material (as measured by the soluble BOD_5 concentration) present in the reactor increases. Since an aerobic phase has not yet been initiated in this cycle, biological degradation of the organic material in the influent wastewater is limited.

The concentration of Total Kjeldahl nitrogen (TKN) in the reactor also increases. The TKN consists of organic nitrogen (Org-N) and ammonia nitrogen (NH_3-N). By the process of hydrolysis (with or without oxygen present), the majority of the organic nitrogen is converted to ammonia nitrogen. The ammonia nitrogen must then be oxidized by the nitrification process. In the presence of oxygen, the nitrification process converts the ammonia nitrogen to nitrate nitrogen (NO_3-N). However, since an aerobic phase has not yet been initiated, active nitrification is not occurring.

Due to the absence of D.O. in the reactor, denitrification is capable of occurring during the Mix Fill phase. As a result, the residual level of nitrate nitrogen that previously existed in the supernatant layer is depleted to a near-zero concentration level. The denitrification process converts the nitrate nitrogen to nitrogen gas (N_2), and the nitrogen gas is subsequently released to the atmosphere.

The Mix Fill phase, in combination with the "non-aerated" periods during the React Fill and React phases, can be effective in producing an extremely low NO_3-N concentration in the system effluent. However, since the nitrogen that enters the reactor is generally not in the form of NO_3-N, the amount of denitrification that occurs during the Mix Fill phase is limited to the residual NO_3-N from the previous cycle.

Before the nitrogen in the influent can be denitrified, it must first be nitrified during the aerated periods of the React Fill and React phases. Therefore, a relatively small fraction of the total nitrogen removal requirement is accomplished during the Mix Fill phase.

At the start of the Mix Fill phase, the effective mixing of the biomass with the influent wastewater in an anoxic environment results in a substantial release of phosphorus from the cell mass to the liquid medium. This phosphorus is now distributed throughout the entire reactor volume. A typical monitoring program would indicate a steady increase in the concentration of phosphorus during the Mix Fill phase. The rate of this increase is significantly greater than what could be attributed to the contribution of phosphorus present in the raw wastewater.

The use of anoxic conditioning of the sludge mass can be highly effective with respect to improved settling characteristics and controlling the predominance of filamentous organisms in the treatment system. The Mix Fill phase of operation readily creates an anoxic condition throughout the entire reactor. A treatment cycle structure which incorporates this repetitive phase of operation can be effective in avoiding or controlling the predominance of filamentous populations in the reactor.

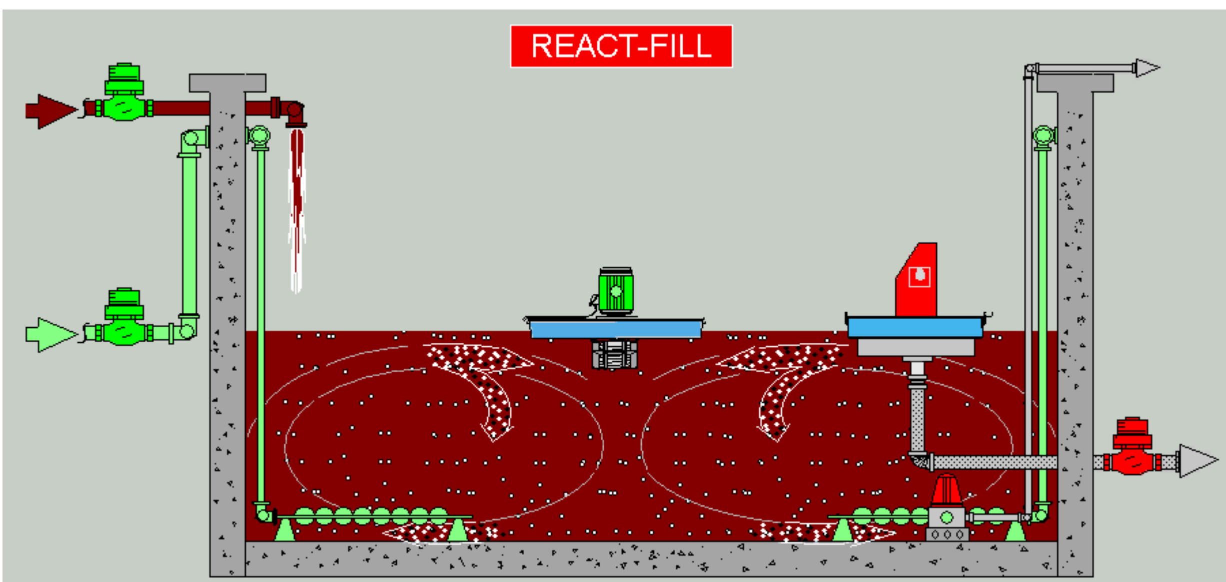
In summary, the Mix Fill phase of operation is characterized by a completely mixed anoxic environment in the reactor. The reactor contains a uniform blend of raw influent wastewater, previously settled biomass, and supernatant from the previous cycle. The environment is classified as anoxic with D.O. concentrations at or near zero. Effluent quality parameters will provide the system operator with a basis for determining the necessity of adjusting the specific duration of this phase of operation. In essence, this phase is utilized for denitrification, biological phosphorus release, and anoxic conditioning of the sludge mass.

React Fill Phase

During the React Fill phase of operation, wastewater continues to enter the reactor, and the air supply system begins delivering oxygen to the reactor. The AquaDDM mixer continues to operate, and the completely mixed environment is maintained. The introduction of oxygen converts the reactor from an anoxic environment to an aerobic environment. Since the AquaSBR was designed to achieve nitrification and denitrification, the aeration system is cycled on and off during the React Fill phase. This alternately creates aerobic and anoxic conditions. Refer to "AquaSBR Description of Operation" for the specific aeration cycle times.

Nitrification occurs during the aerated periods of operation, and denitrification occurs during the non-aerated periods of operation. Although BOD_5 reduction normally occurs under aerobic and anoxic conditions, the rate of BOD_5 reduction is much greater during the aerated periods of operation. A schematic of the React Fill phase of operation is shown in Figure 2.

React Fill Phase (Figure 2)



Process Considerations	Mechanical Considerations
Alternating Aerobic/Anoxic Conditions	Mixer Operating
Complete Mix Conditions	Influent Valve Open/Transfer Pump Operating
BOD_5 Reduction	Aeration System On/Off
Nitrification/Denitrification	Sludge Pump Off
Phosphorus Uptake	Decant Weir Closed

The wastewater that has entered (and continues to enter) the reactor represents a certain potential oxygen demand. The oxygen demand is due to the aerobic metabolism of the organic constituents (i.e. BOD_5 reduction) and the nitrification of NH_3-N. The aeration system has been sized to meet this oxygen demand.

The dissolved oxygen (D.O.) concentration profile in the reactor will normally reveal a pattern of increasing D.O. concentration during the aerated periods, followed by decreasing D.O. concentration (to near-zero) during the non-aerated periods. In other words, the D.O. concentration will reach a peak value at the end of each aeration period.

The repetitive on/off cycling of the air supply will also produce a pattern of increasing peak D.O. concentration with each successive aerated period. This is the result of the system achieving an ever-increasing degree of treatment as this phase progresses. As the degree of treatment increases, a steady decline in the oxygen uptake rate (OUR) of the biomass will result. The exact magnitude of this decline will be affected by the loading to the system and the duration of each of the individual phases of a complete treatment cycle.

The concentration of total nitrogen present in the reactor will steadily decline as the React Fill phase is completed. The nitrification and denitrification processes typically reduce total nitrogen concentrations in the reactor as the raw waste flow continues to enter the reactor with additional nitrogen. In other words, the rates of nitrification and denitrification are typically more than sufficient to offset the rate of nitrogen entering the reactor.

Nitrification is a two-step process involving two individual groups of microorganisms, namely Nitrosomonas and Nitrobacter. This process does not remove nitrogen from the wastewater. It merely converts it from one form of nitrogen to another form of nitrogen. In the presence of oxygen, ammonia nitrogen (NH_3-N) is first converted to nitrite nitrogen (NO_2-N) by the Nitrosomonas. The nitrite nitrogen is then converted to nitrate nitrogen (NO_3-N) by the Nitrobacter. Since the Nitrobacter are generally much faster "workers" than the Nitrosomonas, the NO_2-N concentration in the reactor is usually negligible.

Nitrogen is actually removed from the wastewater by the denitrification process. Denitrification is performed by a broad range of microorganisms, collectively known as "heterotrophs", that are present in most wastewater treatment systems. In the absence of oxygen, these heterotrophs convert nitrate nitrogen to nitrogen gas (N_2). The nitrogen gas is subsequently released from the reactor into the atmosphere.

The amount of soluble organic material (as evidenced by the BOD_5 concentration) in the reactor will typically decrease during the React Fill phase. During this phase, biological oxidation occurs simultaneously with the addition of organic material to the reactor. The decline in BOD_5 concentration will closely parallel the pattern observed for the total nitrogen concentration.

During the initial period of the React Fill phase, the onset of aerobic conditions in the reactor allows the microorganisms to "take in" phosphorus. Therefore, the phosphorus that was previously released into solution (during the Mix Fill phase) is now taken back into the cell mass. The phosphorus present in the influent is also taken in by the biomass.

Since the microorganisms were previously "depleted" of phosphorus, they have a tendency to take in more phosphorus than the amount that is necessary to meet their nutritional requirements. The term used to describe this phenomenon is "enhanced biological phosphorus removal". The anoxic periods during the React Fill and React phases are not long enough to allow a re-release of phosphorus from the biomass into the liquid medium. Therefore, the effluent from the reactor will contain a low concentration of total phosphorus.

Effluent quality parameters will provide the operator with a basis for determining the necessity of adjusting the duration of the React Fill phase and/or the aeration on/off cycle structure. In summary, the React Fill phase features a reactor that is always in a completely mixed condition that alternates between an aerobic and anoxic environment.

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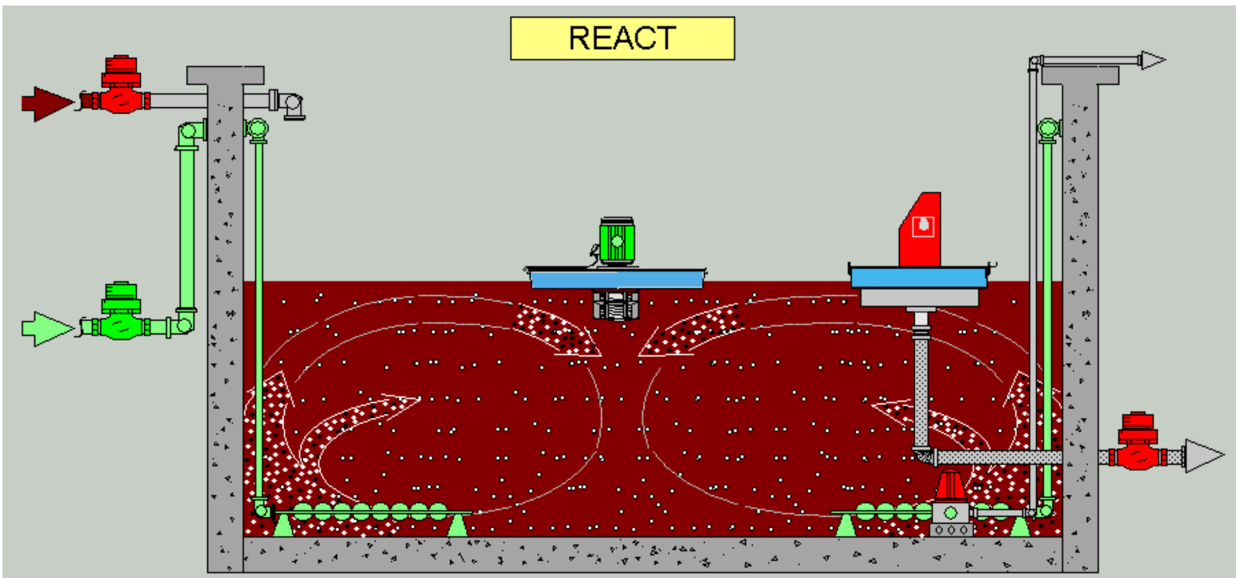
React Phase

During the React phase of operation, wastewater is not entering the reactor. The AquaDDM mixer continues to operate and completely mix the reactor, and the aeration system continues to be cycled on and off. This alternately creates aerobic and anoxic conditions. A schematic of this phase is shown in Figure 3.

React Phase (Figure 3)



Process Considerations	Mechanical Considerations
Alternating Aerobic/Anoxic Conditions	Mixer Operating
Complete Mix Conditions	Influent Valve Closed/Transfer Pump Off
"Polishing Off" BOD_5 and Total N	Aeration System On/Off
	Sludge Pump Off
	Decant Weir Closed

The importance of this phase should be recognized by the operator with respect to the "opportunity" that this phase provides to "reduce the concentration levels of all wastewater parameters without the influence of additional wastewater entering the reactor." In effect, the React phase provides a period of time in which wastewater contaminants are "polished off" to the desired or required concentration levels.

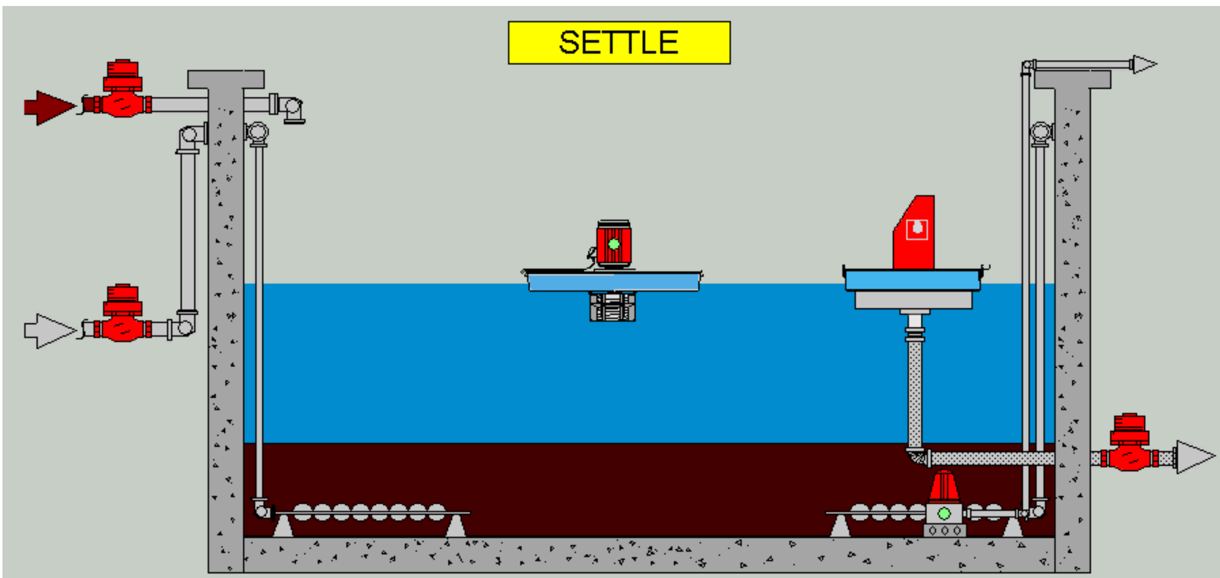
A profile of the soluble BOD_5 concentration in a reactor, as aeration phases occur, indicates a general decline in the amount of organic material present. The initiation of aeration at the start of the React Fill phase results in a gradual decline in BOD_5 concentration. By comparison, the rate of decline in the React phase (with the absence of any additional influent wastewater entering the reactor) is dramatically increased.

In summary, the React phase features a reactor that is always in a completely mixed condition which alternates between an aerobic and an anoxic environment. The absence of flow and organic loading provides a unique opportunity to "polish off" wastewater contaminants. This results in a reduction of organic material (BOD_5) and total nitrogen present in the reactor to very low effluent concentrations. Since the majority of the biological phosphorus removal normally will have already taken place during the React Fill phase, the React phase does not have a major effect on the effluent total phosphorus concentration.

Settle Phase

During the Settle phase, wastewater is not entering the reactor. Also, the AquaDDM mixer and the aeration system are both turned "off". The absence of flow, mixing, and aeration activity produces an ideal quiescent environment in the reactor for solids-liquid separation. Figure 4 shows the related process and mechanical considerations for this phase of operation.

Settle Phase (Figure 4)



Process Considerations	Mechanical Considerations
Quiescent Conditions	Mixer Off
Static Clarifier	Influent Valve Closed/Transfer Pump Off
Settling Biomass	Aeration System Off
	Sludge Pump Off
	Decant Weir Closed

At this point in time, the preceding phases have accomplished all of the process objectives related to the reduction of organic compounds (BOD_5), total nitrogen and total phosphorus. The reactor acts as a "static clarifier" as opposed to a "flow-through clarifier". Since there is no flow entering or exiting the reactor, the settling of solids is simply not affected by system hydraulics.

Furthermore, sludge is removed from the reactor by a stationary sludge pump after the completion of the Settle phase. Therefore, settling is not affected by any type of stirring action caused by a mechanical sludge collector. Such an ideal quiescent settling environment is unique to SBR systems.

Decant Phase

Following the treatment of a batch of wastewater and the subsequent solids-liquid separation achieved during the Settle phase, it is then necessary to remove approximately the same volume of liquid that entered the reactor during the Mix Fill and React Fill phases of operation.

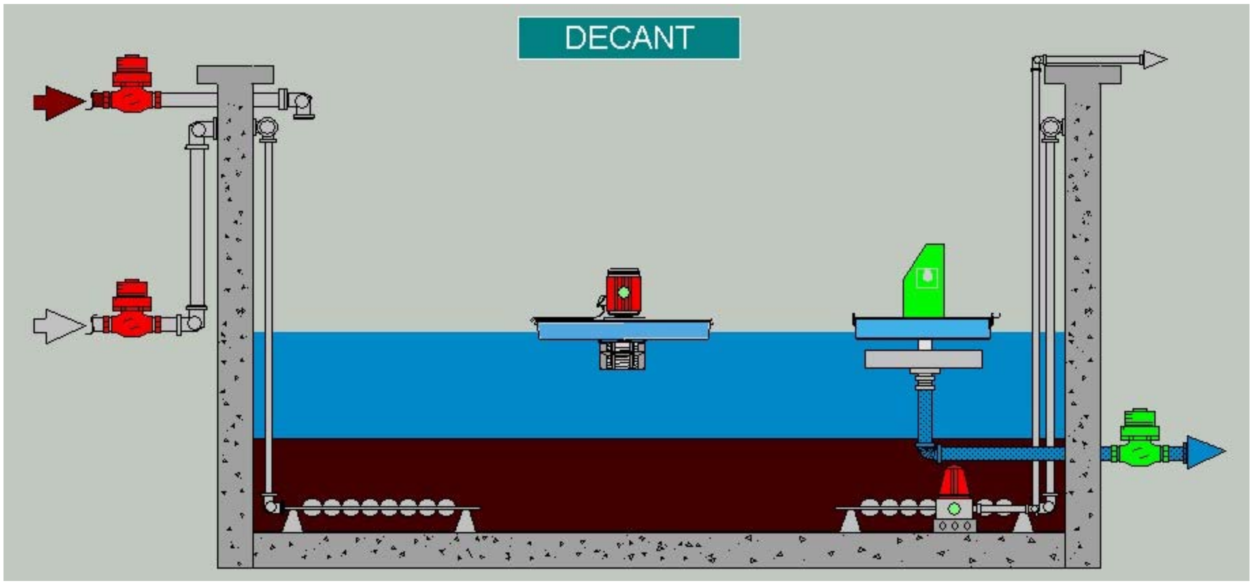
The AquaSBR accomplishes the removal of treated effluent with one or more floating decanters, which remain in the reactor at all times. The decanters are installed in a manner that permits them to rise and descend with the reactor water level during the Fill and Draw modes of operation. Each decanter unit features an outlet weir and discharge system that incorporates a positive seal prohibiting the entry of mixed liquor suspended solids during the mixed and aerated phases of operation.

At the completion of the Settle phase, an electrical signal from the system control panel initiates the opening of the decant weir and the effluent discharge valve.

The configuration of a weir suspended below a floating structure provides an effluent withdrawal point that is located just below the surface of the reactor. The positioning of this withdrawal point provides effluent from the uppermost region of the stratified reactor without allowing any surface scum or foam to be drawn into the effluent. The vertical distance from the top of the settled sludge layer to the effluent withdrawal point is also maximized.

As the Decant phase progresses, the decanter units maintain this optimum position of effluent withdrawal by simply floating on the surface and descending with the reactor water level. The Decant phase of operation is terminated at the predetermined minimum reactor water level that is controlled by a level sensor system. An electrical signal, prompted by the attainment of the minimum reactor water level, reverses the position of the decanter components by closing the effluent valve and sealing the decant weir against the bottom of the float structure. A schematic of the AquaSBR during this phase is shown in Figure 5.

Decant/Idle/Sludge Waste Phase (Figure 5)



Process Considerations	Mechanical Considerations
Quiescent Conditions	Mixer Off
Removing "Clear" Supernatant	Influent Valve Closed/Transfer Pump Off
Continue Settling	Aeration System Off
Removing Excess Biomass	Sludge Pump On
	Decant Weir Open

Once the reactor has been decanted to the design minimum side water depth (SWD), the Decant phase is automatically terminated. At this point, the decant valve and weir are automatically closed. If the minimum SWD is attained before the end of the programmed duration of this phase, the remaining time is utilized as the Idle phase.

Recognize that the time dedicated to the Decant phase represents an extension of the total time during which solids-liquid separation occurs in each reactor.

After the completion of the Settle phase, the mixer and aeration system are still inoperative and the quiescent conditions are maintained in the reactor as the Decant phase is initiated. The settled sludge mass is typically well below the reactor surface water level as the Decant phase starts, and sedimentation continues throughout the Decant phase.

Idle Phase

The Idle phase in an AquaSBR is a variable time period. The exact duration of the Idle phase is dependent upon specific hydraulic aspects of the treatment system. The AquaSBR system is designed on the basis of two distinct volume increments in each reactor. These two volume increments are defined as the "react volume" and the "maximum decant volume".

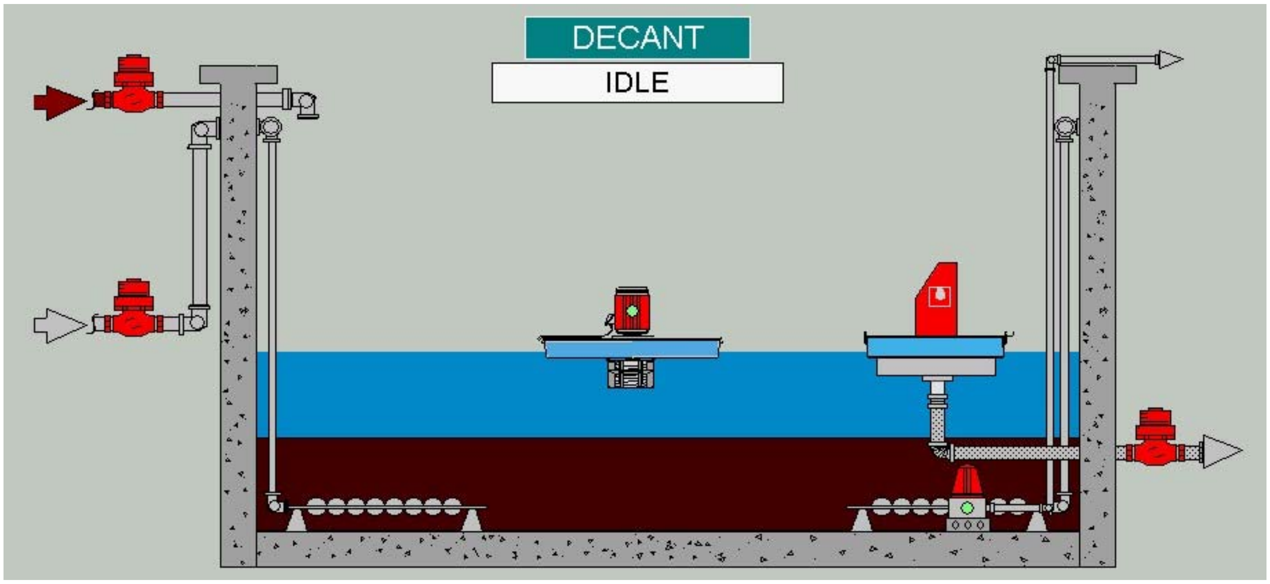
The react volume is the volume present in a reactor at the predetermined minimum reactor side water depth (SWD). The maximum decant volume is the volume represented by the difference between the minimum and maximum side water depths. The maximum decant volume is established in the design as the reactor volume required to receive the maximum design flow sustained throughout a single treatment cycle.

The decanter is appropriately sized (in terms of the decant weir diameter and the outlet piping and valving) to discharge the maximum decant volume over the entire duration of the Decant phase. At system flow rates significantly less than the design maximum value, each reactor will receive less than the maximum decant volume. However, the effluent will still be decanted at approximately the design discharge flow rate.

The volume received in one cycle (at less than the maximum design flow rate) will therefore be discharged over a time period that is less than the programmed duration of the Decant phase. The minimum water level sensor will terminate the decant cycle at the pre-set minimum SWD, regardless of the volume received per treatment cycle during the Fill phases of operation. At this point, the timer within the AquaSBR control system will continue to operate for the entire programmed duration of the Decant phase. The Idle phase is then the resultant time increment between the time of decant termination by the level sensor and the termination of the programmed duration of the Decant phase. As the description implies, the reactor simply remains in an idle mode with all mechanical systems being inoperative.

With respect to process considerations, the reactor is in a stratified condition and wastewater is not entering the reactor. Process and mechanical considerations of the AquaSBR during this phase of operation are shown in Figure 6.

Idle Phase (Figure 6)



Process Consideration	Mechanical Considerations
Quiescent Conditions	Mixer Off
	Influent Valve Closed/Transfer
	Pump Off
	Aeration System Off
	Sludge Pump Off
	Decant Weir Closed

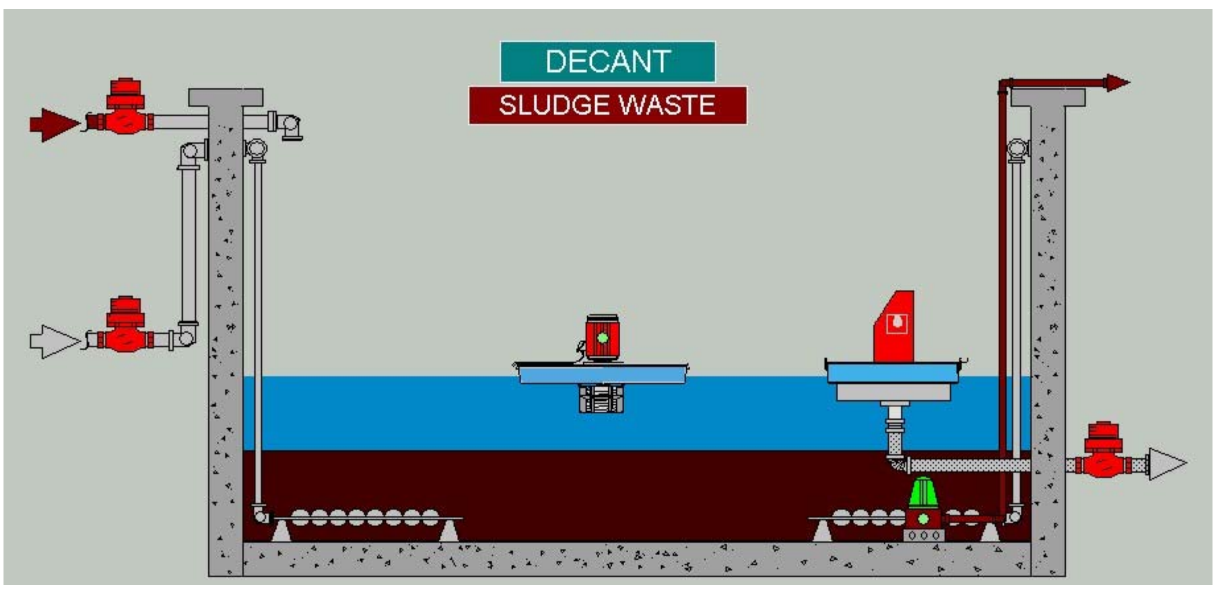
In summary, a description of the Idle phase is dependent upon related factors that affect this phase of operation. It is a necessary phase of operation when a treatment system is required to treat variable hydraulic loading rates on a pre-set time cycle basis of operation.

Waste Sludge Phase

AquaSBR systems, like other activated sludge process variations, are dependent upon the development of a mixed culture of bacteria and other microbial life forms to accomplish treatment objectives. As a result of the biological degradation of organic matter and the accumulation of inert material present in most wastewaters, it is necessary to discharge certain quantities of solids from the reactors in order to maintain an appropriate concentration of mixed liquor suspended solids (MLSS) in the reactor, and to control the sludge age. This phase of operation within the treatment cycle is designed as a time increment that occurs simultaneously with the Decant/Idle phase.

The programmable logic controller (PLC) is programmed to initiate the Waste Sludge phase during the final minutes of the Decant/Idle phase. At this time, the reactor is in a stratified condition, and one or more solids handling pumps are removing settled sludge from the bottom of the reactor. Since waste sludge solids concentration levels are typically in the range of 0.75% to 1.25%, the sludge remains in a fluid condition throughout a typical waste sludge pumping cycle.

Waste Sludge Phase (Figure 7)



AquaSBR® Sequencing Batch Reactor Advantages

The AquaSBR System:

Sequencing Batch Reactor systems represent a variation of the activated sludge process. Like any other activated sludge process, the AquaSBR® Sequencing Batch Reactor system works by developing a mixed culture of bacteria, which is effective in removing BOD, COD and nutrients found in wastewater.

The AquaSBR can treat a wide range of domestic and industrial wastewaters, at flows ranging from a few hundred cubic meters to thousands of cubic meters per day.

Because the AquaSBR operates in a true batch treatment mode, optimum effluent quality is obtained during each cycle. Only a fraction of the total reactor volume, typically 1/6th, is introduced into the reactor each cycle. This raw flow combines with the acclimated biomass, which remains in the reactor at all times.

The ratio of raw flow to biomass is a key factor in obtaining desired effluent quality results in a sequencing batch reactor system. Since only a small amount of sludge is wasted each cycle, the quality of the biomass is always maintained.

A true batch reactor system, like the AquaSBR, does not allow influent wastewater to enter the sequencing batch reactor during final react, settle and decant phases, thereby assuring an excellent quality of final effluent.

The AquaSBR System Advantages:

The AquaSBR is operated in a true batch reactor treatment mode, which does not allow wastewater to enter the reactor during the React, Settle and Decant phases. The system:

- Tolerates variable hydraulic loads – mixed liquor solids cannot be washed out by hydraulic surges since effluent withdrawal is typically accomplished in a separate phase following the termination of flow to each reactor.
- Tolerates variable organic loads – each influent liquid batch is diluted with the reactor contents from the previous cycle.
- Controls filamentous growth – filamentous organisms are controlled by creating an anoxic condition during the initial fill phase.

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- Provides ideal quiescent settling – since there is no flow during settling, and no mechanical sludge collection device stirring the basin, ideal quiescent settling conditions exist.

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The AquaSBR Process Features:

Peak Design Flow

The AquaSBR maintains predetermined cycle times, even at peak daily flow conditions. Cycle integrity is maintained at all flows up to and equal to maximum design flows. There is no cycle advancement up to the maximum design flow which eliminates the possibility of filling and decanting at the same time. Cycle advancement reduces the treatment time and the ability to meet the effluent objectives and filling and decanting is similar to clarifier washout where solids in the basin are carried out through the discharge along with raw sewage as it enters the basin.

Separation of Aeration & Mixing

Aeration – Aeration will be provided by a Diffused aeration system or Aqua-Jet aerators.

Mixing – The separation of aeration from mixing is essential to the success of a sequencing batch reactor system especially for nutrient removal applications.

The floating direct drive AquaDDM mixer provides a powerful downflow discharge for maximum solids suspension and aeration enhancement throughout the basin. Mixing efficiency can be double that of jet mixers or submerged horizontal mixers. The use of the AquaDDM mixer enables the AquaSBR to be operated for nutrient removal and to control filamentous organisms by providing a mixed, non-aerated anoxic environment during selected phases of operation.

Aeration cycling during the reaction period without the loss of a completely mixed basin alternates the basin environment between aerobic and anoxic conditions essential for nutrient removal.

The entire basin is used as an anoxic reactor maximizing the efficiency of the system. Separate zones sectioned off using baffles or walls or separate basins are not required. In addition, the need for recycle pumping (RAS) and the difficulties associated with controlling RAS pumps and rates are eliminated.

Retrievable & Accessible Components

The AquaSBR is designed to minimize operation and maintenance. The majority of the components in the AquaSBR design are accessible from the side of the tank. If total accessibility without tank dewatering is required, this can be obtained by using a retrievable diffuser option, which is an available option.

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Aqua-Aerobic Decanter System

This positively sealed effluent decanter system incorporates several mechanical design features and a mode of operation that results in optimum performance. This design assures that sub-surface withdrawal of supernatant will always be extracted from the reactor at an adequate depth, and within the diameter of the floating structure, to avoid drawing surface material into the effluent flow. At no time does the decanter have to pass through the reactor water surface where scum and floating material can accumulate.

The need to eliminate the layer of scum sometimes found on the surface of activated sludge systems is not crucial to a clear discharge from the Aqua-Aerobic decanter. The float of the decanter prevents any floating material from entering the central chamber of the unit, so there is no impact of any floating material. In addition, the design decanter entrance velocities prohibit the entrainment of surface liquid. Therefore, the need for additional equipment to remove scum is not required.

Aqua-Aerobic Manufactured

All critical components of the AquaSBR are designed and manufactured by Aqua-Aerobic Systems, Inc., a leader in the wastewater treatment industry for more than **35** years.

Consistent Effluent Quality

The use of microprocessors allow the operator to adjust time and/or aeration and mixing based on organic loads and flow conditions to achieve required results.

PLC-Based Control System

The AquaSBR control system is a timer-based system with level overrides. This system provides control, sequence monitoring, and annunciation capabilities, and is designed to focus on an operating strategy to optimize the biological treatment process, while minimizing required operator attention.

Operation & Process Description

The AquaSBR acts as an equalization basin, aeration basin, and clarifier within a single reactor. The termination of flow during the treatment process provides perfectly quiescent settling conditions in the reactor, and permits even very fine particles to settle. Each reactor maintains its own treatment regime and all phases of treatment occur in each reactor for the full cycle time at flow up to the maximum design flow.

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Fill Phases

1. **Mixed Fill –** Influent enters the AquaSBR reactor. Complete mix of the reactor contents is achieved without the use of aeration. This phase assists in control of filamentous organisms and biomass conditioning. The entire basin is used and no RAS required.
2. **React Fill –** Influent flow continues under mixed and aerated conditions. Aeration may be intermittent to promote aerobic or anoxic conditions. Nitrification and denitrification can be achieved. The separation of aeration and mixing allows energy control and anoxic conditions without the loss of a completely mixed system.

Non-Fill Phases

1. **React –** Influent flow is terminated, while mixing and aeration continue. Intermittent operation of the aeration system may continue to complete the nitrification/denitrification process, or to conserve energy.
2. **Settle –** Mixing and aeration cease. Solids/Liquid separation takes place under perfectly quiescent conditions.
3. **Decant/Sludge Waste –** The mixer and aeration system remain off and, at this time, the decantable volume is removed by means of subsurface withdrawal. The reactor is immediately ready to receive the next batch of raw influent. A small amount of sludge is wasted each cycle.

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Process and Mechanical Advantages

The AquaSBR System supplied by Aqua-Aerobic Systems exhibits significant process and mechanical advantages offering mechanical reliability and overall flexibility for the AquaSBR System. The major areas where the AquaSBR System is superior are described below.

Decanter and Decant System Design

The AquaSBR employs a floating decanter which is provided with a circular stainless steel weir to minimize overflow velocities. The major advantages of the decanter and decant system are as follows:

A. The reduced flow velocities result in reduced carryover of suspended solids to downstream units when compared to fixed decanter system or an adjustable decant pipe. In addition, the positive seal between the weir and float assembly assures no leakage during non-decant periods.

B. Carryover of floatable materials during the decant cycle is virtually eliminated due to the submerged weir and the float assembly which maximizes the separation between the water surface and the discharge entrance point. Utilization of a fixed decanter or decanter which is lowered into the basin at the start of the decant cycle can result in the carryover of floatables to downstream units. Other SBR systems may provide for a skimming tank upstream of the SBR basin to entrap floatables, or decant the initial flow back to the plant headworks, thereby increasing the solids and organic loading and complicating the control system.

C. The AquaSBR System is provided with an electrically operated control valve on the decant line to throttle the initial decant flow to acceptable levels, thereby eliminating the possibility of high flow velocities disturbing the settled sludge blanket. This valve also serves as a backup to the positive seal on the decanter in the unlikely event of a decanter malfunction.

D. The decanter is provided with a single motor actuator with only one moving part. This is the most mechanically reliable decanter currently manufactured. Freezing problems are eliminated, as the entire weir assembly is submerged, whereas the use of a removable decanter during extended periods of cold weather can result in icing and freezing problems. Complicated control equipment such as inverters are not required.

Aqua MixAir® Aeration System

The AquaSBR System is provided with a downdraft mixer to allow separation of the power required for mixing and oxygen transfer. The major advantages of the Aqua MixAir® Aeration System are as follows:

A. The AquaSBR basin is operated in a completely mixed mode, thereby providing increased process reliability and flexibility when compared to plug flow systems. Complete mix systems provide stable operation over a wide range of organic and hydraulic loadings due to the ability of the influent load to be dispersed uniformly throughout the tank.

B. Utilization of the mixer provides for higher basin MLSS concentrations to be maintained, thereby resulting in reduced waste sludge quantities due to the lower food-to-microorganism ratio maintained. The higher solids levels also provide for a greater quantity of biomass which is available to absorb higher organic loadings. Operation of the AquaSBR System at these higher MLSS concentrations offers increased design flexibility and conservatism.

C. A significant savings in power costs may be expected due to the ability of the Aqua MixAir Aeration System to maintain solids in suspension during periods of low organic loading, as the air blowers may be throttled to levels normally below those required to maintain solids in suspension.

D. Air flow rates may be varied to match oxygen demand, thereby eliminating the potential for over-aeration of the mixed liquor, which can result in problems with sludge settleability and the carryover of suspended solids to downstream units. In addition to this important process advantage, the MixAir system will reduce annual power costs as discussed above. The MixAir concept is particularly advantageous for projects where low flows are anticipated in the early years of operation, where significant over-aeration could occur with conventional aeration systems.

E. The most important factor involved with the consistently successful operation of the SBR process is the ability to mix the basin efficiently, thereby assuring uniform organic and dissolved oxygen concentrations are maintained throughout the basin. The AquaDDM mixer supplied with the AquaSBR System provides for entrained flow rates up to 35 times greater than direct pumping rates, thereby ensuring a completely mixed basin at all times. Systems relying on diffused aeration or jet aeration systems for mixing are far less efficient in terms of mixing capabilities, flexibility and power requirements.

F. During periods when the AquaDDM mixer is in operation, floatable materials and scum are directed into the flow path and re-entrained into the mixed liquor.

G. Depending upon the type and arrangement of the aeration piping and diffusers, oxygen transfer rates may be enhanced up to 25 percent over comparable diffused air systems when the AquaDDM mixer is employed, resulting in a further reduction of annual power costs.

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H. Anoxic conditions which develop during the Mixed Fill cycle using the AquaDDM mixer without aeration have been demonstrated to markedly reduce the potential for the proliferation of filamentous organisms which adversely affect sludge settling characteristics. Other SBR Systems either provide for Mixed Fill cycles with reduced airflow rates which still adds oxygen to the system, separate anoxic “zones” with inadequate mixing and recycle or inefficient jet mixing systems. These approaches will not provide the same reliability and flexibility in controlling filamentous bacteria.

I. During operation in the nitrification/denitrification mode where the aeration blowers may be cycled to maintain optimum process conditions, the AquaDDM mixer has been demonstrated to reduce by up to 75 percent the time required to bring the basin dissolved oxygen concentration back to operating levels when compared to an aeration system not using the AquaDDM mixer. Similar performance has also been experienced at the end of the Mixed Fill Cycle or after a long idle period. This rapid oxygen level recovery period assures optimum treatment by allowing essentially the entire React Fill and React cycles to be provided with adequate dissolved oxygen levels.

Low-Load System Design

Where effluent limits dictate, the AquaSBR System may be designed for a low food-to-microorganism ratio and high mixed liquor concentration to achieve biological phosphorus and nitrogen removal. Specific advantages of the low-load design include:

A. Increased process reliability and flexibility due to high MLSS concentrations, as previously discussed.

B. The AquaDDM mixer provides the capability to manipulate the reactor environment during appropriate phases of a treatment cycle to achieve biological removal of phosphorus and nitrogen.

C. The inherent design of the AquaSBR low-load system provides for some degree of denitrification during the Mixed Fill cycle when anoxic conditions are developed. During the React Fill and React periods, the use of the MixAir system allow environment manipulation and flexibility for the formation nitrates through nitrification and the removal of nitrates through denitrification.

D. No license fees or royalties of any kind are charged by Aqua-Aerobic Systems for the use of Aqua-Aerobic Systems’ low-load biological phosphorus and nitrogen removal system.

E. The AquaSBR System design provides for adequate basin volume to store the maximum design flow rate during the time that the other basin is completing the React, Settle, and Decant phases of operation. This design basis assures that treatment cycle times are not shortened unless the maximum design flow to the system is exceeded. This assures the absolute highest quality effluent is produced over a wide range of flow and loading conditions. In contrast, other SBR system suppliers may provide a reduced basin volume, with cycle times shortened when peak flow rates exceed average levels.

F. The AquaSBR System is controlled by an operator-friendly microprocessor control system, in which the process variables may be easily changed to match flow or loading conditions. Time control of the operating cycle duration is provided to maximize operating efficiency, with float switches provided in the AquaSBR basin to override the time controls in the event peak flow rates are exceed for extended periods of time.

AQUA-AEROBIC SYSTEMS, INC.

Estimated Operation & Maintenance Costs
for Whitefish MT 113827
Design No. 141346 dated 08-17-2015

Qty	Unit	Service Required	Cost/Unit	1 Year	3 Year	5 Year
2	SBR P.D. Blower*	Oil Change 4/year	$ 50.00	$ 400.00		
2	SBR P.D. Blower*	Replace Inlet Air Filter Elements: One/6 months	$ 80.00	$ 320.00		
2	SBR P.D. Blower*	Belt replacement: One/5 years	$ 236.00			$ 472.00
2	SBR P.D. Blower*	P.D. Blower repair kit: One/5 Years	$ 1,135.00			$ 2,270.00
2	SBR Decanter	Replace:Actuator,Capacitor,Limit Switch/3 years	$ 719.00		$ 1,438.00	
2	SBR D.O. Sensors	Replace: sensor head one/year	$ 126.00	$ 252.00		
900	SBR FB Diff. Membranes	25% Diffuser membrane replacement/5 years	$ 31.00			$ 6,975.00
2	SBR Sludge Pump	Repair kit	$ 451.00			$ 902.00
1	Stand-by P.D. Blower*	Oil Change 4/year	$ 50.00	$ 200.00		
1	Stand-by P.D. Blower*	Replace Inlet Air Filter Elements: One/6 months	$ 80.00	$ 160.00		
1	Stand-by P.D. Blower*	Belt replacement: One/5 years	$ 236.00			$ 236.00
1	Stand-by P.D. Blower*	P.D. Blower repair kit: One/5 Years	$ 2,941.00			$ 2,941.00
1	Controller	Replace Relays, Switches, Fuses /Year	$ 50.00	$ 50.00		
1	Controller	Replace Microprocessor Battery One/3 Years	$ 26.00		$ 26.00	

	1 Year	3 Year	5 Year
EQUIPMENT TOTALS:	**$ 1,382.00**	**$ 1,464.00**	**$ 13,796.00**

Power Costs of all equipment as proposed: **

2,241 = Kilowatt hours/day — Estimated $/kwhr $ 0.08 — **$ 65,431**

Estimated General Operation & Maintenance***

34.9 = Man Hours/week for Process Testing

6 = Man Hours/week for General Plant Cleanup and Routine Maintenance

Notes

* Stand-by blower unit included in estimate for budget purposes. Maintenance costs of stand-by unit may be reduced based upon the actual hours of operation.

** This is based upon operation at 100% of design conditions.

***The values listed are for estimating purposes only. The actual amount of operator attention provided will be dependent upon local requirements and the size of the staff available for testing.

All estimates are based upon equipment maintenance and operation in accordance with the O & M instructions provided by Aqua-Aerobic Systems. They are based on typical SBR Installations with a normal preventative maintenance schedule for the equipment. The actual maintenance man hours required for each project will vary depending upon site and climate conditions, which may alter the frequency of the maintenance schedule.

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AQUA-AEROBIC SYSTEMS, INC.

Estimated Operation & Maintenance Costs
for Whitefish MT 113827
Design No. 141346 dated 08-17-2015

Qty	Unit	Service Required	Cost/Unit	1 Year	3 Year	5 Year
1	Digester P.D. Blower*	Oil Change 4/year	$ 50.00	$ 200.00		
1	Digester P.D. Blower*	Replace Inlet Air Filter Elements: One/6 months	$ 80.00	$ 160.00		
1	Digester P.D. Blower*	Belt replacement: One/5 years	$ 236.00			$ 236.00
1	Digester P.D. Blower*	P.D. Blower repair kit: One/5 Years	$ 2,941.00			$ 2,941.00
1	Digester Sludge Pump	Repair kit	$ 451.00			$ 451.00

		1 Year	3 Year	5 Year
EQUIPMENT TOTALS:		**$ 360.00**	**$ -**	**$ 3,628.00**
Power Costs of all equipment as proposed: **				
1,347 = Kilowatt hours/day	Estimated $/kwhr $ 0.08	**$ 39,325**		

Notes

* Stand-by blower unit included in estimate for budget purposes. Maintenance costs of stand-by unit may be reduced based upon the actual hours of operation.

** This is based upon operation at 100% of design conditions.

All estimates are based upon equipment maintenance and operation in accordance with the O & M instructions provided by Aqua-Aerobic Systems.
They are based on typical SBR Installations with a normal preventative maintenance schedule for the equipment. The actual maintenance man hours required for each project will vary depending upon site and climate conditions, which may alter the frequency of the maintenance schedule.

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Preliminary Manufacturer's

Design Report

Fluidyne SBR

Anderson~Montgomery
CONSULTING ENGINEERS

FLUIDYNE
CORPORATION
5436 Nordic Drive, Suite D Cedar Falls, IA 50613
Phone: (319) 266-9967 Fax: (319) 277-6034
http://www.fluidynecorp.com

PROPOSAL

FLUIDYNE CORPORATION (HEREINAFTER CALLED THE COMPANY) AGREES TO SELL TO THE PURCHASER AND THE PURCHASER AGREES TO BUY AND ACCEPT FROM THE COMPANY, THE ITEM (S) DESCRIBED HEREIN.

PROJECT: **Whitefish, Montana**
Sequencing Batch Reactor

PROPOSAL NO.: FLC 032916

DATE WRITTEN: April 8, 2016

WRITTEN BY: ERICK MANDT
FLUIDYNE CORPORATION
CEDAR FALLS, IOWA

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406-850-0030 Cell, 303/380-0664 fax

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(319) 266-9967

PROPOSAL NO.: FLC 032916
PROJECT: Whitefish,Montana
DATE: April 8, 2016

Fluidyne is pleased to submit our proposal for the supply of our Sequencing Batch Reactor Equipment for the Whitefish, Montana Wastewater Treatment Plant. Fluidyne has based their design on the following influent information:

	2013	2015	2020	2025	2035
Planning Area	11,230	11,661	12,812	14,076	16,992
Connected Pop.	7,736	8,033	8,826	9,697	11,705
Ultimate Buildout - 36,929					
Qavg (mgd)	0.996	1.034	1.136	1.248	1.507
Qwet weather	1.195	1.241	1.363	1.498	1.808
Qmax day		4.266	4.342	4.355	4.53
AVG BOD (lbs/day)	2467.8	2562.5	2815.4	3093.3	3734.0
MAX BOD	3289.6	3415.8	3753.0	4123.4	4977.4
TSS (lbs/day)	1980.4	2056.4	2259.4	2482.4	2996.5
Ammonia (lbs/day)	208.9	216.9	238.3	261.8	316.0
Phosphorous (lbs/day)	49.83	51.74	56.85	62.46	75.40
	Dec	Jan	Feb	Mar	Apr
Avg Influent Temp	9.5	8.8	8.1	8.2	9.2
Avg Alkalinity	266 mg/l				

The required monthly average effluent limits are:

CITY OF WHITEFISH
MPDES Permit MT #0020184
Wastewater Effluent Standards (effective Aug 1, 2015)

Parameter	Units	Avg. Month	Avg. Week	Max Day
5-Day Biochemical Oxygen Demand (BOD_5)	*mg/L*	30	45	--
	lb/day	313	676	--
	% Removal	85%	--	--
Total Suspended Solids (TSS)	*mg/L*	30	45	--
	lb/day	313	676	--
	% Removal	85%	--	--
pH	*SU*	6.0 -9.0		
Ammonia, Total as N	*mg/L*	9.6	--	17.7
Total Nitrogen- summer	*lb/day*	176	--	--

Total Nitrogen- winter	*lb/day*	273	--	--
Total Phosphorus (TP) -year-round	*mg/L*	1.0	--	--
	lb/day	10.4	--	--

Performance assumes proper operation and maintenance. Chemical additional provided by others will be required for the phosphorous requirement.

Fluidyne has looked at both a two tank and three tank SBR. Both options are presented below:

OPTION # 1 - Two Tank SBR - Each tank at 140' X 55' X 20' SWD.

Fluidyne proposes to supply the following equipment:

Influent Control Valves and Actuators

Two (2) 12" Diameter DeZURIK Flanged Eccentric Plug Valve Model PEC, Cast Iron body, bonnet and plug, NBR stem packing, Cr Plug Facing with AUMA Electric Actuator, 120 VAC single phase, NEMA 4X/6. With integral AUMA Matic Motor Controls.

Influent Diffuser Baffles:

Two (2) Fluidyne model# FID-24 304 Stainless Steel Influent Baffles with flanged connection to the vertical tank wall.

Jet Aeration

Two (2) 47 HP Submersible Jet Motive/Recirculation Pumps with Class 1, Division 1, 460/3/60 explosion proof motor and 49' of power cable. Accessories include a straight through discharge connection fitting, lifting bail, stainless steel grab link lifting assembly, 2" diameter stainless steel guide rails, and seal failure module to be mounted in the SBR control panel.

One (1) Shelf Spare 47 HP Submersible Jet Motive/Recirculation Pump with 49' of power cable.

Two (2) Fluidyne model# BDM2JA28 Jet Aeration Headers including all in-basin liquid piping, submerged air piping and standard stainless steel supports. Air piping to terminate with a flange connection just above top water level to mate to the contractor supplied air distribution piping. Liquid piping to terminate with a flange connection to mate to the jet mixing pump discharge connection. The jet aeration and mixing manifold including the nozzle assemblies are fabricated out of minimum schedule 10 304 stainless steel.

Two (2) 8” Diameter Pneumatic Backflush Systems including 8” diameter 304 stainless steel riser piping with flange connections, riser pipe supports and 8” manually operated DeZURIK back-flush plug valve.

One (1) Lot 304 Stainless Steel Anchor bolts for all in-basin supplied supports.

Decanting

Two (2) Fluidyne model #DSED-20 Decanters fabricated out of 304 stainless steel with all in-basin piping and supports. Decanter to terminate with a 16” flange connection to mate to the tank wall spool flange.

Two (2) 1” Electric Operated Decant Vent Valves in NEMA 4 Weatherproof Enclosure.

Two (2) 16” Diameter DeZURIK Effluent Control Flanged AWWA Butterfly Valve, AWWA, Class 150B, Cast Iron Body & Disc, 304 SS Shaft 315 SS disc edge, with AUMA Electric Actuator, 120 VAC single phase, NEM 4X/6, with integral AUMA Matic Motor Controls.

Waste Activated Sludge Pumping.

Two (2) 5 HP Submersible Waste Sludge Pumps with Class 1, Division 1, 460/3/60 explosion proof motor and 49’ of power cable. Accessories include an elbow discharge connection fitting, lifting bail, stainless steel grab link lifting assembly, 2” diameter stainless steel guide rails, and seal failure module to be mounted in the SBR control panel.

Positive Displacement Blowers

Three (3) 75 HP Positive Displacement Blower packages with premium efficiency motor, v-belt drive, automatic belt tensioner, belt guard, vibration isolators, oil drains, inlet filter/silencer, discharge silencer, pressure relief valve, check valve, lifting lugs, sound enclosure, ventilating fan, fabricated steel base, and oil level monitor. **One blower package is a spare.**

Controls:

One (1) SBR Control Panel housed in NEMA 12 enclosure as follows:

SBR Control Panel
Enclosure: NEMA 12 Painted Steel
Approx. size: 60”H x 36”W x 12”D, Single Door, 3-pt Latch
Floor Mounted with 12” Leg Stand Kit
Service Voltage: 120Vac, 1-Phase

UL 508A Listed
Containing the following Equipment:
(4) 1-Pole 15A Circuit Breakers
UPS/Control Power, Valve Power, DO Analyzer Power, Convenience Receptacle
(1) Interior Light Fixture with door activated switch
(1) 120vac Surge Arrestor for UPS/Control Power Circuit
(1) Grace Port Door mount Ethernet Port and Convenience Receptacle
(1) UPS Receptacle
(1) 1000VA UPS
(1) 24Vdc Power Supply
(1) Allen Bradley 1769-L33ER CompactLogix Processor
(1) Allen Bradley 1769-PA4 Rack Power Supply
(3) Allen Bradley 1769-IA16 120vac Input Modules
(2) Allen Bradley 1769-OW16 Relay Output Modules
(1) Allen Bradley 1769-IF8 Analog Input Module
(1) Allen Bradley 1769-ECR Rack End Cap
(1) Allen Bradley PanelView Plus 6 1000, 10" Color Touch Screen
(1) Phoenix 5-port Ethernet Switch
(1) Alarm Strobe Light (Mounted on top of enclosure)
Door Mounted Pilot Devices (22mm Devices)
(1) Alarm Acknowledge Pushbutton
(4) On – Off - Auto 3-position Selector Switches
(10) Open – Auto – Close 3-position Selector Switches
(4) Green Pilot Lights (Running)
(10) Blue Pilot Lights (Valve Closed)
(10) White Pilot Lights (Valve Open)
(4) Overtemp/Seal Fail Pump Modules
(1) Dual-Channel Intrinsically Safe Barrier for float switches
(2) Analog Signal Intrinsically Safe Barrier
700-HA32A1-3 relays with bases.
(lot) Miscellaneous Materials, Terminal Blocks, and Fuses Blocks as required
(lot) Engraved Name Plates as required.

Instrumentation:

One (1) YSI System 2020 XT - 20 Channel Terminal/Controller with 3 Current Outputs, 3 Relay outputs, complete with power supply 100-240 VAC & USB interface. 5 IQ Sensor Net Connections with passive Junction Box IQ with 4 IQ Sensor Net Connections and IQ Sun Shield, and rail mounting kit.

Two (2) Optical DO Sensor for IQ System, 0-20.00 mg/l with required SACIQ cable assembly and handrail mounting kit.

Two (2) Suspended Solids Sensor for IQ System, with required SACIQ cable assembly and adaptor. One unit to be mounted in each SBR basin.

Two (2) Submersible Level Transducers with 30' of cable for 4-20 mA signal.

Two (2) High Water Level Float Level Sensors with support bracket. One is for each SBR.

The price for this equipment including freight and service is $ 685,000

OPTION # 2 – Three Tank SBR - Each tank at 102' X 50' X 20' SWD.

Fluidyne proposes to supply the following equipment:

Influent Control Valves and Actuators

Three (3) 12" Diameter DeZURIK Flanged Eccentric Plug Valve Model PEC, Cast Iron body, bonnet and plug, NBR stem packing, Cr Plug Facing with AUMA Electric Actuator, 120 VAC single phase, NEMA 4X/6. With integral AUMA Matic Motor Controls.

Influent Diffuser Baffles:

Three (3) Fluidyne model# FID-24 304 Stainless Steel Influent Baffles with flanged connection to the vertical tank wall.

Jet Aeration

Three (3) 28 HP Submersible Jet Motive/Recirculation Pumps with Class 1, Division 1, 460/3/60 explosion proof motor and 49' of power cable. Accessories include a straight through discharge connection fitting, lifting bail, stainless steel grab link lifting assembly, 2" diameter stainless steel guide rails, and seal failure module to be mounted in the SBR control panel.

One (1) Shelf Spare 28 HP Submersible Jet Motive/Recirculation Pump with 49' of power cable.

Three (3) Fluidyne model# BDM2JA20 Jet Aeration Headers including all in-basin liquid piping, submerged air piping and standard stainless steel supports. Air piping to terminate with a flange connection just above top water level to mate to the contractor supplied air distribution piping. Liquid piping to terminate with a flange connection to mate to the jet mixing pump discharge connection. The jet aeration and mixing manifold including the nozzle assemblies are fabricated out of minimum schedule 10 304 stainless steel.

Three (3) 6” Diameter Pneumatic Backflush Systems including 6” diameter 304 stainless steel riser piping with flange connections, riser pipe supports and 6” manually operated DeZURIK back-flush plug valve.

One (1) Lot 304 Stainless Steel Anchor bolts for all in-basin supplied supports.

Decanting

Three (3) Fluidyne model #DSED-15 Decanters fabricated out of 304 stainless steel with all in-basin piping and supports. Decanter to terminate with a 16” flange connection to mate to the tank wall spool flange.

Three (3) 1” Electric Operated Decant Vent Valves in NEMA 4 Weatherproof Enclosure.

Six (6) 12” Diameter DeZURIK Effluent Control Flanged AWWA Butterfly Valve, AWWA, Class 150B, Cast Iron Body & Disc, 304 SS Shaft 316 SS disc edge, with AUMA Electric Actuator, 120 VAC single phase, NEM 4X/6, with integral AUMA Matic Motor Controls.

Waste Activated Sludge Pumping.

Three (3) 3 HP Submersible Waste Sludge Pumps with Class 1, Division 1, 460/3/60 explosion proof motor and 49’ of power cable. Accessories include an elbow discharge connection fitting, lifting bail, stainless steel grab link lifting assembly, 2” diameter stainless steel guide rails, and seal failure module to be mounted in the SBR control panel.

Positive Displacement Blowers

Four (4) 50 HP Positive Displacement Blower packages with premium efficiency motor, v-belt drive, automatic belt tensioner, belt guard, vibration isolators, oil drains, inlet filter/silencer, discharge silencer, pressure relief valve, check valve, lifting lugs, sound enclosure, ventilating fan, fabricated steel base, and oil level monitor. **One blower package is a spare**.

Controls:

One (1) SBR Control Panel housed in NEMA 12 enclosure as follows:

SBR Control Panel
Enclosure: NEMA 12 Painted Steel
Approx. size: 72”H x 36”W x 12”D, Single Door, 3-pt Latch
Floor Mounted with 12” Leg Stand Kit
Service Voltage: 120Vac, 1-Phase,
UL 508A Listed

Containing the following Equipment:
(4) 1-Pole 15A Circuit Breakers
UPS/Control Power, Valve Power, DO Analyzer Power, Convenience Receptacle
(1) Interior Light Fixture with door activated switch
(1) 120vac Surge Arrestor for UPS/Control Power Circuit
(1) Grace Port Door mount Ethernet Port and Convenience Receptacle
(1) UPS Receptacle
(1) 1000VA UPS
(1) 24Vdc Power Supply
(1) Allen Bradley 1769-L33ER CompactLogix Processor
(1) Allen Bradley 1769-PA4 Rack Power Supply
(4) Allen Bradley 1769-IA16 120vac Input Modules
(3) Allen Bradley 1769-OW16 Relay Output Modules
(1) Allen Bradley 1769-IF8 Analog Input Module
(1) Allen Bradley 1769-ECR Rack End Cap
(1) Allen Bradley PanelView Plus 6 1000, 10" Color Touch Screen
(1) Phoenix 5-port Ethernet Switch
(1) Alarm Strobe Light (Mounted on top of enclosure)
Door Mounted Pilot Devices (22mm Devices)
(1) Alarm Acknowledge Pushbutton
(6) On – Off - Auto 3-position Selector Switches
(15) Open – Auto – Close 3-position Selector Switches
(6) Green Pilot Lights (Running)
(10) Blue Pilot Lights (Valve Closed)
(10) White Pilot Lights (Valve Open)
(6) Overtemp/Seal Fail Pump Modules
(2) Dual-Channel Intrinsically Safe Barrier for float switches
(3) Analog Signal Intrinsically Safe Barrier
700-HA32A1-3 relays with bases.
(lot) Miscellaneous Materials, Terminal Blocks, and Fuses Blocks as required
(lot) Engraved Name Plates as required.

Instrumentation:

One (1) YSI System 2020 XT - 20 Channel Terminal/Controller with 3 Current Outputs, 6 Relay outputs, complete with power supply 100-240 VAC & USB interface. 5 IQ Sensor Net Connections with passive Junction Box IQ with 4 IQ Sensor Net Connections and IQ Sun Shield, and rail mounting kit.

Three (3) Optical DO Sensor for IQ System, 0-20.00 mg/l with required SACIQ cable assembly and handrail mounting kit.

Three (3) Suspended Solids Sensor for IQ System, with required SACIQ cable assembly and adaptor. One unit to be mounted in each SBR basin.

Three (3) Submersible Level Transducers with 30' of cable for 4-20 mA signal.

Three (3) High Water Level Float Level Sensors with support bracket. One is for each SBR.

The price for this equipment including freight and service is <u>$ 785,000.</u>

<u>CLARIFICATIONS:</u>

Fluidyne assumes the wastewater is non-toxic and readily bio-degradable with sufficient alkalinity and sufficient carbon to nitrogen ratio.

SERVICE: Service is included in the amount of ten man-days (10) days provided in four (4) trips for the SBR system start-up. Blower start-up service is provided in the amount of two (2) days provided in one trip including travel and living expenses. Additional service would be extra at a rate of $1000/day plus travel and living expense.

EXCLUSIONS: Not furnished by Fluidyne are the following; pre-treatment including grit removal or screening; concrete tanks; any pipe, supports, fittings or valves except those specifically included above; influent control valves; out of basin or interconnecting piping, valving or supports; influent pumps; pre-treatment; effluent equalization; effluent pumps and controls; disinfection; sludge handling equipment; chemical feed equipment; chemicals; generator; SCADA; motor starters; VFDs, chemical feed equipment; any remote panels, disconnects or junction boxes; cabling other than standard lengths that come with equipment; conduit; walkway; hand-railing; grating; access hatches; vents; mounting piping and supports for instrumentation; sludge disposal or handling equipment; electrical and mechanical installation labor; off-loading of equipment; jobsite testing; jobsite storage; taxes; duties; insurance and other items not specifically mentioned in the body of this proposal.

SHIPMENT: The price quoted is based on a target shipment date of 14 to 18 weeks after receipt of approved drawings.

TAXES: Any applicable duties, sales, use, excise or similar taxes are not included in the quoted price.

TERMS OF PAYMENT: **Warranties** shall apply only when payments are made in full and according to the following schedule:

100% Net 30 days from shipment.

Unless other terms are specified, all payments shall be in United States Dollars and pro rata payments shall become due as deliveries are made. If date of delivery is delayed by purchaser, date of readiness for delivery shall be deemed date of delivery for payment purposes. If purchaser delays manufacture, a payment shall be made based on the purchase price and percentage of completion; balance payable in accordance with the terms stated.

If, at any time in Company's judgment, purchaser may be or maybe become unable or unwilling to meet the terms specified, Company may require satisfactory assurances or full or partial payment as a condition of commencing or continuing manufacture; or in advance of shipment, if it shipment has been made, recover the product(s) from the carrier.

DURATION: This proposal shall remain in effect for 60 days after proposal date, unless changed in the interim upon written notice.

FLUIDYNE CORPORATION
TERMS OF SALE

The conditions stated below shall constitute a part of the agreement resulting from the acceptance of an order for the whole or any part of the equipment covered by this quotation.

1. ACCEPTANCE:
All orders shall be made out to Fluidyne Corp., 5436 Nordic Drive, Cedar Falls, Iowa 50613, and shall be subject to acceptance by Fluidyne. Orders may not be canceled without Fluidyne's written consent, and then only on terms indemnifying Fluidyne against loss. Fluidyne reserves the right to correct any typographical or clerical errors in the proposal, pricing, or specification. Acceptance of any contract by Fluidyne shall be contingent upon credit approval. Performance shall be subject to strikes, fires, accidents, or curtailments in manufacturing or due to delays unavoidable or beyond the control of Fluidyne. No direct or liquidated damages or penalties shall be accepted. Receipt of the original copy of this proposal, signed by the purchaser, shall constitute a purchase order. The drawings and bulletin illustrations submitted with this proposal shall be general type, arrangement and approximate dimensions of the equipment to be furnished. Fluidyne reserves the right to alter such details in design or arrangement of its equipment, which in its judgment would constitute an improvement in construction, application or operation. Fluidyne shall promptly forward all necessary engineering information for installation of its equipment to the purchaser upon receipt of this accepted proposal. Any changes in equipment, arrangement of equipment, or application of equipment requested by purchaser after acceptance of proposal will be made at purchaser's expense.

2. TAXES
The prices quoted are subject to any addition, which may be necessary to cover any tax charge now existing or hereafter imposed by Federal, State, or Municipal authorities upon equipment or services herein described or the production, sale, distribution or delivery thereof, or upon any feature of this transaction.

3. BINDING RESPONSIBILITIES:
Sales representatives are not authorized to bind us. Typographical errors are not binding.

4. CANCELLATION:
After acceptance, an order shall not be subject to cancellation unless cancellation charges are borne by the Purchaser for work done by the Seller up to the time of receipt of cancellation notice; nor shall such orders be subject to change unless price increases are born by the Purchaser.

5. SHIPMENT AND DELIVERY:
All deliveries quoted are estimates based on Fluidyne's best judgment at the time of this proposal, but shipment on these dates is not guaranteed. Deliveries are figured from date of receipt in Cedar Falls, Iowa of approved order and technical data. Fluidyne will not accept any claims caused by delay in shipment or delivery. It is further understood that storage charges of 1 percent per month will apply commencing 30 days from date of equipment completion if purchaser asks the delivery be delayed after production is started. Billing will be made at time of completion of equipment and paid per standard terms.

6. TERMS OF PAYMENT:
Terms of payment are 10% with order, 20% upon approval of shop drawings, 50% Net 30 days from receipt of the equipment, 15% upon notice of substantial completion of the construction contractor, not to exceed 180 days from shipment whichever occurs first and final 5% net 45 days after operation by the buyer or notice of substantial completion whichever occurs first, not to exceed 270 days from shipment, unless stipulated otherwise in the body of this proposal. Accounts not paid on net cash due date bear interest at the rate of 1.5 percent per month not to exceed the maximum permissible by law. Title shall not pass to purchaser or end user until all payments including final payment and any retention for all goods and services have been received in full by Fluidyne.

7. INSTALLATION AND INITIAL OPERATION:
All equipment shall be installed by and at the expense of the Purchaser unless otherwise stipulated. The Seller will furnish at its option, engineers to supervise the installation and starting up of the equipment. Field service will be provided by a factory-trained representative at a per diem rate of $_1,500_____ plus travel and expenses on any additional period not stated in this contract.

8. WARRANTY:
Fluidyne warrants the SBR equipment proposed and described herein against defects in material and workmanship under normal use for a period of one year after date of start-up, not to exceed eighteen months from date of shipment. This warranty is valid provided that the installation operation and maintenance of the equipment is made in accordance with Fluidyne's instructions. The purchaser

must promptly give written notice of any equipment defects to Fluidyne. Under the warranty, Fluidyne will replace or repair the defective equipment, F.O.B its factory any part or parts returned to it, which examination shall show to have failed under normal use and service by the user within the above time frame. Qualified Fluidyne personnel or its agents must perform all startup service, or this warranty is void.

THIS IS FLUIDYNE'S SOLE WARRANTY. FLUIDYNE MAKES NO OTHER WARRANTY OF ANY KIND, IMPLIED OR EXPRESSED: ALL IMPLIED OR EXPRESSED WARRANTY MADE BY ANY PERSON, AGENT OR REPRESENTATIVE WHICH EXCEEDS FLUIDYNE'S AFOREMENTIONED OBLIGATION ARE HEREBY DISCLAIMED BY FLUIDYNE AND EXCLUDED FROM THIS WARRANTY.

9. PATENTS:
The equipment provided by Fluidyne may be covered by patents pending or issued. Fluidyne grants the right to use this equipment with further charges. Fluidyne does not grant rights to use, royalties, or protection against patent litigation arising from use of this equipment in patented processes controlled by others unless otherwise listed above.

10. CHANGE ORDERS:
Any change orders shall be mutually agreeable between buyer and seller.

11. LIABILITY:
In no event shall either party be liable to the other party for anticipated profits or for incidental, special, indirect, punitive or consequential damages under any circumstances. A party’s liability on any claim of any kind for any loss or damage arising out of, connected with, or resulting from this Agreement or from the performance or breach thereof shall, in no case, exceed the price allocable to the Equipment or the Services or any unit thereof which gives rise to the claim. Neither Buyer nor Seller shall be liable for penalties of any description.

12. PRICING
Fluidyne pricing is based on these terms of sale. No monies have been included for acceptance of different, additional or modified terms of sale.

SUBMITED BY: FLUIDYNE CORPORATION
DATE: April 8, 2016
PROJECT: Whitefish, MT

ACCEPTED BY: ________________________________
(Sign and Title)

(Company Name)
DATED: ________________________________

ISAM™ CALCULATIONS
PROJECT: Whitefish SBR
ENGINEER:
PROJECT #: 032116 SBR
DATE & TIME:
3/29/2016 16:10

	SBR Average	SBR Max Load	SBR Wet Weather
INFLUENT CONDITIONS			
Flow (m3/d)	5704	5704	6843
Flow (mgd)	1.507	1.507	1.808
Flow(gpm)	1047	1047	1256
BOD (mg/l)	297	396	248
(lb/d)	3734	4977	3734
TSS (mg/l)	239	239	199
(lb/d)	2998	2998	2998
NH3 (mg/l)	25	25	21
(lb/d)	317	317	317
OXYGEN REQUIREMENTS			
Pounds TKN required for synthesis	187	249	187
Pounds of NO3-N produced	130	68	130
Pounds O2 recovered/pound NO3-N reduced	2.0	2.0	2.0
Pound of Oxygen/ pound of BOD	1.1	1.1	1.1
Pound of Oxygen/pound of TKN	4.6	4.6	4.6
Actual Oxygen Demand (lb 02/d) Total	4446	5651	4446
Alpha	0.9	0.9	0.9
Beta	0.95	0.95	0.95
Theta	1.024	1.024	1.024
Operating Dissolved oxygen (mg/l)	2	2	2
Clean Water oxygen sat. at op. temp (mg/l)	11.3	11.3	11.3
Clean Water oxygen sat. at std. temp (mg/l)	9.09	9.09	9.09
Clean water 02 sat, std temp,mid depth(mg/l)	11.76	11.76	11.76
Std. condition ambient pressure (psia)	14.7	14.7	14.7
Oper. condition ambient pressure (psia)	13.24	13.24	13.24
Wastewater temperature (c)	10	10	10
SOR/AOR ratio	1.58	1.58	1.58
Standard Oxygen Demand (lb 02/d) total	7007	8907	7007
Standard Oxygen Demand (lb 02/hr)	584	582	584
Standard Oxygen Demand (lb 02/hr/tank)	292	291	292
Specific oxygenation rate (mg/l-hr)	30	30	30
Pounds of oxygen/pound of air	0.23	0.23	0.23
Clean water efficiency (%)	25.5	25.5	25.5
Pounds of air/cubic foot of air	0.075	0.075	0.075
Aeration hours per day	12.00	15.30	12.00
Air flow rate (scfm/tank)	1106	1103	1106
Air pressure losses (lines and nozzle)	0.66	0.66	0.66
Maximum air pressure (psig)	8.45	8.45	8.45
Average air pressure (psig)	7.64	7.64	7.64
NITRIFICATION/DENITRIFICATION			
Required alkalinity for nitrification (mg/l)	74	39	62
Alkalinity recovered, denitrification (mg/l)	31	16	26
Net alkalinity required (mg/l)	43	22	36
Mixed liquor temperature, C	10	10	10
ML dissolved oxygen (mg/l)	2	2	2
Max. nitrifier growth rate, day-1	0.175	0.175	0.175

PROJECT: Whitefish SBR

Minimum SRT required for nitrification, days	5.73	5.73	5.73
Actual SBR SRT, days	27.90	20.81	27.90
Total SRT, days	27.90	20.81	27.90
Kn, half velocity constant (mg/l)	0.22	0.22	0.22
Design growth rate for heterotrophs/nitrifiers	0.0358	0.0480	0.0358
Projected effluent soluble NH3-N, mg/l	0.06	0.09	0.06
Specific utilization rate, lbs BOD5/lb mlvss	0.16	0.18	0.16
lbs. mlvss required for BOD & NH3 removal	23923	27919	23923
mlvss (mg/l)	2450	2450	2450
Tank volume req. for BOD & NH3 removal (MG	1.17	1.37	1.17
Denitrification rate (g/g/day)	0.034	0.034	0.034
lbs mlvss required for denitrification	3875	2023	3875
Tank volume required for NO3 removal (MG)	0.19	0.10	0.19
Total tank volume required (MG)	1.36	1.47	1.36
SBR/SAM™ TANK CONFIGURATION			
No. of SBR tanks	2	2	2
Length SBR (ft)	140	140	140
Length SAM™ (ft)	0	0	0
Width (ft)	55	55	55
Bottom water level (ft)	16.25	16.25	16.25
Top water level (ft)	20	20	20
No. Decanters/tank	2	2	2
SBR Tankage Volume @ TWL(MG)	2.3038	2.3038	2.3038
SBR HRT (hrs)	36.69	36.69	30.58
SAM™ Tankage Volume	0.000	0.000	0.000
SAM HRT (hrs)	0.00	0.00	0.00
SBR+SAM Tankage Volume @ TWL(MG)	2.30	2.30	2.30
Anoxic/Aerobic HRT (hrs)	36.69	36.69	30.58
ISAM™ tankage volume (MG)	0.000	0.000	0.000
Total HRT (hrs)	36.69	36.69	30.58
CYCLE TIMES/CAPACITY CALCULATIONS			
Total decant volume (cubic feet)	57,750	57,750	57,750
Total decant volume (gallons)	431,970	431,970	431,970
Decant volume per tank (gallons)	215,985	215,985	215,985
Number of cycles per day/tank	3.49	3.49	4.19
Total time per cycle (minutes)	413	413	344
Fill rate (gpm)	1047	1047	1256
Fill time (minutes) SBR	206	206	172
Feed rate (gpm)	1047	1047	1256
React Period available (minutes)	125	125	91
Settle period (minutes)	45	45	45
Decant fill (minutes)	0	0	0
Average decant rate (gpm/ft decanter)	100	100	100
Decanter length (feet)	60	60	60
Decanting time (minutes)	36	36	36
Idle time (minutes)	0	0	0
Total decantable volume (gallons)	215985	215985	215985
Maximum aeration period available (hours/day	19.29	19.29	18.35
EQUIPMENT SELECTION			
Air flow per nozzle (scfm)	45	45	45
Number of nozzles required (per tank)	24.58	24.51	24.58
Number of nozzles provided (per tank)	28	28	28
Actual airflow per nozzle (scfm)	39.51	39.39	39.51
Blower capacity required (scfm)	1106	1103	1106

PROJECT: Whitefish SBR

Blower capacity provided (scfm)	1100	1100	1100
POWER CONSUMPTION CALCULATIONS			
Pump efficiency	0.77	0.77	0.77
Blower efficiency	0.65	0.65	0.65
Pump horsepower, BHP/tank	32	32	32
Mixing BHP/MG	28	28	28
Blower horsepower, BHP/tank	65	65	65
Total horsepower, BHP/tank	97	97	97
Aeration BHP/MG	84	84	84
Total design equivalent horsepower, BHP	97	123	97
SLUDGE PRODUCTION			
Sludge Yield Factor	0.66	0.66	0.66
Net Sludge Yield (lbs/d)	2411	3231	2411
Settled Sludge Concentration (%)	0.9	0.9	0.9
Settled Sludge (gpd)	32117	43047	32117
MLSS (mg/l) @ TWL	3500	3500	3500
Sludge inventory total (lbs)	67249	67249	67249
Sludge inventory in SBR (lbs)	67249	67249	67249
SRT (1/days)	27.90	20.81	27.90
SRT in SBR (1/days)	27.90	20.81	27.90
F/M	0.06	0.07	0.06
SVI (ml/g)	150	150	150
Sludge blanket level (ft)	10.52	10.52	10.52
Organic loading (lbs BOD/1000 ft3)	12.12	16.16	12.12

1. Oxic sludge age 8 to 15 days at 20 Deg C	13.95	13.27	13.95
1. Oxic sludge age 8 to 15 days at 20 Deg C	13.95	13.27	13.95
2. F/M 0.05 to 1.0 (assume 0.1) at design avg	0.06	0.07	0.06
3. MLSS 2000 to 4000 mg/l	3500	3500	3500
4. Org. load avg. at BWL 15 lbs BOD/d/1000ft3	14.9		
5. Minimum 2 basins	2	2	2
6. Service w/o capacity reduction	yes	yes	yes
7. Flow thru with 1 basin out of service	yes	yes	yes
8. Minimum BWL > 12 ft	16.25	16.25	16.25
9. Min Settle time >20 minutes	45	45	45
10. Min freeboard 36 inches	36	36	36

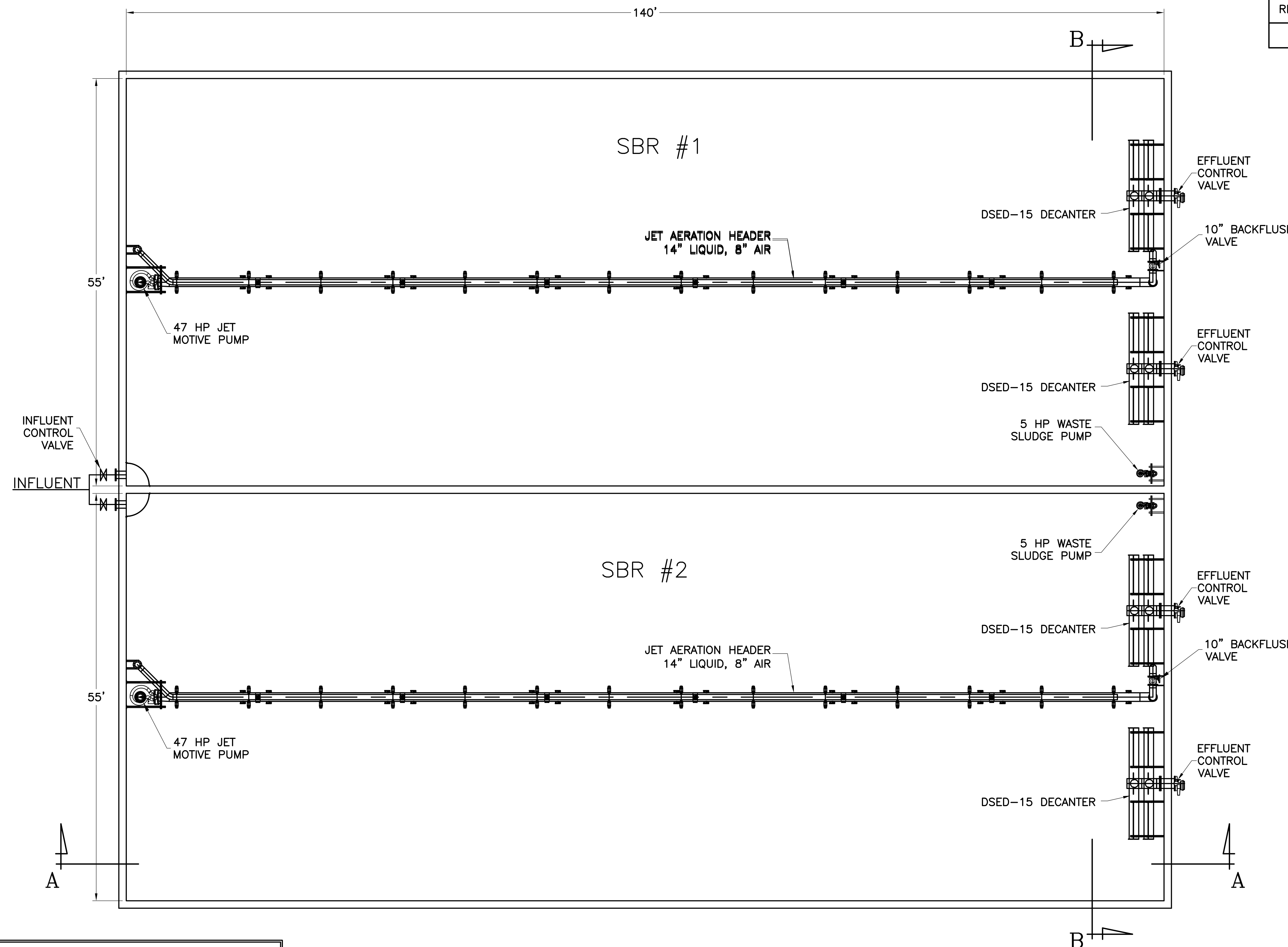
ISAM™ CALCULATIONS
PROJECT: Whitefish SBR
ENGINEER:
PROJECT #: 032116 SBR
DATE & TIME:
3/29/2016 16:24

	SBR Average	SBR Max Load	SBR Wet Weather
INFLUENT CONDITIONS			
Flow (m3/d)	5704	5704	6843
Flow (mgd)	1.507	1.507	1.808
Flow(gpm)	1047	1047	1256
BOD (mg/l)	297	396	248
(lb/d)	3734	4977	3734
TSS (mg/l)	239	239	199
(lb/d)	2998	2998	2998
NH3 (mg/l)	25	25	21
(lb/d)	317	317	317
OXYGEN REQUIREMENTS			
Pounds TKN required for synthesis	187	249	187
Pounds of NO3-N produced	130	68	130
Pounds O2 recovered/pound NO3-N reduced	2.0	2.0	2.0
Pound of Oxygen/ pound of BOD	1.1	1.1	1.1
Pound of Oxygen/pound of TKN	4.6	4.6	4.6
Actual Oxygen Demand (lb 02/d) Total	4446	5651	4446
Alpha	0.9	0.9	0.9
Beta	0.95	0.95	0.95
Theta	1.024	1.024	1.024
Operating Dissolved oxygen (mg/l)	2	2	2
Clean Water oxygen sat. at op. temp (mg/l)	11.3	11.3	11.3
Clean Water oxygen sat. at std. temp (mg/l)	9.09	9.09	9.09
Clean water 02 sat, std temp,mid depth(mg/l)	11.76	11.76	11.76
Std. condition ambient pressure (psia)	14.7	14.7	14.7
Oper. condition ambient pressure (psia)	13.24	13.24	13.24
Wastewater temperature (c)	10	10	10
SOR/AOR ratio	1.58	1.58	1.58
Standard Oxygen Demand (lb 02/d) total	7007	8907	7007
Standard Oxygen Demand (lb 02/hr)	584	582	584
Standard Oxygen Demand (lb 02/hr/tank)	195	194	195
Specific oxygenation rate (mg/l-hr)	31	31	31
Pounds of oxygen/pound of air	0.23	0.23	0.23
Clean water efficiency (%)	25.5	25.5	25.5
Pounds of air/cubic foot of air	0.075	0.075	0.075
Aeration hours per day	12.00	15.30	12.00
Air flow rate (scfm/tank)	737	735	737
Air pressure losses (lines and nozzle)	0.66	0.66	0.66
Maximum air pressure (psig)	8.45	8.45	8.45
Average air pressure (psig)	7.64	7.64	7.64
NITRIFICATION/DENITRIFICATION			
Required alkalinity for nitrification (mg/l)	74	39	62
Alkalinity recovered, denitrification (mg/l)	31	16	26
Net alkalinity required (mg/l)	43	22	36
Mixed liquor temperature, C	10	10	10
ML dissolved oxygen (mg/l)	2	2	2
Max. nitrifier growth rate, day-1	0.175	0.175	0.175

PROJECT: Whitefish SBR			
Minimum SRT required for nitrification, days	5.73	5.73	5.73
Actual SBR SRT, days	27.71	20.68	27.71
Total SRT, days	27.71	20.68	27.71
Kn, half velocity constant (mg/l)	0.22	0.22	0.22
Design growth rate for heterotrophs/nitrifiers	0.0361	0.0484	0.0361
Projected effluent soluble NH3-N, mg/l	0.06	0.09	0.06
Specific utilization rate, lbs BOD5/lb mlvss	0.16	0.18	0.16
lbs. mlvss required for BOD & NH3 removal	23857	27829	23857
mlvss (mg/l)	2450	2450	2450
Tank volume req. for BOD & NH3 removal (MC	1.17	1.36	1.17
Denitrification rate (g/g/day)	0.034	0.034	0.034
lbs mlvss required for denitrification	3875	2023	3875
Tank volume required for NO3 removal (MG)	0.19	0.10	0.19
Total tank volume required (MG)	1.36	1.46	1.36
SBR/SAM™ TANK CONFIGURATION			
No. of SBR tanks	3	3	3
Length SBR (ft)	102	102	102
Length SAM™ (ft)	0	0	0
Width (ft)	50	50	50
Bottom water level (ft)	16.25	16.25	16.25
Top water level (ft)	20	20	20
No. Decanters/tank	2	2	2
SBR Tankage Volume @ TWL(MG)	2.2889	2.2889	2.2889
SBR HRT (hrs)	36.45	36.45	30.38
SAM™ Tankage Volume	0.000	0.000	0.000
SAM HRT (hrs)	0.00	0.00	0.00
SBR+SAM Tankage Volume @ TWL(MG)	2.29	2.29	2.29
Anoxic/Aerobic HRT (hrs)	36.45	36.45	30.38
ISAM™ tankage volume (MG)	0.000	0.000	0.000
Total HRT (hrs)	36.45	36.45	30.38
CYCLE TIMES/CAPACITY CALCULATIONS			
Total decant volume (cubic feet)	57,375	57,375	57,375
Total decant volume (gallons)	429,165	429,165	429,165
Decant volume per tank (gallons)	143,055	143,055	143,055
Number of cycles per day/tank	3.51	3.51	4.21
Total time per cycle (minutes)	410	410	342
Fill rate (gpm)	1047	1047	1256
Fill time (minutes) SBR	137	137	114
Feed rate (gpm)	1047	1047	1256
React Period available (minutes)	193	193	147
Settle period (minutes)	45	45	45
Decant fill (minutes)	0	0	0
Average decant rate (gpm/ft decanter)	100	100	100
Decanter length (feet)	40	40	40
Decanting time (minutes)	36	36	36
Idle time (minutes)	0	0	0
Total decantable volume (gallons)	143055	143055	143055
Maximum aeration period available (hours/day	19.27	19.27	18.33
EQUIPMENT SELECTION			
Air flow per nozzle (scfm)	45	45	45
Number of nozzles required (per tank)	16.39	16.34	16.39
Number of nozzles provided (per tank)	20	20	20
Actual airflow per nozzle (scfm)	36.87	36.76	36.87
Blower capacity required (scfm)	737	735	737

PROJECT: Whitefish SBR			
Blower capacity provided (scfm)	1100	1100	1100
POWER CONSUMPTION CALCULATIONS			
Pump efficiency	0.77	0.77	0.77
Blower efficiency	0.65	0.65	0.65
Pump horsepower, BHP/tank	23	23	23
Mixing BHP/MG	30	30	30
Blower horsepower, BHP/tank	43	43	43
Total horsepower, BHP/tank	66	66	66
Aeration BHP/MG	87	86	87
Total design equivalent horsepower, BHP	99	126	99
SLUDGE PRODUCTION			
Sludge Yield Factor	0.66	0.66	0.66
Net Sludge Yield (lbs/d)	2411	3231	2411
Settled Sludge Concentration (%)	0.9	0.9	0.9
Settled Sludge (gpd)	32121	43051	32121
MLSS (mg/l) @ TWL	3500	3500	3500
Sludge inventory total (lbs)	66812	66812	66812
Sludge inventory in SBR (lbs)	66812	66812	66812
SRT (1/days)	27.71	20.68	27.71
SRT in SBR (1/days)	27.71	20.68	27.71
F/M	0.06	0.07	0.06
SVI (ml/g)	150	150	150
Sludge blanket level (ft)	10.52	10.52	10.52
Organic loading (lbs BOD/1000 ft3)	12.20	16.26	12.20
1. Oxic sludge age 8 to 15 days at 20 Deg C	13.86	13.18	13.86
1. Oxic sludge age 8 to 15 days at 20 Deg C	13.86	13.18	13.86
2. F/M 0.05 to 1.0 (assume 0.1) at design avg	0.06	0.07	0.06
3. MLSS 2000 to 4000 mg/l	3500	3500	3500
4. Org. load avg. at BWL 15 lbs BOD/d/1000ft3	15.0		
5. Minimum 2 basins	2	2	2
6. Service w/o capacity reduction	yes	yes	yes
7. Flow thru with 1 basin out of service	yes	yes	yes
8. Minimum BWL > 12 ft	16.25	16.25	16.25
9. Min Settle time >20 minutes	45	45	45
10. Min freeboard 36 inches	36	36	36

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED



NOTES:

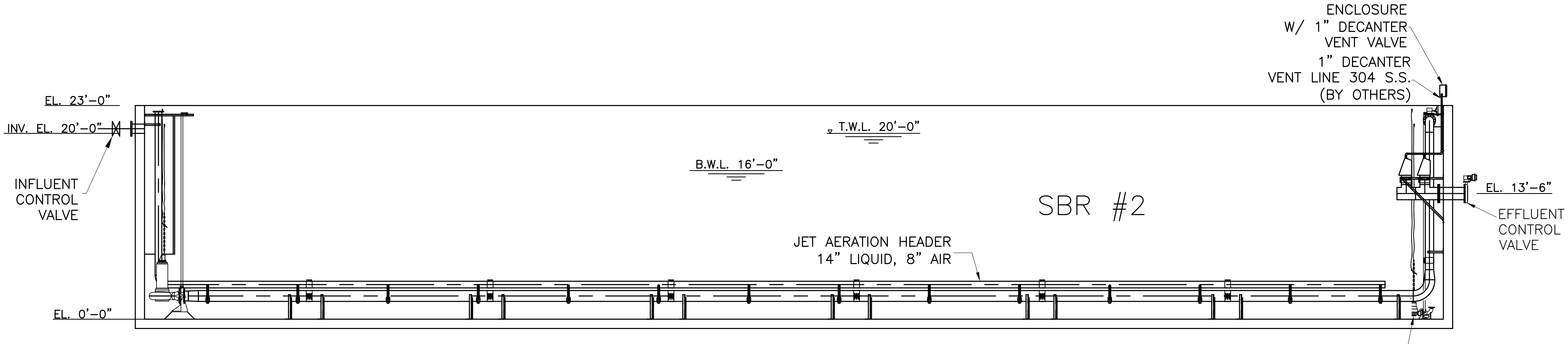
1. THOROUGHLY REVIEW INSTALLATION INSTRUCTIONS PRIOR TO BEGINNING FIELD WORK. IF YOU HAVE ANY QUESTIONS PLEASE CONSULT FACTORY.
2. ALL NOZZLES TO BE LEVELED AND AT THE SAME ELEVATION ± 1/4".
3. (FJ) MAY REQUIRE CUT-TO-FIT OR ADDITIONAL PIPE FOR FIELD ADJUSTABILITY.
4. SEE INSTALLATION INSTRUCTIONS FOR PROPER PREPARATION TO ENSURE PROPER FITTING OF ALL COMPONENTS BEFORE F.R.P. FIELD WELDING AND FIELD LAMINATING.
5. FREEZE PROTECT ALL EXPOSED PIPING, FITTINGS AND VALVES.
6. ALL WALL PENETRATIONS, INTERCONNECTING HARDWARE, GASKETS, AND ANCHOR BOLTS ARE BY OTHERS.

FLUIDYNE

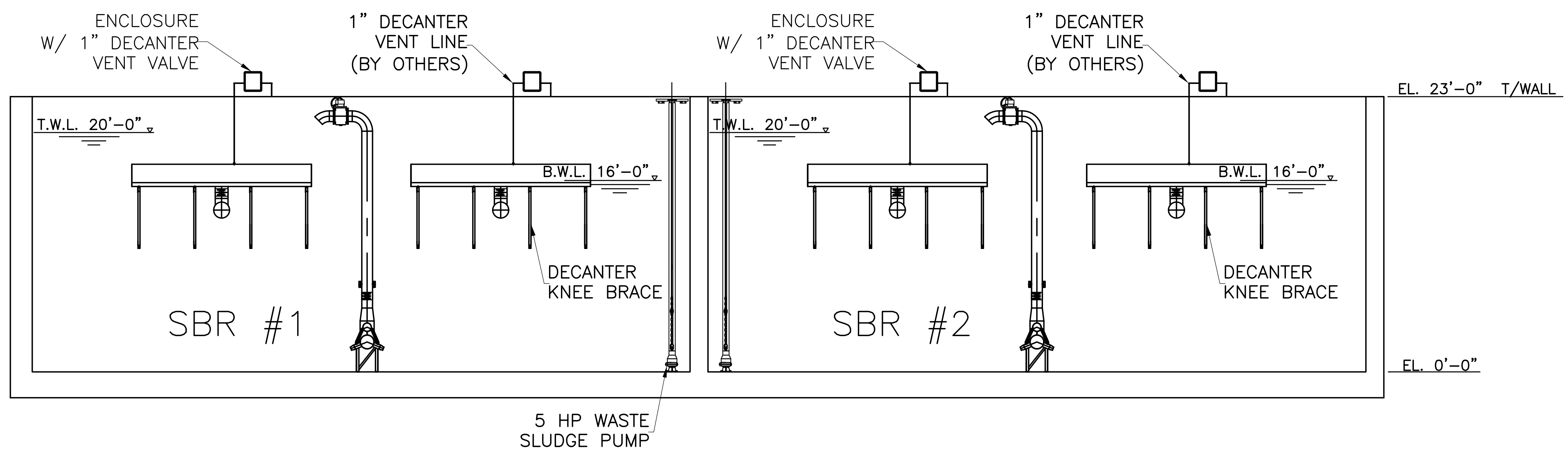
WHITEFISH, MT – 1 – PLAN – TWO TANK

DRAWN NWS	DATE 3/29/16	JOB #	CAD FILE Whitefish, MT – 1 – Plan – Two Tank
CHECKED	DATE	SCALE	SHEET 1 OF 2

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED



SECTION A–A



SECTION B–B

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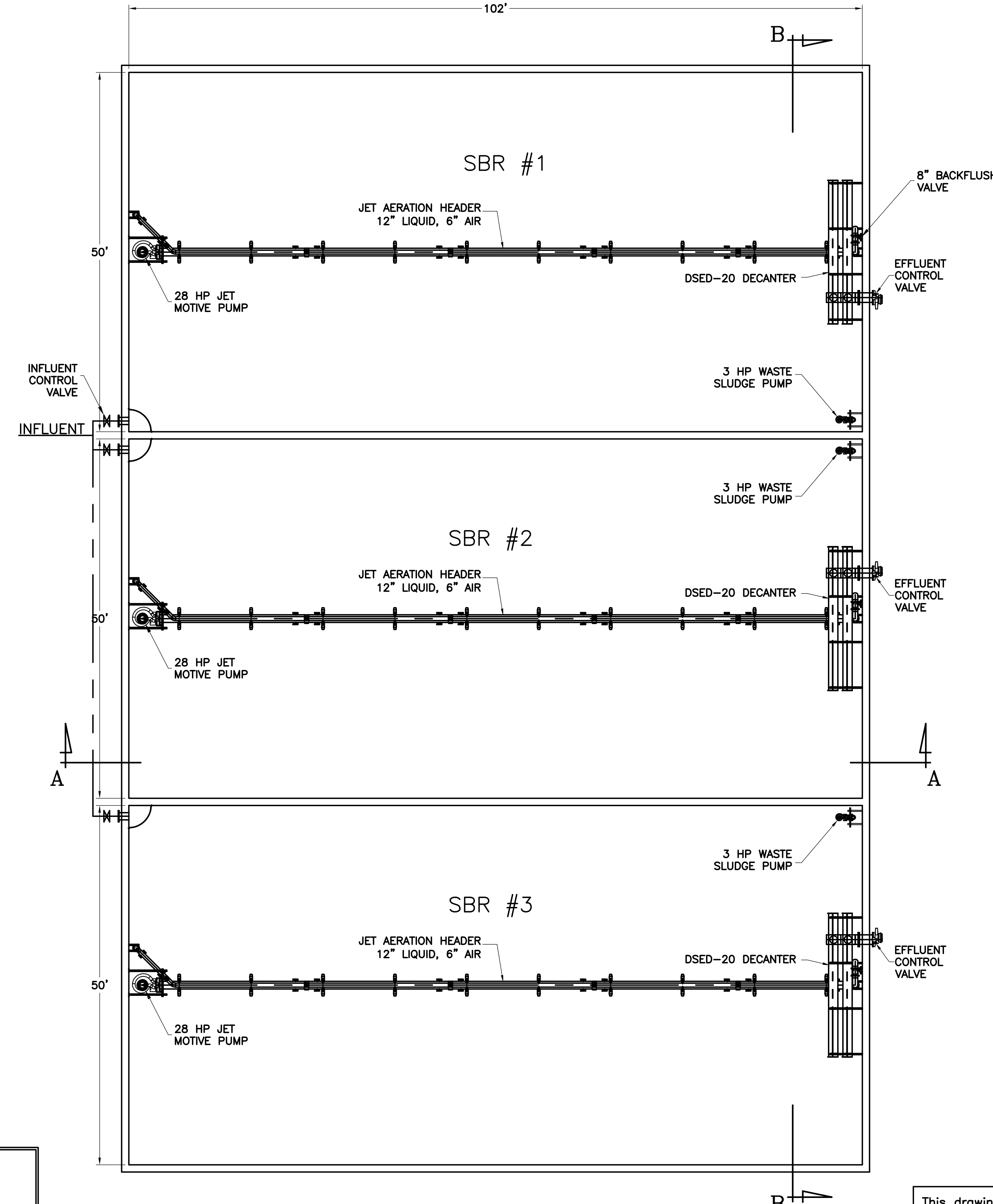
FLUIDYNE

WHITEFISH, MT – 2 – ELEVATION – TWO TANK

DRAWN NWS	DATE 3/29/16	JOB #	CAD FILE Whitefish, MT – 2 – Elevation – Two Tank
CHECKED	DATE	SCALE	SHEET 2 OF 2



REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

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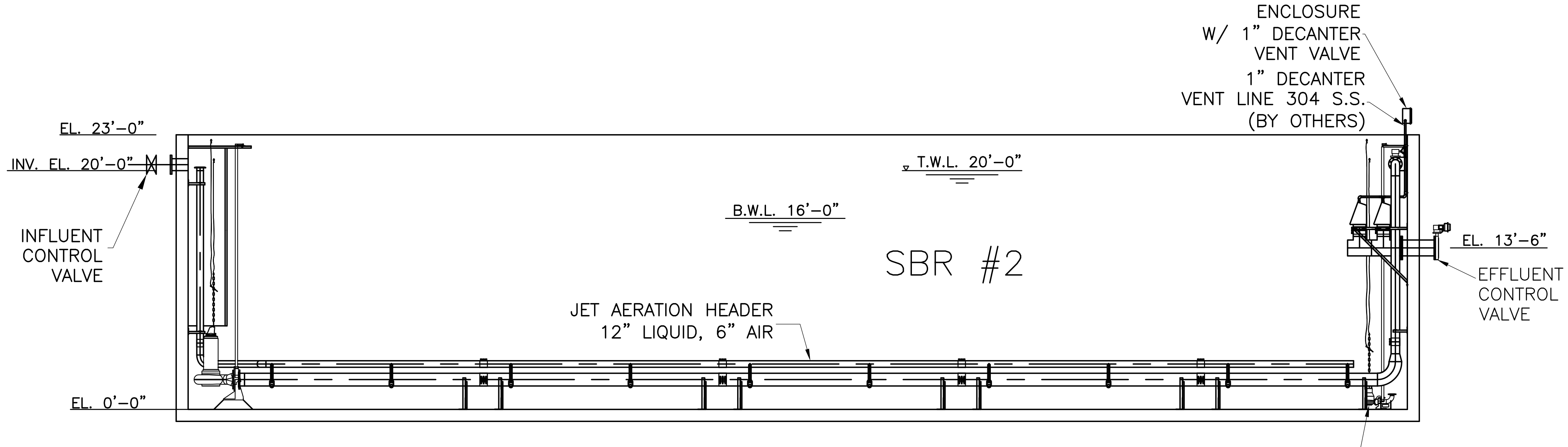
FLUIDYNE

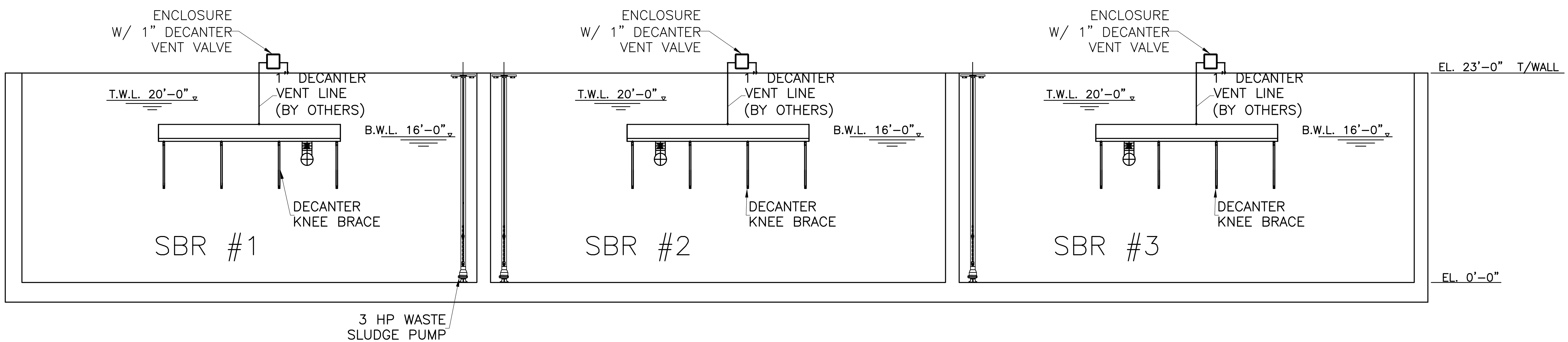
WHITEFISH, MT – 1 – PLAN

DRAWN NWS	DATE 3/21/16	JOB #	CAD FILE Whitefish, MT – 1 – Plan	REV
CHECKED	DATE	SCALE		SHEET 1 OF 2

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED



SECTION A–A



SECTION B–B

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FLUIDYNE

WHITEFISH, MT – 2 – ELEVATION

DRAWN	DATE	JOB #	CAD FILE	REV
NWS	3/21/16		Whitefish, MT – 2 – Elevation	
CHECKED	DATE	SCALE	SHEET 2 OF 2	

Preliminary Manufacturer's

Design Report

Sanitaire SBR

Anderson~Montgomery

CONSULTING ENGINEERS

Sanitaire ICEAS™ Advanced SBR

SANITAIRE®

a xylem brand

Harnessing a simple and reliable solution for quality water

The Sanitaire ICEAS Advanced SBR is a continuous flow biological treatment system that provides multiple advantages over conventional activated sludge and other SBRs by bringing together process, aeration, decanting and control in a single treatment tank. It is fully automated and includes a completely integrated process design consisting of the aeration system, blowers, pumps, mixers, effluent decanters, monitoring and control equipment and comprehensive process control system.

Simplifying operations for reliable results

The ICEAS SBR is designed to reduce complexity of operation. Unlike conventional activated sludge plants, there is no need for primary or secondary settlement tanks or return sludge pumps. All treatment is done in a single basin. Continuous inflow distributes variations in flows and loads evenly across all basins - simplifying day to day operations and operational changes as well as accommodating single basin operation for low flow and maintenance conditions.

The intelligently designed process control system with simple, intuitive time-based control and trending capability provide a full system overview, making it easy to optimize plant performance, predict maintenance and reduce operating costs – taking the complexity out of SBRs.

The ICEAS SBR can handle flows from 25,000 GPD to over 100 MGD. It can be designed to accommodate up to six times average daily flow while assuring high effluent quality across the entire flow range with the unique basin design and actively controlled decanter. Sanitaire's proprietary Sludge Inventory Management System (SIMS) automatically maintains the preset solids retention time, resulting in reliable settling characteristics and effluent quality, all while reducing operator attention requirements.

The ICEAS process also effectively removes nitrogen and phosphorus from wastewater through biological nutrient removal (BNR) process.

Sanitaire ICEAS SBR has proven performance in nearly 1,000 treatment system installations worldwide.

1 Blowers 2 Pre-react 3 Mixer 4 Aeration 5 WAS Pump
6 Decanter 7 Process control

ICEAS products: Sanitaire Silver Series aeration system, Flygt compact mixers, Flygt submersible N-Pumps, Sanitaire decanters, ICEAS control systems.

Designed with life-time efficiency in mind

Sanitaire is focused on producing cost-saving water technologies that use less energy throughout the lifetime of the project by not only using highly efficient aeration grids and blower technology but also cutting edge controls and instrumentation which use innovative algorithms to control the aeration and process, minimizing energy use by up to 50%.

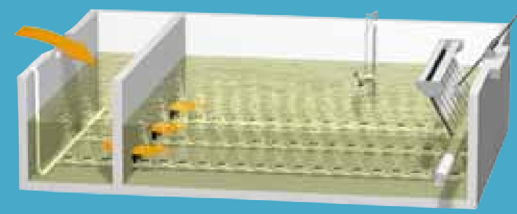
Using Sanitaire's continuous inflow distribution technology, the peak load is spread across all basins simplifying operation and saving up to 30% on the footprint. Continuous inflow also reduces up-front capital expenditure by requiring less equipment, and provides for reduced construction costs. With almost 1000 installations, our experienced design team can put together an optimized, flexible solution to meet not only your current needs but also provide the expandability to meet your future emerging requirements.

A partner from start to finish

Xylem products have been helping to solve water and wastewater challenges for decades. With a broad portfolio of advanced solutions and technologies, we apply our process capability, engineering expertise and regulatory insight to help design systems that are right for you. As your single source provider, we work to reduce your risks by providing equipment-control integration, and the support needed to ensure a successful installation and ownership. Xylem stands behind our solutions with both equipment warranties and process performance guarantees.

The ICEAS phases

With its continuous flow process, Sanitaire ICEAS SBR features three distinct treatment phases:



React phase: Screened and de-gritted wastewater flows continuously into the pre-react zone and enters the main react zone through submerged ports in the non-hydrostatic baffle wall. Biological oxidation and reduction occur through aeration, anoxic and anaerobic sequences within the react phase to predictively achieve the desired treatment.

Settle phase: Basin agitation from the react phase (i.e. aeration and mixing) is stopped to allow the solids to settle to the bottom of the basin. Raw wastewater continues to flow into the pre-react zone while the main react zone settles. As the solids settle, a clear layer of water develops on top of the basin.

Decant phase: The decanter descends gradually downward to draw off the clarified supernatant. Wastewater continues to flow into the pre-react zone as the treated and clarified effluent is decanted from the main react zone at a constant rate. Waste activated sludge is typically removed from the basin during this phase.

Xylem |'zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're 12,000 people unified in a common purpose: creating innovative solutions to meet our world's water needs. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. We move, treat, analyze, and return water to the environment, and we help people use water efficiently, in their homes, buildings, factories and farms. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise, backed by a legacy of innovation.

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14125 South Bridge Circle
Charlotte, NC 28273
Tel 704.409.9700
Fax 704.295.9080
www.xyleminc.com

BIOLOGICAL TREATMENT AND THE ABJ PROCESS

INTRODUCTION

This Biological Treatment and ABJ Process section begins with a general discussion regarding the philosophy and principles of biological treatment. The following discussions include a summary of both the conventional activated sludge process and conventional SBR technology. The final discussion focuses specifically on the ABJ ICEAS process; it's features, benefits and differences from conventional processes.

PRINCIPLES OF BIOLOGICAL TREATMENT

Biological treatment is achieved by creating an environment suitable for the survival and reproduction of various bacterial cultures and exposing them to organic substances present in the wastewater. This is a natural process that also occurs in any natural body of water.

The activated sludge process that is used for treatment of wastewater originating from domestic and industrial sources is a biological system. It is designed to optimize the efficiency or the degree of treatment that occurs in a natural body of water. In order to understand the activated sludge process, it is of paramount importance to be familiar with the principles of biological treatment.

MEASUREMENT OF ORGANIC MATTER

The organic strength of the wastewater is measured experimentally using various test procedures such as Biochemical Oxygen Demand (BOD_5), Ultimate Biochemical Oxygen Demand (BOD_U), Chemical Oxygen Demand (COD) and Total Organic Carbon (TOC). Of these, BOD_5 is the most commonly used parameter.

BIOCHEMICAL OXYGEN DEMAND (BOD_5)

Biochemical Oxygen Demand (BOD_5) is a measurement of the amount of oxygen demand exerted by microorganisms to oxidize the organics present in wastewater during a 5-day test period. The task of biological treatment is to reduce the oxygen demand exerted by the microorganisms to a level that will have no significant impact on the receiving stream. The BOD removal process is illustrated by the following equation:

$$BOD_5 + O_2 \xrightarrow[\text{Nutrients}]{\text{Bacteria}} \text{New Cells} + CO_2 + H_2O + \text{Nutrients} + \text{Energy} \qquad (1)$$

NUTRIENTS

Nitrogen and phosphorus serve as essential nutrients in the growth of living organisms including human beings, plants and microorganisms. High concentrations of these nutrients discharged into receiving water bodies can result in eutrophication. Controlled discharge of these nutrients necessitates their removal during treatment of the wastewater. The forms, in which these nutrients exist in the wastewater and how they are removed during wastewater treatment, are described below.

NITROGEN
The sources of nitrogen in domestic wastewater are urea, feces and other organic material. Inorganic nitrogen is a combination of ammonia nitrogen, nitrite nitrogen and nitrate nitrogen. Total Kjeldahl Nitrogen (TKN) is a combination of ammonia nitrogen and organic nitrogen.

BIOLOGICAL NITROGEN REMOVAL
This process can be divided into two steps:

1. Nitrification - ammonia nitrogen is converted to nitrate by bacteria in the presence of oxygen
2. Denitrification - nitrate is converted to nitrogen gas in the absence of oxygen. Since biological denitrification is performed only on the nitrate ion, nitrification is essential for complete nitrogen removal.

NITRIFICATION
In biological nitrification, two sequential reactions occur:

1. Conversion of ammonia to nitrite by *Nitrosomonas* organisms

   Ammonia Nitrogen + 1.5 O_2 ------> Nitrite + H_2O + Loss of Alkalinity (2)

2. Conversion of nitrite to nitrate by *Nitrobacter* organisms

   Nitrite Nitrogen + 0.5 O_2 ------> Nitrate Nitrogen (3)

The overall nitrification reaction can be expressed as:

Ammonia Nitrogen + 2 O_2 ------> Nitrate Nitrogen + H_2O +Loss of Alkalinity (4)

DENITRIFICATION
In the biological denitrification process, nitrates are converted to nitrogen gas. The gas is ultimately released to the atmosphere. In contrast to nitrification, biological denitrification occurs in the absence of oxygen and uses organic compounds present in wastewater as a source of carbon. Energy is obtained by oxidizing the organic substrates. During denitrification, nitrate acts as an electron acceptor in the absence of free oxygen. The overall denitrification reaction is expressed in Equation 5.

Nitrate Nitrogen + Organic Carbon ------> Nitrogen Gas + Gain of Alkalinity (5)

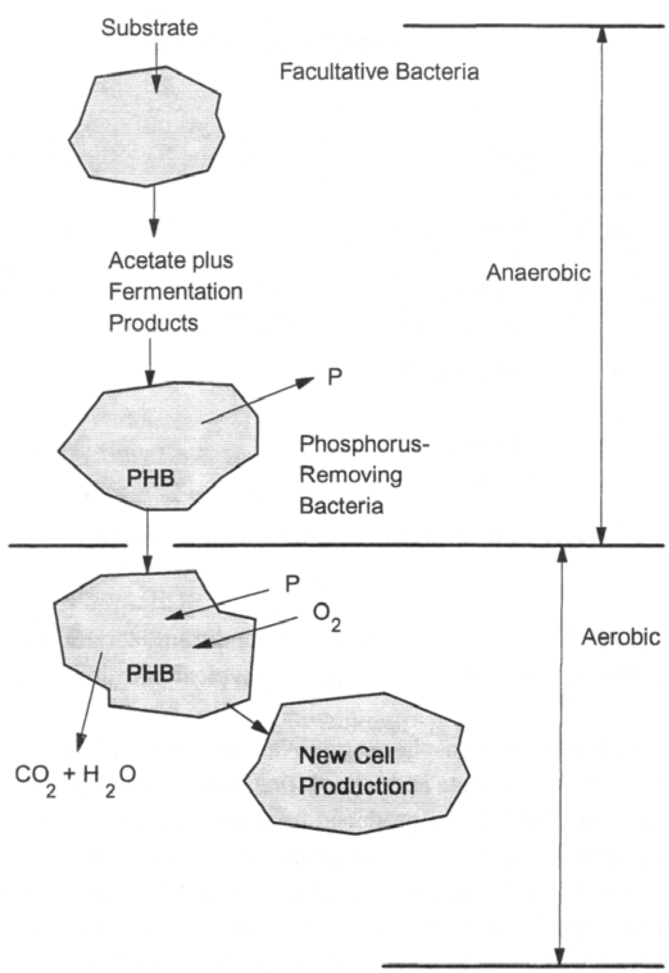
BIOLOGICAL PHOSPHORUS REMOVAL
Phosphorus exists in the forms of orthophosphate, polyphosphate and organic phosphates in wastewater. The major sources of phosphorus in domestic wastewater are human excrement, synthetic laundry detergents and water treatment chemicals.

In biological treatment, the phosphorus in wastewater is removed through incorporation into the cell tissue of microorganisms during BOD removal. This two step process is described in Figure 1:

1. Certain microorganisms, when subjected to anaerobic (absence of oxygen and nitrates) conditions, assimilate and store fermentation products produced by other facultative bacteria. These microorganisms derive energy for this assimilation from stored polyphosphates, which are hydrolyzed to liberate energy. The free phosphorus that results from the hydrolysis reaction is released to the mixed liquor.

2. These same microorganisms, when subsequently exposed to aerobic conditions, consume both phosphorus (which is used for cell synthesis and stored as polyphosphates) and oxygen to metabolize the previously stored substrate for energy production and cell synthesis. The organisms take up the phosphorus in excess to remedy their phosphorus-starved condition. That is, they take in more phosphorus than they previously released. The phosphorus is removed from the system during the normal sludge wasting procedure.

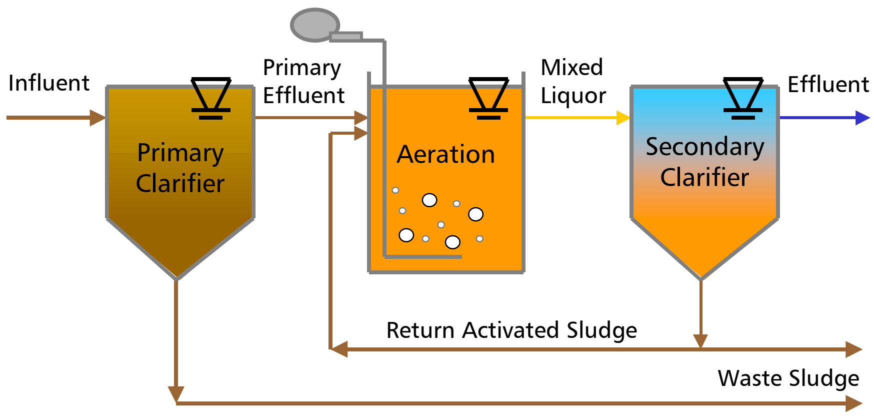
Figure 1



CONVENTIONAL ACTIVATED SLUDGE PROCESS

A typical conventional activated sludge process as shown in Figure 2, consists of separate tanks to accomplish unit processes of primary clarification, BOD removal and secondary clarification with recycle pumping and piping.

Figure 2 Typical Conventional Activated Sludge Process



PRIMARY CLARIFIER

The wastewater from the plant headworks is received in the primary clarifier. The primary clarifier is typically equipped with a sludge collection mechanism and an effluent overflow weir. In this unit process, solids (or sludge) with a higher density settles to the bottom of the clarifier and partially treated primary effluent is discharged over the weirs to the aeration basin. The sludge settled in the primary clarifier is sent to the sludge handling facilities.

AERATION BASIN

The aeration basin is typically equipped with diffusers installed on the floor of the basin. The blowers located in a building near the basins are used to supply the air to the basins via the diffusers. The effluent received from the primary clarifier is continuously mixed and aerated in this basin with return sludge resulting in the oxidation of the BOD. The combination of treated water and sludge from the aeration basin ("mixed liquor") is discharged to the secondary clarifier.

SECONDARY CLARIFIER

The mixed liquor discharge from the aeration basin enters the secondary clarifier through the feed well. Similar to the primary clarification, the liquid solids separation occur in the clarifier where sludge is settled to the bottom and the treated effluent is discharged over the weirs to the downstream facilities. A major portion of the sludge that settled in the secondary clarifier is recycled back as return "activated sludge" to the aeration basin and the remainder is wasted to the sludge handling facilities.

Additional tanks are added to the unit processes discussed above to create the aerobic, anoxic and anaerobic environments required for biological nitrogen and phosphorous removal.

The principle of the conventional activated sludge process discussed above is being used for wastewater treatment in various forms and operational methodologies. One of these variations is the Sequencing Batch Reactor (SBR) process.

CONVENTIONAL SBR

The Sequential Batch Reactor (SBR) process is a variant of the Activated Sludge process. It uses the fill and draw principal in which unit processes occur sequentially on a cyclical basis. The SBR process eliminates the need for primary and secondary clarifiers.

A typical SBR cycle consists of the following phases as illustrated in Figure 3:

Fill: Raw wastewater that has been screened and degritted flows into the basin and mixes with the mixed liquor settled during the previous phase. After the fill phase, the influent valve is closed and the influent is routed to the other basin.

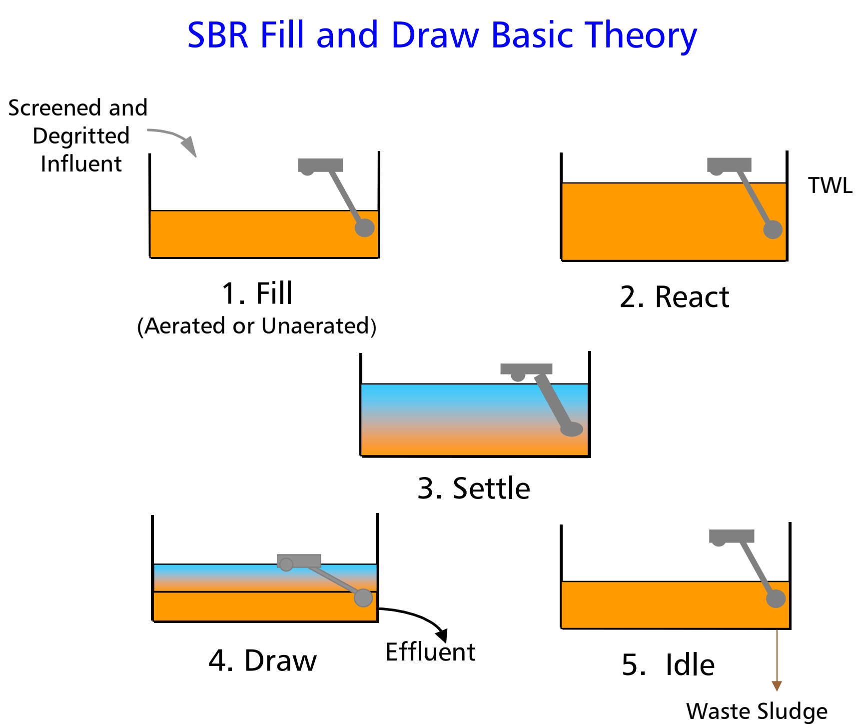
React: The basin is aerated and biological oxidation takes place similar to the aeration basin in the conventional activated sludge process.

Settle: Aeration is stopped and the solids settle to the bottom of the basin leaving the clear water on the top.

Draw: The clear water is discharged using a decant mechanism.

Idle: Sludge is wasted from the bottom of the basin using pumps.

Figure 3



At the end of the idle phase, the cycle begins again with the fill phase. The SBR carries out the functions of primary clarification, aeration and secondary clarification in one basin.

In the conventional activated sludge process, various unit processes such as primary clarification, aeration and secondary clarification are carried out in separate basins. These "trains" of unit processes generally occupy a significant land area as compared to an SBR. In the conventional activated sludge process, a limited amount of flexibility can be exercised by adjusting the rate of return activated sludge (RAS) and waste activated sludge (WAS) or through varying the rate of air introduced in the aeration basin.

In an SBR, the same unit processes that are carried out in the conventional activated sludge process occur sequentially in one basin. As a result, the "footprint" of a SBR is typically much smaller than that of a conventional activated sludge plant. The SBR process is automated through the use of a control system ranging in sophistication from simple timers to PLC or PC based systems. The control system automatically coordinates equipment operation through various phases of the SBR cycle. This feature offers a high degree of flexibility allowing adaptation of the process cycle to meet the changing influent conditions through simple changes in control setpoints.

This difference in system configuration gives the SBR system several advantages over the conventional activated sludge process including:

LOWER CAPITAL COST

- No primary or secondary clarifiers and accompanying pumping systems are needed
- Requires smaller footprint
- Simpler and faster installation
- Lower construction costs

ENHANCED BIOLOGICAL PERFORMANCE

- Low sludge volume
- Enhanced nutrient removal
- Quick response to changing influent conditions
- No washout of activated sludge during peak storm flows

LOWER OPERATING COST

- Reduced power
- Reduced maintenance
- Nutrient removal without costly chemicals

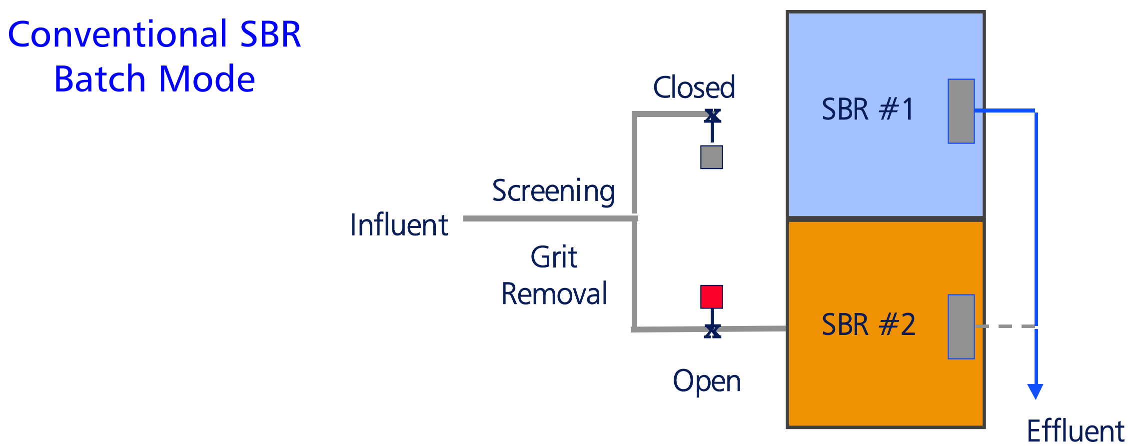
DESIGN FLEXIBILITY

- Easily expandable
- Hydraulic peaks easily accommodated
- Handles shock loads without degradation of final effluent quality
- Control system provides high flexibility

While the conventional SBR system has many advantages, it does have some shortcomings. These include:

- It must be designed with a minimum of either two reactors, (see Figure 4) or an equalization/storage tank in conjunction with a single reactor. These configurations are required to allow continuous acceptance and treatment of the influent. During the react, settle and decant phases of the cycle, flow is diverted to the other basin or to the storage tank.

Figure 4



- When conventional SBR systems are considered for smaller treatment plant applications, two basin designs are typically evaluated. However, due to the batch nature of the process, one basin can not be readily taken out of service for maintenance purposes. In addition, a single tank operational mode cannot be easily utilized for low flow situations.

- For most municipal treatment facilities and some industrial applications, flow and loadings to a plant vary according to a diurnal cycle. With a conventional SBR system, this results in unequal mass and hydraulic loadings to each reactor in a multi-reactor facility. The loadings to a specific reactor are dependent on when it is receiving flow during the diurnal flow variation. The variation in loadings causes differences in the biomass and oxygen demand of the individual reactors. This complicates the operational control of the treatment plant resulting in the need for additional testing, a more intensive instrumentation/control system and greater operator attention to the system.

- The batch treatment approach of conventional SBRs typically incorporates a water level based control system. That is, the duration of the daily process cycles are subject to change based on the specific inflow to a reactor. Since diurnal flow variations occur, the cycling results in different actual aeration times for the biological reactions. This can lead to difficulty in controlling the process and cycling/switchover of the blowers.

- For Biological Nutrient Removal systems, a continuous carbon source is beneficial in maintaining consistent performance. Organic compounds in the raw influent to such secondary treatment systems are typically used as the source of the carbon. Conventional SBR systems however periodically interrupt this food source especially during the react phase. This lowers the removal of nitrogen and phosphorus and may necessitate expensive chemical additions to enhance biological nutrient removal.

ABJ® ICEAS® PROCESS

The ABJ ICEAS process is a modification and enhancement of the superior technology of the conventional SBR. ICEAS, an acronym for Intermittent Cycle Extended Aeration System, allows continuous inflow of wastewater to the basin. Influent flow to the ICEAS basin is not interrupted during the settle and decant phases or at any time during the operating cycle.

A typical ICEAS process consists of the following time-based phases as illustrated in Figure 5:

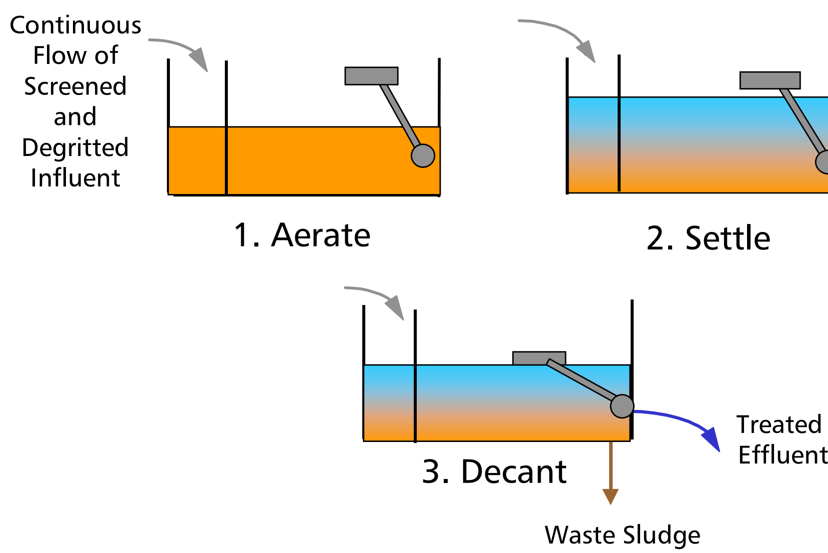
Aerate: Raw wastewater from screening and grit removal flows into the basin and mixes with the mixed liquor. The basin is aerated while filling and biological oxidation takes place simultaneously.

Settle: Aeration is stopped and the solids settle to the bottom of the basin leaving clear water on top. The basin continuously receives the influent.

Decant: The clear water is discharged from the top of the basin, while the basin continuously receives the influent. Typically, sludge is wasted during this phase of the cycle.

Figure 5

ICEAS Operating Cycle



Influent is received continuously during all phases of the cycle, including settle and decant. This allows the ICEAS process to be controlled on a time, rather than flow basis and ensures equal loading and flow to all basins. Use of a time-based control system in the ABJ ICEAS process facilitates simple changes to the process control program. The duration of each cycle and segment of each operating cycle are the same among all basins in a time-based system. Therefore, changes to the process are made simply by changing the duration of individual segments. In a flow-based conventional SBR, cycle times and individual segments of each cycle may be different among basins due to diurnal flow variations. Thus, it is not possible to simply affect a change to the entire system. In essence, separate control must be maintained over each basin in the SBR system.

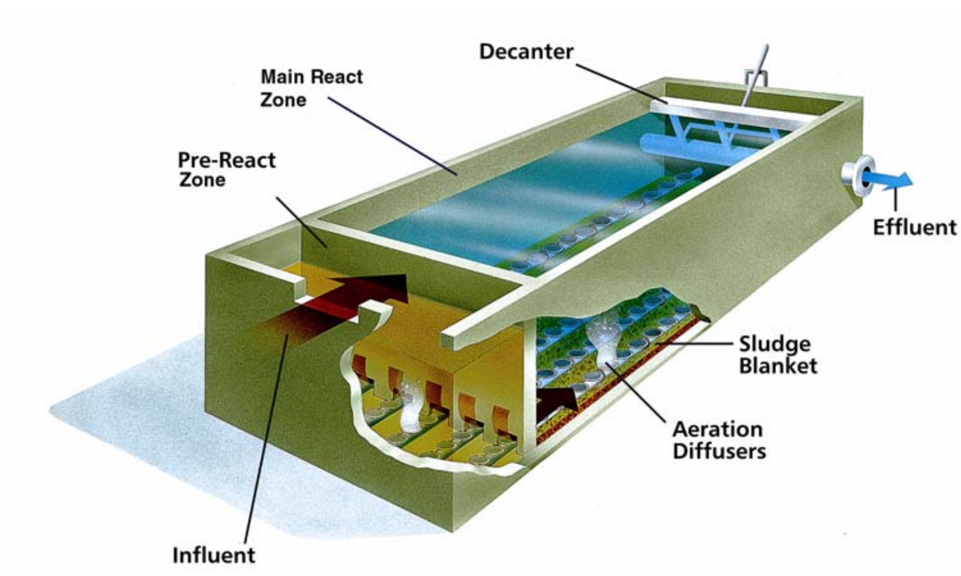
Single basin operation is also possible in the ICEAS process. The process does not require automatic influent control valves or an additional basin to hold diverted flow. This eliminates the need for designated fill and idle phases resulting in smaller basins.

The ICEAS process can be designed to accommodate peak flows up to 6 times the average flow to the plant. This flexibility is facilitated by the ability of the ICEAS to accommodate influent during all phases of the cycle. Peak flows are spread evenly among all operating basins. Typically, a separate cycle with a shorter duration is used to accomplish this flexibility.

ICEAS BASIN

The ICEAS basin is divided into two zones, the pre-react zone and the main react zone as shown in Figure 6. A non-hydrostatic baffle wall with openings at the bottom is constructed to divide the ICEAS basin into the two zones. The influent flows continuously into the pre-react zone and is directed down through engineered orifice openings at the bottom of the baffle wall into the main react zone. The pre-react wall baffles the incoming flow and prevents short-circuiting. The volume of the pre-react zone is typically 10 to 15 percent of the total basin volume.

Figure 6



BIOLOGICAL SELECTOR

The pre-react zone also provides pre-treatment of the wastewater before it enters the main react zone. Since influent flows continuously into the pre-react zone, a high concentration of soluble BOD is available to the microorganisms in a relatively small basin volume. This situation creates a high "Food to Microorganisms" (F:M) ratio. The high F:M ratio encourages the maximum bio-sorption of food by the microorganisms. The pre-react zone therefore acts as a biological selector encouraging the proliferation of the most desirable organisms. The presence of the biological selector at the front end of the ICEAS basin minimizes the growth of filamentous bacteria that cause sludge bulking and poor settling.

ICEAS BASIN SIZING

BASINS

Typically, concrete basins are used. However, in some cases, steel is used depending on the cost evaluation of the plant construction. The number of basins used in the ICEAS process is a function of flow and loading to the plant and the guidelines established by individual Government Agencies. Sanitaire has experience in designing systems built using a single basin to a multitude of parallel basins. The continuous flow feature of the ICEAS process facilitates single basin system design and operation without the need for influent flow equalization or a second basin.

BASIN HYDRAULICS

Time based cycles are used in sizing the ICEAS process. A normal cycle is designed to handle the Average Dry Weather Flow (ADWF) and Peak Dry Weather Flow (PDWF) to the plant. A storm cycle is used to handle the storm flows. The storm cycle operates with a shorter duration compared to the normal cycle so that higher flows can be processed by the system. Typically, the ICEAS process can be designed to handle 3 to 6 times the average flow conditions. The maximum volume required for the average, peak and storm flows are determined based on the cycle times. This volume is the total flow received by the basin from the start of the cycle until the beginning of the decant phase and is defined as basin "Drawdown". The basin drawdown extends from the designated Top Water Level (TWL) to the Bottom Water Level (BWL). The ability to accommodate a Peak Wet Weather Flow (PWWF) of 6 times the ADWF is due to many ICEAS concepts. The ability to have a special "storm" cycle with decanter speed control is very important. ***This cannot be achieved with conventional SBRs using fixed or floating decanters***. SBR's with floating decanters are usually limited to a PWWF of 3 times the ADWF.

PROCESS KINETICS

The influent BOD and ammonia loadings determine the mass of biomass required in the basin. Typically, F:M ratios are used in determining the mass of the biomass for a given BOD loading in conjunction with minimum sludge age requirements for the nitrification process. The typical Food:Microorganism (F:M) ratios used in design of the ICEAS process are in the range of 0.05 to 0.12 lb. BOD/lb. MLSS/day. The Sludge Volume Index (SVI) is used to determine the volume occupied by the calculated mass of biomass in the basin. The Typical SVI value used in the design of the ICEAS process is in the range of 150 to 200 ml/g. In each cycle, a measured amount of sludge is wasted. This allows the ICEAS process to operate in a steady state condition maintaining a desired Mixed Liquor Suspended Solids (MLSS) concentration and Mean Cell Residence Time (MCRT) or Sludge Age (SA).

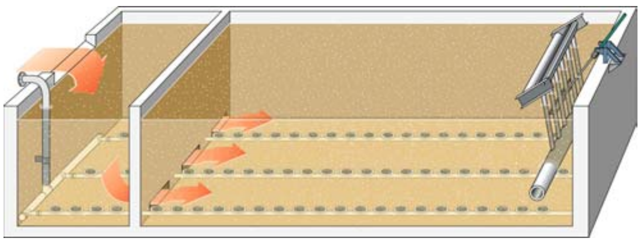
BUFFER ZONE

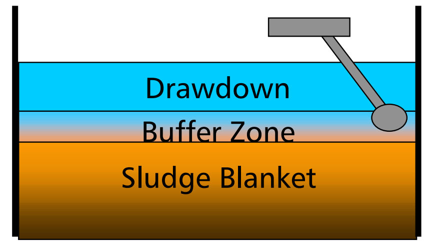
The design volume of the basin is based on a combination of the volume required for the hydraulics based on the peak wet weather flow conditions and the volume occupied by the sludge. A "Buffer Zone" is included in the design as a safety factor to ensure the ICEAS process's ability to withstand the unusual flows and loadings that are typical in wastewater treatment plants. This zone is typically a minimum of three feet deep, extending from the top of sludge blanket to the BWL after decanting.

BASIN DIMENSIONS

The basin depth is a combination of the sludge blanket, the buffer zone and the drawdown as shown in Figure 7. The basin area is calculated using a designated TWL. Typically, the length and width of the basin is calculated such that, a L:W ratio of 3:1 is maintained. This ratio creates a plug flow pattern in the ICEAS basin.

Figure 7





ICEAS PROCESS DESIGN & OPERATION

The ICEAS process offers the following design options to maximize the flexibility of the plant operation and to meet its discharge permit requirements.

ICEAS-NIT Process

Designed for the Removal of:

- BOD
- TSS
- Ammonia and Total Nitrogen (Partial Denitrification)

Typically Used for:

- Municipal Wastewater
- Industrial Wastewater

Nitrification and BOD removal is accomplished in the ICEAS process during the aeration phase of the cycle as shown in Figure 8. The ICEAS basin is designed with F:M ratios and sludge ages suitable to maintain sufficient MLSS in the basin and to achieve the required degree of nitrification based on the temperature range and pH of the influent wastewater. The blowers and aeration system are designed to ensure a sufficient supply of oxygen as required for the process.

A typical operating cycle for a two-(2) basin ICEAS-NIT process is shown in Figure 9. The first half of the cycle is continuously aerated to achieve BOD removal and nitrification. After the aeration phase, the system enters a settling phase where liquid/solids separation occurs. The system then enters the decant phase, where treated effluent is decanted from the basin. The duration of the aeration phase in the four-hour cycle allows one blower to provide air to two basins using motorized air control valves. When Basin #1 is in the aeration phase, Basin #2 is in the settle or decant phase. When Basin #2 is in the aeration phase, Basin #1 is in the settle or decant phase.

The 3-hour storm cycle for the same application is shown in Figure 10. It is of interest to note that the overall aeration, settle and decant times per day remain the same as the normal cycle. It is only the duration per cycle that is changed to accommodate higher flows to the plant. ***SBR systems using fixed or floating type decanters cannot offer this flexibility without affecting the overall duration of the aeration and settle phases on a daily basis***.

Figure 8

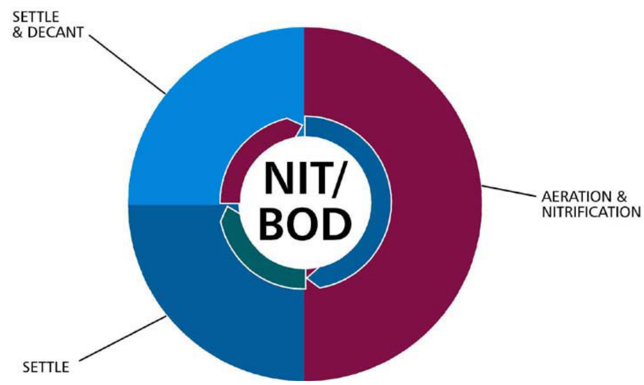


Figure 9

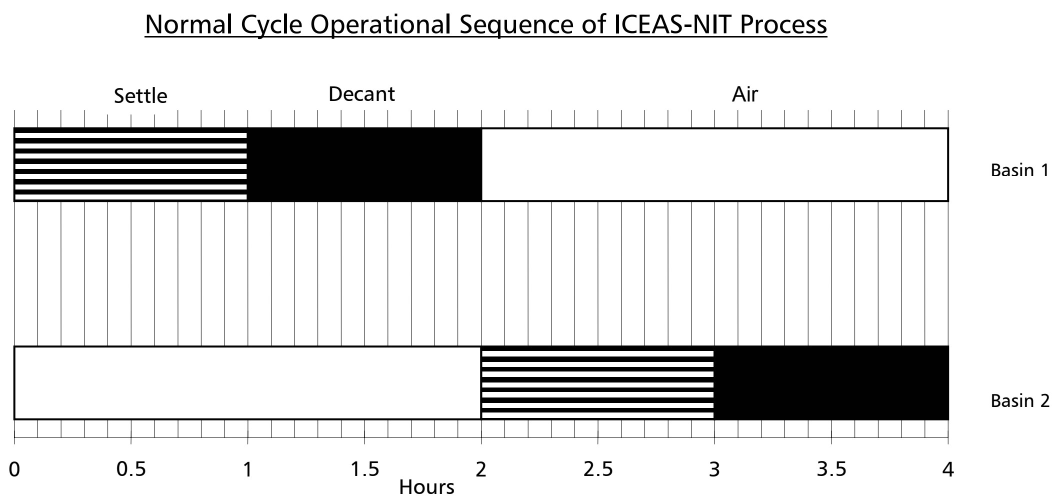
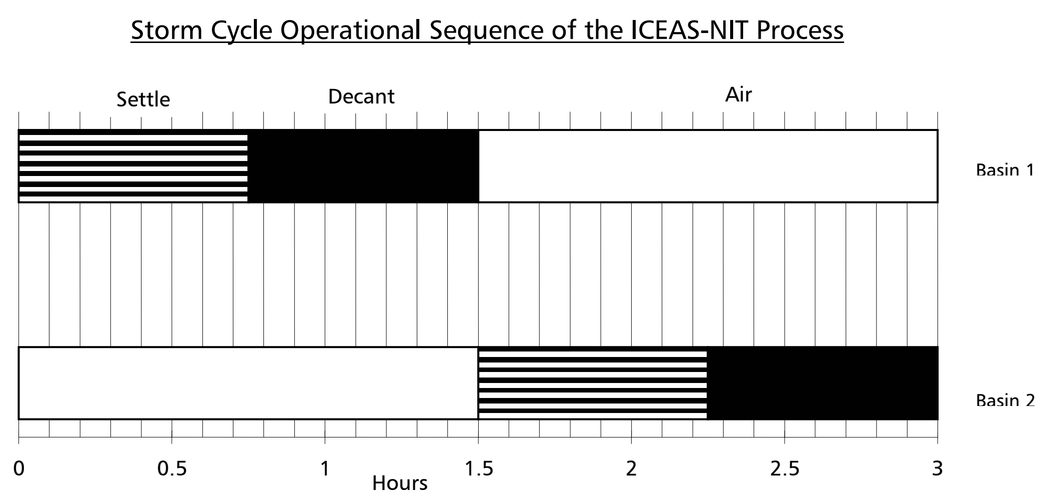


Figure 10



Cycle bar charts depicting the normal and storm cycles for the ICEAS-NIT process using four basins are shown in Figures 11 and 12. The control system provides the flexibility of changing blower run time proportional to the influent flow and loading to the plant. Additional controls such as dissolved oxygen probes in the ICEAS basin with blower output control can be provided.

Figure 11

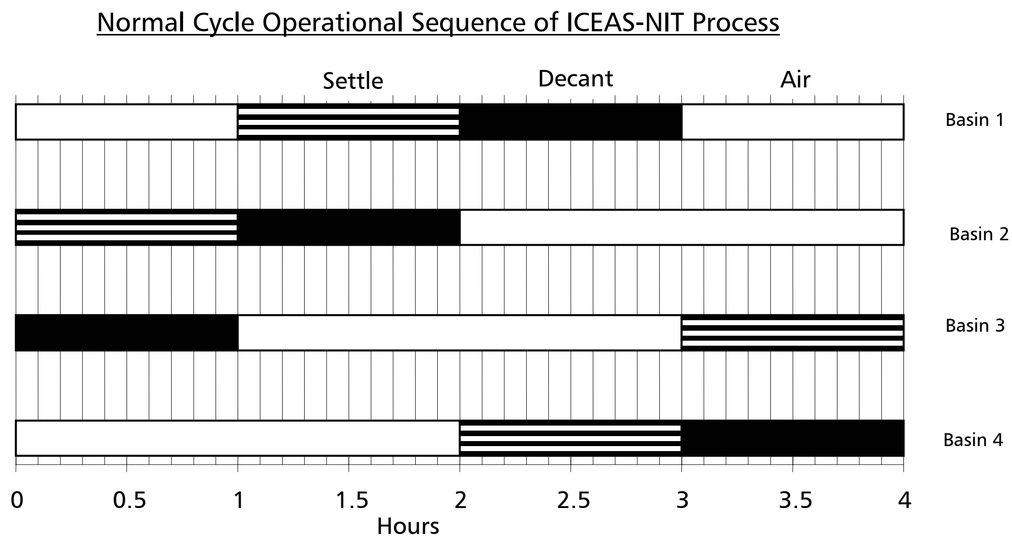
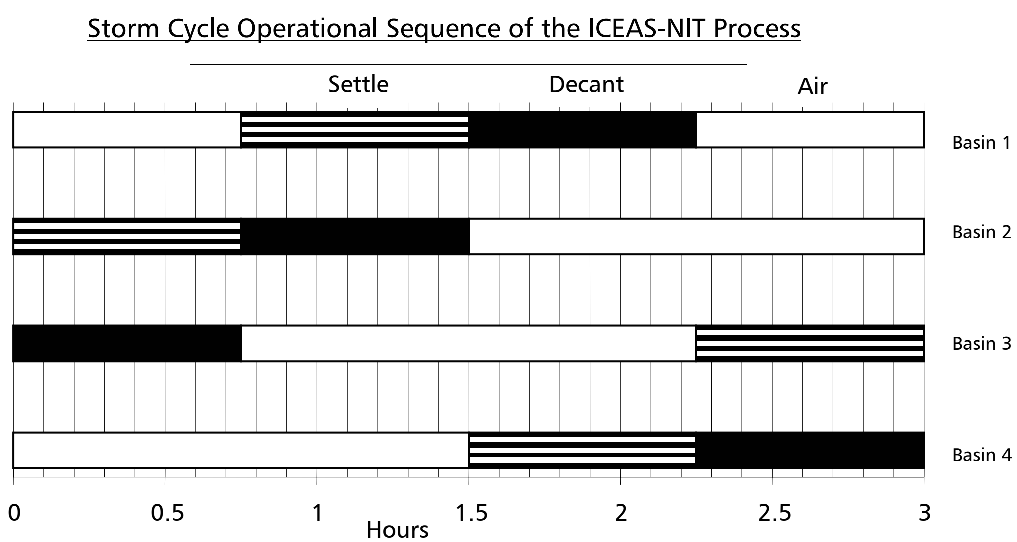


Figure 12



ICEAS-NDN PROCESS: BIOLOGICAL NUTRIENT REMOVAL (BNR)

Designed for the Removal of:

- BOD
- TSS
- Ammonia
- Total Nitrogen
- Total Phosphorous

Typically Used for:

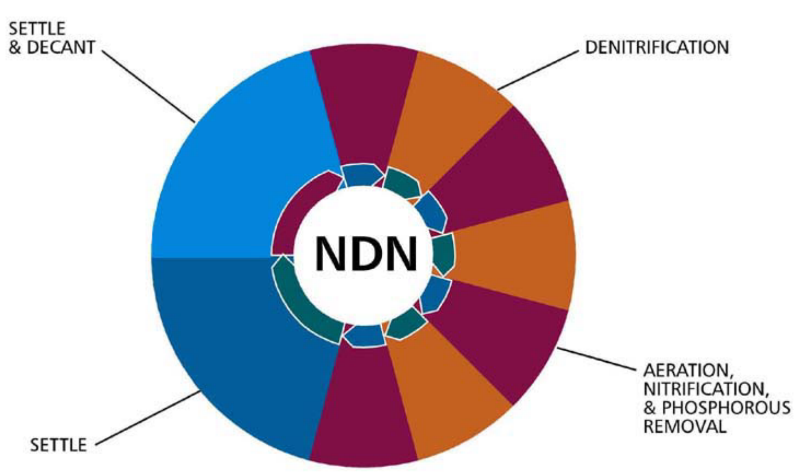
- Municipal Wastewater
- Industrial Wastewater

Biological nutrient removal is accomplished in the ICEAS-NDN process by incorporating alternating phases of oxic-anoxic/anaerobic (air on-air off) conditions in the cycle as shown in Figure 13. The ICEAS basin is sized to ensure complete nitrification, denitrification and to maximize the total biological phosphorus removal.

Typical normal and storm cycles using 2 basins for the ICEAS-NDN process are shown in Figure 14 and 15. The aerobic phases promote BOD removal, nitrification and phosphorus uptake. The anoxic/anaerobic (air off) phases promote denitrification and phosphorus release. Nitrification rates and sludge age requirements for the nitrification process are calculated based on the temperature range and pH of the influent wastewater.

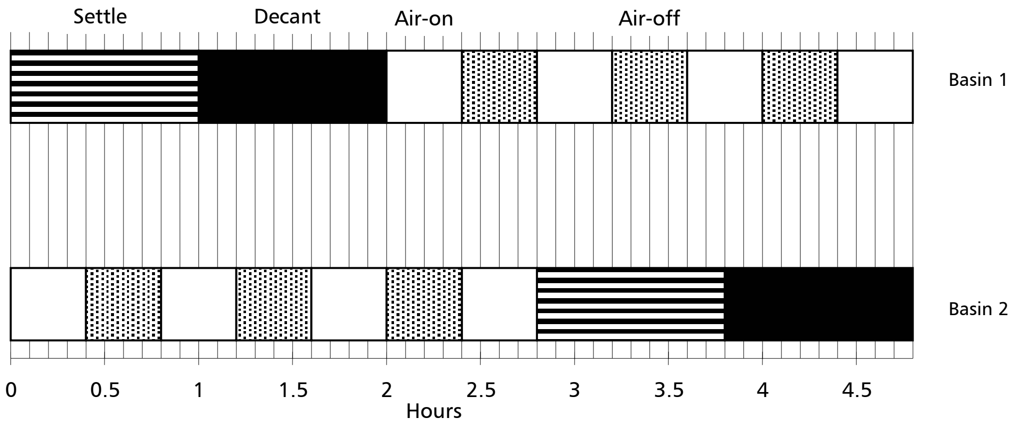
The degree of denitrification and phosphorus removal achieved by the ICEAS-NDN process is dependant on the influent BOD/TN and BOD/TP ratios. The typical blower control for the ICEAS-NDN process involves a D.O. control system with blower output control.

Figure 13



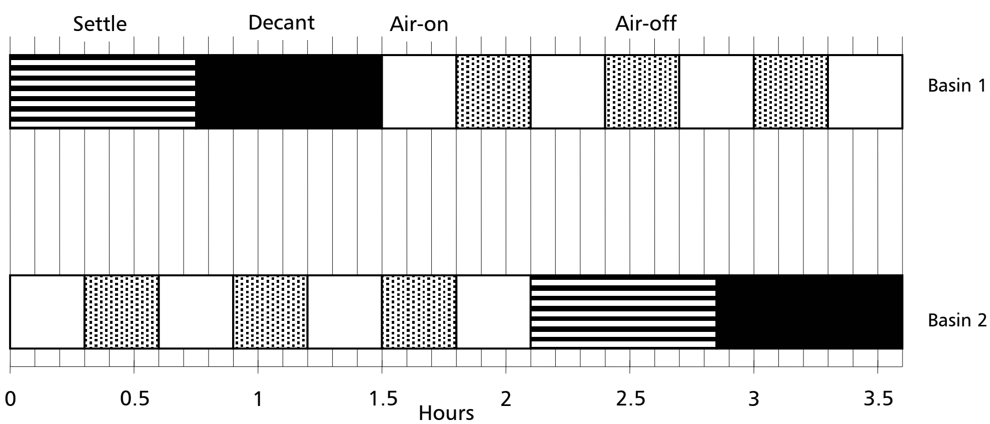
Normal Cycle Operational Sequence of ICEAS-NDN Process

Figure 14



Storm Cycle Operational Sequence of the ICEAS-NDN Process

Figure 15



The cycle charts for the ICEAS-NDN process operating in normal and storm cycles using four basins are shown in Figures 16 and 17.

Figure 16

Normal Cycle Operational Sequence for the ICEAS-NDN Process

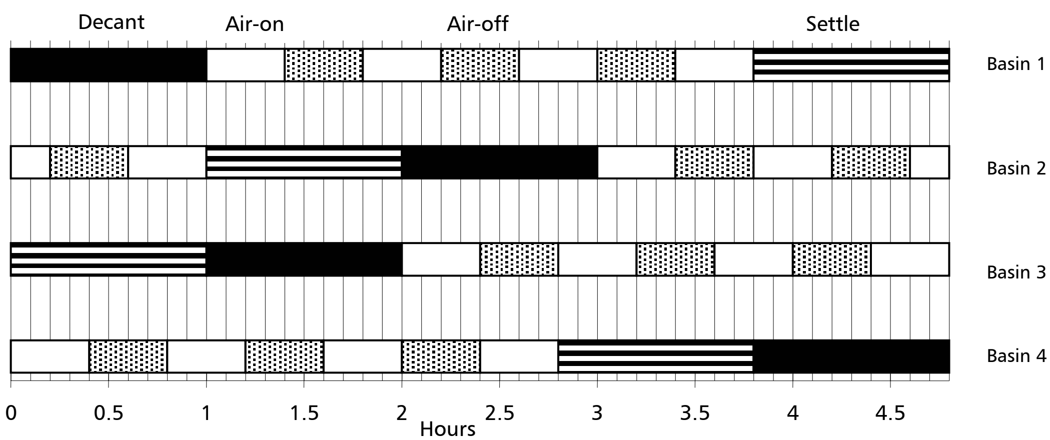
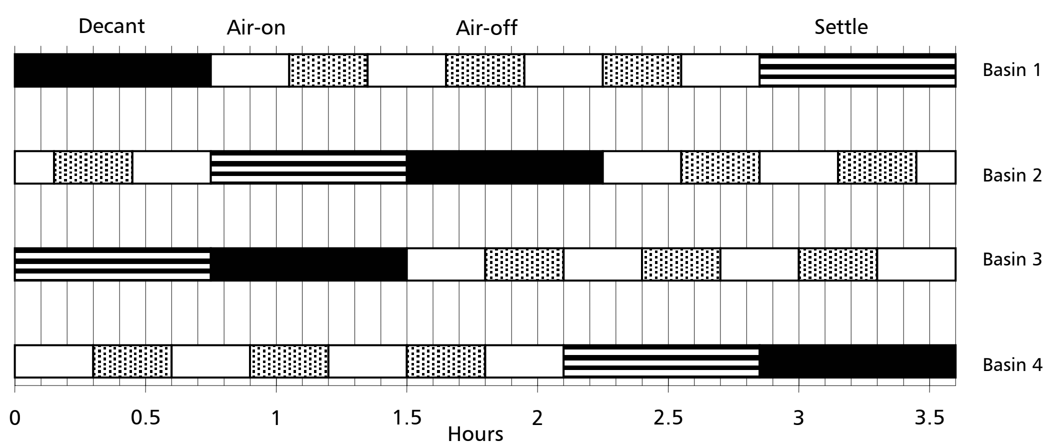


Figure 17

Storm Cycle Operational Sequence of the ICEAS-NDN Process



EXPANSION POTENTIAL

The ICEAS process design allows simplified expansion because each basin forms a modular treatment unit. The ICEAS process is ideal for a growing community requiring wastewater treatment. The installation shown in Figure 18 is a facility designed for an ultimate flow of 2.0 MGD. During Phase-I, the plant was built with a design capacity of 0.25 MGD using two basins. It was expanded to 0.5 MGD in Phase-II by adding one additional basin with a capacity of 0.25 MGD. In serving the growth of the community, the plant was expanded again in Phase-III through the addition of one basin with 0.5 MGD capacity bringing the overall capacity to 1.0 MGD. This plant will continue to expand in the future.

It is of interest to note that all the basins have been built with common wall construction. This is achieved by maintaining the same length for all tanks and increasing the width appropriately. The blower equipment is also sized proportionately to the capacity of each basin such that the same blowers are used before and after expansion.

Figure 18

Phased Expansion of the ICEAS-NDN Process for a Growing Community

GENERAL ADVANTAGES OF THE ABJ ICEAS PROCESS COMPARED TO BATCH SYSTEMS

- Proven process which enhances the standard SBR system through strategic cost, operating and biological advantages
- Continuous inflow provides equal loading and flow to all basins, simplifying operation and process control. It enables single basin operation for maintenance and low flow conditions.
- Incorporates a time, not flow-based control system that enables a constant relationship between aeration, settling and decanting. Provides the same aeration time per day regardless of the cycle time.

BIOLOGICAL AND PROCESS ADVANTAGES

Biological Effluent Quality

- Proven effluent quality below 10 mg/l BOD_5 and TSS
- Proven nutrient removal quality below 1 mg/l Ammonia-N, 1 mg/l total phosphorus and 5 mg/l total nitrogen
- Low volume of highly stabilized sludge – dewaters easily
- Pre-react Zone
    - Enhances bacterial growth with good settling characteristics while minimizing the formation of filamentous organisms
    - Allows continuous operation without short-circuiting
    - Enhances nutrient removal
    - Confines floating material for manual removal
- No chemicals/filters required
- Suitable for municipal/industrial wastewater treatment

Hydraulic and Organic Loading

- Can be designed to accommodate hydraulic peaks up to 6 times average design flow without sludge washout
- No separate influent equalization basin needed, redundant tankage eliminated
- Automatic activation of storm cycle during storm flows
- Equal loading to all basins at all times
- Easily expandable for future needs (modular system)

EQUIPMENT DESIGN ADVANTAGES

Decanter Design

- Easy to install
- Easy accessibility from basin walkway
- In "Park Position," acts as safety overflow weir
- Stainless steel design – robust/corrosion resistant
- Prolonged life
- No flexible, costly, high maintenance knee joints, as needed for floating decanters
- No submerged valves or orifices, which are prone to plugging

Electrical Design

- In-house electrical engineers to coordinate control requirements with biological functions to maximize flexibility with ease of maintenance
- Control system designed to suit overall plant control needs
- Modem to facilitate fault-finding
- SCADA system for remote access

COST ADVANTAGES

- Reduced capital cost when designed as an ICEAS continuous flow process
- Up to 30% less basin volume to achieve same operating performance as an SBR
  - Less Concrete
  - Less Excavation
  - Smaller Land Area
- If others size basins as an SBR, then operating the process as an ICEAS will allow up to 30% greater flow

Reduced Operating Cost

- No supplemental mixing required for aeration system
- Proven D.O. control system for optimizing energy usage
- Ultra high efficient SANITAIRE® Fine Bubble Aeration minimizes energy used for aeration

Reduced Installation Cost

- No influent or effluent control valves
- No retrievable equipment required
- Decanter easy to install

Reduced Maintenance Cost

- No influent or effluent control valves
- Continuous flow enables shut down of one basin to facilitate maintenance of equipment when required
- Retrievable aeration facilities not required
- Decanter easy to service from walkway

INDUSTRIAL WASTEWATER TREATMENT

Inherent flexibility gained through automated control systems and adaptability to high flow and loading fluctuations make SBR systems well suited for the treatment of wastewater originating from industrial facilities. ABJ SBR and the ICEAS process technology are applicable for both pre-treatment and complete secondary treatment.

ABJ SBR and ICEAS technology have been applied in the treatment of several types of industrial effluent including:

- Pulp and Paper
- Meat Packaging
- Pharmaceutical
- Food Processing
- Dairy Industry
- Textile
- Bottling Plants
- Chemical & Agricultural Products
- FGD

SANITAIRE® Fine and Coarse Bubble Aeration systems are tailored specifically for each application to sustain the performance and longevity of the diffusers. Special supports and piping fixtures are used to provide redundancy, thus eliminating the need to take tanks out of service for maintenance.

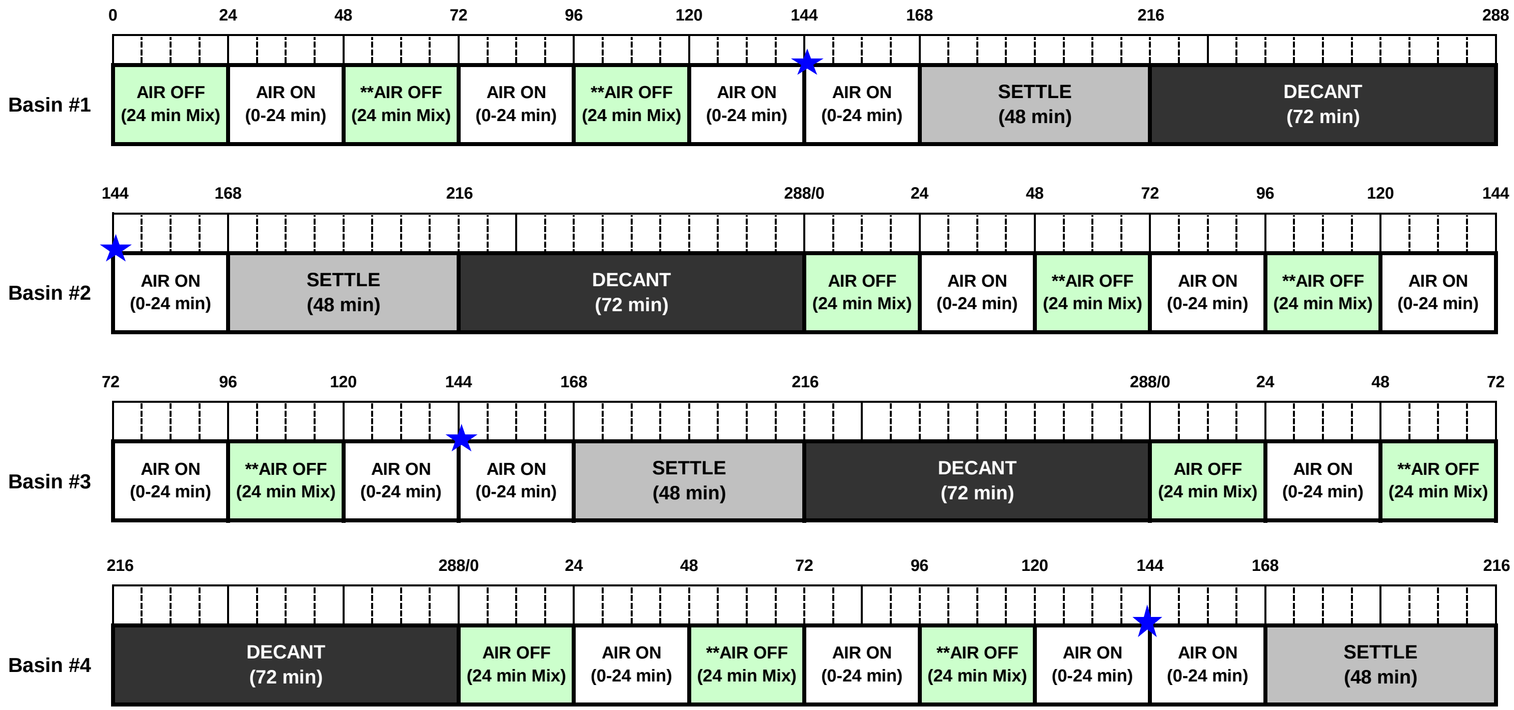
The decanter mechanisms are constructed completely of 304L or 316L stainless steel to provide maintenance free operation in corrosive environments.

The ergonomic and robust system design facilitates a simple process with minimal mechanical and electrical components. In addition, the state of the art control system design with SCADA runs the process with minimal input from the plant operators.

Typical plant profiles are included for your review.

Project Name: Whitefish, MT
Sanitaire Number: 25730-15A

ICEAS 4-Basin NDNP Normal Cycle 288 mins (4.8 hours)



Notes:

Each basin fills continuously over entire cycle. Basins #1 and #2 share blowers and Basins #3 and #4 share blowers.

** "Air Off" periods that do not overlap with the other basin can be aerated if needed.

"Air On" periods in the react phase are programmable from 0 to 24 minutes.

Chemical addition should be made at the beginning of the last air period to allow for mixing.

Sludge wasting occurs during the decant phase, pump run time is programmable.

Project Name: Whitefish, MT
Sanitaire Number: 25730-15A

ICEAS 4-Basin NDNP High Flow Mode 216 mins (3.6 hours)

Basin #1

0	18	36	54	72	90	108	126	162	216
AIR OFF (18 min Mix)	AIR ON (0-18 min)	**AIR OFF (18 min Mix)	AIR ON (0-18 min)	**AIR OFF (18 min Mix)	AIR ON (0-18 min)	AIR ON (0-18 min)	SETTLE (36 min)	DECANT (54 min)	

Basin #2

108	126	162	216/ 0	18	36	54	72	90	108
AIR ON (0-18 min)	SETTLE (36 min)	DECANT (54 min)	AIR OFF (18 min Mix)	AIR ON (0-18 min)	**AIR OFF (18 min Mix)	AIR ON (0-18 min)	**AIR OFF (18 min Mix)	AIR ON (0-18 min)	

Basin #3

54	72	90	108	126	162	216/ 0	18	36	54
AIR ON (0-18 min)	**AIR OFF (18 min Mix)	AIR ON (0-18 min)	AIR ON (0-18 min)	SETTLE (36 min)	DECANT (54 min)	AIR OFF (18 min Mix)	AIR ON (0-18 min)	**AIR OFF (18 min Mix)	

Basin #4

162	216/ 0	18	36	54	72	90	108	126	162
DECANT (54 min)	AIR OFF (18 min Mix)	AIR ON (0-18 min)	**AIR OFF (18 min Mix)	AIR ON (0-18 min)	**AIR OFF (18 min Mix)	AIR ON (0-18 min)	AIR ON (0-18 min)	SETTLE (36 min)	

Notes:
Each basin fills continuously over entire cycle. Basins #1 and #2 share blowers and Basins #3 and #4 share blowers.
** "Air Off" periods that do not overlap with the other basin can be aerated if needed.
"Air On" periods in the react phase are programmable from 0 to 18 minutes.
Sludge wasting occurs during the decant phase, pump run time is programmable.

DESIGN PROPOSAL

Whitefish, MT Sanitaire #25730-15

Table A: INFLUENT WASTEWATER CHARACTERISTICS AND SITE CONDITIONS

Average Dry Weather Flow		1,507,000	GPD
Max. 4.8-Hour Cycle Flow		3,450,000	GPD
Max. 3.6 Hour Cycle Flow		4,600,000	GPD
BOD_5 (20°C)		300	mg/l
BOD_5 (20°C)	(Max. Day used for Design)	3,771	lb/day
Suspended Solids		240	mg/l
TKN		42	mg/l
Total Phosphorus		6	mg/l
Max Wastewater Temperature		15	°C
Min Wastewater Temperature		5	°C
Ambient Air Temperature		20 - 90	°F
Site Elevation		6,820	ft

Table B: ICEAS® EFFLUENT QUALITY (MONTHLY AVERAGE)

BOD_5 (20°C)	30	mg/l	(10/10/1 : BOD/TSS/NH3-N Anticipated)
Suspended Solids	30	mg/l	
NH_3-N	9	mg/l	
TN	10	mg/l	
Total Phosphorus	1.0	mg/l	

*Chemical P-Removal Recommended as BackUp

Table C: ICEAS PROCESS DESIGN CRITERIA

F / M	0.039	lb BOD5/ lb MLSS / day
SVI (after 30 minutes settling)	150	ml/g
MLSS at Bottom Water Level	5,298	mg/l
Waste Sludge Produced (Approx.)	2,387	lb/day
Volume of Sludge Produced (Approx., 0.85% solids)	33,700	GPD
Normal Decant Rate	2,396	GPM
Peak Decant Rate	3,194	GPM
Hydraulic Retention Time	1.59	Days
Sludge Age	38.3	Days
Alkalinity	148	mg/l

Bold, italicized text indicate assumptions made by Sanitaire

CYCLE	AIR-OFF	AIR-ON	SETTLE	DECANT	TOTAL
Normal	72 min	96 min	48 min	72 min	4.8 hour
Storm	54 min	72 min	36 min	54 min	3.6 hour

Table D: KEY ICEAS DESIGN DETAILS

Number of ICEAS Basins	4	
Top Water Level	18.0	ft
Basin Width (Inside)	40.0	ft
Basin Length (Inside)	126.0	ft
Bottom Water Level	14.5	ft

ICEAS EQUIPMENT			Motor HP	No. Req.
Decanter Mechanism	17.5 ' Weir length			4
Decanter Drive Unit			1/2	4
ICEAS Blower	1,440 SCFM	8.5 PSIG	125	3
ICEAS Fine Bubble Aeration System				4
Air Control Valve	10 "			4
Waste Sludge Pump	169 GPM		3.0	4
Submersible Mixer			15.0	4
ICEAS Controls				1

ICEAS POWER REQUIREMENTS		**(At Average Aeration Depth)**			Kwh/Day
Decant Drive Unit	0.4 BHP	4 run	@	6 Hrs/day	7.2
ICEAS Air Blowers	105.0 BHP	2 run*	@	16 Hrs/day	2,506.6
Waste Sludge Pump	2.4 BHP	4 run	@	0.8 Hrs/day	6.0
Submersible Mixer	12.0 BHP	4 run	@	6 Hrs/day	214.8
				KWH/DAY	2,734.6
			AVERAGE	KWH/HR	113.94

* Shared ICEAS Blowers (1-Duty Blower for a Pair of Basin & 1-Common Standby)

SANITAIRE ICEAS Detailed Design Calculations
BOD Removal, Nitrification, and De-Nitrification Process

SANITAIRE Project #25730-15
Whitefish, MT

Design Parameters

A. Flow

Average Daily Flow	1,507,000 GPD	
Peak Dry Weather Flow	3,450,000 GPD	Max. 4.8-Hr Cycle Flow
Peak Wet Weather Flow	4,600,000 GPD	Max. 3.6-Hr Cycle Flow

B. Treatment

	Influent Quality	Effluent Requirement
BOD_5 (20°C), mg/l	300	10
Suspended Solids, mg/l	240	10
TKN, mg/l	42	
NH_3-N, mg/l	0	1
TN, mg/l		10
Phosphorus	6	1

C. Environment

Alkalinity (Minimum Requirement)	150 mg/l
Max Wastewater Temperature	15 °C
Min Wastewater Temperature	5 °C
Ambient Air Temperature	20 - 90 °F
Site Elevation	6,820 ft

D. ICEAS Process Design Criteria

F / M	0.039 BOD_5 / MLSS / day
SVI (after 30 minutes settling)	150 ml/g
Number of ICEAS Basins	4
Top Water Level	18 ft

E. Cycle Timing

		Normal	Storm
Air-On	min	96	72
Air-Off	min	72	54
Settle	min	48	36
Decant	min	72	54
Total	hrs	4.8	3.6

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F. Detailed Calculations

Mass of Biomass

$$BODL = \frac{Q \times BODin \times 8.34}{1{,}000{,}000} = \frac{376{,}750 \times 300 \times 8.34}{1{,}000{,}000} = \textbf{943 lb/day/basin}$$

where: BODL = BOD Load (lb/day/basin)
Q = Average Dry Weather Flow per basin (gal/day)
BODin = Influent BOD concentration (mg/l)
1,000,000 = Conversion (l/mg)
8.34 = Conversion (lb/gal)

Mass of Biomass

$$BMOB = \frac{BOD_L}{F / M} = \frac{943}{0.0392} = \textbf{24,043 lb/basin}$$

where: BMOB = Mass of Biomass (lb/day/basin)
F / M = Food to Microorganism ratio (day^{-1})

Volume of Biomass

$$Vbio = BMOB \times SVI = 24{,}043 \times 2.4 = \textbf{57,704 ft}^3\textbf{/basin}$$

where: Vbio = Volume of Biomass (ft^3/basin)
SVI = Sludge Volume Index (ft^3/lb)

Maximum Volume Above Bottom Water Level

Peak Dry Weather Flow:

$$Vbwld = \frac{PDWF \times (NCT - NDT)}{24 \times 7.48} = \frac{862{,}500 \times (4.8 - 1.20)}{24 \times 7.48} = \mathbf{17{,}296\ ft^3/basin}$$

where: Vbwld = Maximum Volume Above BWL at Peak Dry Weather Flow (ft^3/basin)
PDWF = Peak Dry Weather Flow (gal/day)
NCT = Normal Cycle Time (hr/cycle)
NDT = Decant Time (hr/cycle)
7.48 = Conversion (gal/ft^3)
24 = Conversion (hours/day)

Peak Wet Weather Flow:

$$Vbwls = \frac{PWWF \times (SCT - SDT)}{24 \times 7.48} = \frac{1{,}150{,}000 \times (3.6 - 0.90)}{24 \times 7.48} = \mathbf{17{,}296\ ft^3/basin}$$

where: Vbwls = Maximum Volume Above BWL at Peak Wet Weather (Storm) Flow (ft^3/basin)
PWWF = Peak Wet Weather Flow (gal/day)
SCT = Storm Cycle Time (hr/cycle)
SDT = Storm Decant Time (hr/cycle)

MVAB (Maximum Volume Above Bottom Water Level) is larger of Peak Dry Weather and Peak Wet Weather Calculation

MVAB = **17,296 ft^3/basin**

Decant Rates

Peak Dry Weather Flow:

$$PDR = \frac{MVAB \times 7.48}{NDT} + \frac{PDWF}{1{,}440} = \frac{17{,}296 \times 7.48}{72.0} + \frac{862{,}500}{1{,}440} = \mathbf{2{,}396\ gal/min}$$

where: PDR = Normal Decant Rate (gal/min)
NDT = Normal Decant Time (min/cycle)
1440 = Conversion (min/day)

Peak Wet Weather Flow:

$$PWR = \frac{MVAB \times 7.48}{SDT} + \frac{PWWF}{1{,}440} = \frac{17{,}296 \times 7.48}{54.0} + \frac{1{,}150{,}000}{1{,}440} = \mathbf{3{,}194\ gal/min}$$

where: PWR = Peak Decant Rate (gal/min)
SDT = Storm Decant Time (min/cycle)

Decanter Sizing

Peak Dry Weather Flow:

$$DLa = \frac{PDR}{\text{Weir Loading Rate} \times 7.48} = \frac{2{,}396}{20 \times 7.48} = \mathbf{16.01\ ft}$$

where: DLa = Decanter Length for Average Dry Weather Flow (ft)
20 = Weir Loading Rate (ft^3/min/ft of decanter weir)

Peak Wet Weather Flow:

$$DLp = \frac{PWR}{\text{Weir Loading Rate} \times 7.48} = \frac{3{,}194}{25 \times 7.48} = \mathbf{17.08\ ft}$$

where: DLp = Decanter Length for Peak Wet Weather (Storm) Flow (ft)
25 = Weir Loading Rate (ft^3/min/ft of decanter weir)

Design Decanter Length =	**17.5 ft**

Basin Working Volume

$$BWV = MVAB + Vbio = 17{,}296 + 57{,}704 = \mathbf{75{,}000\ ft^3/basin}$$

where: BWV = Basin Working Volume (ft^3/basin)

Basin Area

$$BA = \frac{BWV}{TWL - BZ} = \frac{75{,}000}{18.0 - 3.0} = \mathbf{5{,}000\ ft^2/basin}$$

where: BA = Basin Area (ft^2)
TWL = Top Water Level (ft)
BZ = Buffer Zone (ft) (Safety Factor)

Sludge Depth

$$SD = \frac{Vbio}{BA} = \frac{57{,}704}{5{,}000} = \mathbf{11.54\ ft}$$

where: SD = Sludge Depth (ft)

Decanter Draw Down

$$DD = \frac{MVAB}{BA} = \frac{17{,}296}{5{,}000} = \mathbf{3.46\ ft}$$

where: DD = Draw Down (ft)

Bottom Water Level

$$BWL = SD + BZ = 11.54 + 3.00 = \mathbf{14.54\ ft}$$

where: BWL = Bottom Water Level (ft)
Vd = Depth of Chemical Sludge for Phosporus precipitation (ft)

Top Water Level

$$TWL = BWL + DD = 14.54 + 3.46 = \mathbf{18.00\ ft}$$

where: TWL = Top Water Level (ft)

Hydraulic Retention Time

$$HRT = \frac{BA \times MAFD \times 7.48}{QT}$$

where: HRT = Hydraulic Retention Time (days)
MAFD = Maximum Average Flow Depth (ft)
QT = Fill Rate at Average Dry Weather Flow (gal/day)

$$MAFD = \frac{Q \times [(NCT \times 60) - NDT]}{BA \times 1{,}440 \times 7.48} + BWL = \frac{376{,}750 \times [(4.8 \times 60) - 72.0]}{5{,}000 \times 1{,}440 \times 7.48} + 14.54 = \mathbf{16.05\ ft}$$

$$HRT = \frac{5{,}000 \times 16.05 \times 7.48}{376{,}750} = \mathbf{1.59\ days}$$

MLSS Concentration at Bottom Water Level

$$MLSS = \frac{Mbio \times 1{,}000{,}000}{BWL \times BA \times 62.42} = \frac{24{,}043 \times 1{,}000{,}000}{14.54 \times 5{,}000 \times 62.42} = \mathbf{5{,}298\ mg/l}$$

where: MLSS = Mixed Liquor Suspended Solids concentration at Bottom Water Level (mg/l)
62.42/1E+06 = Conversion (lb/mg x l/ft³)

Mass of Sludge Produced

$$\Delta M = \left(\frac{Y \times (BOD_{in} - BOD_{out})}{1 + (B \times \theta^{(T-20)} \times SRT)} + Zio + Zno \right) \times \frac{Q \times 8.34}{1{,}000{,}000}$$

$$\Delta M = \left(\frac{0.6 \times (300 - 10.0)}{1 + (0.07 \times 1.04^{(5-20)} \times 38.3)} + 96.0 + 24.0 \right) \times \frac{3.8E{+}05 \times 8.34}{1{,}000{,}000} = \mathbf{597\ lb/day/basin}$$

(Lawrence-McCarty Equation as presented in WEF MOP/8 4th Edition, pg 11-11, Eqn. 11.7)

where: ΔM = Mass of Sludge Produced (lb/day/basin)
Y = Volatile cell yield (VSS/BOD removed)
q = Arrhenius Temperature Correction Factor
B = Decay Rate (day^{-1})
BOD_{out} = Anticipated Effluent BOD (mg/l)
SRT = Solids Retention Time (days)
Zio = Influent nonvolatile suspended solids (mg/l)
Zno = Influent volatile nonbiodegradable solids (mg/l)
T = Minimum Wastewater Temperature (°C)

Volume of Sludge Produced

$$V_{ws} = \frac{\Delta M}{SFws \times 8.34} = \frac{597}{0.0085 \times 8.34} = \textbf{8,417 gal/day/basin}$$

where: Vws = Volume of Waste Sludge (gal/day/basin)
SFws = Solids Fraction in Waste Sludge
8.34 = Density (lb/gal)

Observed Yield Factor

$$Yobs = \frac{\Delta M}{BOD_L} = \frac{597}{943} = \mathbf{0.63}\ \frac{\mathbf{MLSS}}{\mathbf{BOD}}$$

Observed Yield Factor (lb/day MLSS/lb/day BODremoved)

Mean Cell Residence Time

$$MCRT = \frac{Mbio}{\Delta M + ((Q - Vws) \times TESS \times 8.34 / 1E{+}06)}$$

$$MCRT = \frac{24{,}043}{597 + ((376{,}750 - 8{,}417) \times 10.0 \times 8.34 / 1{,}000{,}000)} = \textbf{38.3 days}$$

where: MCRT = Mean Cell Residence Time (days)
TESS = Anticipated Effluent Total Suspended Solids (mg/l)
8.34E-06 = Conversion (lb/mg x l/gal)

Sludge Age for Nitrification

Refer to Metcalf and Eddy, Edition IV pages 614 and 705

Constants and Temperature Corrections:

Coefficient	Base Value	Theta	Temperature Corrected	Symbol
Maximum Specific Growth Rate of Nitrifying bacteria, g VSS/g VSS.day	0.75	1.07	0.272	$\mu_{nm}(T)$
Half-Velocity constant for nitrifiers	0.74	1.053	0.341	Kn(T)
Nitrifier decay rate	0.08	1.04	0.044	Kdn(T)
Dissolved Oxygen, mg/l	2		2	DO
Half-Velocity Constant for Dissolved Oxygen, mg/l	0.5		0.5	Ko
Minimum Water Temperature, °C	5		5	T
Safety Factor	1.5		1.5	SF

Calculations:

$$\mu_n = \left(\mu_{nm}(T) \times \frac{TENH_3}{TENH_3 + Kn(T)} \times \frac{DO}{DO + Ko} \right) - Kdn(T)$$

$$\mu_n = \left(0.272 \times \frac{1.0}{1.0 + 0.341} \times \frac{2.0}{2.0 + 0.5} \right) - 0.044 = \mathbf{0.118\ days^{-1}}$$

$$SRTmin = \frac{1}{\mu_n} = \frac{1}{0.118} = \mathbf{8.5\ days}$$

$$SRTaerobic = SRTmin \times SF = 8.5 \times 1.5 = \mathbf{12.7\ days}$$

$$SRToverall = \frac{SRTaerobic \times 24}{TA} = \frac{12.7 \times 24}{8.0} = \mathbf{38.2\ days}$$

Design sludge age adequate for nitrification.

where: $\mu nm(T)$ = Maximum Temperature Corrected Nitrifier Growth Rate ($days^{-1}$)
μ_n = Specific Nitrifier Growth Rate at Temperature, DO, and Effluent NH_3 (g/g-days)
SRTmin = Minimum Sludge age required for Nitrification (days)
SRTaerobic = Design Aerobic Sludge Age (days)
SF = Safety Factor
SRToverall = Sludge Age accounting for entire ICEAS cycle (days)
TA = Aeration Time (hrs/day)
$TENH_3$ = Anticipated Effluent Ammonia (mg/l)

Denitrification Capacity

Constants and Temperature Corrections

Coefficient	Base Value	Theta	Temperature Corrected	Symbol
Base Denitrification Rate @ 20°C,NO3/MLVSS/hr	0.0025	1.09	0.0007	μ_{DN}
VSS/TSS	0.7			
Sludge Nitrogen Content	0.07			Ns
Minimum Wastwater Temperature, °C	5			T
Effluent Dissolved Organic Nitrogen, mg/l	1			EDON

Nitrogen Balance

N_{Avail} = TKN - EDON - $TENH_3$ - N_{Assim} - N_{Part} = 42 - 1 - 1.0 - 13.3 - 0.5 = **26.2 mg/l**

where: N_{Avail} = Nitrogen available for oxidation and denitrification (mg/l)
TKN = Influent Total Kjeldahl Nitrogen (mg/l)
N_{Assim} = Nitrogen assimilated into sludge (mg/l)

$$N_{Assim} = \frac{\Delta M \times Ns \times 1{,}000{,}000}{Q \times 8.34} = \frac{597 \times 0.07 \times 1{,}000{,}000}{376{,}750 \times 8.34} = \mathbf{13.3\ mg/l}$$

N_{Part} = TESS x Ns x VSS/TSS = 10.0 x 0.07 x 0.7 = **0.5 mg/l**

$NO_{3(Allow)}$ = TN - EDON - $TENH_3$ - N_{Part} = 10 - 1 - 1.0 - 0.5 = **7.5 mg/l**

where: $NO_{3(Allow)}$ = Allowable NO3 concentration in effluent (mg/l)
TN = Total Nitrogen in effluent (mg/l)
N_{Part} = Nitrogen bound to VSS portion of effluent TSS (mg/l)

Required Denitrification Capacity

$$\text{Req'd Capacity} = \frac{(N_{Avail} - NO_{3(Allow)}) \times Q \times 8.34}{1{,}000{,}000} = \frac{(26.2 - 7.5) \times 376{,}750 \times 8.34}{1{,}000{,}000} = \mathbf{59\ lb/day/basin}$$

Design Denitrification Capacity

Design Capacity = μ_{DN} x VSS/TSS x BMOB x ART = 0.0007 x 0.7 x 24,043 x 6.8 = **80 lb/day/basin**

where: ART = Anoxic Retention Time (hours/day)

Design denitrification Capacity exceeds required denitrification capacity.

Waste Sludge Pump Capacity

$$WSP = \frac{Vws \times NCT}{24 \times SPT} = \frac{8,417 \times 4.8}{24 \times 10.00} = \mathbf{169\ gal/min}$$

where: WSP = Waste Sludge Pump Capacity(gal/min)
SPT = Sludge Pumping Time (min/cycle)

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SANITAIRE ICEAS Aeration Design Calculations
BOD Removal, Nitrification, and De-Nitrification Process

SANITAIRE Project #25730-15
Whitefish, MT

Carbonaceous Oxygen Demand

$$AOR1 = A \times \frac{Q \times BODin}{1{,}000{,}000} \times 8.34 = 1.20 \times \frac{376{,}750 \times 300}{1{,}000{,}000} \times 8.34 = \mathbf{1{,}131\ lb/day/basin}$$

where AOR1 = Actual Oxygen Required for BOD oxidation (lb/day/basin)
A = O2 / BOD
Q = Average flow (gal/day/basin)
BODin = Influent BOD received (mg/l)
1,000,000 = Conversion (g x mg)
8.34 = Conversion (lb x gal)

Nitrification Oxygen Demand

AOR2 = TKNox x 4.60 = 82.4 x 4.60 = **379 lb/day/basin**

where AOR2 = Actual Oxygen required for Ammonia Oxidation (lb/day/basin)
TKNox = Nitrogen available for oxidation(lb/day/basin)

Constants

Coefficient	Value	Symbol
VSS/TSS	0.7	
Sludge N	0.07	Ns
Effluent Dissolved Organic Nitrogen, mg/l	1	EDON
Expected Effluent Ammonium concentration	1	$TENH_3$

$$TKN_{ox} = (TKN - EDON - TENH_3 - N_{assim} - N_{part}) \times Q \times 8.34 \div 1{,}000{,}000$$

$$TKN_{ox} = (42 - 1 - 1 - 13.29 - 0.49) \times 376{,}750 \times 8.34 \div 1{,}000{,}000 = \mathbf{82.4\ lb/day/basin}$$

where N_{assim} = Nitrogen assimilated into biomass, (mg/l)

$$N_{assim} = BOD_{in} \times N_s \times Y_{obs} = 300 \times 0.07 \times 0.633 = \mathbf{13.29\ mg/l}$$

where Y_{obs} = Observed Sludge Yield, (MLSS produced / BOD removed)

$$N_{part} = TESS \times N_S \times VSS/TSS = 10 \times 0.7 \times 0.07 = \mathbf{0.49\ mg/l}$$

where N_{part} = Nitrogen bound to VSS portion of effluent TSS (mg/l)
TESS = Anticipated Effluent Total Suspended Solids (mg/l)

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Denitrification Oxygen Credit

$$O_{2denit} = 2.9 \times NO_3\text{-}N_{denit} = 2.9 \times 78 = \mathbf{226\ lb/day/basin}$$

where O_{2denit} = Oxygen mass credit from denitrification (lb/day/basin)

NO3-Ndenit = Mass of NO3-N denitrified (lb/day/basin)

$$NO_3\text{-}N_{denit} = \mu_{DN} \times VSS/TSS \times BMOB \times ART = 0.00069 \times 0.7 \times 24{,}043 \times 6.78 = \mathbf{78\ lb/day/basin}$$

where μ_{DN} = Denitrification rate at 5°C (NO3/MLVSS/hr)

BMOB = Basin biomass (lb/basin)

ART = Anoxic Retention Time, (hrs/day)

Total Actual Oxygen Transfer

$$AOR = AOR1 + AOR2 - O_{2denit} = 1{,}131 + 379 - 226 = \mathbf{1{,}283\ lb/day/basin}$$

where AOR = Total Actual Oxygen Required (lb/day/basin)

Total Standard Oxygen Transfer

$$SOR = \frac{AOR}{AOR / SOR} = \frac{1{,}283}{0.3645} = \mathbf{3{,}520\ lb/day/basin}$$

$$\frac{AOR}{SOR} = \frac{\alpha \times \theta^{(TSite - 20)} \times (\beta \times C^{*}sat_{20} \times Psite / Pstd \times Csurf_{T} / Csurf_{20} - D.O.)}{C^{*}sat_{20}}$$

$$\frac{AOR}{SOR} = \frac{0.65 \times 1.024^{(15 - 20)} \times (0.95 \times 10.53 \times 11.43 / 14.70 \times 10.08 / 9.07 - 2.0)}{10.53} = \mathbf{0.3645}$$

where SOR = Standard Condition Oxygen Requirement (lb/day/basin)

α = Alpha factor

θ = Temperature coefficient

Tsite = Water temperature (°C)

β = Beta factor

Psite = Site Atmospheric Pressure

Pstd = Standard atmospheric pressure (psig)

$C^{*}sat_{20}$ = Dissolved oxygen solubility at standard conditions (mg/l)

$Csurf_{T}$ = Dissolved oxygen solubility at site water temperature (mg/l)

$Csurf_{20}$ = Dissolved oxygen solubility at 20°C (mg/l)

D.O. = Residual dissolved oxygen concentration (mg/l)

Aeration System Standard Oxygen Transfer Rate

$$SOTR = \frac{SOR}{TA} = \frac{3,520}{8} = \mathbf{440\ lb/hr/basin}$$

where SOTR = Standard oxygen transfer rate (lb/hr/basin)
TA = Aeration Time, (hrs/day)

Aeration Depth

Average Aeration Depth

$$AADad = \frac{Q \times [(NCT \times 60) - (NDT + NST)]}{2 \times 1,440 \ \times \ 7.48 \times BA} + BWL$$

$$AADad = \frac{377,000 \times [(4.8 \times 60) - (72 + 48)]}{2 \times 1,440 \ \times \ 7.48 \times 5,000} + 14.54 \ = \ \mathbf{15.13\ ft}$$

where AADad = Average Aeration Depth at Average Dry Weather Flow (gpd)
Q = Average Dry Weather Flow (gpd/basin)
NCT = Normal Cycle Time (hr)
NDT = Normal Decant Time (min)
NST = Normal Settling Time (min)
BA = Basin Area (ft^2)
1440 = Conversion (min/day)
2 = Calculate Aeration Depth at Middle of Normal Reaction Phase (NCT - NST - NDT)
7.48 = Conversion (gal/ft^3)

Maximum Aeration Depth

$$MADpw = \frac{PWWF \times [(SCT \times 60) - (SDT + SST)]}{1,440 \ \times \ 7.48 \times BA} + BWL$$

$$MADpw = \frac{1,150,000 \times [(3.6 \times 60) - (54 + 36)]}{1,440 \ \times \ 7.48 \times 5,000} + 14.54 \ = \ \mathbf{17.23\ ft}$$

where MADpw = Maximum Aerartion Depth at Peak Wet Weather Flow (gpd)
PWWF Peak Wet Weather Flow (gpd/basin)
SCT = Storm Cycle Time (hr)
SDT = Storm Decant Time (min)
SST = Storm Settle time (min)
MAD = Maximum Aeration Depth (ft)

MAD is larger of MADad and MADpw

MAD = **17.23 ft**

Air Flow Requirement

$$\text{Process Air} = \frac{\text{SOTR x 10,000}}{\rho \text{ x SOTE x Opw x 60}} = \frac{440 \text{ x } 10{,}000}{0.075 \text{ x } 29.36 \text{ x } 23.2 \text{ x } 60} = \textbf{1,440 scfm}$$

where Process Air = Process air flow requirement (scfm)
ρ = Air density (0.075 lb/day/ft³)
SOTE = Standard Oxygen Transfer Efficiency @ Submergence of 14.13 ft
Opw = Fraction of Oxygen in air by Weight
10,000 = Conversion (100% * 100%)
60 = Conversion (min/hr)

Mixing Air = MI x BA = 0.13 x 5,000 = **625 scfm**

where Mixing Air = Mixing air flow requirement (scfm)
MI = recommended air flow per unit area of basin (scfm/ft²)

Blower Unit Capacity

Blower unit capacity (BUC) is the larger of the process air requirement and the mixing air requirement.

Process Air 1,440 scfm

Mixing Air 625 scfm

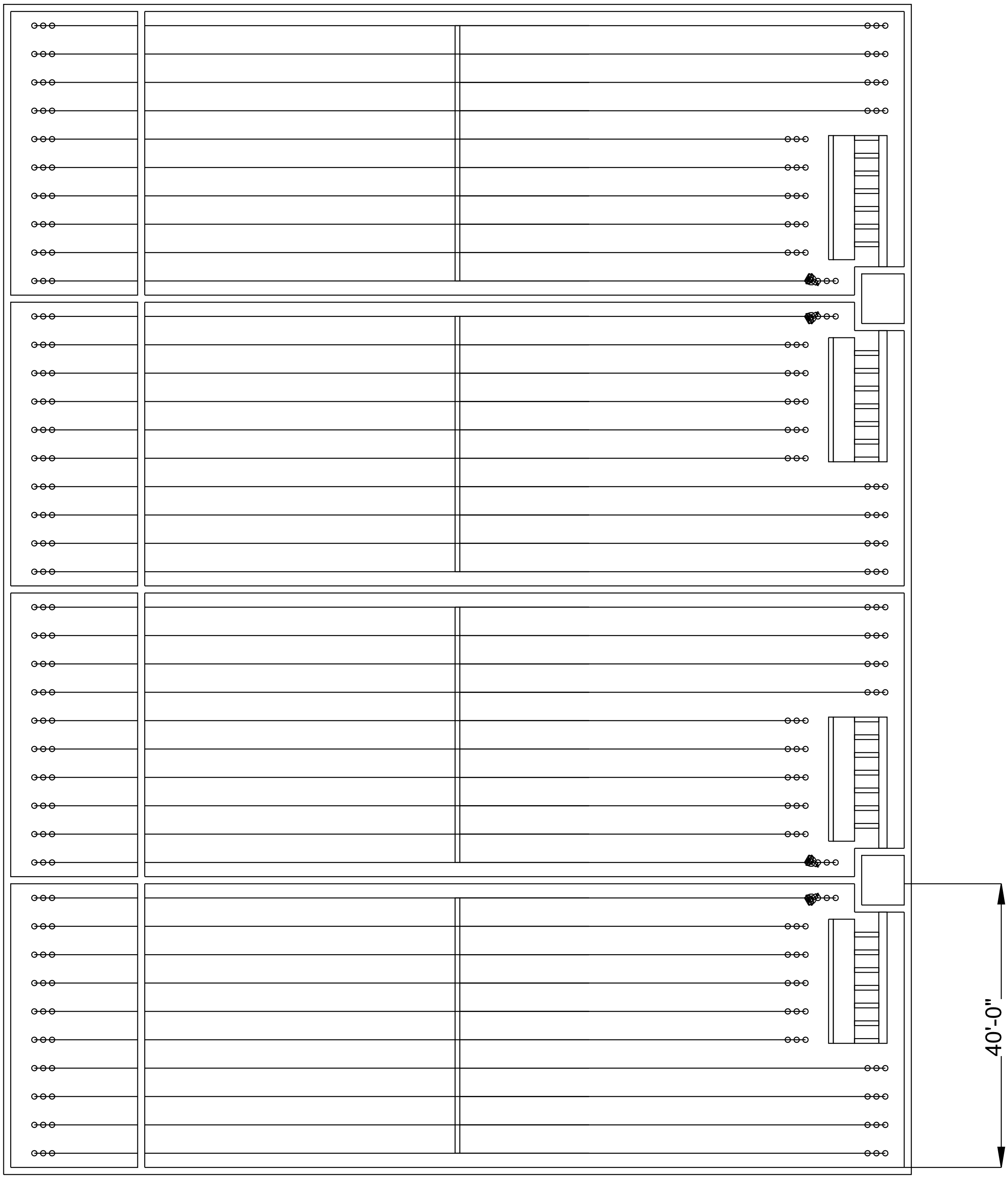
Use 1 blower per tank

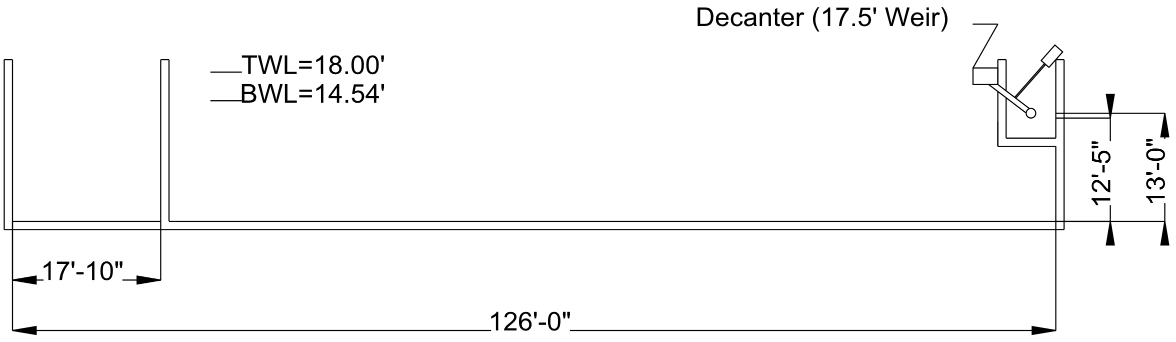
BUC = **1,440 scfm**

Blower Pressure

psig = MAD x 0.432 + H_L = 17.23 x 0.432 + 1.00 = **8.5 psig**

where psig = blower pressure (rounded to next psig)
0.432 = water density (psi/ft)
H_L = Cumulative piping and diffuser headloss (psig)





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Biological Systems Partial Installation List

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
11-7583	Tucker Prison WWTP	AR	Iceas NDN					McClelland Consulting Eng, Inc Fayetteville,, AR 501 443-2377
11-7712	Antara Tower		Iceas NIT	0.10	0.13			
97-3896	Ketchikan - Mountain Point Wtf	AK	Iceas NIT	0.33	1.0	1998	Ketchikan Gateway Borough Ketchikan, AK (907) 247-3881	CRW Engineering Group Anchorage, AK 907 562-3252
93-1467	Montevallo	AL	Iceas NIT	0.85	1.6	1993	Montevallo WWTP Montevallo, AL (205) 665-9209	Carr and Associates Pellham, AL (205) 664-84
94-1402	Bono	AR	SBR NIT	0.30	0.50	1994	Bono WWTP, AR Bono, AR 870-932-8570	GTS, Inc. Paragould, AR 501-236-2166
10-7315	Bono WWTP	AR	Iceas NIT	0.30	0.50			
98-4188	Booneville	AR	Iceas NIT	0.98	4.0	1999	Booneville, AR WWTP Booneville, AR	Mickle Wagner Coleman, Inc Fort Smith, AR 501-649-8484
04-5860	Brookland W W T P	AR	Iceas NIT	0.50	1.5	2005	Brookland, AR Brookland, AR 870-972-8133	NRS Consulting Engineers Paragould, AR
01-4958	Cove WWTP	AR	Iceas NIT	0.08	0.45	2003	Cove WWTP, AR Cove, AR 870-387-5929	Patterson Engineering Texarkana, TX 903 832-0330
92-1351	Fisher	AR	Iceas NIT	0.08	0.15	1992	Fisher, AR WWTP Fisher, AR	Affiliated Engineers Hot Springs, AR 501-624-4691
87-1133	Fountain Hill	AR	Iceas NIT	0.06	0.08	1987	Fountain Hill, AR WWTP Fountain Hill, AR (870) 328-7275	Affiliated Engineers Hot Springs, AR 501-624-4691
06-6391	Hot Springs S. W.	AR	Iceas NDN					NRS Consulting Engineers ,
1351	Humphrey	AR	Iceas NIT	0.08	0.15	1995	Humphrey WWTP, AR Humphrey, AR (870) 853-9820	Civil Design, Inc. Little Rock, AR 501-666-4418
99-4376	Hurricane Lake, Saline Cnty	AR	Iceas NIT	0.25	0.75	2000	Hurricane Lake, Saline County Benton, AR	Perkins and Associates, Inc Russellville, AR 501-968-1885
1403	Lake City	AR	Iceas NIT	0.30	0.50	1994	Lake City, AR WWTP Lake City, AR 870-237-4431 ext. 16	GTS, Inc. Paragould, AR 501-236-2166

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
99-4432	Nucor Yamata Steel Wwtp	AR	Iceas NIT	0.23	0.23	2000	Nucor Yamata Steel WWTP Blytheville, AR 870-762-7198	Mehlburger Little Rock, AR 501-375-5331
1362	Star City	AR	Iceas NIT	0.37	1.0	1994	Star City, AR WWTP Star City, AR (870) 628-4166	Summerford Engineering, Inc. Arkadelphia, AR 501-246-6011
09-7126	Cave Creek	AZ	Iceas NDN	0.71	1.6			Burns and McDonnell Englewood, CO 303 721-9292
10-7413	Ina Road WWTP	AZ						CH2M Hill Corvallis, OR 541-752-4271
03-5399	Jo Max W R F - Shea Sunbelt Pleasant Point Llc	AZ	Iceas NDN	0.28	0.55	2004	Jo Max WRF WWTP, AZ Peoria, AZ 623-764-6328 (cell)	Wilson and Company Phoenix, AZ 480-893-8860
156	Loral Defense Systems	AZ	Iceas NIT	0.06	0.15	1985	Loral Defense Systems WWTP, AZ Litchfield Park, AZ	Loral Corp Litchfield Park, AZ 602-925-7105
142	Paradise Peaks	AZ	Iceas NIT	0.08	0.19	1985	Paradise Peaks WWTP, AZ Phoenix, AZ	AZ Process System Scottsdale, AZ 602-951-8934
06-6320	San Luis - East WWTP	AZ	Iceas NDN	0.09	0.18	2007	San Luis East San Luis, AZ 928-941-1561	Clear Solutions Environeering ,
128	San Luis (1)	AZ	Iceas NIT	0.75	2.2	1993	San Luis Public Works Dept. San Luis, AZ 928-627-0157	Nicklaus Engineering, Inc. Yuma, AZ 520-344-8374
02-5292	San Luis WWTP (II)	AZ	Iceas NDN	1.7	2.6	2003	San Luis Public Works Dept. San Luis, AZ 928-627-0157	Nicklaus Engineering, Inc. Yuma, AZ 520-344-8374
310	Tatum Ranch	AZ	Iceas NIT	0.60	1.5	1986	Tatum Ranch, AZ WWTP Litchfield Park, AZ	Greeley and Hansen Phoenix, AZ 602-275-5595
TMP-102	Alameda County	CA						
05-5931	Angels Camp WWTP	CA	SBR NIT	0.60	1.9	2005	Angels Camp WWTP Angels Camp, CA 209-736-2412	Lee and Ro Inc. Rancho Cordova, CA 916-631-0111
11-7714	Camp Pendleton	CA	Iceas NDN	4.0	12	2012		CDM ,

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
04-5699	Colusa WWTP	CA	Iceas NDN	1.2	4.8	2004	Colusa WWTP Colusa, CA 530-458-8935	Bonadiman Consultants, Inc San Bernardino, CA 909 382-3490
01-4853	Oceanside - San Luis Rey	CA				2002		
236	Pacific Gas & Electric	CA	Iceas NIT	0.04	0.06	1987	Pacific Gas & Electric WWTP Avila Beach, CA	Bechtel San Francisco, CA 415-768-1234
337	Salida (1)	CA	Iceas NIT	1.2	4.3	1991	Salida, CA - City of Salida, CA 209-545-4987	Vail Eng. Corp/CDM Inc. Sacramento, CA 916-929-3323
97-3921	Salida WWTP (2)	CA	Iceas NIT	2.4	8.6	1998	Salida, CA - City of Salida, CA 209-545-4987	G. S. Dodson and Associates Walnut Creek, CA 510 937-3440
09-7087	Sunny Slope	CA	S/I NDN			2012		RMC Water and Environment Walnut Creek, CA 925-299-6733
11-7504	Sunshine Canyon	CA	SBR NIT					
07-6730	Bayfield WWTP	CO	Iceas NIT	0.60	1.5			Stantec Consulting Winnipeg, MB 204 489-5900
05-6047	Berthoud WWTF	CO	Iceas NIT					TEC (The Engineering Co) Ft. Collins, CO 970 484-7444
07-6536	Cherokee Metropolitan District WWTP	CO	S/I NDN	4.8	9.4	2010	Cherokee Metropolitan Dist WWTP Colorado Springs, CO O-719-683-3418 C-499-3382	GMS, Inc Colorado Springs, CO 719-475-2935
04-5858	Colorado City WWTP	CO	SBR NIT	0.40	0.71	2005	Colorado City WWTP Colorado City, CO 719-676-3783	Clyde B. Young and Co. Pueblo, CO 719-543-1941
05-6117	Colorado City WWTP	CO	SBR NIT	0.60	1.1	2005	Colorado City WWTP Colorado City, CO 719-676-3783	Clyde B. Young and Co. Pueblo, CO 719-543-1941
417	Cucharas	CO	Iceas NIT	0.17	0.44	1994	Cucharas, CO WWTP Cuchara, CO 719-742-3108	GMS, Inc Colorado Springs, CO 719-475-2935
05-5933	Elbert WWTP	CO	SBR NIT	0.04	0.12	2007	Elbert WWTP, CO Elbert, CO 720-985-8354	GMS, Inc Colorado Springs, CO 719-475-2935
09-7098	Elizabeth WWTP	CO						Richard P. Arber Assoc. Lakewood, CO

Job #	Plant	Location	Process	MGD		Start	Contact	Engineer
				ADWF	PWWF			
09-7072	Frontier Ranch WWTP	CO	Iceas NIT	0.04	0.05			Professional Eng. & Construction ,
96-3586	Inverness Reservoir - Englewood	CO						Greenhorne and O'Mara, Inc Aurora, CO 303 755-9000
04-5721	Low Point WWTF	CO	Iceas NIT	0.50	1.5	2005	Low Point WWTP - Thompson Crossing Metro District Johnstown, CO 970-587-4664	Jacobson Helgoth Consultants Lakewood, CO 303-986-0733
12-7811	Morrison WWTP	CO	Iceas NDN					Stantec ,
04-5734	Woody Creek	CO	Iceas NIT	0.04	0.08	2005	Woody Creek WWTP Woody Creek, CO 970-948-1385	McLaughlin Water Eng. Denver, CO 303 458-5550
96-3501	Ledyard	CT						Austgen Biojet ,
96-4014	Ledyard	CT	SBR NIT	0.28	0.80	1997	Ledyard WWTP, CT Ledyard, CT 860-536-1769	T S Jones Consulting North Canton, CT 203-693-1116
2965	Montville (1)	CT	SBR NIT	2.4	4.8	1994	City of Montville Uncasville, CT (860) 848-8603 or -3830	Tighe and Bond Westfield, MA 413-562-1600
96-4011	Montville (2)	CT	SBR NIT	2.4	4.8	1996	City of Montville Uncasville, CT (860) 848-8603 or -3830	Fay, Spofford and Thorndike, Inc Burlington, MA 617 221-1000
98-3971	Montville (3)	CT	SBR NIT	1.5	2.5	1999	City of Montville Uncasville, CT (860) 848-8603 or -3830	Fay, Spofford and Thorndike, Inc Burlington, MA 617 221-1000
00-4640	Montville (4)	CT	SBR NIT	4.0	12	2002	City of Montville Uncasville, CT (860) 848-8603 or -3830	Dufresne and Henry Manchester, NH 603-669-8672
03-5518	Brighton WWTF	FL	ceas NDNI	0.15	0.45	2004	Brighton WWTP, FL Brighton, FL 954-962-6800	Gee and Jensen Jacksonville, FL 904-733-9119
96-4024	Camp Blanding WWTP Starke	FL	Iceas NDN	0.04	1.4	1997	Camp Blanding WWTP - Starke, FL Starke, FL	Pittman Hartenstein and Assoc Inc Jacksonville, FL

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
99-4256	Dunes Community Dev. Dist.	FL	Iceas NIT	0.25	0.63	2000	Dunes Community Dev. Dist. WWTP, FL , FL 386-445-9045	Gee and Jensen Jacksonville, FL 904-733-9119
11-7561	Freeport WWTP	FL						
00-4588	Gadsden County East	FL	Iceas NDN	0.25	0.50	2002	Talquin Electric Cooperative, Inc. Midway, FL	Jim Stidham and Associates Tallahassee, FL 850-222-3975
1506	Julington Creek (1)	FL	ceas NDNF	0.25	0.63	1995	Julington Creek, FL Jacksonville, FL	Post Buckley Schuh and Jernigan , FL 904-642-8990
97-3690	Julington Creek (2)	FL	ceas NDNF	1.0	1.3	1998	Julington Creek, FL Jacksonville, FL	England-Thims and Miller, Inc Jacksonville, FL 904 642-8990
98-4092	Julington Creek Plantation (3)	FL	ceas NDNF	0.50	1.3	1998	Julington Creek, FL Jacksonville, FL	England-Thims and Miller, Inc Jacksonville, FL 904 642-8990
08-6928	Meadowcrest	FL	Iceas NIT					McKim and Creed Cary, NC 919 233-8091
01-4700	Talquin Electric - Meadows WWTP	FL	Iceas NDN	0.10	0.30	2001	Talquin Electric Killearn Lake Tallahassee, FL 850-379-8681	Jim Stidham and Associates Tallahassee, FL 850-222-3975
1455	Wewahitchka	FL	Iceas NDN	0.20	0.60	1994	Wewahitchka, FL WWTP Wewahitchka, FL 850-639-5171	Preble Rish, Inc. Tallahassee, FL 850 267 0759
13-8038	Wewahitchka WWTP	FL	Iceas NDN					Preble Rish, Inc. Tallahassee, FL 850 267 0759
05-6118	Barrow County WWTP	GA	SBR NDN	0.50	1.0	2006	Barrow County WWTP, GA Statham, GA	Carter and Sloope Bogart, GA 706-357-5452
06-6385	Blue Ridge Golf & River Club	GA	Iceas NIT	0.10	0.22		Blue Ridge Golf & River Club Blue Ridge, GA	Civil Engineering Consultants Marietta, GA 770 977 5747
04-5817	Calhoun - Mauldin Road WTP	GA					Calhoun WWTP, GA Calhoun, GA 706-280-4652	Peoples and Quigley Atlanta, GA 404 255-2650

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
02-5164	Canton WWTP	GA	ceas NDNI	3.3	7.2	2003	Canton WWTP, GA Canton, GA (770) 720-4194	Gresham Smith and Partners Alpharetta, GA 770 754-0755
05-6165	Cherokee County - Fitzgerald Creek Wpcp	GA	S/I NDNP	6.0	11	2008	Cherokee County - Fitzgerald Creek WWTP, GA Woodstock, GA 678-777-1971	Welker and Associates, Inc Marietta, GA 770 422-1902
05-6180	Crawfordville	GA	Iceas NIT	0.11	0.30	2007	Crawfordville WWTP Crawfordville, GA	G. Ben Turnipseed Engineers, Inc Atlanta, GA 770-642-8200
11-7657	Donaldsonville WWTP	GA	SBR NDN	1.0				Hightower Consulting Engineers Social Circle, GA 770 464-2875
05-6194	Madison I-20 WRF	GA	ceas NDNI	1.0	2.5	2008	Madison, GA 1-20 Water Reclamation Facility Madison, GA 706-343-1273	Jordan, Jones and Goulding Atlanta, GA
1470	Olde Atlanta Club	GA	Iceas NIT	0.03	0.79	1993	Olde Atlanta Club, GA WWTP Suwanee, GA	Civil Engineering Consultants Marietta, GA 770 977 5747
99-4212	Peachtree City Rockaway STP	GA	Iceas NIT	2.0	5.0	1999	Peachtree City, GA WWTP Peachtree City, GA 770-487-7993	Arcadis Atlanta, GA 770-952-8861
1249	Peachtree City-Rockaway STP	GA	Iceas NIT	2.0	5.0	1989	Peachtree City, GA WWTP Peachtree City, GA 770-487-7993	M.G. Engineering and Consult. Peachtree City, GA 770-487-6413
09-7086f	President's Street	GA						City of Sanvannah, GA ,
1484	Vogel State Park	GA	Iceas NIT	0.02	0.08	1993	Vogel State Park W W T P, GA , GA 706-745-2628	Arcadis Geraghty and Miller Raleigh, NC 919 782-5511
98-4121	Waikoloa, West Hawaii Sewer Co	HI	Iceas NIT	0.09	0.27	1999	West Hawaii Utilities Waikoloa, HI 808-883-9355	Witcher Engineering Kailua-Kona, HI 808-334-0322
10-7494	Atlantic WWTP	IA	Iceas NDN	1.1	5.0			Fox Engineering Co Ames, IA 515-233-0000

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
04-5758	Hopkinton WWTP	IA	Iceas NIT	0.07	0.20	2005	Hopkinton WWTP, IA Hopkinton, IA 563-608-2794 (cell)	Howard R. Green Company Cedar Rapids, IA 800-728-7805
05-5971	Oelwein WWTP	IA	)ecant Onl	2.5	4.5	2005	Oelwein WWTP, IA Oelwein, IA	Fox Engineering Co Ames, IA 515-233-0000
11-7567	Washington, Ia WWTP	IA	Iceas NIT	1.0	6.3			Fox Engineering Co Ames, IA 515-233-0000
11-7547	City Of Middleton	ID	Iceas NDN	1.5	8.4			Holladay Engineering ,
12-7734	City Of Jerseyville	IL	Iceas NIT					
06-6496f	Galesburg	IL	Iceas NDN					Crawford, Murphy and Tilly ,
08-6819f	Galesburg	IL						Bruner Corporation Galesburg, IL 309-343-9282
03-5575	Poplar Grove	IL	Iceas NIT	0.25	0.63	2005	Poplar Grove WWTP, IL Poplar Grove, IL (815) 765-1774	Robinson Engineering, Ltd South Holland, IL 708 331-6700
07-6624	Waukegan Gas & Coke WWTP	IL	SBR NDN	0.04	0.04		Waukegan Gas & Coke, IL , IL	Conestoga Rovers and Associates Waterloo, ON 519-884-0510
2274	Centerville	IN	Iceas NIT	0.50	2.0	1991	Centerville WWTP, IN Centerville, IN 765-855-5515	SIECO Columbus, IN 812-372-9911
07-6707	Centerville WWTP	IN	Iceas NIT	1.0	4.0	2008	Centerville WWTP, IN Centerville, IN 765-855-5515	Bonar Assoc Ft. Wayne, IN 260-424-0318
03-5495	Falling Waters WWTP	IN	SBR NDNP	0.15	0.45	2006	Falling Waters WWTP, IN Falling Waters, IN 815-954-3832 (cell)	Michael J. Cap Homewood, IL
1091	Main Aboite	IN	Iceas NIT	1.3	1.9	1986	Main Aboite, IN WWTP Ft. Wayne, IN	Utility Center, Inc. Ft. Wayne, IN 219-489-1502
2298	Scottsburg (1)	IN	Iceas NIT	1.8	3.0	1990	Scottsburg, IN WWTP Scottsburg, IN 812-752-4490	Gove Associates, Inc Indianapolis, IN 317-872-5688
2800	Scottsburg (2)	IN	Iceas NIT	1.8	3.0	1992	Scottsburg, IN WWTP Scottsburg, IN 812-752-4490	Schimpeler Corradino Assoc. Jeffersonville, IN 812-284-5012

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
1097	Thousand Trails I	IN	Iceas NIT	0.02	0.05	1986	Thousand Trails, IN WWTP Clinton, IN	
2522	Warsaw WWTP	IN	Iceas NIT	0.05	1.5	1989	Warsaw WWTP, IN Warsaw, IN 219-453-3314	KSI Group Indianapolis, IN
2447	White Oaks	IN	Iceas NIT	0.05	0.10	1989	White Oaks WWTP, IN Monticello, IN	SIECO Columbus, IN 812-372-9911
97-3857	Conagra Beef - Garden City	KS	Iceas NDN	2.0	1.3	1998	Montfort, Inc - Garden City KS Garden City, KS 316-271-7793	CET Environmental Services Denver, CO 303 331-0062
98-4149	Osawatomie	KS	Iceas NIT	0.56	1.8	1999	Osawatomie WWTP, KS Osawatomie, KS 913-755-2153	Shafer Kline and Warren, Inc Kansas City, MO 816 756-0444
01-4852	Georgetown Post Aeration	KY				2002		
09-7157f	Covington, La - Lee Rd. Jr. High School	LA						None
09-7276	Cullen WWTP	LA	SBR NIT	0.30	0.60		Cullen, LA WWTP Cullen, LA 318-578-0402	, Balar Associates, Inc. Shreveport, LA 318-221-8312
97-3907	Cypress Bayou Casino	LA	Iceas NIT	0.22	0.35	1998	Cypress Bayou Casino WWTP, LA Charenton, LA 337-924-7730	Domingue, Szabo and Associates Lafayette, LA 337-232-5182
03-5321	Folsom WWTP	LA	Iceas NIT	0.20	0.40	2003	Folsom WWTP, LA Folsom, LA 985-796-1487 or 5607	T C Spangler Hammond, LA 504-542-8665
00-4532	Franklinton	LA	Iceas NIT	0.80	2.2	2001	Franklinton WWTP, LA Franklinton, LA 985-839-3551	T C Spangler Hammond, LA 504-542-8665
1605	Greenleaves Utilities	LA	Iceas NIT	0.95	2.1	1995	Greenleaves Utility Company Mandeville, LA	Kelly McHugh and Assoc., Inc. Mandeville, LA 985 626-5611
05-6141	Homer WWTP	LA	SBR NIT	0.90	2.0	2006	Homer, LA WWTP Homer, LA 318-927-3932	Balar Associates, Inc. Shreveport, LA 318-221-8312
05-6022	Lafayette Util. - Ambassador Caffery Pkwy WWTP	LA	Iceas NIT	3.0	7.7	2008	Lafayette - Ambassador Caffery Pkwy, LA Lafayette, LA 337-291-5928	Domingue, Szabo and Associates Lafayette, LA 337-232-5182

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
01-4948	Napoleonville	LA	Iceas NIT	0.30	0.60	2002	Napoleonville WWTP, LA Napoleonville, LA	C. J. Savoie Paincourtville, LA 985-369-2341
03-5419	New Iberia WWTP	LA	Iceas NIT	6.0	30	2006	New Iberia WWTP, LA New Iberia, LA 337-369-2387	Domingue, Szabo and Associates Lafayette, LA 337-232-5182
06-6290	Sandy Hill Water & Sewer Authority - Country Manor	LA	SBR NIT	0.10	0.30	2006	Sandy Hill WWTP - County Manor, LA Leesville, LA	Balar Associates, Inc. Shreveport, LA 318-221-8312
06-6364	The Landings - Hammond	LA	Iceas NDN	0.20	0.60	2007	The Landings WWTP - Hammond, LA Hammond, LA	Kyle Associates Mandeville, LA 985-727-9377
98-4103	Belchertown	MA	SBR NDNP	1.0	3.5	1999	Belchertown WWTP, MA Belchertown, MA 413-323-0449	Tighe and Bond Westfield, MA 413-562-1600
04-5655	Marion WWTP	MA	SBR NDN	0.59	2.4	2005	Marion WWTP, MA Marion, MA 508-784-6701	CDM Manchester, NH 603-222-8300
11-7533	Provincetown	MA					Provincetown WWTP, MA Provincetown, MA 508-487-5474	AECOM ,
01-4840	Provincetown WWTP	MA	SBR NDNP	0.35	0.75	2002	Provincetown WWTP, MA Provincetown, MA 508-487-5474	Metcalf and Eddy Wakefield, MA 781-246-5200
07-6635	Chesapeake Beach WWTP	MD	SBR NDNP	0.14	0.14	2008	Chesapeake Beach WWTP Chesapeake Beach, MD	Stearns and Wheler Bowie, MD 301-805-5629
07-6674	Havre De Grace	MD	SBR NDN	0.40	0.40	2008	Havre de Grace WWTP, MD Havre de Grace, MD	Stearns and Wheler Bowie, MD 301-805-5629
09-7183	Indianhead Naswc	MD	Iceas NDN	0.50	1.0		Indian Head WWTP Indian Head, MD	Patton Harris Rust and Assocates, pc Bridgewater, VA 540-828-2616
3240	Jefferson	MD	Iceas NIT	0.30	1.2	1995	Frederick County Bureau of Water & Sewer Frederick, MD 301-694-1825	McCrone, Inc. Annapolis, MD 410-267-8621
2194	Lake Linganore	MD	Iceas NIT	0.40	1.6	1990	Frederick County, MD Frederick, MD 301-694-2186	

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
3111	Millbottom	MD	SBR NIT	0.10	0.40	1996	Frederick County Bureau of Water & Sewer Frederick, MD 301-694-1825	Sanitary Environmental Eng. Westminster, MD 410 876-7740
98-4076	Monrovia (Abj #2365)	MD						
2980	New Market	MD	Iceas NIT	0.24	0.96	1994	New Market WWTP, MD New Market, MD 301-694-2186	Chester Environmental Moon Township, PA 412-269-5700
2997	Pleasant Branch	MD	Iceas NIT	0.10	0.40	1993	Frederick County Bureau of Water & Sewer Frederick, MD 301-694-1825	Kamber Engineering Gaithersburg, MD 301-840-1030
2539	Spring Ridge	MD	Iceas NIT	0.20	0.80	1990	Spring Ridge WWTP, MD Fredrick, MD 301-694-2186	Gannett Fleming Baltimore, MD 410-585-1460
97-3731	Augusta - Wwtp	ME	Iceas NDN				Augusta, ME - City of ,	
99-4227	McCain Foods - Easton	ME	Iceas NIT	0.02	0.05	2000	McCain Foods, Inc. Eaton, ME 207-488-2561 xt 217	Geomatrix Waterloo, ON 519-886-7500
96-3459	Orleans -Tritown Stf	ME						Wright Pierce Topsham, ME
97-3854	French Paper Co	MI	Iceas NIT	0.50	0.75	1998	French Paper Company Niles, MI 269-683-1100	ABB Environmental Portland, ME 423-531-1922
2245	Atochem, Inc.	MN	Iceas NIT	0.03	0.04	1990	Atochem, Inc. WWTP, MN Blooming Praire, MN 507-583-6641	MWH Metairie, LA 504 835-4252
11-7637	Central Iron Range	MN	SBR NIT	2.5				Howard R. Green Company Cedar Rapids, IA 800-728-7805
06-6460	Harris WWTP	MN	ceas NDNI	0.12	0.28	2007	Harris WWTP, MN Harris, MN 320-420-5367	Bonestroo,Rosene,Anderlik Asso St. Paul, MN 612 636-4600
01-4781	Lewiston	MN	SBR NDNP	0.28	0.40	2002	Lewiston, MN WWTP Lewiston, MN 507-523-1001	Bonestroo,Rosene,Anderlik Asso St. Paul, MN 612 636-4600
96-4021	Monticello	MN	SBR NIT	2.1	4.6	1998	Monticello WWTP, MN Monticello, MN 763-295-2225	HDR Minneapolis, MN 763-591-5400

Job #	Plant	Location	Process	MGD ADWF	PWWF	Start	Contact	Engineer
97-3724	Monticello WWTP	MN	SBR NIT	2.1	4.7	1998	Monticello WWTP, MN Monticello, MN 763-295-2225	HDR Minneapolis, MN 763-591-5400
00-4527	St. Michael	MN	Iceas NDN	1.4	3.9	2002	St. Michaels WWTP, MN St. Michael, MN 763-497-8309	Mc Combs Frank Roos Assoc Plymouth, MN 612 476-6010
08-6902f	Bonne Terre	MO						Horner and Shifrin, Inc. St. Louis, MO 314-531-4321
03-5349	Festus - Crystal City WWTP	MO	Iceas NIT	3.0	12	2004	Festus - Crystal City WWTP, MO Festus, MO 636-937-7444	Horner and Shifrin, Inc. St. Louis, MO 314-531-4321
08-6995f	Fremont Hills	MO					Fremont Hills WWTP, MO Fremont Hills, MO	Schaffer Hines Nixa, MO
11-7525f	Galena	MO						
01-4825	Jefferson City	MO	Iceas NIT	11	50	2002	Jefferson City WWTP, MO Jefferson City, MO 573-634-6502	Sverdrup Corp. , MO 314-770-4529
08-6999	Kimmswick - Rock Creek WWTP	MO						Horner and Shifrin, Inc. St. Louis, MO 314-531-4321
06-6418	Kimmswick Rock Creek P S D	MO					Kimmswick WWTP, MO Kimmswick, MO 636-461-2578	Owner ,
03-5366	Kimmswick WWTP - Rock Creek P S D	MO	Iceas NIT	4.8	17	2004	Kimmswick WWTP, MO Kimmswick, MO 636-461-2578	Horner and Shifrin, Inc. St. Louis, MO 314-531-4321
00-4536	Platte City	MO	Iceas NIT	0.61	2.0	2001	Platte City, MO Platte City, MO 816-935-3526	Shafer Kline and Warren, Inc Kansas City, MO 816 756-0444
11-7596	Rock Creek Psd	MO	Iceas NDN				Kimmswick, MO Imperial, MO 636-461-2579	
10-7326	Rock Creek WWTP	MO	Iceas NDN	4.8	17			Horner and Shifrin, Inc. St. Louis, MO 314-531-4321
08-6877	Sullivan	MO	Iceas NIT	2.0	6.0		Sullivan WWTP, MO Sullivan, MO 573.468.8223	Jacobs Engineering St. Louis, MO 314-335-4000
13-8107	Glendive WWTP	MT	Iceas NIT					Tetra Tech RTW Denver, CO

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02-5224	Bakersville - WWTP	NC	Iceas NIT	0.20	0.50	2003	Bakersville WWTP, NC Bakersville, NC 828-260-5213	Hobbs, Upchurch Associates Southern Pines, NC 910-692-5616
06-6457f	Camden Village /core Project - Camden County WWTP	NC				2007		Hobbs, Upchurch Associates Southern Pines, NC 910-692-5616
2934	Claremont	NC	Iceas NIT	0.30	0.60	1994	Claremont, NC WWTP Claremont, NC 704-459-1090	G. Eugene Smithson and Assoc. Hickory, NC 704-327-6911
1020	Conover (1)	NC	Iceas NIT	0.30	1.4	1991	Public Works - City of Conover Conover, NC 704-464-4911	G. Eugene Smithson and Assoc. Hickory, NC 704-327-6911
1209	Conover (2)	NC	Iceas NIT	1.5	3.0	1991	Conover II, NC WWTP Conover, NC 828-465-2279	G. Eugene Smithson and Assoc. Hickory, NC 704-327-6911
07-6703	Dunescape WWTP	NC						Rod Butler, PE Swansboro, NC
97-3689	Elizabethtown WWTP	NC	Iceas NIT	0.73	1.6	1998	Elizabethtown, NC - City of Elizabethtown, NC 910-862-2612	Engineering Services, PA Garner, NC 919 662-7272
07-6638	Harnett County - South Central WWTP	NC	Iceas NIT	5.0	13		Harnett Co. South Central WWTP Spring Lake, NC 910893-7575 X6470	Marziano and Minier Ashboro, NC 336-629-3931
09-7294	Harnett County - South Regional Phase 2	NC	Iceas NDN	10.0	25		Spring Lake, NC-Harnett Cty South Lillington, NC 910-893-7575 X6470	Marziano and Minier Ashboro, NC 336-629-3931
07-6807	Innsbrook	NC						Hobbs, Upchurch Associates Southern Pines, NC 910-692-5616
07-6769	Innsbrook WWTP	NC						Hobbs, Upchurch Associates Southern Pines, NC 910-692-5616
99-4429	Ocean Isle Beach WWTP	NC	Iceas NIT	2.0	3.2	2001	Ocean Isle Beach WWTP Ocean Isle Beach, NC	Hobbs, Upchurch Associates Southern Pines, NC 910-692-5616

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
96-4025	Excel WWTP	NE	Iceas NDN	2.7	2.7	1997	Excel WWTP - Schuyler, NE Schuyler, NE 402-352-8397	Fox Engineering Co Ames, IA 515-233-0000
96-3557	North Conway Wwtp	NH						
2139	Bernardsville	NJ	Iceas NIT	0.76	2.5	1991	Bernardsville WWTP, NJ Bernardsville, NJ 908-766-1151	Malcolm Pirnie, Inc. Fairlawn, NJ 201-797-7400
97-3779	Food Processing	NJ						
2993	Johnson & Johnson	NJ	Iceas NIT	0.04	0.09	1993	Johnson & Johnson, NJ Skillman, NJ 908-874-2560	CH2M Hill Parsippany, NJ 973-316-9300
09-7278	Phillipsburg	NJ	Iceas NDN	4.7	12		Phillipsburg, NJ WWTP Phillipsburg, NJ 908-454-9348	DVIRKA and BARTILUCCI I OCCI Woodbury, NY 516-364-9890
2222	Phillipsburg	NJ	Iceas NIT	3.5	7.0	1991	Phillipsburg, NJ WWTP Phillipsburg, NJ 908-454-9348	BCM Engineers, Inc. Plymouth Meeting, PA 215-825-3800
2268	Prudent Publish	NJ	Iceas NIT	0.01	0.02	1991	Prudent Publish Roxbury, NJ 201-428-7593	Storch Engineers Florham Park, NJ 201-822-5116
2443	Wrightstown	NJ	Iceas NDN	0.35	1.0	1992	Wrightstown, NJ WWTP Wrightstown, NJ 609-723-8484	Marc Associates Mt. Holly, NJ 609-267-5115
08-7043	Acoma Pueblo I I	NM	Iceas NDN	0.08	0.22		Pueblo of Acoma - Acomita WWTP Acoma, NM 505 552-6604	Owner ,
96-4016	Alto Lakes	NM	Iceas NDN	0.02	0.04	1998	Alto Lakes, NM - City of Alto, NM 505-336-4333	Wilson and Company Albuquerque, NM 505 348-4000
98-4135	Angel Fire WWTP	NM	Iceas NIT	1.0	3.0	1999	Angel Fire, NM WWTP Angel Fire, NM 575-377-1682 xt 103	Gannett Fleming Albuquerque, NM 505-265-8468
00-4565	Dona Ana Cnty. Santa Theresa	NM	Iceas NDN	0.30	0.60	2001	Santa Teresa, NM WWTP Santa Teresa, NM	Leedshill - Kerkenhoff, Inc Albuquerque, NM 505 647-4221
02-5129	Dona Ana County - So. Central Reg WWTF	NM	Iceas NIT	1.0	1.0	2003	Las Cruces, NM - City of Las Cruces, NM 505-528-3599	Wilson and Company Albuquerque, NM 505 348-4000
02-5080	Jemez Springs WWTP	NM	Iceas NDN	0.08	0.22	2003	Jemez Springs WWTP, NM Jemez Springs, NM 575-829-4203	Wilson and Company Albuquerque, NM 505-254-4000

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
05-6185	Lovington WWTP	NM	Iceas NDN	1.1	2.8	2007	Lovington WWTP, NM Lovington, NM 575.396.2758	Larkin Eng. Albuquerque, NM 575.275.7500
09-7219	Pecos	NM	Iceas NDN	0.15	0.60		Pecos, NM Pecos, NM 505-757-3431	Wilson and Company Albuquerque, NM 505 348-4000
99-4303	Pueblo of Acoma WWTP	NM	Iceas NDN	0.08	0.22		Pueblo of Acoma - Acomita WWTP Acoma, NM 505 552-6604	Gannett Fleming Albuquerque, NM 505-265-8468
00-4501	Pueblo Of Sandia	NM	ceas NDNI	0.30	0.75	2001	Pueblo of Sandia, NM Albuquerque, NM 505-771-5186	Daniel B. Stephens and Assoc Albuquerque, NM 505 822-9400
02-5021	Pueblo Of Santa Ana	NM	Iceas NDN	0.07	0.20	2002	Pueblo of Santa Ana WWTP, NM Bernalillo, NM 505-867-2940	Wilson and Company Albuquerque, NM 505-254-4000
99-4208	Pueblo Of Santa Ana WWTP	NM	Iceas NDN	0.20	0.60	2002	Pueblo of Santa Ana WWTP, NM Bernalillo, NM 505-867-2940	Wilson and Company Albuquerque, NM 505-254-4000
06-6275	Raton Wwtp	NM	Iceas NDN	0.90	2.7	2007	Raton WWTP, NM Raton, NM 575-445-2292	Wilson and Company Albuquerque, NM 505 348-4000
96-4019	Ruidoso - Decanters	NM	)ecant Onl			1996	Ruidoso WWTP, NM Ruidoso, NM	Drew Engineering Ruidoso, NM 505-257-6010
313	Santa Fe Community College	NM	Iceas NIT	0.03	0.08	1988	Santa Fe Community College WWTP, NM Santa Fe, NM 505-438-1224	Lawrence Vigil and Assoc. Inc. Corrales, NM 505-898-1637
713	Sipapu	NM	Iceas NIT	0.04	0.06	1994	Sipapu, NM WWTP Vadito, NM 505-587-2240	Weaver General Const. Co. Englewood, CO 303 789-4111
679	Socorro	NM	Iceas NIT	1.3	3.3	1994	Socorro, NM Socorro, NM 505-838-1606	H.G.E. Inc. Portland, OR 503-222-1687
11-7620	Socorro	NM	Iceas NDN					
05-6134	Village Of Cloudcroft - Membrae Purification Syste	NM						Linvingston Associates ,
99-4291	Indian Hills WWTP - Carson City	NV	Iceas NDN	0.60	1.5	2000	Indian Hills General Improvement Dist Minden, NV 775-267-9860	Hsi Geotrans Westminster, CO 303-426-7501

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
03-5596	Rolling A Ranch - Dayton	NV	Iceas NDN	0.25	0.75	2002	Rolling A Ranch WWTP, NV Dayton, NV 775-720-7357/233-1768	Brown and Caldwell Walnut Creek, CA 925 937-9010
01-4696	Rolling A Ranch - Dayton	NV	ceas NDNI	0.13	0.38	2001	Rolling A Ranch WWTP, NV Dayton, NV 775-720-7357/233-1768	Brown and Caldwell Boise, ID 208-336-1340
05-6115	Rolling A Ranch I I I	NV	Iceas NDN	1.0	3.0	2006	Rolling A Ranch WWTP, NV Dayton, NV 775-720-7357/233-1768	Brown and Caldwell ,
00-4638	South Dayton WWTP	NV	Iceas NDN	0.20	0.50	2002	Dayton Utilities Dayton, NV 775-720-7357	CDM Denver, CO 303-298-1311
03-5578	Alexandria Orleans Clayton WWTP	NY	Iceas NIT	0.19	0.34	2004	Alexandria-Orleans-Clayton WWTP, NY Alexandria, NY 315-486-9304	Bernier Carr and Associates Watertown, NY 315-782-8130
3276	Avery Village	NY	Iceas NIT	0.03	0.08	1994	Avery Village, NY WWTP East Patchogue, NY 516-752-1414	Henderson and Bodwell Plainview, NY 516 935-8870
09-7101	Boiceville WWTP	NY	Iceas NDN	0.08	0.33	2010		Lamont Engineers , NY
04-5718	Bristal Estates	NY	S/I NDN	0.05	0.14	2005	4H Maintenance Eastport, New York 631-924-0701	Nelson and Pope Melville, NY 631-427-5665
01-4751	Browning Hotel - Ronkonkoma	NY	Iceas NDN	0.05	0.16	2002	Browning Hotel WWTP, NY Ronkonkoma, NY 516-903-4063	Nelson and Pope Melville, NY 631-427-5665
06-6223	Canaseraga WWTP	NY	S/I NIT	0.10	0.38	2006	Canaseraga WWTP, NY Canaseraga, NY 607-545-6124	Bernier Carr and Associates Watertown, NY 315-782-8130
3143	Canisteo	NY	Iceas NIT	0.70	2.0	1995	Canisteo, NY WWTP Canisteo, NY 607-698-2886	Hunt Engineers Horseheads, NY 607-358-1000
11-7686	Cape Vincent	NY	Iceas NIT					Bernier Carr and Associates Watertown, NY 315-782-8130
97-3734	Cenacle Manor	NY	Iceas NDN	0.05	0.20	1998	Cenacle Manor WWTP, NY Cenacle Manor, NY 516-584-2515	Nelson and Pope Melville, NY 631-427-5665
12-7727	Chatham WWTP	NY	Iceas NIT					, 518-758-7500

Job #	Plant	Location	Process	MGD ADWF	PWWF	Start	Contact	Engineer
00-4544	Chazy Wwtp	NY	ceas NDNI	0.09	0.25	2001	Chazy, NY WWTP Chazy, NY 518-846-7544	Bernier Carr and Associates Watertown, NY 315-782-8130
01-4882	Clayton, Village Of, WWTF	NY	Iceas NIT	1.1	2.7	2002	Village of Clayton WWTP, NY Clayton, NY 315-686-2717	Bernier Carr and Associates Watertown, NY 315-782-8130
11-7604	Ellenville WWTP	NY	Iceas NIT	1.1	2.4			BARTON and LOGUIDICE Syracuse, NY 315 457-5200
97-3810	Emerald Green	NY	Iceas NDN	0.03	0.03	1998	Emerald Green WWTP, NY Emerald Green, NY 516-499-6660	Nelson and Pope Melville, NY 631-427-5665
00-4543	Erwin, Town Of - WWTP	NY	Iceas NIT	2.7	5.4	2002	Town of Erwin Painted Post,, New York 607-962-3483	Hunt Engineers Horseheads, NY 607-358-1000
10-7396	Essex WWTP	NY	Iceas NDN	0.06	0.16		Essex, NY Essex, NY 518.963.7027	AES Northeast, PLLC Plattsburgh, NY 518 561-1598
01-4710	Fairfield @ Seldon Greens A	NY	Iceas NDN	0.05	0.21	2002	Fairfield Properties Commack, NY 631-445-0548	Nelson and Pope Melville, NY 631-427-5665
98-4065	Fairfield Hills - Seldon	NY	SBR NDN	0.05	0.21	1999	Fairfield Properties Commack, NY 631-445-0548	Nelson and Pope Melville, NY 631-427-5665
11-7675	Flatline Pilot Project	NY						
2972	Gore Mountain	NY	Iceas NIT	0.00	0.02	1992	Gore Mountain, NY WWTP Gore Mountain, NY 518-251-2411	Morse Engineering Glen Falls, NY 518792-5382
09-7260	Groton WWTP	NY	ceas NDNI	0.50	1.8		Groton, NY Groton, NY 607-898-5185	C. T. Male Associates, P.C. Latham, NY 518 786-7400
04-5737	Guilderland	NY	Iceas NIT	3.6	6.0	2005	Guilderland, NY Guilderland, NY 518-456-2745	Delaware Engineering, P.C. Albany, NY 518-452-1290
00-4447	Gurwin Jewish Center - Wwtp	NY	S/I NDN	0.03	0.09	2000	Severn Trent (Contract) Commack, NY 631-715-8576	James and Leonard Engineers , 516-938-5666
09-7094	Hamlet Of W. Windsor Sewer Dist.	NY	S/I NDN	0.11	0.43		West Windsor West Windsor, NY 607-768-5113	Bernier Carr and Associates Watertown, NY 315-782-8130

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
03-5339	Hilton Gardens WWTP - Ronkonkoma	NY	Iceas NDN	0.03	0.06	2004	Waste Incorporated Ronkonkoma, NY 631-738-7800	Nelson and Pope Melville, NY 631-427-5665
03-5401	Holt Hotel WWTP - Brookhaven	NY	S/I NDN	0.03	0.08	2004	Waste Incorporated Brookhaven, NY 631-981-8570	Nelson and Pope Melville, NY 631-427-5665
05-5973	Hoosick Falls WWTP	NY	Iceas NIT	1.0	3.0	2006	Hoosick Falls WWTP Hoosick Falls, NY 518-686-7701	Clough, Harbour and Associates Albany, NY 518 453-4500
3389	I R S Center Holtsville	NY	Iceas NIT	0.16	0.40	1994	IRS - Holtsville, NY WWTP Glen Cove, NY 516-447-4700	Naylor Engineering Ridge, NY 516-929-2860
12-7826	Inlet WWTP	NY	Iceas NIT	0.02	0.10			Bernier Carr and Associates Watertown, NY 315-782-8130
05-6163	Islip - Broadway Knolls WWTP	NY	S/I NDN	0.07	0.13	2006	Broadway Knolls WWTP, NY Islip, NY 631-981-8570	Michael P. Chiarelli Huntington Station, NY 631-673-3808
02-5171	Keeseville WWTP	NY	ceas NDNI	0.70	2.0	2003	Keeseville WWTP, NY Keeseville, NY 518-834-7238	AES Northeast, PLLC Plattsburgh, NY 518 561-1598
13-7981	Maybrook	NY	SBR NIT					Bipin Gandhi PC Goshen, NY 845-294-5404
01-4849	Mexico WWTP	NY						
04-5885	New York City Watershed Project,kak	NY	ceas NDNI	0.05	0.19	2005	Allied Pollution Control Bedford Hills, NY 845-878-0007	Bipin Gandhi PC Goshen, NY 845-294-5404
98-4137	Owego - City of	NY	Iceas NIT	0.85	2.0	1999	Owego, NY WWTP Owego, NY 607-687-3740/607-625-2197	Delaware Engineering Onconta, NY 607-432-8073
99-4213	Park Meadow STP - Smithtown	NY	Iceas NDN	0.08	0.28	1999	Park Meadow (Center Point) STP Smithtown, NY 631-981-8570	Nelson and Pope Melville, NY 631-427-5665
02-5000	Patchogue Apts.	NY	Iceas NDN	0.05	0.20	2003	Patchogue Apts. WWTP, NY , NY 631-271-1840	Nelson and Pope Melville, NY 631-427-5665
05-6213	Patterson WWTP	NY	Iceas NDN	0.08	0.16		Patterson WWTP, NY Patterson, NY 845-878-0007	Dufresne and Henry Newburgh, NY

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97-3841	Philmont - Wwtp	NY						Clark Engineering New Lebanon, NY 513 794-8613
07-6724	Port Henry	NY	ceas NDNI	0.60	2.5	2007	Port Henry WWTP, NY Port Henry, NY 518-546-8635	AES Northeast, PLLC Plattsburgh, NY 518 561-1598
06-6309	Port Henry WWTP	NY	ceas NDNI	0.60	2.5	2007	Port Henry WWTP, NY Port Henry, NY 518-546-8635	AES Northeast, PLLC Plattsburgh, NY 518 561-1598
05-6147	Prattsville WWTP	NY	ceas NDNI	0.09	0.33	2006	Prattsville WWTP, NY Prattsville, NY 518-299-3054	Lamont, Van Devalk Eng. Cobleskill, NY 518-234-4028
99-4398	Red House	NY	Iceas NIT	0.04	0.16	1999	NYS Office of Parks - Red House WWTP Salamanca, NY 716-354-9101 xt 275	Bergmann Associates Rochester, NY 716-232-5135
05-6211	Rockland County	NY	S/I NDN	1.8	3.4	2009	Rockland County WWTP, NY Hillburn, NY 845.357.1585	Delaware Engineering Onconta, NY 607-432-8073
99-4285	Sag Harbor - WWTP	NY	Iceas NDN	0.25	0.60	2000	Sag Harbor WWTP, NY Sag Harbor, NY 631-725-3889	Dietrich Engineering, PC Huntington Station, NY 516 427-5540
01-4878	Sayville Villas - Islip	NY	Iceas NDN	0.10	0.37	2003	Sayville Villas WWTP, NY Islip, NY 516-805-8924	Nelson and Pope Melville, NY 631-427-5665
02-5045	Selden Sewer District No. 11	NY	S/I NDN	0.89	2.0	2004	Selden Sewer District No. 11, NY Coram, NY 631-427-5665	Nelson and Pope Melville, NY 631-427-5665
11-7540	Selden WWTP	NY	Iceas NDN					Owner ,
02-5105	Senior Housing - East Moriches	NY	Iceas NDN	0.08	0.21	2003	Senior Housing WWTP, NY Shirley, NY 631-924-0701 (office)	Nelson and Pope Melville, NY 631-427-5665
03-5405	Setauket Meadows WWTP - Hauppauge	NY	S/I NDN	0.03	0.09		Setauket Meadows WWTP, NY East Setauket, NY	Nelson and Pope Melville, NY 631-427-5665
05-5934	Setauket Meadows WWTP - Hauppauge	NY	S/I NDN	0.03	0.09	2005	Setauket Meadows WWTP, NY East Setauket, NY	Nelson and Pope Melville, NY 631-427-5665
95-4005	Sharon Springs	NY	Iceas NIT	0.43	1.5	1996	Sharon Springs, NY - Village of Sharon Springs, NY 518-284-3148	Lamont, Van Devalk Eng. Cobleskill, NY 518-234-4028
95-3387	Sharon Springs (Abj #3256)	NY	SBR NDN					

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
95-3387	Sharon Springs (Abj #3256)	NY					Sharon Springs, NY - Village of Sharon Springs, NY 518-284-3148	
2212	Shelter Island	NY	Iceas NDN	0.03	0.15	1988	Summerfield Place Shelter Island Height, NY 516-749-0139	Peconic Associates Greenport, NY 516-477-0030
01-4818	Smith Haven Mall WWTP- Lake Grove,	NY	Iceas NDN	0.10	0.37	2002	Smith Haven Mall WWTP, NY Lake Grove, NY 516-903-4063	Nelson and Pope Melville, NY 631-427-5665
08-6895	Smithtown Galleria	NY						Avalon Bay Communities ,
00-4495	Smithtown Galleria II	NY	Iceas NDN	0.09	0.31	2001	Smithtown, NY - City of Smithtown, NY 516-903-4063	Henderson and Bodwell Plainview, NY 516 935-8870
3350	Southampton Commons	NY	Iceas NIT	0.03	0.10	1996	Southampton Commons WWTP, NY , NY 516-744-3420	Naylor Engineering Ridge, NY 516-929-2860
96-4022	Southern Meadows	NY	Iceas NDN	0.08	0.32	1997	Southern Meadows WWTP, NY , NY	Naylor Engineering Ridge, NY 516-929-2860
3018	Stonehurst (1)	NY	Iceas NDN	0.14	0.50	1996	Stonehurst WWTP, NY Coram, NY 516-903-4063	Nelson and Pope Melville, NY 631-427-5665
95-3190	Stonehurst (2)	NY	S/I NDN	0.14	0.50	1996	Stonehurst WWTP, NY Coram, NY 516-903-4063	Henderson and Bodwell Plainview, NY 516 935-8870
03-5541	Stonehurst WWTP (2)	NY	Iceas NDN				Stonehurst WWTP, NY Coram, NY 516-903-4063	Henderson and Bodwell Plainview, NY 516 935-8870
03-5463	Stonehurst WWTP (3)	NY	Iceas NDN	0.21	0.76	2007	Stonehurst WWTP, NY Coram, NY 516-903-4063	Henderson and Bodwell Plainview, NY 516 935-8870
97-3694	Stonington	NY	SBR NDN	0.05	0.21	1998	Stonington WWTP, NY Stonington, NY 516-476-9260	Henderson and Bodwell Plainview, NY 516 935-8870
02-5066	Suffolk Community College - WWTP	NY	Iceas NDN	0.01	0.02	2003	Suffolk Community College WWTP, NY Riverhead, NY 631-451-4233 (Jon D.)	Gannett Fleming Pittsburgh, PA 412-922-5575
10-7473f	Suny Campus	NY	)ecant Onl					Owner ,
01-4694	Tallmadge Woods Wwtp	NY	S/I NDN	0.42	0.83	2002	Tallmadge Woods WWTP, NY , NY 631-854-1624	Henderson and Bodwell Plainview, NY 516 935-8870

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Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
02-5053	The Greens	NY	Iceas NDN	0.33	1.1	2003	The Greens WWTP, NY , NY 516-674-6032 (office)	Nelson and Pope Melville, NY 631-427-5665
02-5078	Tioga County Industrial Development Agency	NY	Iceas NIT	0.04	0.16	2002	Tioga County Industrial Development Agency, NY , NY 607-687-1824	Clough, Harbour and Associates Albany, NY 518 453-4500
08-6996	Town Of Fishkill	NY	Iceas NIT	0.75	3.0		Camo Pollution Control Fishkill, NY 845-463-7310	Delaware Engineering, P.C. Albany, NY 518-452-1290
98-4124	Victoria Gardens	NY	Iceas NDN			1999	Victorian Gardens WWTP, NY Holbrook, NY	Nelson and Pope Melville, NY 631-427-5665
98-4124	Victorian Gardens - Holbrook	NY	Iceas NDN	0.10	0.37	1999	Victorian Gardens WWTP, NY Holbrook, NY	Nelson and Pope Melville, NY 631-427-5665
12-7822	Village Of Altamont	NY	Iceas NIT					BARTON and LOGUIDICE Syracuse, NY 315 457-5200
08-6911	Village Of Bainbridge WWTP	NY	Iceas NIT	0.32	0.80		Bainbridge, Village of WWTP, NY Bainbridge, NY 607-967-8698	Clough, Harbour and Associates Albany, NY 518 453-4500
11-7541	Village Of Belmont WWTP	NY	Iceas NDN					MRB Group Rochester, NY 716 381-9250
13-8121	Village Of Cayuga	NY	Iceas NDN	0.13	0.52			BARTON and LOGUIDICE Syracuse, NY 315 457-5200
10-7355	Village Of Dryden	NY	Iceas NDN	0.71	2.5	2011	Lobar, Inc. Dillsburg, PA 717-432-9728	MRB Group Rochester, NY 716 381-9250
09-7277	Village Of Sackets Harbor	NY	S/I NIT	0.60	2.7	2011		Bernier Carr and Associates Watertown, NY 315-782-8130
10-7397	Village Of Woodbridge WWTP	NY	Iceas NDN	0.80	2.4	2011		Clough, Harbour and Associates Albany, NY 518 453-4500
06-6250	Villages Of Lake Grove	NY	S/I NDN	0.06	0.13		Villages of Lake Grove WWTP, NY Lake Grove, NY 516-903-4063	Nelson and Pope Melville, NY 631-427-5665

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01-4900	Warwick - Blue Lake WWTF	NY	ceas NDNI	0.15	0.38	2002	Warwick, NY - Blue Lake WWT Tuxedo, NY 845-753-6122	Bipin Gandhi PC Goshen, NY 845-294-5404
08-6910	Waverly Park Condo	NY	S/I NDN	0.06	0.13		Waverly Park Condos WWTP, NY Holtsville, NY	Michael P. Chiarelli Huntington Station, NY 631-673-3808
05-5960	Wayland WWTP	NY	)ecant Onl			2005	Wayland WWTP, NY Wayland, NY	MRB Group Rochester, NY 716 381-9250
05-6143	West Hampton Drag Strip WWTP	NY	S/I NDN	0.03	0.08	2007	Westhampton Drag Strip WWTP, NY Westhampton, NY	Nelson and Pope Melville, NY 631-427-5665
05-6090	Westport WWTP	NY	S/I NDNP	0.14	1.0	2006	Westport WWTP, NY Westport, NY	Bernier Carr and Associates Watertown, NY 315-782-8130
06-6396	Whitney Point WWTP	NY	Iceas NDN	0.15	0.50	2007	Whitney Point WWTP, NY Whitney Point, NY 607-862-0039	Lamont, Van Devalk Eng. Cobleskill, NY 518-234-4028
00-4516	Willow Pond On The Sound	NY	Iceas NDN	0.07	0.27	2003	Sound Housing, LLC Babylon, NY 516-903-4063	Nelson and Pope Melville, NY 631-427-5665
99-4206	Woodcrest Estates	NY	Iceas NDN	0.05	0.18	1999	Woodcrest Estates, NY Port Jefferson Station, NY 516-674-6032	
2337	Botkins	OH	Iceas NIT	0.50	1.5	1989	Botkins WWTP, OH Botkins, OH 937-693-3220	Design Enterprise, Ltd. Indianapolis, IN 317-255-7088
06-6484f	Eaton Homes WWTP	OH					Lorain County, OH WWTPs Elyria, OH 440-329-5584	K E McCartney and Assoc. Mansfield, OH
05-6177	Haskins Wwtp	OH	Iceas NIT	0.26	1.0	2006	Haskins WWTP, OH Haskins, OH 419-262-2037	Kirk Bros. Co. Alvada, OH 419-595-4020
06-6404	Leipsic WWTP	OH	S/I NIT	0.20	0.20	2007	Leipsic WWTP, OH Leipsic, OH 419-943-1365	Poggemeyer Design Group, Inc. Bowling Green, OH
12-7756	Leipsic WWTP	OH	Iceas NIT					Poggemeyer Design Group, Inc. Bowling Green, OH
06-6485f	Lorain County - Brentwood WWTP	OH					Lorain County, OH WWTPs Elyria, OH 440-329-5584	K E McCartney and Assoc. Mansfield, OH

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
06-6475f	Lorain County - Cressthaven WWTP	OH					Lorain County, OH WWTPs Elyria, OH 440-329-5584	K E McCartney and Assoc. Mansfield, OH
2756	North Lewisburg	OH	Iceas NIT	0.17	0.40	1993	North Lewisburg, OH WWTP North Lewisburg, OH 513-747-2200	Design Enterprise, Ltd. Indianapolis, IN 317-255-7088
2107	Ohio Air Int'l Guard	OH	Iceas NIT	0.07	0.18	1988	Ohio Air Int'l Guard WWTP, OH Springfield, OH 419-868-4170	Finkbeiner, Pettis and Strout Akron, OH 419-473-1121
09-7285	Pemberville WWTP	OH	Iceas NIT	0.40	1.3	2010	Pemberville WWTP Pemberville, OH 419.409.0847	Feller and Finch ,
08-7044	Put-in-bay	OH	Iceas NIT	0.50	1.3		Put-in-Bay WWTP, OH Put-in-Bay, OH 419-285-8545	Poggemeyer Design Group, Inc. Bowling Green, OH
2167	Springboro	OH	Iceas NIT	2.0	5.0	1988	US Filter EOS Springboro, OH 513-748-9453	Finkbeiner, Pettis and Strout Akron, OH 419-473-1121
2285	Trutec	OH	SBR NIT	0.02	0.04	1988	Nihon Pk. Of America Trutec, OH 513-789-3223	
1264	Williamsburg	OH	SBR NIT	0.50	1.9	1990	Williamsburg, OH WWTP Williamsburg, OH 513-724-2244	Balke Engineers Cincinnati, OH 513-761-1700
01-4850	Bartlesville WWTP	OK				2002		FHC, Inc Tulsa, OK 918 491-9995
04-5919	Green Country Sewer Company, Llc	OK	Iceas NIT	0.75	2.0	2006	Green Country WWTP, OK Broken Arrow, OK 918-637-7013	Spradling and Associates Tulsa, OK 918-369-3701
98-4184	Republic Paperboard Co-Lawton	OK	Iceas NIT	0.94	1.2	1999	Republic Pulp & Paperboard Company Lawton, OK 580-510-2200	Fluor Daniels Greenville, SC
07-6784	Cobble Beach WWTP	ON	Iceas NIT	0.41	1.2	2008	Cobble Beach, Ontario WWTP Owen Sound, Ontario 519-376-4640	Stantec Consulting London, ON 519-645-2007
11-7661	Coquille WWTP	OR	Iceas NIT	2.0				Dyer Partnership Coos Bay, OR 541-269-0732

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
03-5362	Garibaldi WWTP	OR	Iceas NIT	0.49	1.9	2004	Garibaldi WWTP, OR Garibaldi, OR 503-322-0217	H.G.E. Inc. Portland, OR 503-222-1687
11-7595	Gold Beach WWTP	OR	Iceas NIT				Gold Beach WWTP , 541-247-7459	Dyer Partnership Coos Bay, OR 541-269-0732
09-7180	Jefferson WWTP	OR	Iceas NIT	0.63	4.8		Jefferson, OR Jefferson, OR 541-327-1135	Westech Engineering Inc. Salem, OR 503-585-2474
05-5977	Lafayette WWTP	OR	ceas NDNI	1.6	2.2	2006	Lafayette WWTP, OR Lafayette, OR 503-864-3464	HBH Tigard, OR 503 670-0499
187	Meadows WWTP	OR	SBR NIT	0.04	0.05	1985	Mt. Hood - Meadow, OR WWTP Mt. Hood, OR 503-337-2222	Century West Engineering and Environmental Bend, OR 541-322-8962
545	Neskowin	OR	Iceas NIT	0.11	0.35	1994	Neskowin, OR WWTP Neskowin, OR 503-392-3257	H.G.E. Inc. Portland, OR 503-222-1687
09-7265	Neskowin WWTP	OR	Iceas NIT				Neskowin, OR WWTP Neskowin, OR 503-392-3257	Westech Engineering Inc. Salem, OR 503-585-2474
10-7460	Netarts Oceanside Sanitary Dist.	OR	Iceas NIT	0.70	2.5			Westech Engineering ,
13-8116	Powers	OR	Iceas NIT					Civil West ,
96-4020	Rogue River	OR	Iceas NIT	0.48	1.5	1997	Rogue River WWTP, OR Rogue River, OR 541-582-3319	Dyer Partnership Coos Bay, OR 541-269-0732
520	Siletz	OR	Iceas NIT	0.23	0.62	1994	Siletz, OR WWTP Siletz, OR 541-444-2128	Gary Dyer Assoc. Coss Bay, OR 503-269-0732
07-6677	Yachats WWTP	OR	Iceas NIT	0.33	2.2		Yachats WWTP, OR Yachats, OR (541) 547-3243	Dyer Partnership Coos Bay, OR 541-269-0732
2256	Abbottstown	PA	Iceas NIT	0.21	0.52	1990	Abbotstown, PA WWTP Abbotstown, PA 717-259-6443	Nassaux-Hemsley, Inc Chambersburg, PA 717-627-4459
98-4138	Antrim TWP	PA	ceas NDNI	1.2	3.0	1999	Antrim Township, PA - Tnsp of Greencastle, PA 717-597-9798	Brinjac Engineering, Inc. Harrisburg, PA 717-233-4502

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Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
2281	Archbald	PA	Iceas NIT	4.0	8.1	1991	Archbald WWTP, PA Archbald, PA 570-489-7563	W.G. Karam Associates Clark Summit, PA 717-586-7989
TMP-103	Archbald	PA						
02-5140	Archbald WWTP Equipment	PA	Iceas NIT	4.0	8.1	1991	Archbald WWTP, PA Archbald, PA 570-489-7563	W.G. Karam Associates Clark Summit, PA 717-586-7989
99-4402	Armstrong County Industrial Park - Slate Lick	PA	Iceas NIT	0.20	0.40	2000	Armstrong County Industrial WWTP Freeport, PA 724-294-0078	Widmer Engineering Connellsville, PA 724-626-1909
96-4015	Barnsboro	PA	Iceas NDN	0.90	2.3	1997	Barnsboro, PA - City of Barnsboro, PA 814-948-8696	L. Robert Kimball and Associates Ebensburg, PA 814 472-7712
03-5496	Beach Lake Mun. Auth - WWTP	PA	Iceas NDN	0.09	0.34	2004	Beach Lake WWTP, PA Beach Lake, PA 570-821-1644	Reilly Associates West Pittston, PA 570 654-2473
01-4793	Berwick	PA	ceas NDNI	0.30	0.75	2002	Berwick, PA WWTP New Oxford, PA 717-624-2712	Wm. F. Hill and Assoc., Inc. Gettysburg, Pa
01-4791	Berwick Twp Wwtp	PA	Iceas NDN	0.30	0.75	2002		Wm. F. Hill and Assoc., Inc. Gettysburg, Pa
99-4403	Bethlehem Township East Wwtp	PA	Iceas NIT	0.35	0.88	2001	East Bethlehem, PA Municipal Authority Fredricktown, PA 724-377-2511	Gannett Fleming Pittsburgh, PA 412-922-5575
02-5076	Big Sewickley Creek Ww	PA	Iceas NIT	1.3	5.0	2004	Economy Borough, Big Sewickley Creek WWTP, PA Sewickley, PA 724-266-3509	KLH Engineers Inc. Pittsburgh, PA 412-494-0510
02-5209	Blacklick Valley - Control Panel	PA					Blacklick Valley Municipal Authority Johnstown, PA 814-749-8763 office	Hegemann and Wray Cresson, PA 814 886-8870
02-5024	Blacklick Valley Municipal Auth - WWTP	PA	SBR NIT	0.20	0.50	2003	Blacklick Valley Municipal Authority Johnstown, PA 814-749-8763 office	Hegemann and Wray Cresson, PA 814 886-8870
08-6914	Borough Of Cochranton	PA	ceas NDNI	0.17	0.44		Cochranton, Borough of WWTP, PA Cochranton, PA 724-372-3339	Leonnon, Smith, Souleret Eng Corapopolis, PA 412 264-4400
2765	Breakneck	PA	ceas NDNI	2.0	8.0	1993	Breakneck, PA WWTP Mars, PA 724-625-1699	KLH Engineers Inc. Pittsburgh, PA 412-494-0510

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
02-5065	Breakneck Creek Regional Auth	PA	ceas NDNI	3.0	8.0	2003	Breakneck, PA WWTP Mars, PA 724-625-1699	Gannett Fleming Pittsburgh, PA 412-922-5575
05-5937	Brownsville Municipal Auth WWTP	PA	Iceas NIT	1.0	5.0	2006	Brownsville WWTP, PA Brownsville, PA 724-785-4436	Widmer Engineering Connellsville, PA 724-626-1909
2157	Buckingham	PA	Iceas NIT	0.24	0.71	1989	Buckingham, PA WWTP Buckingham, PA 215-794-3838	Tatman and Lee Assoc. Inc. Wilmington, DE 302-791-0700
98-4169	Burgettstown-Smith Township Jt.S.A.	PA	Iceas NIT	0.80	3.2	1999	Burgettstown-Smith Township Joint Sewer Authority Burgettstown, PA 724-947-5365	BCM Engineers, Inc. Pittsburg, PA 412-829-6000
08-6926	Butler Township	PA	ceas NDNI	2.2	5.5		Butler Township WWTP, PA St. Johns, PA 578.788.4425	Alfred Benesch and Co Pottsville, PA 570 622-4055
12-7930	California	PA	Iceas NIT	1.2	4.8			Fayette Engineering Co., Inc Uniontown, PA 724 438-5573
04-5746	Central Mainline WWTP	PA	Iceas NIT	0.35	1.4	2005	Central Mainline Sewer Authority Portage, PA 814-736-3863/814-243-2235	EADS Group Altoona, PA 814-944-5035
01-4884	Cresson WWTP	PA	Iceas NIT	1.5	4.5	2001	Cresson, PA WWTP Cresson, PA 814-886-2139x6	Hegemann and Wray Cresson, PA 814 886-8870
01-4718	Cresson WWTP - Equipment	PA	Iceas NIT	1.5	4.5	2001	Cresson, PA WWTP Cresson, PA 814-886-2139x6	Hegemann and Wray Cresson, PA 814 886-8870
01-4896	Cumberland - North Twp. Municipal Auth.	PA	SBR NDN	0.50	0.98	2002	Cumberland Township Gettysburg, PA 717-334-1526	HRG Consulting Engineers Harrisburg, pa 717-564-1121
01-4894	Cumberland - South Twp. Municipal Auth.	PA	SBR NDNP	0.65	1.3	2003	Cumberland Township Gettysburg, PA 717-334-1526	HRG Consulting Engineers Harrisburg, pa 717-564-1121
2471	Dry Tavern	PA	Iceas NIT	0.05	0.15	1990	H & H Water Control Rices Landing, PA 724-966-2278	BCM Engineers, Inc. Pittsburg, PA 412-829-6000
05-6195	Dry Tavern Sewer Authority	PA	Iceas NIT	0.12	0.30	2006	H & H Water Control Rices Landing, PA 724-966-2278	Mc Millan Engineering Uniontown, PA

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
01-4946	Dunbar Township Mun. Auth - WWTP	PA	Iceas NIT	0.30	0.75	2002	H & H Services Dunbar, PA 724-966-2278	Widmer Engineering Connellsville, PA 724-626-1909
12-7766	Dunbar Township WWTP	PA	Iceas NIT	0.50				Widmer Engineering Connellsville, PA 724-626-1909
08-7039	Duncansville	PA	Iceas NDN	1.8	4.1		Duncansville WWTP, PA Duncansville, PA 814-695-1497	EADS Group Altoona, PA 814-944-5035
2440	East Stroudsburg	PA	Iceas NIT	1.0	3.8	1990	East Stroudsburg, PA WWTP East Stroudsburg, PA 717-421-0248	Glace Associates, Inc. Harrisburg, PA 717-957-5800
2472	Ebensburg	PA	SBR NDN	1.3	4.0	1990	Ebensburg, PA WWTP Ebensburg, PA 814-472-9681	L. Robert Kimball and Associates Ebensburg, PA 814 472-7712
07-6785	Ebensburg Borough - WWTP	PA	SBR NDNP	2.0	5.5	2008	Ebensburg, PA WWTP Ebensburg, PA 814-472-9681	L. Robert Kimball and Associates Ebensburg, PA 814 472-7712
04-5698	Ebensburg WWTP	PA	SBR NDN	1.3	4.0	2005	Ebensburg, PA WWTP Ebensburg, PA 814-472-9681	Hegemann and Wray Cresson, PA 814 886-8870
2172	Elmhurst (1)	PA	Iceas NIT	0.11	0.21	1988	Elmhurst, PA WWTP Elmhurst, PA 717-842-9999	Klepadlo Associates Scranton, PA 717-457-1677
95-4006	Elmhurst (2)	PA	Iceas NIT	0.19	0.39	1996	Elmhurst, PA WWTP Elmhurst, PA 717-842-9999	CECO Associates, Inc. Scranton, PA 570-342-3101
13-8069	Evans City WWTP	PA	Iceas NDN					HRG Consulting Engineers Harrisburg, pa 717-564-1121
2124	Fairchance (1)	PA	Iceas NIT	0.35	0.88	1989	Fairchance-Georges Joint Municipal Sewage Authorit Smithfield, PA 724-564-1000	Fayette Engineering Co., Inc Uniontown, PA 724 438-5573
98-4107	Fairchance (2)	PA	SBR NIT	0.45	0.90	1999	Fairchance-Georges Joint Municipal Sewage Authorit Smithfield, PA 724-564-1000	Widmer Engineering Connellsville, PA 724-626-1909

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
05-5975	Fairchance (3)	PA	Iceas NIT	0.75	3.5	2006	Fairchance-Georges Joint Municipal Sewage Authorit Smithfield, PA 724-564-1000	Gaydos-Chambers Associates, Inc Uniontown, PA 724-439-4084
04-5895	Flaugherty Run WWTP Expansion	PA	S/I NIT	2.4	6.4	2006	Moon Township WWTP Corapolis, PA 412-264-2600/412-906-7265	Nichols and Slagle Moon Township, PA 412-269-9440
06-6503	Forest Hills Municipal Authority - South Fork	PA	Iceas NIT	1.2	3.0	2007	Forest Hills Municipal Authority - South Fork, PA South Fork, PA 814-242-1736 -mobile	EADS Group Altoona, PA 814-944-5035
09-7266	Foxburg	PA	ceas NDNI	0.16	0.40		Foxburg, PA WWTP , PA	Dakota Engineering Associates. Pittsburgh, PA 412-784-9228
2393	Frackville	PA	Iceas NIT	1.4	3.7	1994	Frackville, PA WWTP Frackville, PA 717-874-4421	Alfred Benesch and Co Pottsville, PA 570 622-4055
02-5117	Franklin / Fayette Sewer Authority	PA	Iceas NIT	0.10	0.25	2003	Franklin - Fayette WWTP, PA Smock, PA 724-677-2272	Widmer Engineering Connellsville, PA 724-626-1909
06-6339	G.r.o.w.s. Landfill	PA				2006	G.R.O.W.S. Landfill, Morrisville, PA Morrisville, PA	Metcalf and Eddy Wakefield, MA 781-246-5200
12-7878	German Twp	PA	Iceas NIT					Widmer Engineering Connellsville, PA 724-626-1909
91-2774	Granville (1)	PA	Iceas NIT	0.40	1.0	1991	Granville Township WWTP Lewistown, PA 717-242-1838	
09-7151	Granville I I I	PA	Iceas NDN	0.50	1.6	2010	Granville Township WWTP Lewistown, PA 717-242-1838	Glace Associates - Camp Hill, PA ,
10-7380	Granville Township	PA	Iceas NDN				Granville Sewer & Water Lewiston, PA 717-363-0349	Owner ,
01-4821	Granville Township WWTP (II)	PA	Iceas NIT	0.40	1.0	2002	Granville Township WWTP Lewistown, PA 717-242-1838	Benatec Associates New Cumberland, PA 717.901.7055
2305	Greenfield	PA	Iceas NIT	0.14	0.35	1988	Greenfield WWTP, PA Moosic, PA 717-222-4888	Klepadlo Associates Scranton, PA 717-457-1677

Job #	Plant	Location	Process	MGD ADWF	PWWF	Start	Contact	Engineer
09-7196	Gregg Township WWTP	PA						Bassett Engineering Williamsport, PA 570 478-2114
11-7545	Hanover Township Sewer Authority	PA	Iceas NIT	0.25				Gannett Fleming Pittsburgh, PA 412-922-5575
06-6510	Hazelton - Can Do WWTP	PA					Hazelton - Can Do WWTP, PA Hazelton, PA	EEMA Kulpsville, PA
05-6027	Hempfield Township Mun Auth - Darragh STP	PA	Iceas NIT	1.1	5.9	2006	Hempfield Township - Darragh WWTP, PA Darragh, PA 724 446-7840	Gibson Thomas Engineering Latrobe, PA
2348	Hollidaysburg	PA	Iceas NIT	5.0	13	1994	Hollidaysburg, PA WWTP Hollidaysburg, PA 814-695-8368	EADS Group Altoona, PA 814-944-5035
04-5820	Hollidaysburg WWTP	PA	Iceas NIT	6.0	15	2005	Hollidaysburg WWTP Hollidaysburg, PA 814 695-8368	EADS Group Altoona, PA 814-944-5035
11-7653	Hollidaysburg WWTP	PA	Iceas NDN					EADS Group Altoona, PA 814-944-5035
01-4880	Hopewell Township - Raccoon Creek WPCP	PA	Iceas NIT	1.3	8.0	2002	Hopewell Township WWTP, PA Aliquippa, PA	Nira Consulting Engineers, Inc Coraopolis, PA 412 262-3970
12-7927	Jeannette WWTP	PA	Iceas NIT	1.8	5.6			Gannett Fleming Pittsburgh, PA 412-922-5575
12-7932	Kiski Valley WWTP	PA	Iceas NDN	7.0	31			KLH Engineers Inc. Pittsburgh, PA 412-494-0510
02-5225	Koppel Borough Of WWTP	PA	ceas NDNI	0.24	0.90	2003	Borough of Koppel WWTP, PA Koppel, PA 724.846.9003	Michael Baker Beaver, PA
03-5585	Kulpmont Marion Heights WWTP	PA	Iceas NIT	0.50	1.4	2004	Kulpmont - Marion Heights WWTP, PA Maysville, PA 570-644-0461	Brinjac Engineering, Inc. Harrisburg, PA 717-233-4502
06-6410	Lake Mead Mun. Auth. - WWTP	PA	ceas NDNI	0.35	0.76	2007	Lake Meade WWTP, PA East Berlin, PA 717-259-9998	Wm. F. Hill and Assoc., Inc. Gettysburg, Pa
96-4023	Lakeview Joint Sewer Authority	PA	Iceas NIT	0.45	1.4	1997	Lakeview Joint Sewer Auth Sandy Lake, PA 412-376-3273	Wodzianski and Smith Franklin, PA 814-432-8257

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
99-4249	Ligonier Borough Wwtp	PA	Iceas NIT	0.45	3.1	2000	Ligonier Borough WWTP, PA Ligonier, PA 724-238-9020	Neilan Engrs Somerset, PA 814 445-6551
10-7416	Linesville Pine Joint Muni. Auth.	PA	NDNP	0.36	2.1			Leonnon, Smith, Souleret Eng Corapopolis, PA 412 264-4400
06-6239	Lower Moreland WWTP	PA				2007	Lower Moreland Township WWTP, PA Huntington Valley, PA	CKS Engineers, Inc. Doylestown, PA 215-340-0600
2068	Marcel Lakes	PA	ceas NDNI	0.10	0.25	1991	Marcel Lakes WWTP, PA Marcel Lakes, PA 570-828-7713	William G. Karam Associates Clarks Summit, PA 717-587-3339
01-4856	Marcel Lakes Estates - Dingmans Ferry	PA	Iceas NDN	0.10	0.25	2001	Marcel Lakes WWTP, PA Marcel Lakes, PA 570-828-7713	
2441	Martinsburg	PA	Iceas NDN	0.70	2.1	1994	Martinsburg, PA WWTP Martinsburg, PA 814-793-2992	Leonnon, Smith, Souleret Eng Corapopolis, PA 412 264-4400
11-7577	Mckeesport	PA	Iceas NDN	4.0	24			KLH Engineers Inc. Pittsburgh, PA 412-494-0510
03-5526	Midway WWTP	PA	Iceas NIT	0.50	1.3	2005	Midway WWTP, PA Midway, PA 724-926-8050/724-825-7758	Gannett Fleming Pittsburgh, PA 412-922-5575
11-7706	Millerstown WWTP	PA	Iceas NDN	0.12	0.30			Glace Associates, Inc. Harrisburg, PA 717-957-5800
01-4847	Mon Valley WWTP - Denora	PA				2002		
06-6386	Moniteau Jr. / Sr. High School WWTP	PA	ceas NDNI	0.02	0.06		Moniteau Jr/Sr High School WWTP, PA West Sunbury, PA	Gray Warnick Butler, PA
2790	Moon Township - Flaugherty Run WWTP	PA	Iceas NIT	1.0	3.2	1994	Moon Township Mun. Auth. Moon Township, PA 412-264-2600	BCM Engineers, Inc. Pittsburg, PA 412-829-6000
10-7480	Mount Pleasant	PA	Iceas NIT					Widmer Engineering Connellsville, PA 724-626-1909
01-4693	Mount Union	PA	Iceas NIT	1.1	3.0	2001	Mount Union, PA WWTP Mount Union, PA 814-542-2656	Gannett Fleming Pittsburgh, PA 412-922-5575

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11-7505	Mt. Alto WWTP	PA	Iceas NDN	0.30	0.75			William F. Hill ,
09-7161	Mt. Carmel Township	PA	Iceas NDN	2.3	13			Brinjac Engineering, Inc. Harrisburg, PA 717-233-4502
2181	Nazareth Borough	PA	Iceas NIT	1.3	2.6	1990	Nazareth Borough, PA WWTP Nazareth, PA 610-759-0727	EDM Consultants Allentown, PA 215-432-4531
10-7371	Nazareth Borough	PA	Iceas NDN	2.1	4.2		Nazareth Borough, PA WWTP Nazareth, PA 610-759-0727	Keller Consulting Engineers Nazareth, PA 610-759-9700
01-4766	Nescopeck	PA	Iceas NIT	0.25	0.50	2002	Nescopeck WWTP Nescopeck, PA 724-872-6373	Quad Three Group, Inc Wilkes-Barre, PA 570 829-4200
05-5945	New Bedford Area STP - Pulaski Township	PA	Iceas NIT	0.28	0.70	2006	New Bedford - Pulaski WWTP, PA Pulaski, PA	Leonnon, Smith, Souleret Eng Corapopolis, PA 412 264-4400
08-6936	Newville Borough	PA	Iceas NDN	0.60	1.2	2009	Newville PA WWTP Newville, PA 717 776-5633	Wm. F. Hill and Assoc., Inc. Gettysburg, Pa
2432	North Beaver (1)	PA	Iceas NIT	0.08	0.19	1992	North Beaver, PA WWTP New Castle, PA 412-654-4664	Leonnon, Smith, Souleret Eng Corapopolis, PA 412 264-4400
02-5007	North Beaver WWTP (2)	PA	Iceas NIT	0.11	0.30	2002	North Beaver Township Municipal Authority New Castle, PA 724-667-0450	Leonnon, Smith, Souleret Eng Corapopolis, PA 412 264-4400
2044	Northampton	PA	Iceas NIT	1.5	4.4	1990	Northampton, PA WWTP Northampton, PA 610-262-6131	Gannett Fleming Harrisburg, PA 717-763-7211
06-6311	Osceola Mills WWTP	PA	ceas NDNI	0.40	0.60	2008	Osceola Mills WWTP, PA Osceola Mills, PA 814-339-6504 x1	Gwin Dobson and Foreman Altoona, PA 814-943-5214
3218	Penelec	PA	SBR NIT	0.83	0.83	1994	Penelec WWTP New Florence, PA 908-653-9482	EBASCO Atlanta, GA 404-231-1604
07-6795	Portage WWTP	PA	ceas NDNI	2.0	6.0		Portage WWTP, PA Portage, PA	Gwin Dobson and Foreman Altoona, PA 814-943-5214

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
05-5946	Pulaski Township WWTP	PA	Iceas NIT	0.11	0.28	2006	Pulaski Township WWTP, PA Pulaski, PA	Leonnon, Smith, Souleret Eng Corapopolis, PA 412 264-4400
98-4104	Reading Township	PA	SBR NDNP	0.42	0.75	2000	Reading Township New Oxford, PA 717-259-9998	Wm. F. Hill and Assoc., Inc. Gettysburg, Pa
11-7599	Reibold STP - Wilson Ridge	PA	Iceas NIT	0.14				Dakota Engineering Associates. Pittsburgh, PA 412-784-9228
2655	Richeyville	PA	Iceas NIT	0.17	0.54	1991	Richeyville WWTP, PA Richeyville, PA 412-632-2223	KLH Engineers Inc. Pittsburgh, PA 412-494-0510
10-7373	Richeyville WWTP	PA	Iceas NDN	0.17	0.54		Richeyville WWTP, PA Richeyville, PA 412-632-2223	Gannett Fleming Pittsburgh, PA 412-922-5575
2422	Roaring Springs	PA	Iceas NIT	0.70	1.8	1989	Roaring Springs WWTP, PA Roaring Springs, PA 814-224-5878	Leonnon, Smith, Souleret Eng Corapopolis, PA 412 264-4400
01-4671	Rostraver - Sweeney - Fellsburg WWTP	PA	Iceas NIT	1.5	5.3	2002	Rostravar Township Sewage Authority West Newton, PA 724-872-6373	KLH Engineers Inc. Pittsburgh, PA 412-494-0510
10-7390	S C I Dallas State Prison	PA	ceas NDNF	0.50	1.0	2011	Dallas, PA-SCI Dallas State Prison , PA	Quad Three Group, Inc Wilkes-Barre, PA 570 829-4200
07-6640	Saxton Borough - WWTP	PA	ceas NDNF	0.60	2.0		Saxton Borough WWTP, PA Bedford County, PA 814-635-3403	Gwin Dobson and Foreman Altoona, PA 814-943-5214
04-5775	Schuykill Valley	PA	Iceas NIT	0.55	1.4	2006	PA American Water Co. Cumbola, PA	Alfred Benesch and Co Pottsville, PA 570 622-4055
01-4750	Schuylkill County - Gordon WWTP (2)	PA	Iceas NIT	0.60	2.4	2002	Schuylkill County - Gordon WWTP Pottsville, PA	Alfred Benesch and Co Pottsville, PA 570 622-4055
2683	Schuylkill County (1)	PA	Iceas NIT	0.40	1.6	1991	Schuylkill County - Gordon WWTP Pottsville, PA	Alfred Benesch and Co Pottsville, PA 570 622-4055
09-7179	Sewickley Twp STP	PA						Gibson Thomas Engineering Latrobe, PA

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
05-5976	Shippingport Borough WWTP	PA	Iceas NIT	0.15	0.38	2006	Shippingport WWTP Shippingport Borough, PA 724-825-0240	Leonnon, Smith, Souleret Eng Corapopolis, PA 412 264-4400
2528	Silver Springs	PA	Iceas NIT	0.60	1.5	1991	Silver Springs WWTP, PA Silver Springs, PA 717-697-2764	Glace Associates, Inc. Harrisburg, PA 717-957-5800
12-7785	Slippery Rock	PA	Iceas NIT	1.2	5.2			HRG Consulting Engineers Harrisburg, pa 717-564-1121
05-6108	Somerset Township Mun Auth	PA	Iceas NIT	0.15	0.60	2006	Somerset Township WWTP, PA Somerset, PA 814-443-2434x103/483-0472	EADS Group Altoona, PA 814-944-5035
04-5700	South Fork - Forest Hills WWTP	PA	Iceas NIT	1.2	4.8	2004	Forest Hills Municipal Authority - South Fork, PA South Fork, PA 814-242-1736 -mobile	EADS Group Altoona, PA 814-944-5035
98-4141	South Fork Mun Authority	PA	Iceas NIT	1.2	4.2	2000	Forest Hills Municipal Authority - South Fork, PA South Fork, PA 814-242-1736 -mobile	Chester Environmental Moon Township, PA 412-269-5700
01-4962	St. Marys Municipal Authority WWTP	PA	Iceas NIT	2.2	12	2002	St. Marys WWTP St. Marys, PA 814-834-6650	KLH Engineers Inc. Pittsburgh, PA 412-494-0510
2168	St. Thomas	PA	Iceas NIT	0.40	1.0	1991	St. Thomas Township Mun. Auth. St. Thomas, PA 717-369-5495	Glace Associates, Inc. Harrisburg, PA 717-957-5800
2895	Strodes Mill	PA	Iceas NIT	0.08	0.20	1995	Strodes Mill WWTP, PA Lewistown, PA 717-242-1838	Glace Associates, Inc. Harrisburg, PA 717-957-5800
01-4798	Summerville Borough	PA	Iceas NIT			2002	Summerville Borough Municipal Authority Export, PA 814-541-0833	,
01-4798	Summerville Borough Municiple Authority	PA	Iceas NIT	0.09	0.22	2002	Summerville Borough Municipal Authority Export, PA 814-541-0833	Nichols and Slagle Moon Township, PA 412-269-9440
01-4848	Sunbury WWTP	PA				2002		Uni-Tec Consulting Engineers State College, PA 814 238-8223
97-3744	Tobyhanna	PA	ceas NDNI	0.30	1.2	1999	Tobyhanna WWTP, PA Tobyhanna, PA 215-643-4013	Michael J. Pasonick Jr., Inc. Wilkes-Barre, PA 717-823-4712

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
12-7885	Tobyhanna Army Depot	PA	Iceas NDN					Quad Three Group, Inc Wilkes-Barre, PA 570 829-4200
2340	Trails End	PA	Iceas NIT	0.20	0.41	1988	Trails End, PA WWTP Shohola, PA	William G. Karam Associates Clarks Summit, PA 717-587-3339
03-5523	Twin County Joint Municipal Auth - North Union Tns	PA	Iceas NIT	0.13	0.32	2004	Twin County WWTP, PA North Union Tns, PA 570-384-1147	Michael J. Pasonick Jr., Inc. Wilkes-Barre, PA 717-823-4712
04-5598	Union Chapman Reg. Auth - WWTF	PA	ceas NDNI	0.10	0.25	2005	Arrow Engineering Port Trevorton, PA 717-278-3505	Herbert Rowland and Grubic State College, PA 814 238-7117
99-4262	Upper Allegheny Wwtp	PA						Gibson Thomas Engineering Latrobe, PA
12-7892	Veteran's Center WWTP	PA	Iceas NIT					CKS Engineers, Inc. Doylestown, PA 215-340-0600
04-5810	Warminster	PA	ceas NDNI	1.2	3.0	2005	NAWC - Wastewater Treatment Plant Warminster, PA 215-675-6113	CKS Engineers, Inc. Doylestown, PA 215-340-0600
3361	Washington Township	PA	Iceas NIT	0.25	0.75	1996	Washington TWP, PA WWTP Bally, PA 610-845-3697	EDM Consultants Southhampton, PA 215-364-2520
95-4001	Weatherly	PA	Iceas NIT	0.60	1.2	1996	Weatherly, PA - City of Weatherly, PA 570-427-4396	Quad Three Group, Inc Wilkes-Barre, PA 570 829-4200
97-3891	West Mifflin Thompson	PA	Iceas NIT	1.5	5.0	1998	West Mifflin - Thompson WWTP, City of, PA West Mifflin, PA 412-466-5952	Chester Environmental Moon Township, PA 412-269-5700
01-4778	White Run Region. Auth.	PA	Iceas NDN	0.39	1.1	2002	White Run Region. Auth. WWTP, PA Gettysburg, PA 717-334-7476	Gannett Fleming Harrisburg, PA 717-763-7211
01-4777	White Run Regional Authority	PA	Iceas NDN	0.39		2002		Gannett Fleming Harrisburg, PA 717-763-7211
00-4575	Wickham Village Wwtp - Hopewell Tnsp	PA	Iceas NIT	0.12	1.0	2001	Wickham Village, PA WWTP Aliquippa, PA 724-375-2428	Nira Consulting Engineers, Inc Coraopolis, PA 412 262-3970

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
09-7125	Williamstown WWTP	PA	Iceas NDN	0.45	2.0			Glace Associates, Inc. Harrisburg, PA 717-957-5800
05-6015	Windber Area Authority WWTP - Cambria County	PA	Iceas NIT	4.0	10.0	2005	Windber Area Authority - Ingleside WWTP, PA Johnstown, PA 814-266-8422	EADS Group Altoona, PA 814-944-5035
98-3931	Wood-Broad Top-Wells Jt.Mun Auth	PA	SBR NIT	0.08	0.22	1998	Wood-Broad Top-Wells Joint Mun Auth, PA Wood, PA 814-635-4016	CET Engineering Services Huntingdon, PA 814 643-8260
03-5573	Bush River Utilities - Lexington	SC	Iceas NIT	0.50	1.5		Bush River Utilities Lexington, SC 803-359-4803	HPG and Co West Columbia, SC 803-739-2888
04-5855	Dorchester County, Sc - WWTP	SC	)ecant Onl			2006	Dorchester County WWTP, SC North Charleston, SC	B.P. Barber and Associates Spartanburg, NC 843-767-4602
06-6350	Hill City WWTP	SD	Iceas NDN	0.25	0.25	2007	Hill City WWTP, SD Hill City, SD 605-209-1778	McLaughlin Water Eng. Denver, CO 303 458-5550
11-7550	Bledsoe Prison	TN	Iceas NDN					GRW Engineers, Inc. Lexington, KY 605 223-3999
1268	Byrdstown WWTP (1)	TN	Iceas NIT	0.20	0.50	1990	Byrdstown, TN WWTP Byrdstown, TN 615-834-3748	James C. Hailey and Co. Nashville, TN 615 883-4933
00-4480	Byrdstown WWTP (2)	TN	Iceas NIT	0.60	1.5	2001	Byrdstown, TN WWTP Byrdstown, TN 615-834-3748	James C. Hailey and Co. Nashville, TN 615 883-4933
10-7334	Cleveland	TN	Iceas NIT	22	33	2010	Cleveland WWTP, TN Cleveland, TN 423-336-5165	
97-3718	Cleveland Utilities Charleston-Hiwas	TN	Iceas NIT	16	44	1998	Cleveland WWTP, TN Cleveland, TN 423-336-5165	Resource Consultants, Inc. Brentwood, TN 615-373-5040
01-4730	Gainesboro	TN	Iceas NIT	0.50	1.5	2002	Gainesboro, TN WWTP Gainesboro, TN 931-268-6250	James C. Hailey and Co. Nashville, TN 615 883-4933
10-7345	Sweetwater WWTP	TN	Iceas NDN	1.5	4.0		Sweetwater, TN WWTP Sweetwater, TN	
1002	Tullahoma	TN	Iceas NIT	3.0	12	1985	Tullahoma WWTP, TN Tullahoma, TN 931-455-2009	

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
1014	Union City	TN	Iceas NIT	4.0	17	1986	Union City, TN WWTP Union City, TN 901-885-9144	J.R. Wauford and Company Jackson, TN
07-6583	Union City	TN						Owner ,
02-5318	Union City - WWTP Bearing & Seal Replacement	TN	Iceas NIT	4.0	17	2003	Union City, TN WWTP Union City, TN 901-885-9144	J.R. Wauford and Company Jackson, TN
04-5677	Union City WWTP	TN	Iceas NIT	4.0	17	2004	Union City, TN WWTP Union City, TN 901-885-9144	J.R. Wauford and Company Jackson, TN
04-5626	Union City WWTP	TN	Iceas NIT	4.0	17	2004	Union City, TN WWTP Union City, TN 901-885-9144	J.R. Wauford and Company Jackson, TN
03-5564	Union City WWTP - Decanters	TN	Iceas NIT	4.0	17	2003	Union City, TN WWTP Union City, TN 901-885-9144	J.R. Wauford and Company Jackson, TN
1324	West Warren	TN	Iceas NIT	0.60	1.8	1991	West Warren, TN Morrison, TN 615-635-2899	James C. Hailey and Co. Nashville, TN 615 883-4933
08-6923	Alvarado	TX	Iceas NIT	0.60	1.6		Alvarado WWTP, TX Alvarado, TX	Dannenbaum Engineering Houston, TX 713-520-9570
1432	Atlanta	TX	Iceas NIT	2.0	5.0	1995	Atlanta, TX WWTP Atlanta, TX 903-799-4063	Brannon Corporation Tyler, TX 903-597-2122
11-7699	Atlanta WWTP	TX					City of Atlanta, TX Atlanta, TX 903-799-0643	
05-5923	Aubrey WWTP	TX	Iceas NIT	0.25	0.75	2005	Aubrey WWTP, TX Aubrey, TX	Brannon Corporation Tyler, TX 903-597-2122
06-6333	Big Lake	TX	Iceas NIT	0.35	1.3	2007	Big Lake WWTP, TX Big Lake, TX 325-884-2814	Hibbs and Tobb, Inc Abilene, TX 915-698-4330
95-4008	Bonham, TX - ABJ Plt	TX	Iceas NIT	2.5	6.6	1996	Bonham, TX - City of Bonham, TX 903-583-4033	Hayter Engineering Paris, TX 903-785-0303
02-5005	Celina WWTP	TX	Iceas NIT	0.25	0.82	2002	Celina, TX Celina, TX 972-382-2682	Hunter Assoc Austin, TX 972-712-6400

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
99-4230	Clifton WWTP	TX	ceas NDNI	0.65	1.8	2000	Clifton WWTP, TX Clifton, TX 254/386-7431	Brannon Corporation Tyler, TX 903-597-2122
09-7106	Eden	TX	Iceas NIT	0.44	1.3		Eden, TX Eden, TX 325-456-0582	Burgess & Niple ,
05-6214	Fort Bend County MUD 118- Upper Oyster Creek WWTP	TX	Iceas NIT	0.75	3.0	2007	ECO Resources Inc. Sugarland, TX 281-253-8273/240-1700	Carter and Burgess Houston, TX 713-869-7900
95-3375	Harris County Mud #149 Wwtp	TX						
06-6483	Hico WWTP	TX	ceas NDNI	0.25	0.75	2007	Hico WWTP, TX Hico, TX 254-977-4431	Brannon Corporation Tyler, TX 903-597-2122
09-7118	Hico WWTP	TX	Iceas NDN				Hico WWTP, TX Hico, TX 254-977-4431	KSA Engineers Lufkin, TX 936 637-6061
02-4985	Houston - Cypress Hill MUD # 1 - WWTP	TX	Iceas NIT	0.80	2.1	2002	Aqua Source Houston, TX 832-347-0232	Dannenbaum Engineering Houston, TX 713-520-9570
06-6447	Italy WWTP	TX	Iceas NIT	0.65	1.5	2007	Italy, TX Italy, TX 254-687-2642	Brannon Corporation Tyler, TX 903-597-2122
10-7471	La Joya	TX	Iceas NIT					S & B Infrastructure ,
1358	Livingston	TX	Iceas NIT	2.3	6.8	1991	Livingston, TX WWTP Livingston, TX 409-327-3251	Brannon Corporation Tyler, TX 903-597-2122
09-7256	Livingston WWTP	TX	Iceas NIT				Livingston, TX WWTP Livingston, TX 409-327-3251	Brannon Corporation Tyler, TX 903-597-2122
1530	Mineral Wells	TX	Iceas NIT	1.3	3.2	1995	Mineral Wells - Pollard Creek WWTP Mineral Wells, TX 817-325-3861	Freese and Nichols Ft. Worth, TX 817-735-7300
05-6010f	Northwest Harris County MUD #36	TX					Northwest Harris County MUD #36, TX Spring, TX 281-330-8415	Alexander Engineering, Inc. Spring, TX 281 350-7027
99-4395	Reno WWTP	TX	Iceas NIT	0.52	1.6	2000	City of Reno Reno, TX 903-785-6581	Hayter Engineering Paris, TX 903-785-0303
1381	Rio Vista	TX	Iceas NIT	0.10	0.22	1992	Rio Vista, TX WWTP City of Rio Vista, TX 817 373 2588	Brannon Corporation Tyler, TX 903-597-2122

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97-3759	Saint Jo	TX	Iceas NIT	0.15	0.52	1998	City of Saint. Jo Saint Jo, Texas 940-995-2337	Chiang, Patel and Yerby, Inc Dallas,, TX 214 638-0500
97-3717	Sinton	TX	Iceas NIT	0.80	2.4	1998	Sinton WWTP, TX Sinton, TX 361-364-1964	Naismith Engineering, Inc. Corpus Christi, TX 361-814-9900
01-4858	Sugarland - North Mission Glen WWTP	TX						Turner, Collie and Braden Houston, TX
01-4832	Sweetwater WWTP	TX	Iceas NIT	2.2	8.0	2002	Sweetwater WWTP, TX Sweetwater, TX 325-235-8130	Hibbs and Todd, Inc Arlington, TX 915 698-4330
08-6912	T R A - Denton Creek WWTP	TX	SBR NDNP	2.5	6.7		Denton Creek WWTP, TX Roanoke, TX 817-430-4657	Alan Plummer Associates, Inc. Fort Worth, TX 817-284-2724
12-7752	Tex Americas Center WWTP	TX	Iceas NIT	1.5	4.5			
02-5130	Trinity River Auth - Denton Creek T P - Arlington	TX	SBR NIT	2.5	6.7	2004	Denton Creek WWTP, TX Roanoke, TX 817-430-4657	Alan Plummer Associates, Inc. Fort Worth, TX 817 284-2724
11-7652	Weston Mud	TX						Jacobs Engineering Baton Rouge, LA 225 768-5077
10-7377	Acoma Pueblo	Usa					Pueblo of Acoma - Acomita WWTP Acoma, NM 505 552-6604	
10-7439	Center West Joint Sewer Auth.	Usa	Iceas NIT					Widmer Engineering Connellsville, PA 724-626-1909
08-7022	Forest Hills Municipal Authority	Usa						EADS Group Altoona, PA 814-944-5035
12-7857	Southern Hs WWTP	Usa	Iceas NIT					Gannett Fleming Baltimore, MD 410-585-1460
09-7202	Weatherly Borough, Pa	Usa	Iceas NIT					Owner ,
95-4002	James River (2)	VA	Iceas NIT	0.11	0.27	1996	James River WWTP, VA Maysville, VA 804-784-3551	Dewberry and Davis Richmond, VA 804-672-0452

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Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
359	Nottoway	VA	Iceas NIT	0.50	1.3	1989	Nottoway, VA WWTP Burkeville, VA 804-767-5543	Virginia Dept. of Corrections Richmond, VA 804 897-6666
01-4813	Nottoway Correction Center - Burkeville	VA	Iceas NDN	0.50	1.3	2001	Nottoway, VA WWTP Burkeville, VA 804-767-5543	Virginia Dept. of Corrections Richmond, VA 804 897-6666
11-7532	Selma	VA	Iceas NDN					Bowman Consulting ,
02-5223	Virginia D O T - I-64 Rest Area - Jerry's Run	VA	SBR NDN	0.01	0.01	2004	Virginia DOT, I-64 Rest Area, VA Jerry's Run, VA 336-408-7922	R. Stuart Royer and Assoc, Inc Richmond, VA 804 740-0181
97-3814	Castleton Wwtp	VT	S/I NDNP	0.54	1.4	1998	Castleton, VT - City of Castleton, VT 802-468-5315	Forcier Aldrich and Associates Willston, VT 802-879-7733
10-7325	Hartford	VT	S/I NIT	1.5	4.8			Forcier Aldrich and Associates Willston, VT 802-879-7733
3187	Johnson	VT	SBR NIT	0.27	0.85	1995	Village of Johnson WWTF Johnson, VT 802-635-2951	Forcier Aldrich and Associates Willston, VT 802-879-7733
05-5965	Milton WWTP	VT	S/I NIT	1.0	3.0	2006	Milton WWTP, VT Milton, VT 802-893-1170	Forcier Aldrich and Associates Willston, VT 802-879-7733
01-4743	Poultney	VT	S/I NDN	0.50	1.6	2002	Poultney, VT Poultney, VT 802-287-9727	Forcier Aldrich and Associates Willston, VT 802-879-7733
05-6020	Pownal WWTP	VT	S/I NIT	0.26	0.74	2006	Pownal, VT - WWTP Pownal, VT 802.823.9814	Forcier Aldrich and Associates Willston, VT 802-879-7733
98-3985	Stratton Mountain	VT	ceas NDNI	0.85	1.7	2000	Stratton Corporation Stratton Mountain, VT 802 297-4158/2200	Technicon ,

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10-7333	Troy - Jay	VT	S/I NDNP	0.40	1.2			Leach Engineering Consultants Lyndonville, VT 802 626-4510
99-4298	West Rutland	VT	SBR NDNP	0.45	1.1	2000	West Rutland WWTP Rutland, VT 802-438-2114	Forcier Aldrich and Associates Willston, VT 802-879-7733
01-4786	Chelan	WA				2002		Gray and Osborne, Inc. Seattle, WA 206-284-0860
07-6804	Entiat WWTP	WA	Iceas NIT	0.15	0.36		Entiat WWTP, WA Entiat, WA 509-784-1224	Hammond Collier Wade Livingstone Wenatchee, WA 509 662-1762
04-5665	Kalama W W T P	WA						Gray and Osborne, Inc. Seattle, WA 206-284-0860
01-4846	King County - Renton South WWTP	WA				2002		
01-4741	Lewis County W & Sd #6 - Lake Mayfield Village	WA	Iceas NIT	0.08	0.24	2002	Lewis County W & Sd #6 Mossyrock, WA 360-985-0597 (LAB)	Parametrix Sumner, WA 253 863-5128
07-6815	Mason County- Rustlewood WWTP	WA	Iceas NIT	0.06	0.29	2008	Mason County, WA Grapeview, WA 360-490-0277	Hammond Collier Wade Livingstone Wenatchee, WA 509 662-1762
04-5835	Mc Cleary W W T P	WA	SBR NIT	0.57	1.3	2005	McCleary, WA McCleary, WA 360-520-9494	Parametrix Sumner, WA 253 863-5128
05-6204	Cedar Grove WWTP	WI	ceas NDNI	0.40	1.4	2006	Cedar Grove, WI WWTP Cedar Grove, WI 920-668-6913	McMahon Assoc Neenah, WI 920 751-4200
08-6959	Danbury	WI	Iceas NDN	0.09	0.18		Danbury WWTP, WI Danbury, WI 715-656-3331	Short Elliott Hendrickson St. Paul, MN 800-325-2055
06-6423	Dekorra WWTP	WI	Iceas NDN	0.10	0.20	2007	Dekorra WWTP, WI Poynette, WI 608-566-5150	General Engineering Portage, WI 608 742-2169
07-6743	Green Lake - WWTP	WI	ceas NDNI	0.50	1.5	2008	Green Lake, WI WWTP Green Lake, WI 920-369-8394	McMahon Assoc Neenah, WI 920 751-4200

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02-5147	Harmony Grove WWTP - Okee	WI	Iceas NDN	0.50	0.80	2003	Harmony Grove WWTP, WI Lodi, WI 608-592-4699	General Engineering Portage, WI 608 742-2169
04-5875	Lebanon Sanitary District #2 - W W T P	WI	Iceas NIT	0.05	0.13	2005	Lebanon WWTP, Hidden Meadows Association Lebanon, WI 920-261-2764	McMahon Assoc Neenah, WI 920 751-4200
01-4956	Readstown WWTP	WI	Iceas NIT	0.09	0.35	2003	Readstown WWTP Readstown, WI 608-629-5157	McMahon Assoc Neenah, WI 920 751-4200
01-4944	Readstown WWTP	WI	Iceas NIT	0.09	0.35	2003	Readstown WWTP Readstown, WI 608-629-5157	McMahon Assoc Neenah, WI 920 751-4200
95-4003	Red Arrow Products	WI	SBR NIT	0.01	0.01	1996	Red Arrow Products, WI WWTP Rhinelander, WI 715-365-5500	MSB Corporation Appleton, WI 920-759-1100
09-7271	Spring Valley	WI	ceas NDNF	0.25	0.70			Foth and Van Dyke Green Bay, WI
06-6340	St. Joseph WWTP	WI	Iceas NDN	0.07	0.17	2007	St. Joseph WWTP, WI St. Joseph, WI 608-397-0251	Ayres and Associates Eau Claire, WI 715 834-3161
04-5729	Athens	WV	Iceas NIT	0.50	2.0	2005	Athens, WV Athens, WV 304-384-7068/320-5579	Stafford Consultants, Inc Princeton, WV 304-425-9555
00-4541	Cameron WWTP	WV	Iceas NIT	0.21	0.52	2001	Cameron, WV WWTP Cameron, WV 304-686-2245	Leonnon, Smith, Souleret Eng Corapopolis, PA 412 264-4400
00-4545	Charles Town	WV	Iceas NIT	1.2	4.8	2001	Charles Town, WV WWTP Charles Town, WV 304-725-8179	Chester Environmental Moon Township, PA 412-269-5700
05-6070	Charles Town WWTP	WV	Iceas NIT	1.2	4.8	2006	Charles Town, WV WWTP Charles Town, WV 304-725-8179	Chester Engineers Gaithersburg, MD
08-7005	Claywood Park P S D	WV	Iceas NIT	0.43	1.3		Claywood Park - Red Hill WWTP, WV , WV	Cerrone Associates, Inc. Wheeling, WV 304-232-5550
01-4914	Crab Orchard WWTP - Macarthur	WV	Iceas NIT	2.0	5.0	2002	Crab Orchard WWTP, WV MacArthur, WV 304-252-5628	Dunn Engineers, Inc Charleston, WV 304 342-3436
2823	Fayetteville	WV	Iceas NIT	0.50	2.1	1994	Fayetteville WWTP Fayetteville, WV 304-574-2916	Woolpert Associates Charleston, WV 304.344.2223

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01-4755	Glenville WWTP	WV	Iceas NIT	0.65	2.0	2002	Glenville, WV Glenville, WV 304-462-7021	Dunn Engineers, Inc Charleston, WV 304 342-3436
00-4468	Grantsville	WV	Iceas NIT	0.10	0.40	2001	Town of Grantsville Grantsville, West Virginia 304-354-7804	Haworth Meyer and Boleyn - Charl S Charleston, WV 304-744-5200
06-6508	Hancock County - Route 8 WWTP	WV	Iceas NIT	0.25	0.75		Hancock County, WV New Cumberland, WV 304-670-8249 cell	L. Robert Kimball and Associates Coraopolis, PA 412-262-5400
99-4384	Hancock County PSD - Route 2	WV	Iceas NIT	0.30	1.1	2000	Hancock County, WV Chester, WV 304-387-1433 (or670-8384)	L. Robert Kimball and Associates Coraopolis, PA 412-262-5400
02-4986	Hazelton - Preston County P. S. D. WWTP	WV	Iceas NIT	0.50	1.8	2003	Hazelton, Preston County PSD WWTP, WV Hazelton, WV	Thrasher Engineering Clarksburg, WV 304 624-4108
11-7713	Hazelton WWTP	WV	Iceas NIT					Thrasher Engineering Charleston, WV
09-7172	Kermit WWTP	WV	Iceas NIT	0.05	0.09	2010	Kermit, WV Kermit, WV 304-393-4690	Woolpert Associates Charleston, WV 304.344.2223
12-7906	Lakin- Camp Conley- Sand Hill Sewer	WV	Iceas NIT	0.35	1.0			Cerrone Associates, Inc. Wheeling, WV 304-232-5550
02-5268	Logan County WWTP	WV	Iceas NIT	1.0	3.5	2003	Logan County WWTP, WV Logan, WV 304-792-8667	Haworth Meyer and Boleyn - Charl S Charleston, WV 304-744-5200
99-4235	Mullens WWTP	WV	Iceas NIT	0.33	0.88	1999	Mullens WWTP, WV Mullens, WV 304-294-4103	Woolpert Associates Columbus, OH
2676	New Cumberland	WV	Iceas NIT	0.18	0.54	1995	New Cumberland, WV WWTP New Cumberland, WV 304-564-4066	KLH Engineers Inc. Pittsburgh, PA 412-494-0510
00-4474	Oceana, Wyoming County Wwtp	WV	Iceas NIT	0.50	2.1	2001	Town of Oceana Oceana, WV 304-682-6655	Dunn Engineers, Inc Charleston, WV 304 342-3436
96-4013	Rocket Center	WV	Iceas NIT	0.20	0.50	1996	Rocket Center WWTP, WV Rocket Center, WV 304-726-5244	Alliant Tech Systems, Inc. Rocket Center, WV 304-726-5000

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04-5910	Salt Rock Sewer PSD, Wv	WV	Iceas NIT	2.5	10.0	2005	Salt Rock PSD, WV Ona, WV 304-743-6945 x302	Dunn Engineers, Inc Charleston, WV 304 342-3436
99-4426	St. Albans WWTP	WV	Iceas NIT	4.0	14	2001	St. Albans, WV WWTP St. Albans, WV 304-722-3355	Dunn Engineers, Inc Charleston, WV 304 342-3436
10-7305	St. Marys WWTP	WV						S and S Engineering Charleston, SC
99-4361	Terra Alta	WV	Iceas NDN	0.25	0.75	2000	Terra Alta WWTP, WV Terra Alta, WV 304-789-6664	Thrasher Engineering Clarksburg, WV 304 624-4108
04-5615	Union Williams PSD - WWTP	WV	Iceas NIT	0.80	2.4	2005	Union Williams WWTP, WV Waverly, WV 304-481-7205	Cerrone Associates, Inc. Wheeling, WV 304-232-5550
05-5982	Union Williams WWTP	WV					Union Williams WWTP, WV Waverly, WV 304-481-7205	Cerrone Associates, Inc. Wheeling, WV 304-232-5550
11-7552	Hoxton Park	Australia						
09-7150	Koorlong	Australia	)ecant Onl			2011		
06-6285	Maggie Hays STP	Australia	Iceas NDN	0.03	0.06	2006	Maggie Hays WWTP, Australia ,	Flygt Australia Silverwater, ns
05-6009	New Warragamba STP	Australia						
09-7099	Westdale WWTP	Australia	)ecant Onl					
12-7741	Imbirussu Ete	Brazil	Iceas NIT	2.6	4.3			
05-6182	Aslan Technologies - WWTP	Canada	ceas NDNI	0.07	0.14	2007	Aslan Technologies WWTP, Ontario Burlington, Ontario	
01-4855	Banff WWTP	Canada				2002		Earth Tech Kelowna, BC 250 762-3727
04-5762	Baysville - Birch Glen WWTP Muskoka	Canada	ceas NDNI	0.12	0.44	2006	Baysville WWTP, Dist Mun. of Muskoka, Canada Baysville, Muskoka, Ontario	Stantec Consulting Winnipeg, MB 204 489-5900
97-3728	Brethren of Early Christianity	Canada	Iceas NDN	0.01	0.04	1997	Brethren of Early Christianity, Canada Bright, Ontario (519) 684-7392	Cumming Cockburn, Limited Canada, 519 885-5440
02-5287	Brethren Of Early Christianity - Bright	Canada	Iceas NDN	0.01	0.04	1997	Brethren of Early Christianity, Canada Bright, Ontario (519) 684-7392	Cumming Cockburn, Limited Canada, 519 885-5440

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
05-6168	Britannia Beach WWTP	Canada	Iceas NIT	0.21	0.57	2006	Britannia Beach WWTP, BC Britannia Beach, BC 604-896-1549	Kerr Wood Leidal Assoc Vancouver, BC
05-6048	Britannia Beach WWTP	Canada	Iceas NIT	0.21	0.57		Britannia Beach WWTP, BC Britannia Beach, BC 604-896-1549	Kerr Wood Leidal Assoc Vancouver, BC
95-4007	Casino Rama	Canada	ceas NDNI	0.55	1.7	1996	Mnjikaning First Nation WWTP Rama, Ontario 705-325-3611 x1640	Marshall Macklin Monaghan Ltd. Thornhill, Ontario, 905-882-1100
04-5627	Conestoga Meats WWTP - Breslau	Canada	ceas NDNI	0.20	0.20	2004	Conestogo, Ontario WWTP Conestogo, Ontario 519-886-7500	Geomatrix Waterloo, ON 519-886-7500
95-3259	District Of Kent (Abj 0817)	Canada	Iceas NIT			1996	District of Kent, BC WWTP Agassized, British Columbia 604-796-9145	Austgen Biojet ,
09-7080	Dominion WWTP	Canada	Iceas NIT	1.0	3.0			
08-6876	Dominion WWTP	Canada	)ecant Onl	1.0	3.0		Dominion WWTP Nova Scotia Canada Dominion, NS	Dillon Consulting London, ON 519-438-6192
09-7057	Dominion, Nova Scotia	Canada				2010		Stantec Consulting Winnipeg, MB 204 489-5900
10-7488	Dryden	Canada	Iceas NDN	2.4	6.8			Stantec Consulting Winnipeg, MB 204 489-5900
08-6966	East St Paul	Canada	ceas NDNI	0.29	0.80		East St. Paul WWTP Manitoba Canada East St. Paul, MB	Stantec Consulting Winnipeg, MB 204 489-5900
08-6833	East St. Paul WWTP	Canada	ceas NDNI	0.30	0.80		East St. Paul WWTP Manitoba Canada East St. Paul, MB	Stantec Consulting Surrey, BC 604 597-0422
04-5917	Flin Flon, Mb - WWTP	Canada	Iceas NIT	1.3	3.2	2005	City of Flin Flon, AB Flin Flon, AB 204-681-7501	Dillon Consulting London, ON 519-438-6192
00-4641	Garden Hill First Nation WWTP	Canada	Iceas NIT	0.41	1.6	2002	Garden Hill First Nation WWTP, Canada Island Lake, Manitoba	Stantec Consulting Winnipeg, MB 204 489-5900
01-4641	Garden Hill First Nation WWTP	Canada	Iceas NIT	0.41	1.6	2002	Garden Hill First Nation WWTP, Canada Island Lake, Manitoba	Stanley Consulting Group Ltd Winnipeg MB R3T 5P4, 204 489-5900

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
04-5794	Gibsons WWTP, Bc	Canada	Iceas NIT	0.79	1.8	2005	Gibsons WWTP, BC Gibsons, BC	Stantec Consulting Surrey, BC 604 597-0422
99-4302	Gillam Wwtp	Canada	Iceas NIT	0.42	1.7	2000	Gillam WWTP (MB), Canada Gillam, Manitoba (204) 652-2377	Stantec Consulting Winnipeg, MB 204 489-5900
06-6383	Gimli WWTP	Canada	ceas NDNI	1.1	2.3	2007	Gimli WWTP, Manitoba Canada Gimli, MB	Stantec Consulting Winnipeg, MB 204 489-5900
05-6098	Gimli WWTP	Canada	ceas NDNI	1.1	2.3		Gimli WWTP, Manitoba Canada Gimli, MB	Stantec Consulting Winnipeg, MB 204 489-5900
04-5621	Golden WWTP	Canada	Iceas NIT	0.66	1.1	2004	Golden WWTP, BC Golden, British Columbia 250-344-2271	Urban Systems Ltd. Kamploops, BC 250-374-8311
00-4571	Haley Industries, Limited	Canada	Iceas NIT	0.02	0.04	2002	Haley Industries Haley, Ontario 613-432-8846 xt 560	Geomatrix Waterloo, ON 519-886-7500
99-4232	Headingley Correctional Inst	Canada	Iceas NIT	0.36	0.71	2000	Headingley Correctional Inst WWTP, Canada Headingley, MB 204-837-1351	Stantec Consulting Winnipeg, MB 204 489-5900
09-7213	Headingly	Canada	Iceas NDN	0.62	2.0		Headingley Correctional Inst WWTP, Canada Headingley, MB 204-837-1351	Dillon Consulting London, ON 519-438-6192
96-4018	Horseshoe Resort Corp.	Canada	ceas NDNI	0.54	1.9	1997	Horseshoe Valley Resort Barrie, Ontario 705-835-3420	Thornburn Penny Cons. Eng. East Milton, Ontario, 905-875-2144
01-4836	Horseshoe Valley Resort	Canada	Iceas NIT	0.14	0.49	2002	Horseshoe Valley Resort Barrie, Ontario 705-835-3420	Azurix North America Hamilton, ON 905 521-1988
A01-483	Horseshoe Valley Resort	Canada	Iceas NIT	0.14	0.49	2002	Horseshoe Valley Resort Barrie, Ontario 705-835-3420	Azurix North America Hamilton, ON 905 521-1988
95-4000	Kent, BC	Canada	Iceas NIT	0.95	1.4	1996	District of Kent, BC WWTP Agassized, British Columbia 604-796-9145	Stanley Associates Eng Ltd. Surrey, BC, 604-597-0422
03-5416	La Ronge, Town Of WWTP	Canada	Iceas NDN	0.64	1.4	2004	La Ronge, Town of, WWTP, Canada La Ronge, Saskatchewan	UMA Engineering Saskatoon, SK 306-955-3300
04-5836f	Lake Cowichan, Bc - Creekside Plant	Canada				2005	Lake Cowichan - Lakeside WWTP, BC Lake Cowichan, BC	Giles Environ. Engineering ,

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02-5134	Langdon (Hamlet Of) WWTP	Canada	ceas NDNI	0.36	0.86	2003	Langdon (Hamlet of) WWTP, Canada Langdon, Alberta 403-863-0921	UMA Constructors Lethbridge, ab 403-329-4822
06-6452	Langdon WWTP	Canada	ceas NDNI	0.79	1.1		Langdon (Hamlet of) WWTP, Canada Langdon, Alberta 403-863-0921	Simflo Calgary, AB
97-3840	Lockport	Canada	Iceas NIT	0.05	0.15	1998	Lockport (MB) WWTP, Canada Lockport, Manitoba (204) 757-4756	Stanley Associates Eng Ltd. Surrey, BC, 604-597-0422
3242	Long Sault	Canada	ceas NDNI	0.71	3.0	1995	Long Sault, ONT WWTP Long Sault, Ontario 613-534-2152	M.S. Thompson and Assoc. Cornwall, ON 613-933-5602
03-5490	Lytton WWTP	Canada	Iceas NIT	0.07	0.09	2004	EPCOR Lytton, British Columbia 604-232-2235/604-250-8027	Stantec Consulting London, ON 519-645-2007
04-5644	MacTier Conger Marsh Lane WWTP Muskoka	Canada	ceas NDNI	0.18	0.61		MacTier Conger Marsh Lane WWTP MacTier, ON	Totten, Sims, Hubicki Assoc Whitby, ON 905-668-9363
05-5959	MacTier Conger Marsh Lane WWTP Muskoka	Canada	ceas NDNI	0.18	0.61	2006	MacTier Conger Marsh Lane WWTP MacTier, ON	Totten, Sims, Hubicki Assoc Whitby, ON 905-668-9363
96-3430	Mccain Foods, Grand Falls	Canada	SBR NIT			1998	McCain Foods Limited Grand Falls, New Brunswick	Gore and Storrie ,
02-5301	Namgis First Nation - Alert Bay	Canada	Iceas NIT	0.17	0.63	2003	Namgis First Nation - Alert Bay, Canada Alert Bay, British Columbia 250-974-5837	Kerr Wood Leidal Assoc Vancouver, BC
96-4026	New Tecumseth	Canada	ceas NDNI	1.4	3.6	1997	New Tecumseth (ON) WWTP, Canada New Tecumseth, Ontario 705-435-0104	KMK Consultants Limited Brampton, ON 905 459-4780
00-4515	North Dorchester WWTP	Canada	SBR NDNP	0.14	0.49	2001	North Dorchester Wwtp Dorchester, Ontario 519-389-7276	Stantec Consulting London, ON 519-645-2007
00-4508	Oneida Nation Of Thames	Canada	ceas NDNI	0.04	0.09	2001	Oneida Nation Of Thames Delaware, Ontario 519-445-0040	First Nations Eng Svcs Ltd Ohsweden, On 519 445-0040
97-3695	Oxford House, 1st Nation	Canada	Iceas NIT	0.22	0.87	1997	Oxford House (MB) WWTP, Canada Oxford House, Manitoba (204) 538-2879	Ininew Project Management Ltd Winnipeg,Manitoba, 204 956-0900
04-5709	Pemberton WWTP	Canada	Iceas NIT	0.45	1.1	2004	Village of Pemberton, BC Pemberton, BC 604-894-5742	Earth Tech Thornhill, ON 905 886-7022

Job #	Plant	Location	Process	MGD ADWF	PWWF	Start	Contact	Engineer
03-5392	Pembroke, On - WWTP	Canada	S/I NDN	4.2	11	2006	Pembroke WWTP, Canada Pembroke, Ontario 613-732-0544/613-735-6821	J.L. Richards and Assoc. Ltd. Ottawa, ON 613-728-3571
96-4012	Petawawa	Canada	ceas NDNI	2.3	4.6	1996	Petawawa (ON) WWTP, Canada Petawawa, Ontario (613) 687-2141	J.L. Richards and Assoc. Ltd. Ottawa, ON 613-728-3571
06-6227	Port Hardy	Canada	Iceas NIT	0.37	1.2	2007	Port Hardy WWTP, BC Port Hardy, BC	Stantec Consulting Surrey, BC 604 597-0422
96-4017	Port Severn	Canada	ceas NDNI	0.19	0.58	1996	Port Severn (ON) WWTP, Canada Port Severn, Ontario (705) 762-1175	CH2M Hill North York, ON 416-499-9000
07-6699	Prescott Wpcc	Canada	ceas NDNI	1.5	4.2		Prescott WWTP, Ontario Canada Prescott, ON	Ainley and Associates Limited Collingwood,, ON
07-6578	Red Leaves Resort	Canada	ceas NDNI	0.11	0.14	2008	Red Leaves Resort - Burlington, Ontario Canada Burlington, ON 905-515-9609	Azimuth Engineering Barrie, ON
02-5150	Reg Mun Of Waterloo - Conestogo WWTP	Canada	SBR NDNP	0.05	0.17	2005	Waterloo Waterloo, Ontario 519-884-0260	Acres and Associated Env Toronto, ON 416 622-9502
01-4844	Reg Mun Of York - Sutton W P C F	Canada	ceas NDNI	0.81	3.2	2002	York, Sutton WPCF, Canada Sutton, Ontario 905.722.1470	Azurix North America Hamilton, ON 905 521-1988
09-7194	Shakespeare WWTP	Canada	Iceas NIT	0.09	0.15			
08-6970f	Shawnigan Lake	Canada						Giles Environ. Engineering ,
04-5882	Sooke WWTP	Canada	Iceas NIT	0.79	1.8	2005	Sooke WWTP Sooke, BC 250-642-0151	Stantec Consulting Winnipeg, MB 204 489-5900
09-7192	St. Theresa Point	Canada	Iceas NIT					None ,
98-3943	St. Theresa Point	Canada	Iceas NIT	0.39	1.2	1999	St. Theresa Point, Canada St. Theresa Point, Manitoba 204-462-2796	Burnside Engineering Western Winnipeg,
10-7404	Thorndale	Canada	Iceas NDN					Stantec Consulting London, ON 519-645-2007

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
11-7614	Thorndale	Canada	Iceas NDN					Stantec Consulting London, ON 519-645-2007
07-6532	Tobiano Resort	Canada	Iceas NIT	0.13	0.18	2007		Urban Systems Ltd. Kamploops, BC 250-374-8311
06-6504	Tobiano Resort	Canada	Iceas NIT	0.13	0.18		Kamland Holdings Kamloops, BC 250-434-4406	Urban Systems Ltd. Kamploops, BC 250-374-8311
96-4010	Tsawwassen	Canada	ceas NDNI	0.20	0.45	1996	Tsawwasen, BC WWTP Delta, British Columbia 604-943-2112	Stanley Associates Eng Ltd. Surrey, BC, 604-597-0422
96-3641	Vancouver S & D Dist-Lulu Island Wwtp	Canada						Associated Engineering Edmonton, AL 703 451-7666
06-6335	Winnipeg WWTP	Canada	)ecant Onl			2008	Winnipeg WWTP, MB Canada Winnipeg, MB	
06-6470	Aconcagua Foods	Chile	Iceas NIT	3.1	3.1	2007	Aconcauga Foods WWTP Chile ,	
06-6308	Agrofrut - Rengo WWTP	Chile	Iceas NIT	0.95	0.95	2006	Agrofrut - Rengo, Chile WWTP Rengo,	Ecoriles Santiago,
00-4539	Autoclub Antofagusta	Chile	Iceas NIT	0.09	0.14	2001	Autoclub Antofagusta WWTP, Chile ,	Biwater Santiago, 011-562-203-
07-6740	Buin-maipo WWTP	Chile	SBR NDN	3.1	6.8		Buin - Malpo WWTP, Chile ,	Aguas Andinas Santiago, 56(2)6942964
05-6131	Calama WWTP	Chile	Iceas NIT	5.7	10	2005	Calama WWTP, Chile Biwater,	Flygt- Chile Santiago, 5627386935
01-4679	Calama WWTP - Biwater	Chile	Iceas NDN	1.0	3.8	2002	Calama WWTP, Chile Biwater,	Biwater Santiago, 011-562-203-
04-5845	Curacavi W W T P	Chile	SBR NDN	1.0	1.8	2005	Curacavi WWTP, Chile Curacavi,	Aguas Andinas Santiago, 56(2)6942964
02-5319	El Monte - El Paico Y Lo Chacon	Chile	SBR NDN	1.1	1.8	2003	El Monte - El Paico y Lo Chacon, Chile ,	Aguas Andinas Santiago, 56(2)6942964
09-7232	El Monte Expansion	Chile	SBR NDN	1.6	2.6			
00-4564	Laja Sn Rosendo & Canete	Chile	Iceas NIT	1.3	2.7	2001	Laja San Rosendo/Canete, Chile ,	Black and Veatch Orlando, FL 407-419-3500

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
06-6280	Melipilla	Chile	SBR NDN	4.4	8.9	2007	Melipilla WWTP, Chile Melipilla,	Aguas Andinas Santiago, 56(2)6942964
01-4883	Pan de Azucar	Chile	Iceas NIT	0.23	0.61	2002	Pan de Azucar WWTP, Chile , 011-632-924-2275	Bauer International Cubao, Quezon City, USA
07-6559	Til Til WWTP	Chile	SBR NDN	0.29	0.51	2008	Tezontle WWTP, Mexico ,	
02-5167	Chengyang Wastewater Treatment Co Ltd - Quing Dao	China	Iceas NDN	13	21	2003	Chengyang WWT Co. Ltd, China Quing Dao,	
02-5037	Chengyang Wastewater Treatment Co Ltd - Quingdao	China	Iceas NDN	13	21	2002	Chengyang WWT Co. Ltd, China Quing Dao,	
353	Coca Cola	China	Iceas NIT	0.09	0.10	1989	Coca-Cola WWTP, China , 415-974-6210	
668	Kunming	China	ceas NDNI	40	80	1997	Kunming WWTP, China , 086-216-293-2941	BHP Engineering North Sydney, AU
11-7510	Aguazul	Colombia	Iceas NIT					
11-7584	Rio Frio WWTP	Colombia	Iceas NDN					
12-7902	Tolu Ptard	Colombia	Iceas NIT					
09-7049	Iberostar Bavaro Golf & Resort	Dominican Republic	Iceas NDN	0.69	1.0			
99-4341	Amira Wwtp	Egypt	Iceas NIT	1.6	2.4	2000	Horse Engineering Works SAE Alexandria, 011-203-522-3112 or -2994	Horse Engineering Works SAE Alexandria, VA 203-52229994
05-6176	Momi Bay Resort & Spa, Fiji	Fiji	ceas NDNI	0.25	0.33		Momi Bay Resort & Spa WWTP, Fiji Momi Bay,	
01-4834	Mako	Hungary	Iceas NIT	1.6	3.4	2002	Mako WWTP, Hungary Mako,	
00-4481	Dublin Bay	Ireland	SBR NIT	130	256	2001	Dublin Corporation WWTP Dublin,	Paterson Candy ,
02-4999	Wexford WWTP	Ireland	Iceas NIT	3.0	6.7	2002	Wexford Co. Wexford,	Jones Environmental ,
12-7939	Farod Project	Israel	Iceas NIT					Envirotreat ,
12-7848	Ah - Po	Korea	Iceas NDN					
07-6770	Beob - Seong	Korea	Iceas NDN	0.62	1.0	2008	Seha Corporation-Environmental Div. Seoul, 82-2-515-1166	

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
00-4491	Bo Ryung Stp	Korea	Iceas NDN	0.18	0.32	2001		Serim Paper Mfg. Co., LTD Seoul, 118225114981
09-7233	Bong Pyung	Korea	Iceas NDN	0.28	0.47			
99-4353	Boon Won WWTP	Korea	Iceas NDN	0.50	1.0	1998		Serim Paper Mfg. Co., LTD Seoul, 118225114981
04-5800	Dae Bu Do W W T P	Korea	Iceas NDN	1.1	1.9	2005		Serim Paper Mfg. Co., LTD Seoul, 118225114981
01-4887	Dae Jung WWTP	Korea	Iceas NDN	2.1	8.2	2002		Serim Paper Mfg. Co., LTD Seoul, 118225114981
03-5443	Do - Am WWTP	Korea	Iceas NDN	1.2	3.3	2006		Serim Paper Mfg. Co., LTD Seoul, 118225114981
09-7240	Do Am	Korea	Iceas NDN	1.3	2.1	2010		
98-4148	Do Gae	Korea	ceas NDNI	0.26	0.50	1999		Serim Paper Mfg. Co., LTD Seoul, 118225114981
04-5649	Dong Hak Sa WWTP	Korea	Iceas NDN	0.51	0.75	2005	Serim Paper Mfg. Co., Ltd. Seoul, 011-822-511-4981	Serim Paper Mfg. Co., LTD Seoul, 118225114981
00-4505	Feedlot Waste	Korea	Iceas NIT	0.07	0.07	2000	Feedlot Waste Seoul, 9-011-82-2-511-4981	Serim Paper Mfg. Co., LTD Seoul, 118225114981
10-7386	Ga - Ya	Korea	Iceas NDN	0.34	0.57		ITT WWW Korea Dongan-Gu, Anyang-Si, Kyeonggi-Do 011-82-1-478-5582	
06-6400	Gok Soo WWTP	Korea	Iceas NDN	0.19	0.32		Seha Corporation-Environmental Div. Seoul, 82-2-515-1166	
04-5648	Gong Am WWTP	Korea	Iceas NDN	0.52	0.88	2005		Serim Paper Mfg. Co., LTD Seoul, 118225114981
08-6847	Im - Won	Korea	Iceas NDN	0.81	1.1		Seha Corporation-Environmental Div. Seoul, 82-2-515-1166	Seha Corporation - Env. Division Seoul, 82220568800
02-5027	Ji Pyung	Korea	Iceas NDN	0.31	0.53	2004		Serim Paper Mfg. Co., LTD Seoul, 118225114981

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
01-4782	Kang Dong Pusan City	Korea	Iceas NDN	4.0	5.5	2002	Kang Dong Pusan City WWTP, Korea ,	Serim Paper Mfg. Co., LTD Seoul, 118225114981
00-4602	Kang Jin	Korea	Iceas NIT	4.3	7.6	2002	Kang Jin WWTP, Korea ,	Serim Paper Mfg. Co., LTD Seoul, 118225114981
01-4807	Kum Sung WWTP	Korea	Iceas NDN	1.0	2.1	2002		Serim Paper Mfg. Co., LTD Seoul, 118225114981
01-4942	Moon Kyung, Korea - WWTP	Korea	Iceas NDN	2.2	3.7	2003		Serim Paper Mfg. Co., LTD Seoul, 118225114981
04-5597	Mu Chang Po Expansion	Korea	Iceas NDN	0.21	0.34	2005	Serim Paper Mfg. Co. Seoul, 044-822-511-4981	Serim Paper Mfg. Co., LTD Seoul, 118225114981
02-5082	Mu Chang Po WWTP	Korea	Iceas NDN	0.21	0.34	2003		Serim Paper Mfg. Co., LTD Seoul, 118225114981
03-5385	Nam Won S. Cheju Island WWTP	Korea	Iceas NDN	2.1	8.5			Serim Paper Mfg. Co., LTD Seoul, 118225114981
07-6533	Neunggok WWTP	Korea	ceas NDNI	1.9	2.8			Serim Paper Mfg. Co., LTD Seoul, 118225114981
12-7794	North Cheju - East Expansion	Korea	Iceas NDN	1.6	2.9			
13-8143	North Cheju - West	Korea	Iceas NDN	3.2	5.9			
05-5981	North Cheju Island East WWTP	Korea	Iceas NDN	3.2	5.9		North Cheju Island East WWTP Seoul, 0118225114981	Serim Paper Mfg. Co., LTD Seoul, 118225114981
03-5547	Om Chon WWTP	Korea	Iceas NDN	0.03	0.05	2004		Serim Paper Mfg. Co., LTD Seoul, 118225114981
09-7234	Pyeong Chang	Korea	Iceas NDN	0.49	0.69			
01-4654	Sam Cheok	Korea	Iceas NIT	1.7	6.6	2002	Sam Cheok, Korea WWTP ,	Serim Paper Mfg. Co., LTD Seoul, 118225114981
03-5548	Shin Poong WWTP	Korea	Iceas NDN	0.05	0.08	2004	Shin Poong WWTP Seoul, 118225114981	Serim Paper Mfg. Co., LTD Seoul, 118225114981
02-5084	Sung San WWTP	Korea	Iceas NDN	1.1	4.2	2003		Serim Paper Mfg. Co., LTD Seoul, 118225114981

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
08-7030	Won Dong	Korea	Iceas NDN				Seha Corporation-Environmental Div. Seoul, 82-2-515-1166	Seha Corporation - Env. Division Seoul, 82220568800
98-4166	Yang Su - Korea	Korea	Iceas NDN	0.48	0.98	1999	Yang Su, Korea Seoul, 9-011-82-2-511-4981	Serim Paper Mfg. Co., LTD Seoul, 118225114981
07-6604	Yang Su W W P	Korea	Iceas NDN	0.26	0.50		Seha Corporation-Environmental Div. Seoul, 82-2-515-1166	Serim Paper Mfg. Co., LTD Seoul, 118225114981
00-4622	Yang Yang	Korea	ceas NDNI	3.2	5.3	2002	Yang Yang, Korea ,	Serim Paper Mfg. Co., LTD Seoul, 118225114981
08-6894	Yeon - Moo	Korea	ceas NDNI	2.3	3.9		Seha Corporation-Environmental Div. Seoul, 82-2-515-1166	
03-5365	Young Kwang WWTP	Korea	Iceas NIT	2.0	2.9	2003		Serim Paper Mfg. Co., LTD Seoul, 118225114981
02-5083	Young Kwang WWTP	Korea	Iceas NIT	2.4	8.0	2003		Serim Paper Mfg. Co., LTD Seoul, 118225114981
04-5647	Yu Gu WWTP	Korea	Iceas NDN	0.97	1.9	2005	Yu Gu WWTP Seoul, 118225114981	Serim Paper Mfg. Co., LTD Seoul, 118225114981
11-7512	El Monte	Mexico						
06-6440	Galerias Merida, Mexico - WWTP	Mexico	Iceas NIT	0.11	0.15			
05-5927	Galerias Metepec - WWTP	Mexico	Iceas NIT	0.11	0.17	2005	Galerias Metepec WWTP Mexico Mexico City, 011-525-55-5421-9414	Hidroecologia S.A de CV Mexico City, df 11-525-55-54
98-4100	Galerias Metepec WWTP	Mexico	Iceas NIT	0.09	0.14	1999	Amanco Armando Aceves , 011-525-490-8833	Amanco Mexico City, 525553228800
04-5894	Las Americas, Mexico - WWTP	Mexico	Iceas NIT	0.20	0.26	2005	Las Americas WWTP, Mexico Mexico City, 011-525-55-5421-9414	
07-6796	Liverpool Atizapan WWTP	Mexico	Iceas NIT	0.29	0.39		Hidroecologia, S.A DE C.V ,	
04-5815	Liverpool Cuernavaca WWTP	Mexico	Iceas NIT	0.13	0.20	2005	Liverpool Cuernavaca WWTP, Mexico Cuernavaca,	Amanco Mexico City, 525553228800
07-6794	Liverpool South WWTP	Mexico	Iceas NIT	0.23	0.31		Hidroecologia, S.A. DE C.V. ,	

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
08-6984	Palacio De Hierro	Mexico	Iceas NIT	0.06	0.09			
13-8000	Plaza Gentio Queretaro	Mexico	Iceas NIT					
98-4016	Plaza Satellite I - Bauer Int'l	Mexico	Iceas NIT	0.22	0.31	1999	PLAZA SAETLLITE II , 9-011-525-490-8833	Amanco Mexico City, 525553228800
99-4286	Plaza Satellite I - Bauer Int'l	Mexico	Iceas NIT	0.22	0.31	2000	PLAZA SAETLLITE II , 9-011-525-490-8833	Amanco Mexico City, 525553228800
01-4652	Plaza Universidad	Mexico	Iceas NIT	0.12	0.18	2002	Plaza Universidad WWTP, Mexico ,	Amanco Mexico City, 525553228800
03-5532	Punta Norte WWTP	Mexico	Iceas NIT	0.08	0.21	2004	Puenta Norte WWTP La Quebrada, DF 011-525-55-5421-9414	
98-4106	Satelite I	Mexico	Iceas NIT	0.10	0.19	1998	Satelite WWTP, Mexico ,	
05-6012	Televisa WWTP	Mexico	Iceas NIT	0.08	0.12		Televisa WWTP, Mexico Televisa,	
07-6561	Tezontle WWTP	Mexico	Iceas NIT	0.22	0.30		Tezontle WWTP, Mexico ,	Hidroecologia S.A de CV Mexico City, df 11-525-55-54
04-5728	Via Moliere WWTP	Mexico	Iceas NIT	0.22	0.29	2005	Via Moliere WWTP, Mexico Mexico City, 011-525-55-5421-9414	Amanco Mexico City, 525553228800
08-6935	Villa Hidalgo	Mexico	Iceas NIT	1.4	3.4			AyMA Guadalajara, 33 3647-7608
03-5595	Auckland - Army Bay WWTP	New Zealand	)ecant Onl				Army Bay WWTP, New Zealand Auckland, 011-64-9-913-8999	
11-7570	Somers Stp	New Zealand	Iceas NIT					AECOM ,
08-7032	Manchay	Peru	Iceas NIT					Sedapal Lima, 51-1-3173000
11-7524	Yunguyo Ptar	Peru	Iceas NIT					
99-4272	Avon Products - Bauer Int'l.	Philippines	Iceas NIT	0.02	0.03	1999	Avon Products, Bauer Int'l., TX , TX	
00-4434	Bauer Int'l - Regalia Tower	Philippines	Iceas NIT	0.08	0.17	2000	The Regalia Group Corporation Cubao, Quezon City, 00632-438-0721 to 22	

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
99-4221	Brent International School - Phillipines	Philippines	Iceas NIT	0.19	0.35	2000	Brent International School, Phillipines , 651-765-8586	Pacific River Rehab. ,
00-4523	Camp John Hay Phase 2	Philippines	Iceas NIT	0.33	0.53	2000	Camp John Hay WWTP ,	Bauer International Cubao, Quezon City, USA
98-4105	Marco Polo Hotel Philippines	Philippines	Iceas NIT	0.08	0.16	1999	Marco Polo Hotel WWTP ,	Rickmond Engineering Williamburg, VA
98-4039	Miascor Catering - Manila	Philippines	SBR NDN	0.01	0.03	1999	Miascor Catering - Manilla, Phillipines , 011-632-924-2275	
01-4776	Splash Manufacturing Inc	Philippines	Iceas NIT	0.02	0.04	2002	Splash Mfg ,	Bauer International Cubao, Quezon City, USA
TMP-011	Abbott Laboratories	Puerto						
2544	Abbott Labs (1)	Puerto	SBR NIT	1.2	1.6	1991	Abbott Laboratories Barcelonia, 787-846-3500 ext 6320	Pedro Panzardi and Assoc. San Francis, 809-722-3644
3043	Abbott Labs (2)	Puerto	SBR NIT	3.0	3.0	1994	Abbott Laboratories Barcelonia, 787-846-3500 ext 6320	Malcolm Pirnie, Inc. White Plains, NY 914-694-2100
2610	Coca-Cola	Puerto	Iceas NDN	0.11	0.21	1990	Coca-Cola, PR WWTP Cidra, 787-739-8452	Engineering Science Atlanta, GA 704-327-6911
09-7081	Dupont - Puerto Rico Sdr	Puerto	SBR NIT					Dupont Wilmington, DE 302-774-8023
99-4417	Dupont Agricultural Caribe Ind	Puerto	Iceas NIT	0.22	0.43	2002	DuPont Agricultural Caribe Ind Ltd Manati, Puerto Rico 787 884-1256	Century Engineering, Inc. Houston, TX 713-780-8871
99-4339	DuPont Agricultural Caribe Industries Ltd	Puerto	Iceas NDN			2002	DuPont Agricultural Caribe Ind Ltd Manati, Puerto Rico 787 884-1256	
2784	Goya De	Puerto	SBR NIT	0.10	0.20	1994	Goya de WWTP, Puerto Rico , 787-740-4900	Fernando Rodriquez Hato Rey, 809-751-7810
2815	Dupont WWTP (1)	Spain	SBR NIT	1.2	1.8	1992	Dupont Iberica, Spain Asturias, 348-484-7754	Intecsa Industrial SA Madrid,
3340	Dupont WWTP (2)	Spain	SBR NIT	0.26	0.38	1995	Dupont Iberica, Spain Asturias, 348-484-7754	Dupont Wilmington, DE 302-774-8023

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
98-4139	Dupont WWTP (3) (iberica S. A.)	Spain	Iceas NIT	1.0	1.3	1999	Dupont Iberica, Spain Asturias, 348-484-7754	Fluor Daniels , 3498-5264091
11-7528	Escarrilla	Spain	Iceas NDN					
11-7530	Formigal	Spain	Iceas NDN					
09-7231	Magallon WWTP	Spain	Iceas NDN	0.20	0.59			
09-7153	Riaza WWTP	Spain	Iceas NIT	0.50	1.2			
10-7382	Serraga	Spain	Iceas NDN	0.12	0.41			
11-7529	Tramacastilla	Spain	Iceas NDN					
98-4173	Afan Baglan	United Kingdom	SBR NIT	0.24	0.50	2000		Hyder Engineers Bradford,
98-4170	Afan Baglan WWTP	United Kingdom	SBR NIT	14	28	2000	Afan Baglan WWTP, Welsh Water Rugby, Wales 011-441-788-563-459	Hyder Engineers Bradford,
01-4676	Banff Mac Duff WWTP	United Kingdom	Iceas NIT	0.99	1.8	2002	North of Scotland Water Authority , Scotland	
98-4136	Cardiff WWTP	United Kingdom	SBR NIT	76	143	2000	Cardiff WWTP, United Kingdom Rugby, England	Hyder Engineers Bradford,
98-4150	Cardiff WWTP	United Kingdom	SBR NIT	76	143	2000	Cardiff WWTP, United Kingdom Rugby, England	Hyder Engineers Bradford,
97-3875	Cardigan	United Kingdom	Iceas NIT	0.60	1.2	1998	Cardigan WWTP, Welsh Water , Wales	Hyder Engineers Bradford,
98-4112	Dollar STW	United Kingdom	Iceas NIT	0.55	1.1	1999	Dollar STW WWTP, Scotland Rugby, England 044-178-856-3459	
98-3993	Ganol	United Kingdom	Iceas NIT	5.8	12	1999	Ganol, United Kingdom - STP Rugby, England 011-441-788-563-459	Hyder Engineers Bradford,
00-4550	Girvan	United Kingdom	SBR NIT	2.1	4.0	2001	West of Scotland Water Authority , Scotland	Alfred Benesch and Co Pottsville, PA 570 622-4055
00-4438	Kinnegar WWTP	United Kingdom	Iceas NDN	11	20	2000	Kinnegar Sewage Treatment Works ,	Hyder Engineers Bradford,
00-4441	Kinneil Kerse Wwtp	United Kingdom	Iceas NIT	7.6	15	2000	East of Scotland Water , Scotland	Paterson Candy ,
02-4977	Llanasa WWTP	United Kingdom	Iceas NIT	2.7	5.3	2002	Llanasa WWTP, Welsh Water , Wales	Galliford ,
01-4674	Moray East WWTP	United Kingdom	Iceas NIT	1.5	4.4	2002	North of Scotland Water Authority , Scotland	
01-4675	Moray West WWTP	United Kingdom	SBR NIT	5.5	10	2002	North of Scotland Water Authority , Scotland	

Job #	Plant	Location	Process	MGD ADWF	MGD PWWF	Start	Contact	Engineer
02-4988	Watchet & Doniford WWTP	United Kingdom	Iceas NIT	1.1	2.4	2002	Wessex Water Watchet & Doniford, England	Mowlem Construction, Inc. ,
01-4724	Whitehaven	United Kingdom	Iceas NIT	3.6	8.8	2001	United Utilities Whitehaven, England	MWH ,
01-4724	Whitehaven	United Kingdom				2001		MWH Albany, NY 518 640-6010
12-7715	Thu Dau Mot South STP	Vietnam	Iceas NDN	4.7	7.0			

772 Installations

November 21, 2014

Kimmswick MO Case Study – Using SBR Technology to Cost Effectively Accommodate Future BNR Requirements

Francis Pastors
Sanitaire – Xylem Inc.

Outline

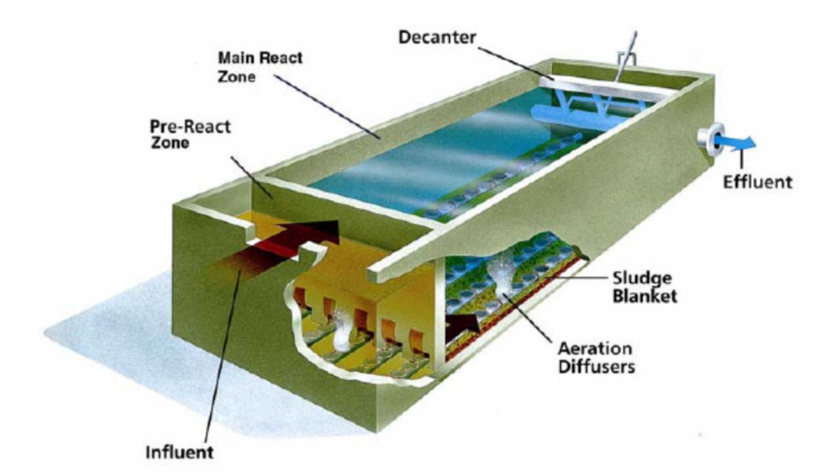
- Introduction
  - Kimmswick, MO Background – 2004 Centralized Plant Upgrade
  - SBR/ICEAS Process
  - 2004 SBR Design & Costs
  - Future BNR Design Considerations
- 2010 BNR Upgrade
  - BNR Upgrade Procedure
  - Performance
- Conclusion

Kimmswick, MO (Brief History)

- Sewer district formed in 1979, contained 14 treatment plants
  - 8,000 dwelling units (approx. 22,000 PE)
- Had new permit limits for 2003, Serving a PE of 22,000
  - Wanted new centralized plant for more economic treatment
    - 32 square miles newly formed sewer district boundary
    - Replace 14 treatment plants and 17 miles of interceptor
  - Wanted to design for future BNR (future), though permit did not call for advanced nutrient removal

Secondary Treatment Process Selection

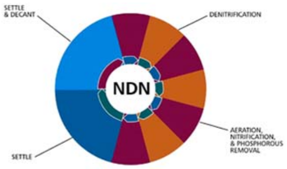
- Technology pre-selected on basis of proven effluent quality, footprint, peak flow capability, O&M, **ease of future expansion to BNR treatment** and $$$.



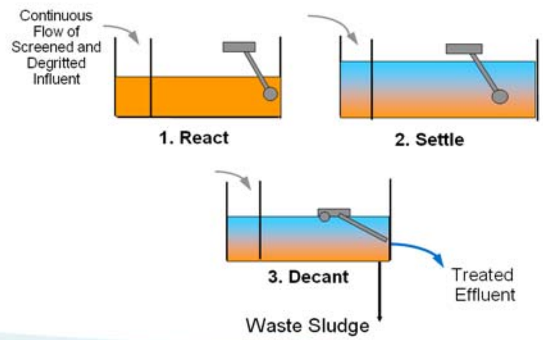
- District evaluated oxidation ditch, conventional systems, MBR and SBR.

- SBR Selected based on grading of above criteria.

ICEAS/SBR vs. Conventional BNR

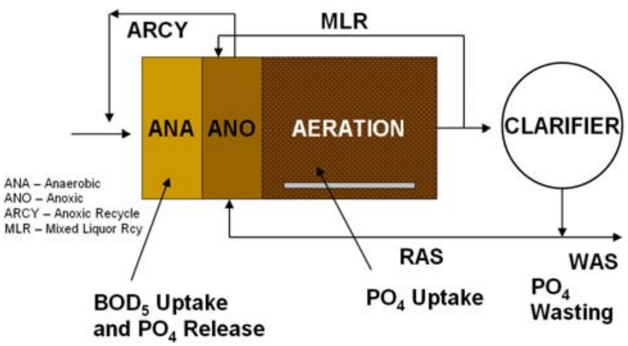


ICEAS Operating Cycle

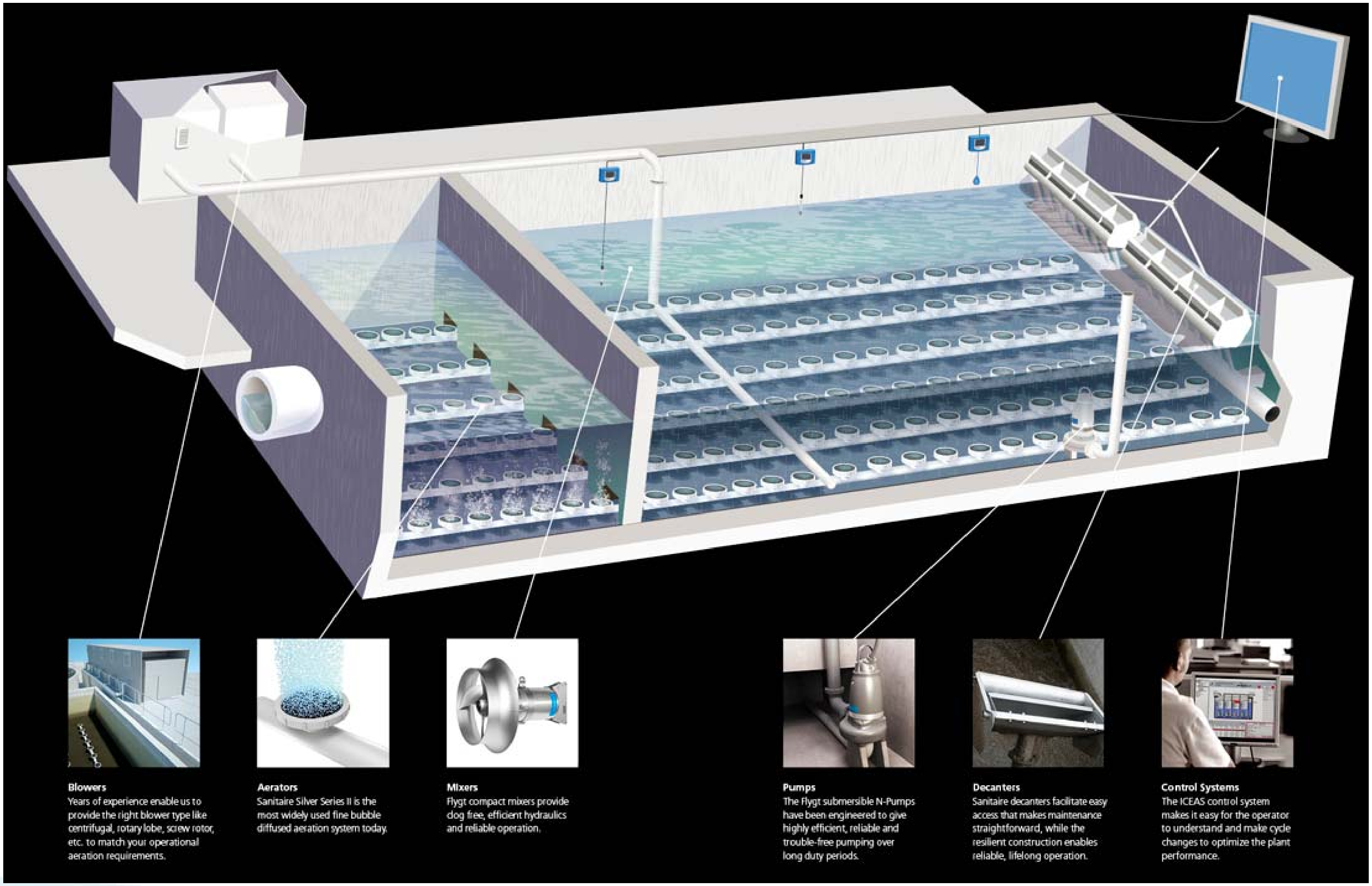


Typical BNR Process

Phosphorus Removal Occurs Through Anaerobic & Aeration Zones



ICEAS Equipment



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Rock Creek SD - Kimmswick, MO WWTP

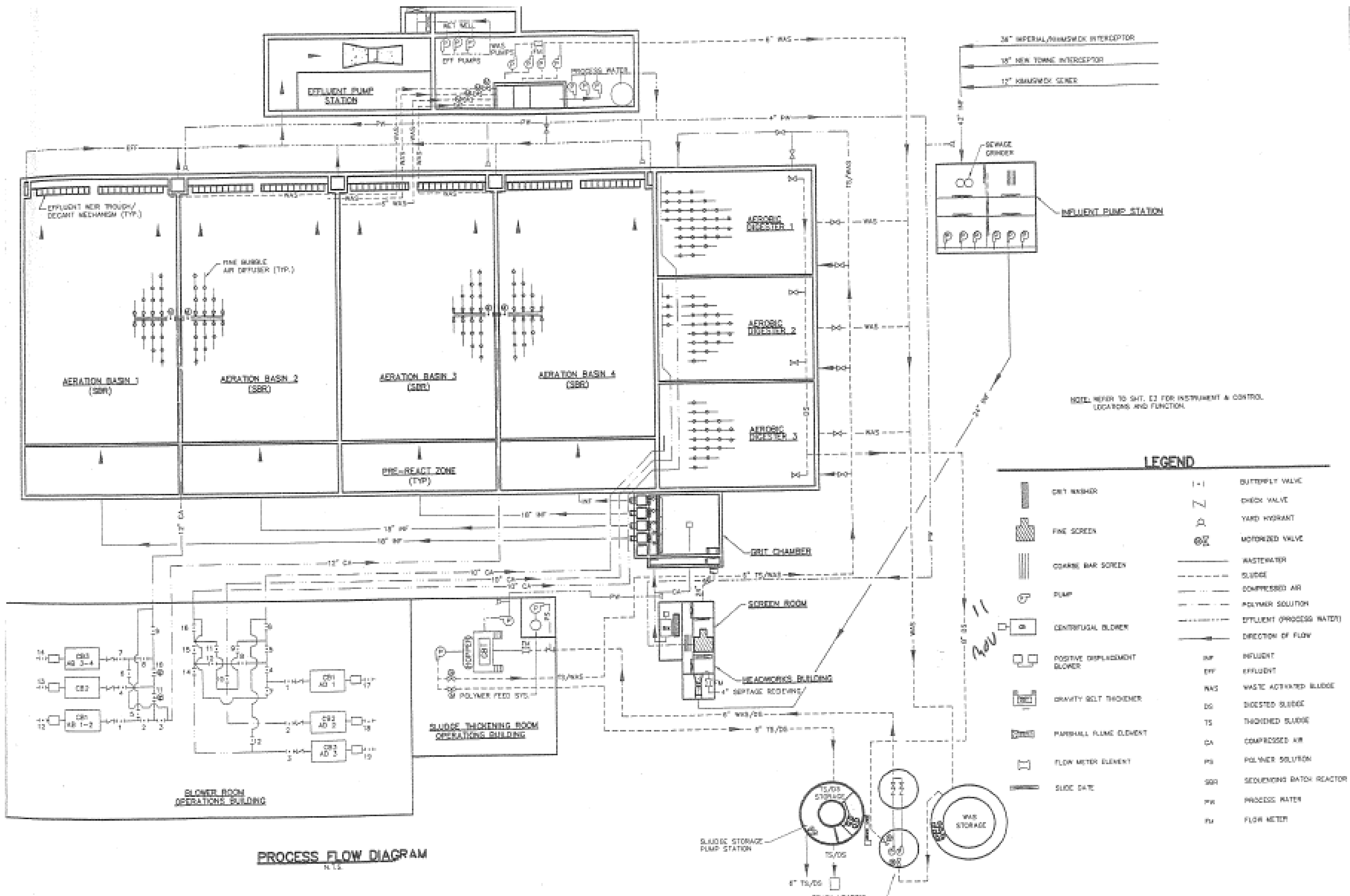
- Four (4) Basin ICEAS NIT Design
  Each Basin: 129' x 63' x 18'
- Mississippi River discharge permit 30/30 BOD/TSS (<5/5/1 average typical)
- 4.8 MGD, 3.5 peaking factor
- Commissioned Sept 2004
- Sanitaire provided complete ICEAS equipment, SHT aeration, SIMS, SCADA and plant wide integration

Considerations for Future BNR

2004 Design Considerations

- Oversized basins by 20% - Inclusion of Air-Off periods for TN & P removal.
- Increase blower capacity - 10 vs. 12 hours of aeration
  - Less than a 20% increase due to denitrification credit
- Designed with spare diffusers – plugged before upgrade
- Size SBR control panel future mixers.

Kimmswick PFD



2004 Upgrade – Capital Cost and O&M

Treatment Plant Capital Cost (2002) = $2.12/gal. treated

Total Project cost $22M USD
- $3.9M Engineering and other construction costs
- **$10.2M WWTP**
- $7.9M Interceptors

Operations Budget = $1.4M
- $155,000 annual electricity spend (treatment, pumping, operations building)

Plant Staff
- 1 Operations Supt
- 1 Lab Director
- 4 Maintenance
- 3 Operators

ICEAS Upgrade – Nitrification Requirement

(2010)

	(4) Basins - Each 130’ x 63’ x 18’ TWL		
	Influent	**Effluent (NIT)**	
	Design	Design	Operating (2008)
ADWF [MGD]	4.8		3.5
PWWF [MGD]	7.2		
PWWF1 [MGD]	10.55		
PWWF2 [MGD]	16.7		
BOD [mg/L]	220	30	4.8
TSS [mg/L]	220	30	4.0
TKN [mg/L]	55	14 (NH3-N)	3.1 (NH3-N) 11.5 (TN)

*Winter Effluent of 5.7 (NH3-N) & 8.3 (TN)

2010 – Upgrade for BNR Treatment

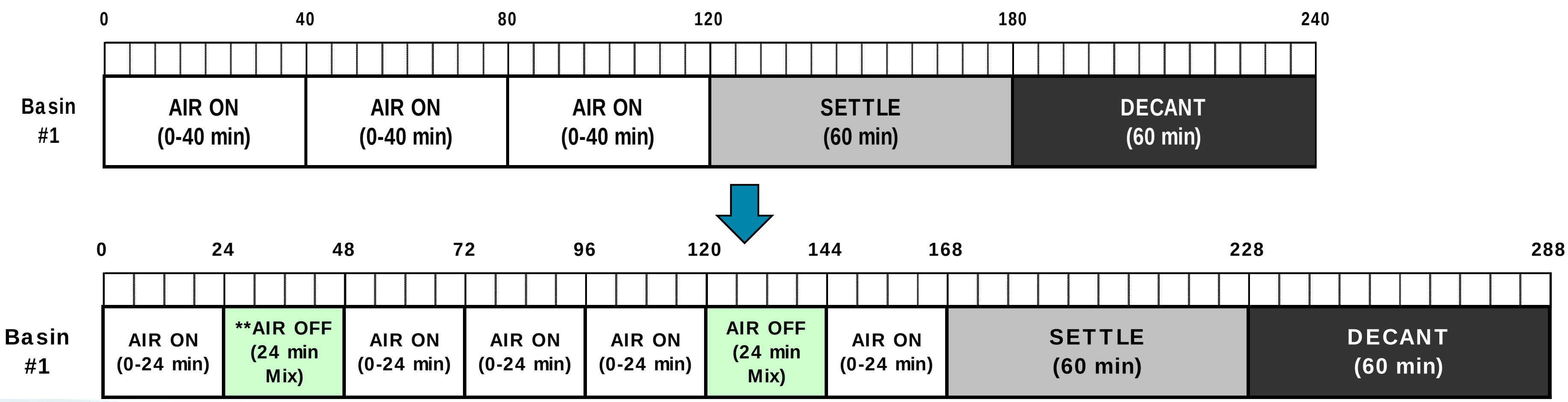
- Upgrade SBR to BNR for Denite Credit (Energy) & to Optimize Prior to Potential Permit Changes

- SBR Upgrade Scope
  - PLC Upgrade
  - Mechanical Upgrade (Add Mixers)
  - Changes to Process & Operation
  - Controls & Reporting

PLC Upgrade

Programming Changes

- Changes in cycle structure
  - 4 to 4.8 hour cycles
  - Altering Air-On/Off during react period
- Changes to level sensor settings to adjust storm mode triggers
- SCADA upgrade to reflect current plant



Mechanical Upgrade

Design Considerations

- Mixers
  - Designed and installed one submersible mixer per basin
  - Used ½'' guide supports in original design to accommodate extra force from mixers – no need to remove or adjust diffuser location
  - Control panel cut spot provided from the start
- Decanter
  - Same size as original design
  - Adjusted down-comer limit switches

Process

Changes in Process and Operation

- Biomass
  - Increased design mass by 10% to provide nitrification with less aeration time
  - Top and bottom water level raised for holding additional biomass

- WAS Pump
  - Same as original design
  - Adjusted run time to accommodate one less cycle per day and additional biomass

Process

Changes in Controls and Reporting

- Control System
  - DO Control
    - Same as original design
  - SIMS (Sludge Inventory Management System)
    - Change target SRT (user input)
    - Logic and equipment remained the same
- Reporting Package
    - Initial reporting package did not include BNR requirements, updated to our proprietary reporting system

ICEAS Upgrade – TN and TP Design

(2010)

		(4) Basins - Each 130' x 63' x 18' TWL		(4) Basins - Each 130' x 63' x 18.5' TWL	
	Influent	**Effluent (NIT)**		**Effluent (NDN)**	
	Design	Design	Operating (2008)	Design	Operating (2012)
ADWF [MGD]	4.8		3.5		1.9
PWWF [MGD]	7.2				
PWWF1 [MGD]	10.55				
PWWF2 [MGD]	16.7				
BOD [mg/L]	220	30	4.8	10	5.7
TSS [mg/L]	220	30	4.0	10	4.7
TKN [mg/L]	55	14 (NH3-N)	3.1 (NH3-N)* 11.5 (TN)	1 (NH3-N) 8 (TN)	1.0 (NH3-N)* 6.8 (TN)
P [mg/L]	8	n/a	n/a	3	2.7**

*Winter Effluent of 5.7 (NH3-N) & 8.3 (TN)

*Winter Effluent of 2.2 (NH3-N) & 6.9 (TN)

** With Chemical Dosing

Summary

Planning for future BNR requirements during initial design will ease the upgrade process.

Preparing:

- Basin Size
- Blower and Grid Size
- Control Panel
- Mixers

Capital Cost to upgrade to BNR treatment in 2010: **$600,000.** ($0.11 per Gal.)

Conclusion

Acknowledgements

Jason Seger – Rock Creek Public Sewer Operations Manager
(MWEA 2010 Plant of the Year)
Sarah Walsh – Xylem-Sanitaire Process Engineer Abstract Author
John Koch – Xylem Sanitaire Process Engineering Manager
Mark Gehring – Xylem-Sanitaire Marketing Manager

November 21, 2014

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Let's Solve Water

Thank You!

We Welcome Your Questions

Preliminary Manufacturer's

Design Report

Parkson SBR

Anderson~Montgomery

CONSULTING ENGINEERS

Parkson
Treating Water Right

EcoCycle SBR™

Sequencing Batch Reactor (SBR)

Whitefish, MT

Diffused Aeration Option

Preliminary Design Proposal

June 30, 2016

June 30, 2016

Mr. Scott Anderson, P.E.
Anderson-Montgomery Consulting Engineers

Whitefish, MT
Diffused Aeration Option
Parkson EcoCycle SBR™

Dear Mr. Anderson

Thank you for your interest in Parkson's *EcoCycle SBR™* treatment system. The *EcoCycle SBR™* is an activated sludge treatment process which operates in a batch mode. The SBR process is ideal for organics removal, BNR, and ENR applications. Based upon the data provided for this project, we believe the *EcoCycle SBR™* process is an ideal treatment selection.

A number of equipment options and configurations can be used with the *EcoCycle SBR™*, all of which are designed to meet each project's specific needs. Equipment selections most suitable for each application are dependent on variables such as effluent requirements, O&M costs, energy efficiency, expansion capabilities, and initial capital cost. Parkson welcomes the opportunity to discuss equipment options that will best meet the project requirements.

We appreciate the opportunity to offer our equipment and services for this project. Should you have any questions or need clarifications, please do not hesitate to contact me at (913) 745-1232.

Sincerely,

Brad Linsey
Sr. Applications Engineer

PARKSON CORPORATION
An Axel Johnson, Inc. Company

1. Design Basis

1.1. Influent and Effluent Specifications

The proposed system design is based on wastewater influent with the following characteristics:

Table 1.1 – Design Influent flow requirements

PARAMETER	UNITS	AVERAGE
Ave Daily Flow	MGD	1.81
Peak Hourly Flow	MGD	4.53

Table 1.2 - Influent Water Quality

PARAMETER	UNITS	AVERAGE
Max WW Temperature	Deg C	20
Minimum WW Temperature	Deg C	8.1
BOD_5	mg/L	330
Total Suspended Solids	mg/L	200
NH_3-N	mg/L	21
TKN	mg/L	41
Total Phosphorous (TP)	mg/L	6
pH	-	6 to 8

Table 1.3 - Effluent Water Quality

PARAMETER	UNITS	QUALITY
BOD_5	mg/L	10
Total Suspended Solids	mg/L	15
NH_3-N	mg/L	1.0
Total Nitrogen	mg/L	8.0
Total Phosphorus	mg/L	1.0

A process design spreadsheet has been attached which includes details regarding the process design, equipment sizing calculations, and estimated power costs. The calculations were utilized as the basis for the equipment that has been selected and included in this proposal.

The design spreadsheet may include some assumed values that will need to be confirmed as the project moves forward. This proposal is contingent upon the following criteria:

a. The wastewater will be pretreated to remove debris and grit. Fine screening is recommended.

b. Sufficient alkalinity is present or will be added to allow uninhibited nitrification and pH of 6.5-8.

c. The incoming oil and grease is below 100 mg/l.

d. Chemical and metals concentrations are below toxic thresholds for organics and ammonia removal.

e. Sufficient nutrients (P, N, micronutrients) are present in the influent for biomass growth or will be added by the plant operating staff.

f. A qualified operator will supervise plant activities and performance.

2. System Description

The ***EcoCycle SBR™*** is a fill and draw activated sludge process that operates in a batch mode. The SBR completes all unit process treatment steps within the reactors, eliminating the need for anaerobic or anoxic zones, RAS systems, and secondary clarifiers. The treatment is achieved using 5 primary steps.

2.1. ANOXIC FILL

The SBR tanks are typically operated in series with one tank being filled at any given time. During anoxic fill, the influent valve is opened allowing raw influent to enter the basin. No aeration occurs during this period so that anaerobic and anoxic conditions are present to discourage the growth of filamentous bacteria. The anoxic condition also encourages the growth of well settling, facultative bacteria. Residual nitrate is removed creating anaerobic conditions that promote the growth of VFA's and bio-P bacteria.

During the later part of the anoxic fill, the aeration system is operated to allow the bacteria to begin metabolizing organic matter that was absorbed. This part of the fill period is **AERATED FILL**. SND (Simultaneous Nitrification / Denitrification) occurs during the aerated fill period since both anoxic and aerobic conditions exist. The high oxygen uptake creates an aerated anoxic condition where blowers are operated at full speed yet residual D.O. levels remain near zero.

2.2. REACT

Once the SBR reaches top water level or the designated fill time has been reached, the flow will be diverted to another SBR basin. Aeration and mixing occurs in the rector until complete biodegradation of organics has occurred. Since no flow enters the basin during react, no short circuiting of raw, untreated waste can occur. Dissolved oxygen (D.O.) is typically monitored during the react phase to determine when residual D.O. starts to form, indicating that oxygen demand for the batch has been satisfied and treatment is completed. Luxury uptake of phosphorous also occurs during the aeration step.

For BNR or ENR applications, the aeration system can be cycled on / off to help promote denitrification. This can be a time based step or can be controlled using instrumentation such as ORP, ammonia analyzers, and nitrate analyzers. Carbon source for nitrate removal and metal salts for P precipitation (if required) are typically added during the un-aerated mix steps near the end of the react period.

2.3. SETTLE

Following react, the SBR will begin a settle mode in which liquids / solids separation occurs. No influent enters the basin during this period allowing for a perfect quiescent condition. All of the reactor volume is used for solids separation. The settle period typically lasts for 45 minutes but is field adjustable through the operator setpoints.

2.4. DECANT

The effluent withdrawal (Decant) begins once the settling period is finished. A floating decanter is used to maximize interface between the withdrawal ports and the settled biomass. The decanter is designed to remove effluent from below the water surface to prevent the inclusion of foam, scum, or floatables. Typical systems will have roughly 25%-35% of the basin contents removed from the upper portion of the reactor during the decant period.

2.5. IDLE

The final step in the treatment process is the idle period. During idle, waste activated sludge is typically removed to maintain the correct biomass population in the reactor. The aeration and mixing system are typically not operated during idle and the reactor simply waits for the next cycle to begin. An option to aerate during extended idle periods is provided through the control system.

3. System Components / Features

3.1. Flow Control Manifold (FCM)

A Flow Control Manifold (FCM) is used to bring raw wastewater into the SBR reactor. The FCM is typically located with the bottom of the manifold 6" above the floor with a series of openings facing the floor. Raw influent is fed through the FCM which insures intimate contact between the raw influent and the settled biomass. The FCM also allows the influent to enter at a low velocity so the settled biomass is undisturbed in cases where fill and decant may occur simultaneously (such as during high sustained peaks and single tank operation). This same manifold is also used for multipoint sludge collection during the waste sludge step in some cases.

3.2. Floating Decanter

The Parkson ***DynaCanter™*** is a floating style decanter which utilizes a flex joint to allow vertical articulation. The decanter collects treated effluent from 16"-24" below the water surface to preclude foam, scum, or other floatables from the effluent. A series of check valves are provided in the decanter draw tube to isolate the effluent piping from the mixed liquor during mixing and aeration steps. A standard open / close valve is used in the effluent piping to control flow rate through the decanter. No electromechanical components are used inside the basin making operation and maintenance convenient for the operator.

3.3. DynaPhase Controls™

The Parkson ***DynaPhase Controls™*** use constant level measurement analysis to determine rate of influent flows and adjusts treatment steps accordingly. During high flow events, this unique feature allows the system to dynamically adjust treatment steps based on actual flow rather than toggling between a normal mode and a storm mode. For example, if the plant is experiencing a 1.75X peaking factor, the control system will automatically cater cycle length and structure based on this specific flow. The ***DynaPhase Controls™*** also include a first response feature in which the control system will automatically take a tank off line in the event of a primary equipment failure.

4. Equipment and Services Provided

Flow Control Manifolds: Four (4) Model FCM14-3200 Manifolds shall be provided. Manifolds will be constructed of FRP with 304 stainless steel supports. Manifolds shall include adequate number and size of openings to reduce inlet velocities to <0.5 fps.

Fixed Diffusers: Four (4) Fixed Fine Bubble Diffuser Systems shall be provided. Each system shall consist of disk type membrane diffusers, PVC manifold piping, 304 stainless steel supports and 304 stainless steel air drop pipe. All in-basin air piping between air drops (including supports) shall be provided by the Contractor.

Decanters: Four (4) Model ED14-3800 ***DynaCanter™*** Floating, Effluent Decanters shall be provided. Each decanter shall include 304 stainless steel supports and in-basin discharge piping. The in-basin discharge piping of the decanter shall terminate with a 14” flange for connection to the flanged wall penetration supplied by others.

Floating Mixers: Four (4) Floating Mixers shall be provided. Each mixer shall consist of fiberglass float, 316 stainless steel impeller, 304 stainless steel motor mounting base, 17-4 ph stainless steel motor shaft, 304 stainless steel intake volute assembly, 304 stainless steel cable mooring system, electric cable w/ floats and a 25 Hp, 900 rpm, 460 volt, 3 ph., 60 Hz, TEFC motor.

Blowers and Accessories: Four (4) Rotary Positive Displacement Blowers (one as a standby) shall be provided. Each blower will be selected to deliver 977 SCFM at 10.0 PSIG. Each blower will be furnished complete with inlet filter, inlet silencer, discharge silencer, butterfly valve, check valve, pressure relief valve, base plate, V-belt with sheaves, and a 75 Hp, 1800 RPM, 460 volt, 3 ph, 60 hz, TEFC motor.

Waste Sludge Pumps: Four (4) Submersible Centrifugal Pumps shall be provided for sludge wasting. Each pump will be selected to deliver 300 GPM at a total pump head of 15 ft. Each pump will be furnished complete with elbow discharge connection, 30 ft. power cable, thermal overload / seal failure protection, retrieval guide rails and guide rail brackets, stainless steel lifting cable, and a 5.0 Hp, 460 volt, 3 ph, 60 hz, submersible motor.

Valves: Valves shall be furnished as listed below. All automatic valves will have 120 volt single phase electric motor actuators.

Function	Quantity	Size	Type	Operator
Influent	4	14”	Plug	Electric
Effluent	4	14”	Butterfly	Electric

Air	4	6”	Butterfly	Electric

FRP Field Weld Material: FRP field wrap kits shall be provided to complete FRP field welds as identified on Parkson’s submittal drawings. Kits shall include FRP mat and woven roving, resin, catalyst, and gel coat. Labor for completing field joints shall be by the installing contractor.

Supports: Supports for the in-basin equipment supplied by Parkson and described in this proposal are included. Supports will be constructed of 304 Stainless Steel. Field welding of supports shall be by the installing contractor.

Hardware: Anchor bolts, gaskets, and connecting hardware for mounting in-basin equipment supplied by Parkson are included. Anchor bolts and connecting hardware shall be 18-8 SS.

Note: Hardware and gaskets at Parkson/Contractor interfacing flanged connections are not included and shall be provided by the installing contractor.

D.O. Control: One (1) D.O. probe with mounting bracket and one (1) analyzer shall be provided for each SBR basin.

Process Control Panel: A control panel capable of directing operation of components listed in this proposal shall be provided. Control features shall include the following:

- NEMA 12 Enclosure
- Analog I/O modules as required
- Digital I/O modules as required
- 10% spare I/O of each type
- Allen Bradley PLC
- Operator Interface
- Control / Monitoring of Proposed Equipment and Instrumentation
- HOA / OCA Switches
- LED Lights
- Modem
- Submersible Pressure Transducers for Each SBR Basin (including stilling well)
- Emergency TWL Float
- ***DynaPhase Controls™*** Software
- D.O. blower control feature

On-Site Service: Field service shall be provided for dry inspection, wet start up, O&M training, and follow up training. A total of four (4) trips / twelve (12) man days of service are included. Additional service can be provided at Parkson’s daily field service rates.

Submittals and O&M Manuals: Submittals and O&M Manuals shall be provided as required by the project specifications.

5. Cost Estimate and Terms

Budget price for equipment and services……………………$______________

Freight terms are FOB jobsite, offloading by others.

Taxes are not included.

Terms are 10% Submittals, 80% Shipment, 10% Start up (NTE 180 days from Shipment).

Approval drawings: 6-10 weeks after receipt of written order.*

Equipment Shipment: 16-20 weeks after complete release for manufacture.*

*Schedules will be verified at time of Order.

6. Clarifications / Exclusions

Decanter wall spools must be cast in place or supported with additional bracing if link seals are used.

All equipment is quoted with manufacturer's standard coatings.

Chemical feed equipment has not been included. Any requirements for addition of metal salts, carbon source, alkalinity, nutrients, or micronutrients shall be by others.

If blower sound enclosures are used, contractor shall be responsible for providing 120 volt power source if required.

This proposal is based on providing Parkson's standard SBR control program. Additional programming for other equipment or upgrades to standard hardware formats can be provided at additional cost. SCADA / PC graphics packages are available if not already included in this proposal.

A minimum of 3.5 ft of static head differential (plus pipe friction losses) between SBR BWL and water level at discharge elevation must be provided for the decanter to function properly.

Outlet at effluent pipe discharge must be constantly submerged or provided with an upturned elbow to prevent air from entering the effluent piping.

Out of basin air and liquid piping are not included. In basin air piping between air drops (if used) is by others.

Concrete must be designed to accommodate 6” anchor bolts.

Unless specified in the controls section of this proposal, valve power through the SBR control panel has not been included.

Contractor/Owner shall be responsible for providing freeze protection.

All welding shall be per AWS standards only (ASME standards, if required, may result in additional cost).

MCC, VFD’s, and motor starters are by others.

7. Supplemental Information and References

EcoCycle SBR™ design Calculations

EcoCycle SBR™ **Sequencing Batch Reactor (SBR) Design Outline**

Parkson
Treating Water Right

Whitefish, MT
Diffused Air Option

Designer: KBB
Date: 6/29/2016

Flow (ADF)	**1.81**	**MGD average**	**6,851 m^3/d**
Flow (PHF)	**4.53**	**MGD ***	**17,127 m^3/d**

INFLUENT CHARACTERISTICS

	mg/l	lbs/d	kg/d
BOD	330	4,977	2,257
* COD	577	8,710	3,950
TSS	199	2,997	1,359
TKN	41	624	283
NH4-N	21	316	143
* TN	41	624	283
P	6	91	41
* TDS	500	7,548	3,423

* Inert TSS fraction 40 %

EFFLUENT REQUIREMENTS

	mg/l	lbs/d	kg/d
BOD	10	151	68.5
COD	NR	NR	NR
TSS	15	226	102.7
TKN	NR	NR	NR
NH3-N Sum	1	15	6.8
NH3-N Win	1	15	6.8
TN	8	121	54.8
** P	1	15	6.8

** Alum or ferric chloride addition req'd

SITE CONDITIONS

Winter WW Temperature (min.)	8.1 °C	47 °F
Summer WW Temperature (max)	20 °C	68 °F
Average WW Temperature	14.05 °C	57 °F
Elevation	2,500 ft	762 m
Average barometric pressure	13.41 psia*	92 kPa
Winter Air Temperature	-12 °C	10 °F
Summer Air Temperature	38 °C	100 °F

PROCESS DESIGN PARAMETERS

Design MLSS	3,500 mg/l @ TWL		
Design MLSS	4,224 mg/l @ BWL		
Hydr. Retention Time provided	1.46 days	35.0 hours	
Aerobic Sludge Age (SRTox)	11.3 days		
System SRT	22.6 days		
Biosolids growth rate	0.22	gVSS/gCODr/d	
	0.45	gVSS/gBODr/d	
F:M (adjusted for aeration %)	0.23	gCOD/gMLSS/d	
	0.13	gBOD/gMLSS/d	
System F:M	0.06	gBOD/gMLSS/d	
Avg biosolids yield	2,172	lbs./day*	985 kg/d
Avg net sludge yield (bio+inerts)	2,982	lbs/d based on CODr*	1,352 kg/d
	3,404	lbs/d based on BODr*	1,544 kg/d
Mass aerobic MLSS req'd	38,525	lbs	17,472 kgs
Mass aerobic volume req'd	1.32	MG	4,995 m^3
Aerated portion of day	50.0	%	
Required total SBR volume	2.64	MG	9,991 m^3

BASIN DIMENSIONS

Number of SBR basins	4	
Rectangular Dimensions:		
Length/Width Ratio	1.0 : 1	
Length	66 ft.	20.24 m
Width	66 ft.	20.24 m
Round Dimensions		
Diameter	75 ft.	22.85 m
Top Water Level	20.0 ft.	6.10 m
Bottom Water Level	16.6 ft.	5.05 m
TWL at Design Average Flow	20.0 ft.	6.10 m
Total Volume in SBR's	2.64 MG	9,991 m^3
Total Retention Time in SBR	35.0 hrs.	

AERATION SYSTEM SIZING

First Estimate :

lbs. O2/lb. BOD removed	1.25	kg O2/kg BOD removed		
lbs. O2/lb. TKN oxidized	4.6	kg O2/kg TKN oxidized		
lbs. O2/lb. NO_3x denitrified	-2.86			
Denitrification credit	60 %			
Actual Oxygen Req'd, AOR	7,288	lbs. O2/day	3,305	kg/d

Second Estimate :

AOR = CODi - CODw - CODes + 4.6*TKNox - 2.86*NO3Ndn

where :	CODi	influent	=	8,710	lbs./day	3,950	kg/d
	CODw	wasted	=	2,606	lbs./day	1,182	kg/d
	CODes	eff soluble	=	755	lbs./day	342	kg/d
	TKNox**	oxidized	=	435	lbs./day	197	kg/d
	NO_3Ndn	denitrified	=	216	lbs./day	98	kg/d
	Mass balance AOR			6,740	lbs./day	3,057	kg/d

Use highest estimate ***DESIGN AOR = 7,288 lbs/day*** ***3,305 kg/d***

Conversion Formula from ASCE Manual of Practice :

$$SOR = \frac{AOR * Cs}{a * (ßCsd - DO) * Ø^{(T-20)}}$$

Cs = DO saturation at Stnd Conditions	Csd	=	DO saturation at design conditions	
= 9.092*(1+0.4*D/34)	Cst	=	DO saturation@liquid temp & 1 sea level	
= 11.23 mg/l	where :	=	Cst*(Fe+0.4*D/34)	
		=	9.07	mg/l
ElevFactor Fe = 0.91	Therefore, Csd	=	10.39	mg/l

Alpha, a	0.60 *	SWD, D	20.0 ft
D.O., mg/l	2.0 mg/l	Beta, ß	0.95 *
WW Temp T	20 °C	Theta, Ø	1.024

Standard Oxygen Required, SOR	=	**17,326**	**lbs. O2/day**	**7,865 kg/d**
SOR Peaking Factor	=	**1**		
DESIGN SOR	=	**17,326**	**lbs. O2/day**	**7,865 kg/d**

CYCLE TIMES

Batches per day	4.00	per SBR	
Complete Cycle time	6.00	hrs. per basin	
Fill time at ADF	1.50	hrs.	
Anoxic Fill time	0.75	hrs.	50 % of FILL is anoxic.
Aerated Fill	0.75	hrs.	
React time	2.25	hrs.	50 % of cycle is aerated.
Denite time	0.25	hrs.	
Settle Time	0.75	hrs.	3.0 hrs. anoxic per cycle
Decant time	0.50	hrs.	
Idle time	0.75	hrs.	3.0 hrs. aerated per cycle

DIFFUSED AERATION SYSTEM SIZING

Aerator elevation	1.0	ft.	0.30 m
Avg aerator submergence	18.8	ft.	5.73 m
Total aeration time	3.00	hrs./cycle	
	12.0	hrs./basin/day	
SOR	361	lbs./hr/basin	164 kg/hr
Normal gassing rate at ADF	1.2	SCFM / diffuser	0.03 m^3/min/dif
Max gassing rate	2.4	SCFM / diffuser	0.07 m^3/min/dif
Oxygen transfer efficiency (ADF)	35.7	%	
Design air flow	977	SCFM	28 m^3/m
Diffusers required per basin	800	diffusers	
Grids / Racks per basin	1		
Diffuser per rack / grid	800		
Diffuser mixing energy	11.1	scfm/1000ft3	
Diffuser density	0.22	scfm/ft2	

BLOWER SIZING DETAILS

Operating blowers	=	1	per aerating basin		
Type of Blowers :	=	1	*1=PD, 2=Centrifugal, 3=Turbo*		
Total Number of Blowers	=	4	including a spare		
Air flow per blower	=	977	SCFM	1,661 m^3/hr	
Inlet losses	=	0.3	psig *	2.07 kPa	0.02 bar
Net inlet pressure	=	13.11	psia (absolute)	90.37 kPa	0.90 bar
Discharge piping losses	=	0.7	psig *	4.83 kPa	0.05 bar
Losses at aerator	=	0.75	psig	5.17 kPa	0.05 bar
Total discharge pressure	=	9.88	psig average	68.14 kPa	0.68 bar
		9.98	psig maximum	68.78 kPa	0.69 bar
		8.49	psig minimum	58.54 kPa	0.58 bar
Site air flow required	=	1,163	ICFM average	32.95 m^3/min	
Assumed blower efficiency	=	68	% *		
BHp per blower	=	57	BHp/Blower	42.8 BkW	
				45.6 kW @ 94% ME	
Blower BHp/aerating basin	=	57	BHp/Basin	42.8 BkW	
				45.6 kW @ 94% ME	

MIXERS

Number of mixers	1	per basin	
Type of mixer:	1	*1=Floating, 2=Submersible*	
Hp per MG required	30		
Total mixer energy req'd	20	Hp per basin	
Hp req'd per mixer	20	Hp per mixer	
Mixer size selected	25	Hp per mixer	18.7 BkW
			19.8 kW @ 94% ME
Total mixer BHp/basin	25	BHp/Mixer	18.7 BkW
			19.8 kW @ 94% ME

DECANTERS

Cycles per day	16			
Avg TWL to BWL volume	113,125	Gallons	428	cubic meters
Max TWL to BWL volume	113,125	Gallons	428	cubic meters
Decant time	0.50	hrs.	30	minutes
Average decant flow	3,771	GPM	238	liters per second
Number of decanters per basin	1			
Average flow per decanter	3,771	GPM	238	liters per second

SLUDGE WASTING

Dry solids (BOD estimate)	3,404	lbs/day	1,544	kg/d
Solids concentration in WAS	0.85	%		
Total volume wasted per day	48,014	gallons per day	182	m3 / day
Wasting frequency	4	per tank per day		
Volume wasted each period	3,001	gallons	11	m3
Length of each wasting period	10	minutes		
WAS pump rate	300	gpm	19	liters per second
WAS pump discharge head	15	ft	4.6	meters
WAS pump efficiency	65	%		
WAS pump BHp	1.7	BHp	1.3	kW

POWER SUMMARY

Equipment	BHp/basin	Hours/day operating		kW hr/day	kW hr/annual
SBR blowers	57.4	48		2057	750,667
SBR mixers	25.0	20		373	136,145
Cost of power per kWhr	0.05		Total	2,430	886,812
****Annual power cost**	**$44,341**				

** does not include corrections for motor efficiency, VFD losses, V-belt losses, or power factor

***Denotes parameters assumed by Parkson. These parameters to be confirmed by Owner or Owner's representative**

Parkson
Treating Water Right

EcoCycle SBR™
Sequencing Batch Reactor (SBR)

Whitefish, MT
Jet Aeration Option

Preliminary Design Proposal

June 30, 2016

June 30, 2016

Mr. Scott Anderson, P.E.
Anderson-Montgomery Consulting Engineers

Whitefish, MT
Jet Aeration Option
Parkson EcoCycle SBR™

Dear Mr. Anderson

Thank you for your interest in Parkson's *EcoCycle SBR™* treatment system. The *EcoCycle SBR™* is an activated sludge treatment process which operates in a batch mode. The SBR process is ideal for organics removal, BNR, and ENR applications. Based upon the data provided for this project, we believe the *EcoCycle SBR™* process is an ideal treatment selection.

A number of equipment options and configurations can be used with the *EcoCycle SBR™*, all of which are designed to meet each project's specific needs. Equipment selections most suitable for each application are dependent on variables such as effluent requirements, O&M costs, energy efficiency, expansion capabilities, and initial capital cost. Parkson welcomes the opportunity to discuss equipment options that will best meet the project requirements.

We appreciate the opportunity to offer our equipment and services for this project. Should you have any questions or need clarifications, please do not hesitate to contact me at (913) 745-1232.

Sincerely,

Brad Linsey
Sr. Applications Engineer

PARKSON CORPORATION
An Axel Johnson, Inc. Company

1. Design Basis

1.1. Influent and Effluent Specifications

The proposed system design is based on wastewater influent with the following characteristics:

Table 1.1 – Design Influent flow requirements

PARAMETER	UNITS	AVERAGE
Ave Daily Flow	MGD	1.81
Peak Hourly Flow	MGD	4.53

Table 1.2 - Influent Water Quality

PARAMETER	UNITS	AVERAGE
Max WW Temperature	Deg C	20
Minimum WW Temperature	Deg C	8.1
BOD_5	mg/L	330
Total Suspended Solids	mg/L	200
NH_3-N	mg/L	21
TKN	mg/L	41
Total Phosphorous (TP)	mg/L	6
pH	-	6 to 8

Table 1.3 - Effluent Water Quality

PARAMETER	UNITS	QUALITY
BOD_5	mg/L	10
Total Suspended Solids	mg/L	15
NH_3-N	mg/L	1.0
Total Nitrogen	mg/L	8.0
Total Phosphorus	mg/L	1.0

A process design spreadsheet has been attached which includes details regarding the process design, equipment sizing calculations, and estimated power costs. The calculations were utilized as the basis for the equipment that has been selected and included in this proposal.

The design spreadsheet may include some assumed values that will need to be confirmed as the project moves forward. This proposal is contingent upon the following criteria:

a. The wastewater will be pretreated to remove debris and grit. Fine screening is recommended.

b. Sufficient alkalinity is present or will be added to allow uninhibited nitrification and pH of 6.5-8.

c. The incoming oil and grease is below 100 mg/l.

d. Chemical and metals concentrations are below toxic thresholds for organics and ammonia removal.

e. Sufficient nutrients (P, N, micronutrients) are present in the influent for biomass growth or will be added by the plant operating staff.

f. A qualified operator will supervise plant activities and performance.

2. System Description

The ***EcoCycle SBR™*** is a fill and draw activated sludge process that operates in a batch mode. The SBR completes all unit process treatment steps within the reactors, eliminating the need for anaerobic or anoxic zones, RAS systems, and secondary clarifiers. The treatment is achieved using 5 primary steps.

2.1. ANOXIC FILL

The SBR tanks are typically operated in series with one tank being filled at any given time. During anoxic fill, the influent valve is opened allowing raw influent to enter the basin. No aeration occurs during this period so that anaerobic and anoxic conditions are present to discourage the growth of filamentous bacteria. The anoxic condition also encourages the growth of well settling, facultative bacteria. Residual nitrate is removed creating anaerobic conditions that promote the growth of VFA's and bio-P bacteria.

During the later part of the anoxic fill, the aeration system is operated to allow the bacteria to begin metabolizing organic matter that was absorbed. This part of the fill period is **AERATED FILL**. SND (Simultaneous Nitrification / Denitrification) occurs during the aerated fill period since both anoxic and aerobic conditions exist. The high oxygen uptake creates an aerated anoxic condition where blowers are operated at full speed yet residual D.O. levels remain near zero.

2.2. REACT

Once the SBR reaches top water level or the designated fill time has been reached, the flow will be diverted to another SBR basin. Aeration and mixing occurs in the rector until complete biodegradation of organics has occurred. Since no flow enters the basin during react, no short circuiting of raw, untreated waste can occur. Dissolved oxygen (D.O.) is typically monitored during the react phase to determine when residual D.O. starts to form, indicating that oxygen demand for the batch has been satisfied and treatment is completed. Luxury uptake of phosphorous also occurs during the aeration step.

For BNR or ENR applications, the aeration system can be cycled on / off to help promote denitrification. This can be a time based step or can be controlled using instrumentation such as ORP, ammonia analyzers, and nitrate analyzers. Carbon source for nitrate removal and metal salts for P precipitation (if required) are typically added during the un-aerated mix steps near the end of the react period.

2.3. SETTLE

Following react, the SBR will begin a settle mode in which liquids / solids separation occurs. No influent enters the basin during this period allowing for a perfect quiescent condition. All of the reactor volume is used for solids separation. The settle period typically lasts for 45 minutes but is field adjustable through the operator setpoints.

2.4. DECANT

The effluent withdrawal (Decant) begins once the settling period is finished. A floating decanter is used to maximize interface between the withdrawal ports and the settled biomass. The decanter is designed to remove effluent from below the water surface to prevent the inclusion of foam, scum, or floatables. Typical systems will have roughly 25%-35% of the basin contents removed from the upper portion of the reactor during the decant period.

2.5. IDLE

The final step in the treatment process is the idle period. During idle, waste activated sludge is typically removed to maintain the correct biomass population in the reactor. The aeration and mixing system are typically not operated during idle and the reactor simply waits for the next cycle to begin. An option to aerate during extended idle periods is provided through the control system.

3. System Components / Features

3.1. Flow Control Manifold (FCM)

A Flow Control Manifold (FCM) is used to bring raw wastewater into the SBR reactor. The FCM is typically located with the bottom of the manifold 6" above the floor with a series of openings facing the floor. Raw influent is fed through the FCM which insures intimate contact between the raw influent and the settled biomass. The FCM also allows the influent to enter at a low velocity so the settled biomass is undisturbed in cases where fill and decant may occur simultaneously (such as during high sustained peaks and single tank operation). This same manifold is also used for multipoint sludge collection during the waste sludge step in some cases.

3.2. Floating Decanter

The Parkson ***DynaCanter™*** is a floating style decanter which utilizes a flex joint to allow vertical articulation. The decanter collects treated effluent from 16"-24" below the water surface to preclude foam, scum, or other floatables from the effluent. A series of check valves are provided in the decanter draw tube to isolate the effluent piping from the mixed liquor during mixing and aeration steps. A standard open / close valve is used in the effluent piping to control flow rate through the decanter. No electromechanical components are used inside the basin making operation and maintenance convenient for the operator.

3.3. DynaPhase Controls™

The Parkson ***DynaPhase Controls™*** use constant level measurement analysis to determine rate of influent flows and adjusts treatment steps accordingly. During high flow events, this unique feature allows the system to dynamically adjust treatment steps based on actual flow rather than toggling between a normal mode and a storm mode. For example, if the plant is experiencing a 1.75X peaking factor, the control system will automatically cater cycle length and structure based on this specific flow. The ***DynaPhase Controls™*** also include a first response feature in which the control system will automatically take a tank off line in the event of a primary equipment failure.

3.4. *VariOx™* Jet Aeration

The Parkson ***VariOx™*** aeration system is being recommended for this project. Jet aeration provides many benefits when used in activated sludge processes.

- Materials of construction are FRP with stainless steel supports. Operational life is typically >25 years with no wear of jet nozzles. Oxygen transfer efficiency of the jets does not diminish over time.
- Jets provide the ability to mix independent of aeration. This is a critical advantage for process control and a requirement in BNR and ENR applications.
- The jets combine the functionality of diffused aeration and mechanical aeration since both pumps and blower are used. Alpha values in municipal wastewater are typically .85 or higher.
- No maintenance is required on the FRP or stainless steel components making O&M simple and less costly.
- No electromechanical components are located inside the reactors when dry pit pumps are used, allowing for ease of operation and maintenance.

4. Equipment and Services Provided

Flow Control Manifolds: Four (4) Model FCM14-3200 Manifolds shall be provided. Manifolds will be constructed of FRP with 304 stainless steel supports. Manifolds shall include adequate number and size of openings to reduce inlet velocities to <0.5 fps.

Jet Aeration Manifolds: Four (4) Model DD12/44A-20 ***VariOx™*** aeration manifolds shall be provided. Each manifold will include twenty (20) jet aerators and will terminate with a 12” flanged connection. In-basin vertical air drop pipe is included and will terminate at the top of the tank wall, directly above the aeration header, with a 6” flanged connection (any in basin piping beyond these termination points shall be by others). Materials of construction shall be FRP utilizing vinyl ester resin.

Pneumatic Flushout: Four (4) Pneumatic Flushout Systems shall be provided. Each flushout system shall include riser pipe, discharge elbow, valve, and supports. The flushout riser pipe and valve shall be 8”.

Decanters: Four (4) Model ED14-3800 ***DynaCanter™*** Floating, Effluent Decanters shall be provided. Each decanter shall include 304 stainless steel supports and in-basin discharge piping. The in-basin discharge piping of the decanter shall terminate with a 14" flange for connection to the flanged wall penetration supplied by others.

Jet Motive Liquid Pumps: Four (4) Submersible Centrifugal Pumps shall be provided. Each pump will be selected to deliver 3,715 GPM at a total pump head of 20 ft. Each operating pump will be furnished complete with discharge connection, 30 ft. of power cable, thermal overload / seal failure protection, retrieval guide rails and guide rail brackets, 304 stainless steel lifting cable, and a 30 Hp, 460 volt, 3 ph, 60 hz, submersible motor.

Blowers and Accessories: Four (4) Rotary Positive Displacement Blowers (one as a standby) shall be provided. Each blower will be selected to deliver 910 SCFM at 8.7 PSIG. Each blower will be furnished complete with inlet filter, inlet silencer, discharge silencer, butterfly valve, check valve, pressure relief valve, base plate, V-belt with sheaves, and a 60 Hp, 1800 RPM, 460 volt, 3 ph, 60 hz, TEFC motor.

Waste Sludge Pumps: Four (4) Submersible Centrifugal Pumps shall be provided for sludge wasting. Each pump will be selected to deliver 300 GPM at a total pump head of 15 ft. Each pump will be furnished complete with elbow discharge connection, 30 ft. power cable, thermal overload / seal failure protection, retrieval guide rails and guide rail brackets, stainless steel lifting cable, and a 5.0 Hp, 460 volt, 3 ph, 60 hz, submersible motor.

Valves: Valves shall be furnished as listed below. All automatic valves will have 120 volt single phase electric motor actuators.

Function	Quantity	Size	Type	Operator
Influent	4	14"	Plug	Electric
Effluent	4	14"	Butterfly	Electric
Air	4	6"	Butterfly	Electric
Header Flushout	4	8"	Plug	Manual

FRP Field Weld Material: FRP field wrap kits shall be provided to complete FRP field welds as identified on Parkson's submittal drawings. Kits shall include FRP mat and woven roving, resin, catalyst, and gel coat. Labor for completing field joints shall be by the installing contractor.

Supports: Supports for the in-basin equipment supplied by Parkson and described in this proposal are included. Supports will be constructed of 304 Stainless Steel. Field welding of supports shall be by the installing contractor.

Hardware: Anchor bolts, gaskets, and connecting hardware for mounting in-basin equipment supplied by Parkson are included. Anchor bolts and connecting hardware shall be 18-8 SS.

Note: Hardware and gaskets at Parkson/Contractor interfacing flanged connections are not included and shall be provided by the installing contractor.

D.O. Control: One (1) D.O. probe with mounting bracket and one (1) analyzer shall be provided for each SBR basin.

Process Control Panel: A control panel capable of directing operation of components listed in this proposal shall be provided. Control features shall include the following:

- NEMA 12 Enclosure
- Analog I/O modules as required
- Digital I/O modules as required
- 10% spare I/O of each type
- Allen Bradley PLC
- Operator Interface
- Control / Monitoring of Proposed Equipment and Instrumentation
- HOA / OCA Switches
- LED Lights
- Modem
- Submersible Pressure Transducers for Each SBR Basin (including stilling well)
- Emergency TWL Float
- ***DynaPhase Controls™*** Software
- D.O. blower control feature

On-Site Service: Field service shall be provided for dry inspection, wet start up, O&M training, and follow up training. A total of four (4) trips / twelve (12) man days of service are included. Additional service can be provided at Parkson's daily field service rates.

Submittals and O&M Manuals: Submittals and O&M Manuals shall be provided as required by the project specifications.

5. Cost Estimate and Terms

Budget price for equipment and services……………………$_____________

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Jet Aeration Option

Designer: KBB

Date: 6/29/2016

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** Alum or ferric chloride addition req'd

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Winter WW Temperature (min.)	8.1	°C	47	°F
Summer WW Temperature (max)	20	°C	68	°F
Average WW Temperature	14.05	°C	57	°F
Elevation	2,500	ft	762	m
Average barometric pressure	13.41	psia*	92	kPa
Winter Air Temperature	-12	°C	10	°F
Summer Air Temperature	38	°C	100	°F

PROCESS DESIGN PARAMETERS

Design MLSS	3,500	mg/l @ TWL		
Design MLSS	4,225	mg/l @ BWL		
Hydr. Retention Time provided	1.46	days	35.0 hours	
Aerobic Sludge Age (SRTox)	11.3	days		
System SRT	22.6	days		
Biosolids growth rate	0.22	gVSS/gCODr/d		
	0.45	gVSS/gBODr/d		
F:M (adjusted for aeration %)	0.23	gCOD/gMLSS/d		
	0.13	gBOD/gMLSS/d		
System F:M	0.06	gBOD/gMLSS/d		
Avg biosolids yield	2,172	lbs./day*	985	kg/d
Avg net sludge yield (bio+inerts)	2,933	lbs/d based on CODr*	1,330	kg/d
	3,404	lbs/d based on BODr*	1,544	kg/d
Mass aerobic MLSS req'd	38,464	lbs	17,444	kgs
Mass aerobic volume req'd	1.32	MG	4,988	m^3
Aerated portion of day	50.0	%		
Required total SBR volume	2.64	MG	9,975	m^3

BASIN DIMENSIONS

Number of SBR basins	4	
Rectangular Dimensions:		
Length/Width Ratio	1.8 : 1	
Length	88 ft.	26.85 m
Width	50 ft.	15.24 m
Round Dimensions		
Diameter	75 ft.	22.83 m
Top Water Level	20.0 ft.	6.10 m
Bottom Water Level	16.6 ft.	5.05 m
TWL at Design Average Flow	20.0 ft.	6.10 m
Total Volume in SBR's	2.64 MG	9,975 m^3
Total Retention Time in SBR	35.0 hrs.	

AERATION SYSTEM SIZING

First Estimate :

lbs. O2/lb. BOD removed	1.25	kg O2/kg BOD removed		
lbs. O2/lb. TKN oxidized	4.6	kg O2/kg TKN oxidized		
lbs. O2/lb. NO_3x denitrified	-2.86			
Denitrification Credit	60 %			
Actual Oxygen Req'd, AOR	7,289	lbs. O2/day	3,305	kg/d

Second Estimate :

AOR = CODi - CODw - CODes + 4.6*TKNox - 2.86*NO3Ndn

where :	CODi	influent	=	8,710 lbs./day	3,950 kg/d
	CODw	wasted	=	2,606 lbs./day	1,182 kg/d
	CODes	eff soluble	=	980 lbs./day	444 kg/d
	TKNox**	oxidized	=	435 lbs./day	197 kg/d
	NO_3Ndn	denitrified	=	189 lbs./day	86 kg/d
	Mass balance AOR			6,592 lbs./day	2,990 kg/d

Use highest estimate ***DESIGN AOR = 7,289 lbs/day*** ***3,305 kg/d***

Conversion Formula from ASCE Manual of Practice :

$$SOR = \frac{AOR * Cs}{a * (\beta Csd - DO) * Ø^{(T-20)}}$$

Cs = DO saturation at Stnd Conditions
= 9.092*(1+0.4*D/34)
= 11.23 mg/l

ElevFactor Fe = 0.91

Csd = DO saturation at design conditions
Cst = DO saturation@liquid Temp & 1 sea level
where : = Cst*(Fe+0.4*D/34)
= 9.07 mg/l
Therefore, Csd = 10.39 mg/l

Alpha, a	0.85 *	SWD, D	20.0 ft
D.O., mg/l	2.0 mg/l	Beta, ß	0.95 *
WW Temp T	20 °C	Theta, Ø	1.024

Standard Oxygen Required, SOR	=	**12,232**	**lbs. O2/day**	**5,552 kg/d**
SOR Peaking Factor	=	**1**		
DESIGN SOR	=	**12,232**	**lbs. O2/day**	**5,552 kg/d**

CYCLE TIMES

Batches per day	4.00	per SBR	
Complete Cycle time	6.00	hrs. per basin	
Fill time at ADF	1.50	hrs.	
Anoxic Fill time	0.75	hrs.	50 % of FILL is anoxic.
Aerated Fill	0.75	hrs.	
React time	2.25	hrs.	50 % of cycle is aerated.
Denite time	0.25	hrs.	
Settle Time	0.75	hrs.	3.0 hrs. anoxic per cycle
Decant time	0.50	hrs.	
Idle time	0.75	hrs.	3.0 hrs. aerated per cycle

JET AERATION SYSTEM SIZING

Aerator elevation	2.5	ft.		0.76 m
Nozzle Angle	25	°		
Avg aerator submergence	17.3	ft.		5.27 m
Total aeration time	3.00	hrs./cycle		
	12.0	hrs./basin/day		
SOR	255	lbs./hr/basin		116 kg/hr
Normal gassing rate at ADF	45.5	SCFM / jet		1.29 m^3/min/jet
Max gassing rate	91.0	SCFM / jet		2.58 m^3/min/jet
Oxygen transfer efficiency (ADF)	27.1	%		
Design air flow	910	SCFM		26 m^3/m
Jets required per basin	20.0	Model 44 A Jets		
Add'l jets for mixing	0			
Total jets per basin	20.0			
Jet headers per basin	1	Type : **D**	D = Dual, S = Single	
Jets per header	20	Model 44 A Jets		

BLOWER SIZING DETAILS

Operating blowers	=	1	per aerating basin		
Type of Blowers :	=	1	*1=PD, 2=Centrifugal, 3=Turbo*		
Total Number of Blowers	=	4	including a spare		
Air flow per blower	=	910	SCFM	1,546 m^3/hr	
Inlet losses	=	0.3	psig *	2.07 kPa	0.02 bar
Net inlet pressure	=	13.11	psia (absolute)	90.37 kPa	0.90 bar
Discharge piping losses	=	0.7	psig *	4.83 kPa	0.05 bar
Losses at aerator	=	0.1	psig	0.69 kPa	0.01 bar
Total discharge pressure	=	8.58	psig average	59.18 kPa	0.59 bar
		8.68	psig maximum	59.82 kPa	0.60 bar
		7.19	psig minimum	49.58 kPa	0.49 bar
Site air flow required	=	1,083	ICFM average	30.67 m^3/min	
Assumed blower efficiency	=	68	% *		
BHp per blower	=	48	BHp/Blower	35.4 BkW	
				37.7 kW @ 94% ME	
Blower BHp/aerating basin	=	48	BHp/Basin	35.4 BkW	
				37.7 kW @ 94% ME	

JET MOTIVE PUMPS

Number of pumps	1	per basin	
Type of Pumps :	2	*1=Dry pit, 2=Submersible, 3=Axial flow*	
Total number of pumps	4		
Design pressure at nozzle	18	ft.	5.3 m
Flow per nozzle	186	GPM	11.7 l/s
Flow per pump	3,715	GPM	234.3 l/s
System headloss	2	ft.*	0.6 m
Total pump head	20	ft.	5.9 m
Assumed pump efficiency	70	% *	
BHp per pump	26	BHp/Pump	19.5 BkW
			20.7 kW @ 94% ME
Total pump BHp/basin	26	BHp/Basin	19.5 BkW
			20.7 kW @ 94% ME

DECANTERS

Cycles per day	16			
Avg TWL to BWL volume	113,000	Gallons	428	cubic meters
Max TWL to BWL volume	113,000	Gallons	428	cubic meters
Decant time	0.50	hrs.	30	minutes
Average decant flow	3,767	GPM	238	liters per second
Number of decanters per basin	1			
Average flow per decanter	3,767	GPM	238	liters per second

SLUDGE WASTING

Dry solids (BOD estimate)	3,404	lbs/day	1,544	kg/d
Solids concentration in WAS	0.85	%		
Total volume wasted per day	48,017	gallons per day	182	m3 / day
Wasting frequency	4	per tank per day		
Volume wasted each period	3,001	gallons	11	m3
Length of each wasting period	10	minutes		
WAS pump rate	300	gpm	19	liters per second
WAS pump discharge head	15	ft	4.6	meters
WAS pump efficiency	65	%		
WAS pump BHp	1.7	BHp	1.3	kW

POWER SUMMARY

Equipment	BHp/basin	Hours/day operating		kW hr/day	kW hr/annual
SBR blowers	47.5	48		1701	620,946
SBR jet pumps	26.1	52		1014	370,006
Cost of power per kWhr	0.05		Total	2,715	990,952
****Annual power cost**	**$49,548**				

** does not include corrections for motor efficiency, VFD losses, V-belt losses, or power factor

***Denotes parameters assumed by Parkson. These parameters to be confirmed by Owner or Owner's representative**

Whitefish, MT

Present Worth Comparison (6% Interest Rate)

Fine Bubble SBR Item	Present Worth	0	1	2	3	4	5
Initial Capital	$975,000	$975,000					
Annual Power Cost	$508,591		$44,341	$46,558	$48,885	$51,330	$53,897
Annual Maintenance Cost	$57,350		$5,000	$5,000	$5,000	$5,000	$5,000
Diffuser Replacement	$101,740						$50,000
	$1,642,681						

Jet Aeration SBR Item	Present Worth	0	1	2	3	4	5
Initial Capital	$975,000	$975,000					
Annual Power Cost	$568,316		$49,548	$49,548	$49,548	$49,548	$49,548
Annual Maintenance Cost	$57,350		$5,000	$5,000	$5,000	$5,000	$5,000
Motive Pump Rebuild	$17,404						
	$1,618,070						

Year														
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
$44,341	$46,558	$48,885	$51,330	$53,897	$44,341	$46,558	$48,885	$51,330	$53,897	$44,341	$46,558	$48,885	$51,330	$53,897
$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
				$50,000					$50,000					$50,000

Year														
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
$49,548	$49,548	$49,548	$49,548	$49,548	$49,548	$49,548	$49,548	$49,548	$49,548	$49,548	$49,548	$49,548	$49,548	$49,548
$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
				$20,000										$20,000