Regional Wastewater and Septage Treatment Study

Matanuska-Susitna Borough
In cooperation with:
City of Palmer
City of Wasilla

Prepared by:

Hattenburg Dilley & Linnell Engineering Consultants

3335 Arctic Ave., Suite 100
Anchorage, AK 99503
(907) 564-2120

Project Contact:
Scott Hattenburg, P.E.
shattenburg@hdlalaska.com

HDR Alaska

2525 C. Street, Suite 305
Anchorage, AK 99503
(907) 644-2000

Project Contact:
Jennifer Gastrock, P.E.
jennifer.gastrock@hdrinc.com

GV Jones & Associates, Inc.
Water and Wastewater Process Engineers

1200 E. 76th Ave., Unit 1207
Anchorage, AK 99518
(907) 346-4123

Project Contact:
Greg Jones, P.E.
greg@gvjones.com

Regional Wastewater & Septage Treatment Study

Matanuska-Susitna Borough, Alaska

Prepared for:

Matanuska-Susitna Borough, Alaska
City of Palmer, Alaska
City of Wasilla, Alaska

Prepared by:

HATTENBURG DILLEY & LINNELL, LLC.
3335 Arctic Blvd, Suite 100
Anchorage, AK 99503

GV JONES & ASSOCIATES, INC.
1200 E. 76th Ave., Unit 1207
Anchorage, AK 99518

HDR ALASKA, INC.
2525 C. Street, Suite 305
Anchorage, AK 99503

JULY 2010

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICIES

Abbreviations and Definitions

AAC	Alaska Administrative Code
ADF	Average daily flow
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AHRS	Alaska Heritage Resources Survey
ANWR	Arctic National Wildlife Refuge
ARRC	Alaska Rural Rehabilitation Corporation
AWWU	Anchorage Water and Wastewater Utility
BOD_5	Five-day Biochemical Oxygen Demand
°C	Degrees Celsius
CAS	Conventional Activated Sludge
CAT-EX	Categorical Exclusion
CBOD	Carbonaceous five-day Biochemical Oxygen Demand
COE	Corps of Engineers, U.S. Army
DCRA	Department of Community and Regional Affairs
DGC	Division of Governmental Coordination, Office of Management and Budget
EA	Environmental Assessment
EAAS	Extended Aeration Activated Sludge
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
°F	Degrees Fahrenheit
FC	Fecal coliform
FEMA	Federal Emergency Management Association
Ft	Feet
ft/sec	Feet per second
FPPA	Farmland Protection Policy Act
gal	Gallon
GPD	Gallons per day
GPM	Gallons per minute
GVJ&A	G.V. Jones and Associates
HDL	Hattenburg Dilley & Linnell
HDR	HDR Alaska, Inc.
HDPE	High Density Polyethylene
HRT	Hydraulic residence time
ISER	Institute of Social and Economic Research
KABATA	Knik Arm Bridge and Toll Authority
Lb	Pound
MBR	Membrane Bioreactor
MG	Million gallons
MGD	Million gallons per day
mg/l	Milligrams per liter
MLSS	Mixed liquor suspended solids
N/A	Not applicable
NE	Northern Economics

NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NH_4	Ammonia
NRCS	Natural Resources Conservation Service
NFPA	National Fire Protection Association, Inc.
O&M	Operation and Maintenance
PHFSGR	Palmer Hay Flats State Game Refuge
PSA	Palmer Service Area
PVC	Polyvinylchloride
PVDA	Polyvinylidene fluoride
RBC	Rotating Biological Contactor
RCA	Regulatory Commission of Alaska
SBR	Sequencing Batch Reactor
SRT	Solids Retention Time
SWX	Palmer Southwest Utility Extension, Phase I
TSS	Total suspended solids
UA	University of Alaska
USDA	United States Department of Agriculture
UV	Ultraviolet
VSS	Volatile suspended solids
WEF	Water Environment Federation
WWTP	Wastewater Treatment Plant
µm	Microns ($1x10^{-6}$ meters)

Regional Wastewater and Septage Treatment Study
Executive Summary

ES.1 BACKGROUND

The Cities of Palmer and Wasilla currently operate independent wastewater collection and treatment utilities. Due to forecast growth within the service areas, and a changing regulatory environment, these cities must improve their respective systems, or face regulatory action. The City of Palmer (Palmer) has until December 31, 2011 to come into regulatory compliance with NPDES permit limits for ammonia and total suspended solids (TSS). The City of Wasilla (Wasilla) struggles with ADEC regulatory limits for nitrates and cannot increase plant capacity because of its groundwater discharge. Septage haulers operating within the Matanuska-Susitna Borough (Borough) face escalating costs because there is no way to treat and dispose of septage in the Borough. Septage is currently driven to and disposed of in Anchorage's wastewater system. The study team, consisting of Hattenburg Dilley and Linnell (HDL), HDR Alaska (HDR), and G.V. Jones and Associates (G.V. Jones) was retained in January of 2009 to help the Borough and the two Cities address these challenges from a regional approach.

ES.2 PURPOSE

The purpose of this study is to address the short term regulatory compliance and capacity needs of the Palmer and Wasilla wastewater treatment plants and to address the long-term regional needs for a wastewater and septage treatment system in the Core Area of the Borough between Palmer and Wasilla. Construction of a wastewater collection and treatment system within the Core Area would allow for growth, higher density development and would reduce potential groundwater contamination from on-site septic systems. The existing municipal wastewater treatment systems for Palmer and Wasilla have limited capacity to meet the needs of future growth within the core area and the Borough has no facility for accepting or treating septage generated within the Borough. Wasilla, Palmer and the Borough need to determine if there is an economic advantage to joining together in a regional solution that will address the needs of the entities.

ES.3 BASIS OF DESIGN

Early in the study process, the study team evaluated many wastewater treatment process types in depth and forecasted wastewater flows for a 50-year planning period. A technical memorandum detailing design objectives and possible process solutions was presented to the entities involved in the study on April 21, 2009. Upon consultation with the Borough, Palmer and Wasilla, the wastewater process types were eventually refined to the top three candidates for detailed analysis and costing: Lagoon Activated Sludge (LAS), Conventional Activated Sludge (CAS) and the Membrane Bioreactor (MBR) system. A 4.0 million gallon per day (MGD) average daily flow (ADF) plant size was selected for the regional solution because it provided a reasonable design life for pricing, and avoided major portions of the treatment train lying dormant until the higher flows were realized. The 4.0 MGD plant size represents the year 2022 flow.

Early in the study, Palmer also suggested analysis of a 2.0 MGD near term alternative to allow time for a regional solution to be implemented. Wasilla also suggested a similar analysis of a 1.0 MGD near term alternative which is the approximate capacity of their subsurface disposal system.

Along with the flow rates presented for wastewater, septage production rates were projected out to a potential 30-year flow rate. The study team consensus was to base alternatives on a design flow rate of 170,000 gpd. The size and location of a potential septage receiving/pretreatment facility is based on this estimate.

ES.4 SUMMARY OF ALTERNATIVES

Based on the findings of the technical memorandum and suggestions by the entities involved in the study, the following alternatives and flow rates were advanced for detailed analysis and costing:

Near Term Alternatives

- Lagoon Activated Sludge Upgrade at the Palmer WWTP (2.0 MGD)
- Lagoon Activated Sludge Upgrade at the Wasilla WWTP (1.0 MGD)

Long Term Regional Alternatives

- Improve City of Palmer WWTP Further to Accept Regional Flows (4.0 MGD)
- Construct New Regional WWTP at a Central Location (4.0 MGD)

Near Term Upgrades

Near Term upgrades provide regulatory permit compliance and capacity increases so each City can accept larger incoming flows.

Palmer Near Term

Under this scenario, Palmer would upgrade its existing wastewater treatment plant to 2.0 MGD ADF. Upgrades to the treatment system would consist of converting Lagoon 1 into an extended aeration activated sludge process, referred to in the report as "Lagoon Activated Sludge." These upgrades include:

- Installation of additional headworks screw pumps, comminution and screening equipment
- Construction of separate reactor zones in Lagoon 1 using baffling to facilitate nitrification and denitrification
- Installation of additional aeration capacity to maintain completely mixed conditions in Lagoon 1
- Construction of an earthen dike to shorten the process basin length, and facilitate a shorter reaction time
- Installation of a floating, semi-permeable, insulated lagoon cover and a new lagoon liner
- Construction of secondary clarifiers within a large temperature controlled enclosure
- Installation of a granular media filtration unit to provide tertiary quality effluent
- Installation of additional UV disinfection capacity to handle increased flows

- Aerobic digestion of settled waste solids within the existing Lagoon 3

Upgrades will provide Palmer with capacity to the year 2026 at current projected population growth rates. The total project cost (including administration, construction, design, contingency, and inflation) for the proposed upgrades is **$43,716,100.** The estimated annual O&M cost for the Palmer near term LAS upgrades operating at an ADF of 2.0 MGD is **$1,354,000** per year**.**

Wasilla Near Term Upgrades

Under this scenario, Wasilla would upgrade its existing wastewater treatment facility to 1.0 MGD ADF of Septic Tank Effluent Pump (STEP) effluent using an LAS system similar to Palmer's near term project. These upgrades include:

- Construction of separate reactor zones in one lagoon using baffling to facilitate nitrification and denitrification
- Installation of additional aeration capacity to maintain completely mixed conditions within the existing lagoons
- Construction of an earthen dike to shorten the process basin length, and facilitate a shorter reaction time
- Installation of a floating, semi-permeable, insulated lagoon cover and a new lagoon liner
- Construction of secondary clarifiers inside a large temperature controlled enclosure
- Installation of a granular media filtration unit to provide tertiary quality effluent before ultimate disposal to the effluent drain fields
- Construction of additional aerobic sludge digestion capacity to handle increased septage flows from Wasilla

Upgrades will provide Wasilla with capacity to the year 2016 at current projected population growth rates. The total project cost (including administration, construction, design, contingency, and inflation) for the proposed upgrades is **$25,505,400.** The estimated annual O&M cost for the Wasilla near term LAS upgrades operating at an ADF of 1.0 MGD is **$982,000 per year**, excluding septage truck operations.

Long Term Regional Solutions

Upgrades presented as "Long Term" are intended to provide adequate initial capacity to treat wastewater for approximately 10-15 years, depending on actual growth rates. This time period was chosen due to the overwhelming cost of constructing and operating a larger scale plant with redundant parallel trains while flows are not adequate to fully utilize the design capacity. For the purpose of pricing, regional plant concepts were based on 4.0 MGD capacity with parallel train redundancy. Regional concepts also allow modular expansion beyond 4.0 MGD. A summary of the long term upgrades is presented in the following paragraphs.

Palmer LAS Regional WWTP

One of the regional solutions is to upgrade the Palmer WWTP using LAS. This 4.0 MGD upgrade would consist of converting both Lagoons 1 and 2 to the activated sludge process. Improvements would produce tertiary quality effluent for continued discharge to the Matanuska River. 4.0 MGD upgrades would include:

- Installation of additional headworks pumping, comminution and screening capacity
- Installation of primary clarifiers to remove settleable solids prior to them entering the lagoons
- Installation of anaerobic digestion units for sludge stabilization and potential biogas generation to be used in a cogeneration process
- Conversion of Lagoon 2 to an LAS process
- Construction of a third secondary clarifier
- Construction of additional granular media filtration capacity
- Construction of a new UV disinfection unit

While LAS systems are not widely used in the State of Alaska, it is a proven technology in cold weather climates in the lower 48. This option is the least expandable of the three regional solutions when flows increase past the 4.0 MGD threshold because more land will be required and new lagoons constructed at considerable cost, or the treatment process will need to be changed to something other than lagoons.

The upgrades will provide treatment capacity to year 2022, based on population projections in the study. The total project cost for the Palmer 4.0 MGD LAS upgrade including a septage receiving station located off-site is **$96,740,600.** The expected annual O&M cost at 4.0 MGD is estimated to be approximately **$3,525,300** including septage receiving off-site**.**

In addition to Palmer WWTP upgrades, a large diameter sewage conveyance pipeline would need to be constructed between the Wasilla WWTP and the Palmer Southwest Utility Extension (SWX) sewer main near the Mat-Su Regional Medical Center. This conveyance pipeline would be approximately 5.1 miles in length and would include three lift stations capable of pumping 2.0 MDG ADF from Wasilla. It would also require lift station capacity upgrades to the Palmer SWX system. The total project cost (including administration, construction, design, contingency, and inflation) for the Wasilla conveyance system and the Palmer SWX upgrades is estimated to be **$22,446,000.**

Centrally Located Regional WWTP

The other option is to construct a new centrally located regional WWTP somewhere between the two cities. A number of different sites were evaluated for construction of a centrally located treatment plant. Several criteria were used to screen candidate locations including:

- Proximity to permittable receiving waters
- Central location to the combined service area
- Low elevation to maximize the use of gravity sewer and reduce pumping costs
- Land availability (at least a 20 acre tract of undeveloped land)

After studying a number of potential locations, two candidate sites were selected for further analysis. The sites are:

Site A – A gravel pit located to the south west of the Glenn/Parks Interchange. This site is currently owned by Arctic Devco, the developers of "The Ranch" subdivision. The outfall would be a surface discharge to a large privately-owned (same owner as the

WWTP site) wetland located on the flats south of Site A. The large 600 acre private parcel abuts the PHFSGR and would need to be purchased or leased. Sewage conveyance from Wasilla to Site A would consist of approximately 22,500 L.F. of sewer main with two lift stations; approximately 6,000 L.F. of sewer main between Woodworth Loop near the Mat-Su Regional Medical Center and Site A; reversing the flow in the 5 miles of the Palmer SWX system including conversion of gravity sewers to force mains, and upgrading lift station and piping capacity. The total project cost (including administration, construction, design, contingency, and inflation) of conveying wastewater to Regional Site A is estimated to be **$29,644,800.**

Site B - Site B is located at a gravel pit south of Palmer between the Glenn Highway and the Matanuska River. Private property in the site area is owned by Granite Construction, Inc. and Agg Pro. For purposes of the study, the Agg Pro property has been illustrated, however, either of the properties have favorable qualities for a wastewater treatment plant. The outfall from this location would be to the floodplain of the Matanuska River. Sewage conveyance to Site B would consist of approximately 5.1 miles of new sewer main with three lift stations between the Wasilla WWTP and the Palmer SWX; reversing of flow through approximately 3.6 miles of the Palmer SWX system between the Palmer WWTP and Site B including conversion of gravity sewer to force mains and lift station capacity upgrades; constructing lift station capacity upgrades between the Mat-Su Regional Medical Center and Site B to handle the additional flow from Wasilla; constructing approximately 1,600 L.F. of new sewer main from the Palmer SWX system to Site B. The total project cost (including administration, construction, design, contingency, and inflation) of conveying wastewater to Regional WWTP Site B is estimated to be **$24,737,500.**

Centrally Located CAS Regional WWTP

A centrally-located CAS treatment option would consist of the following:

- Preliminary screening to remove large items (rocks, rags, etc.) and grit removal
- Primary clarification to remove settleable solids prior to them entering process basins, and also to aid in potential biogas generation
- Secondary treatment configured with anoxic reactors to facilitate sludge settleability and aeration efficiencies
- Secondary clarification for gravity biosolids separation
- Granular media filtration units to produce tertiary quality effluent
- UV disinfection prior to effluent discharge
- Anaerobic digestion for sludge stabilization and potential biogas generation

This option would require the construction of buildings to house the reactor basins, headworks and clarifiers. These buildings are needed to maintain the wastewater temperatures during the long, cold Alaskan winters. CAS is a proven wastewater treatment technology and is used throughout the lower 48 and in Alaska. Anchorage Water and Wastewater Utility's (AWWU) Eagle River Alaska WWTP is a tertiary plant that discharges into salmon migrating habitat. If planned properly, CAS allows for easy modular expansion beyond 4.0 MGD.

A regional CAS plant would provide capacity to the year 2022, at current projected population growth rates. The total project cost (including administration, construction, design, contingency, and inflation) of a centrally located regional 4.0 MGD CAS plant including septage receiving/pretreatment is **$107,605,000.** Expected annual O&M costs for a regional CAS WWTP at 4.0 MGD are estimated to be approximately **$3,558,700** including septage receiving**.**

Centrally Located MBR Regional WWTP

A centrally located membrane bioreactor (MBR) plant would include the following:

- 2-stage screening process consisting of coarse and fine screening plus grit removal
- Primary clarification to remove settleable solids prior to them entering process basins, and also to aid in potential biogas generation
- Secondary treatment configured for optimum sludge settleability and aeration energy efficiency
- Secondary biosolids separation through the use of membranes
- UV disinfection prior to effluent discharge
- Anaerobic digestion for sludge stabilization and potential biogas generation

The size of process buildings for this option is much smaller than those required for the CAS process. This is due in large part by the use of membranes for secondary biosolids separation, as they require smaller reactor basins and eliminate the use of tertiary filters and gravity clarifiers. MBR is also a proven wastewater treatment technology and is generally regarded as "state of the art" in terms of treatment processes. MBR allows easy modular upgrades beyond a flow rate of 4.0 MGD.

A regional MBR plant would provide capacity to the year 2022, at current projected population growth rates. The total project cost (including administration, construction, design, contingency, and inflation) of a centrally located regional 4.0 MGD MBR plant including septage receiving/pretreatment is **$101,418,800.** Expected annual O&M costs for a regional MBR WWTP at 4.0 MGD are estimated to be approximately **$4,008,600** including septage receiving**.**

Septage Receiving and Pretreatment

The final goal of this study was to address septage handling within the Borough. Landfill leachate handling and treatment was also included in the initial phase of the study, however, conversations with the Borough's Central Landfill manager indicate that they intend to develop their own landfill leachate handling plan. Three options for septage receiving and pretreatment were evaluated during this study. These options include:

<u>Septage Option 1 - Septage Receiving and Treatment at the Central Landfill</u>

This option would consist of on-site treatment of septage. It would require a new treatment and disposal system separate from the existing Palmer and Wasilla or new regional WWTPs. This option was not advanced further because the cost of building a separate treatment facility is cost prohibitive and not consistent with the Borough's plans at the landfill.

<u>Septage Option 2 – Septage Receiving at a Central Location Not at the Regional WWTP</u>

This option consists of a septage receiving station providing pre-treatment located away from the site of a regional WWTP. The facility would be built near an existing or new sewer main. Septage received at the station would then be screened and mixed with wastewater in the collection system and treated at the regional WWTP. Locations considered include near Palmer's Lift Station 4 near the Glenn Highway, or near the Mat-Su Regional Medical Center.

Septage Option 3 – Septage Receiving Co-Located with the Regional WWTP

This option consists of a septage receiving station co-located at the site of a regional WWTP. This option would be feasible only for the centrally located regional WWTPs, as septage truck traffic along Inner/Outer Springer Loop Road near the Palmer WWTP is not publicly acceptable according to Palmer.

The process for pre-treatment of septage is essentially the same for either Alternative 2 or 3, and consists of:

- Coarse screening at the truck emptying area to remove large items
- Flow attenuation to avoid overloading downstream processes
- Additional fine screening and grit removal with discharge to a storage tank
- Metering of septage into wastewater stream to avoid upsetting the wastewater treatment process with high nutrient loadings
- Trucking of screenings and grit to the Borough Central Landfill

The septage receiving station developed for this study consists of a dual bay septage receiving area with hot water wash stations. The site requires space for trucks to pull through the site without the need to turn around. Improvements would be designed for ease of expandability just as in the other regional treatment options.

A septage plant would provide capacity to the year 2048, at current projected population growth rates. The total project cost (including administration, construction, design, contingency, and inflation) for either a co-located or non co-located regional septage receiving/pretreatment station is **$7,133,000.** Annual operational and maintenance (O&M) costs are estimated to be **$165,000.**

Phasing

Costs provided in this report for regional treatment options are for wastewater treatment and conveyance of 4.0 MGD to a single point. The initial capital costs required for startup of a wastewater treatment plant could be reduced by phasing improvements to provide initial treatment to meet the required permits, adding equipment and processes as needed as flows increase or as permit limits warrant. Phasing of upgrades and improvements would also serve to reduce the burden placed on initial ratepayers and could be more likely to secure funding.

Preferred Alternative

In order to make a proper recommendation for a solution to regional wastewater and septage treatment within the MSB, it is necessary that the full process laid out in the National Environmental Policy Act of 1969 (NEPA) be followed. To help expedite this process and aid in the selection of a preferred alternative the study team has developed a decision matrix consisting of 9 monetary and non-monetary factors which influence the selection of the preferred treatment process. This decision matrix is provided in Section 11.0 of the report.

ES.5 FINDINGS

1. Constructing a regional wastewater and septage treatment facility is technically feasible.

2. Additional environmental studies following the National Environmental Policy Act of 1969 (NEPA) will be required if federal funding is used. The environmental process could take 1 to 3 years, depending on the environmental impacts.

3. Planning, design, permitting, and construction of a regional facility will require approximately 4 years to complete.

4. Based on a forecast ADF of 4.0 MGD, total project cost (including administration, construction, design, contingency, and inflation) of constructing a regional wastewater and septage facility including conveyance piping is estimated to range from $119 million to $132 million - depending on the location and treatment process selected. See Table EX-1.

Table EX-1: Summary of Combined Capital Costs

	WWTP Construction	Conveyance Piping, Wasilla, 4.0 MGD	Conveyance Piping, Palmer, 4.0 MGD	Off-Site Septage Receiving	Total Project Cost
Palmer, Regional	$89,607,600	$19,218,000	$3,228,000	$7,133,000	**$119,186,600**
CAS, Regional	$107,605,000	$19,654,000	$5,083,500	-	**$132,342,500**
MBR, Regional	$101,418,800	$19,654,100	$5,083,600	-	**$126,156,300**

5. The cost of the three entities "going it alone" and treating 4.0 MGD independently versus joining in a regional wastewater and septage treatment solution is estimated to be $107 million versus $119-132 million, respectively. See Table EX-2.

Table EX-2: Summary of Capital Costs for Independent Treatment vs. Regional Treatment

Item	Capital Cost
Independent Treatment	$107,216,100
Regional-LAS	$119,186,600
Regional-CAS	$132,342,500
Regional MBR	$126,156,300

6. The total project cost of a septage receiving/pretreatment facility regardless of whether co-located or non co-located is approximately $7.133 million.

7. The septage facility will require an upgraded wastewater treatment plant regardless of the alternative selected.

8. The septage facility costs are based on locating the facility in close proximity to a large diameter sewer main capable of handling the additional flow.

9. Based on an ADF of 4.0 MGD, annual O&M costs for a regional wastewater and septage facility are estimated to range from approximately $3.5 million to $4.0 million depending on the treatment process selected. See Table EX-3.

Table EX-3: Regional WWTP O&M Costs (Includes Septage Receiving)

Palmer-Regional WWTP (4.0 MGD ADF)	**$3,525,300**
CAS-Regional WWTP (4.0 MGD ADF)	**$3,558,700**
MBR-Regional WWTP (4.0 MGD ADF)	**$4,008,600**

10. The costs to the rate payer for constructing and operating regional wastewater and septage facilities were estimated based on a variety of factors. Rates will vary depending on whether the customer is served by a STEP system (Wasilla) or a conventional gravity collection system (Palmer), the amount of grant funding received for construction, and the year the user comes online. MSB rates presented are the tipping fees for septage haulers dumping an average truck load of 3,000 gallons. A detailed break down of the ratepayer study can be found in Section 10.3 and Appendix F of this report. Table EX-4 presents a ratepayer matrix showing how different factors will affect the cost to the ratepayer.

Table EX-4: Breakdown of Potential Rate Payer Costs

	Amount of Grant Funding Received														
Estimated Rate at Year	0%			25%			50%			75%			100%		
Wasilla, 2015	$177	$192	$198	$148	$159	$165	$118	$126	$131	$89	$93	$98	$60	$59	$65
Wasilla, 2020	$121	$130	$137	$103	$110	$116	$86	$90	$96	$68	$70	$76	$50	$50	$55
Wasilla, 2025	$93	$100	$105	$80	$85	$90	$68	$71	$76	$55	$56	$61	$42	$42	$47
Palmer, 2015	$137	$148	$154	$115	$124	$129	$94	$99	$105	$72	$74	$80	$50	$50	$55
Palmer, 2020	$103	$130	$117	$103	$94	$100	$74	$78	$84	$60	$62	$68	$46	$46	$52
Palmer, 2025	$83	$88	$94	$80	$76	$81	$61	$64	$69	$51	$52	$57	$40	$40	$45
MSB, 2015	$166	$175	$182	$138	$146	$152	$111	$116	$122	$84	$86	$92	$57	$57	$62
MSB, 2020	$141	$148	$155	$120	$125	$132	$100	$103	$110	$79	$80	$87	$58	$58	$64
MSB, 2025	$121	$126	$132	$104	$108	$114	$87	$90	$96	$70	$72	$77	$54	$54	$59
	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR
	Regional WWTP Type														

11. Constructing a 4.0 MGD regional WWTP at Palmer provides the least initial total project cost because of the reuse of access roads, utilities, lagoons, headworks and UV disinfection.

12. Beyond 4.0 MGD, a CAS or MBR plant may be incrementally less expensive to build and/or operate compared to the LAS plant because of the smaller foot print, compactness, higher energy efficiency and no need for additional land.

ES.6 RECOMMENDATIONS

1. Our preliminary scoring of alternatives in the scoring matrix suggests that a regional CAS or MBR WWTP are the preferred alternatives. We, however, recommend that the Borough and Cities meet, discuss, and adjust the weighting of importance factors based on their priorities, and finalize the selection of the preferred treatment process.

2. Initiate the environmental process as soon as practical upon the selection of a preferred alternative.

3. If Palmer is selected as the regional site, and flows are anticipated to increase significantly beyond 4.0 MGD, consider using the CAS or MBR process to maximize expandability in the future.

1.0 INTRODUCTION

This study was commissioned by the Matanuska-Susitna Borough (MSB/Borough), the City of Palmer (Palmer), and the City of Wasilla (Wasilla) to determine the feasibility of joining together in a regional wastewater and septage treatment facility. The study answers fundamental questions of: if the Borough, Palmer and Wasilla (the entities) were to join in a regional wastewater and septage facility, how would the governing body be structured; how much would it cost the rate payer; and where and how would such a facility likely be built. The study also looks at the cost of the entities developing their facilities independently, should a regional entity not be economically feasible or politically desired.

1.1 Background

The Matanuska-Susitna Borough is the fastest growing region in the State of Alaska. Its population is expected to nearly triple in the next thirty years, from an estimated population of 82,515[1] in 2008 to nearly 235,000[2] by the year 2039. The highest population density is generally located in and around the cities of Palmer and Wasilla, in the southern part of the Borough. The current wastewater treatment and collection systems in the Palmer and Wasilla area are at or nearing their capacity, and are experiencing conditions which periodically result in regulatory non-compliance with their current effluent discharge permits.

As the population of the Borough outside of the core area of Palmer and Wasilla grows, new residents who are unable to connect into the wastewater collection system are installing septic tanks. When the septic tanks are pumped out, the solids and liquids removed are called septage. Septage generated within the Borough is trucked to Anchorage and disposed of at the Anchorage Water and Wastewater Utility (AWWU) Turpin Street septage receiving station.

Additionally, the MSB operates a landfill (Central Landfill) located between Palmer and Wasilla. This landfill is underlain with a perforated piping network to collect liquids from the landfill, called leachate. Leachate flows through the piping network where it is collected for transport to the Turpin Street receiving station.

The Borough, with funding support from Palmer and Wasilla has retained Hattenburg Dilley & Linnell, LLC, (HDL), HDR Alaska, Inc. (HDR) and G.V. Jones and Associates, Inc. (G.V. Jones) to study the concept of joining together to provide a regional wastewater and septage solution, versus expanding the entities' respective facilities independently. The study team has defined and studied four distinct alternatives for providing combined or independent wastewater treatment for the cities of Palmer and Wasilla, as well as a septage and leachate receiving and treatment facility for septage haulers operating within the Borough. This study expands upon the current wastewater treatment plant (WWTP) master plans for the cities of Palmer[3] and Wasilla[4], and the MSB Septage Handling and Disposal Plan[5].

1 Population of Alaska by labor market Area, Borough, and Census Area, 1990-2008, Alaska Department of Labor
2 See Appendix C for a complete population projection analysis
3 Palmer Wastewater Treatment Plant Preliminary Engineering Report, Hattenburg Dilley and Linnell, LLC and G.V. Jones and Associates, Inc., April 10, 2008
4 Wasilla Sewer Master Plan, LCMF Incorporated and G.V. Jones and Associates, Inc., December 1, 1999
5 Matanuska-Susitna Borough Septage Handling and Disposal Plan, HDR Alaska, Inc., April 2007

1.2 Scope

The scope of this study is to evaluate the current wastewater treatment facilities and septage handling plan, and provide alternatives for needed improvements. This report includes reviews of the existing wastewater treatment processes for Palmer and Wasilla; forecasts of future wastewater flows; analysis of wastewater treatment and septage management alternatives including capital and operation and maintenance (O&M) costs; identification and analysis of potential regional wastewater plant and septage receiving facility locations; evaluation of the formation of a unified treatment authority; and a decision matrix to aid in selection of a preferred alternative.

Future federal funding will require a separate environmental document that follows the National Environmental Policy Act of 1969 (NEPA). The environmental process will determine if a categorical exclusion (CAT-EX), an environmental assessment (EA) or an environmental impact statement (EIS) is needed. The scope of this study does not include a NEPA environmental analysis; however the NEPA process should be the next step if the Cities and Borough continue the public process and move toward a regional facility.

1.2.1 Basis of Design

Early in the study process, the study team evaluated many wastewater treatment process types in depth and forecasted wastewater flows for a 50-year planning period. A technical memorandum detailing design objectives and possible process solutions was presented to the entities involved in the study on April 21, 2009. Upon consultation with the Borough, Palmer and Wasilla, the wastewater process types were eventually refined to the top three candidates: Lagoon Activated Sludge (LAS), Conventional Activated Sludge (CAS) and the Membrane Bioreactor (MBR) system. A 4.0 million gallon per day (MGD) average daily flow (ADF) plant size was selected for the regional solution because it provided a reasonable design life for pricing, and avoided major portions of the treatment train lying dormant until the higher flows were realized. The 4.0 MGD plant size represents the year 2022 flow.

Early in the study, Palmer also suggested analysis of a 2.0 MGD near term alternative to allow time for a regional solution to be implemented. Wasilla also suggested a similar analysis of a 1.0 MGD near term alternative which is the approximate capacity of their subsurface disposal system.

Along with the flow rates presented for wastewater, septage production rates were projected out to a potential 30-year flow rate. The study team consensus was to base alternatives on a design flow rate of 170,000 gpd. The size and location of a potential septage receiving/pretreatment facility is based on this estimate.

1.2.2 Summary of Alternatives

There are many options for treatment of wastewater. In order to expedite the evaluation of treatment options and to provide definite alternatives to be advanced in the study, a technical review document was compiled and presented to the entities. This document included an extensive evaluation of potential treatment processes, potential locations of a new regional WWTP and evaluation of potential pipeline alignments. After review and consultation with the entities, the consensus was to provide near term alternatives to solve the current problems faced at the Palmer and Wasilla plants, and long term alternatives to provide capacity to the expanding population within the Borough. The alternatives are:

Near Term Alternatives

- Lagoon Activated Sludge Conversion at City of Palmer WWTP (2.0 MGD)
- Lagoon Activated Sludge Conversion at City of Wasilla WWTP (1.0 MGD)

Long Term Alternatives

- Improve City of Palmer WWTP Further to Accept Regional Flows (4.0 MGD)
- Construct New Regional WWTP at a Central Location (4.0 MGD)

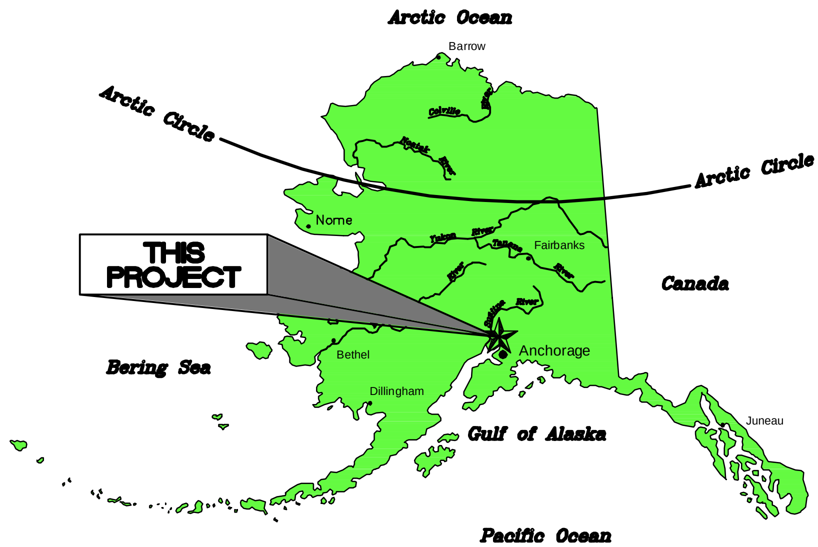
Septage

In addition to wastewater treatment alternatives, three options for septage receiving and pretreatment were evaluated and advanced in the study. These options include a septage receiving and screening facility at (1) the MSB Central Landfill, (2) near the City of Palmer's Lift Station 6 or along Trunk Road and (3) a new Regional WWTP. Alternatives for septage receiving are discussed in Section 8.

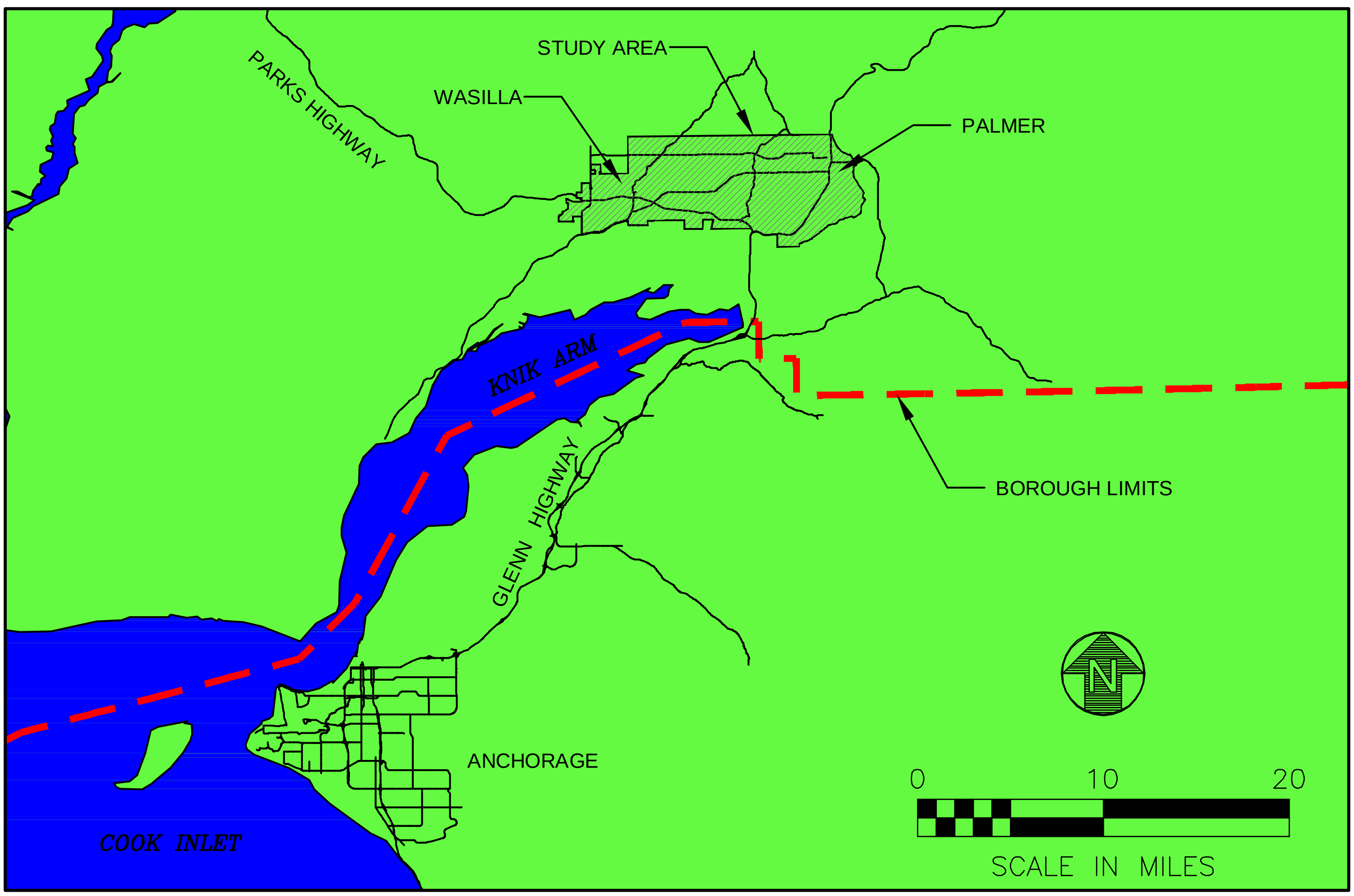
Landfill Leachate

Initially, the study team investigated co-treating leachate from the Borough Central Landfill concurrently with the septage. However, landfill leachate can cause a number of problems at wastewater treatment plants including addition of toxic heavy metals, contamination of wastewater biosolids, changes in the pH of the wastewater by the acidic nature of the leachate, and nutrient starvation to biological communities that perform wastewater treatment. Discussions with the Borough Central Landfill managers revealed they plan to develop an alternate plan for storage and treatment of leachate on site at the landfill.

Near term plans include continued hauling of leachate to AWWU's Turpin Street receiving facility. Long term plans include implementing either recirculation or evaporation of landfill leachate collected on-site. Either of these alternatives would eliminate leachate disposal at a regional facility and therefore leachate flows and treatment were not advanced beyond the Borough's plan in this study. Further discussion of the leachate is included in Section 7.4.



LOCATION MAP



VICINITY MAP

HDL HATTENBURG DILLEY & LINNELL
Engineering Consultants

- ENGINEERING
- EARTH SCIENCE
- PROJECT MANAGEMENT
- PLANNING

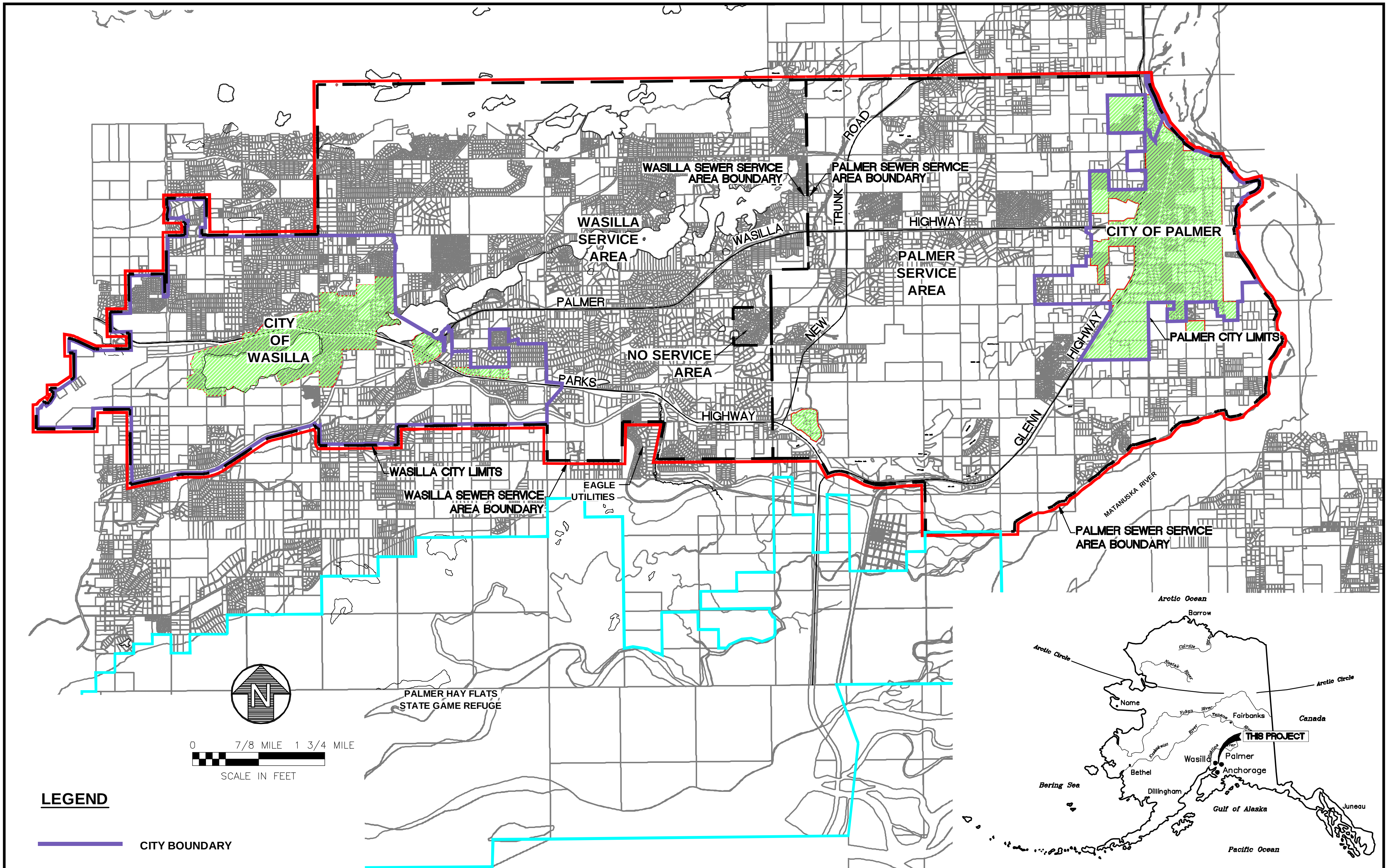
(907) 564-2120
www.HDLalaska.com

MSB REGIONAL WASTEWATER/SEPTAGE STUDY

VICINITY AND LOCATION MAP

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE: JULY, 2010	DRAWN BY: TLC	SHEET: FIGURE 1
SCALE: AS NOTED	CHECKED BY: SLH	JOB NO.: 08–039



LEGEND

- CITY BOUNDARY
- UTILITY DISTRICT BOUNDARY
- PALMER HAY FLATS BOUNDARY
- STUDY AREA BOUNDARY
- AREA CURRENTLY SERVED BY SEWER

HDL HATTENBURG DILLEY & LINNELL Engineering Consultants

GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
STUDY AREA

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 2
SCALE:	1" = 1 3/4 MILE	CHECKED BY:	SLH	JOB NO.:	08–039

2.0 PURPOSE AND NEED

The purpose of this study is to address the short term regulatory compliance and capacity needs of the Palmer and Wasilla wastewater treatment plants and to address the long-term regional needs for a wastewater and septage treatment system in the Core Area of the Borough between Palmer and Wasilla. Construction of a wastewater collection and treatment system within the Core Area would allow for growth, higher density development and would reduce potential groundwater contamination from on-site septic systems. The existing municipal wastewater treatment systems for Palmer and Wasilla have limited capacity to meet the needs of future growth within the Core Area and the Borough has no facility for treating septage generated within the Borough. Wasilla, Palmer and the Borough need to determine if there is an economic advantage to joining together in a regional solution that will address the needs of the entities.

2.1 Palmer Needs

The Palmer WWTP is occasionally out of compliance with its federal National Pollutant Discharge Elimination System (NPDES) permit and does not have adequate capacity to treat forecast wastewater flows from the Palmer Service Area (PSA). Based on estimates, the City will need to expand its current treatment capacity of 1.0 MGD by 2015 to meet forecast wastewater flows from the PSA. The need for either an upgraded WWTP or joint regional treatment facility is being driven by a number of factors, including:

Service area size. In April of 2004, the Regulatory Commission of Alaska (RCA) approved the expansion of boundaries for the PSA for water and sewer utilities. This expansion added 17.9 square miles to the PSA, increasing it from 13.2 square miles to 31.1 square miles – more than doubling its size. This service area increase includes projected high growth areas along Trunk Road, the Palmer-Wasilla Highway, and the Glenn and Parks Highways. In 2006, water and sewer mains were extended along the Glenn Highway to serve the Mat-Su Regional Medical Center and surrounding areas.

Population growth. Palmer's population has grown from 2,833 in 1990 to a 2008 estimated population of 5,559[6]. This is an annual growth rate of approximately 3.8% compared to an annual statewide growth rate of approximately 1.2%[7]. Providing access to safe and reliable water and sewer service is a key component to sustainable growth.

Discharge permit changes. Palmer's current WWTP is not capable of meeting its effluent discharge limits for ammonia during certain times of the year. The NPDES permit for the City's wastewater was renewed on January 1, 2007 for five years. The new permit includes more restrictive effluent limits due to the discovery of a salmon spawning habitat in the existing outfall's receiving waters. Palmer has until December 31, 2011 to comply with these new discharge limitations, or it will risk potential fines of up to $32,500 per day, per violation.

Eagle Utilities. Eagle Utilities, Inc., (EU) an independent regulated water and sewer utility located south of the Parks Highway between Palmer and Wasilla has expressed interest in connecting their "The Ranch" subdivision to Palmer's wastewater collection system. At ultimate

6 State of Alaska, Department of Community and Economic Development, Alaskan Community Information Database Online, March 2009

7 Population of Alaska by labor market Area, Borough, and Census Area, 1990-2008, Alaska Department of Labor

buildout, this development will contain approximately 1,900 homes, plus schools and commercial businesses. Flows generated from this development largely depend on timing of the development's construction. Discussions with EU indicate that development is expected to progress cautiously after the recent national economic downturn. The Ranch Subdivision will begin development when a positive housing climate returns and housing demand increases. Expectations are for the next housing growth cycle to return in 5 to 10 years. For the purposes of this study, flows are estimated to contribute approximately 350,000 gallons per day in the year 2020 at full build-out[8].

Aging On-Site Utilities. There are many large commercial/institutional facilities with on-site septic systems located within the PSA. Businesses along the Palmer-Wasilla Highway, Matanuska-Susitna College and Colony Schools have on-site septic systems. The leach fields of these on-site septic systems generally have a practical life of 15 to 20 years depending on soils and the quality of effluent. As the leach fields age and clog from biomat buildup or broken pipes they will need to be replaced. As systems fail and development density increases, the extension of sewer service to these facilities would improve the public health by providing reliable piped wastewater collection and treatment.

2.2 Wasilla Needs

The needs of Wasilla are very similar to those of Palmer. The factors driving the need for an upgraded collection and treatment system include the following:

Service area size. The current size of the Wasilla Service Area (WSA) is 37.7 square miles. It includes areas that have already been developed with residential subdivisions, as well as areas of expected commercial growth along the Parks Highway, Palmer-Wasilla Highway, and Bogard Road. Wasilla's current collection system cannot be extended without substantial upgrades and expansion of its current WWTP due to treatment capacity limitations.

Population growth. Wasilla has grown from 4,028 in 1990 to a 2008 estimated population of 7,176[6], an annual growth rate of 3.3%. Wasilla has also become the commercial/retail hub for the region. In order to maintain this high level of growth, avoid groundwater contamination from septic systems and the current Wasilla WWTP drainfields, and to attract new residents and businesses to the area, expanded piped wastewater collection and treatment is needed.

Discharge Permit Compliance. Wasilla's existing WWTP is currently operating under an ADEC wastewater discharge permit. The permit expiration date was December 1, 2001; however, it was administratively extended until renewed. This permit requires periodic sampling of groundwater quality at several monitoring wells for the presence of contaminants. These contaminants, consisting mainly of nitrates and ammonia, have been consistently found at elevated levels in the monitoring wells near the facility's drainfields. In order to comply with state and federal water quality standards, either more land must be purchased to buffer the leach field and improve water quality at the point of treatment compliance, a new plant needs to be constructed, or a new surface water discharge must be built. The concept of a new outfall was investigated in 2001[9] and the ADF&G indicated that crossing or discharging into the Palmer

[8] Study of Impact of Connecting The Ranch Subdivision to the City of Palmer WWTP, HDL, 2008 (Modified to 66% of projected flow based on conversation with Rex Turner, owner of "The Ranch")

[9] City of Wasilla Sewer Outfall Analysis, HDL, 2001

Hay Flats State Game Refuge (PHFSGR) would not be allowed. ADF&G suggested that an outfall to the Knik River via the Glenn Highway corridor would be permittable with tertiary treatment[10]. The cost of extending the outfall to the Knik River was estimated to be up to $33 million in 2001.

Aging On-Site Utilities. Similar to Palmer, there are numerous large facilities within the Wasilla service area with on-site disposal systems in operation. These facilities are primarily located along the Parks and Palmer-Wasilla Highway corridors and along Bogard Road. As these systems age, the possibility of groundwater contamination increases. Systems that partially fail or provide improper treatment could contaminate groundwater and go unnoticed for extended periods of time. Lake Lucille has been listed by ADEC as an impaired water body since 1994, in part because of the high density of urban development in the area. The expansion of sewer mains to these areas would address the need for growth, would allow higher density development and would reduce the risk of groundwater contamination.

2.3 Matanuska-Susitna Borough Needs

The Borough wishes to build a septage and leachate receiving and treatment facility within the Borough. Some of the factors driving the need for such a facility are as follows:

Population Growth. As previously stated, the MSB is growing at the most rapid rate of any region in the State of Alaska. Approximately 80% of households within the Borough are currently on septic systems. It is estimated that the amount of septage produced will increase from the current rate of 13.8 million gallons annually[11] to 40.7 million gallons by the year 2039 (See Section 4.2 of this report for wastewater and septage flow projections).

Septage and Landfill Leachate Disposal. There is currently no means of disposing septage or landfill leachate within the Borough. All septage and leachate is trucked to Anchorage by licensed waste haulers and disposed of at the AWWU Turpin Street septage receiving station. This process is expensive due to AWWU's recent rate increase, rising fuel costs and hauling distance.

3.0 EXISTING FACILITIES

3.1 City of Palmer

Palmer's sanitary sewer system consists of a piped collection system and six lift stations which collect and convey sewage to an aerated lagoon treatment system. The WWTP consists of a headworks facility, three lagoons, an ultraviolet (UV) disinfection facility, and sludge drying and disposal areas.

[10] ADF&G letter to Laurie Hulse, P.E., HDL dated November 8, 2002.
[11] AWWU Annual Wastewater Summary, 2007

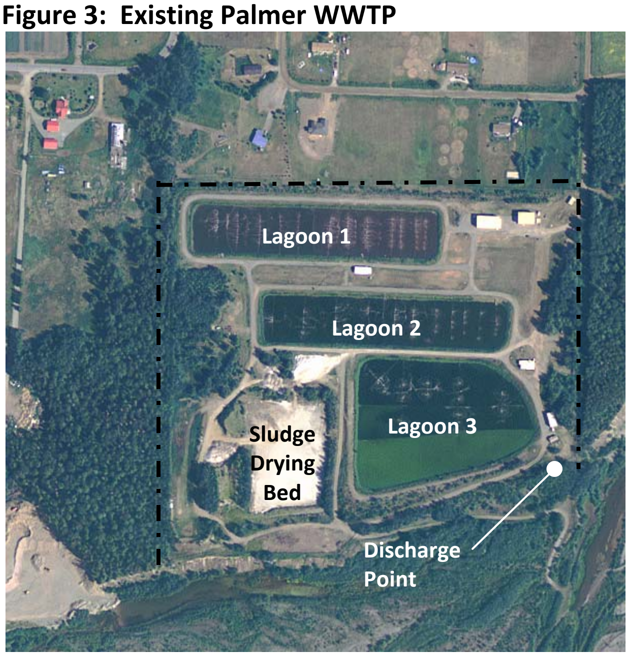
3.1.1 Wastewater Collection and Treatment System History

Palmer's original wastewater collection system was constructed in the 1950's by the Alaska Rural Rehabilitation Corporation (ARRC). At that time the service area consisted of the old ARRC subdivision between the new Glenn Highway and the railroad south of East Arctic Avenue and the old school (now the Mat-Su Borough offices). Wastewater was transported via a 12-inch concrete pipe to the present treatment plant site and discharged directly to the Matanuska River. As the area grew and the collection system was expanded to serve new customers, the wastewater treatment plant grew to meet new regulatory standards passed in the Clean Water Act, and to handle additional flows.

Construction of the first treatment system was in 1964 and 1965 when a large irregular shaped lagoon (the current Lagoon 3) was constructed along with two small cells. This treatment system discharged through the same outfall with no disinfection. The first aerated lagoon was constructed in 1972 (this is now Lagoon 2). This lagoon used perforated tubing and 20 horsepower blowers to treat wastewater more efficiently by keeping the process aerobic. Lagoon 3 was used as a polishing lagoon and wastewater was discharged through a new chlorine contact chamber for disinfection.

In 1984, a new 24-inch sewer main was constructed from East Fireweed Avenue to the wastewater treatment plant, replacing the old 12-inch concrete pipe. Then, in 1985, another aerated lagoon (Lagoon 1) was constructed ahead of Lagoon 2. The first headworks building was constructed in 1988 along with new blowers, aeration improvements and manhole flow control structures. In 1998, additional treatment system improvements were completed including piping changes to improve flow, a new blower building with 2-20 HP and 2-50 HP blowers, new suspended air diffuser systems for all three lagoons, curtain baffles for each lagoon, a sludge drying bed, recirculation pumps and controls, and raising the water level of Lagoon 3.

Figure 3: Existing Palmer WWTP



In 2002 the wastewater treatment plant was further upgraded to include a new headworks facility with a lift station and screening system and ultraviolet (UV) disinfection facility. The City also developed a sludge management program.

Over the years, the City has expanded its collection system to serve the growing population. In 2006, Palmer completed construction on Phase I of the Southwest Utility Extension (SWX), providing service to the Mat-Su Regional Medical Center and nearby facilities. The SWX involved the installation of three lift stations and approximately 31,000 feet of sewer and force mains.

This project was built as part of a long term, phased plan to provide water and sewer utilities throughout the Palmer Service Area.

3.1.2 Existing Wastewater Treatment System

The site plan for the existing Palmer wastewater treatment plant is shown in Figure 4. It is comprised of three earthen lagoons operated in series. Flows from Palmer's wastewater collection system arrive at the site via a 24-inch gravity interceptor sewer. Up until 2002, raw sewage entered the first earthen lagoon without any pretreatment. An upgrade project in 2002 constructed a new headworks facility to improve capacity and the quality of sludge. To improve the performance of the lagoons, Palmer began removing settled sludge from the lagoons and initiated a drying, treatment and land application disposal program. To improve the quality of the sludge for land application, an upgrade project in 2002 constructed a new headworks facility.

The headworks facility is presently configured to accept approximately 1 million gallons of raw sewage per day with expansion capacity to 2 MGD with the addition of a second comminutor/screen and screw pump. Screw pumps in the headworks lift raw influent sewage to an elevation sufficient for gravity flow through the entire treatment process. Wastewater is then run through comminution and screening equipment to remove large solids prior to entering the lagoons. Screenings are washed, compacted, and transported to the MSB Central Landfill for final disposal. Critical components in the headworks facility are fully redundant, and the facility is equipped with automatic standby power capable of full facility operation.

In 2002 a new UV disinfection facility replaced effluent chlorination to eliminate chlorine and the formation of chlorinated organics and thereby eliminate toxicity and improve the quality of the effluent discharged to the Matanuska River. The disinfection facility can currently process approximately 1.0 MGD, and has the hydraulic capacity to accommodate future flows of up to 2 MGD with additional banks of UV lamps. Critical components in the disinfection facility are redundant, and the facility is equipped with automatic standby power capable of full facility operation.

Normally, flow is lifted in the headworks facility, screened for solids, passed in series through Lagoons 1, 2, and 3, and then flows through the disinfection facility prior to disposal. However, as indicated in Figure 3, either Lagoon 1 or Lagoon 2 may be bypassed using the existing system's piping and control gates.

Bypassing the lagoons allows them to be isolated from service for periodic dredging for sludge removal.

All lagoons are excavated into the natural soils for the site and are reported to have bentonite liners. Groundwater in the vicinity of the lagoons is reported to be approximately 50 feet below the ground surface[12].

Flow through the treatment facility is by gravity downstream of the headworks via both 12-inch and 24-inch pipes that connect the lagoons. Lagoons 1 and 2 are each approximately 6.3 million gallons (MG) in volume including volume for seasonal ice cover and accumulated sludge. The

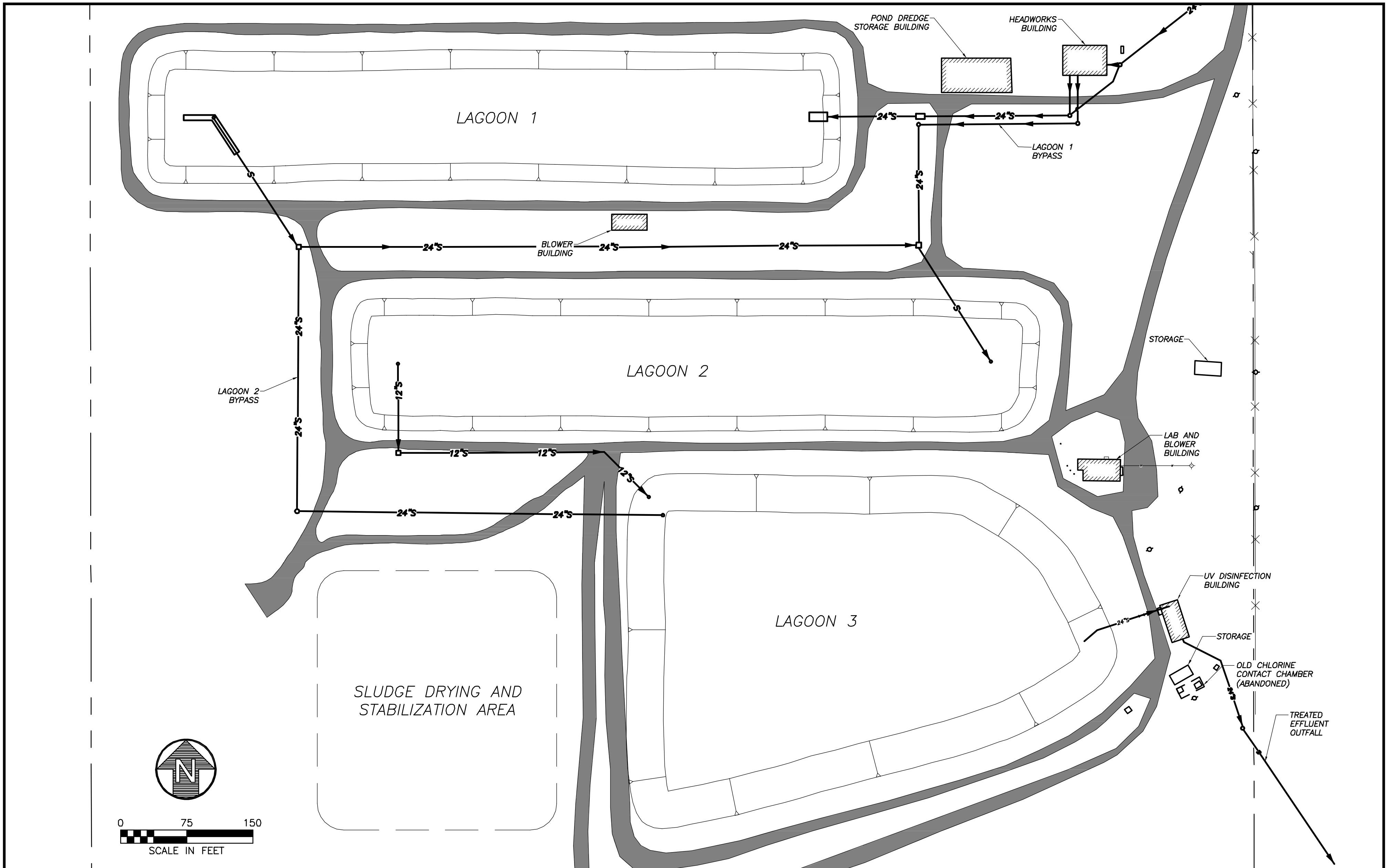
[12] Geotechnical Report, Wastewater Treatment Plant Subsurface Discharge, Palmer, AK, HDL, 2009

volume of Lagoon 3 is approximately 9.7 MG. Floating curtain walls are used in all three lagoons to minimize the potential for hydraulic short-circuiting within the lagoons.

Low pressure air for Lagoons 1 and 2 is supplied from four rotary lobe blowers installed in a building located between the two lagoons. These include two each 50 HP blowers and 2 each 20 HP blowers. The air for the submerged diffusers in Lagoon 3 is supplied by four blowers in the lab and blower building which is located to the northeast of Lagoon 3. The Lagoon 3 blowers are all 20 HP blowers. Aeration is provided to maintain dissolved oxygen levels in all three lagoons, but with the majority of air directed to the upstream end of Lagoon 1 where screened wastewater enters. From the blowers, air passes through buried polyethylene piping which branches out into header piping. The header piping floats on the surface of the lagoon and is cable anchored on each end. Parkson Biofuser® submerged fine bubble membrane diffusers are suspended in the water column from the air header piping.

3.1.3 Existing Sludge Handling

Consistent sludge removal from the Lagoons significantly improves the performance of the aerated lagoons by increasing detention time, improving oxidation and reducing the amount of ammonia producing bacteria. Palmer utilizes a City-owned floating dredge to periodically remove sludge from the lagoons. Sludge is pumped into a drying bed located adjacent to the lagoons where it dries through evaporation. The typical drying time for the sludge is approximately 1 year after which it is treated with lime to raise the pH above 12 for at least 2 hours, followed by a 22 hour period in which the pH is not allowed to drop below 11.5. Palmer uses a free waste lime source from a local acetylene manufacturing facility to condition the sludge. After conditioning, the sludge is mixed with topsoil and used as fill around the WWTP. This treatment process produces a Class B sewage sludge eligible for disposal in a municipal solid waste landfill permitted to receive sludge or for land application per the requirements of 40 CFR 503. Based on records and interviews with WWTP staff, from 2004 to 2009 approximately 0.5 feet of sludge accumulates on the lagoon bottoms per year.



HATTENBURG DILLEY & LINNELL Engineering Consultants

GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
EXISTING SITE PLAN PALMER WWTP

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 4
SCALE:	1" = 150'	CHECKED BY:	SLH	JOB NO.:	08–039

3.1.4 Current Wastewater Discharge Permit

Palmer operates its wastewater treatment facility under an NPDES permit issued by the EPA. The NPDES permit is renewed and updated every five years. The permit was renewed January 1, 2007 and the effluent limits became more restrictive because of the discovery of spawning salmon in the receiving waters, a clear water side channel of the Matanuska River that is fed by springs rather than the silty glacial river water. The renewed permit eliminated the mixing zone in July and August when spawning may occur. The permit requires that the treatment facility meet effluent quality limits summarized in Table 1. The prior permit limits are provided for comparison.

Table 1: Current and Prior NPDES Permit Limits

	CURRENT PERMIT			PRIOR PERMIT		
Parameter	**Average Monthly Limit**	**Average Weekly Limit**	**Max Daily Limit**	**Average Monthly Limit**	**Average Weekly Limit**	**Max Daily Limit**
Ammonia N, mg/L September thru June	8.7	-	18.5	34	-	71
Ammonia N, mg/L July and August	1.7	-	3.6	34	-	71
BOD_5, mg/L	30	45	60	30	45	60
DO, mg/L	>2	>2	>2	>2	>2	>2
Fecal Coliform, FC/100 mL Sept thru June	100	-	200	100	-	200
Fecal Coliform, FC/100 mL July and August	20	-	40	100	-	200
Flow, MGD	-	-	0.95	-	-	0.75
pH	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
TSS, mg/L	30	45	60	45	65	-
Total Residual Chlorine, µg/L	-	-	-	1.7	-	3.4

3.1.5 Infiltration and Inflow (I&I)

Influent raw wastewater flow data for the past three years of record at Palmer's WWTP were compared with rainfall and ambient air temperature data to identify correlations between high influent flows and weather events that contribute to I&I. Reviews of this data suggest that typical I&I events, such as high rainfall and/or warm air temperatures during months with snow cover, increase plant daily flows by approximately 9 to 12 percent. Higher flow events have been recorded which increased plant flows nearly twofold; for the three years of plant flows studied, two such events were recorded.

3.1.6 Historical Performance

Since 2002, effluent flows averaged between 430,000 and 460,000 gpd, with the higher average flow rates coming during the summer months. Last year's (2008) performance at the WWTP is illustrated in Table 2 below.

Table 2: Historical Performance at Palmer WWTP

	Influent			Effluent					
	BOD (mg/L)	TSS (mg/L)	COD	BOD (mg/L)	TSS (mg/L)	COD	pH	NH_4 (mg/L)	Temp (C) (Avg.)
Spawning (July-Aug.)	337	323	709	18	28	94	7.4	14.4	18.4
Permit Limits (Spawning)	-	-	-	30	30	-	6.5-8.5	1.7	-
Non-Spawning (Sept.-June)	300	316	698	18	20	84	7.5	18	5.4
Permit Limits (Non-Spawning)	-	-	-	30	30	-	6.5-8.5	8.7	-

In addition to the average yearly ammonia concentration of around 16 mg/L, periodic process upsets have produced effluent ammonia concentrations measured at a level of around 43 mg/L.

3.1.7 Design Objectives

Design objectives for the Palmer WWTP include improving effluent quality to bring the plant into compliance with its current NPDES permit, providing additional treatment capacity to handle increasing flows and solve odor problems experienced during certain times of the year.

Recommended near term and long term improvements to the Palmer WWTP are discussed in depth in later sections of this report.

3.2 City of Wasilla

Wasilla's collection system consists of a Septic Tank Effluent Pump (STEP) system. This system conveys septic tank effluent by means of individual customer pump stations through a series of pressurized sewer mains to Wasilla's WWTP. This system is maintenance intensive and Wasilla has expressed an interest in constructing conventional gravity collector mains for future system expansions.

3.2.1 Wastewater Collection and Treatment System History

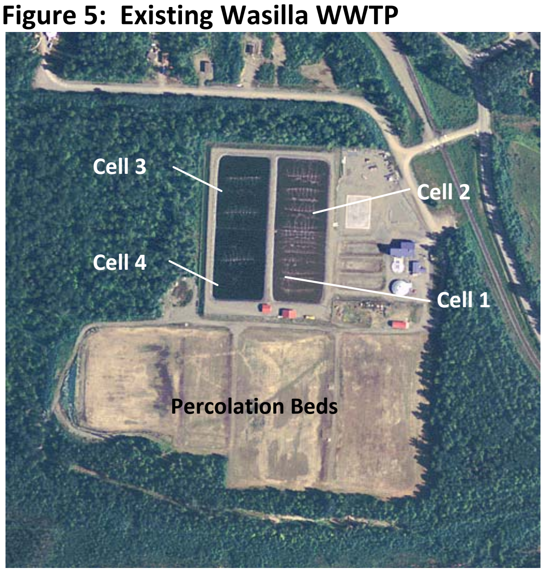
Wasilla was incorporated in 1974, allowing it to provide the rapidly growing community with services essential to proper growth. Because the local residents and businesses already had septic tanks and low lying areas with groundwater would be difficult to serve with conventional gravity sewer, the decision was made to use a STEP system for wastewater collection. This system allowed for lower initial startup costs because the depth of bury of the STEP system force mains is shallower and follow the existing contours of the land, as opposed to a conventional gravity system which consists of straight, downhill, sometimes deeply buried pipe. It was also constructed to prevent ground and surface water contamination from the densely packed system of leach fields which has contributed to ADEC's listing of Lake Lucille as an impaired waterbody. A STEP system around lakes is also common to avoid placing gravity sewer below the water table. The City began construction on the new STEP system and WWTP in 1985; full operation began in 1988.

The STEP system consists of an individual customer on-site septic tank with a submersible effluent pump. Septic tank effluent is pumped through a small diameter HDPE collection system into a single large lift station which pumps wastewater to a section of gravity pipe from the Parks Highway/Seward Meridian Road intersection to the WWTP.

Maintenance on septic tanks on the STEP system includes pumping solids every 1-3 years. This is done to keep both the individual pump stations and the pressure collection system working as required. Solids building up in the small diameter pressure mains or pumps could eventually clog the system. Wasilla uses the following schedule for pump-out maintenance:

Heavy Commercial Customers	Annually
Light Commercial Customers	Bi-Annually
Residential Customers	Every Third Year

Figure 5: Existing Wasilla WWTP



Minor plant upgrades have been performed over the years.

In 1993, additional air aeration piping was added to the existing lagoons to increase the quality of effluent wastewater applied to the percolation beds.

Upgrades performed in 1999 consisted of providing the lagoon effluent clarifier with a bypass. During the summer months, the clarifier is operated normally. During the winter months, the clarifier is bypassed and taken out of operation. Effluent quality is not compromised as suspended solids are less problematic in the winter months. This modification eliminated the maintenance and costs associated with clarifier thawing, due to freeze up in the winter.

In 2001, Wasilla completed upgrades to their WWTP including the installation of a Parkson Biofuser® air diffuser system and a septage receiving station sized for septage contributions from residents and businesses which use the STEP system. These upgrades allowed the City to reduce O&M costs from frequent clogging of the old aeration diffuser system installed in 1993, and also to improve dissolved oxygen levels in the lagoons.

3.2.2 Existing Wastewater Treatment System

A site plan of the existing wastewater treatment system is shown in Figure 6. It consists of a four-cell aerated lagoon system, lagoon effluent clarifier, and nine percolation beds. Sewage enters the plant through a flow measurement weir and flows by gravity into Cell 1 of the aerated lagoon system. Air is provided for Cells 1 through 4 by submerged fine bubble air diffusers to maintain dissolved oxygen levels in all four cells. The majority of air is directed to Cell 1, with each respective cell receiving less air as BOD_5 decreases.

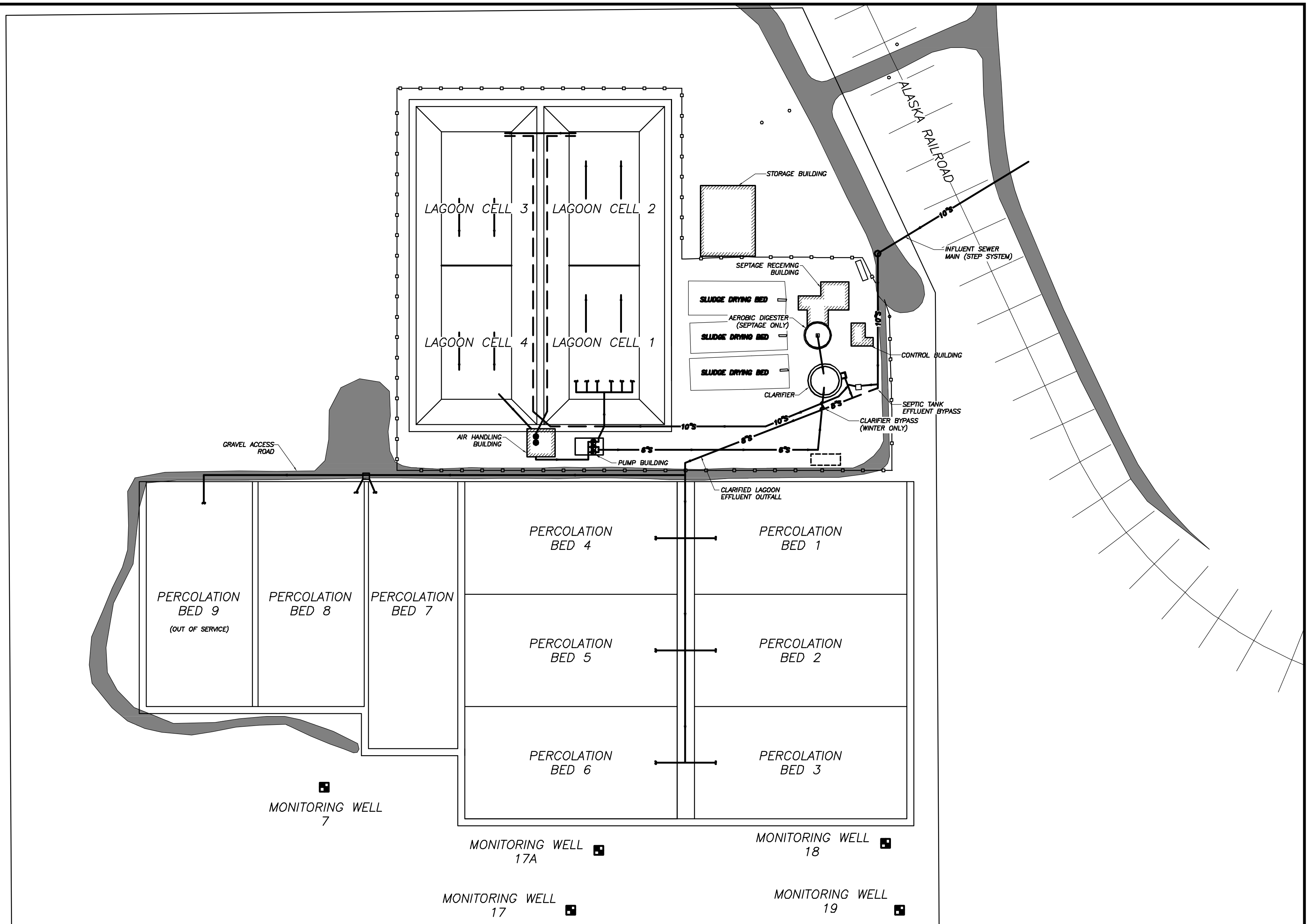
Effluent from Cell 4 flows by gravity through a flow measurement weir in the wet well inside the lagoon blower building and on to the buried pump vault located outside and south of the lagoon blower building. Recirculation pumps in the pump building draw from the pump vault and deliver lagoon effluent back to the head of the plant or to the clarifier depending on activation of four pump vault float switches. It is estimated that the lagoon effluent recirculation rate back to the clarifier is approximately 50% of the plant flow rate. Lagoon effluent is recirculated to control algae formation by causing more flow and agitation through the lagoons. In the summer, the clarifier is used to settle solids out of the lagoon effluent stream by means of a saw-tooth weir. Water flows over the weir into a trough located around the perimeter of the clarifier and into a wet well. Dosing pumps in the wet well deliver clarified effluent to percolation beds depending on float switch activation.

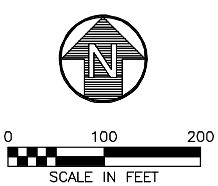
The percolation bed system consists of 9 individual beds each with a surface area of approximately 48,400 ft^2. Eight beds are currently in service. The ninth bed was abandoned shortly after startup due to effluent daylighting on the nearby bluff. Waste sludge from the lagoons was pumped on to the surface of bed 9 in 1999. The dosing pumps located in the clarifier wet well are used to dose the beds on an intermittent basis. Four beds receive effluent at any one time and every 3 months, 2 of the beds are rotated out of service. The current dosing schedule is intended to operate and rest the beds for a 6-month period each. The rotation schedule is as follows:

Table 3: Existing Wasilla Drainfield Rotation Schedule

Bed	1	2	3	4	5	6	7	8
Mar-May		X		X	X			X
Jun-Aug		X		X		X	X	
Sep-Nov	X		X			X	X	
Dec-Feb	X		X		X			X

The percolation bed system was originally designed to receive 440,000 gpd of septic tank effluent at a design loading rate of 1.5 gpd/ft^2. In 1988, a performance evaluation indicated that the system could not accept treated septic tank effluent at the design rates. Effluent ponding on several of the beds and the formation of a thick biomat were observed at application rates of less than 50% of the original design rates. Nitrate contamination of the groundwater, presumably from the percolation bed discharge, was observed in several of the monitoring wells installed to evaluate percolation bed performance. After reviewing the design and performance evaluation data, RSE Scientists and Engineers suggested that the design hydraulic loading rate for the percolation beds receiving septic tank effluent should be reduced to 0.6 gpd/ft^2. Operating data indicate that the current loading rate is approximately 1.7 gpd/ft^2.[4]





HATTENBURG DILLEY & LINNELL
Engineering Consultants

GV Jones & Associates, Inc.
WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
EXISTING SITE PLAN, WASILLA WWTP

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 6
SCALE:	1" = 200'	CHECKED BY:	SLH	JOB NO.:	08–039

3.2.3 Existing Septage/Sludge Handling

Only septage generated within Wasilla's STEP system is received at the wastewater treatment plant. Septage is currently discharged along with sludge from the clarifier through a manually cleaned bar rack into the digester. These biosolids are aerobically digested in a batch mode. Historically, the batch duration has been approximately one year. During the year, the digester contents are periodically allowed to settle and the liquid (supernatant) is returned to Lagoon Cell 1. The treated septage sludge is discharged to the sludge drying beds in May or June, allowed to dry over the winter and then collected for spreading on top of the percolation beds.

Currently, Cell 4 provides solids separation via gravity sedimentation. The area dedicated for this purpose is often referred to as the settling basin. Sludge deposited in the lagoon is stabilized by both aerobic and anaerobic processes as it accumulates, and is periodically removed to the sludge drying beds for dewatering and ultimate disposal by spreading on top of the percolation beds. No conditioning of the sludge takes place prior to disposal. Sludge is removed by draining the liquid from the lagoon and placing a pump in the bottom of the lagoon for removal of the accumulated sludge. Discussions with Wasilla indicate that on average 2 feet of sludge accumulates on the bottom of the lagoons for every three years of normal operation.

3.2.4 Current Wastewater Discharge Permit

Wasilla operates its subsurface discharge under ADEC Wastewater Discharge Permit, No. 9622-DB006 (expiration date was December 1, 2001; permit is administratively extended until renewed). This permit does not include any discharge limits but requires annual monitoring of effluent for metals (lead, chromium, cadmium, mercury and silver), and quarterly/annual monitoring of wells 7, 17A, 18A (3 in upper aquifer), and 19 (lower aquifer) for fecal coliform, nitrate, conductivity and pH. See Table 4 for a summary of Wasilla's effluent discharge permit.

Table 4: Permit No. 9622-DB006 Wasilla WWTP

Effluent Characteristics	Effluent Limitation	Monitoring Frequency	Sample Type
METALS MONITORING			
Lead	Report	Annual*	Grab
Chromium	Report	Annual*	Grab
Cadmium	Report	Annual*	Grab
Mercury	Report	Annual*	Grab
Silver	Report	Annual*	Grab
GROUND WATER MONITORING LEACH BED MONITORING			
Fecal Coliform	1 FC/100mL	Quarterly/Annually**	Grab
Nitrate as Nitrogen	10 mg/l	Quarterly/Annually**	Grab
Conductivity	Report	Quarterly/Annually**	Grab
pH	6.5 to 8.5	Quarterly/Annually**	Grab

* In the immediate future as the facility is operated in its traditional mode as a drainfield this annual sampling will take place during the month of June at the monitoring wells specified below. The annual sampling for metals may be increased to a more frequent schedule if sample results indicate elevated levels of these metals.

** Samples shall be taken during the months of March, June, September and December for the upper aquifer (monitoring wells #7, 17A, and 18A) samples will be taken in June for the lower aquifer (monitoring well #19)

3.2.5 Infiltration and Inflow (I&I)

Influent raw wastewater flow data for the past three years of record at Wasilla WWTP were compared with rainfall and ambient air temperature data to identify correlations between high influent flows and weather events that contribute to I&I. Reviews of this data suggest that typical I&I events, such as high rainfall and/or warm air temperatures during months with snow cover, increase plant daily flows by approximately 9 to 13 percent. Higher flow events have been recorded which increased plant flows nearly threefold; however, these events occurred during weather conditions that did not favor I&I contributions and could be due to sewer main flushing or other sources.

3.2.6 Historical Performance

Table 5: Historical Performance at Wasilla WWTP

	Influent					Effluent				
	BOD (mg/L)	VSS (raw sludge)	pH	Temp. (C)	NH_4 (mg/L)	BOD (mg/L)	VSS	DO (lagoon)	DO (Digester)	NH_4 (mg/L)
Summer (June-Sept.)	190	82%	6	15	34.7	27	65%	4	4	28.6
Winter (Oct.-May)	202	83%	6	13	N/A	34	68%	5	5	N/A

Table 5 shows performance data for the Wasilla WWTP. In 2008, average influent wastewater flows averaged between 320,000 to 350,000 gpd, with the higher average flow rates coming during the winter months.

Nitrogen concentrations in nearby monitoring wells have been steadily increasing since plant startup in 1988. Current nitrate-nitrogen concentration levels of up to 45 mg/l have been found in nearby monitoring wells, well above the 5 mg/l ADEC enforcement level (18AAC72.260(a)(5)).

During the spring thaw period, turnover occurs in the lagoon which causes much of the anaerobic bacteria located at the bottom of the lagoons to become re-suspended. This causes a strong hydrogen sulfide smell to emanate from the plant. On occasion, residents surrounding the treatment plant have complained about this odor.

3.2.7 Design Objectives

The design objectives for the Wasilla WWTP include increasing the effluent quality to eliminate the nitrate problem in monitoring wells, solve the odor problem and increase treatment capacity to allow growth.

3.3 Matanuska-Susitna Borough

The MSB has two concentrated wastewater streams that need treatment and disposal. They are septage from septic tanks and leachate from the MSB Central Landfill. Due to the overwhelmingly rural nature of development within the Borough, the majority of people use on-site septic systems to dispose of wastewater. Solids (or septage) from these systems must be pumped out on a regular basis to maintain satisfactory operation.

Also, the MSB operates a landfill located between Palmer and Wasilla. To avoid groundwater contamination, leachate is collected and disposed of at AWWU's Turpin Street receiving station.

3.3.1 Septage Disposal and Treatment System History

In the mid-1980's MSB operated a septage treatment and disposal facility located in the City of Houston, AK. This facility was designed by CRW engineers for a population of approximately

33,000 and a design flow of 2.5 Million Gallons per Year (MGY)[5]. The facility consisted of a receiving station, storage tank, screenings disposal area, control building, two primary lagoons, two secondary lagoons, two leaching lagoons, a sludge drying bed, and three monitoring wells. The facility was undersized and operated for four years, from 1986 to 1990. Due to the way that the facility performed discharges (large discharges over a short period of time) groundwater was impacted by pollutants. The facility was never cost effective, as disposal fees were set too high. Waste haulers chose to use the facility in Anchorage because it was cheaper than paying the fees at the Houston facility.

3.3.2 Septage and Leachate Waste Stream Characteristics and Quantities

Periodic sampling of the septage being disposed of at the Turpin Street receiving station measured the following characteristics:

Table 6: Seasonal Septage Characteristics at AWWU Turpin St. Receiving Station

	BOD_5 (mg/L)		TSS	
	Seasonal Average	Seasonal Maximum	Seasonal Average	Seasonal Maximum
Summer (June-Sept.)	2,805	3,900	6,440	10,050
Winter (Oct.-May)	2,140	3,975	6,110	28,900

Source: AWWU records

Current quantities of septage disposed of at the Turpin Street receiving station are estimated by AWWU to be approximately 46,000 gpd for summer months (June-September) and 34,000 for winter months (October-May). Table 6 shows the septage characteristics recorded at the Turpin Street receiving station for 2006-2008.

Reports indicate that leachate produced at the MSB Central Landfill has the following characteristics:

1. BOD_5 average of 5,800 and maximum of 19,200 mg/L
2. TSS average of 250 and maximum of 1,960 mg/L
3. Oil and Grease average of 62 and maximum of 250 mg/L

In 2008, AWWU reported that approximately 700,000 gallons of leachate were disposed of at the Turpin Street receiving station.

3.3.3 Design Objectives

The MSB's main objective is to provide a cost effective means of treating and disposing of septage and leachate within the Borough limits and to ensure that local haulers and the MSB Central Landfill will have a location to discharge their waste. Using Turpin as a discharge location limits the daily amount of trips that haulers can make because of the lengthy driving time required to bring the septage into Anchorage. The current system of disposal in Anchorage will become more expensive as fuel prices and tipping fees rise.

4.0 DATA COLLECTION AND ANALYSIS

4.1 Population Projections

The Matanuska-Susitna Borough has had the highest population growth rate in the State in recent history, and is expected to continue growing for the near future. Between 2000 and 2008, the Borough grew at an annual rate of 4.0%, the highest in the State[13].

Base Population. The base population for the Borough was estimated to be 82,515 for the year 2008[13] with much of the population located in and around Palmer and Wasilla. There are currently three wastewater collection and treatment systems operating within the Borough; at Palmer, Wasilla, and Talkeetna. For the purpose of septage production numbers, residents served by an existing wastewater collection and treatment systems are not included in septage production numbers.

Wastewater flows in the study are from the combined service areas of Palmer and Wasilla (the study area) and Eagle Utilities. The existing population used for wastewater flows includes residents and businesses currently served by a wastewater collection network. This area is illustrated in Figure 1 on Page 4. To determine future flow rates, it is assumed that a wastewater collection system will eventually be expanded to serve Palmer and Wasilla's entire combined service area. The current population for the study area is estimated to be approximately 29,000.

Future Population Growth. Future population growth projections within the MSB are well studied. As a part of the Environmental Impact Study (EIS) for the Knik Arm Bridge, the Knik Arm Bridge and Toll Authority's (KABATA) consultants analyzed 84 economic factors that affect

[13] Population of Alaska by Labor Market Area, Borough, and Census Area, 1990-2008, Alaska Department of Labor, 2009

growth and summarized the results into six possible population growth scenarios for the MSB[14]. For this study, the KABATA "No Bridge – Base Case" scenario represents the growth rate of the study areas. This study suggests that growth rates will peak at 6.8% in 2012 and then drop to about 1.9% in 2016. Because this study only projects growth rates to the year 2030, HDL extended projected populations out to the study year limit (2059). Growth rates are expected to taper off in the years following the initial boom throughout the 2020's, mostly due to an eventual limit in developable land in the Palmer-Wasilla area. Projected growth rates suggest that the study area will grow from the current estimated population of 29,000 to approximately 120,000 in the year 2059. A graphical summary of projected population growth within the study area are provided in Figure 7 and Figure 8 on the following page. Detailed population growth analysis and assumptions are provided in Appendix C.

[14] Memorandum on the Economic and Demographic Effects of a Knik Arm Bridge, University of Alaska-Anchorage Institute of Social and Economic Research (ISER), September 2005

Figure 7: Projected Population Growth Rates

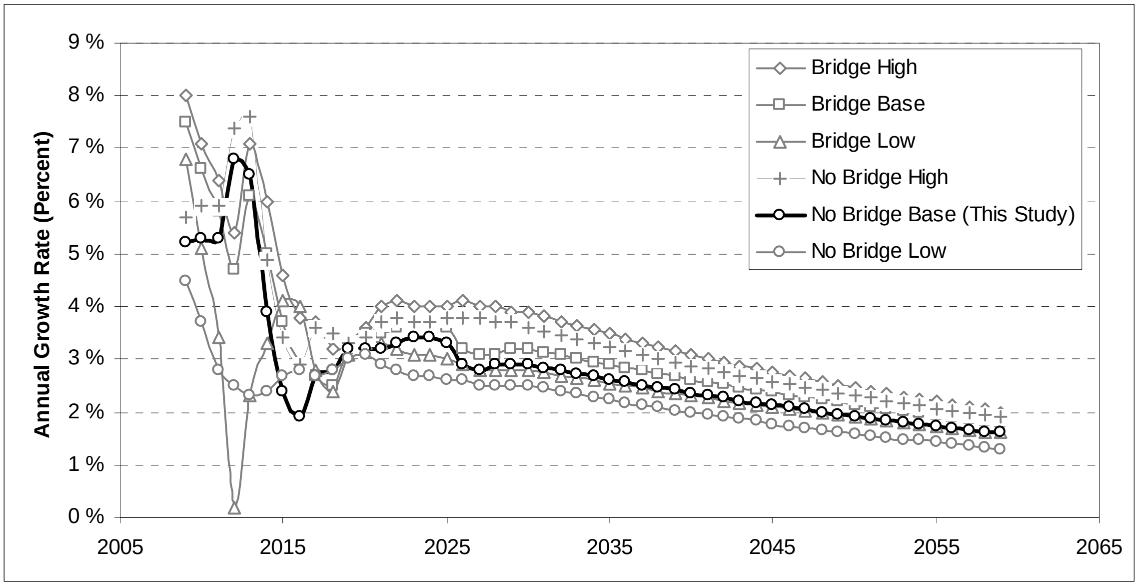
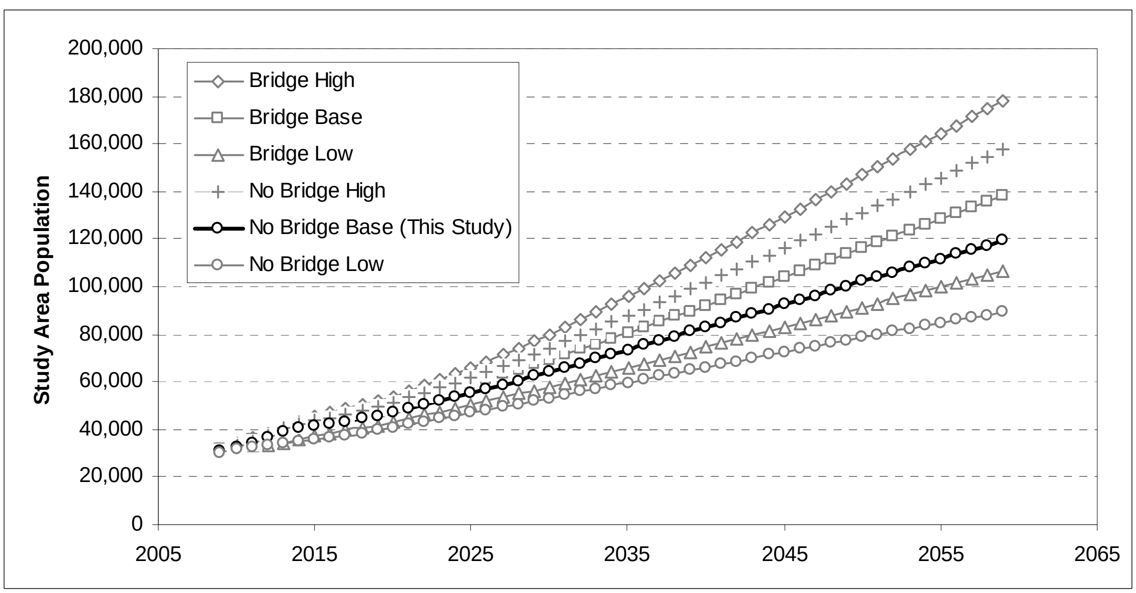


Figure 8: Projected Study Area Population



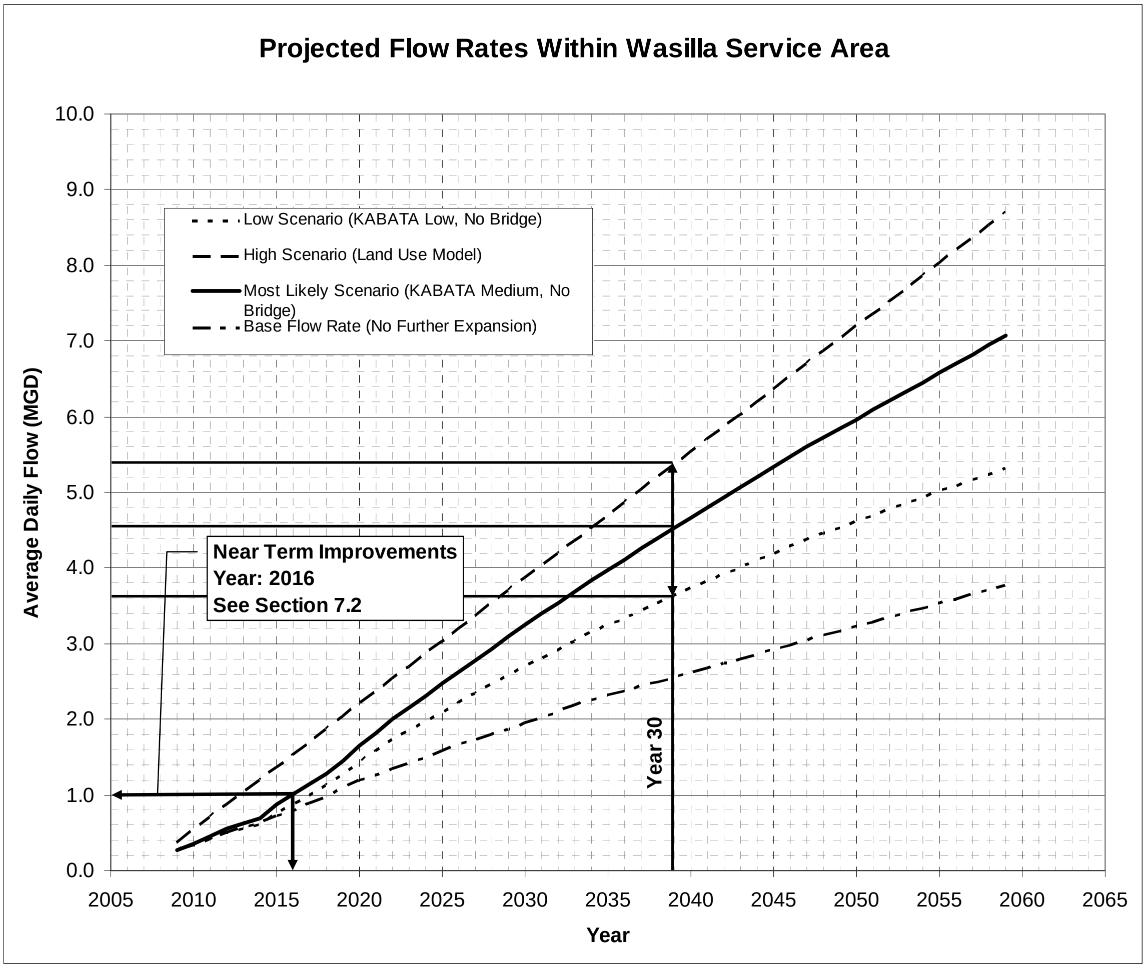
4.2 Flow Projections

Two modeling techniques were used to predict future average daily wastewater flows within the study area. The first model is based on expected future population and applies a per capita flow rate to determine wastewater generation. The second model is based on expected future land use and applies a per acre wastewater flow for the various expected developments in the area. These two methods were used to establish a high and low range, and help forecast a most likely flow. The methodology behind the wastewater and septage flow projections is discussed further in Appendix C.

4.2.1 Wasilla Wastewater Flow Projections

Figure 9 illustrates the projected average daily flow rates for the Wasilla Service Area for a 50-year period (2009-2059) as well as the projected date for which near term improvements will provide capacity:

Figure 9: Projected Flow Rates – Wasilla

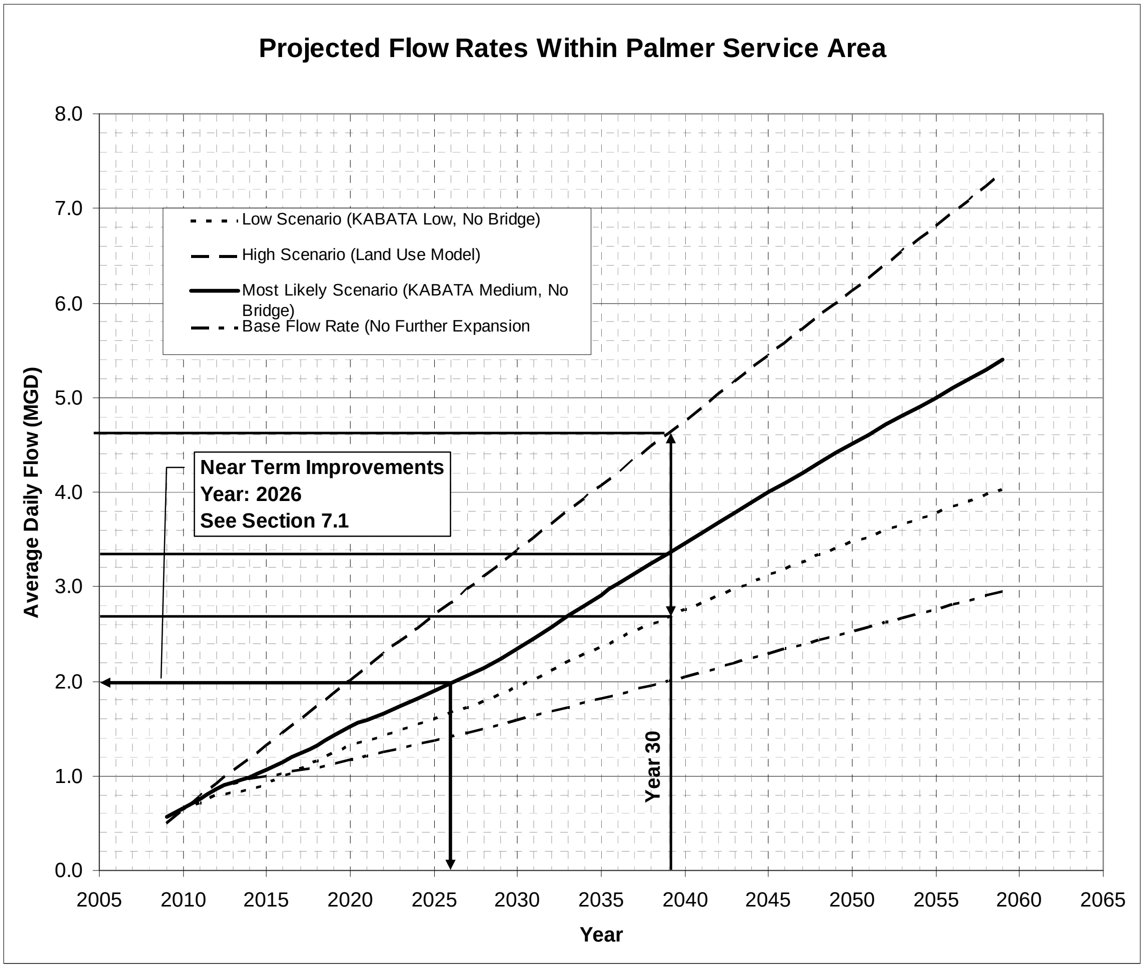


This model suggests that Wasilla's projected 30-year flow will range between 3.6 and 5.4 MGD with the most likely flow being 4.5 MGD, assuming Wasilla expands its existing collection system to serve potential customers within its utility service area.

4.2.2 Palmer Wastewater Flow Projections

Figure 10 illustrates the projected average daily flow rates for the Palmer Service Area for a 50-year period (2009-2059), as well as the projected date for which near term improvements will provide capacity:

Figure 10: Projected Flow Rates - Palmer

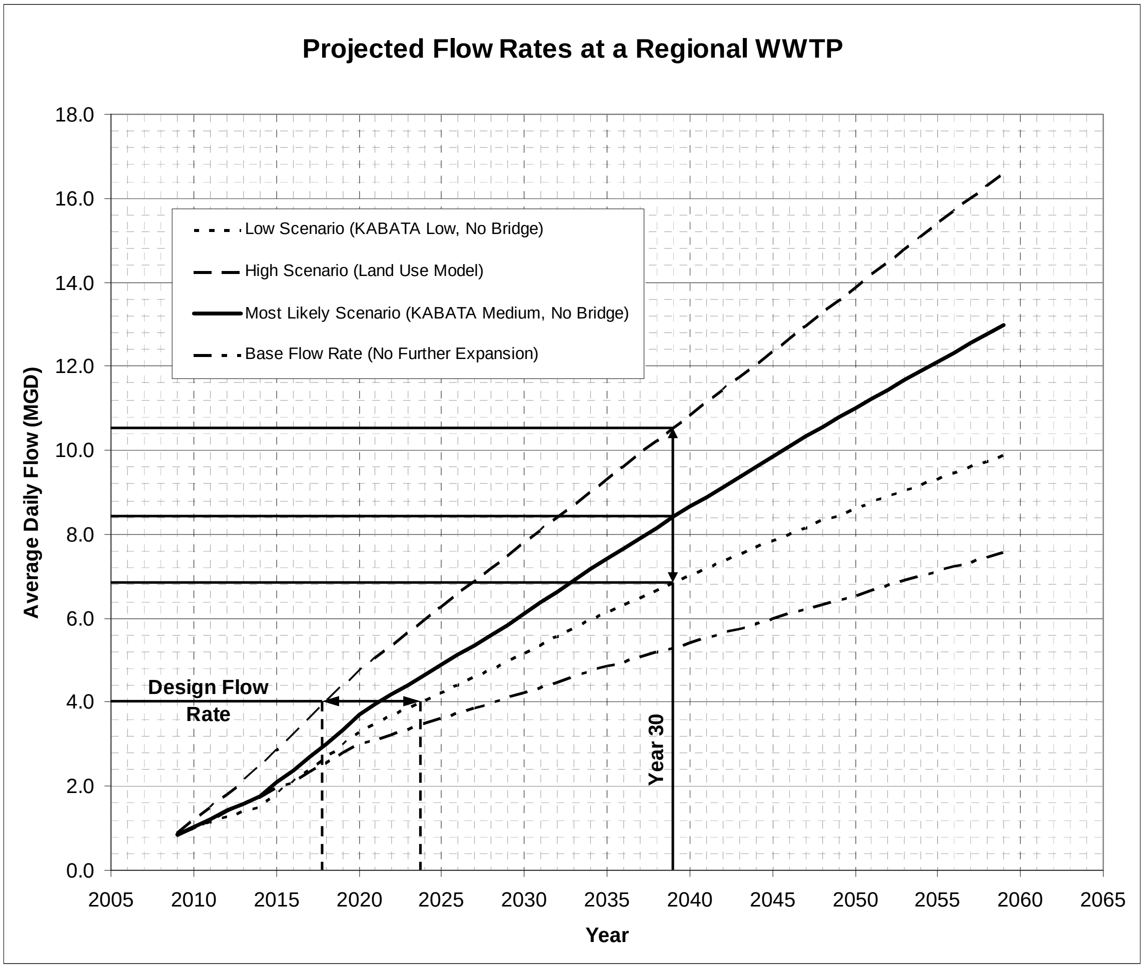


This model suggests that Palmer's 30-year flow rate will range between 2.6 and 4.6 MGD ADF with the most likely flow being 3.4 MGD ADF, assuming Palmer follows its current phased utility expansion plan.

4.2.3 Regional Wastewater Flow Projections

Figure 11 illustrates the projected average daily flow rates for a regional WWTP (Palmer and Wasilla combined) for a 50-year period (2009-2059):

Figure 11: Projected Flow Rates - Regional WWTP

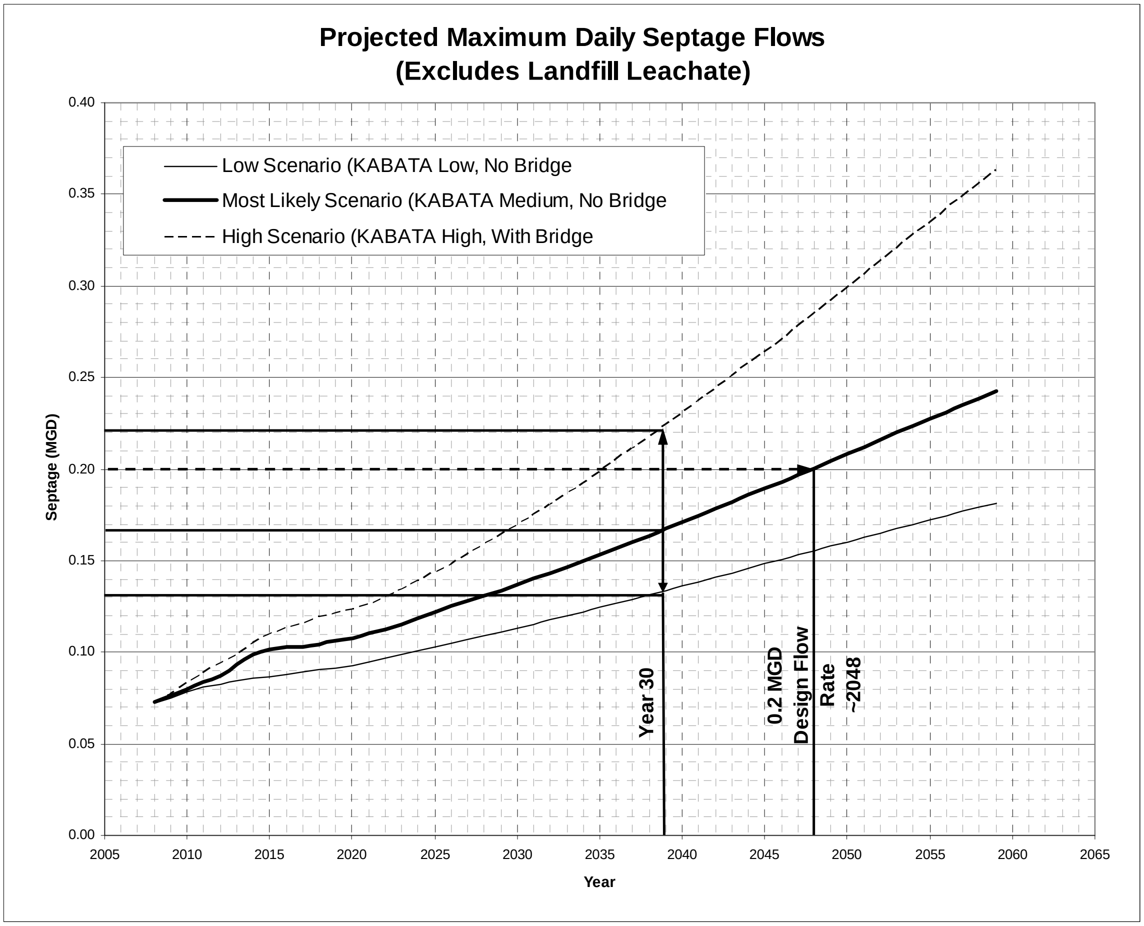


Depending on actual growth in the region, the design flow rate of 4.0 MGD ADF could be reached any time between the years of 2018 and 2024, a range of 6 years and a design flow rate of 8.0 MGD ADF between the years of 2028 and 2046, a range of 18 years. This model also anticipates that the collection and conveyance networks for Palmer and Wasilla will continue to be expanded to serve potential customers. Also included in the flow rates are projected flows from The Ranch Subdivision at about 0.35 MGD at full build-out. A base flow rate has also been included as a reference, assuming that there is no further expansion to the combined collection systems beyond what is detailed in this report.

4.2.4 MSB Septage Flow Projections

Figure 12 illustrates anticipated peak summer septage flow rates from septic tanks within the Borough excluding Central Landfill leachate and septage currently collected and processed by Wasilla for a 50-year period:

Figure 12: Projected Maximum Daily Flow Rates – Septage



This model suggests that the projected 30-year septage flow will range between 0.13 and 0.22 MGD ADF with the most likely flow being 0.17 MGD ADF, assuming that there is no development of additional wastewater collection/treatment systems serving customers outside the study area or Talkeetna. This septage flow projection also assumes that customers currently served by Wasilla's STEP system would be converted to a system which did not involve pumping of septage solids (grinder pumps or gravity collection). The study team has designed septage collection and treatment equipment to handle an average daily flow of 0.2 MGD of septage. (See Section 5.2.2 on Page 48)

AWWU records show that around 700,000 gallons of landfill leachate are disposed at the Turpin Street receiving station per year. Future leachate flow rates are expected to grow as the lined area in the central landfill increases. Future leachate flows were not estimated for this report, as conversations with the Borough indicate that they would prefer to process and dispose of leachate on-site.

4.3 Land Ownership and Right-of-Way

4.3.1 Palmer WWTP Expansion

The Palmer WWTP currently sits on 47.74 acres on two abutting tracts of land near the Matanuska River. There is a vacant tract of land to the northeast of the current site that is owned by Geo Allen of Anchorage. There is also a vacant tract of land to the southwest of the current site that is owned by Kenneth Loyer of Palmer. Palmer is in the process of purchasing the 35.77 acre parcel from Kenneth Loyer. The WWTP is abutted on the north with private residential properties. Figure 13 illustrates the local land ownership in the vicinity of the Palmer WWTP. If Palmer were selected for the site of a new regional WWTP, approximately 37 acres of easements or Right-of-Way would need to be acquired for wastewater conveyance improvements.

4.3.2 Wasilla WWTP Expansion

The Wasilla WWTP is situated on a 39.20-acre parcel of land adjacent to the Alaska Railroad in the southeast portion of the Wasilla city limits. There are vacant tracts of land adjacent to the current plant on the east and west sides, however, these two parcels are mostly wetlands. There are also residential and commercial developments to the north and south of the plant. Figure 14 illustrates the local land ownership in the vicinity of the Wasilla WWTP.

4.3.3 New Regional WWTP

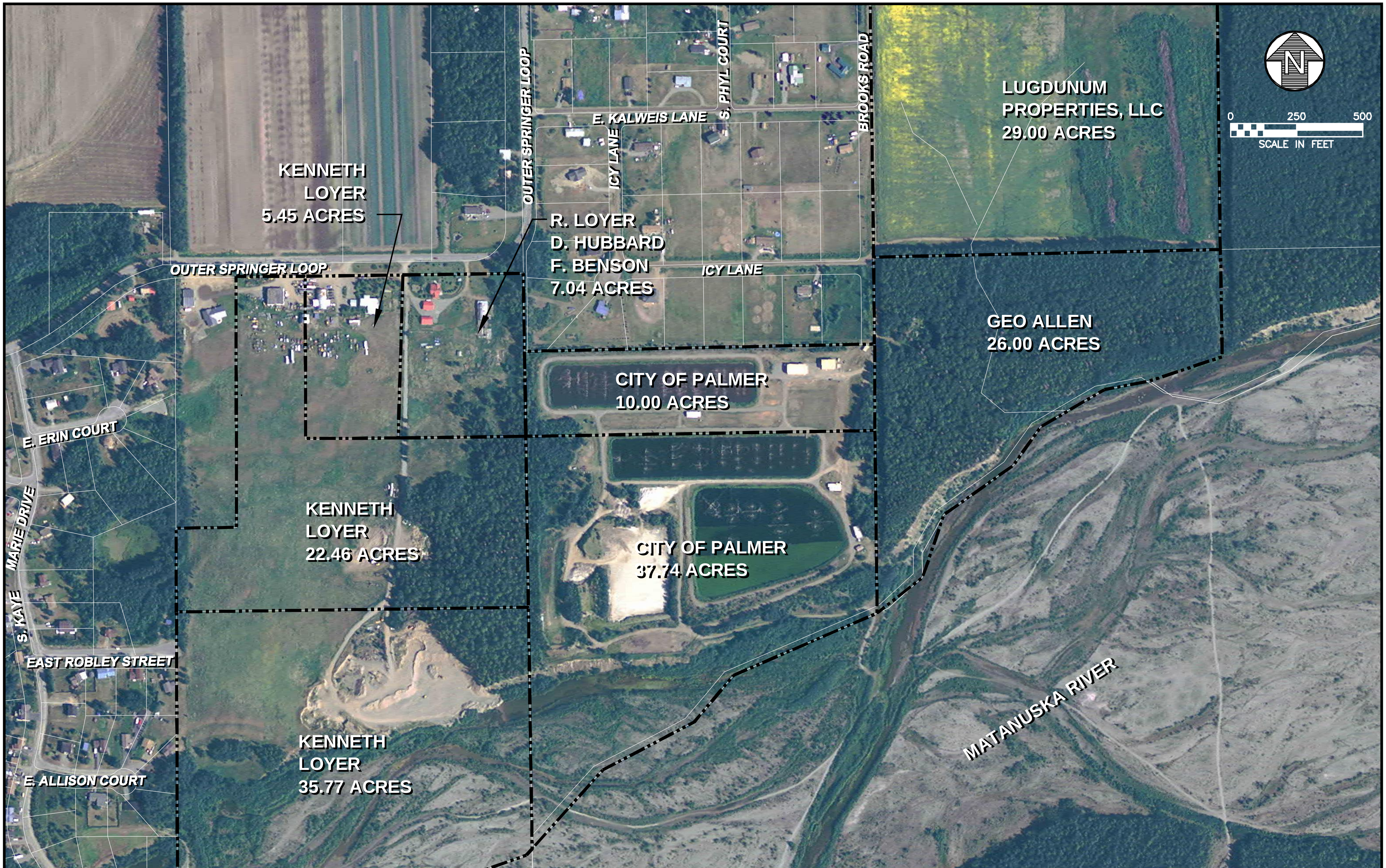
Approximately 20 acres is needed for a new regional WWTP with 5 to 10 acres needed initially and an additional 10 acres needed as a reserve and buffer as the plant grows in the future.

A number of alternative sites were considered for a new Regional WWTP. Siting criteria for a regional facility included sufficient land area, central location, low elevation and flat topography that optimizes gravity flow, land ownership, compatible land use, proximity to existing wastewater pipelines, and likelihood of public acceptance. Based on the above criteria, the study team evaluated several sites. Two potentially feasible sites were advanced for further analysis and costing.

Site A is located south of the Parks Highway at a gravel pit owned by Arctic Devco, the developer of The Ranch subdivision. Discharge from Site A would be a surface discharge onto private lands north of the Palmer Hay Flats State Game Refuge. Site B is located on the banks of the Matanuska River at the back of the Palmer gravel pits south of the Fairgrounds. Discharge from Site B would be a surface discharge into the flood plain of the Matanuska River in the vicinity of the Palmer gravel pits. A regional WWTP constructed at Site A would also require approximately 32 acres of easements or Right-of-Way to be acquired for construction of conveyance pipelines.

The properties in the vicinity of Site B are owned by Aggpro and Granite Construction. For purposes of the study, the Aggpro property is shown, but either property would be feasible for a regional plant. Figure 15 shows a map of the potential locations for a regional WWTP and their associated outfall location. A regional WWTP constructed at Site B would also require approximately 37 acres of easements or Right-of-Way to be acquired for construction of conveyance pipelines.

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 13-14 Local Land Ownership, 1=100, 01/13/10 at 14:56 by tlc
LAYOUT: Palmer
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P



HATTENBURG DILLEY & LINNELL
Engineering Consultants

GV Jones & Associates, Inc.
WATER AND WASTEWATER PROCESS ENGINEERS

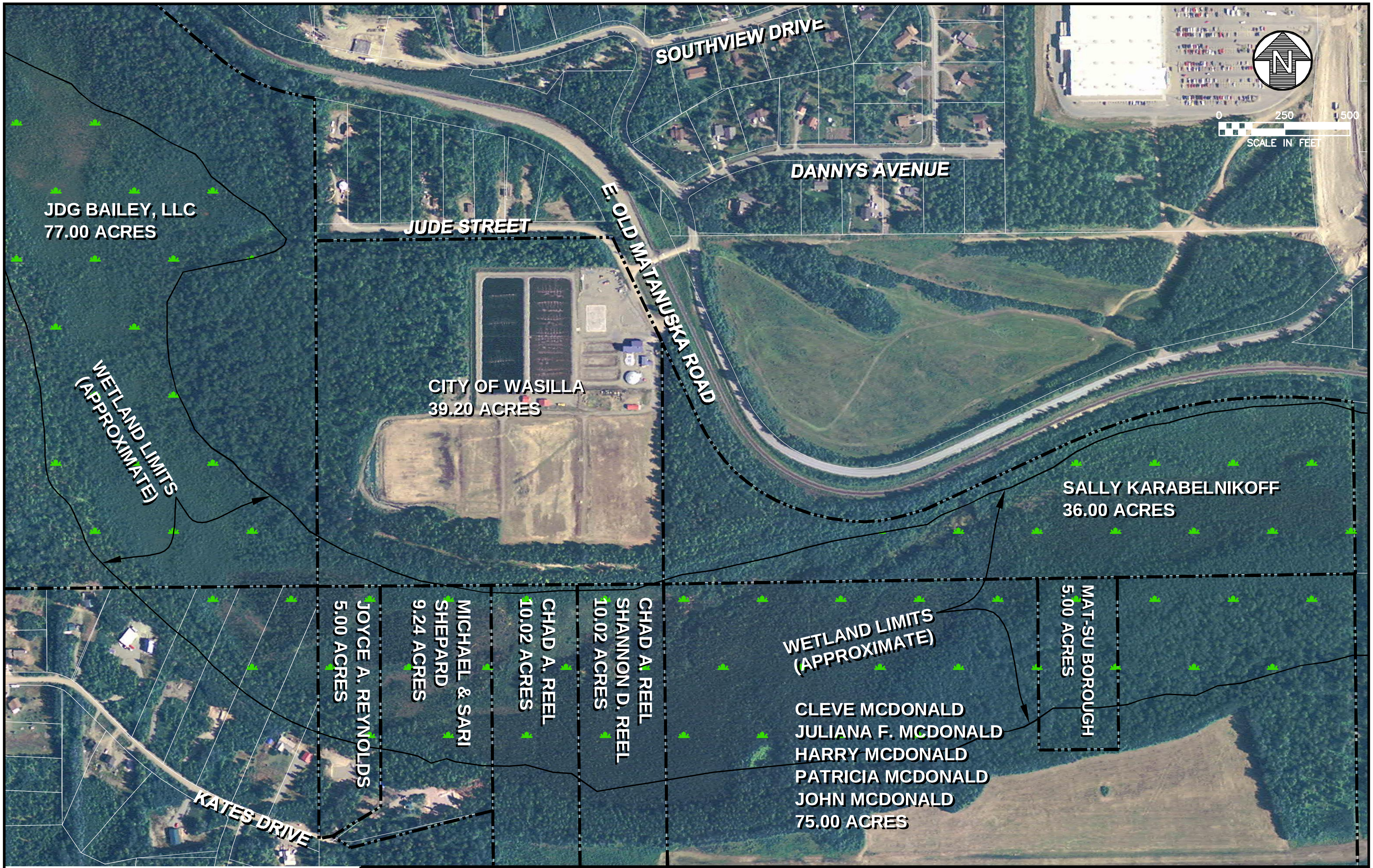
HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
PALMER WWTP LAND OWNERSHIP

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE: JULY, 2010	DRAWN BY: CJB	SHEET: FIGURE 13
SCALE: 1" = 500'	CHECKED BY: SLH	JOB NO.: 08-039

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 13-14 Local Land Ownership, 1=100, 01/13/10 at 14:56 by tlc
LAYOUT: Wasilla
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P



HATTENBURG DILLEY & LINNELL
Engineering Consultants

GV Jones & Associates, Inc.
WATER AND WASTEWATER PROCESS ENGINEERS

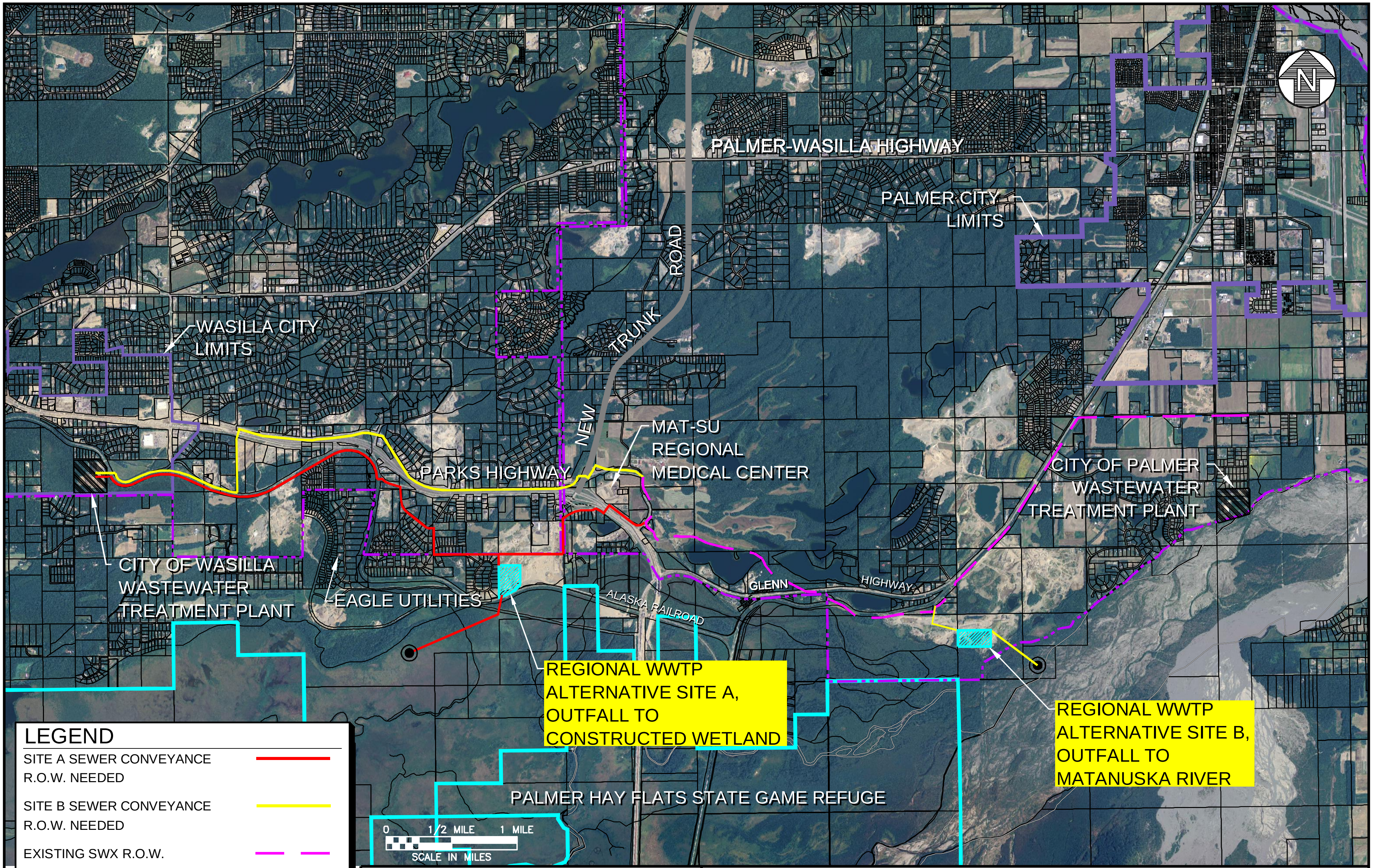
HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
WASILLA LAND OWNERSHIP

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 14
SCALE:	1" = 500'	CHECKED BY:	SLH	JOB NO.:	08-039

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 15 – RWWTP Alt Sites and Outfalls, 1=100, 01/13/10 at 15:01 by tlc
LAYOUT: Alternative Routes
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P



HATTENBURG DILLEY & LINNELL Engineering Consultants

GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
REGIONAL WWTP ALTERNATIVE SITES AND OUTFALLS

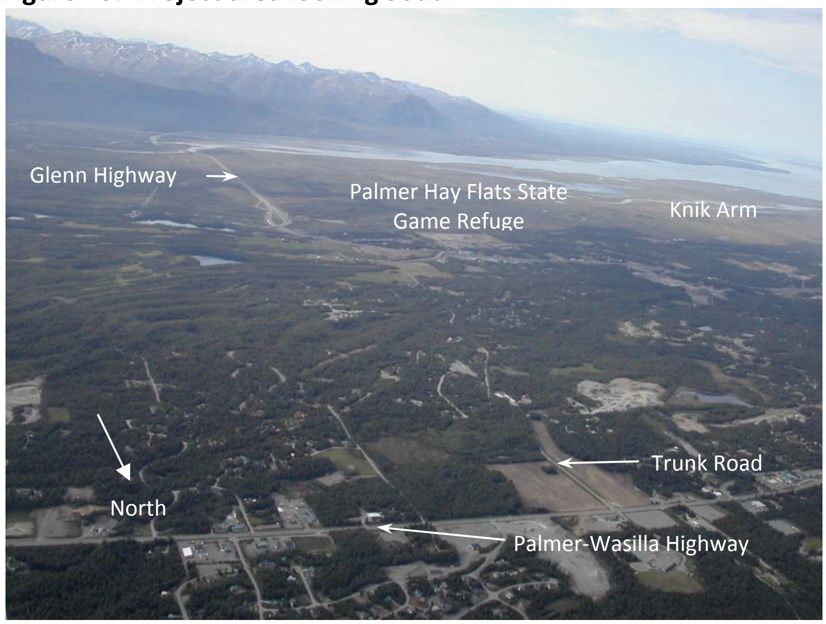
MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 15
SCALE:	1" = 1 MILE	CHECKED BY:	SLH	JOB NO.:	08–039

4.4 Local Geology, Topography and Soils

4.4.1 Geology

Figure 16: Project area looking South



The Study Area is located in the heart of the Matanuska Valley. The current topography was created during the last Ice Age (ended approximately 13,000 to 15,000 years ago) as the Matanuska and Knik Glaciers receded into the valleys south of the Talkeetna and Chugach Mountains[15]. The general geology of the Matanuska Valley was created by several glacial advances. Glacial and pre-glacial features such as drumlins, eskers, moraines, outwash plains, kettles, and kames produced the rolling topography of the valley floor and account for the large gravel deposits and terrain features. See Figure 16

The Matanuska Valley is an agricultural area, which lies in a wide flat-floored valley formed by the merging of the Matanuska, Knik, and Susitna Valleys. The Matanuska Valley is bounded by the Talkeetna Mountains to the north, the Chugach Mountains to the east and the Knik Arm of Cook Inlet to the south. The peaks of the two mountain groups range from 3,000 to 10,000 feet, while the valley floor is commonly not more than a few hundred feet above sea level. Most of the valley floor is a gently rolling surface crossed by narrow flat-floored stream courses. The hills and intervening valleys commonly trend southwestward. Most of the area is drained by the Matanuska River with a few interstream depressions containing small lakes.

Bedrock in the area is exposed along the cut banks of the Matanuska River, Bodenburg Butte, and at numerous locations within the Palmer. A thick mantle of very gravelly and sandy glacial drift overlies the bedrock. These deposits are capped with a mantle of loess, which is silty and very fine sandy material blown from barren areas on the nearby Matanuska River, Knik River, and as far away as the Susitna River flood plains. Fine lenses of volcanic ash occur within the loess deposits.

As glaciation came to an end, there was widespread stagnation of the Matanuska and Knik glaciers resulting in subglacial meltwater activity and rapid stream incision. In the Palmer area, the stagnation of the Knik glacier resulted in the Matanuska River flowing through tunnels in the stagnant ice (eskers) and ice-walled canyons (crevasse filled ridges). As the Knik ice thinned, the

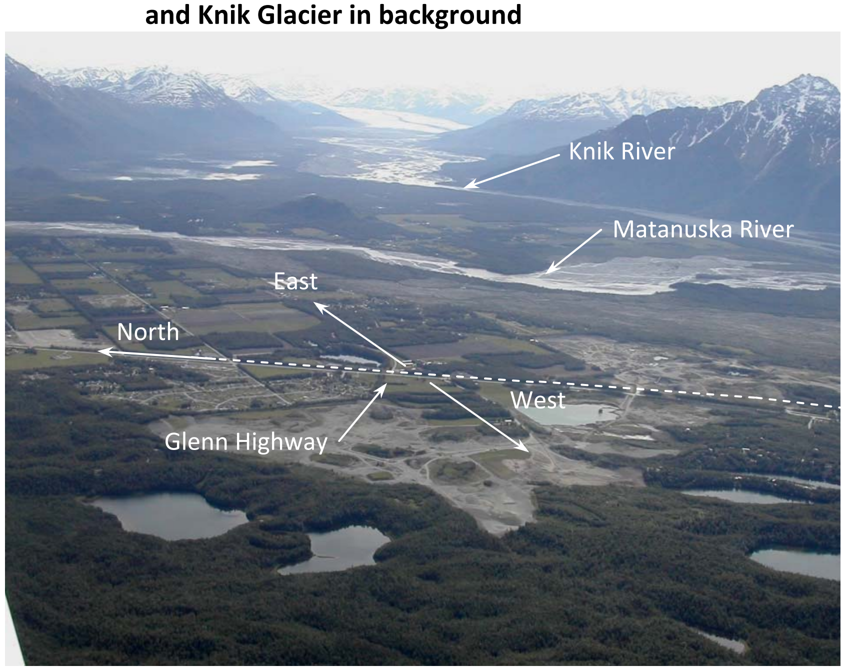
[15] Lorie Dilley, P.E., Principal Geologist, Hattenburg Dilley & Linnell, 2004.

river changed from west-southwest to the south and southeast, and a broad fan was built in the Palmer-Bodenburg Butte area. Subsequently, the river cut a series of alluvial terraces, pitted with kettles into the older outwash material. This most likely occurred about 8,000 years ago.

4.4.2 Topography and Soils

Surficial soils consisting of deposits of loess approximately 5 to 15 feet thick overlie deposits of clean glacial sands and gravels that extend to bedrock. The wind-blown silt provides the rich topsoil for the highly-productive Matanuska agricultural region. Topography slopes gently southward from an elevation of 275 feet to 150 feet.

Figure 17: Glenn Highway at the Gravel Pits with Matanuska River and Knik Glacier in background



The area west of the Glenn Highway, continuing past Wasilla, consists of a series of glacial landforms including drumlins, eskers, kames and kettles topography. This area is characterized by rolling hills and elongated lakes that have filled depressions between the topographical highpoints. The material within the hills is glacial drift typically consisting of well sorted sands and gravels with low percentage of fines. The hills and depressions vary in elevation from 50 feet to 500 feet and slopes can be as steep as 45 degrees. Loess mantles all of the areas and good soils consisting of typic cryorthents occur over the loess and glacial materials. These soils are typically 15 to 60 inches thick and are interbedded with loess and ash. The soils are dark grayish brown to dark brown silty loam and very fine sandy loam.

4.5 Drainage and Outfall Options

Drainage of the Palmer-Wasilla area generally follows a north-south gradient. The main drainages of the area are the Matanuska River, Wasilla Creek, and the Little Susitna River, all of which originate in the northern part of the study area and flow into the Knik Arm of Cook Inlet. Additionally, there are several kettle lakes between Palmer and Wasilla.

4.5.1 Subsurface Disposal

If wastewater effluent is disposed of in a subsurface soil absorption system, it would mean that an Alaska Pollutant Discharge Elimination System (APDES). permit would not be required.

Periodic upset of treatment processes could be somewhat minimized due to the dilution of wastewater within a groundwater aquifer. Effluent quality objectives would be to produce a liquid stream that would limit production of a biomat within the soil absorption system causing it to plug, and which does not produce contributions of nitrates to the area groundwater that exceed 5 mg/L as nitrogen. For the purposes of this study, the assumed effluent quality required to sustain the operation of a soil absorption system would be concentrations of BOD_5 and TSS of 15 mg/L each.

4.5.1.1 Regulatory Agency Requirements

The State of Alaska administers wastewater regulations under Chapter 19 of the Alaska Administrative Code (18 AAC 72). Under these regulations, discharge of domestic wastewater to the subsurface may occur only if the wastewater has received a minimum of primary treatment and is discharged to a soil absorption system.

ADEC also requires that operators monitor the levels of nitrate in the local groundwater. Monitoring wells are placed at the point of compliance as determined by the ADEC. A limit of 5 mg/L is the ADEC trigger level and nitrate levels of 10 mg/L are the maximum level before ADEC enforcement.

A Class V injection well inventory form is also required to be submitted to the EPA for the soil absorption system.

4.5.2 Surface Water Outfall

Several options for surface outfalls were explored. These options included effluent discharge to the Matanuska River floodplain somewhere between the Glenn/Parks Interchange and Palmer's existing WWTP, a new outfall to the main channel of the Knik River near the Glenn Highway bridge, or discharge to a large constructed wetland located in the area south of the Parks Highway/Trunk Road interchange. Effluent disposal to a surface water would require the issuance of an APDES permit by the ADEC, under EPA regulations. Generally, this would require a higher level of treatment than that required for disposal to a subsurface drainfield.

Matanuska River. The State reports spawning salmon activity in some of the Matanuska River's tributaries, including the one that is currently the receiving water for Palmer's WWTP. For a discharge to the Matanuska River, the target minimum treatment objectives would include meeting secondary effluent quality criteria and total nitrogen reduction. It is assumed that current and future effluent characteristics would need to meet the water quality limitations in Palmer's latest NPDES permit for any discharge. Treatment processes for nutrient reduction would be needed to produce effluent ammonia (NH_3-N) concentrations of <1.7 and 3.6 mg/L monthly average and maximum day, respectively, during the spawning season in July and August. During the other months of the year the limits would be 8.7 and 18.5 mg/L monthly average and maximum day, respectively.

A discharge to the main channel of the Matanuska River near the Old Glenn Highway bridge was considered, but dismissed because of the high cost of constructing a pipeline in high groundwater across the hay flats and the similarity to upstream anadromous stream conditions.

Knik River. For a discharge to the Knik River, the target treatment objectives would include meeting secondary effluent quality criteria. This discharge location may be eligible for a mixing zone as the State's Fish Distribution Maps do not show evidence of fish spawning or rearing for over four miles upstream from the Glenn Highway bridge. Target effluent NH_3-N concentrations would be achievable with normal secondary treatment processes. For the purposes of this study, it is assumed that effluent NH_3-N concentrations of 5 mg/L or less, at least during summer fish spawning events, would need to be achieved.

A discharge to the Knik River near the Glenn Highway bridge was considered, but dismissed because of the high cost involved with construction of a pipeline to the outfall location.

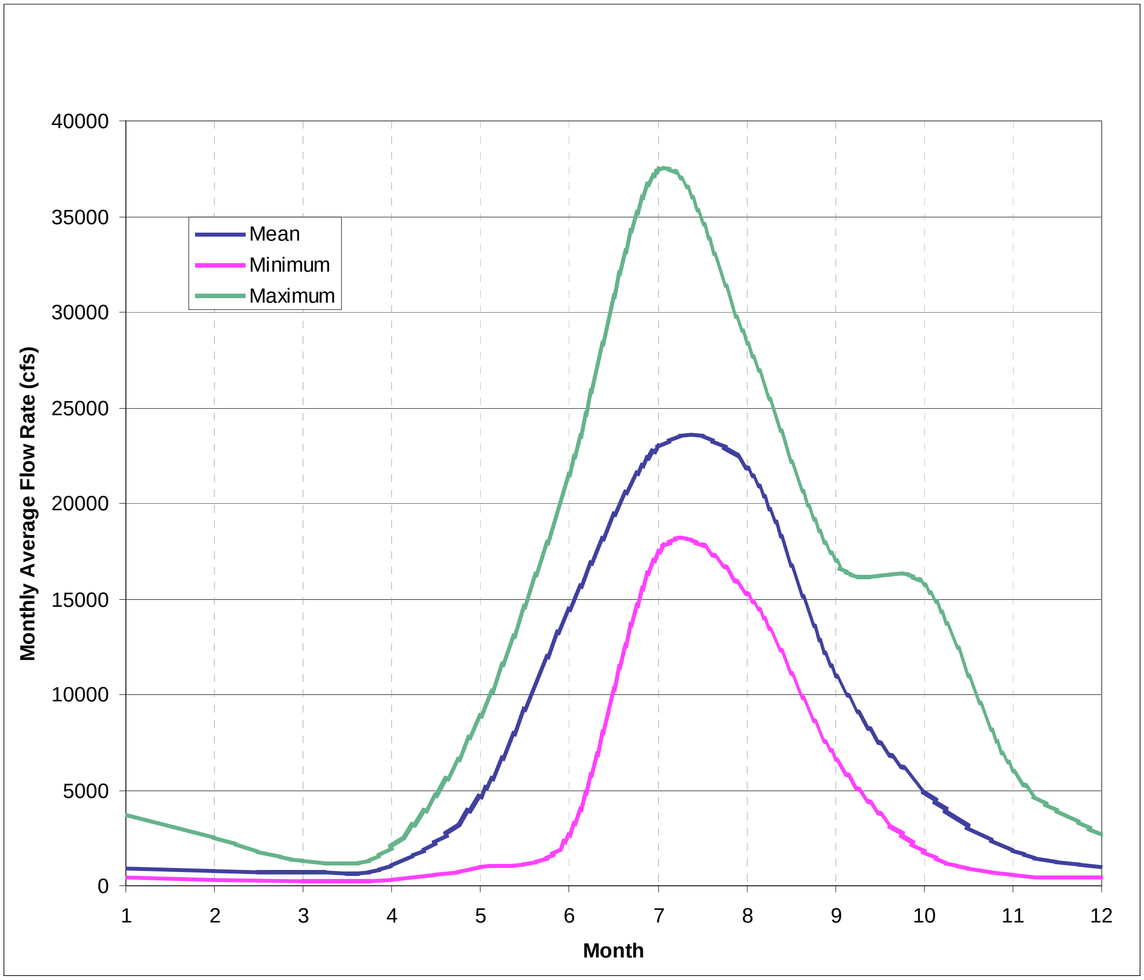
Constructed Wetland. For constructed wetlands, where the wastewater passes through a contained wetland, the wetland is considered part of the treatment process and wastewater quality regulatory criteria are applied to the discharge of the wetland to the receiving environment. If the discharge from the constructed wetland is to the land or water surface, including natural wetlands, the Clean Water Act and State of Alaska require effluent quality to meet both secondary effluent quality criteria (40 CFR 133.102), and State water quality standards (18 AAC 70.050) that protect the uses of the receiving water which include growth and propagation of fish. In the area of the discharge that was evaluated, there are several anadromous fish streams, including Wasilla Creek and Palmer Slough. As a consequence, for purposes of this report, it is assumed that the water quality criteria applicable to protecting the use of the receiving water includes the ammonia concentration limits published in Palmer's existing discharge permit.

4.5.2.1 Receiving Water Flow and Characteristics

Receiving water data is used by regulatory agencies to determine ultimate discharge permit limits, including the viability of including a mixing zone. Flow data for the Matanuska and Knik Rivers was gathered through the USGS Surface Water Database for the USA.

Data for the Knik River has been collected by the USGS at the Old Glenn Highway gauging station (15281000) from 1960-1988, 1991-1992, and 2001-2007. Monthly averages by year (1966-2009) were used to create the following graph:

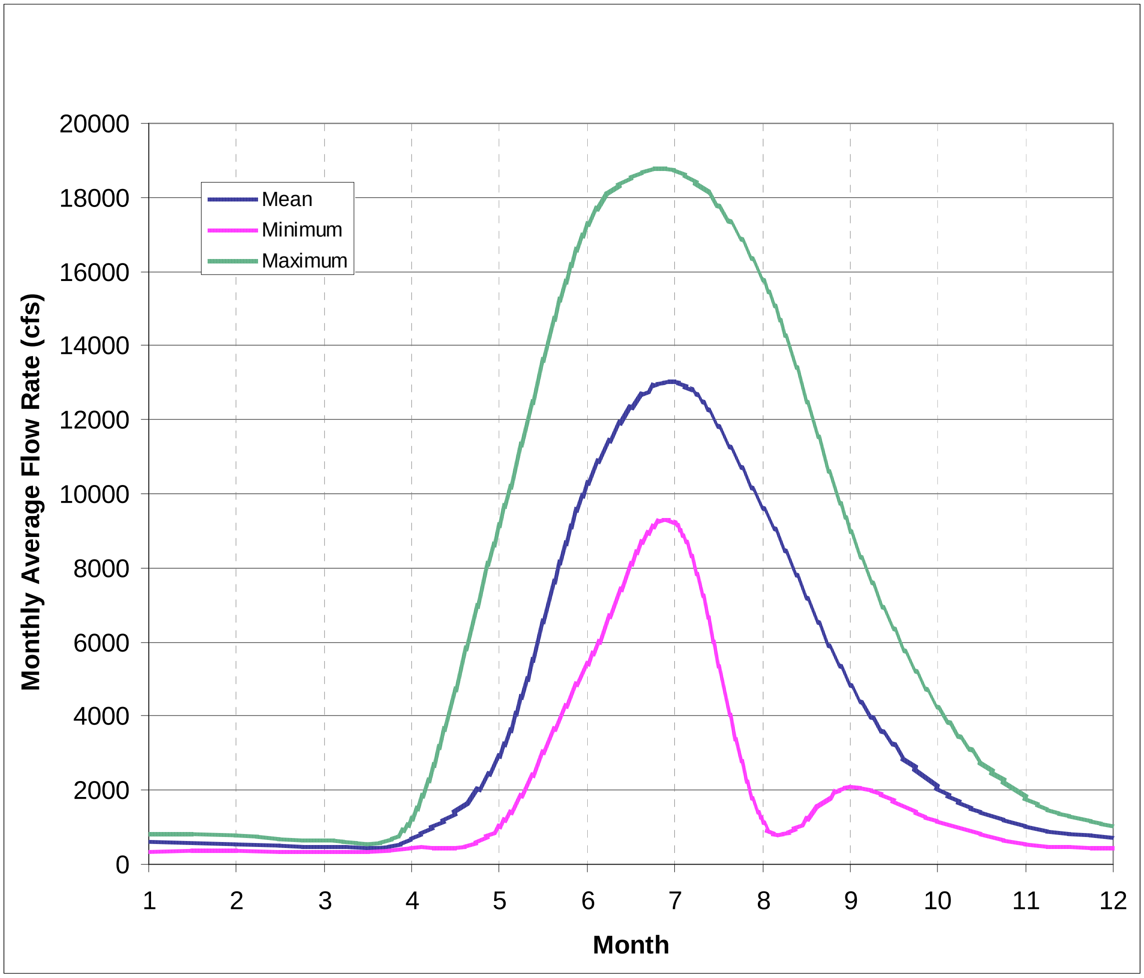
Figure 18: Knik River Historical Flow Rates



As shown in Figure 18, flow is lowest in the winter months, as the river is mostly frozen. Rainfall and glacial melt cause flows to peak in July and August with flows tapering off after that. Prior to 1966 periodic glacial dam bursts would occur on the Knik glacier causing flows to spike. The highest instantaneous flow experienced was 37,450 cfs. Due to the recession of the Knik Glacier, these types of events no longer occur. Because data prior to 1966 was influenced by these glacial damming events, it was not used in the creation of Figure 18. After 1966, the highest flow experienced at the gauging station was 28,090 cfs.

Data for the Matanuska River has been collected by the USGS at the Old Glenn Highway gauging station (15284000) from 1950-1973, 1985-1986, 1991-1992, and 2001-2007. Monthly averages by year were used to create Figure 19

Figure 19: Matanuska River Historical Flow Rates



Flow follows a similar pattern to that of the Knik River with flows peaking in July, and generally tapering off after that. There doesn't appear to be any large spikes caused by glacial events as there were with the Knik River. The highest instantaneous flow measured was 18,750 cfs in 2000.

4.5.2.2 River Bank Erosion

During high flow events, particularly during spring breakup and periods of warm and rainy summer weather, the banks of the Matanuska River will experience significant erosion. The MSB is in the process of developing a management plan for the Matanuska River[16]. This plan identifies locations of past severe erosion, and also indicates areas and facilities at risk of erosion. The existing Palmer WWTP was threatened by river bank erosion in the 1980's when the main channel of the Matanuska River was on the west bank of the floodplain.

Because of the threat from river bank erosion, new construction related to WWTP buildings, piping, tanks and outfalls will require erosion protection. This can be achieved through bank armoring or groins using large armor rock.

[16] Draft Matanuska River Management Plan, Missal, LLC, October 2009

4.5.2.3 Regulatory Agency Requirements

Federal and state wastewater and water quality regulations, state operator certification regulations and state and federal solid waste disposal regulations are applicable to the performance and operation of municipal sewage treatment facilities in Alaska. The following paragraphs describe the regulations applicable for the facilities described in this report.

Federal Water Quality Regulations. The discharge of treated wastewater directly to waters of the United States is regulated by the EPA under the authority of the Clean Water Act enacted in 1972. The EPA enacted regulations and a permitting program, entitled the National Pollutant Discharge Elimination System (NPDES), which addresses all point source wastewater discharges to navigable waters. Section 502 of the Clean Water Act further defines the term "navigable waters" to mean "waters of the United States…" Several legal challenges and decisions have been made to further define the phrase "waters of the United States". Legal decisions in 1985 (*Riverside)* and 2003 (*SWANCC*) ruled the authority of the NPDES program extended to protection of wetlands that abut navigable waterways. As a result, EPA has regulatory authority for wastewater discharges to wetlands abutting navigable waterways.

For point source discharges to the land or water surface, the Clean Water Act and EPA require the equivalent of secondary wastewater treatment, defined by 40 CFR 133.102 as treatment that produces effluent meeting minimum water quality criteria. Table 7 summarizes the minimum treatment requirements for conventional wastewater treatment plants and waste stabilization lagoons as stipulated in the federal regulations.

Table 7: Clean Water Act Secondary Effluent Quality Criteria

Parameter	Secondary Effluent Quality Criteria: Conventional Wastewater Treatment Systems
BOD_5	30-day average shall not exceed 30 mg/L. 7-day average shall not exceed 45 mg/L.
	30-day percent removal shall not be less than 85% unless influent waste strength is dilute.
Carbonaceous Biochemical Oxygen Demand (CBOD) [CBOD may be substituted for BOD_5]	30-day average shall not exceed 25 mg/L. 7-day average shall not exceed 40 mg/L.
	30-day percent removal shall not be less than 85% unless influent waste strength is dilute.
TSS	30-day average shall not exceed 30 mg/L. 7-day average shall not exceed 45 mg/L.
	30-day percent removal shall not be less than 85% unless influent waste strength is dilute.
pH	> 6.0 and < 9.0
Fecal Coliform	Stipulated by EPA Approved State Water Quality Standards

Section 401 of the Clean Water Act delegates authority to States and Tribes to deny all Federal permits or licenses that might result in discharge to State or Tribal water including wetlands.

Currently, the Clean Water Act does not have a standard for tertiary treatment. The term “tertiary” is used primarily to describe water treated to a level beyond secondary and can include many different processes and target many different parameters depending on the effluent quality and the receiving water quality. For instance, the treatment levels as stipulated in Palmer’s NPDES permit are referred to as “tertiary quality” in this study to indicate that a high level of treatment beyond secondary levels is required.

State Water Quality Regulations. The EPA offers to delegate the administration of the Clean Water Act NPDES program to the States if they elect to accept that responsibility. The State of Alaska was granted that responsibility in October of 2008 and the NPDES program in Alaska is now primarily administered by the State with assistance from the EPA through October 31, 2011. The State of Alaska administers the program under the name Alaska Pollutant Discharge Elimination System (APDES).

State and Federal Solid Waste Disposal Regulations. Disposal of sewage solids in a landfill is an option only at sites permitted for this activity. In order to co-dispose sewage solids (grit, screenings or biosolids) with municipal solid waste in a permitted landfill, the following requirements must be met:

1. The sewage solids must be free of hazardous wastes and polychlorinated biphenyls (PCBs) in accordance with 40 CFR 261 and 40 CFR 761.
2. The sewage solids must not contain “free-liquids” as defined by EPA Method 9095 (Paint Filter Test)[17]
3. The sewage solids must meet the vector reduction requirements in 40 CFR 503.33(b)(11); or must be treated and stabilized to meet Class A or B pathogen reduction requirements in accordance with 40 CFR 503.22 and vector attraction reduction requirements of 40 CFR 503.33 (b)(1)-(10) as adopted by reference in 18 AAC 60.505.

Biosolids may also be disposed by beneficial application to agricultural or municipal lands. Land application of sludge may increase the organic and nutrient content of the soil and enhance its water retention character. To be eligible for land application, the regulations cited for disposal to a landfill apply with the following conditions added:

1. The soils to which biosolids shall be applied must have concentrations of metals below and must remain below limits established in 40 CFR 503.13
2. Biosolids applied to agricultural land or public contact sites must have concentrations of metals lower than the limits established in 40 CFR 503.13
3. Biosolids applied to agricultural land or public contact sites must satisfy one of the following conditions:
    a. The concentration of metals at the application sites shall not exceed the cumulative limits for metals established in 40 CFR 503.13 or
    b. The maximum concentrations of contaminants in the applied sludge shall not exceed the limits listed in 40 CFR 503.13
4. The biosolids cannot be applied to the land designated as endangered species critical habitat or adversely affect endangered species
5. The biosolids cannot be applied to land during periods when the land is frozen, snow covered or flooded
6. The biosolids cannot be applied to land within 10 meters of navigable waterways
7. The biosolids cannot be applied to land in excess of the rate at which the nutrients in the biosolids are used by the vegetative cover for the area
8. The biosolids must be treated and stabilized to meet Class A or B pathogen reduction requirements in accordance with 40 CFR 503.32; and vector attraction reduction requirements of 40 CFR 503.33 (b)(1)-(10), as adopted by reference in 18 AAC 60.505.

[17] Paint Filter Test is described in “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition, November 1986 (SW-846)

4.6 Preliminary Mixing Zone Review

4.6.1 Existing City of Palmer Outfall

The ADEC completed a mixing zone analysis for the Palmer wastewater discharge and issued a Draft Certificate of Reasonable Assurance dated August 28, 2000. This analysis was subsequently used by the EPA along with several other assumptions on the receiving water characteristics to establish wastewater effluent limitations in the reissuance of Palmer's NPDES permit (AK-002249-7) in 2006. This mixing zone was defined as beginning at the existing discharge in the Matanuska River and extending 1600 meters downstream with a maximum width of 11 meters. With a maximum daily discharge of 0.95 MGD, this results in an ammonia effluent limit of 8.7 mg/L and 18.5 mg/L (as nitrogen) on an average monthly and maximum daily basis.

State of Alaska water quality regulations (18 AAC 70.4240 (e(1)) and the permit effluent limitations eliminate the mixing zone for the months of July and August when salmon are present. Permit limits were based on the water quality criteria and established as "end of pipe" values of 1.7 mg/L and 3.6 mg/L ammonia as nitrogen on an average monthly and maximum daily basis, respectively. It is anticipated that if discharge of treated effluent continues at this location, the permit limits will reflect those currently in Palmer's NPDES permit. If effluent flow from this outfall were to increase, the ADEC would possibly adjust the effluent limits and/or modify the mixing zone sizing during the non-spawning times of the year based upon proposals made by Palmer in the permit renewal application. The ADEC may also adjust effluent limits and mixing zone sizing should the main channel of the Matanuska River change course and impact the current receiving water body characteristics.

4.6.2 Discharge to Matanuska River Flood Plain

The proposed outfall location for one of the centrally located regional WWTP options is a discharge to the Matanuska River flood plain. No flowing stream exists at this location and a mixing zone analysis is not applicable. The discharge would be authorized by the State of Alaska through an individual effluent APDES discharge permit.

4.6.3 Discharge to Hay Flats

The other proposed outfall location for a centrally located regional WWTP is to a large scale constructed wetland north of the PHFSGR and southeast of The Ranch subdivision. This discharge would be to private land; however, effluent wastewater would eventually move offsite. For this reason, it is assumed that coordination with the ADF&G would need to be coordinated as well as an authorization through the State of Alaska with an individual effluent APDES discharge permit.

4.7 Environmental Resources

4.7.1 Farmlands

The Matanuska Valley is known for producing some of the largest vegetables in the world. It is considered the agricultural center of Alaska. Current farmlands in the study area are used for growing vegetables, livestock feed, and University of Alaska (UA) plant research. Most agricultural products for the Alaska consumer are imported because of the short growing season and seasonal nature of farming limits availability.

The Farmland Protection Policy Act (FPPA), the United States Department of Agriculture (USDA) regulation implementing the FPPA and USDA Departmental Regulation No. 9500-3: Land Use Policy provides protection for important farmland and prime rangeland and forest land. The Secretary of Agriculture has not designated “prime” or “unique” farmlands in Alaska. However, the Palmer, Upper Susitna, and Wasilla Soil and Water Conservation Districts and The Matanuska-Susitna Valley Area Soils Survey have formally established criteria and designated soils of “local importance”. The Natural Resources Conservation Service (NRCS) has accepted the designation of these soils. There are 10 soil units in the study area. One unit, Yensus silt loam, is designated a soil of local importance.

4.7.2 Alaska Coastal Management Program

The State of Alaska uses a multiple agency coordinated system for reviewing and processing all resource related permits which are required for proposed projects in or affecting coastal areas of Alaska. This system, called “project consistency review,” is based on the Alaska Coastal Management Program (ACMP). A Coastal Zone Questionnaire and project consistency review will be required.

4.7.3 Wetlands

There are areas of wetlands near the proposed centrally located regional WWTP project sites. These wetlands are classified as the following:

Site A

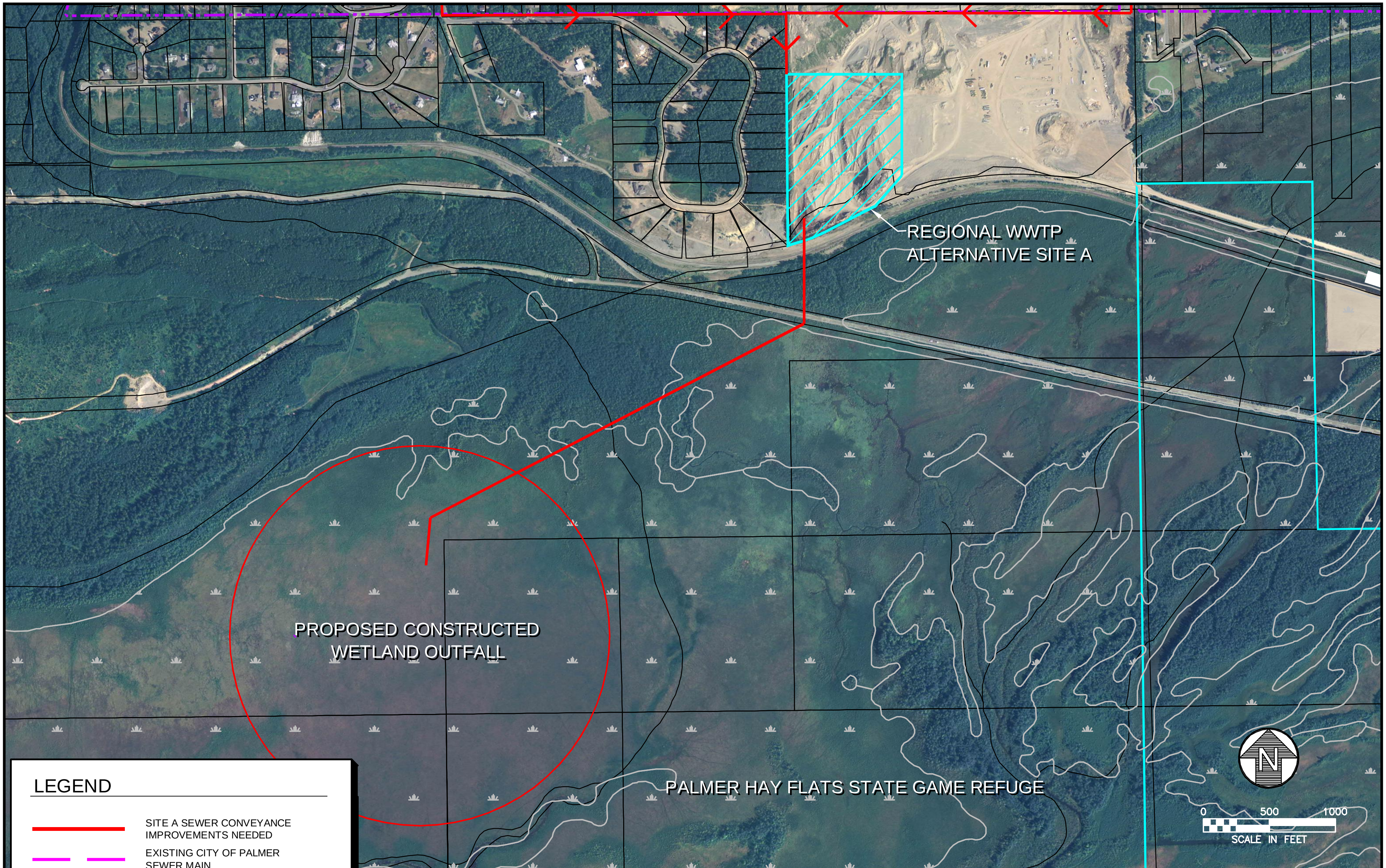
1. Palustrine, Scrub-Shrub, Broad-Leaved Deciduous/Emergent, Persistent, Saturated (PSS1/EM1B)
2. Palustrine, Emergent, Persistent/Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded (PEM1/SS1C)
3. Palustrine, Scrub-Shrub, Needle-Leaved Evergreen, Saturated (PSS4B)

Site B

1. Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Temporarily Flooded (PSS1A)
2. Palustrine, Scrub-Shrub, Broad-Leaved Deciduous/Emergent, Persistent, Temporarily Flooded (PSS1/EM1A)
3. Palustrine, Unconsolidated Shore/Emergent, Persistent, Temporarily Flooded (PUS/EM1A)

Matanuska River Flood Plain. The Matanuska River is classified as “waters of the United States” and as such falls under the jurisdiction of the US Army Corps of Engineers. Alaska Corps of Engineers consultation will be required. See Figures 20 and 21 for maps of wetlands in the areas of the centrally located regional WWTP sites selected for evaluation in this study. Wetland mitigation will be required if any of these wetlands are disturbed from construction of a new centrally located regional WWTP. Because the Palmer WWTP is an existing disturbed site, no mitigation is required if improvements stay within the boundaries of the existing permitted WWTP.

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 20-21 – Wetlands Map, 1=100, 06/08/10 at 08:07 by tlc
LAYOUT: Site A



LEGEND

- SITE A SEWER CONVEYANCE IMPROVEMENTS NEEDED
- EXISTING CITY OF PALMER SEWER MAIN
- PALMER HAY FLATS BOUNDARY
- CITY LIMITS
- SERVICE AREA BOUNDARY
- ALTERNATIVE RWWTP SITE CONSIDERED
- WETLANDS

HATTENBURG DILLEY & LINNELL Engineering Consultants

HDR ALASKA

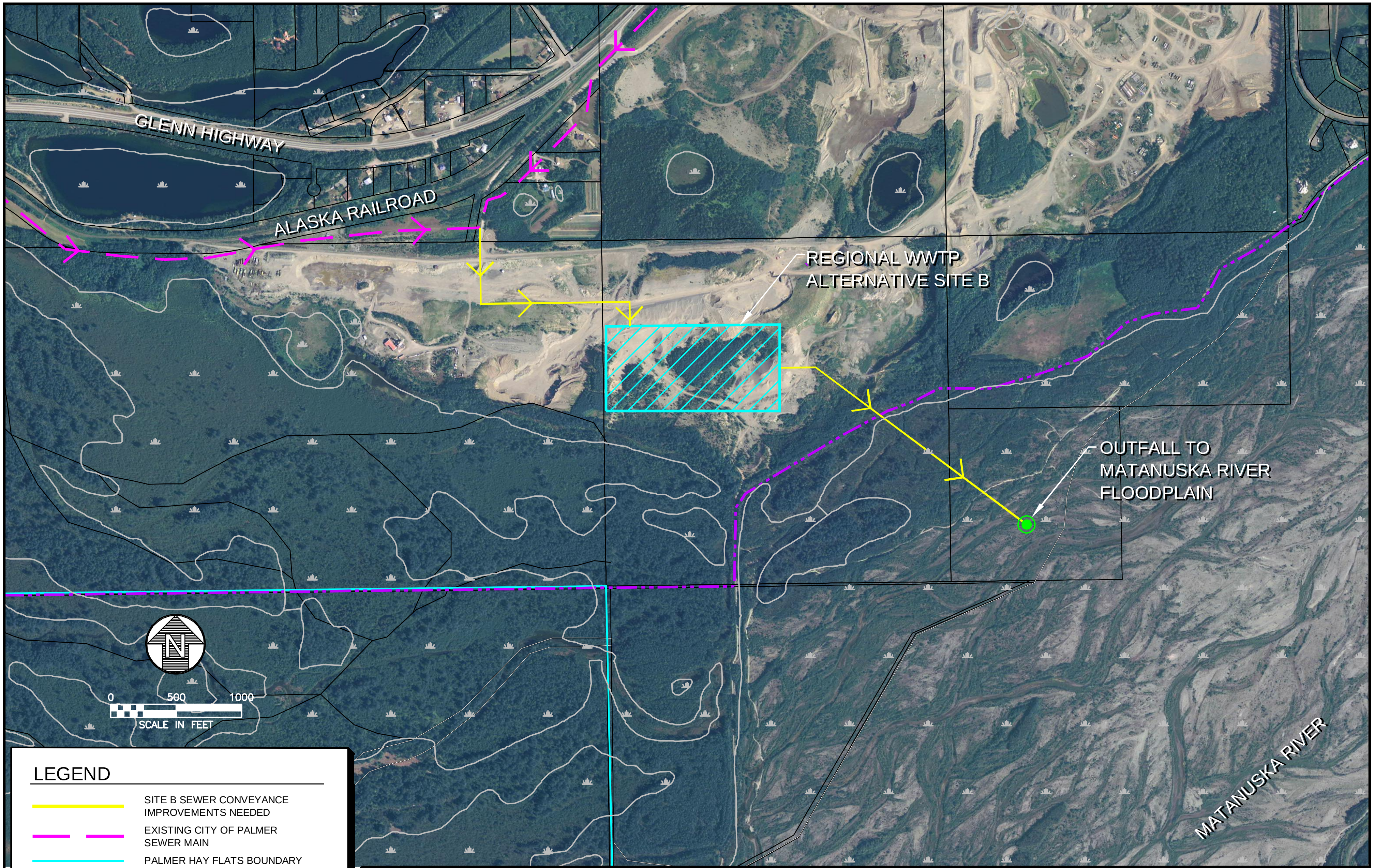
GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
SITE A WETLANDS

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	BCY	SHEET:	FIGURE 20
SCALE:	1" = 1000'	CHECKED BY:	SLH	JOB NO.:	08-039

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 20-21 - Wetlands Map, 1=100, 06/08/10 at 08:07 by tlc
LAYOUT: Site B



HATTENBURG DILLEY & LINNELL Engineering Consultants

GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
REGIONAL WWTP ALTERNATIVE SITE B WETLANDS

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	BCY	SHEET:	FIGURE 21
SCALE:	1" = 1000'	CHECKED BY:	SLH	JOB NO.:	08-039

4.7.4 Wildlife and Fisheries

Moose frequent the area in the vicinity of the proposed improvements. Black and brown bears are very uncommon. No other large animals are known to inhabit the project area. Migratory waterfowl, including swans, ducks and geese rest and feed and can be found in nearby water bodies as well as along the shore of the Matanuska River.

Site A is located just north and upstream of the PHFSGR. While the outfall would be located on private land, coordination with the ADF&G would occur when the permits are processed.

According to the ADF&G Atlas of the Catalog of Waters Important to the Spawning, Rearing, and Migration of Anadromous Fishes, the silt-laden main channel of the Matanuska River is known to contain migrating salmon. Because of the silty nature of the river water, fish migrate to clear water streams upstream and spawn. The spring-fed clear water channel (AWC 247-50-10220-2037-3020) of the Matanuska River into which Palmer discharges treated effluent is currently indicated as spawning habitat for Chum and Coho salmon which are present seasonally. Adjacent to the proposed location of Site B is Spring Creek (AWC 247-50-10260-2019-3020) which is a rearing and spawning habitat for Coho salmon as well as a sport fishing location. Conveyance piping for Site B also proposes to cross Wasilla Creek (AWC 247-50-10260-2019-3038) which is currently indicated as a rearing habitat for Coho salmon.

4.7.5 Endangered Species

According to the US Fish & Wildlife Service there are no threatened and endangered species found in the study area.

4.7.6 Historical and Archeological Sites

At the time the first Russians arrived in Cook Inlet in the late 1700's, the Athabaskan Tanaina (also referred to as the Dena'ina) and the Athabaskan Ahtna inhabited the Upper Cook Inlet valleys between the Susitna River and the glacial head waters of the Matanuska River. Noted by early explorers in the region, the Dena'ina inhabited a number of small villages on Knik Arm at the confluence of the Knik and Matanuska Rivers. Between 1840 and 1845 small pox almost decimated the native population. It was not long after that the establishment of the Russian Orthodox Church at Kenai in 1894 brought a greater non-native presence in Upper Cook Inlet.

In the 1930's during the Great Depression the United States government sponsored a program organized under the US Resettlement Administration that brought 202 families to the valley from the Midwest. The result of which was the establishment of the town of Palmer. Many of these early homesteads are now historic sites listed in the Alaska Heritage Resource Survey (AHRS).

According to the AHRS a root cellar site along the piping conveyance for Site A was identified (ANC-02834). Consultation with the State Historical Preservation Office (SHPO) would be required for this alternative. Additionally, the AHRS identified no known historic properties within the potential project area for Site B. Although there are sites within a ½ mile radius, none would be affected by this alternative. A cultural resource evaluation and SHPO concurrence would be required during the NEPA process for the proposed project.

4.7.7 Flood Hazard Information

The team reviewed the Federal Emergency Management Association (FEMA) mapping for the MSB (Community Panel numbers 020021 9725 D, 1986, and 020021 9700 C, 1986). Regional WWTP sites A and B as well as the current Palmer and Wasilla WWTPs are classified as Zone C. Zone C is defined as areas of minimal flooding outside the 100 and 500-year flood plains.

5.0 DESIGN CRITERIA

5.1 Predicted Influent Wastewater Flow and Strength Characteristics

The characteristics of any wastewater stream are highly dependent upon system users, and conditions of the existing infrastructure. Heavy industrial users, high ground water, deteriorating pipe, and improper maintenance can all contribute to poor influent wastewater quality and can put a strain on wastewater treatment processes. Design criteria for proposed treatment processes will be based on current influent wastewater characteristics in Palmer and Wasilla, with the assumption that no large industrial users contributing high levels of BOD_5 or COD will be connected to the system, and also that the cities of Palmer and Wasilla or a new regional treatment authority will maintain existing and future conveyance sewer mains to prevent significant I&I contributions. It will also meet current regulatory requirements and take into account future regulatory changes.

5.1.1 Projected Wastewater Strength

As noted in the paragraph above, projected influent wastewater quality is based on data taken from Palmer and Wasilla's influent wastewater streams. These combined flows will form the basis for influent quality to a regional wastewater treatment plant. Wastewater characteristics used in process design for upgrades to existing facilities, or for a new wastewater treatment facility are shown in Table 9 on page 49.

5.1.2 Design Wastewater Flow Rates

An extensive technical review document was presented to the Borough, Wasilla, and Palmer in April of 2009. This document presented information on projected population growth rates, anticipated wastewater flows and strength at WWTPs and potential process benefits and drawbacks. A meeting between the three entities involved and the Regional WWTP study team was held on April 7, 2009 in Palmer. From this meeting, the consensus between the entities was to perform conceptual design of near term improvements to the Wasilla and Palmer WWTPs to treat 1.0 and 2.0 MGD, respectively. Additionally, it was agreed upon that a regional WWTP would be designed to treat 4.0 MGD initially, with expansion capability in 4.0 MGD increments.

5.2 Predicted Septage/Leachate Flow and Strength Characteristics

5.2.1 Projected Septage/Leachate Strength

Septage strength was based on sample data taken at the Turpin receiving station, as well as published values. Projected septage strength is not expected to change from the current strength observed in the septage being hauled to Turpin Street. Septage shows a fairly constant and predictable level of BOD_5, TSS and other targeted constituents. Septage strength is included in Table 6 on page 21.

Based on discussions with MSB Central Landfill managers, their intent is to manage and provide treatment of leachate on-site. Leachate flows and strength can be expected to be become higher as the landfill matures and the lined portion of the landfill increases. This strength is highly dependent on what is allowed in the landfill. For reference, current leachate characteristics are provided in Table 8.

Table 8: Leachate Characteristics

Category	Average	Maximum
Flow (gallons per month))	40,000	-
BOD_5 (mg/L)	5,800	19,500
TSS (mg/L)	250	1,960

5.2.2 Design Septage/Leachate Flow Rates

Septage flow rates were estimated in Section 4 based on the growth predictions in the region with assumptions on a percentage of that growth being served by onsite well and septic systems (See Appendix C for percentage breakdown by growth area). This amount was compared to existing septage production in the MSB based on Turpin Street receiving station data. Based on growth projections and discussions with haulers, 0.2 MGD was used as the estimate for maximum daily flow contribution from the septage haulers; see Section 4.2.4 on Page 28.

Current and future leachate flows are not included in septage flow forecasts because the Borough indicates they will process and dispose of leachate at the landfill. Leachate flow rates are expected to grow as the lined area in the landfill increases.

5.3 Target Effluent Quality

The treatment requirements for wastewater depend on the ultimate disposal location. For the purposes of this study, it is assumed that effluent wastewater will be discharged to a surface water (Matanuska River or constructed wetland) and will be required to meet tertiary standards; effluent wastewater which is applied to the land (percolation bed) will need to meet secondary treatment standards with nitrate limits. Treatment standards for a surface outfall are defined in Section 4.5.2.3 on Page 39.

5.4 WWTP Design Criteria

Data collected from sources presented in the previous paragraphs was evaluated and compiled into various design criteria. This data is used for conceptual design and costing of wastewater treatment upgrades and eventually construction of a regional WWTP. For the purposes of this study, it is assumed that for near term improvements to the Wasilla and Palmer WWTPs disposal of treated effluent will be to the existing permitted location; and for long range design purposes, regional WWTP effluent will be treated to tertiary standards regardless of whether it is located at Palmer or a new centrally located site. A summary of design criteria is presented in Table 9 and Table 10:

Table 9: Summary of Design Criteria – Influent Characteristics

	Palmer WWTP		Wasilla WWTP		Regional WWTP		Septage Receiving Station	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
Average Daily Flow, MGD	2.0		1.0		4.0		-	
Maximum Daily Flow, MGD	4.3		2.2		7.3		0.2	
Peak Hourly Flow, gpm	3,800		1,900		5,800		-	
Average BOD_5, mg/L	294	355	202	190	240	250	2,150	2,800
Maximum BOD_5, mg/L	545	544	546	414	540	470	4,000	3,900
Average TSS, mg/L	320	322	500	500	230	250	6,100	6,450
Maximum TSS, mg/L	865	672	1,800	1,800	400	400	28,900	10,050

Table 10: Summary of Design Criteria – Target Effluent Quality

	Palmer WWTP		Wasilla WWTP		Regional WWTP		Septage Receiving Station	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
Average BOD_5, mg/L	15		15		15		-	
Average TSS, mg/L	15		15		15		-	
pH	6.5 – 8.5		6.5 – 8.5		6.5 – 8.5		-	
Fecal Coliform, #/100 mL								
Average Monthly	100	20	ND	ND	100	20	-	-
Maximum Daily	200	40	ND	ND	200	40	-	-

6.0 FINANCIAL STATUS OF EXISTING FACILITIES

6.1 City of Wasilla

The Wasilla City Council recently voted to increase rates charged for sewer service. The new rates will increase by 7.5% per year over the next five years. Fees charged for sewer service are intended to fund much needed improvements on the aging STEP system, as well as allow for expansion of the utility services. The increase also brings Wasilla more in line with other similar utility systems.

6.1.1 Current Rate Schedule

Sewer fees are based on gallons of water used. Customers with a water meter are charged for a minimum of 5,000 gallons and at a set rate per 1,000 gallons thereafter. Customers that lack a water meter are charged a set rate per month. Sewer fees collected include service to clean and empty customer septic tanks as well as repair or replacement of system components between the septic tank and the main line piping including pumps, floats and control panels. The sewer rate schedule with annual increases is shown in Table 11 below.

Table 11: Wasilla Sewer Fee Schedule

Sewer Service Monthly Rate	9/1/2009-8/31/2010	7/1/2010-6/30/2011	7/1/2011-6/30/2012	7/1/2012-6/30/2013	7/1/2013-6/30/2014
With Water Meter	$7.73 per 1000 gallons	$8.30 per 1000 gallons	$8.93 per 1000 gallons	$9.60 per 1000 gallons	$10.32 per 1000 gallons
Without Water Meter	$49.13*	$52.81*	$56.77*	$61.03*	$65.61*
Minimum Monthly Charge	$38.63**	$41.52**	$44.64**	$47.98**	$51.58**

* Customers without a water meter pay a flat fee per month.
** Minimum monthly fee based on 5,000 gallons of flow. Customers are charged per 1,000 gallons for flow above 5,000 gallons

6.2 City of Palmer

Palmer has completed a utility rate study and found that in order to keep up with rising costs an increase was needed. New water/sewer utility rates went into effect on November 1, 2008. The rate increase brought the City's fees in line with other similar systems and will supply the financial resources needed to continue to operate and maintain the system.

6.2.1 Current Rate Schedule

Sewer fees are based on the amount of water used. Customers with a water meter are charged for a minimum of 5,000 gallons and at a set rate per 100 gallons thereafter. Palmer's current rate schedule is shown in Table 12 below.

Table 12: Palmer Sewer Fee Schedule

Sewer Service Monthly Rate	Minimum Monthly Rate	Fee per 100 Gallons
0 to 5,000 gallons	$20.45 plus sales tax	-
Over 5,000 gallons	$18.45 plus sales tax	$ 0.409 plus sales tax

6.3 Septage Tipping Fees

Septage tipping fees are the cost haulers pay the utility to dispose of septage. Currently, the septic haulers travel to Anchorage and discharge into the AWWU wastewater system at the Turpin receiving station. AWWU is in the process of upgrading the station and has changed the tipping fees for haulers. In the past (prior to August 8, 2008) haulers were charged a flat monthly fee for disposal called a capacity charge and a standard monthly customer charge that is applied to all AWWU customers. These fees were the same regardless of how many times an individual hauler discharged at the station and was independent of haul truck size. After August 8, 2008, AWWU changed the rate structure to transition toward a usage based rate schedule. During the transition period from August 2008 thru August 2010 customers are charged a flat monthly capacity charge, the monthly customer charge, and a usage charge per 1,000 gallons that is estimated for each time a hauler discharges at the facility. Haulers are required to report each time the pumper truck discharges into the wastewater facility by filling out a Septic Haulers Trip Ticket. This form documents the vehicle capacity (gallons), estimated volume dumped (gallons), and the source location of the waste. The usage charge is based on an estimated volume discharged and is calculated by multiplying the total vehicle capacity by 87%.

6.3.1 Current Rate Schedule

Table 13 below summarizes the tipping fee schedule and outlines the time period for each of the fees.

Table 13: AWWU Septage Tipping Fee Schedule

Service Description		Monthly Rate	Fee per 1,000 Gallons
Customer Service Charge	Applies to all Customers	$5.45	-
Capacity Charge[1]	Aug. 8, 2009- Aug. 8, 2010	$157.88	-
Usage Charge[2]	Aug. 8, 2009- Aug 8. 2010	-	$10.55
Usage Charge[3]	Aug. 8, 2010- Next Rate	-	$15.84

1. Capacity charge is a flat monthly rate charged to all septage haulers in addition to the customer charge and usage charged. After August 8, 2010 the capacity charge will be eliminated and exchanged with the usage charge.
2. The Usage charge represents an estimated volume discharged. This value is estimated by calculating 87% of tank capacity, or if seasonal weight restrictions are in effect, 50% of tank capacity. Rates will be subject to annual increase as shown in the table.
3. Usage charge will be increased on August 8, 2010 from previous rates.
4. Fee schedule is taken from the Anchorage Water and Wastewater Utility Tariff

6.4 Leachate Hauling Tipping Fees

Currently, the MSB Central Landfill hauls collected leachate to Anchorage for discharge into the AWWU system at the Turpin receiving station. AWWU charges the same schedule and rates as the septage haulers described in Table above.

6.5 Potential Funding Sources and Requirements

Funding for this project may come from multiple sources including federal direct appropriations, USDA grants, other federal grants, state legislative appropriation, ADEC grants or loans, bonds, taxes, fees, or commercial loans. A summary of these funding sources is provided in Table 14. Additional information on each potential funding source along with blank applications can be found in Appendix E of this report.

Table 14: Summary of Funding Sources

Funding type	Eligibility requirements	Eligible loan/grant purposes	Terms	Contact
USDA Rural Development Loans	Entity must be: Non-profit, tribe, public, or a special purpose district	1) Construct, repair, modify, expand or otherwise improve wastewater collection and treatments systems. Certain other costs related to development of the facility may also be covered. 2) Acquire needed land, water sources and water rights. 3) Pay costs such as legal and engineering fees when necessary to develop the facilities.	1) Maximum repayment is 40 years or the useful life of the facility 2) Interest rates determined based on median household income (in the most recent census) in the service area 3) Interest rates fixed and range from 4.25% to 5.5%, subject to change. 4) Bank loans can be combined with these loans and grants for joint funding.	Tasha Deardorff, Community Programs Specialist, (907)761-7726, tasha.deardorff@ak.usda.gov
USDA Rural Development Grants	Same as loans	Same as loans	1) Grants made for up to 75% of eligible project costs (based on a median income of $38,000/yr). 2) Eligibility percent determined by median household income (in the most recent census) in the service area 3) Grants require matching funds, but USDA Rural Development loan funds can match grant funds to provide 100% financing.	Same as USDA Rural Development Loans
Legislative Appropriation	N/A	N/A	Determined by Governor and Legislature	
ADEC Municipal Matching Grants	Determined by ADEC scoring criteria	Can be used to assist in planning, design or construction of wastewater collection, treatment and discharge.	Funding is available for up to 85% of total project cost for communities of less than 1,000 people; 70% for communities of 1,000-5,000; 50% for communities of more than 5,000	Mike Phillips, Environmental Engineer, 907-269-7619, mike.phillips@alaska.gov.
Alaska Clean Water Fund	Must be incorporated City or Borough	Planning, design and construction of eligible publicly owned facilities including: Wastewater Treatment Facilities, Sewer Interceptor and Collection Systems and Storm Water Collection and Treatment	Funding is available for up to 100% of eligible projects. Loans are made with up to a 20-year repayment period with different rates of repayment depending on the length of loan contract.	Same as ADEC Municipal Matching Grants

Table 14 Continued: Summary of Funding Sources

Funding type	Eligibility requirements	Eligible loan/grant purposes	Terms	Contact
General Obligation Bonds	Must be approved by voters	Determined by tax payer	Determined by tax payer	
Revenue Bonds	Must have significant capital to bond against	Any	Paid off through revenue generated through the operation of project being financed, or though other non-property tax sources.	
Taxes and Fees	Must be approved by voters	Determined by tax payer	Determined by tax payer	
Commercial Loans	Must be approved by lending agency	Any	Varies depending on lending institution, type of loan, collateral, etc.	

7.0 NEAR TERM ALTERNATIVES

7.1 Upgrade Palmer WWTP

For the near term, Palmer would like to continue using its existing lagoons for treatment of wastewater generated within the Palmer Service Area. In order to meet the requirements of the City's NPDES discharge permit, significant upgrades will need to be made to the current treatment process. The upgrades presented in the following paragraphs will reduce effluent ammonia concentrations to below a 30-day average value of 1.7 mg/L as nitrogen during the months of July and August and below a 30-day average value of 8.7 mg/L as nitrogen for the rest of the year. Additionally, effluent TSS concentrations would be reduced below 30 mg/L for the entire year. A comparison between the City's new and prior NPDES permit requirements can be found in Table 1 on Page 13.

Conversations with Palmer indicate that the City's near term upgrades to its treatment plant are expected to enable treatment of up to 2.0 MGD. In the Palmer WWTP's current configuration, process flows through the treatment system are limited hydraulically by the existing headworks, which is configured for an average daily flow rate of 1.0 MGD.

The following paragraphs address the upgrades recommended for Palmer's near term operation of the existing WWTP.

7.1.1 Lagoon Activated Sludge System

The existing lagoons are partially mixed aerated lagoons. Aeration of the lagoons supports the growth of microorganisms that provide biological stabilization. In portions of the lagoon where aeration does not provide mixing, sewage solids settle to the lagoon bottom. This arrangement has been successful in producing effluent quality that was capable of meeting previous discharge permit limits for treated effluent organics and TSS provided that the accumulated solids on the pond bottoms were routinely removed. Settled solids release ammonia to the water column above and can result in effluent ammonia concentrations that exceed current permit limitations.

In order to meet the more stringent limits stipulated in Palmer's latest NPDES permit, the application of a treatment process to remove ammonia from the effluent stream must be implemented. Biological wastewater treatment that reduces ammonia nitrogen is called nitrification. To achieve biological nitrification using an aerated lagoon treatment system, several operating conditions are needed including temperature control, removal of settled solids and recycling of beneficial microbes to the head end of the overall treatment cycle. Wastewater must then go through a denitrification process by use of an anoxic (non-aerated) completely mixed zone. This treatment process is referred to as "Activated Sludge Treatment."

Treatment process equipment manufacturers and suppliers offer activated sludge process equipment specifically intended for aerated lagoon systems. Two of these manufacturers/suppliers and their system offerings are Parkson Corporation's Biolac® and Lemna Technologies, Inc.'s LemTec™ Covered Lagoon Activated Sludge System (CLASS). These systems can be configured in such a manner as to achieve biological nitrification/denitrification by means of diffusers that would alternately aerate and then be idle. This would provide aerobic and anoxic conditions within the same lagoon volumes. This process is sometimes referred to as "wave aeration".

The system requires fine bubble diffused aeration equipment and a clarifier for gravity separation of suspended solids. Supernatant from the clarifier is decanted and directed to downstream treatment prior to disposal. Sludge from the clarifier is either returned to the aerated lagoon, or wasted for stabilization, dewatering, and disposal. This treatment system is depicted schematically in Figure 22 on Page 58. Equipment information for this system is also available in Appendix D of this report.

Biological nitrification is provided by microorganisms that are temperature sensitive. Colder water temperatures restrict their ability to achieve nitrification. Since Palmer's lagoons freeze in colder weather, the near term upgrade will need to maintain treatment process water temperatures near the temperature of influent raw sewage which is approximately 48 degrees F. The application of a floating, semi-permeable lagoon cover will help to minimize heat loss from the pond and aid in the overall biological nitrification process. In addition, an earthen dike would be constructed to shorten the lagoon basin; this will reduce the hydraulic retention time to approximately just over 24 hours assuming a return activated sludge recycle rate set to 75% of influent flows.

Another operating condition to be addressed during the Palmer near term upgrades is the control of solids. Specifically, suspended solids in the aerated lagoon will have to be prevented from accumulating at the pond bottoms where they release ammonia. This can be achieved by mechanical mixing and supplying additional aeration to provide complete mixing of the wastewater. Solids would then be settled out through the use of secondary clarifiers. The addition of secondary clarification will also allow active biosolids, referred to as activated sludge, to be either recycled to the head of the biological treatment process, or wasted to a stabilization and holding area. Clarifiers would be housed inside of a building to provide a controlled environment against freezing. Space would be provided inside of this building for aeration blowers, chemical storage, and pumps.

For the near term, Lagoon 3 could be utilized as a waste biosolids stabilization/holding area without any significant structural modifications. Aeration would need to be added to Lagoon 3 to maintain aerobic digestion and stabilization of biosolids.

Downstream of the new secondary clarification unit, a continuously backwashing granular media filtration unit would be installed to provide final polishing of the wastewater prior to disinfection. This unit would provide additional removal of suspended solids from the waste stream. A bypass pipeline would be constructed to connect the filtration unit to the existing UV disinfection building. Additional banks of UV bulbs would need to be installed to treat flows in excess of 1.0 MGD. The current configuration of the UV disinfection unit would allow for this upgrade without the need to install additional hydraulic capacity.

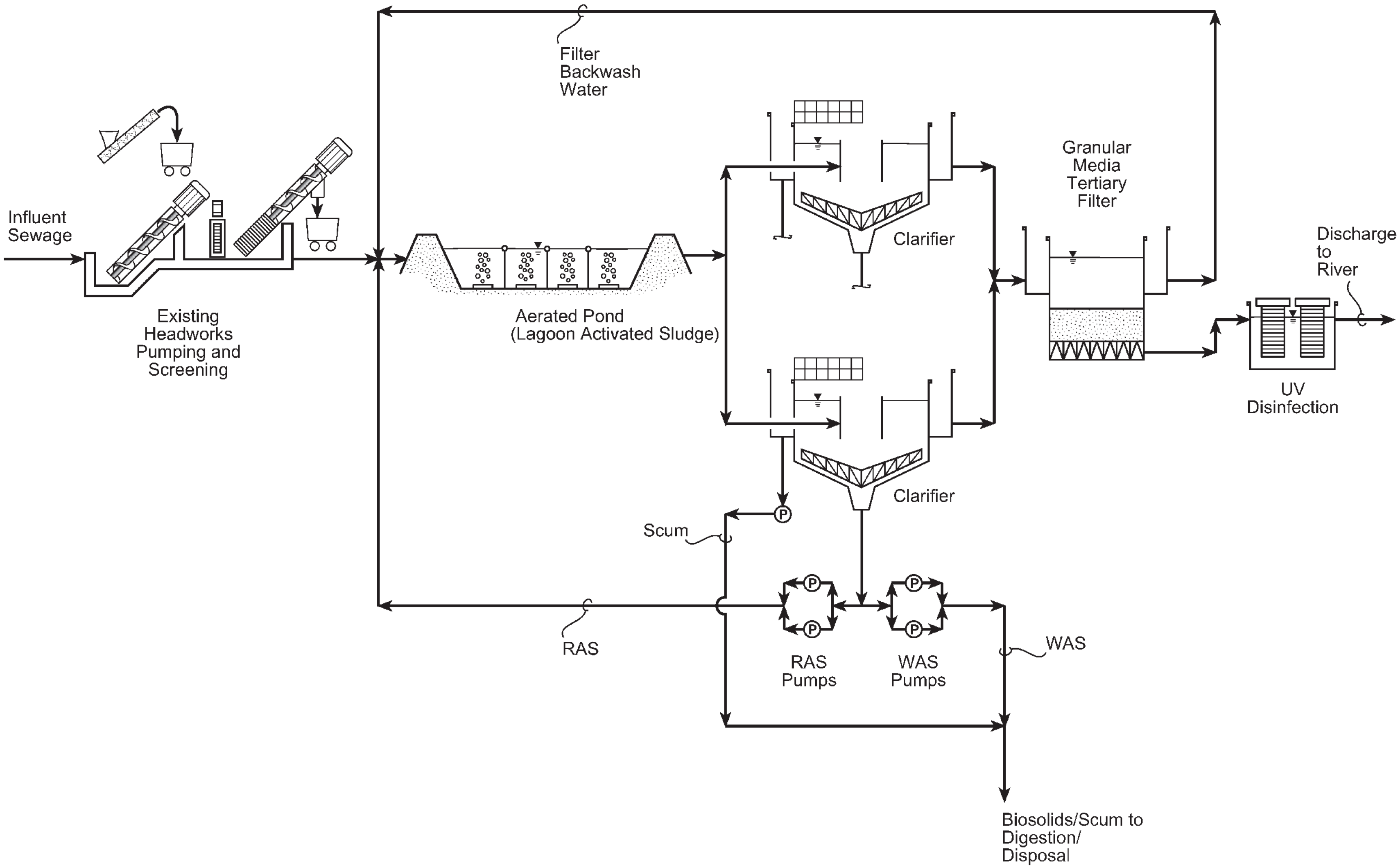
In order to treat an ADF of 2.0 MGD, several other upgrades will need to be made. Upgrades to the headworks will need to be performed to allow for additional redundancy between pumps. The addition of a third screw pump capable of lifting 1.0 MGD and an additional "Channel Monster" comminutor/screen would allow a portion of the existing equipment to be taken down for routine maintenance operations while still passing the average daily flow rate.

Preliminary design data for the Palmer near term upgrade improvements are summarized in Table 15.

Table 15: Preliminary Lagoon Activated Sludge Design Parameters - Palmer

Parameter	2.0 MGD ADF
Hydraulic Retention Time at ADF, hours	32
Nominal Aerated Lagoon Volume Required, MG	4.8
Clarifier Overflow Rate at ADF, gpd/ft^2	650
Nominal Clarifier Diameter, feet	70
Number of Clarifiers (one existing)	2
Proposed Bottom Lagoon Dimensions, feet	746 x 105
Proposed Top Lagoon Dimensions, feet	785 x 146
Lagoon Liquid Depth, feet	9.7
Mixed Liquor Concentration, mg/l	3,000 to 3,500

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 22 - Palmer Process Schematic, 1=1, 06/08/10 at 08:22 by tlc
LAYOUT: Layout2
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P



HATTENBURG DILLEY & LINNELL Engineering Consultants

GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
PALMER NEAR TERM PROCESS SCHEMATIC (2.0 MGD)

PALMER, ALASKA

DATE: JULY, 2010	DRAWN BY: CJB	SHEET: FIGURE 22
SCALE: NTS	CHECKED BY: SLH	JOB NO.: 08-039

7.1.2 Sludge Management

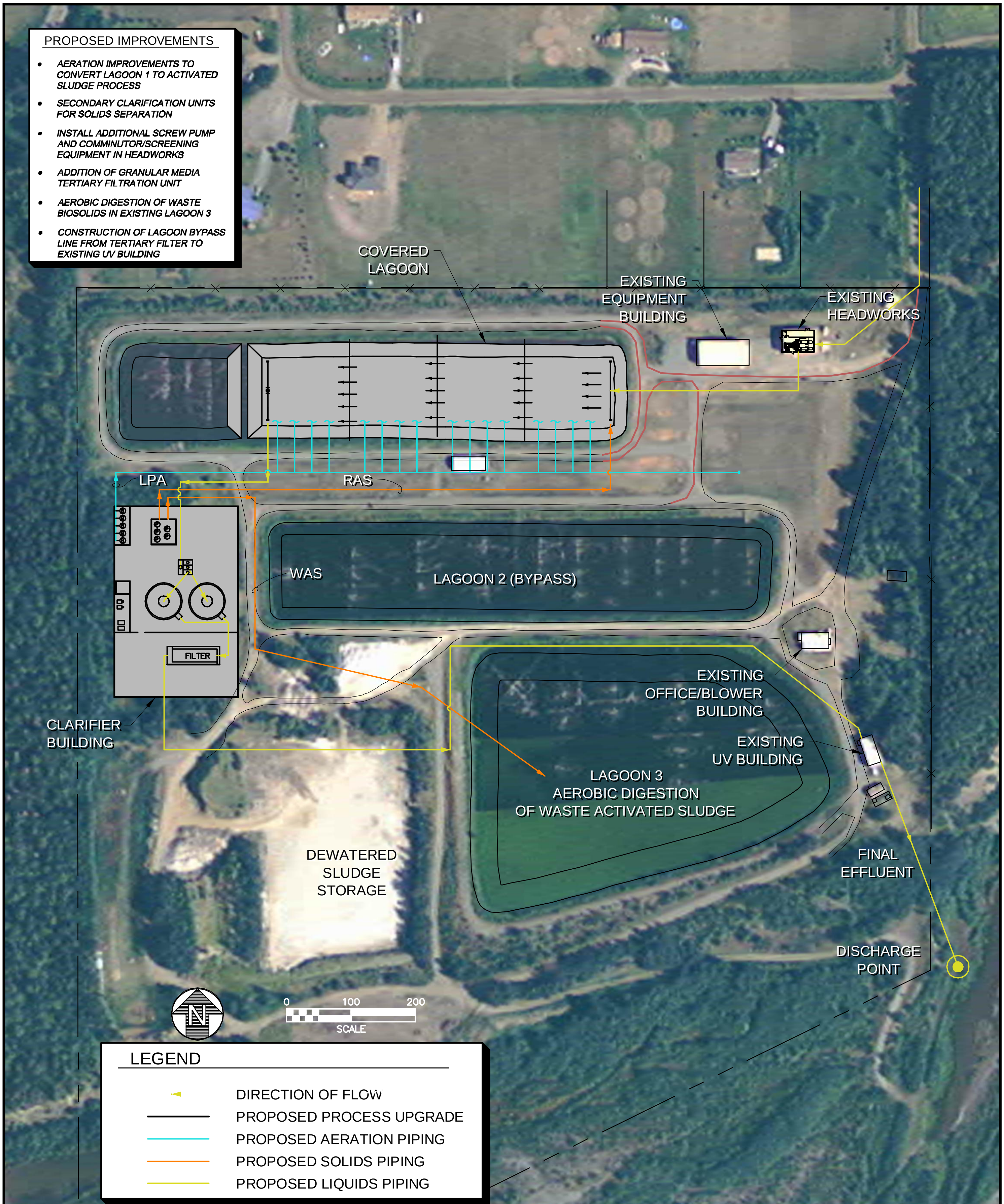
Palmer's current sludge management plan involves dredging the lagoon bottoms on a regular basis and transferring sludge to a drying bed where it dries through evaporation. The sludge is then treated with lime and used as fill around the WWTP site. Under the upgrades discussed in previous paragraphs, Lagoon 3 would be used to aerobically stabilize sludge prior to ultimate disposal. The use of this type of system would require minimal modifications to the existing site and operations practices. One drawback to this type of system is that seasonal turnover within Lagoon 3 could produce objectionable odors released by the re-suspension of settled solids in the lagoon. While this could be mitigated through the use of a lagoon cover, it is not necessary to maintain treatment and has not been included in cost estimates.

7.1.3 Effluent Disposal

In order to maximize the use of existing on-site infrastructure, near term upgrades will utilize the existing outfall to the Matanuska River. Palmer had previously expressed an interest in temporarily developing a subsurface discharge to a 50 to 60 acre parcel of land located directly west of the current WWTP. While a subsurface discharge would eliminate the need to meet the requirements stipulated in the City's NPDES permit, preliminary subsurface investigations[1] indicated that effluent disposal rates in excess of 1.0 MGD would cause daylighting of wastewater on the bluff located south of the proposed drainfield. Additionally, if effluent was not treated to remove nitrates to a level below 10 mg/L, area wells would be negatively impacted by the discharge.

A site plan for the proposed near term upgrades to the Palmer WWTP is shown in Figure 23.

[1] Memo on Preliminary Nitrate/Groundwater Modeling – Palmer Subsurface Discharge, Lorie Dilley, P.E., Principal Geologist, Hattenburg Dilley & Linnell, 2009.



HATTENBURG DILLEY & LINNELL
Engineering Consultants

GV Jones & Associates, Inc.
WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
PALMER NEAR TERM WWTP (2.0 MGD)

PALMER, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CDB	SHEET:	FIGURE 23
SCALE:	1" = 200'	CHECKED BY:	SLH	JOB NO.:	08-039

H:\Jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 23 - Palmer Near Term Site Plan, 1=1, 01/13/10 at 15:28 by tlc
LAYOUT: palmer
XREF: 08039_00_IMAGE, WASILLA SITE PLAN

7.1.4 Advantages/Disadvantages for Palmer's Near Term Upgrades

Advantages of the Palmer Near Term WWTP upgrades include:

- A portion of the existing treatment system can be reused. Specifically, the existing blowers and much of the earthwork needed to reconfigure the lagoon to an activated sludge system are already in place.
- Covering the lagoon reduces UV exposure and algae growth. Not covering the lagoon requires shorter hydraulic retention time and complete mixing to reduce algae growth.
- Completely mixed conditions in Lagoon 1 will eliminate seasonal pond turnover which has been the cause of process upsets and degradation of effluent quality.
- The upgrades have expansion capability to 4 MGD without building additional lagoons.

Disadvantages of the Palmer Near Term WWTP upgrades include:

- Treatment performance may be compromised in the coldest winter months even if the lagoon is covered.
- As sludge production increases, the aeration requirements for sludge stabilization will increase, contributing to O&M costs.
- Seasonal turnover in Lagoon 3 could produce objectionable odors and could give rise to local homeowner complaints.
- The quality of the effluent relies on the gravity settling characteristics of the aerated solids within the wastewater, referred to as mixed liquor. Any upset condition that alters the settling characteristics of the mixed liquor causes more frequent backwashes in the granular media filter.

7.1.5 Recommended Phasing – Palmer (2.0 MGD)

We recommend that 2.0 MGD upgrades to the Palmer WWTP be constructed in the following phased approach:

- Phase 1: Modify the existing partially mixed aerated lagoon to a lagoon activated sludge system implementing a lagoon cover, modified process basin area, clarifier enclosed in a building, bypass line around Lagoons 2 and 3 to the UV disinfection building, and sludge stabilization in Lagoon 3.
- Phase 2: Expand treatment capacity and provide redundancy by adding a second clarifier, expanding the existing headworks capacity and adding UV disinfection capacity.
- Phase 3: Install an effluent granular media tertiary filter enclosed in a building. Effluent filters constructed during this phase of the overall upgrade would further improve effluent quality by reducing effluent solids concentrations and providing a buffer against possible permit violations during process upsets.

7.2 Upgrade City of Wasilla WWTP

For the near term, Wasilla wishes to continue to use its existing lagoons and percolation beds for treatment and disposal of wastewater collected within the City. STEP system septage will continue to be processed at the City's aerobic digester with digested sludge gravity dewatered and land applied for final disposal.

Objectives of treatment for the near term operation of the WWTP would be to increase the quality of effluent applied to the percolation beds by reducing nitrogen content, BOD_5, and TSS loading to extend the useful life of the percolation beds. For purposes of this study it is assumed that the average (end of pipe) effluent quality required to sustain percolation bed operations would be 30-day average concentrations of BOD_5 and TSS of 15 mg/L each, and nitrate as nitrogen to below 5 mg/L.

Wasilla has expressed an interest in expanding its current WWTP to handle an ADF of up to 1.0 MGD. Because Wasilla's WWTP is land locked, the limiting factor in facility capacity would appear to be the ability of the existing drainfield to percolate wastewater into the soil without becoming hydraulically overloaded. Operational drainfield data over the years have suggested that higher hydraulic loadings are possible when higher quality effluent is applied as long as the hydraulic capacity of the receiving soils is not exceeded. For Wasilla's drainfield, a 2001 study showed that it is able to receive and hydraulically pass 0.25 to 0.35 MGD operating on aerated lagoon effluent using 4 of the available 8 functional percolation beds. It is possible that the percolation beds could handle additional flows if a higher quality effluent is applied. If, in the future, it is shown that the percolation beds cannot handle these flows the City would need to reconstruct the existing percolation beds, develop additional percolation bed capacity, or develop an alternative method of effluent disposal.

Potential forms of alternative effluent disposal include construction of a surface water outfall. HDL surveyed potential alignments and outfall locations for Wasilla in 2001. All potential outfall locations involved crossing the PHFSGR. A letter received from ADF&G in 2002 indicated that the only outfall presented would require the construction of a pipeline following the Glenn Highway with a discharge to the Knik River. One other potential outfall, a constructed wetland north of the PHFSGR similar to that presented for RWWTP Site A, could be considered as a possibility for effluent disposal.

The following paragraphs address the upgrades recommended for the City of Wasilla's near term operation of the existing WWTP.

7.2.1 Lagoon Activated Sludge System

The challenges facing the Wasilla WWTP are similar to those experienced at Palmer's WWTP. The existing treatment system operated by Wasilla is a partially mixed aerated lagoon process. In this process, raw wastewater from the Wasilla's STEP system is processed through two aerated earthen lagoons configured to operate in series. Submerged fine bubble diffusers configured in a step-aeration mode (application of air decreases with travel through lagoons) provide dissolved oxygen to the lagoons for partial, but incomplete mixing of suspended solids. This allows biological stabilization of influent organics and solids removal via sedimentation in the lagoons.

Effluent quality is degraded by seasonal algae blooms and temperature inversions of the water column which re-suspend settled solids and release ammonia. As a consequence, the quality of effluent disposed of in the existing percolation beds can include excessive concentrations of nitrogen which can result in exceedance of nitrate limits at the facility's monitoring wells.

To reduce or eliminate the occurrence of these types of events, Wasilla will need to implement a solids control process which can remove biosolids before they accumulate on the lagoon bottoms. One such way of doing this is to implement a lagoon activated sludge system similar to that described in Palmer's Near Term Upgrades on Page 55. This upgrade alternative can be configured to produce low levels of ammonia and nitrate nitrogen in treated effluent, in addition, this eliminates the requirement to periodically remove accumulated sludge solids from the lagoons. As part of the upgrades, a granular media effluent filter should be used to decrease solids loading and prolong the useful life of the percolation beds. The lagoon activated sludge system for near term improvements to the Wasilla WWTP is shown schematically in Figure 24. Equipment information for this system is also available in Appendix D of this report.

At the target flow rate of 1.0 MGD ADF, the hydraulic retention time for the aerated lagoon with a return activated sludge recycle rate of 75% of the influent flow rate would be between 1.75 and 2.25 days at average daily flows. To achieve this, one of the existing lagoons would be shortened by building an earthen dike and replacing the liner. The modified lagoon would also be fitted with a floating cover to retain heat.

An upgraded blower building would house higher capacity blowers to maintain complete mixed conditions and minimize sludge deposition.

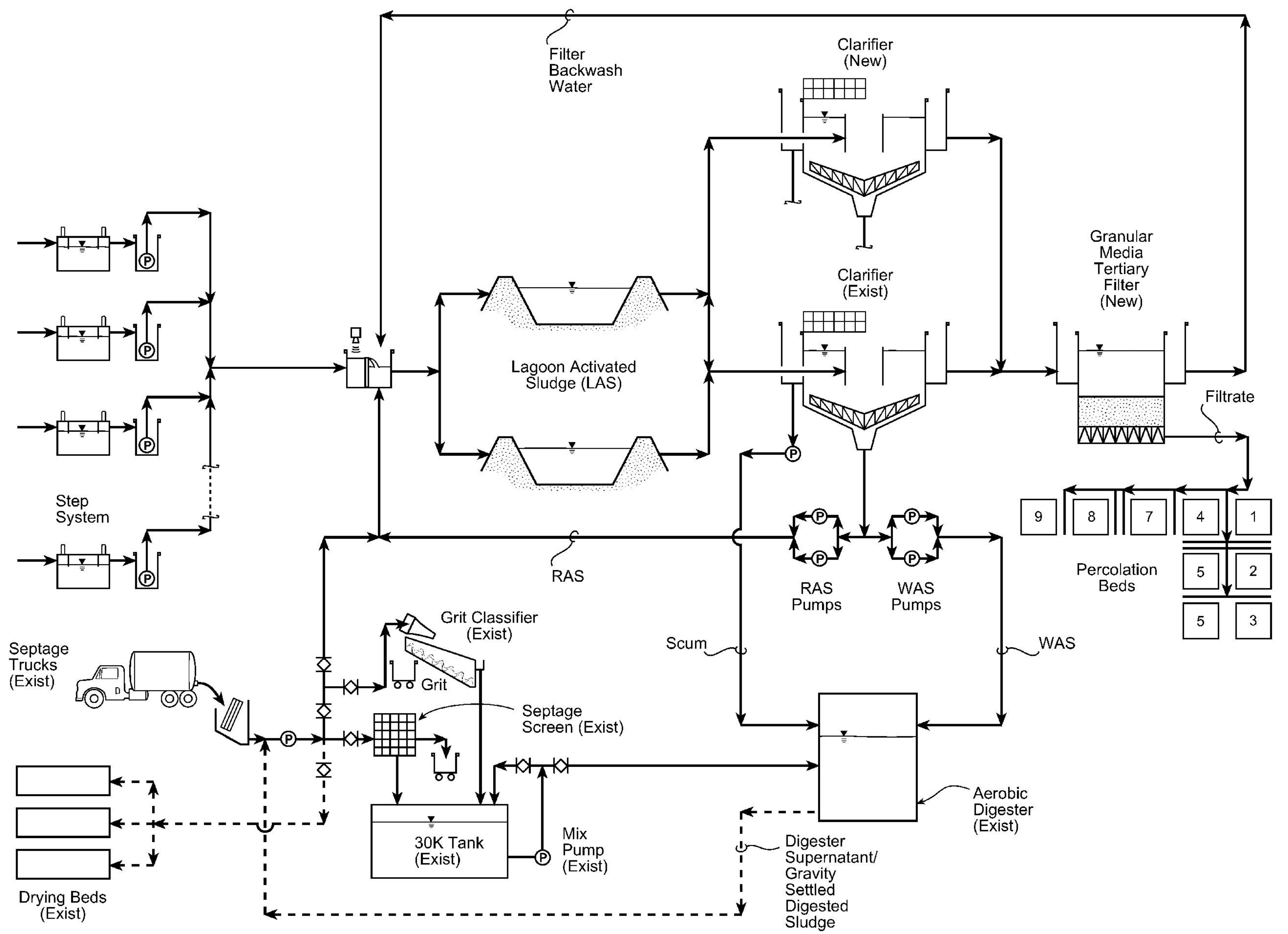
The existing clarifier should be suitable for rehabilitation and reuse. A second circular clarifier would be constructed of reinforced concrete. Both clarifiers, process piping and pumps would be enclosed in a heated, insulated and ventilated building.

Proposed upgrades would include a continuously backwashing granular media effluent filter housed within the clarifier building. The filter would be backwashed with filtrate. Backwash waste would be directed to the head of the plant. Suppliers of this type of filter include Aqua-Aerobic Systems, Inc., AquaABF®, and Infilco Degremont's ABW® Automatic Backwash Filter. Preliminary design data for a Wasilla lagoon activated sludge treatment system is summarized in Table 16.

Table 16: Preliminary Lagoon Activated Sludge Design Parameters-Wasilla

Parameter	1.0 MGD ADF
Hydraulic Retention Time at ADF, hour	49
Nominal Aerated Lagoon Volume Required, MG	3.6
Clarifier Overflow Rate at ADF, gpd/ft^2	500
Nominal Clarifier Diameter, feet	50
Number of Clarifiers (one existing)	2
Proposed Bottom Lagoon Dimensions, feet	Width = 100 Length = 300
Proposed Top Lagoon Dimensions, feet	Width = 172 Length = 372
Lagoon Liquid Depth, feet	15
Mixed Liquor Concentration, mg/l	3,000 to 3,500

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 24 - Wasilla LAS Process Schematic, 1=1, 06/08/10 at 08:39 by tlc
LAYOUT: Layout2
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P



HATTENBURG DILLEY & LINNELL Engineering Consultants

GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
WASILLA NEAR TERM PROCESS SCHEMATIC (1.0 MGD)

WASILLA, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 24
SCALE:	NTS	CHECKED BY:	SLH	JOB NO.:	08-039

7.2.2 Effluent Disposal Percolation Beds

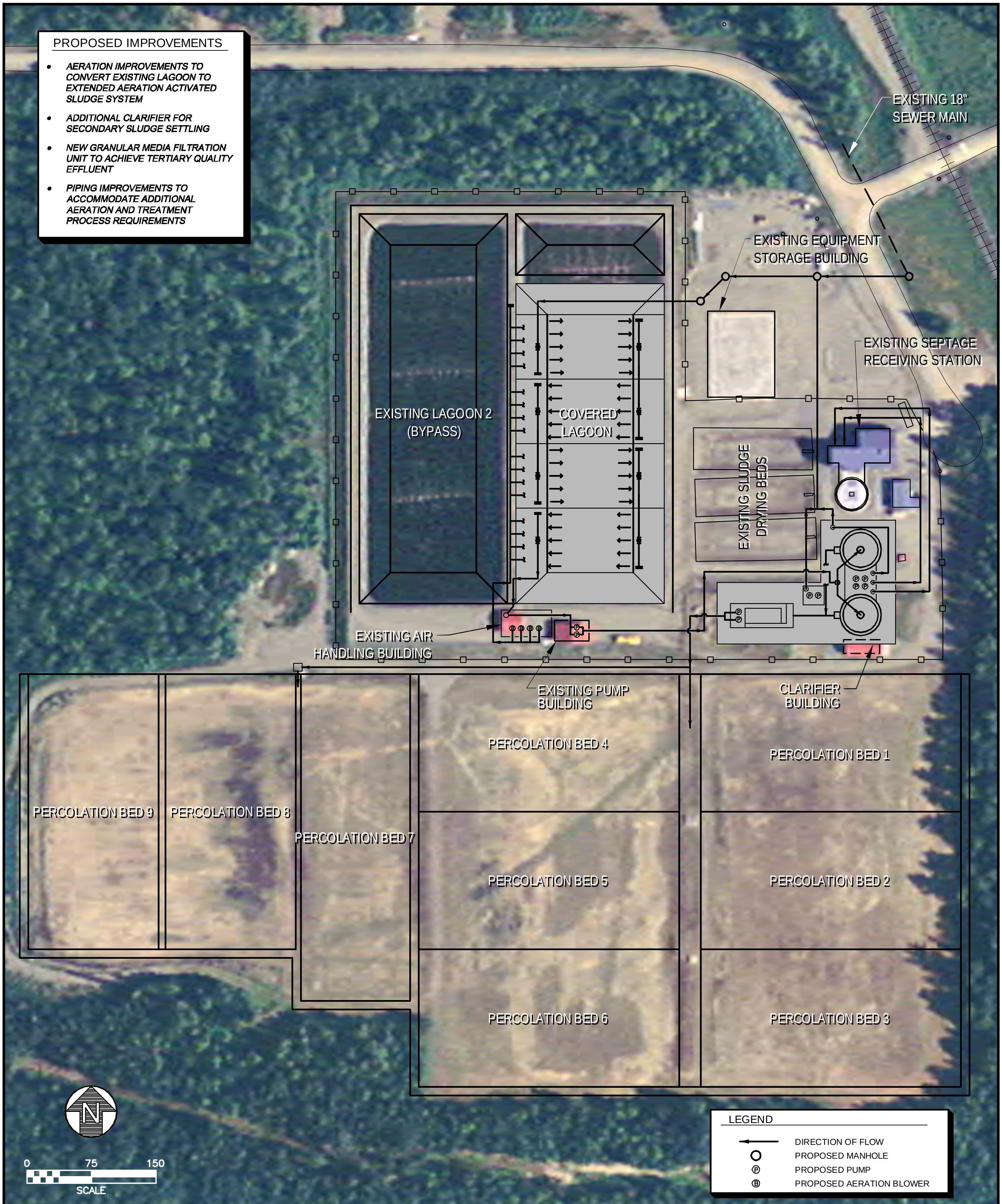
Wasilla's existing percolation beds are located on 10 acres containing a total of 9 beds each with a surface area of approximately 48,400 ft^2. Only eight of the percolation beds are currently operated in a rotation of 4 beds in service and 4 resting. The 9^{th} bed was abandoned shortly after system startup because of effluent daylighting on the nearby bluff.

Upgrading or expanding the existing percolation beds would have to be designed carefully to avoid past performance problems. However, the existing percolation beds may continue to be useful into the future if they receive a high quality low nitrogen concentration effluent.

The 1999 *Wasilla Sewer Master Plan (WSMP)* and the 2003 *Wastewater Treatment Plant Alternatives Review and Update* describes the existing percolation beds, and summarizes past studies and existing loading rates and performance. The discussions presented in the two reports still apply today. Generally, conclusions from past studies and research of percolation bed recovery suggests application of a high quality effluent would allow percolation bed hydraulic loading rates of 1.2 to 9.6 gallons per day per square foot (gpd/ft^2). Assuming that 4 beds are in service at any one time, each with an infiltrative area of 48,400 ft^2, a new treatment facility may be able to load the existing drainfield at average daily flows in excess of 1 MGD.

In addition to improving the quality of effluent, Wasilla may wish to consider adding drainfield capacity by rebuilding bed 9 and/or constructing additional percolation beds. The addition of one or two more beds could enable a total of 5 or 6 beds to be in service at any one time, allowing for an increase in hydraulic loading proportional to the additional infiltrative surface area.

<u>It is critical to note that the projections would be realized only if advanced treatment were performed and actual hydraulic loading field tests were performed to more accurately predict the increased capacity based on the actual effluent quality.</u>



HATTENBURG DILLEY & LINNELL
Engineering Consultants

GV Jones & Associates, Inc.
WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
WASILLA WWTP NEAR TERM IMPROVEMENTS

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 25
SCALE:	1" = 150'	CHECKED BY:	SLH	JOB NO.:	08–039

H:\Jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 25 – Wasilla Proposed Upgrades, 1=100, 06/08/10 at 08:43 by tlc
LAYOUT: WASILLA
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P

7.2.3 Advantages/Disadvantages

Advantages of the Wasilla WWTP upgrades include:

- A portion of the existing treatment system can be reused. Specifically, the existing blowers, clarifier, percolation beds, and much of the earthwork needed to configure a lagoon activated sludge system are already in place.
- Covering the lagoon reduces UV exposure and algae growth. Not covering the lagoon requires shorter hydraulic retention time and complete mixing to reduce algae growth.
- Completely mixed conditions in the lagoons will eliminate seasonal pond turnover which has been the cause of process upsets and degradation of effluent quality.
- Existing percolation bed performance may improve as a result of higher quality effluent (including reduced nitrates), and bed useful life may be extended.

Disadvantages of the Wasilla WWTP upgrades include:

- Treatment performance in the coldest winter months may be compromised even if the lagoon is covered.
- The percolation bed system has a finite capacity, beyond which an alternative means of effluent disposal will be required.
- The quality of the effluent relies on the gravity settling characteristics of the aerated solids within the wastewater, referred to as mixed liquor. Any upset condition that alters the settling character of the mixed liquor causes more frequent filter backwashes (if a tertiary filter is installed) or more solids loading to the percolation beds.

7.2.4 Recommended Phasing – Wasilla (1.0 MGD)

We recommend that the 1.0 MGD upgrades to the Wasilla WWTP be constructed in the following phased approach:

- Phase 1: Modify existing partially mixed aerated lagoon to a lagoon activated sludge system as described previously. The modified lagoon sizing, lagoon aeration and blower improvements, addition of a return activated sludge system, and sludge wasting from the existing clarifier will produce a lower nitrate effluent.
- Phase 2: Upgrade the existing clarifier, install a second clarifier, and enclose the two clarifiers in a new building. The Phase 2 clarifiers, and the aeration blowers completed under Phase 1 would allow the plant to operate up to 1.0 MGD.
- Phase 3: Install an effluent filter enclosed in an effluent filter building. Effluent filters constructed during this phase would further improve effluent quality. Solids to the percolation beds would be reduced which may improve percolation bed performance and extend their useful life.
- On-site septic tanks and leach fields represent a sizable percentage of wastewater systems in the MSB. Because of the larger lot sizes on-site wastewater systems will continue to be used by residents outside the core developed areas where municipal sewer is not available.

7.3 Septage Receiving/Pretreatment

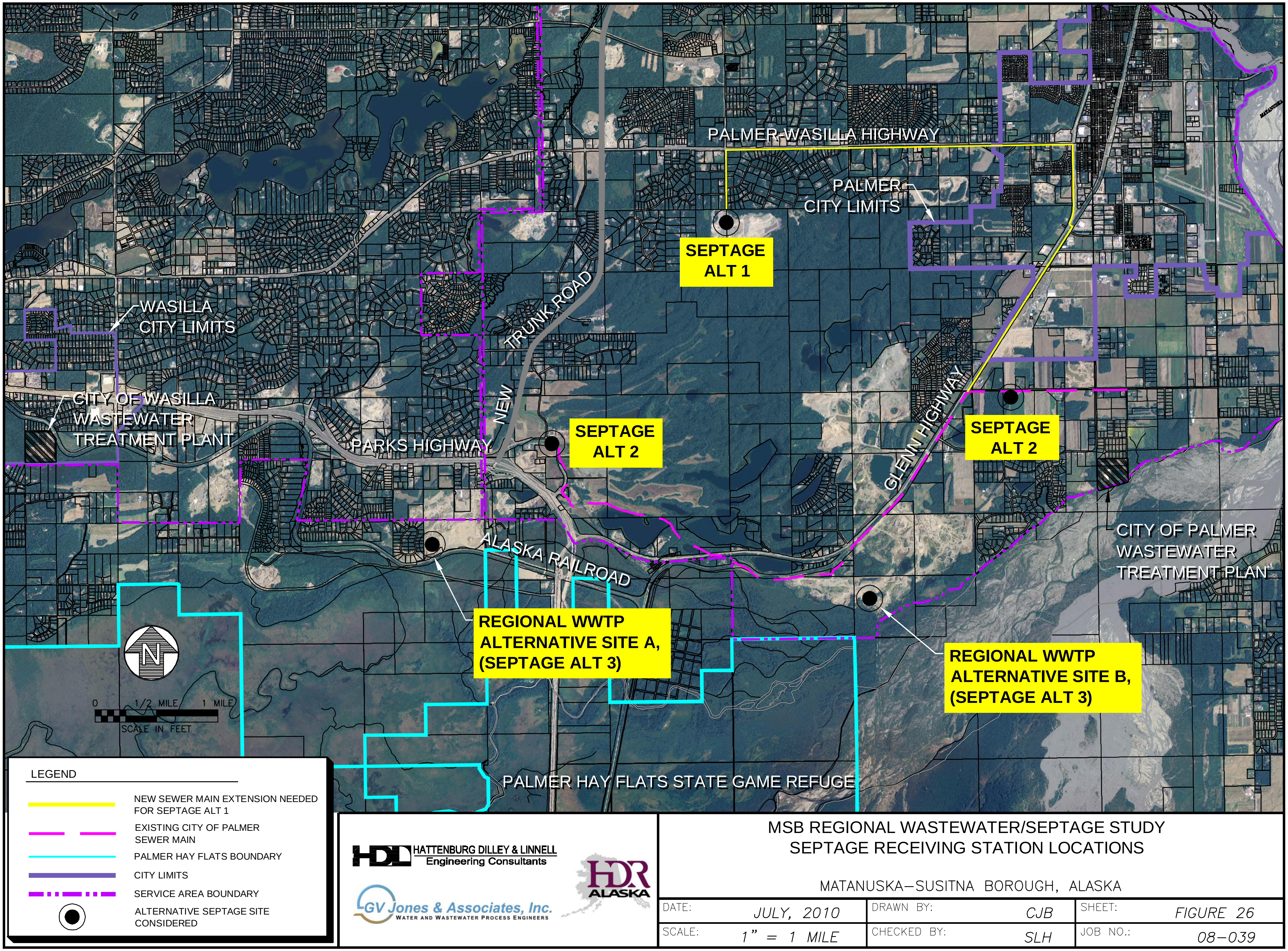
Septage pumped from on-site wastewater systems is transported by truck to the AWWU Turpin Street Facility for disposal. The cost to dispose of septage is influenced by three factors; labor for the round trip from the septic tank to the Anchorage disposal site, cost to operate and maintain the septic truck, and AWWU tipping fees. The longer the round trip, the higher the cost. The one-way distance from Wasilla to the AWWU Turpin Facility is approximately 40 miles. AWWU tipping fees are described in Section 6.3. The three cost factors are passed on to the rate payer.

Part of this study is to evaluate construction of a regional septage receiving facility for MSB septage haulers. The primary functions of the receiving facility are to allow transfer of the septage from the haul trucks, provide preliminary treatment of the septage (i.e. screening), and if the septage facility is located at a treatment plant, provide storage and equalization of the septage flows to avoid overloading the WWTP. The septage facility requires a treatment plant that is capable of treating the high-strength waste.

Septage receiving facilities are designed to allow haul trucks to drive through, empty septage into a receiving area and provide pretreatment with screening. Solids from the screening process would require dewatering and disposal. The high-strength liquid decant from the pre-treatment process would require treatment at a wastewater treatment facility. The following options were investigated for this study shown in Figure 26:

- Alternative 1: Stand alone septage receiving and screening facility at the MSB Central Landfill with on-site solids disposal, liquid decant mixed into a piped collection system and treated at a selected treatment facility.
- Alternative 2: Stand alone septage receiving and screening facility at a central location (near Palmer's Lift Station 6 or along Trunk Road) with liquid decant mixed into a piped collection system and treated at the selected treatment facility.
- Alternative 3: Septage receiving facility co-located with the proposed Regional WWTP at a central location.

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 26 - Alternative Septage Sites, 1=100, 06/08/10 at 08:47 by tlc
LAYOUT: Alternative Routes
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P



HATTENBURG DILLEY & LINNELL Engineering Consultants

GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
SEPTAGE RECEIVING STATION LOCATIONS

MATANUSKA-SUSITNA BOROUGH, ALASKA

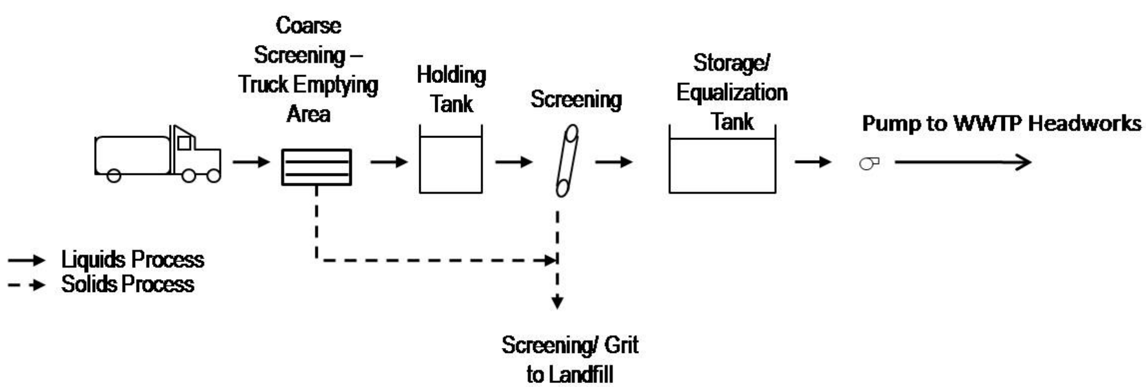
DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 26
SCALE:	1" = 1 MILE	CHECKED BY:	SLH	JOB NO.:	08-039

Regardless of location, the process and footprint of the facility remains essentially the same. The location of the facility can be moved to best fit land availability and proximity to existing piped sewer collection for discharge. These items are discussed further in the sections below.

7.3.1 Treatment Process

Stand-Alone Septage Recovering & Treatment (Septage Alt's 1 and 2). Pre-treatment for the septage would consist of coarse screening for large items (rags, rocks, etc.) via bar screening at the unloading site. From the bar screen, septage would be briefly collected in a holding tank prior to receiving additional screening and grit removal. A holding tank is advised to attenuate loading on the screen from the receiving of an entire haul truck load in a short unloading time. Additional screening would be required for pretreatment and grit removal. Screened septage would be held in a holding/equalization tank and metered into the municipal piped system for further treatment at the selected treatment facility. Solids from both the bar screen and screen/grit equipment would be collected and trucked to the central landfill for disposal. A schematic process of the stand alone facility is shown in Figure 27.

Figure 27: Septage Receiving Process



Co-located Septage Receiving & Treatment (Septage Alt 3). For Alternative 3, the process would be similar to that shown in Figure 27 above. Coarsely screened septage would be held in a small holding tank prior to fine screening and grit removal. This holding tank prevents overloading to the screening and grit removal process by attenuating high flow rates due to fast truck emptying. Liquids from the screen would be sent to a septage thickener. The thickeners would consist of a large holding tank with a rake arm to collect solids, and a decant weir for liquids collection. Liquids would be sent to the headworks of the treatment facility while thickened sludge would be collected and pumped to a digester or holding tank if a digester has not been constructed yet. Solids from both the bar screen and screen/grit equipment would be collected and mixed with dewatered solids from the rest of the treatment equipment ready for disposal.

Initial screening for the septage would require a coarse screen (approximately 2-inch openings). Self-cleaning models can be purchased to reduce maintenance. An example is manufactured by Headworks Mahr®. These screens are self cleaning, and can be enclosed for odor control.

Figure 28: Huber Technologies ROTAMAT®

Additional screening for septage can be achieved in a compact, integrated unit that includes screening, washing, dewatering, and compaction in one unit. An example of this type of assembly is manufactured by Huber Technology's ROTAMAT Series™ shown in Figure 28 Lakeside and Parkson manufacture similar equipment. Some advantages of these types of units are that they offer a compact footprint and no odor nuisance due to the enclosure and screening bagger.

7.3.2 Location

7.3.2.1 Septage Alternative 1: MSB Central Landfill Location

Septage Alternative 1 would be located at the MSB Central Landfill off the Palmer-Wasilla Highway. A plan view is shown on Figure 29. This alternative assumes that leachate would continue to be collected and treated on-site at the landfill in a separate process from the septage receiving. Separation of the two waste streams is recommended to eliminate introduction of toxic chemicals into the wastewater which could contaminate solids developed from downstream wastewater treatment processes. On-site measures for leachate are discussed further in Section 0.

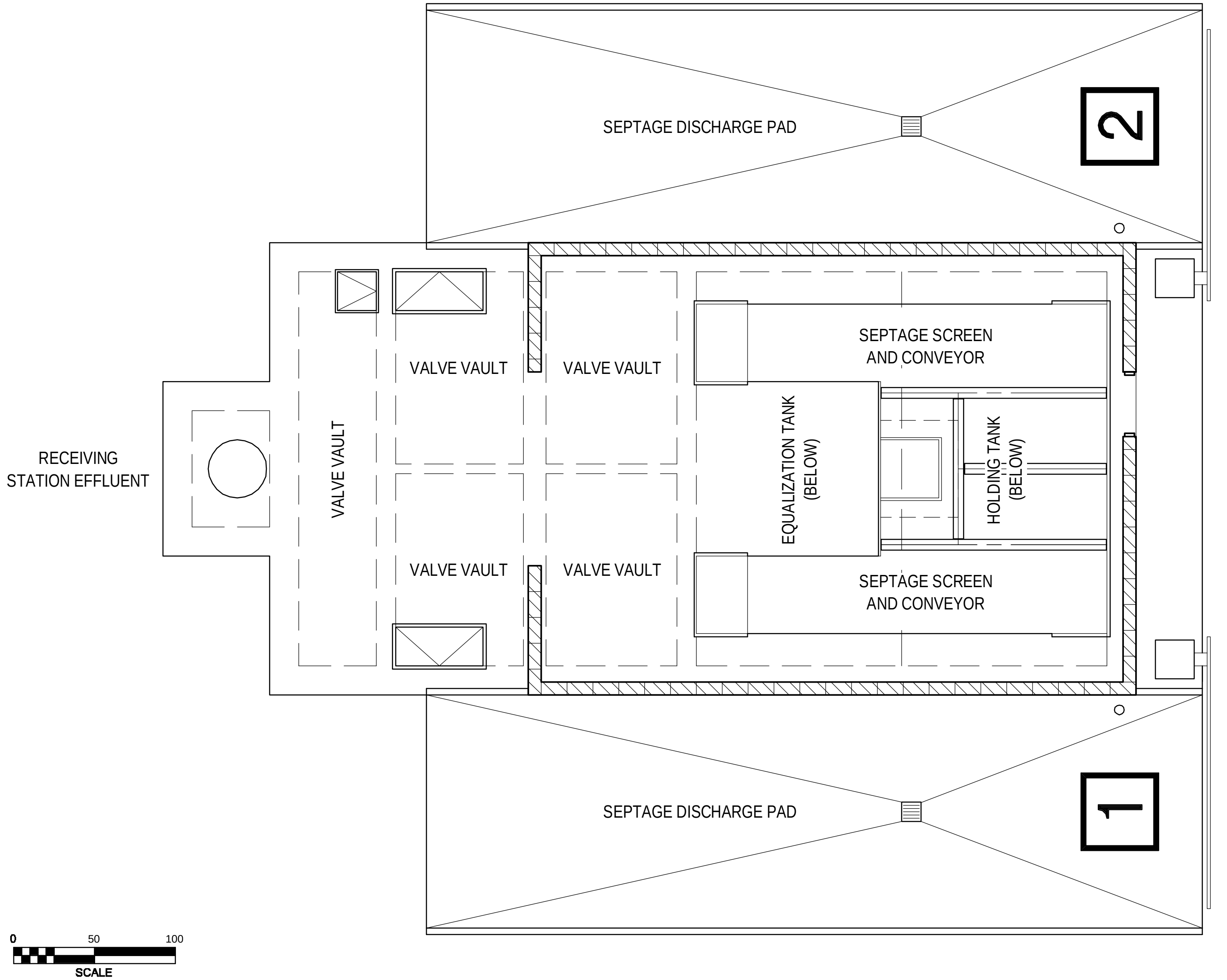
Advantages for locating the septage receiving facility at the landfill are:

- Good central location between Palmer and Wasilla.
- Existing landfill accomodates large septage haul truck access.
- Allows for some mixing of high strength liquid decant with lower strength municipal wastewater in the piping conveyance to attenuate BOD_5 and TSS loading at the wastewater treatment plant.
- Allows new municipal piped sewer services to connect to the decant piping conveyance.
- Utilizes existing land owned by the MSB.
- Eliminates hauling of solids – solids would be disposed of on-site at the landfill.
- Allows easy conversion of future discharge of liquid decant into the landfill for recirculation and methane recovery.

Disadvantages include:

- Requires approximately 29,000 lineal feet of conveyance piping.
- Requires operation of a satellite facility in addition to the WWTP.
- Requires space at the landfill that can no longer be used for solid waste services and disposal.

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 29 - General Septage Receiving Plan, 1=1, 06/08/10 at 08:51 by tlc
LAYOUT: Layout2
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P



HATTENBURG DILLEY & LINNELL Engineering Consultants

GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
SEPTAGE RECEIVING STATION PLAN

MATANUSKA-SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 29
SCALE:	1" = 100'	CHECKED BY:	SLH	JOB NO.:	08-039

7.3.2.2 Septage Alternative 2: Central Location not at the WWTP

Septage Alternative 2 could be located either near Palmer's Lift Station 6 on Inner Springer Loop or along Trunk Road.

Advantages for locating the septage receiving facility at a central location not at the WWTP are:

- Reduces new conveyance piping and pumping required to get liquid discharge to a treatment facility because it is located near existing sewer system infrastructure.
- Allows for some mixing of high strength liquid discharge with lower strength municipal wastewater in the piping conveyance to attenuate BOD_5 and TSS loading prior to arriving at the wastewater treatment plant.
- Trunk Road is a good central location near the Parks Highway.

Disadvantages include:

- Requires operation of a satellite location for pre-treatment of wastewater in addition to treatment facilities already in operation.
- Requires purchase of private land.
- Located near other private property with unknown development plans. Land use conflicts may occur.
- Requires seperate hauling of solids and disposal at the landfill.
- Inner Springer Loop location is not as centrally located. (Access may be more difficult)

7.3.2.3 Septage Alternative 3: Co-Located Facility

Septage Alternative 3 would be located at or very near the location selected for the new regional wastewater facility.

Advantages for co-locating the septage receiving facility at the new regional wastewater plant are:

- Provides a fairly central location between Palmer and Wasilla.
- Connects to main roads conducive for large haul truck access.
- Does not require operation of a satellite facility.
- Solids management and disposal can be integrated with the solids processes from the wastewater treatment equipment.
- Eliminates need for pipe conveyance for the decant liquid to the selected treatment facility.

Disadvantages include:

- Not necessarily the most convenient location for haulers to access.

7.4 Landfill Leachate

As precipitation percolates through landfills the water becomes contaminated by contact with the decomposing solid waste creating leachate. Contaminants include heavy metals, organic compounds such as PCBs and dioxins, fuels, and inorganic compounds. The percolation of water also promotes and assists in the decomposition process of the waste. The by-products of this decomposition are methane, carbon dioxide, heat, a decrease in the pH, and release of additional water which generates more leachate volume.

Sometimes, treatment of leachate is achieved at a wastewater treatment facility. However, leachate co-mingled with wastewater can cause a number of problems at the WWTP. Toxic metals from the leachate accumulate in the sewage sludge making disposal of the solids generated from the wastewater treatment processes difficult without incurring risk to the environment. Additionally, leachate can be difficult to treat because it contains high ammonia nitrogen concentrations, is acidic, and is often anoxic and low in phosphorus content which can result in nutrient starvation to the biological communities that perform the biological treatment.

An alternative method of leachate management is to collect the leachate and re-inject it into the waste mass for recirculation. This process can accelerate the decomposition of the waste and increase methane gas production. Landfills around the country are also investigating re-injection and circulation of screened septage at landfills to promote methane gas production, which can be captured and converted for energy generation.

Currently leachate generated at the MSB Central Landfill is collected on-site, trucked to Anchorage, discharged into the AWWU system at the Turpin receiving station, and treated at the Asplund Wastewater Treatment Facility. This disposal practice is costly because of the long-distance hauling requirements and disposal fees associated with discharging into the Anchorage system.

Discussions with the landfill managers indicate that they intend to pursue engineering solicitations to provide options on long-term management of the leachate on-site. This may include evaporation and leachate re-circulation.

For the near term, the MSB intends to continue hauling the leachate to Turpin Street for discharge into the AWWU system. During this period, on-site leachate management techniques will be evaluated and prepared for implementation. Once these options are installed, the leachate will be managed and treated on-site; therefore it is not included in this evaluation.

8.0 LONG TERM ALTERNATIVES

8.1 City of Wasilla

The existing Wasilla WWTP site could serve as a possible location for a regional WWTP using a mechanical process; however, the non-central location and disposal issues precluded it from further consideration. The existing site with a lagoon activated sludge process can accommodate the near term upgrades described in Section 7.2 Once capacity is reached, no additional sewer services could be added to the system, without a change in the disposal method.

Converting to a surface water disposal would require the construction of 4.5 to 8 miles of new out fall and two new lift stations, depending on the out fall location permitted. The preliminary cost of a new outfall has been estimated to be between $12 and $21 million (2009). Because of the high outfall cost, Wasilla has suggested joining with Palmer may be the most attractive option.

The long term solution preferred by Wasilla is to eventually convey all wastewater (including septic tank effluent and septage) to a regional WWTP located either in a central location, or at Palmer's existing WWTP site.

The expansion of Wasilla's wastewater collection system within their Utility Service Area is expected to occur in phases. The expanded collection system would use gravity sewers with lift stations to pump from low areas. Current and future septic tank effluent from the City's piped STEP system would be collected at the existing WWTP site and conveyed by lift stations and piping into the new regional WWTP. Septage processing would continue at the Wasilla site until the septage treatment facility reaches its useful life or it becomes less expensive to process septage at a regional facility.

8.2 Regional Facility Constructed at Existing Palmer WWTP

8.2.1 Lagoon Activated Sludge System

One alternative for a regional WWTP is to upgrade Palmer's existing WWTP to handle the anticipated flows from the region. The lagoon activated sludge system presented as part of the proposed near term upgrades for Palmer could be expanded to treat up to 4 MGD without earthwork for additional lagoons. This system would take advantage of existing conveyance and treatment infrastructure already in place. See Figure 2 on Page 5 for a site layout of potential improvements to make Palmer a regional WWTP.

Improvements to the Palmer lagoon system would involve covering both lagoons and shortening the lagoon process basins with earthern dikes to maintain an approximate one to two day hydraulic retention time. Upgrades would be made to the headworks to allow for average daily flows of up to 4 MGD. Primary clarification basins would be installed inside of this headworks building to remove settleable solids from the influent waste stream prior to discharge to the treatment lagoons. A clarifier building housing three secondary clarifiers, redundant filtration units and a new UV disinfection system would be built. Sludge stabilization would be achieved with the installation of anaerobic digestion units. Digested sludge would be pumped to a new biosolids building where it would be mechanically dewatered prior to ultimate disposal. Table 17 shows preliminary design parameters for the sizing of a 4.0 MGD average daily flow lagoon activated sludge treatment system at the Palmer WWTP.

Table 17: Preliminary Design Parameters – Palmer LAS

Parameter	4.0 MGD ADF
Design Hydraulic Retention Time, hours	25
Ratio of Return Sludge Flow to Plant Inflow	0.75
Solids Retention Time, days	55 to 70
MLSS Concentration, mg/L	3,000 to 3,400
Total Pond Volume Required, MG	7.2
Number of Treatment Ponds, each	2
Total Aerobic Pond Volume, MG	3.6
Total Anoxic Pond Volume, MG	3.6
Overall Top of Water Pond Dimensions, feet	132 x 500
Side Water Depth (SWD), feet	9.7

Advantages of constructing a 4.0 MGD Lagoon Activated Sludge regional WWTP at Palmer include:

- Maximizes the use of existing excavations for lagoons.
- Retains continued use of the existing permitted effluent discharge outfall to the Matanuska River without influencing local area groundwater wells with subsurface disposal of treated effluent.
- Continues to use and expand existing wastewater treatment infrastructure.
- Does not require additional land.

Disadvantages of constructing a 4.0 MGD Lagoon Activated Sludge regional WWTP at Palmer Include:

- Treatment performance may be compromised in the coldest winter months even if the lagoons are covered.
- Additional earthwork and land for lagoons may be required to treat wastewater flows beyond 4 MGD.
- The system is subject to the same constraints of any activated sludge process where the quality of the effluent relies on the gravity settling characteristics of the mixed liquor. Any process upset that alters the settling character of the mixed liquor results in loss of solids in the treated effluent causing more frequent backwashes to a tertiary filter.

8.2.2 Solids Handling

Solids from the lagoon activated sludge treatment processes will require dewatering and stabilization prior to disposal. While the 2.0 MGD process evaluated for near term upgrades to the Palmer WWTP involves sludge stabilization with Lagoon 3, it is assumed that the stabilization and removal of solids generated from a 4.0 MGD wastewater plant will contribute to O&M costs through aeration and pumping and will make this practice very expensive as flows increase. Because of these anticipated costs and also the potential to offset energy costs to the plant through biogas recovery and reuse, waste activated sludge solids will be thickened and sent to an anaerobic digester for stabilization. Solids from anaerobic digesters will be sent to a solids holding tank prior to dewatering. Dewatering can be achieved with multiple belt filter presses, which can achieve a minimum of 20% solids.

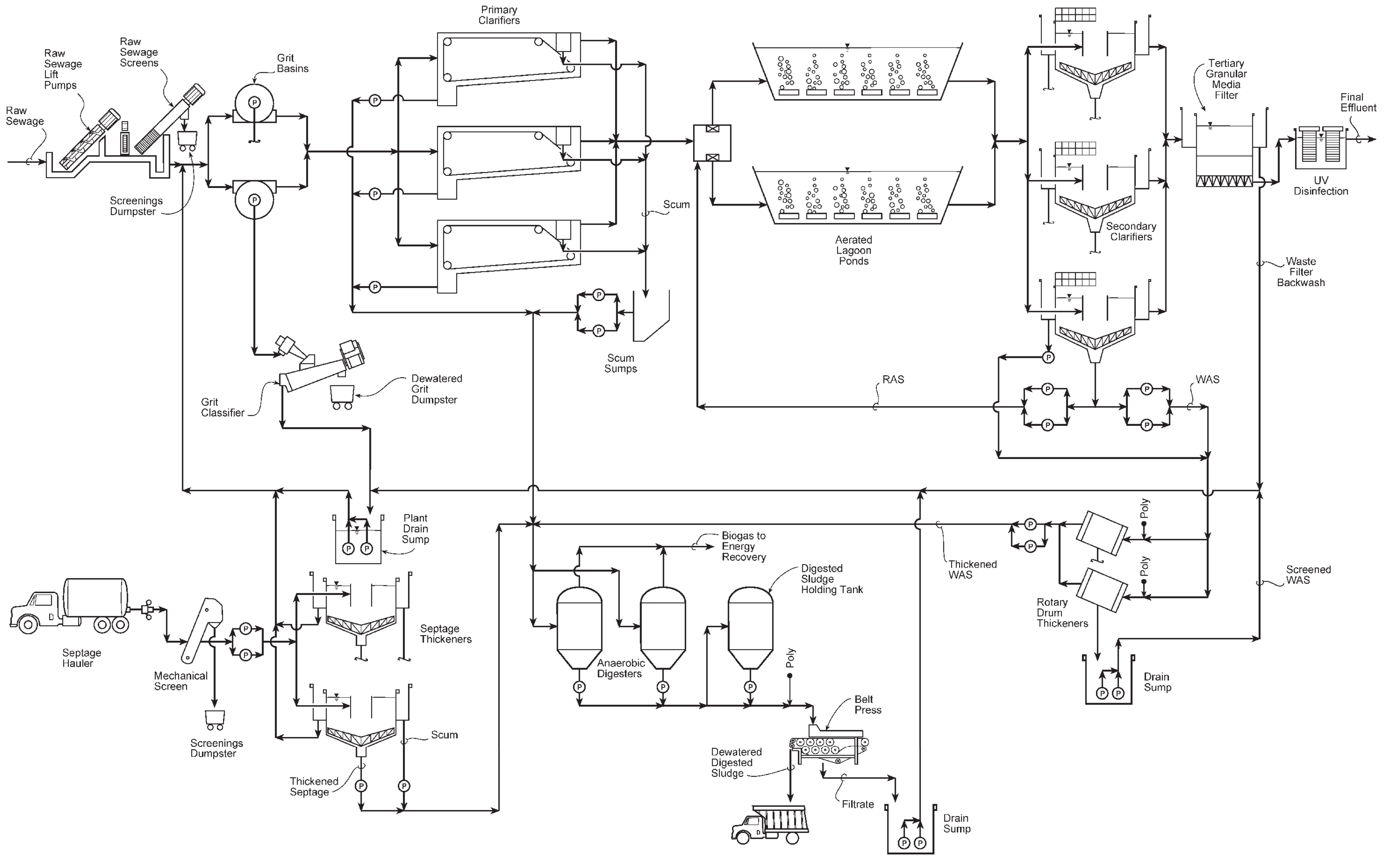
Primary clarification is also included in the 4.0 MGD process train, which reduces the loadings to the secondary treatment process and reduces the size of lagoon reactor basins. Primary clarifiers will send solids to the anaerobic digester, where they can potentially be used for methane gas generation and energy recovery. It is recommended that a redundant filter press system be used to contain operations within a 40 hour work week and be available during maintenance. Polymers would be added prior to mechanical dewatering to achieve the desired solids concentration. Return flows from the filter press will be sent to the headworks for treatment in the main stream.

Dewatered solids will be stabilized and disposed of by on-site monofill, trucking to the landfill, or land application. The method employed will depend on permit limits and the level of stabilization achieved.

8.2.3 Recommended Phasing

We recommend that 4.0 MGD upgrades to the Palmer WWTP be constructed in the following phased approach; these upgrades assume that near-term process upgrades have been previously implemented:

- Phase 1: Modify Lagoon 2 into a lagoon activated sludge process by adding a lagoon cover, modifying process basin area, improving aeration equipment and piping. Construct additional clarifiers in space allotted inside of clarifier building. Expand headworks building to accommodate up to 4.0 MGD ADF of influent flows.
- Phase 2: Construct additional filtration units and UV disinfection basins to handle up to 4.0 MGD ADF of effluent flows. Construct sludge dewatering building to handle increased sludge and to provide enhanced sludge treatment/stabilization and disposal.
- Phase 3: Construct primary clarification units to manage influent solids loadings to lagoon process basins. Construct anaerobic digesters for sludge stabilization and possible biogas generation.



HATTENBURG DILLEY & LINNELL Engineering Consultants

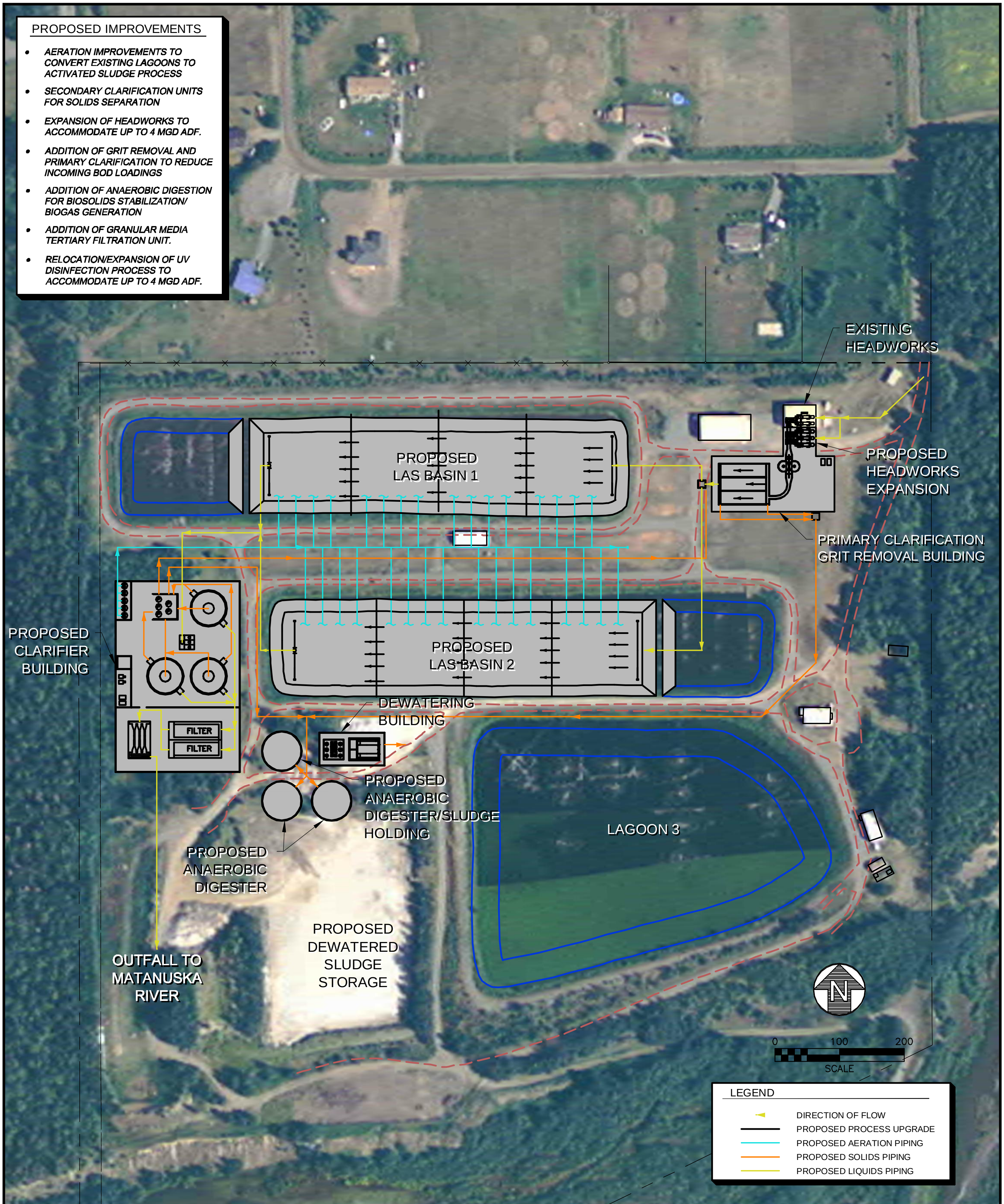
GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
PALMER WWTP PROCESS SCHEMATIC-LAS (4.0 MGD)

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 30
SCALE:	NTS	CHECKED BY:	SLH	JOB NO.:	08–039



HATTENBURG DILLEY & LINNELL
Engineering Consultants

GV Jones & Associates, Inc.
WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
PALMER WWTP (4.0 MGD)

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE: JULY, 2010	DRAWN BY: CDB	SHEET: FIGURE 31
SCALE: 1" = 200'	CHECKED BY: SLH	JOB NO.: 08–039

H:\jobs\08–039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 31 – Palmer RWWTP Site Plan, 1=100, 06/08/10 at 08:57 by tlc
LAYOUT: palmer
XREF: 08039_00_IMAGE, WASILLA SITE PLAN

8.2.4 Wastewater Conveyance

To convey wastewater from the existing Wasilla WWTP to a regional WWTP either centrally located or located at Palmer, a variety of routes were evaluated, see Figure 39 on Page 100. A route that follows the Parks Highway was selected for further detailed evaluation because of lower cost and proximity to projected high growth areas between Wasilla and Palmer. This provides maximum recuperation of capital costs by providing service to more customers earlier. Sizing of this pipeline includes flows from Wasilla's wastewater collection system, plus portions of the Wasilla Utility Service Area along the Parks Highway and Palmer Wasilla Highway corridors as well as flows from The Ranch subdivision.

Conveyance of wastewater to a regional WWTP located at Palmer would maximize the reuse of existing sewer infrastructure. In 2005, Palmer extended its sewage collection network to the Mat-Su Regional Medical Center located near the Parks Highway/Trunk Road interchange. This extension consisted of approximately 31,000 linear feet of gravity sewer and force main that moves wastewater from the hospital area westward to the Palmer WWTP. The piping is sized to handle maximum flows of approximately 3.85 MGD with the installation of larger lift station pumps and lift station storage capacity. If flow from Wasilla is accepted into Palmer's system it is anticipated that portions of the gravity sewer and force main between the hospital and Lift Station 5 will need to be upgraded when flows reach approximately 3.5 MGD, which is expected to be in approximately 2033.

8.3 Regional Facility – Centrally Located

Two separate treatment processes were evaluated for a new, centrally located regional WWTP: CAS and MBR. The CAS system produces a secondary quality effluent and with the addition of a granular media filter, would produce a tertiary quality effluent. The MBR process would produce the highest quality effluent. While each is well suited to meet current performance objectives of the receiving water body, the MBR plant is better suited to meet potentially more stringent future regulations placed on the receiving waters. The new, centrally located regional facility would also be configured to receive and treat septage on-site. A brief discussion of the two alternative treatment processes selected for study as a regional WWTP is provided in sections 8.3.2.1 and 8.3.2.2. For a more in depth discussion on process biology and equipment, please refer to Appendix D of this report.

8.3.1 Preliminary Treatment

Preliminary treatment generally consists of processes designed to remove large solids and grit. This can also include flow metering equipment and flow attenuation tanks. The preliminary treatment processes selected for the purposes of this study were defined in the Technical Memorandum presented to the entities in April. Based on information presented in the memorandum it was decided that drum screens will be utilized for fine screening of influent and a forced vortex style system will be used for grit removal. In addition to screening and grit removal processes it was determined after an analysis by HDR that preliminary treatment processes, including primary clarification would be implemented prior to biological treatment processes. The processes selected will be utilized as the basis for equipment layouts and cost analysis.

8.3.2 Wastewater Treatment Process Alternatives

8.3.2.1 Conventional Activated Sludge

CAS is a biological treatment system that uses a dispersed growth biomass to operate on influent organic loadings. The process maintains aerated biomass reactor basins with solids (referred to as mixed liquor solids) concentrations of approximately 2,500 to 3,500 mg/L on average. Aeration is provided with low pressure blowers that maintain dissolved oxygen concentrations between 1.5 and 4 mg/L. Mixed liquor leaving the aerated reactors is directed to a clarifier where solids separate from the main process flow by gravity sedimentation. Settled water (supernatant) from the clarifier receives tertiary granular media filtration prior to UV disinfection and discharge. Settled solids are collected in the clarifier and, except for a small portion of the total solids flow, returned to the flow entering the aerated biological reactor basins and referred to as return activated sludge (RAS). A certain amount of RAS is needed to maintain the necessary levels of nitrifying microbes within the process basins. The remaining fraction of solids is wasted from the system for further processing and ultimate disposal. Table 18 summarizes preliminary design parameters for a conventional activated sludge system.

Table 18: Preliminary Design Parameters - CAS

Parameter	4.0 MGD ADF
Design Hydraulic Retention Time, hours	14.7
Ratio of Return Sludge Flow to Plant Inflow	0.75
Solids Retention Time, days	15 to 20
MLSS Concentration, mg/L	2,100 to 2,200
Total Tank Volume Required, MG	4.29
Number of Treatment Trains	3
Total Aerobic Tank Volume, MG	3.63 summer 2.97 winter
Total Anoxic Tank Volume, MG	0.66 summer 1.32 winter
Overall Bioreactor Tank Dimensions, feet	Width: 125 Length: 270 Height: 19
Side Water Depth (SWD), feet	16

Advantages of constructing a 4.0 MGD Conventional Activated Sludge treatment system at a new RWWTP site include:

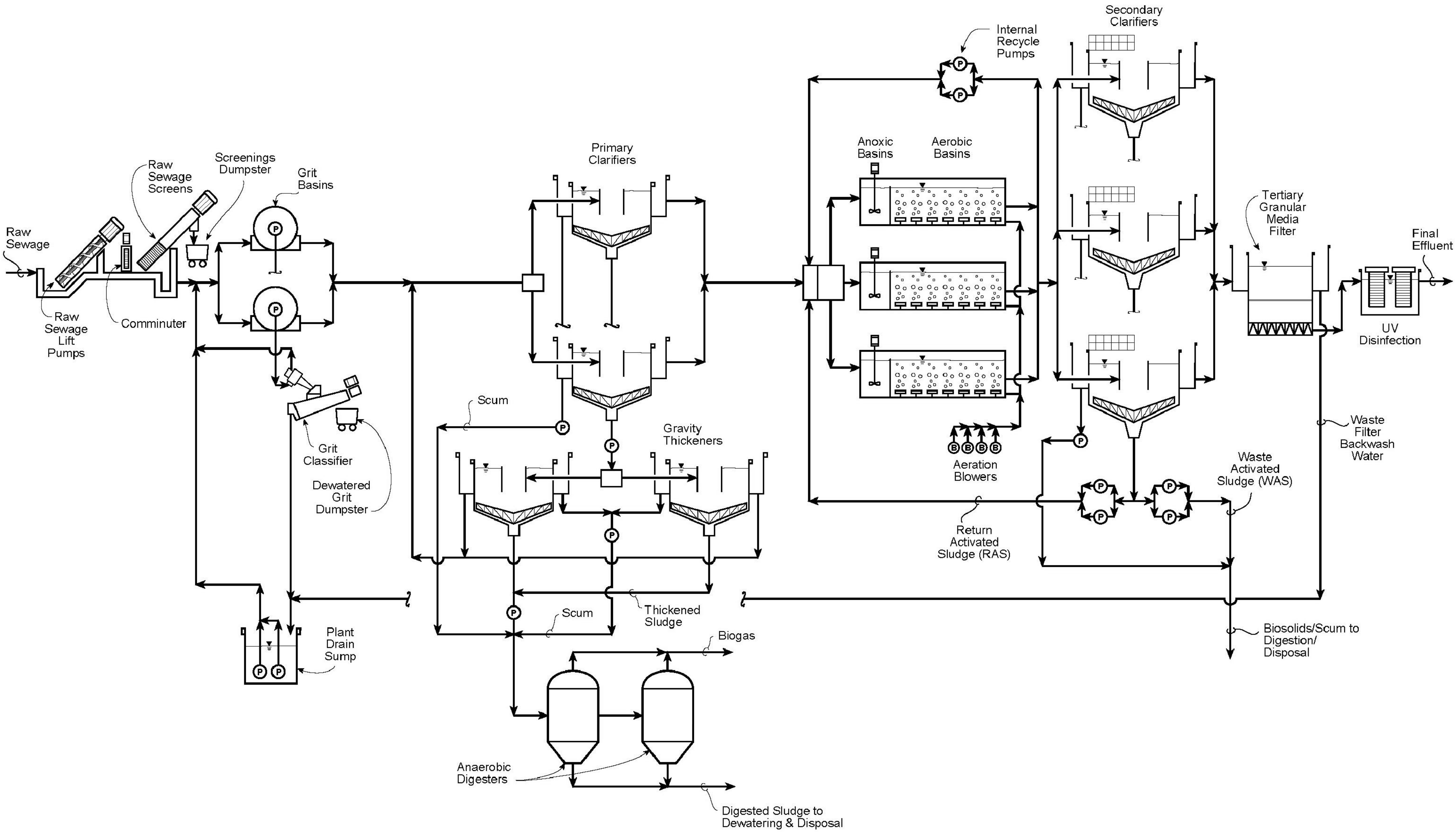
- Well established, understood, and widely used process across the US and Alaska. AWWU's Eagle River, Alaska plant is a 2.5 MGD CAS WWTP that discharges in to a salmon migration stream.
- Process can be expanded in modular format with future additional reactor basins and clarifiers.
- Range of peak day influent flows that can be handled is up to 2 times ADF.

- Moderate levels of nitrification are possible if sufficient alkalinity is available and if normal influent hydraulic loadings do not wash microorganisms out of the treatment plant.

Disadvantages include:

- Process performance falls off when flows are increased by stormwater or groundwater infiltration and when higher than normal influent biological loadings occur from intermittent sources.
- Relatively large biological reactor basins are required.
- Large heated weather enclosure for biological reactor basins is required.
- Low process solids retention time (SRT) can result in limited capacity to nitrify at colder temperatures.
- Periodic events of sludge bulking impair settling and deteriorate effluent quality.
- To routinely achieve a tertiary target objective of average 15/15 mg/L for effluent BOD5 and TSS, granular media filtration would be needed.
- To routinely achieve target objective of less than 5 mg/L effluent nitrate concentrations, system configuration for biological nitrification/de-nitrification likely required.

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 32 - Regional WWTP CAS Process Schematic, 1=1, 06/08/10 at 09:01 by tlc
LAYOUT: Layout2
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P



HATTENBURG DILLEY & LINNELL
Engineering Consultants

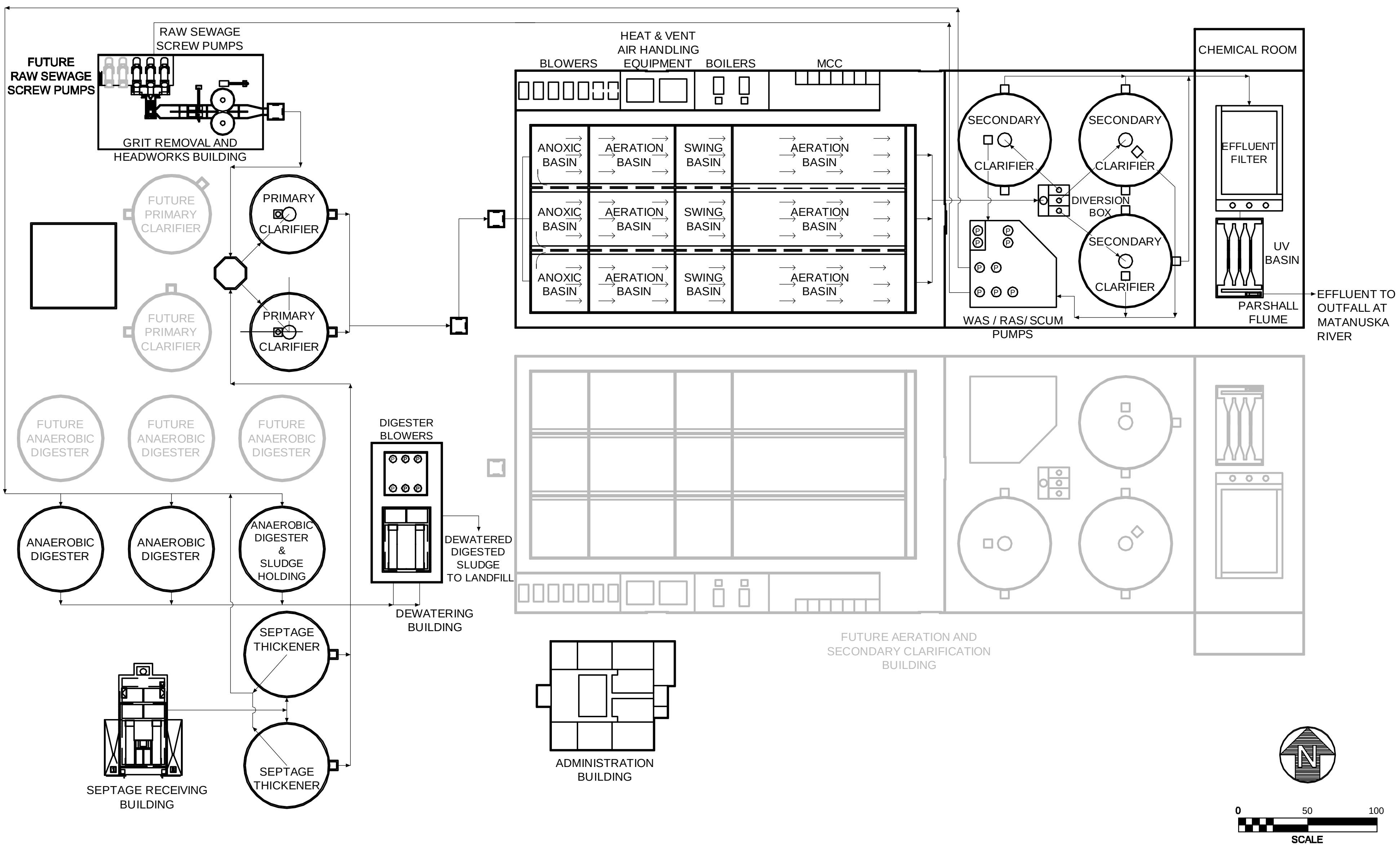
GV Jones & Associates, Inc.
WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
REGIONAL WWTP PROCESS SCHEMATIC-CAS (4.0 MGD)

MATANUSKA-SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 32
SCALE:	NTS	CHECKED BY:	SLH	JOB NO.:	08-039



LEGEND

- DIRECTION OF FLOW
- PROPOSED MANHOLE
- PROPOSED PUMP
- PROPOSED AERATION BLOWER

HATTENBURG DILLEY & LINNELL
Engineering Consultants

GV Jones & Associates, Inc.
WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
REGIONAL WWTP PLAN - CAS (4.0 MGD)

MATANUSKA-SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 33
SCALE:	1" = 100'	CHECKED BY:	SLH	JOB NO.:	08-039

8.3.2.2 Membrane Bioreactor

The MBR system is also a dispersed growth activated sludge process, but the MBR achieves solids separation through mechanical sieving provided by microfiltration (MF) or ultrafiltration (UF) membranes immersed in mixed liquor rather than gravity clarification.

Because of the unique way that the MBR process works it can produce a treated effluent that meets or exceeds tertiary treatment standards. A system with a hydraulic residence time (HRT) of less than 8 hours can typically produce an effluent with less than 10 mg/L BOD_5 and less than 3 mg/L TSS. A significant reduction in fecal coliforms (prior to disinfection) can also be achieved. Biological nutrient removal is possible by configuring the biological reactor basins upstream of the membrane filters to include anoxic and/or anaerobic basins and extending the hydraulic retention time. The membrane modules also allow MBR's to operate at long sludge ages reducing the amount of sludge produced.

Membranes are commonly immersed in an aerated basin of mixed liquor. Filtration occurs in a manner termed "outside-in" when a vacuum is applied to the inside of the membrane drawing wastewater from outside the membrane to the interior, leaving the solids in the basin. Aeration is provided at the base of the membrane to scour and agitate the membranes as applicable thus reducing the accumulation of solids at the membrane surface. Several times each hour, the membranes are backwashed with stored filtrate (i.e., treated effluent), or allowed to "rest" (i.e. no permeation) such that the scour air may better dislodge accumulated solids.

MBR's typically operate at much higher mixed liquor concentrations (i.e. 8,000 to 10,000 mg/L) than the other dispersed growth biological treatment processes discussed in this report. As a result, the aerated reactor basin volumes are often smaller than conventional activated sludge processes. The efficiency of solids separation provided by the membranes is largely independent of influent flow rate, influent wastewater organic concentration, and/or mixed liquor properties making the system easier to operate than conventional activated sludge treatment systems.

Flow through MBR treatment plants is limited by the rate of flow that can pass the membrane filters. Common references indicate at 15 to 18 degrees C, and mixed liquor solids concentrations of 8,000 to 10,000 mg/L, most membrane filters are rated to operate at a flux of 6 to 13 gallons per square foot per day (gfd) of membrane surface area, but can operate at up to 20 gfd for short periods of time. By contrast, conventional gravity clarifiers are usually designed to pass a much wider range of influent flows. To overcome this limitation in process flows, MBR treatment facilities are configured with either an equalization tank to control the peak rate of flow through the treatment facility, or increased numbers of membrane modules such that at peak flow conditions, the membranes are still operating at less than their maximum rated flux. Table 19 summarizes selected preliminary design parameters for a membrane bioreactor system.

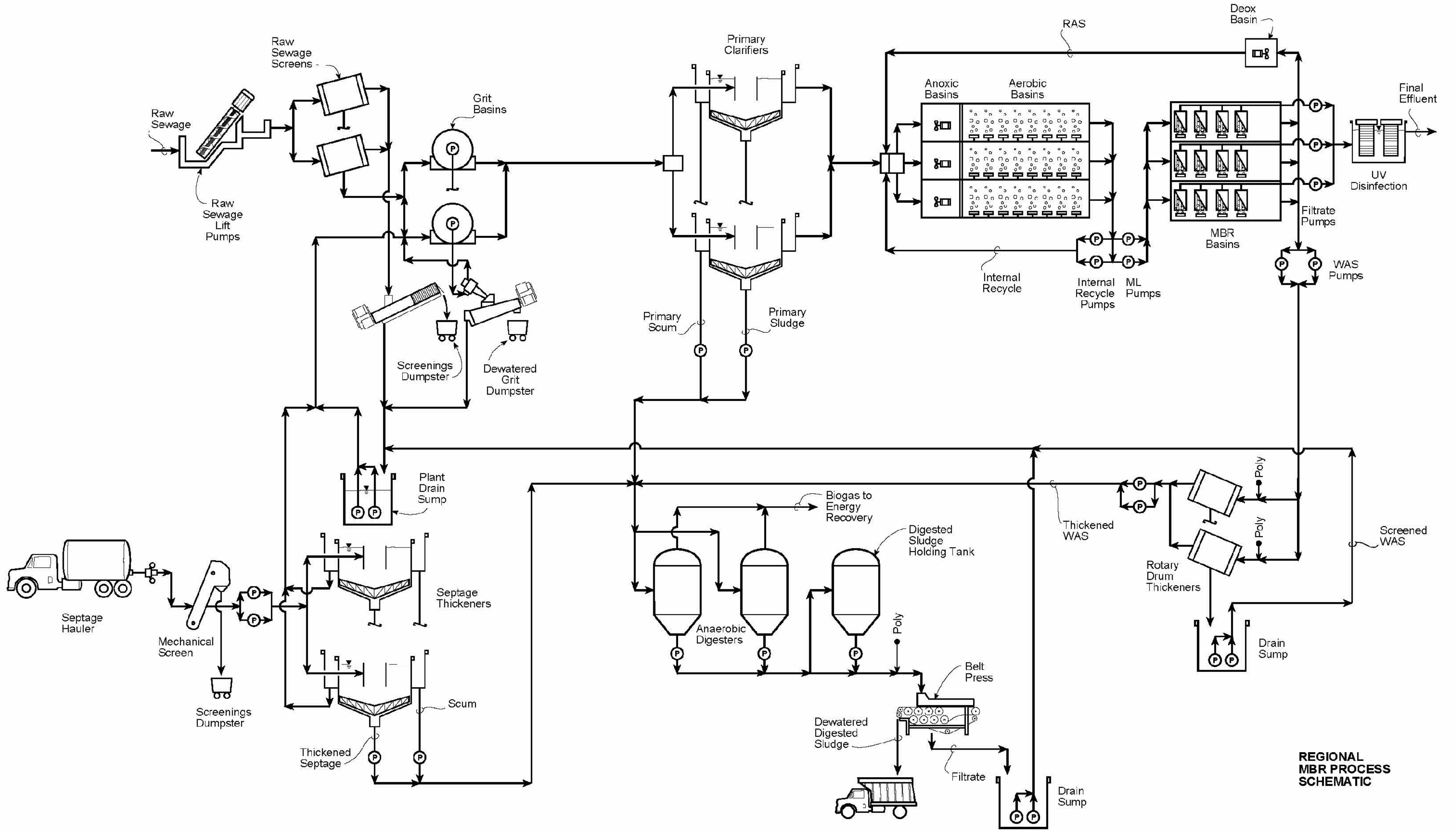
Table 19: Preliminary Design Parameters - MBR

Parameter	4.0 MGD ADF
Design Hydraulic Retention Time, hours	3.9
Ratio of Return Sludge Flow to Plant Inflow	0.75
Solids Retention Time, days	16 to 26
MLSS Concentration, mg/L	6,700 to 8,000
Total Tank Volume Required, MG	1.14
Number of Treatment Trains	3
Total Aerobic Tank Volume, MG	0.90
Total Anoxic Tank Volume, MG	0.24
Overall Tank Dimensions, feet	Width: 65 Length: 156 Height: 19
Side Water Depth (SWD), feet	16
Number of Membrane Submodules	1,900

Advantages of constructing a 4.0 MGD MBR treatment system at a new RWWTP site include:

- The process produces excellent quality effluent.
- The effluent quality is more consistent than effluent from a lagoon or conventional activated sludge treatment process.
- The effluent quality is easier to control. Solids separation is achieved by membrane filtration and not with gravity settling as occurs in a clarifier. As a result, the effluent quality is independent of the gravity settling characteristics of the mixed liquor.
- Smaller process basins result in a smaller footprint for the treatment plant that is comparatively less expensive to enclose with weather protection and heat.
- The elevated concentration of active biomass in the system enables greater opportunities for biological nitrification and nutrient removal.
- The process is more adaptable to automated operation and control than conventional or lagoon activated sludge systems.
- The membrane filters are configured as modules that can be added as flow increases over time. Unlike conventional treatment, this modularity enables capital expense to more closely track the growth of the service area.

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 34 - Regional WWTP MBR Process Schematic, 1=1, 06/08/10 at 09:10 by tlc
LAYOUT: Layout2
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P



REGIONAL MBR PROCESS SCHEMATIC

HATTENBURG DILLEY & LINNELL Engineering Consultants

GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

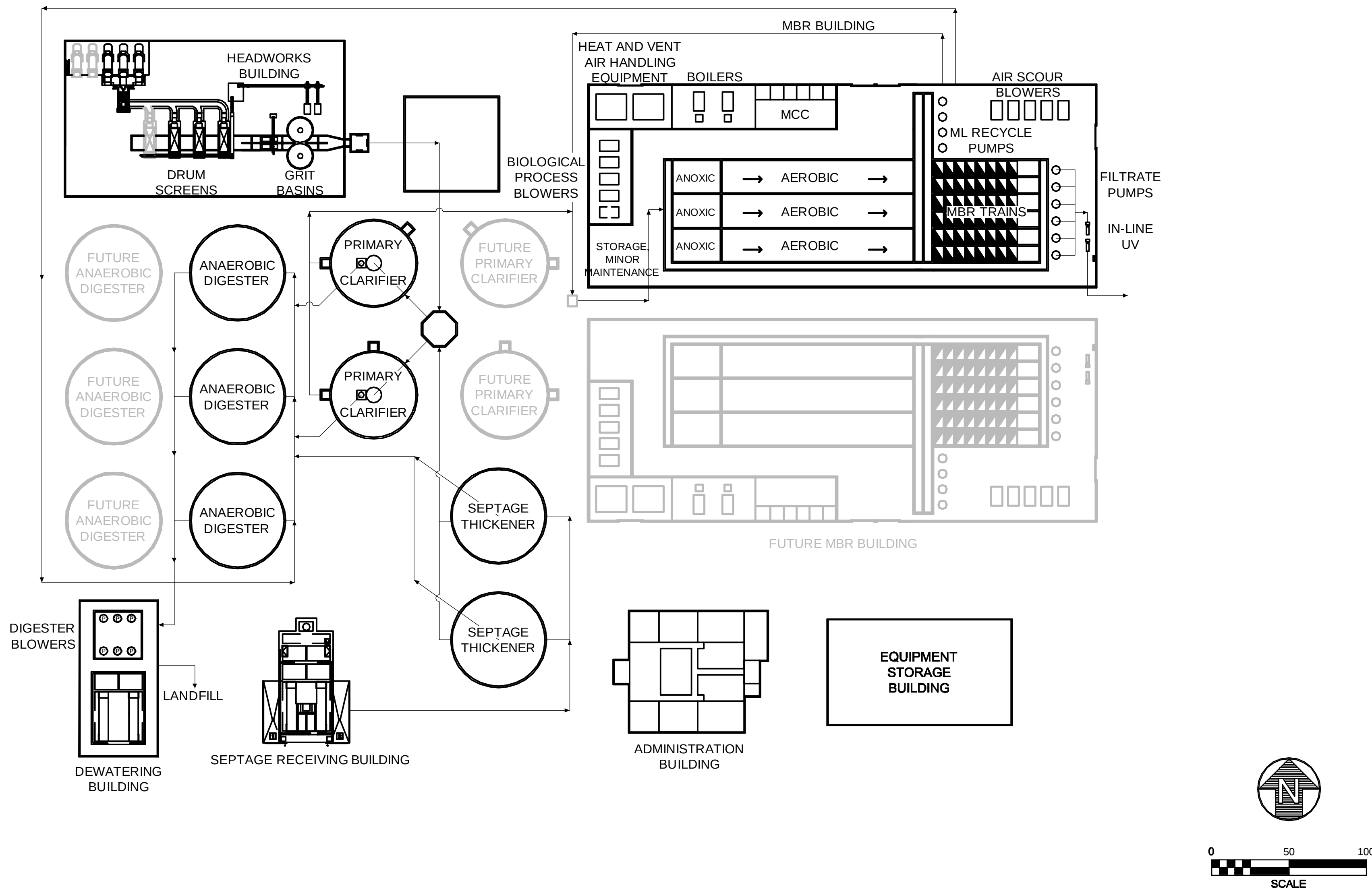
HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
REGIONAL WWTP PROCESS SCHEMATIC-MBR (4.0 MGD)

MATANUSKA-SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 34
SCALE:	NTS	CHECKED BY:	SLH	JOB NO.:	08-039

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 35 - Regional WWTP MBR Layout, 1=1, 06/08/10 at 09:13 by tlc
LAYOUT: Layout2
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P



LEGEND

←	*DIRECTION OF FLOW*
○	*PROPOSED MANHOLE*
Ⓟ	*PROPOSED PUMP*
Ⓑ	*PROPOSED AERATION BLOWER*

HATTENBURG DILLEY & LINNELL
Engineering Consultants

GV Jones & Associates, Inc.
WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
REGIONAL WWTP - MBR (4.0 MGD)

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 35
SCALE:	1" = 100'	CHECKED BY:	SLH	JOB NO.:	08-039

Disadvantages include:

- Energy consumption is generally higher for the MBR process than for other biological treatment processes.
- Fouling occurs on the membranes. Cleaning to remove these foulants consists of periodic air scour with aeration, intermittent in-place maintenance cleaning with chlorinated backwashing, and chemical cleaning where the membranes are subject to various chemical cleaning regimens.
- Biomass fouling can accumulate in the air headers beneath the membranes if not routinely scoured with air or periodically cleaned by chemical means.
- Membrane filters have a limited operating life and require replacement generally every 5 years at a relatively high purchase cost.
- The membrane filters and related equipment are not interchangeable between membrane equipment manufacturers. Once a decision is made to use a manufacturer's equipment, no other manufacturer can supply (or easily supply) replacement membranes or service for that product.
- The process is susceptible to foaming events during low food-to-microorganism loading conditions. This is more common during plant start up conditions.

8.3.3 Solids Handling

Solids from the various treatment processes will require dewatering and stabilization prior to disposal. For either the MBR or the CAS treatment alternatives, excess waste activated sludge solids will be thickened and sent to a digester for stabilization. Digesters will be configured for aerobic stabilization initially and converted to an anaerobic process after necessary flows are achieved to maintain process temperatures and potentially generate excess biogas for energy recovery. Solids from the digesters will be sent to a holding tank prior to dewatering. Dewatering can be achieved with multiple belt filter presses, which can achieve a minimum of 20% solids.

Primary clarification is included in the process train, which will reduce the loadings to the secondary treatment process and thereby reduce the size of aeration and/or MBR basins. These primary clarifiers will be installed concurrently with conversion of digesters to an anaerobic process. They will send solids to the anaerobic digesters, where they can potentially be used for energy recovery. We recommend a redundant filter press system be employed to keep operation within a 40 hour work week and to be available during maintenance. Polymers would be added prior to mechanical dewatering to achieve the desired solids concentration. Return flows from the filter press will be sent to the headworks for treatment in the main stream.

Dewatered solids will be stabilized and disposed of by on-site monofill, trucking to the landfill, or land application. The method employed will depend on permit limits and the level of stabilization achieved.

8.3.4 Recommended Phasing – Regional CAS WWTP (4.0 MGD)

We recommend that the following phasing plan be implemented for construction of the 4.0 MGD centrally located regional CAS WWTP:

- Phase 1: Construct Headworks, biological process basins, two complete secondary clarifiers (and third basin), effluent filter and UV disinfection basins, sludge dewatering building and septage receiving station, enclosed in weather tight buildings. Construct two aerobic digesters for sludge stabilization prior to dewatering and disposal. Initial phases would include equipment to handle 2.0 MGD ADF with hydraulic capacity to expand to 4.0 MGD ADF. Only the addition of equipment for clarifiers, filters, UV, etc. would be required to handle the additional flows.
- Phase 2: Install additional equipment for third secondary clarifier, additional filter and UV disinfection capacity, etc. to handle increasing flows of up to 4.0 MGD ADF. Construct one septage thickener to allow for liquid decant to be metered into treatment process.
- Phase 3: Construct additional septage thickener, convert aerobic digesters to anaerobic process and construct third unit. This will provide for additional redundancy and storage capacity to even out flow rates to downstream processes. Construct primary clarification units prior to biological treatment processes to allow for sludge to be treated and used for possible biogas generation within anaerobic digestion units.

8.3.5 Recommended Phasing – Regional MBR WWTP (4.0 MGD)

We recommend that the following phasing plan be implemented for construction of the 4.0 MGD centrally located regional MBR WWTP:

- Phase 1: Construct Headworks, biological process basins, four complete membrane filtration units (six basins total), UV disinfection, sludge dewatering building and septage receiving station, enclosed in weather tight buildings. Construct two aerobic digesters for sludge stabilization prior to dewatering and disposal. Initial phases would include equipment to handle 2.0 MGD ADF with hydraulic capacity to expand to 4.0 MGD ADF. Only the addition of equipment for MBR trains, etc. would be required to handle the additional flows.
- Phase 2: Install additional membrane filters, UV disinfection capacity, etc. to handle increasing flows of up to 4.0 MGD ADF. Construct one septage thickener to allow for liquid decant to be metered into treatment process.
- Phase 3: Construct additional septage thickener, convert aerobic digesters to anaerobic process and construct third unit. This will provide for additional redundancy and storage capacity to even out flow rates to downstream processes. Construct primary clarification units prior to biological treatment processes to allow for sludge to be treated and used for possible biogas generation within anaerobic digestion units.

8.3.6 Wastewater Conveyance

8.3.6.1 Site A

Site A for a potential regional WWTP is located in an abandoned gravel pit to the west of the Glenn/Parks Interchange and south of the Parks Highway/Trunk Road Interchange on land owned by Arctic Devco. This site is at a relatively low elevation compared to most of the Palmer-Wasilla area, which would aid in the use of gravity sewers. Construction of a WWTP at this site would require the extension of sewer from the Wasilla WWTP and the Palmer WWTP by reversing flows in the Palmer Southwest Utility System. These improvements are conceptually illustrated in Figure 15 on Page 32 of this report.

The central location of this site means that flows will be approximately equal from both directions (from Palmer and from Wasilla). Flows of 4.0 MGD are expected to be reached in approximately 2022, based on population projections in this study. For the purposes of sizing conveyance pipelines, cost estimates have been performed based on flows of 4.0 MGD and 8.0 MGD.

For the portion of sewer main between Wasilla and Site A, it is estimated that approximately 2,450 L.F. of force main, and 17,550 L.F. of gravity sewer main would need to be constructed, assuming the preliminary route we have selected. Two lift stations will be needed to pump wastewater to higher elevations from intermediate low points.

For the portion of sewer main between Palmer and Site A, it is estimated that approximately 2,500 L.F. of force main, and 3,400 L.F. of gravity sewer main would need to be constructed. One lift station will be needed to pump water from a low point near the Parks Highway. Additionally, flow would need to be reversed in Palmer's SWX between Inner Springer Loop Rd. and the Mat-Su Regional Medical Center. This could be done by installing new force mains in place of gravity sewer mains, and creating a pressurized conveyance system. These upgrades would require the installation of new lift station pumps, additional lift station storage capacity, and approximately 15,600 L.F. of new force main. One additional lift station would need to be constructed near the intersection of Outer Springer Loop and Brooks Road.

8.3.6.2 Site B

Site B is located to the south and east of the Glenn Highway on land currently owned by Aggpro, parent company of Q.A.P. (formerly Quality Asphalt & Paving, Inc.). This site was used for gravel extraction operations and is currently dormant. Discussions with the property owner have indicated that they desire to mine further below the water table and eventually redevelop this land for possible residential and/or commercial uses when the gravel is ultimately depleted. This site is also at a relatively low elevation and would maximize the use of gravity sewers to convey wastewater.

This site would also require extending mains from existing sewer mains to the site; however, existing infrastructure constructed as part of Palmer's sewer main extension to serve the Mat-Su Regional Medical Center could be utilized for a large portion of the conveyance work. The Wasilla sewer would be connected to the Palmer System near the intersection of Trunk road and Woodworth Loop. From there, the existing sewer main would be utilized in its current configuration up until Lift Station 5. It is expected that after flow reaches its maximum hydraulic capacity of approximately 3.85 MGD, flow capacity upgrades such as installation of a third force main, and larger diameter gravity sewers would be needed. Flow in the remaining section of pipe would need to be reversed by converting approximately 3,000 L.F. of gravity sewer to force main, installing new lift station pumps and additional lift station storage capacity. In addition, a new lift station would need to be constructed near the intersection of Outer Springer Loop and Brooks Road. The extensions required for use of this site are illustrated in Figure 15 on Page 31 of this report. Cost estimates on sewer main extensions were performed based on flows of 4.0 and 8.0 MGD being received at the new regional WWTP.

For the portion of sewer main between Wasilla and Site B, it is estimated that approximately 6,500 L.F. of force main and 18,200 L.F. of gravity sewer main would need to be constructed, assuming the preliminary route we have selected. Three lift stations would be needed to pump water to higher elevations from intermediate low points.

8.3.7 Effluent Disposal

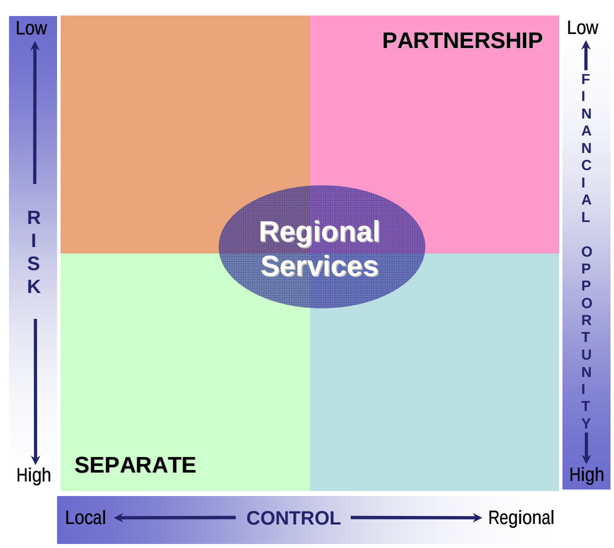
Ultimate disposal of treated effluent depends on the final location of the regional wastewater treatment plant (RWWTP), the receiving waters and regulations imposed by various governmental agencies (EPA, ADF&G, ADEC, etc.) The disposal options, subject to completion of environmental studies and permitting, would be to use a constructed wetland located to the south of the plant if Site A is chosen for the RWWTP or the Matanuska River floodplain if the RWWTP is located at Site B.

8.4 REGIONAL ENTITY FORMATION

The main goal of a regional entity is to use economies of scale to solve a problem faced by multiple local jurisdictions for the common good. The successful formation of a regional entity is predicated on the development of a regional institutional framework that considers appropriate levels of service, meets the needs of a diverse group of customers, ensures equitable service and representations, uses a business-like approach and is cost-based to serve the benefactors throughout the life of the project.

The establishment of a regional wastewater treatment system creates several opportunities for greater reliability and capacity in meeting treatment and discharge requirements. A regional system can, however, also pose several challenges and decisions in order to ensure the regional system is administered in a capable and balanced manner. The opportunity for successful regional arrangements increases dramatically if partner objectives are clearly established and clear and fair regional agreements are crafted. This approach relies on the development of "objective-based", clear, unambiguous intergovernmental agreements that

Figure 36: Regional Services and Risk Avoidance



address issues related to ownership, governance, funding and cost allocation decisions which benefit all regional partners.

Some of the objectives frequently cited by local governments and purveyors are:

- Support land use policies
- Enhanced reliability
- Operational assistance and improvements
- Economies of scale

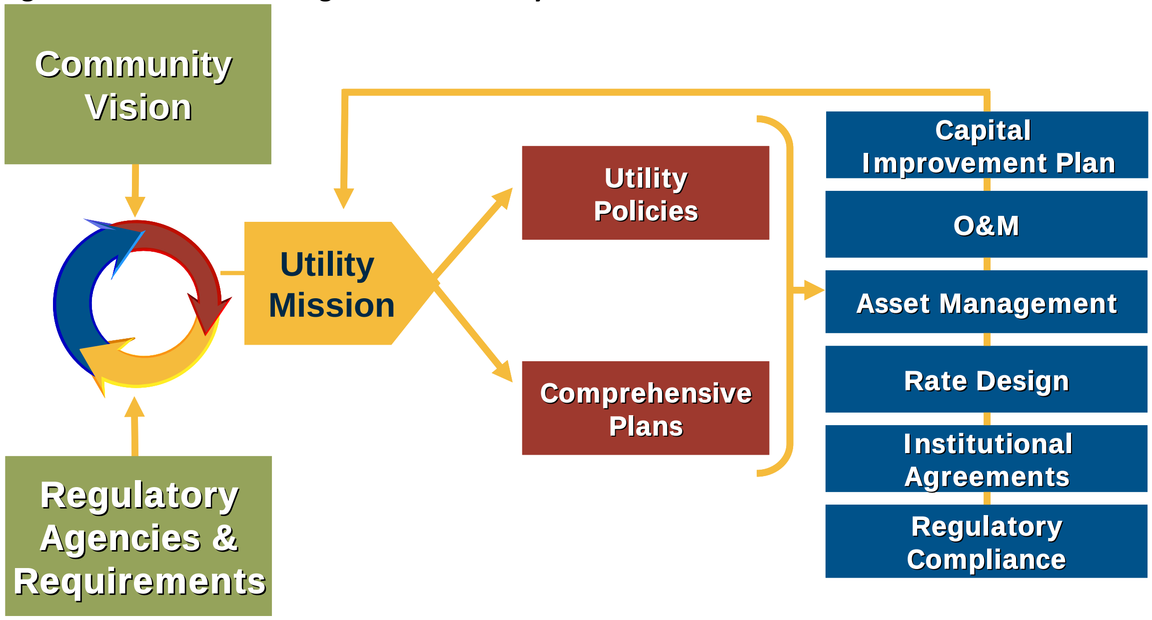
Generally, concerns regarding loss of control or ownership, lack of representative governance or input, and inequities related to the allocation of capital or operating costs are impediments to regional solutions.

In visual form, Figure 36 illustrates the compromise utilities face as they consider a regional solution. Any decision is fundamentally a contrast between trade-offs related to control versus risk. The lower left corner of the graphic indicates a utility that prefers to maintain total autonomy and control but, in so doing, must singularly accept all risks and financial responsibility of achieving and maintaining compliance.

8.4.1 Regional Roles and Responsibilities

Regardless of which governance structure is implemented, owning and managing a utility is essentially the same as running a business. It requires a complete suite of technical, financial and managerial skills and attributes. Figure 37 illustrates a strategic business approach which is applicable to either individual or regional utilities. As illustrated in the graphic, the overall role and direction of utility services are driven by input and guidance from its customers, regulatory agencies, elected officials, internal policies and planning documents. The column of activities at the right of this graphic cites the routine functions and skills essential for regular operation of an effective utility. Given the need for cost effective and efficient services over a larger geographical area, it can be argued that a regional provider might be best fulfilled by an entity that routinely provides or has broader access to these skills.

Figure 37: Business Strategic Plan and Utility Roles



In June 2008, the Water Environment Federation, American Water Works Association, US Environmental Protection Agency, American Public Works Association and several other public works/utility organizations published a document entitled "*Effective Utility Management - A Primer for Water and Wastewater Utilities".* Within the document, there are ten best practices generally accepted as those a utility should adopt to be an effective, well managed service provider. These practices are:

- Produces its product (treated effluent) in full compliance with any regulatory and reliability requirements.
- Provides "reliable, responsive, and affordable services."
- Strives to recruit and retain competent, motivated, adaptive and safe employees and leaders.
- Ensures all facets of utility operations are optimized.
- Should be financially viable.
- Should have stable infrastructure and know the condition of all assets.
- Is operationally resilient with a collaborative and proactive work environment.
- Is conscious of the effects and impacts its decisions have on the community.
- Ensures water/wastewater service provided is consistent with current and future customer needs.
- Should gain and maintain stakeholder understanding and support.

8.4.2 Key Policy Issues

In order to strike that balance between the "greater good" and the benefits to each involved entity, it is recommended that an objective-based approach be followed to determine any regional institutional framework for a future regional entity formation. Likely this will involve numerous discussions between Wasilla, Palmer, MSB, and the regulatory authorities to establish their key objectives. It will be important that these discussions provide a transparent and open atmosphere with no pre-determined outcomes to enable input of any kind.

One course of action to provide the objective-based approach is to conduct a series of workshops both individually and jointly with representatives of the cities, Borough and regulatory agencies to explore the opportunities and obstacles of a regional wastewater treatment facility. In addition, questionnaires, and interviews can be conducted with individual representatives. Each of the entities was asked to provide their input on key policies, issues, and "deal breakers" that would make regional wastewater treatment and service either acceptable or unacceptable. From the workshops and input from each entity, key topics can be generated to resolve if a regional solution is viable and identify issues of common interest and items requiring further resolution.

8.4.3 Implementation Measures

The Borough, Wasilla, and Palmer should explore implementation measures that will support these common principles and address some of the key concerns identified above. Incorporating these important principles and measures into the process is intended to strike an acceptable, customized balance and compromise solution.

Some examples of implementation measures are as follows:

- **Initial Memorandum of Understanding (MOU).** Crafting an MOU early in developing a regional partnership will outline the key principles that are universally acceptable. Before investing a substantial amount of time and energy into developing the details of a long-term Joint Powers Agreement (JPA), an MOU will determine initially if enough common understanding and benefit exists to continue. If so, the MOU will serve as the foundation for developing a detailed, fair, and clear JPA that will lead to an effective and sustained working relationship.
- **Committee Roles and Input.** Having representation and input for all regional participants is essential. Upon formation, committee authority and composition need to be established to create realistic expectations of their role and responsibilities. Either multiple or a single committee may be sufficient for securing input, representation, oversight of rate making actions, dispute resolution, or other assigned duties. It may be possible to utilize the existing advisory committees for some or all of these purposes provided there is fair representation.
- **Equitable Cost Allocation Procedures.** Cost allocation, rates, and special charges should all reflect procedures that utilize the principle of cost follows benefit. Committing to establish or endorse methodologies that utilize cost of service principles and techniques that are generally accepted in the industry will reduce potential dispute.
- **Dispute Resolution.** Identifying an objective process to resolve disputes is critical to calm fears and balance any perception of having lost ownership, control, and fairness. The first level of resolution is generally at the local level, with other subsequent outside intervention if needed using some combination of mediation, arbitration, or court involvement.

8.4.4 Regional Wastewater Entity Formation Process

Changing from individual ownership and operation to regional roles and responsibilities will require many discussions and agreements along the way. The general process for creating a regional entity may follow the following steps.

1. Establish key objectives and desired outcomes for each individual stakeholder
2. Establish shared benefits, costs, liabilities, staffing, resources and alternatives available for regional entity formation
3. Evaluate shared benefits, costs, liabilities, staffing, resources and alternatives available for regional entity formation
4. Summarize discussions from the work group in short white papers to document progress of the entity formation process
5. Develop a memorandum of understanding to capture key issues resolved during the process including:
    a. Principals of partnership
    b. Balanced governance policies, voting, hierarchy and dispute resolution process
    c. Integrated committees
    d. Clear and fair agreement between parties

The process for entity formation can take many years to develop depending on the key objectives and/or deal breakers for the individual stakeholders. Several examples of successful partnerships exist in the Pacific Northwest region including the following:

Table 20: Examples of Regional Partnerships

	Location	Number of Partnering Entities	Governance Structure
LOTT Alliance	Washington	4	501 (c) 3, Public Non-Profit-
Clark County	Washington	3	Advisory Board
Clean Water Service	Oregon	12	Independent Agency
Spokane	Washington	2	City, County and Independent Advisory Board

In order to continue investigating the feasibility of forming a regional entity between Palmer, Wasilla and the Borough, the interested stakeholders will need to continue to initiate a series of discussions/workshops to further define what the objectives and limiting criteria will be for the three jurisdictions to enter into an agreement.

9.0 OTHER ALTERNATIVES CONSIDERED

9.1 Alternative Treatment Processes

A variety of treatment process alternatives were considered for this effort from which the treatment options (LAS, CAS, and MBR) presented in this report were selected. A Technical Memorandum titled *Regional Wastewater and Septage Study* dated April 21, 2009 provided a detailed discussion of those alternatives. This paragraph summarizes the alternatives reviewed and considerations of selection of particular unit processes or systems.

Various types of preliminary treatment fine screens were reviewed, including bar, climber-type, band, drum, and perforated plate of various physical configurations. The drum type screen was selected as the basis for equipment layouts and cost analysis.

Various types of preliminary treatment for grit removal were reviewed, including aerated basins, and forced vortex and free vortex systems of various physical configurations. The forced vortex type grit removal system was selected as the basis for equipment layouts and cost analysis.

An analysis was performed to determine whether primary clarifiers should be included in the treatment system configured for this study. Inclusion of primary clarifiers was found to favorably impact both capital and energy costs. As such, primary clarification is included in the equipment layouts and cost analysis.

Various types of secondary treatment systems were reviewed, including biological, physical, and chemical-physical processes. Physical-chemical treatment processes, though in use at some small Alaska facilities, were not considered applicable to this type of municipal system and were not considered further in this study.

Biological-based processes reviewed were dispersed growth systems, fixed growth systems, and combined or integrated dispersed growth/fixed film systems. Dispersed growth systems reviewed included: conventional activated sludge and variants of this process such as lagoon, contact stabilization, extended aeration, step feed, high rate, high purity oxygen, sequencing batch reactor, and membrane bioreactor. Fixed growth systems reviewed included the rotating biological contactor. Integrated dispersed growth/fixed film systems reviewed included: integrated fixed-film activated sludge, and biologically aerated filters. Wetland and aquatic, land based and hydroponic treatment systems were also reviewed as wastewater treatment alternatives.

Tertiary treatment if determined necessary in a treatment train, may consist of systems reviewed including: microfiltration or ultrafiltration membrane filters, synthetic fiber filters, cloth media filters, or sand media filters. Depending on the receiving waters and final permits, tertiary treatment may or may not be required. If tertiary treatment is deemed necessary, the sand media filter system was selected as the basis for equipment layouts and cost analysis.

9.2 Alternative Outfall Alignments/Locations

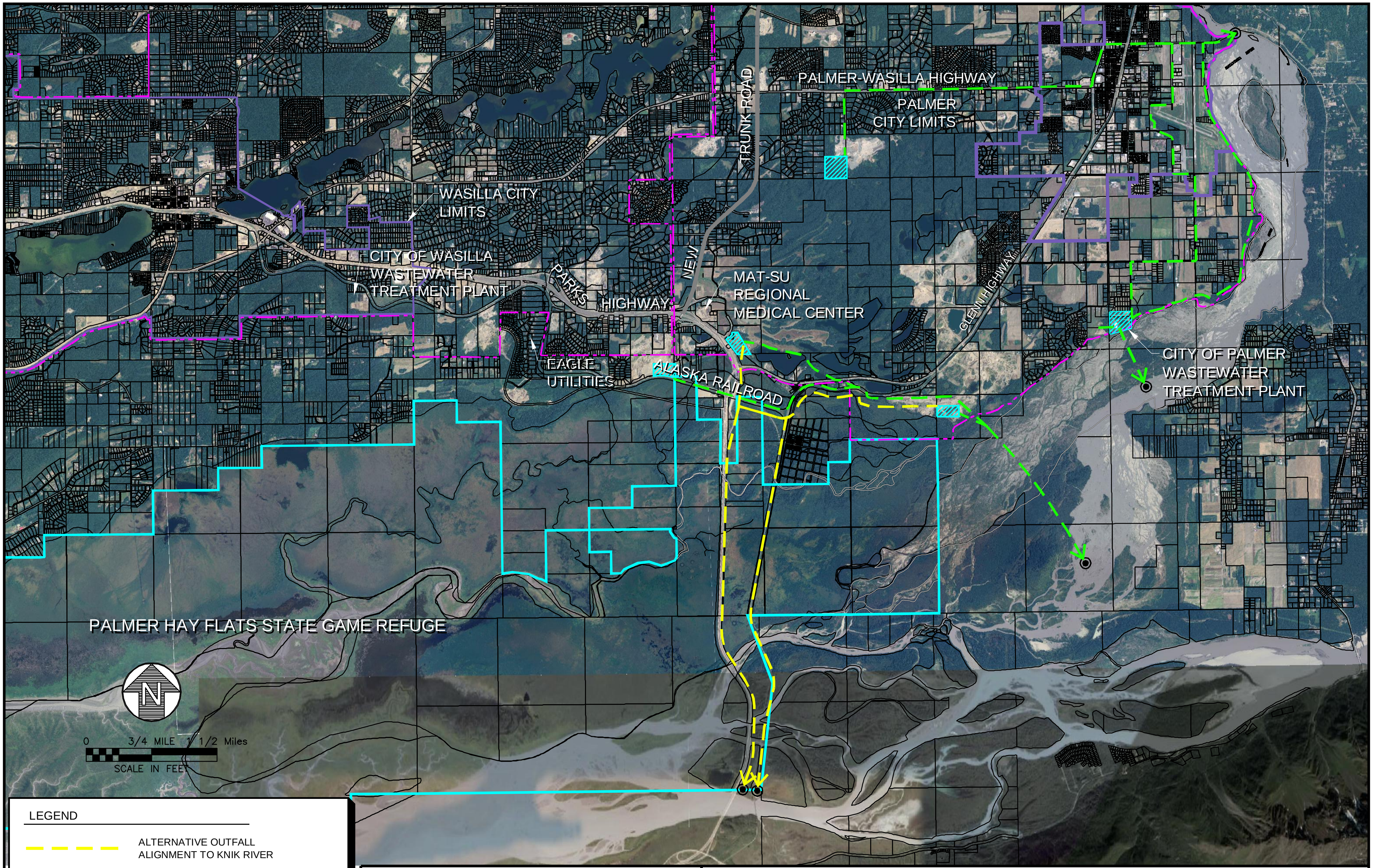
Four possible effluent receiving waters were initially considered. These included the Matanuska River Main Channel at the Old Glenn Highway Bridge, the Knik River Main Channel near the

Alaska Railroad Bridge, a surface discharge to the Matanuska River Floodplain, and a surface discharge to the north of the PHFSGR.

Matanuska River Main Channel: Upon review of receiving water characteristics, a discharge to the main channel of the Matanuska River near the Old Glenn Highway Bridge near the Palmer Airport was ruled out early on due to the presence of spawning salmon in the area. This discharge point would not provide any improvements in regulatory requirements over the current discharge, and it was located up gradient from all WWTP sites being considered. Additionally, a discharge to the main channel at any point other than the Old Glenn Highway Bridge was considered not feasible due to the extremely dynamic nature of the main channel of the Matanuska River.

Knik River: Discharges to the Knik River and directly to the PHFSGR were also ruled out from ongoing conversations with the ADF&G about other wastewater projects. In 2003 HDL and GV Jones approached ADF&G about the possibility of discharging wastewater from the Wasilla WWTP to the PHFSGR. In response to this request, ADF&G stated that an outfall would only be allowed at the Knik River, and only if it did not adversely affect any portion of the PHFSGR. ADF&G stated effluent wastewater would need to be treated to tertiary quality at that discharge point, and the outfall alignment would need to follow the Glenn Highway corridor. Figure 38 illustrates the outfall alignments and locations which were considered but deemed not practical for technical, economic or environmental reasons.

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 38-39 – Alternative Outfalls and WWTPs Considered, 1=100, 06/08/10 at 09:31 by tlc
LAYOUT: Alternative Outfalls
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P



HATTENBURG DILLEY & LINNELL Engineering Consultants

GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
OTHER ALTERNATIVE OUTFALLS CONSIDERED

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 38
SCALE:	1" = 1.5 MILES	CHECKED BY:	SLH	JOB NO.:	08-039

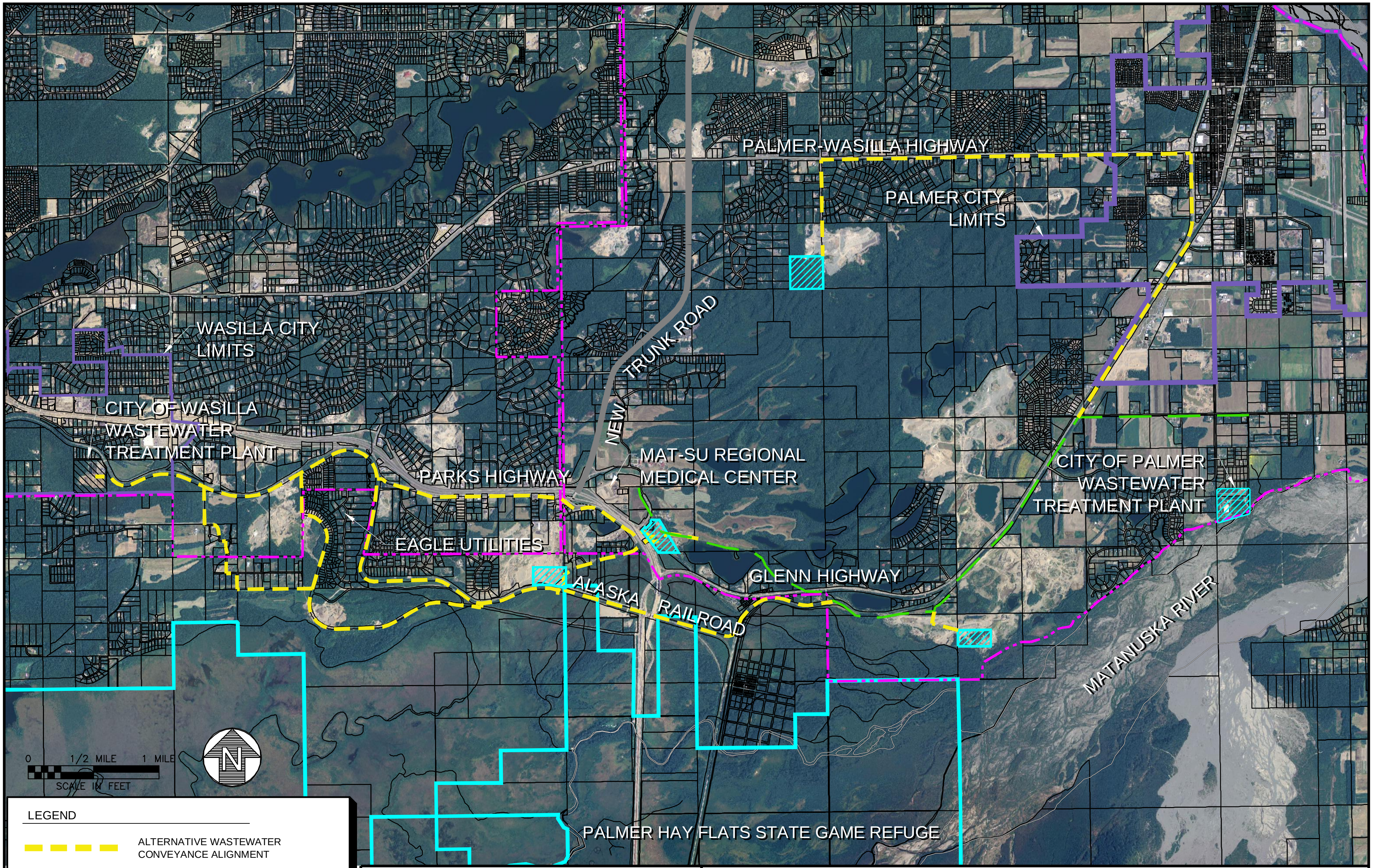
9.3 Alternative Conveyance Alignments

Along with the multiple outfall alignments considered, a number of alignments were considered for conveying wastewater to a central location. Alignment routes between the Wasilla WWTP and the Glenn-Parks interchange had the widest variation, with six possible alignments considered.

Options for conveyance within the Palmer service area were limited to the existing Palmer Southwest Utility Extension sewer main, located along the Glenn Highway. Generally speaking, the largest variation was the direction of flow which depended mainly on the location of the proposed WWTP.

We also looked at the possibility of conveying all wastewater to the existing site of the MSB central landfill, located south of the Palmer-Wasilla Highway on 49th State Street. This option was dismissed because of the large elevation gain from the Glenn-Parks area to the central landfill (about 250 feet), and the very long sewer main extensions which would be needed to get the wastewater there, and for an outfall. Figure 39 illustrates the alternative conveyance alignments considered but deemed not practical.

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure 38-39 - Alternative Outfalls and WWTPs Considered, 1=100, 06/08/10 at 09:31 by tlc
LAYOUT: Alternative Routes
VIEW: PLOT
XREF: 04016_00_XMAP, 07-025-B001-P



LEGEND

- ALTERNATIVE WASTEWATER CONVEYANCE ALIGNMENT
- EXISTING CITY OF PALMER SEWER MAIN
- PALMER HAY FLATS BOUNDARY
- CITY LIMITS
- SERVICE AREA BOUNDARY
- ALTERNATIVE RWWTP SITE CONSIDERED

HATTENBURG DILLEY & LINNELL Engineering Consultants

GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
OTHER CONVEYANCE ALIGNMENTS CONSIDERED

MATANUSKA–SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE 39
SCALE:	1" = 1 MILE	CHECKED BY:	SLH	JOB NO.:	08-039

9.4 Alternatives for Septage Receiving Station

One option that was investigated was co-locating the septage receiving facility at the Palmer WWTP. This alternative was dropped from further consideration due to public opposition to septage trucks driving through quiet, residential areas in the vicinity of the Palmer WWTP.

Additionally, the team briefly looked into treating liquid decant from a septage facility on-site at the Central Landfill instead pumping to a wastewater treatment plant for additional treatment. However, this alternative was dropped from further consideration due to the size, cost of constructing a separate treatment plant and long outfall pipeline, along with on-going operational requirements of operating a satellite treatment facility, and the land required for subsurface discharge of the treated effluent.

10.0 COSTS

Numerous factors will contribute to the overall cost of the alternatives presented. In order to provide accurate information for planning of future budgets, and ultimately construct a rate structure to make proposed improvements sustainable, the study team prepared cost estimates for up-front total project capital costs, O&M costs and administrative costs associated with formation of a regional wastewater authority. These costs were ultimately combined to develop estimated cost to the rate payer and to plan and finance a regional entity.

The various proposed improvements were amortized over a 30 year life-cycle cost beginning in 2013. Cost estimates were completed for the year 2009 and 4-years of inflation were added to allow for additional environmental review and planning. The life-cycle costs were compared by calculating the net present value (NPV) so that the costs of the various regional WWTP options could be compared. The present year chosen for the purposes of this study was 2009, therefore all of the values presented in this section of the report are given in 2009 dollars.

10.1 Capital

Capital costs are total project costs that include construction costs for a fully operational system. For the purposes of this report, capital costs for construction of WWTP alternatives and conveyance alternatives have been separated.

The total project costs for the alternatives are summarized in Table 21, and include 2% for owner administration, 10% for design, 12% for construction management, a 20% project contingency and 4 years of inflation at 2.5% per year. A detailed break down of capital costs for each option is provided in Appendix A of this report.

Table 21: WWTP Capital Costs

Palmer Near Term Improvements (2.0 MGD ADF)	**$43,716,100**
Wasilla Near Term Improvements (1.0 MDG ADF)	**$25,505,400**
Palmer-LAS Regional WWTP (4.0 MGD ADF)	**$96,740,600***
Regional-CAS WWTP (4.0 MGD ADF)	**$107,605,000***
Regional-MBR WWTP (4.0 MDG ADF)	**$101,418,800***

*Includes cost of constructing septage receiving station

In addition to the wastewater treatment plant costs, costs of conveyance piping and lift stations to get wastewater to the plant sites based on 4.0 MGD are summarized in Table 22. These costs include 2% for owner administration, 10% for design, 12% for construction management, a 15% project contingency and 4 years of inflation at 2.5% per year.

Table 22: 4.0 MGD ADF Wastewater Conveyance Capital Costs

Regional Site A	**$29,644,800**
Regional Site B	**$24,737,500**
Palmer-Regional WWTP	**$22,446,000**

Additional costs of conveyance piping and lift stations for an average daily flow of 8.0 MGD were also estimated for this report. These costs are summarized in Table 23, they include 2% for owner administration, 10% for design, 12% for construction management, a 15% project contingency and 25 years of inflation at 2.5% per year.

Table 23: 8.0 MGD ADF Wastewater Conveyance Capital Costs

Regional Site A	**$21,557,500**
Regional Site B	**$23,483,580**
Palmer-Regional WWTP	**$24,546,600**

Costs presented in this table are for additional costs to upgrade conveyance from 4.0 MGD to 8.0 MGD ADF.

The estimated **total project cost** for each alternative is presented in Table 24. For clarity, the least expensive siting option (Site B) for regional wastewater conveyance has been included and only the 4.0 MGD conveyance option has been included. The following assumptions were used when preparing cost estimates:

- Tertiary level treatment will be required for a surface water outfall
- The project is competitively bid in 2013
- A 20% contingency has been added for WWTP projects
- A 15% contingency has been added for conveyance piping projects

Table 24: Estimate of Total Project Costs

	WWTP Construction	Conveyance Piping, Wasilla, 4.0 MGD	Conveyance Piping, Palmer, 4.0 MGD	Construct Off-Site Septage Receiving Station	Total Project Cost
Palmer, Near Term	$43,716,100	-	-	-	**$43,716,100**
Wasilla, Near Term	$25,505,400	-	-	-	**$25,505,400**
Palmer, Regional	$89,607,600	$19,218,000	$3,228,000	$7,133,000	**$119,186,600**
CAS, Regional	$107,605,000*	$19,654,000	$5,083,500	-	**$132,342,500**
MBR, Regional	$101,418,800*	$19,654,100	$5,083,600	-	**$126,156,300**

* Includes septage receiving station constructed on-site

10.2 Operation and Maintenance

O&M costs consist of all costs related to operating a facility as well as regularly scheduled maintenance. These costs generally consist of staffing costs, electricity and heating costs, replacement of equipment, vehicles, fuel costs for vehicles, tools, consumables, etc. The average annual operating and maintenance costs are based on 4.0 MGD ADF and are summarized in Table 25. They include yearly plant and conveyance pumping costs at 4.0 MGD ADF, a 20% contingency has been added. A detailed break down of O&M costs for each option is provided in Appendix B of this report.

Table 25: O&M Costs

Palmer Near Term Improvements (2.0 MGD ADF)	**$1,353,600**
Wasilla Near Term Improvements (1.0 MGD ADF)	**$952,000**
Palmer-Regional WWTP (4.0 MGD ADF)	**$3,360,500**
CAS-Regional WWTP (4.0 MGD ADF)	**$3,393,900**
MBR-Regional WWTP (4.0 MGD ADF)	**$3,843,800**
Septage Receiving Station	**$164,800**

10.3 Cost to Rate Payer

Ultimately, the cost to the rate payer will depend on the amount of grant funding which can be obtained by the entities. Table 26 presents the projected costs to rate payers which could be expected for a given amount of grant funding. Rates presented for Wasilla and Palmer are projected monthly billing rates; MSB rates are the projected tipping fees for one load of septage at an average truck volume of 3,000 gallons.

Table 26: Estimated Rate Payer Cost Per Month, Dollars, Wasilla*

Grant Funding Received	0%			25%			50%			75%			100%		
WWTP Type	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR
Year 2015	177	192	198	148	159	165	118	126	131	89	93	98	60	59	65
Year 2020	121	130	137	103	110	116	86	90	96	68	70	76	50	50	55
Year 2025	93	100	105	80	85	90	68	71	76	55	56	61	42	42	47

*Costs include operation of existing wastewater collection system (Current rate payer cost is approx. $20/month).

Table 27: Estimated Rate Payer Cost Per Month, Dollars, Palmer*

Grant Funding Received	0%			25%			50%			75%			100%		
WWTP Type	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR
Year 2015	137	148	154	115	124	129	94	99	105	72	74	80	50	50	55
Year 2020	103	130	117	103	94	100	74	78	84	60	62	68	46	46	52
Year 2025	83	88	94	80	76	81	61	64	69	51	52	57	40	40	45

*Costs include operation of existing wastewater collection system (Current rate payer cost is approx. $50/month, set to go up to approx. $65/month).

Table 28: Estimated Cost to Dispose of One Load of Septage, Dollars, MSB*

Grant Funding Received	0%			25%			50%			75%			100%		
WWTP Type	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR
Year 2015	166	175	182	138	146	152	111	116	122	84	86	92	57	57	62
Year 2020	141	148	155	120	125	132	100	103	110	79	80	87	58	58	64
Year 2025	121	126	132	104	108	114	87	90	96	70	72	77	54	54	59

*Average Septage Load Assumed to be 3,000 gal.

Cost to the rate payer is estimated based on the total administrative costs of running a regional wastewater entity, WWTP O&M costs, WWTP debt service, wastewater collection debt service and wastewater collection O&M costs. Depending on the year, cost to the ratepayer would be lower; as more users are added to the collection and treatment system, fixed costs are spread between a larger number of people. For additional information on the rate models developed for this study, detailed breakdowns of each scenario and a discussion on the methodology for determining cost to the rate payer, please refer to Appendix F of this report.

11.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

11.1 Comparison between Independent Treatment and Regional Treatment

A comparison of regionalizing wastewater treatment and the Borough and Cities remaining independent can be made by making some basic assumptions and extrapolating pricing generated for the study alternatives. In order to compare independent development with the 4.0 MGD regional solutions, we assume that Palmer will upgrade to the 2.0 MGD plant independently; Wasilla would expand to 2.0 MGD independently at a cost similar to that of Palmer; and a new outfall for the Wasilla WWTP would be constructed to the privately held wetlands south of Site A. The estimated capital and O&M costs for these improvements are estimated in Table 27.

Table 29: Summary of Capital Costs for Development

Item	Capital Cost	Annual O&M Cost
Wasilla Upgrades	\$44,000,000[1]	\$1,400,000[1]
Wasilla Outfall	\$12,500,000[2]	\$50,000[2]
Palmer Upgrades	\$43,716,100	\$1,353,600
Septage Receiving/Pretreatment	\$7,000,000	\$164,760
Total	**\$107,216,100**	**\$2,968,360**

[1] Costs for upgrades to Wasilla WWTP are assumed to be the same as the Palmer WWTP to 2.0 MGD.

[2] Costs for the outfall to the private wetlands are assumed to be the same as to convey wastewater to RWWTP Site A

The capital costs presented in Table 27 are total project costs including 2% owner administration, 10% design, 12% construction management, 20% contingency and 4 years inflammation @ 2.5% per year and can be compared to the estimated capital and O&M costs in Tables 24 and 25.

11.2 Decision Matrix

The study team has developed a matrix rating system to assist in selection of a preferred regional alternative. In this analysis, it is assumed that near term upgrades will be required at both Palmer and Wasilla. In addition to this, it is assumed that if Palmer is selected as the most viable alternative, septage receiving will take place off site of the WWTP; but if a more central location is chosen, septage receiving will take place at the WWTP site. For these reasons, only the regional alternatives for wastewater treatment have been compared within the decision matrix.

Eight monetary and non-monetary selection criteria were established to compare cost, performance, reliability and public acceptance. This decision matrix is presented in Table 28. The selection criteria are as follows:

- **Ability to Meet Future Regulatory Changes.** This criterion is used to evaluate adaptability of the treatment process to upgrades anticipated to meet more stringent regulatory constraints in the future. The MBR option was scored the highest because it produces the highest quality effluent of the alternatives considered.
- **Process Reliability.** This criterion is used to evaluate the probability that the treatment process will be subjected to periodic upset conditions. MBR was scored the highest because all process equipment is enclosed in weather tight enclosures and the solids separation method is achieved using membrane filtration as opposed to gravity sedimentation. The CAS process would also be staged in a weather tight building, but the solids separation could be subjected to overloading during a high influent flow event or sludge bulking. The LAS solids separation uses the same method as CAS, however, the process is separated from exterior conditions only by a floating insulated lagoon cover, and subject to performance deterioration should the integrity of the insulated cover become breached.
- **Ease of Expansion.** This criterion is used to compare the treatment process's ability to easily expand capacity in the future. Both the MBR and CAS processes were scored the highest due to their compact footprint when compared to the LAS process. MBR and CAS can be easily expanded to handle up to 8 MGD of flow within the limits of the land parcels acquired for these plant alternatives' initial development.. The LAS process will require the purchase of additional property to expand past 4 MGD.
- **Effluent Quality.** This criterion is used to compare the projected effluent quality of the various alternatives. MBR produces the best effluent quality out of the three options, while CAS and LAS produce an effluent with slightly lower quality.
- **Manpower and Equipment Support in Alaska.** This criterion is used to compare the level of manpower and equipment that is available in Alaska to operate and maintain the plant. Are there trained operators available in Alaska with experience operating the type of plant proposed? Are there vendors in Alaska that will support the process equipment? The CAS and LAS alternatives utilize equipment which is commonly deployed throughout Alaska for biological treatment of domestic wastewater. The MBR alternative utilizes membranes for solids separation, a configuration relatively new and therefore limited in application within Alaska. Consequently the labor force within Alaska is not as familiar with MBR equipment as it is with the CAS and lagoon treatment systems. In addition, most membrane manufacturers' membranes are not interchangeable with other manufacturers products, and therefore local manufacturer's support for MBR products is limted.
- **Public Acceptance.** This criterion is used to compare the potential for negative public acceptance, whether because of proximity to construction, increased traffic or increased user fees. During our initial public meetings, there has been a vocal contingent of residents from near the Palmer WWTP who have spoken out against the proposed upgrades. While any plant of this magnitude will have a "Not In My Backyard" effect, it is more substantial in the Palmer WWTP alternative due to its proximity to residential developments. The

centrally located regional options have been sited so that they are away from existing housing developments, which contribute to their higher score.

- **Septage Addressed.** While all three regional options are designed to accept septage flows, the CAS and MBR options would have on-site septage receiving. Septage is a relatively strong waste with very high demands for oxygen, and elevated concentrations of solids and organics. By receiving septage at the sewage treatment plant, the opportunity is available to deploy solids removal/organic stabilization processes specifically tailored to septage that would minimize adverse loading impacts of the septage to the downstream treatment plant. Lower loadings to the wastewater treatment process would result in improved performance and consistent treated effluent quality. In addition, operations personnel would be reporting locally to a single combined septage disposal/sewage treatment facility enabling more cost effective, rapid, responsive oversight and management of the septage disposal service. And finally septage discharge to conventional gravity sewer systems with minimal slope and flow velocities would allow solids passing the septage receiving station to drop out into the sewers resulting in more O&M costs for periodic sewer cleaning. Alternative 1 does not address septage and haulers would be required to continue to dispose of septage loads at the Turpin St. Receiving Station.
- **Capital Cost.** This criterion is used to rank the alternatives with respect to the capital cost of construction including design and construction. Scoring was determined by taking the lowest cost alternative (Independent Treatment Facilities), dividing by the cost of the alternative and multiplying by five.
- **Operation & Maintenance Cost.** This criterion is used to compare the annual operating cost of the plant including manpower, equipment, parts, supplies, repairs, testing, contract support, energy and plant management and administration. O&M scoring was determined in the same way as capital cost scoring.
- **Likelihood of Grant Funding.** This criterion is used to compare the likelihood that each alternative will receive all or a portion of the capital costs in the form of grants, low interest loans or other funding other than through the use of bonds. Previous conversations with various funding agencies demonstrated their lack of support of a non-regional option for wastewater treatment. For this reason, Alternative 1 has received a score of zero, while Alternatives 2, 3 and 4 received a score of 5.

An importance factor is also provided to differentiate between criteria with a high importance and those with less importance. To complete the scoring matrix and alternative selection process, the entities should make adjustments to the study team's suggested preliminary scoring, and apply importance factors to the criteria based on their respective needs and priorities. The team has applied a score of 1 to 5 to each scoring criteria based on how well each alternative meets the respective need.

Table 30: Criteria Scoring and Weighting Matrix

	Importance Factor	Alt 1	Alt 2	Alt 3	Alt 4
1 = doesn't meet need 5 = meets need	**Score**	**Independent Treatment at Palmer and Wasilla**	**Regional Treatment at Palmer, Lagoon Activated Sludge**	**Centralized Regional Treatment, Conventional Activated Sludge**	**Centralized Regional Treatment, Membrane Bioreactor**
NON-MONETARY					
Ability to Meet Future Regulatory Changes	5	2	4	4	5
Process Reliability	5	3	3	4	5
Ease of Expansion	10	1	2	5	5
Effluent Quality	5	3	4	4	5
Manpower & Equipment Support in Alaska	5	3	4	4	3
Public Acceptance	5	2	3	4	5
Septage Addressed	5	0	4	5	5
TOTAL WEIGHTED SCORE NON-MONETARY		**65**	**115**	**155**	**165**
MONETARY					
Capital Cost	10	5	4.5	4.1	4.4
O & M Cost	40	5	4.2	4.2	3.7
Likelihood of Grant Funding	10	0	5	5	5
TOTAL WEIGHTED SCORE MONETARY		**250**	**263**	**259**	**242**
COMBINED SCORE	**100**	**315**	**378**	**414**	**407**

12.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the engineering analysis and studies conducted for this report, we recommend the following:

- Construct either a regional MBR or CAS WWTP. The Criteria Scoring and Weighting Matrix suggests that either of these two process alternatives will provide the greatest ease of expansion and process reliability.
- Select a site for the new Regional WWTP. Selection of a site will ultimately depend on the effluent discharge point and the ability to obtain an NPDES permit to the receiving water. Cost of obtaining land for placement of a new plant must also be factored into site selection.
- Initiate the environmental process as soon as practical upon the selection of a preferred alternative.
- Secure grant funding for the WWTP, conveyance piping and a new septage receiving station. As evidenced by the rate model, securing a large percentage of the initial capital costs in the form of grants will significantly reduce the impact to the rate payer.
- Initiate the process to develop the structure for a regional wastewater authority.

APPENDIX A

Capital Cost Estimates

City of Palmer

Near Term Upgrades

Initial Project Estimate Summary
Palmer Wastewater Treatment Plant Improvements
(2.0 MGD Average Daily Flow)

Date Prepared: 16-December-2009

ITEM	ESTIMATED QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
1		**SECONDARY TREATMENT SYSTEMS**		
2	1	Headworks and Screening	3,631,000	3,631,000
3	1	Lagoon Activated Sludge Equipment	5,906,000	5,906,000
4	1	Secondary Clarification	10,607,000	10,607,000
5	1	Tertiary Filter	3,489,000	3,489,000
6	1	UV Disinfection	371,000	371,000
7	1	Miscellaneous Equipment	695,000	695,000
		SITE CIVIL WORK		
8	1	Miscellaneous Site Development Costs	375,000	375,000
9	1	Yard Piping Systems	2,420,000	2,420,000
10	1	Utility Services	166,000	166,000
11	1	Access Roads and Parking	425,000	425,000
12	1	Landscaping	62,000	62,000
13	1	Security	170,000	170,000
		Subtotal Construction		$28,317,000

Land Acquisition	0
City Administration @ 2%	566,300
Design @ 10%	2,831,700
Construction Management @ 12%	3,398,000
Project Contingency @ 20%	5,663,400
4 Years Inflation @ 2.5%	2,939,700
Subtotal	$43,716,100

Palmer WWTP Improvements
Rough Order of Magnitude Cost Estimate
(2.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
1. SECONDARY TREATMENT SYSTEMS					
HEADWORKS AND SCREENING……					$2,951,900
Wastewater Equipment					
Static Raw Sewage Bar Screen	1	EA	20,000	20,000	
Overhead Crane Rail System in Headworks	1	EA	25,000	25,000	
Raw Sewage Lift Station Pumps	1	EA	175,000	175,000	
Raw Sewage Comminutor/Screens and Appurtenant Equ	1	EA	76,000	76,000	
Headworks Channel Sluice Gates	4	EA	20,000	80,000	
Flow Metering	1	EA	25,000	25,000	
Odor Control Towers and Fans	All Req'd	LS	330,000	330,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	731,000	43,860	
Installation Labor	6%	of	731,000	43,860	
Instrumentation Equipment Allowance	6%	of	731,000	43,860	
Instrumentation Labor	3%	of	731,000	21,930	
Process Piping Allowance	6%	of	731,000	43,860	
Process Piping Labor	3%	of	731,000	21,930	
Electrical Equipment Allowance	20%	of	731,000	146,200	
Electrical Labor	15%	of	731,000	109,650	
Buildings					
Expand Existing Headworks Building (45x50')	8,400	SF	160	1,344,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	10%	of	1,344,000	134,400	
Civil and Foundations					
Mass Excavation	3030	CY	4.00	12,120	
Backfill w/ Selective Material	2000	CY	3.50	7,000	
Structural Fill	560	CY	24.00	13,440	
Load and Haul Excavated Material	1030	CY	9.50	9,785	
Concrete, Formed, Poured In-Place, Structural	250	CY	850.00	212,500	
Epoxy Coating (Interior Only)	5000	SF	2.50	12,500	
LAGOON ACTIVATED SLUDGE EQUIPMENT……					$4,802,000
Wastewater Equipment					
LAS Fine Bubble Diffusers, One Pond	1	LS	1,300,000	1,300,000	
Blowers, Hi Speed Turbine, 1,400 scfm at 6.5 psi	5	EA	130,000	650,000	
Na_2CO_3 Bulk Feeder/Dissolver Tk to Supplement Alk	All Req'd	LS	35,000	35,000	
Rapid Mixer for Na_2CO_3 Solution Dispersion	1	EA	40,000	40,000	
Na_2CO_3 Dosing for Supplemental Alkalinity	All Req'd	LS	32,000	32,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	2,057,000	123,420	
Installation Labor	6%	of	2,057,000	123,420	
Instrumentation Equipment Allowance	6%	of	2,057,000	123,420	
Instrumentation Labor	3%	of	2,057,000	61,710	
Process Piping Allowance	6%	of	2,057,000	123,420	
Process Piping Labor	3%	of	2,057,000	61,710	
Electrical Equipment Allowance	20%	of	2,057,000	411,400	
Electrical Labor	15%	of	2,057,000	308,550	
Buildings					
Weather Enclosures for LAS Air Valves	All Req'd	LS	200,000	200,000	
Civil and Foundations					

Palmer WWTP Improvements
Rough Order of Magnitude Cost Estimate
(2.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
Lagoon Liner (45 mil EPDM)	100,000	SF	4.50	450,000	
Lagoon Baffles (12' x 720 LF x 45 mil)	720	LF	210.00	151,200	
Insulated Lagoon Cover (4-inch, installed)	84,100	SF	4.50	378,450	
Soil Anchors, 5' Deep	150	EA	500.00	75,000	
Excavation	1,400	CY	4.00	5,600	
Structural Backfill	5,400	CY	24.00	129,600	
Load and Haul Excavated Material	1,400	CY	9.50	13,300	
Geotextile Fabric	9,500	SF	0.50	4,750	
SECONDARY CLARIFICATION……					$8,623,200
Wastewater Equipment					
Secondary Clarification Scraper and Bridge Equipment	2	EA	155,000	310,000	
Scum Pumps	2	EA	15,000	30,000	
RAS Pumps	2	EA	20,000	40,000	
WAS Pumps	2	EA	18,000	36,000	
Drain Pumps	2	EA	14,000	28,000	
RAS and WAS Meters	2	EA	4,500	9,000	
NaOCl RAS Dosing for Bulking Control	All Req'd	LS	15,000	15,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	468,000	28,080	
Installation Labor	6%	of	468,000	28,080	
Instrumentation Equipment Allowance	6%	of	468,000	28,080	
Instrumentation Labor	3%	of	468,000	14,040	
Process Piping Allowance	6%	of	468,000	28,080	
Process Piping Labor	3%	of	468,000	14,040	
Electrical Equipment Allowance	20%	of	468,000	93,600	
Electrical Labor	15%	of	468,000	70,200	
Buildings					
Clarifier Building (190'x200')	38,000	SF	150	5,700,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	10%	of	5,700,000	570,000	
Civil and Foundations (2 Clarifiers)					
Mass Excavation	15,461	CY	4.00	61,844	
Backfill w/ Selective Material	7,280	CY	3.50	25,480	
Structural Fill	2,185	CY	24.00	52,440	
Load and Haul Excavated Material	8,181	CY	9.50	77,720	
Concrete, Formed, Poured In-Place, Structural	1,560	CY	850.00	1,326,000	
Epoxy Coating (Interior Only)	15,000	SF	2.50	37,500	
TERTIARY FILTER……					$2,836,500
Wastewater Equipment					
Effluent Filter Equipment	1	LS	290,000	290,000	
W2 Pumps	3	EA	18,000	54,000	
Coagulant Bulk Feeder and Dissolver Tank for Filter	All Req'd	LS	35,000	35,000	
Rapid Mixer for Coagulant Dosing into SE	1	EA	40,000	40,000	
Coagulant Dosing for SE Flow to Filter	All Req'd	LS	20,000	20,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	439,000	26,340	
Installation Labor	6%	of	439,000	26,340	
Instrumentation Equipment Allowance	6%	of	439,000	26,340	
Instrumentation Labor	3%	of	439,000	13,170	
Process Piping Allowance	6%	of	439,000	26,340	
Process Piping Labor	3%	of	439,000	13,170	
Electrical Equipment Allowance	20%	of	439,000	87,800	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
Electrical Labor	15%	of	439,000	65,850	
Buildings					
Tertiary Filtration Building (190'x50')	9,500	SF	175	1,662,500	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	10%	of	1,662,500	166,250	
Civil and Foundations					
Mass Excavation	1800	CY	4.00	7,200	
Backfill w/ Selectived Material	1022	CY	3.50	3,577	
Structural Fill	300	CY	24.00	7,200	
Load and Haul Excavated Material	778	CY	9.50	7,391	
Concrete, Formed, Poured In-Place, Structural	290	CY	850.00	246,500	
Epoxy Coating (Interior Only)	4600	CY	2.50	11,500	
UV DISINFECTION……					$302,000
Wastewater Equipment					
UV Lamp Assembly	1	LS	183,000	183,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	183,000	10,980	
Installation Labor	6%	of	183,000	10,980	
Instrumentation Equipment Allowance	6%	of	183,000	10,980	
Instrumentation Labor	3%	of	183,000	5,490	
Process Piping Allowance	6%	of	183,000	10,980	
Process Piping Labor	3%	of	183,000	5,490	
Electrical Equipment Allowance	20%	of	183,000	36,600	
Electrical Labor	15%	of	183,000	27,450	
Buildings					
None - Equipment installed in Existing Building					
Civil and Foundations					
None					
MISCELLANEOUS EQUIPMENT……					$565,000
Wastewater Equipment					
Standby Generator	800	kW	300.00	240,000	
Generator Fuel Oil Storage	1	LS	25,000	25,000	
Motor Control Center	1	EA	150,000	150,000	
Utility Water Pumps	3	EA	3,500	10,500	
Plant Drain Pumps	2	EA	6,500	13,000	
Hot Water Generator	1	LS	6,500	6,500	
Laboratory Equipment	1	LS	60,000	60,000	
Sampling Equipment	2	EA	30,000	60,000	
SUBTOTAL - 1. SECONDARY TREATMENT SYSTEMS					$20,080,600
OH&P	23.00%				$4,618,500
TOTAL - 1. SECONDARY TREATMENT SYSTEMS					**$24,699,100**

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
2. SITE CIVIL WORKS & DISTRIBUTED COSTS					
MISCELLANEOUS SITE DEVELOPMENT COSTS					$305,000
Mobilization and Demobilization	1	LS	150,000	150,000	
Demolition & Materials Disposal	1	LS	80,000	80,000	
Construcftion Surveying	1	LS	50,000	50,000	
Stormwater Controls	1	LS	25,000	25,000	
YARD PIPING SYSTEMS					$1,967,700
Raw Sewage (RS)	150	LF	375	56,250	
Drain Piping (D)	400	LF	65	26,000	
Lagoon Effluent (LE)	440	LF	375	165,000	
Secondary Effluent (SE)	150	LF	375	56,250	
Filtrate (FIL)	1480	LF	375	555,000	
Potable Water (W1)	2200	LF	65	143,000	
Non-Potable Utility Water (W2)	2200	LF	65	143,000	
Waste Activated Sludge (WAS)	870	LF	80	69,600	
Return Activated Sludge (RAS)	1070	LF	80	85,600	
Natural Gas (NG)	2000	LF	45	90,000	
Storm Drainage (S)	1800	LF	150	270,000	
60" Manholes, 8' deep	8	EA	8,500	68,000	
Yard Piping 8" LPA	1375	LF	80	110,000	
Yard Piping 12" LPA	1000	LF	100	100,000	
Sewage Bypass Pumping During Construction	1	LS	30,000	30,000	
UTILITY SERVICES					$135,000
Electrical Service	All Req'd	LS	75,000	75,000	
New 6" Gas Service	All Req'd	LS	60,000	60,000	
ACCESS ROADS AND PARKING					$345,600
Access Roadways, 20 Foot Wide, Paved	2,200	LF	60.00	132,000	
Parking Areas, Paved	20,000	SF	10.00	200,000	
Curb and Gutter	400	LF	24.00	9,600	
Sidewalk	200	LF	20.00	4,000	
LANDSCAPING					$50,000
Topsoil and Seed	All Req'd	LS	50,000	50,000	
SECURITY					$138,000
Outdoor Lighting	8	EA	13,500	108,000	
Perimeter Security Fencing	1500	LF	20.00	30,000	
SUBTOTAL - 2. SITE CIVIL WORK					$2,941,300
OH&P	23.00%				$676,500
TOTAL - 2. SITE CIVIL WORK					**$3,618,000**
TOTAL					**$28,317,100**

City of Wasilla

Near Term Upgrades

Initial Project Estimate Summary
Wasilla Wastewater Treatment Plant Improvements
(1.0 MGD Average Daily Flow)

Date Prepared: 16-December-2009

ITEM	ESTIMATED QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
		SECONDARY TREATMENT SYSTEMS		
1	1	Lagoon Activated Sludge System	3,924,000	3,924,000
2	1	Secondary Clarification	4,216,000	4,216,000
3	1	Teriary Filter	2,844,000	2,844,000
4	1	Septage Receiving & Digester Improvements	3,482,000	3,482,000
5	1	Miscellaneous Equipment	620,000	620,000
		SITE CIVIL WORK		
6	1	Miscellaneous Site Development Costs	375,000	375,000
7	1	Yard Piping Systems	1,193,000	1,193,000
8	1	Utility Services	166,000	166,000
9	1	Access Roads and Parking	150,000	150,000
10	1	Landscaping	62,000	62,000
11	1	Security	42,000	42,000
		Subtotal Construction		$17,074,000

Land Acquisition		0
City Administration	@ 2%	341,500
Design	@ 10%	1,707,400
Construction Management	@ 12%	2,048,900
Project Contingency	@ 15%	2,561,100
4 Years Inflation	@ 2.5%	1,772,500
Subtotal		$25,505,400

Wasilla WWTP Improvements
Rough Order of Magnitude Cost Estimate
(1.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
1. SECONDARY TREATMENT SYSTEMS					
LAGOON ACTIVATED SLUDGE SYSTEM ……					$3,190,000
Wastewater Equipment					
LAS Fine Bubble Diffusers, One Pond	1	LS	776,000	776,000	
Blowers, Hi Speed Turbine, 2,600 scfm at 6.5 psi	3	EA	100,000	300,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	1,076,000	64,560	
Installation Labor	6%	of	1,076,000	64,560	
Instrumentation Equipment Allowance	6%	of	1,076,000	64,560	
Instrumentation Labor	3%	of	1,076,000	32,280	
Process Piping Allowance	6%	of	1,076,000	64,560	
Process Piping Labor	3%	of	1,076,000	32,280	
Electrical Equipment Allowance	20%	of	1,076,000	215,200	
Electrical Labor	15%	of	1,076,000	161,400	
Buildings					
F&I Blower Building (60'x30')	1,800	SF	180	324,000	
Rehabilitate Existing Blower/Demo Clarifier Cover	1	LS	50,000	50,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	5%	of	324,000	16,200	
Civil and Foundations					
F&I Lagoon Liner (45 mil EPDM)	74,000	SF	5.00	370,000	
F&I Lagoon Baffles (12' x 720 LF x 45 mil)	720	LF	210.00	151,200	
F&I Insulated Lagoon Cover (360' x 160' x 4-inch)	57,600	SF	4.50	259,200	
Soil Anchors, 5' Deep	100	EA	500.00	50,000	
Excavation	1,500	CY	4.00	6,000	
Structural Backfill	7,000	CY	24.00	168,000	
Load and Haul Excavated Material	1,500	CY	9.50	14,250	
Geotextile Fabric	12,000	SF	0.50	6,000	
SECONDARY CLARIFICATION……					$3,428,000
Equipment					
Secondary Clarification Equipment	2	EA	147,350	294,700	
Scum Pumps	2	EA	15,000	30,000	
RAS Pumps	2	EA	12,000	24,000	
WAS Pumps	2	EA	12,000	24,000	
Drain Pumps	2	EA	12,000	24,000	
RAS and WAS Meters	2	EA	4,500	9,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	405,700	24,342	
Installation Labor	6%	of	405,700	24,342	
Instrumentation Equipment Allowance	6%	of	405,700	24,342	
Instrumentation Labor	3%	of	405,700	12,171	
Process Piping Allowance	6%	of	405,700	24,342	
Process Piping Labor	3%	of	405,700	12,171	
Electrical Equipment Allowance	20%	of	405,700	81,140	
Electrical Labor	15%	of	405,700	60,855	
Buildings					
F&I Clarifier Building (90'x150')	13,500	SF	150	2,025,000	
Misc Metals Allow. (Stairs, Handrails, and Platforms)	5%	of	2,025,000	101,250	
Civil and Foundations					

Wasilla WWTP Improvements
Rough Order of Magnitude Cost Estimate
(1.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
Excavation	11,614	CY	4.00	46,456	
Backfill w/ Selective Material	7,620	CY	3.50	26,670	
Structural Fill	2,080	CY	24.00	49,920	
Load and Haul Excavated Material	3,994	CY	9.50	37,943	
Concrete, Formed, Poured In-Place (Clarifiers Only)	540	CY	850.00	459,000	
Epoxy Coating (Interior Only)	5,000	SF	2.50	12,500	
TERTIARY FILTER……					$2,312,000
Equipment					
Effluent Filter Equipment	1	LS	400,000	400,000	
Effluent Pumps W2 Pumps	2	EA	10,000	20,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	420,000	25,200	
Installation Labor	6%	of	420,000	25,200	
Instrumentation Equipment Allowance	6%	of	420,000	25,200	
Instrumentation Labor	3%	of	420,000	12,600	
Process Piping Allowance	6%	of	420,000	25,200	
Process Piping Labor	3%	of	420,000	12,600	
Electrical Equipment Allowance	20%	of	420,000	84,000	
Electrical Labor	15%	of	420,000	63,000	
Buildings					
F&I Filter Building (120'x60')	7,200	SF	175	1,260,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	5%	of	1,260,000	63,000	
Civil and Foundations					
Excavation	2,700	CY	4.00	10,800	
Backfill w/ Selectived Material	1,600	CY	3.50	5,600	
Structural Fill	470	CY	24.00	11,280	
Load and Haul Excavated Material	1,100	CY	9.50	10,450	
Concrete, Formed, Poured In-Place, Structural	290	CY	850.00	246,500	
Epoxy Coating (Interior Only)	4,600	CY	2.50	11,500	
SEPTAGE RECEIVING AND DIGESTER IMPROVEMENTS……					$2,831,000
Equipment					
Digester Equipment	1	LS	250,000	250,000	
Digested Sludge Pump	2	EA	35,000	70,000	
Digester Blowers	2	EA	50,000	100,000	
Digester Hatches	2	EA	10,000	20,000	
Rehabilitate Digester Building/Septage Receiving	1	LS	250,000	250,000	
Mechanical Improvements	1	LS	220,000	220,000	
Electrical Improvements	1	LS	235,000	235,000	
Septage Equipment Allowances					
Shipping Allowance	6%	of	1,145,000	68,700	
Installation Labor	6%	of	1,145,000	68,700	
Instrumentation Equipment Allowance	6%	of	1,145,000	68,700	
Instrumentation Labor	3%	of	1,145,000	34,350	
Process Piping Allowance	6%	of	1,145,000	68,700	
Process Piping Labor	3%	of	1,145,000	34,350	
Electrical Equipment Allowance	20%	of	1,145,000	229,000	
Electrical Labor	15%	of	1,145,000	171,750	
Buildings					
None					

Wasilla WWTP Improvements
Rough Order of Magnitude Cost Estimate
(1.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
Civil and Foundations					
Excavation	32,150	CY	4.00	128,600	
Backfill w/ Selective Material	24,050	CY	3.50	84,175	
Structural Fill	6,500	CY	24.00	156,000	
Load and Haul Excavated Material	8,100	CY	9.50	76,950	
Concrete, Formed, Poured In-Place, Structural	540	CY	850.00	459,000	
Epoxy Coating (Interior Only)	15,000	SF	2.50	37,500	
MISCELLANEOUS EQUIPMENT……					$504,000
Standby Generator	1,000	kW	300	300,000	
Generator Fuel Oil Storage	All Req'd	LS	24,000	24,000	
Motor Control Center	1	EA	$150,000	150,000	
Laboratory Equipment	All Req'd	LS	30,000	30,000	
SUBTOTAL - 1. SECONDARY TREATMENT SYSTEMS					$12,265,000
OH&P	23.00%				$2,821,000
TOTAL - 1. SECONDARY TREATMENT SYSTEMS					**$15,086,000**

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
2. SITE CIVIL WORK & DISTRIBUTED COSTS					
MISCELLANEOUS SITE DEVELOPMENT COSTS……					$305,000
Mobilization and Demobilization	1	LS	150,000	150,000	
Demolition & Materials Disposal	1	LS	80,000	80,000	
Construcftion Surveying	1	LS	50,000	50,000	
Stormwater Controls	1	LS	25,000	25,000	
YARD PIPING SYSTEMS……					$970,000
Raw Sewage (RS)	440	LF	375	165,000	
Drain Piping (D)	720	LF	65	46,800	
Lagoon Effluent (LE)	560	LF	375	210,000	
Secondary Effluent (SE)	150	LF	375	56,250	
Filtrate (FIL)	120	LF	375	45,000	
Potable Water (W1)	700	LF	65	45,500	
Non-Potable Utility Water (W2)	850	LF	65	55,250	
Secondary Scum (SS)	440	LF	65	28,600	
Waste Activated Sludge (WAS)	370	LF	80	29,600	
Return Activated Sludge (RAS)	490	LF	80	39,200	
Natural Gas (NG)	400	LF	45	18,000	
Storm Drainage (S)	350	LF	150	52,500	
60" Manholes, 8' deep	6	EA	8,500	51,000	
Yard Piping 8" LPA	640	LF	80	51,200	
Yard Piping 12" LPA	460	LF	100	46,000	
Sewage Bypass Pumping During Construction	1	LS	30,000	30,000	
UTILITY SERVICES……					$135,000
Electrical Service	All Req'd	LS	75,000	75,000	
New 6" Gas Service	All Req'd	LS	60,000	60,000	
ACCESS ROADS AND PARKING……					$122,000
Access Roadways, 20 Foot Wide, Paved	300	LF	60.00	18,000	
Parking Areas	10,000	SF	10.00	100,000	
Curb and Gutter	0	LF	24.00	0	
Sidewalk	200	LF	20.00	4,000	
LANDSCAPING……					$50,000
Topsoil and Seed	All Req'd	LS	50,000	50,000	
SECURITY……					$34,000
Outdoor Lighting	1	EA	13,500	13,500	
Perimeter Security Fencing	1,000	LF	20.00	20,000	
SUBTOTAL - 2. SITE CIVIL WORK					$1,616,000
OH&P	23.00%				$372,000
TOTAL - 2. SITE CIVIL WORK					**$1,988,000**
TOTAL					**$17,074,000**

City of Palmer

Regional LAS

Initial Project Estimate Summary
Palmer Wastewater Treatment Plant Improvements
(4.0 MGD Average Daily Flow)

Date Prepared: 16-December-2009

ITEM	ESTIMATED QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
1		**SECONDARY TREATMENT SYSTEMS**		
2	1	Headworks and Screening	6,180,000	6,180,000
3	1	Primary Clarification	4,727,000	4,727,000
4	1	Anaerobic Digestion	5,514,000	5,514,000
5	1	Lagoon Activated Sludge System	10,733,000	10,733,000
6	1	Secondary Clarification	11,716,000	11,716,000
7	1	Tertiary Filtration	6,178,000	6,178,000
8	1	UV Disinfection	1,595,000	1,595,000
9	1	Dewatering and Sludge Thickening	4,191,000	4,191,000
10	1	Miscellaneous Equipment	1,765,000	1,765,000
		SITE CIVIL WORK		
11	1	Miscellaneous Site Development Costs	535,000	535,000
12	1	Yard Piping Systems	4,014,000	4,014,000
13	1	Utility Services	166,000	166,000
14	1	Access Roads and Parking	436,000	436,000
15	1	Landscaping	62,000	62,000
16	1	Security	231,000	231,000
		Subtotal Construction		$58,043,000

Land Acquisition		0
City Administration	@ 2%	1,160,900
Design	@ 10%	5,804,300
Construction Management	@ 12%	6,965,200
Project Contingency	@ 20%	11,608,600
4 Years Inflation	@ 2.5%	6,025,600
Total		$89,607,600

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
1. SECONDARY TREATMENT SYSTEMS					
HEADWORKS AND SCREENING……					$5,024,600
Wastewater Equipment					
Static Raw Sewage Bar Screen	1	EA	20,000	20,000	
Overhead Crane Rail System in Headworks	1	EA	25,000	25,000	
Raw Sewage Lift Station Pumps	3	EA	175,000	525,000	
Raw Sewage Comminutor/Screens and Appurtenant Equ	3	EA	76,000	228,000	
Headworks Channel Sluice Gates	4	EA	20,000	80,000	
Grit Removal Equipment and Appurtenances	2	EA	334,500	669,000	
Flow Metering	1	EA	25,000	25,000	
Grit Channels	1	LS	25,000	25,000	
Grit Basins	1	LS	50,000	50,000	
Odor Control Towers and Fans	All Req'd	LS	330,000	330,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	1,977,000	118,620	
Installation Labor	6%	of	1,977,000	118,620	
Instrumentation Equipment Allowance	6%	of	1,977,000	118,620	
Instrumentation Labor	3%	of	1,977,000	59,310	
Process Piping Allowance	6%	of	1,977,000	118,620	
Process Piping Labor	3%	of	1,977,000	59,310	
Electrical Equipment Allowance	20%	of	1,977,000	395,400	
Electrical Labor	15%	of	1,977,000	296,550	
Buildings					
Headworks / Grit Removal Building (80' x 80' + 50' x 50')	8,900	SF	160	1,424,000	
Misc Metals Allow. (Stairs, Handrails, and Platforms)	5%	of	1,424,000	71,200	
Civil and Foundations					
Mass Excavation	3,030	CY	4.00	12,120	
Backfill w/ Selective Material	2,000	CY	3.50	7,000	
Structural Fill	560	CY	24.00	13,440	
Load and Haul Excavated Material	1,030	CY	9.50	9,785	
Concrete, Formed, Poured In-Place, Structural	250	CY	850.00	212,500	
Epoxy Coating (Interior Only)	5,000	SF	2.50	12,500	
PRIMARY CLARIFICATION……					$3,843,000
Wastewater Equipment					
Primary Clarifier Splitter Box Weir Gates	3	EA	30,000	$90,000	
Primary Clarifier Basins Chain and Rake Collector	3	EA	175,000	$525,000	
Primary Sludge Pump	3	EA	24,000	$72,000	
Primary Scum Pump	2	EA	28,000	$56,000	
Primary Basin Drain Pumps	2	EA	14,000	$28,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	771,000	46,260	
Installation Labor	6%	of	771,000	46,260	
Instrumentation Equipment Allowance	6%	of	771,000	46,260	
Instrumentation Labor	3%	of	771,000	23,130	
Process Piping Allowance	6%	of	771,000	46,260	
Process Piping Labor	3%	of	771,000	23,130	
Electrical Equipment Allowance	20%	of	771,000	154,200	
Electrical Labor	15%	of	771,000	115,650	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
Buildings					
Primary Clarifier Building (80' x 120')	10,000	SF	160	1,600,000	
Misc Metals Allow. (Stairs, Handrails, and Platforms)	5%	of	1,600,000	80,000	
Civil and Foundations					
Mass Excavation	9,025	CY	4.00	36,100	
Structural Fill	4,340	CY	24.00	104,160	
Concrete, Formed, Poured In-Place, Structural	883	CY	850.00	750,550	
ANAEROBIC DIGESTION…					$4,482,900
Wastewater Equipment					
Equipment	6	EA	10,000	60,000	
Digester In-Tank Mixing Equipment	3	LS	120,000	360,000	
Heater/Heat Exchanger	1	EA	145,000	145,000	
Waste Gas Burner	1	LS	55,000	55,000	
Gas Safety Equipment	1	LS	95,000	95,000	
Digested Sludge Solids Handling Tank	3	CY	140,000	420,000	
Digester Feed and Recirculation Pumps	3	CY	25,000	75,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	1,210,000	72,600	
Installation Labor	6%	of	1,210,000	72,600	
Instrumentation Equipment Allowance	6%	of	1,210,000	72,600	
Instrumentation Labor	3%	of	1,210,000	36,300	
Process Piping Allowance	6%	of	1,210,000	72,600	
Process Piping Labor	3%	of	1,210,000	36,300	
Electrical Equipment Allowance	20%	of	1,210,000	242,000	
Electrical Labor	15%	of	1,210,000	181,500	
Buildings					
None	0	SF	160	0	
Misc Metals Allow. (Stairs, Handrails, and Platforms)	5%	of	0	0	
Civil and Foundations (for 3 Digestors)					
Mass Excavation	13,050	CY	4.00	52,200	
Structural Fill	7,050	CY	24.00	169,200	
Concrete, Formed, Poured In-Place, Structural	1,500	CY	850.00	1,275,000	
Spiral Guided Gas Holder Cover	3	EA	330,000	990,000	
LAGOON ACTIVATED SLUDGE SYSTEM…					$8,726,100
Wastewater Equipment					
LAS Fine Bubble Diffusers, One Pond	2	LS	1,300,000	2,600,000	
Blowers, Hi Speed Turbine, 2,600 scfm at 6.5 psi	5	EA	175,000	875,000	
Na_2CO_3 Bulk Feeder/Dissolver Tk to Supplement Alk	All Req'd	LS	35,000	35,000	
Rapid Mixer for Na_2CO_3 Solution Dispersion	1	EA	40,000	40,000	
Na_2CO_3 Dosing for Supplemental Alkalinity	All Req'd	LS	32,000	32,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	3,582,000	214,920	
Installation Labor	6%	of	3,582,000	214,920	
Instrumentation Equipment Allowance	6%	of	3,582,000	214,920	
Instrumentation Labor	3%	of	3,582,000	107,460	
Process Piping Allowance	6%	of	3,582,000	214,920	
Process Piping Labor	3%	of	3,582,000	107,460	
Electrical Equipment Allowance	20%	of	3,582,000	716,400	
Electrical Labor	15%	of	3,582,000	537,300	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
Buildings					
Weather Enclosures for LAS Air Valves	All Req'd	LS	400,000	400,000	
Civil and Foundations (2 Lagoons)					
Lagoon Liner (45 mil EPDM)	200,000	SF	4.50	900,000	
Lagoon Baffles (12' x 720 LF x 45 mil)	1,440	LF	210.00	302,400	
Insulated Lagoon Cover (4-inch, installed)	168,200	SF	4.50	756,900	
Soil Anchors, 5' Deep	300	EA	500.00	150,000	
Mass Excavation	2,800	CY	4.00	11,200	
Structural Backfill	10,800	CY	24.00	259,200	
Load and Haul Excavated Material	2,800	CY	9.50	26,600	
Geotextile Fabric	19,000	SF	0.50	9,500	
SECONDARY CLARIFICATION……					$9,525,000
Wastewater Equipment					
Secondary Clarification Scraper and Bridge Equipment	3	EA	$155,000	$465,000	
Scum Pumps	2	EA	$15,000	$30,000	
RAS Pumps	2	EA	$20,000	$40,000	
WAS Pumps	2	EA	$18,000	$36,000	
Drain Pumps	2	EA	$14,000	$28,000	
RAS and WAS Meters	2	EA	$4,500	$9,000	
NaOCl RAS Dosing for Bulking Control	All Req'd	LS	$15,000	$15,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	623,000	37,380	
Installation Labor	6%	of	623,000	37,380	
Instrumentation Equipment Allowance	6%	of	623,000	37,380	
Instrumentation Labor	3%	of	623,000	18,690	
Process Piping Allowance	6%	of	623,000	37,380	
Process Piping Labor	3%	of	623,000	18,690	
Electrical Equipment Allowance	20%	of	623,000	124,600	
Electrical Labor	15%	of	623,000	93,450	
Buildings					
Clarifier Building (190'x200')	38,000	SF	150	5,700,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	10%	of	5,700,000	570,000	
Civil and Foundations (for 3 Clarifiers)					
Mass Excavation	21,700	CY	4.00	86,800	
Backfill w/ Selective Material	9,100	CY	3.50	31,850	
Structural Fill	2,600	CY	24.00	62,400	
Load and Haul Excavated Material	12,600	CY	9.50	119,700	
Concrete, Formed, Poured In-Place, Structural	2,200	CY	850.00	1,870,000	
Epoxy Coating (Interior Only)	22,500	SF	2.50	56,250	
TERTIARY FILTRATION……					$5,023,000
Wastewater Equipment					
Effluent Filter Equipment	1	LS	340,000	340,000	
W2 Pumps	3	EA	18,000	54,000	
Coagulant Bulk Feeder and Dissolver Tank for Filter	1	LS	35,000	35,000	
Rapid Mixer for Coagulant Dosing into SE	1	EA	40,000	40,000	
Coagulant Dosing for SE Flow to Filter	1	LS	20,000	20,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	489,000	29,340	
Installation Labor	6%	of	489,000	29,340	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
Instrumentation Equipment Allowance	6%	of	489,000	29,340	
Instrumentation Labor	3%	of	489,000	14,670	
Process Piping Allowance	6%	of	489,000	29,340	
Process Piping Labor	3%	of	489,000	14,670	
Electrical Equipment Allowance	20%	of	489,000	97,800	
Electrical Labor	15%	of	489,000	73,350	
Building					
Tertiary Filtration Building (190'x100')	19,000	SF	175	3,325,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	10%	of	3,325,000	332,500	
Civil and Foundations					
Mass Excavation	3,600	CY	4.00	14,400	
Backfill w/ Selectived Material	1,500	CY	3.50	5,250	
Structural Fill	600	CY	24.00	14,400	
Load and Haul Excavated Material	2,100	CY	9.50	19,950	
Concrete, Formed, Poured In-Place, Structural	580	CY	850.00	493,000	
Epoxy Coating (Interior Only)	4,600	SF	2.50	11,500	
UV DISINFECTION……					$1,296,600
Wastewater Equipment					
UV Lamp Assembly	2	EA	290,000	580,000	
Parshall Flume Channel	1	LS	7,500	7,500	
Parshall Flume	1	EA	14,000	14,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	601,500	36,090	
Installation Labor	6%	of	601,500	36,090	
Instrumentation Equipment Allowance	6%	of	601,500	36,090	
Instrumentation Labor	3%	of	601,500	18,045	
Process Piping Allowance	6%	of	601,500	36,090	
Process Piping Labor	3%	of	601,500	18,045	
Electrical Equipment Allowance	20%	of	601,500	120,300	
Electrical Labor	15%	of	601,500	90,225	
Building					
Included in the Tertiary Filtration Building				0	
Civil and Foundations					
Mass Excavation	2,800	CY	4.00	11,200	
Backfill w/ Selectived Material	1,700	CY	3.50	5,950	
Structural Fill	520	CY	24.00	12,480	
Load and Haul Excavated Material	1,100	CY	9.50	10,450	
Concrete, Formed, Poured In-Place, Structural	290	CY	850.00	246,500	
Epoxy Coating (Interior Only)	7,000	SF	2.50	17,500	

Palmer WWTP Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
DEWATERING AND SLUDGE THICKENING……					$3,407,400
Equipment					
Rotary Drum Thickener	2	EA	110,000	220,000	
Screw Press Dewatering Equipment	2	EA	400,000	800,000	
Screw Press Feed Pumps	2	EA	6,500	13,000	
W2 Wash Water Booster Pumps	2	EA	5,000	10,000	
Batch Polyelectrolyte Solution Prep/Dosing Equipment.	1	LS	260,000	260,000	
Instrument Air Compressor and Reciever/Dryer/Filters	2	EA	20,000	40,000	
Residuals Building Odor Control Towers and Fans	1	LS	200,000	200,000	
Residuals Building Drain Pumps	2	LS	6,500	13,000	
Equipment Allowances					
Shipping Allowance	6%	of	1,556,000	93,360	
Installation Labor	6%	of	1,556,000	93,360	
Instrumentation Equipment Allowance	6%	of	1,556,000	93,360	
Instrumentation Labor	3%	of	1,556,000	46,680	
Process Piping Allowance	6%	of	1,556,000	93,360	
Process Piping Labor	3%	of	1,556,000	46,680	
Electrical Equipment Allowance	20%	of	1,556,000	311,200	
Electrical Labor	15%	of	1,556,000	233,400	
Buildings					
Dewatering Building (50'x100')	5,000	SF	160	800,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	5%	of	800,000	40,000	
MISCELLANEOUS EQUIPMENT……					$1,435,000
Standby Generator	1,200	kW	300.00	360,000	
Generator Fuel Oil Storage	1	LS	25,000	25,000	
Rehab/Remodel Existing Admin. Building	1	LS	750,000	750,000	
Motor Control Center	1	EA	150,000	150,000	
Utility Water Pumps	3	EA	3,500	10,500	
Plant Drain Pumps	2	EA	6,500	13,000	
Hot Water Generator	1	LS	6,500	6,500	
Laboratory Equipment	1	Req'd	60,000	60,000	
Sampling Equipment	2	EA	30,000	60,000	
SUBTOTAL - 1. SECONDARY TREATMENT SYSTEMS					$42,763,600
OH&P	23.00%				$9,835,600
TOTAL - 1. SECONDARY TREATMENT SYSTEMS					**$52,599,200**

Palmer WWTP Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
2. SITE CIVIL WORKS & DISTRIBUTED COSTS					
MISCELLANEOUS SITE DEVELOPMENT COSTS					$435,000
Mobilization and Demobilization	1	LS	250,000	250,000	
Demolition & Materials Disposal	1	LS	80,000	80,000	
Construcftion Surveying	1	LS	80,000	80,000	
Stormwater Controls	1	LS	25,000	25,000	
YARD PIPING SYSTEMS					$3,263,400
Raw Sewage (RS)	150	LF	375	56,250	
Primary Effluent (PE)	510	LF	375	191,250	
Primary Sludge/Scum (PSS)	1070	LF	80	85,600	
Drain Piping (D)	400	LF	65	26,000	
Lagoon Effluent (LE)	630	LF	375	236,250	
Secondary Effluent (SE)	360	LF	375	135,000	
Filtrate (FIL)	180	LF	375	67,500	
Potable Water (W1)	2500	LF	65	162,500	
Non-Potable Utility Water (W2)	2500	LF	65	162,500	
Waste Activated Sludge (WAS)	710	LF	80	56,800	
Return Activated Sludge (RAS)	1050	LF	80	84,000	
Final Effluent (FE)	3000	LF	375	1,125,000	
Digested Sludge (DS)	480	LF	65	31,200	
Biogas (BG)	700	LF	45	31,500	
Natural Gas (NG)	2000	LF	45	90,000	
Storm Drainage (S)	1800	LF	150	270,000	
60" Manholes, 8' deep	12	EA	8,500	102,000	
Yard Piping 8" LPA	2750	LF	80	220,000	
Yard Piping 12" LPA	1000	LF	100	100,000	
Sewage Bypass Pumping During Construction	1	LS	30,000	30,000	
UTILITY SERVICES					$135,000
Electrical Service	All Req'd	LS	75,000	75,000	
New 6" Gas Service	All Req'd	LS	60,000	60,000	
ACCESS ROADS AND PARKING					$354,400
Access Roadways, 20 Foot Wide, Paved	2,200	LF	60.00	132,000	
Parking Areas, Paved	20,000	SF	10.00	200,000	
Curb and Gutter	600	LF	24.00	14,400	
Sidewalk	400	LF	20.00	8,000	
LANDSCAPING					$50,000
Topsoil and Seed	1	LS	50,000	50,000	
SECURITY					$188,000
Outdoor Lighting	8	EA	13,500	108,000	
Perimeter Security Fencing	4000	LF	20.00	80,000	
SUBTOTAL - 2. SITE CIVIL WORK					$4,425,800
OH&P	23.00%				$1,018,000
TOTAL - 2. SITE CIVIL WORK					**$5,444,000**
TOTAL					**$58,043,200**

Initial Project Estimate Summary
Conveyance Estimates to Palmer RWWTP
(4.0 MGD Average Daily Flow)

Date Prepared: 09-December-2009

ITEM	ESTIMATED QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
1	1	Construct Influent Sewer from Wasilla	12,865,000	12,865,000
2	1	Capacity Upgrades to SWX	2,161,000	2,161,000
		Subtotal Construction		$15,026,000

Land Acquisition		0
City Administration	@ 2%	300,500
Design	@ 10%	1,502,600
Construction Management	@ 12%	1,803,100
Project Contingency	@ 15%	2,253,900
4 Years Inflation	@ 2.5%	1,559,900
Subtotal		$22,446,000

Palmer RWWTP Conveyance Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
1. CONSTRUCT INFLUENT MAIN FROM WASILLA……					$12,865,000
CONSTRUCT SANITARY SEWER (26,960 LF)					
Clearing and Grubbing	15	Acre	9,000.00	131,400	
Usable and Unusable Excavation	18,000	CY	12.00	216,000	
Trench Excavation & Backfill (8' depth, sewer)	25,110	LF	55.00	1,381,050	
Bedding Material, Class C	24,200	Ton	14.00	338,800	
F&I 30" HDPE SDR 17 Sewer Main-Gravity	15,475	LF	110.00	1,702,250	
F&I 12" HDPE SDR 17 Sewer Main-Pressure	10,560	LF	60.00	633,600	
F&I 16" HDPE SDR 17 Sewer Main-Pressure	10,560	LF	70.00	739,200	
F&I 20" HDPE SDR 17 Sewer Main-Pressure	10,560	LF	85.00	897,600	
Air/Vacuum Relief Valve	3	LS	60,000	180,000	
Construct Type A Manhole (all depths)	33	EA	8,500	280,500	
Construction Surveying	1	LS	250,000	250,000	
Traffic Maintenance	1	LS	150,000.00	150,000	
Storm Water Pollution Prevention Plan	1	LS	50,000.00	50,000	
Directional Bore w/ Steel Casing (Parks Hwy)	400	LF	750.00	300,000	
Directional Bore w/ Steel Casing (Alaska RR)	150	LF	750.00	112,500	
Directional Bore w/ Steel Casing (Wasilla Crk)	200	LF	750.00	150,000	
Directional Bore w/ Steel Casing (Trunk Rd.)	175	LF	750.00	131,250	
Topsoil	1,201	ksf	200.00	240,200	
Seeding, Schedule C Mix	1,201	ksf	100.00	120,100	
Culvert Replacements	2,000	LF	75.00	150,000	
Utility Relocates	1	LS	120,000	120,000	
Salvage/Replace Signs	1	LS	15,000	15,000	
Driveway Crossings	35	EA	5,000.00	175,000	
Road Crossings	11	EA	12,000.00	132,000	
Force Main Cleanout Assembly	13	EA	17,500.00	227,500	
Reconstruct Bike Path	7,450	SF	30.00	223,500	
CONSTRUCT NEW LIFT STATIONS (3)					
Excavation (Over 12 feet)	14,400	CY	12.00	172,800	
Lift Station Wet Well (Concrete)	975	CY	850.00	828,750	
Classified Fill	1,290	CY	24.00	30,960	
Backfill	10,740	CY	3.50	37,590	
Load and Haul Excavated Material	3,660	CY	9.50	34,770	
F&I Lift Station Pumps	12	EA	30,000	360,000	
Misc. Equipment	3	LS	150,000	450,000	
Construction Surveying	3	LS	15,000	45,000	
Storm Water Pollution Prevention Plan	3	LS	5,000	15,000	
Lift Station Pump Building (16' x 16')	768	SF	450.00	345,600	
Pump Controls, Misc. Electrical	3	LS	50,000	150,000	
Site Grading, Parking, Accessibility	3	LS	50,000	150,000	
F&I Lift Station Valve Vault	3	LS	150,000	450,000	
Backup Generator	3	LS	200,000	600,000	
Electric Utility Extensions	3	LS	25,000	75,000	
Lift Station Access Road	1,200	LF	60.00	72,000	

Palmer RWWTP Conveyance Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
2. SWX CAPACITY UPGRADES…					$2,161,000
RETROFIT EXISTING SEWER LIFT STATIONS (3)					
Excavation (Over 12 feet)	14,400	CY	12.00	172,800	
Lift Station Wet Well	975	CY	850.00	828,750	
Classified Fill	1,290	CY	24.00	30,960	
Backfill	10,740	CY	3.50	37,590	
Load and Haul Excavated Material	3,660	CY	9.50	34,770	
F&I Lift Station Pumps	12	EA	30,000	360,000	
Misc. Equipment	3	LS	150,000	450,000	
Pump Controls, Misc. Electrical	3	LS	50,000	150,000	
Construction Surveying	3	LS	15,000	45,000	
Storm Water Pollution Prevention Plan	3	LS	5,000	15,000	
Topsoil	120	ksf	200	24,000	
Seeding, Schedule C Mix	120	ksf	100	12,000	
TOTAL					$15,026,000

Initial Project Estimate Summary
Conveyance Estimates to Palmer RWWTP
(8.0 MGD Average Daily Flow)

Date Prepared: 09-December-2009

ITEM	ESTIMATED QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
1	1	Wasilla Conveyance Main Capacity Upgrades	2,373,000	2,373,000
2	1	SWX Capacity Upgrades	8,566,000	8,566,000
		Subtotal Construction		$10,939,000

Land Acquisition		0
City Administration	@ 2%	218,800
Design	@ 10%	1,093,900
Construction Management	@ 12%	1,312,700
Project Contingency	@ 15%	1,640,900
25 Years Inflation	@ 2.5%	9,341,300
Subtotal		$24,546,600

Palmer RWWTP Conveyance Improvements
Rough Order of Magnitude Cost Estimate
(8.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
1. WASILLA CONVEYANCE MAIN CAPACITY UPGRADES……					$2,373,000
UPGRADE LIFT STATION CAPACITIES (3)					
Excavation (Over 12 feet)	14400	CY	12.00	172,800	
Lift Station Wet Well (Concrete)	975	CY	850.00	828,750	
Classified Fill	1290	CY	24.00	30,960	
Backfill	10740	CY	3.50	37,590	
Load and Haul Excavated Material	3360	CY	9.50	31,920	
F&I Larger Lift Station Pumps	12	LS	60,000	720,000	
Misc. Equipment	3	LS	150,000	450,000	
Site Grading	3	LS	5,000	15,000	
Construction Surveying	3	LS	10,000	30,000	
Storm Water Pollution Prevention Plan	3	LS	5,000	15,000	
Topsoil	135	ksf	200.00	27,000	
Seeding	135	ksf	100.00	13,500	
2. SWX CAPACITY UPGRADES……					$8,566,000
CONSTRUCT SANITARY SEWER (31,225 L.F.)					
Trench Excavation & Backfill (8' depth, sewer)	31225	LF	14.00	437,150	
Bedding Material, Class C	21400	Ton	14.00	299,600	
F&I 42" HDPE SDR 17 Sewer Main-Gravity	14561	LF	120.00	1,747,320	
F&I 20" HDPE SDR 17 Sewer Main-Pressure	16664	LF	85.00	1,416,440	
Construct Type A Manhole (all depths)	37	EA	8,500	314,500	
Construction Surveying	1	LS	250,000	250,000	
Traffic Maintenance	1	LS	450,000	450,000	
Storm Water Pollution Prevention Plan	1	LS	50,000	50,000	
Directional Bore w/ Steel Casing (Alaska RR)	250	LF	500.00	125,000	
Directional Bore w/ Steel Casing (Glenn Hwy.)	250	LF	500.00	125,000	
Topsoil	1934	ksf	200.00	386,800	
Seeding, Schedule C Mix	1934	ksf	100.00	193,400	
Culvert Replacements	240	LF	75.00	18,000	
Signs	1	LS	15,000	15,000	
Driveway Crossings	12	EA	5,000	60,000	
Road Crossings	5	EA	12,000	60,000	
Force Main Cleanout Assembly	14	EA	17,500	245,000	
UPGRADE LIFT STATION CAPACITIES (3)					
Excavation (Over 12 feet)	14400	CY	12.00	172,800	
Lift Station Wet Well (Concrete)	975	CY	850.00	828,750	
Classified Fill	1290	CY	24.00	30,960	
Backfill	10740	CY	3.50	37,590	
Load and Haul Excavated Material	3360	CY	9.50	31,920	
F&I Larger Lift Station Pumps	12	LS	60,000	720,000	
Misc. Equipment	3	LS	150,000	450,000	
Site Grading	3	LS	5,000	15,000	
Construction Surveying	3	LS	10,000	30,000	
Storm Water Pollution Prevention Plan	3	LS	5,000	15,000	
Topsoil	135	ksf	200.00	27,000	
Seeding	135	ksf	100.00	13,500	
TOTAL					$10,939,000

Regional WWTP - CAS

Initial Project Estimate Summary
Regional Wastewater Treatment Plant Improvements
Conventional Activated Sludge - 4.0 ADF

Date Prepared: 16-December-2009

ITEM	ESTIMATED QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
		SECONDARY TREATMENT SYSTEMS		
1	1	Septage Handling	4,775,000	$4,775,000
2	1	Headworks and Screening	7,319,000	7,319,000
3	1	Primary Clarification	4,032,000	4,032,000
4	1	Anaerobic Digestion	5,440,000	5,440,000
5	1	Conventional Activated Sludge Process	25,387,000	25,387,000
6	1	Secondary Clarification	4,796,000	4,796,000
7	1	Tertiary Filtration	1,897,000	1,897,000
8	1	Ultraviolet Disinfection	1,482,000	1,482,000
9	1	Dewatering and Sludge Thickening	4,191,000	4,191,000
10	1	Administration/Lab and Equipment Storage	4,080,000	4,080,000
11	1	Miscellaneous Equipment	688,000	688,000
		SITE CIVIL WORK		
12	1	Miscellaneous Site Development Costs	498,000	498,000
13	1	Yard Piping Systems	3,306,000	3,306,000
14	1	Utility Services	258,000	258,000
15	1	Access Roads and Parking	632,000	632,000
16	1	Landscaping	62,000	62,000
17	1	Security	210,000	210,000
		Subtotal Construction		$69,053,000

Land Acquisition (20 Acres @ 50,000/acre)		1,000,000
City Administration	@ 2%	1,381,100
Design	@ 10%	6,905,300
Construction Management	@ 12%	8,286,400
Project Contingency	@ 20%	13,810,600
4 Years Inflation	@ 2.5%	7,168,600
Subtotal		$107,605,000

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
1. SECONDARY TREATMENT SYSTEMS					
SEPTAGE HANDLING……					$3,882,000
Equipment					
Screening, Degrit, Compaction and Dewatering	2	LS	$200,000	$400,000	
Bar Screens	2	LS	$20,000	$40,000	
Effluent Pumps	2	EA	$6,500	$13,000	
Flow Meters	2	EA	$7,000	$14,000	
Thickened Septage Pumps	2	EA	$3,000	$6,000	
Thickened Septage Scum Pumps	2	EA	$3,000	$6,000	
Booster Pump for Hot Wash Water	2	EA	$3,000	$6,000	
Thickener Basin Scraper Drive and Bridge Equipment	2	EA	$150,000	$300,000	
Holding Tank Blowers	2	EA	$3,000	$6,000	
Drain Pumps	2	EA	$3,000	$6,000	
Odor Control Towers and Fans	1	LS	$200,000	$200,000	
Equipment Allowances					
Shipping Allowance	6%	of	997,000	59,820	
Installation Labor	6%	of	997,000	59,820	
Instrumentation Equipment Allowance	6%	of	997,000	59,820	
Instrumentation Labor	3%	of	997,000	29,910	
Process Piping Allowance	6%	of	997,000	59,820	
Process Piping Labor	3%	of	997,000	29,910	
Electrical Equipment Allowance	20%	of	997,000	199,400	
Electrical Labor	15%	of	997,000	149,550	
Buildings					
F&I Septage Receiving Building (35'x50')	1,750	SF	$190	$332,500	
F&I Septage Thickener Pump Building (20'x20')	400	SF	$160	$64,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms	5%	of	396,500	19,825	
Civil and Foundations					
Mass Excavation	13,560	CY	$4.00	54,240	
Backfill	3,940	CY	$3.50	13,790	
Structural Fill	3,120	CY	$24.00	74,880	
Load and Haul Excavated Material	9,620	CY	$9.50	91,390	
Concrete, Formed, Poured In-Place, Structural	1,605	CY	$850.00	1,364,250	
Epoxy Coating (Interior Only)	21,000	SF	$2.50	52,500	
Holding Tank Hatches	2	EA	$10,000	$20,000	
Thickener Covers	2	EA	$75,000	$150,000	

Regional CAS WWTP Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
HEADWORKS AND SCREENING........					$5,950,000
Equipment					
Static Raw Sewage Bar Screen	1	EA	$20,000	$20,000	
Raw Sewage LS Screw Pumps	3	EA	$350,000	$1,050,000	
Overhead Crane Rail System in Headworks	1	EA	$25,000	$25,000	
Raw Sewage Comminutor/Screens and Appurtenant Eq	3	EA	$125,000	$375,000	
Grit Removal Equipment and Appurtenances	2	EA	$334,500	$669,000	
Flow Metering (Influent, RAS, WAS)	3	EA	$7,000	$21,000	
Odor Control Towers and Fans	All Req'd	LS	$200,000	$200,000	
Equipment Allowances					
Shipping Allowance	6%	of	2,360,000	141,600	
Installation Labor	6%	of	2,360,000	141,600	
Instrumentation Equipment Allowance	6%	of	2,360,000	141,600	
Instrumentation Labor	3%	of	2,360,000	70,800	
Process Piping Allowance	6%	of	2,360,000	141,600	
Process Piping Labor	3%	of	2,360,000	70,800	
Electrical Equipment Allowance	20%	of	2,360,000	472,000	
Electrical Labor	15%	of	2,360,000	354,000	
Buildings					
Grit and Headworks Building (70'x120')	8,400	SF	$160	$1,344,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms	5%	of	1,344,000	67,200	
Civil and Foundations					
Mass Excavation	2150	CY	$4.00	8,600	
Backfill	1130	CY	$3.50	3,955	
Structural Fill	470	CY	$24.00	11,280	
Load and Haul Excavated Material	1020	CY	$9.50	9,690	
Concrete, Formed, Poured In-Place, Structural	610	CY	$850.00	518,500	
Epoxy Coating (Interior Only)	5000	SF	$2.50	12,500	
Headworks Channel Sluice Gates	4	EA	$20,000	$80,000	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
PRIMARY CLARIFICATION……………………………………………………………………………………					$3,278,000
Equipment					
Primary Clarifier Scraper Drive and Bridge Equipment	2	EA	$140,000	$280,000	
Primary Sludge Pump	3	EA	$15,000	$45,000	
Thickened Sludge Pump	3	EA	$6,500	$19,500	
Primary Scum Pump	2	EA	$6,500	$13,000	
Primary Basin Drain Pumps	2	EA	$6,500	$13,000	
Equipment Allowances					
Shipping Allowance	6%	of	370,500	22,230	
Installation Labor	6%	of	370,500	22,230	
Instrumentation Equipment Allowance	6%	of	370,500	22,230	
Instrumentation Labor	3%	of	370,500	11,115	
Process Piping Allowance	6%	of	370,500	22,230	
Process Piping Labor	3%	of	370,500	11,115	
Electrical Equipment Allowance	20%	of	370,500	74,100	
Electrical Labor	15%	of	370,500	55,575	
Buildings					
Primary Clarifier Pump Building (60'x60')	3,600	SF	$160	$576,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms	5%	of	576,000	28,800	
Civil and Foundations					
Mass Excavation	14615	CY	$4.00	58,460	
Backfill	4565	CY	$3.50	15,978	
Structural Fill	1950	CY	$24.00	46,800	
Load and Haul Excavated Material	10050	CY	$9.50	95,475	
Concrete, Formed, Poured In-Place, Structural	1765	CY	$850.00	1,500,250	
Epoxy Coating (Interior Only)	30000	SF	$2.50	75,000	
Primary Clarifier Covers	2	EA	$95,000.00	190,000	
Primary Clarifier Splitter Box Weir Gates	4	EA	$20,000	$80,000	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
ANAEROBIC DIGESTION……					$4,423,000
Wastewater Equipment					
Equipment	6	EA	10,000	60,000	
Digester In-Tank Mixing Equipment	3	LS	120,000	360,000	
Heater/Heat Exchanger	1	EA	145,000	145,000	
Waste Gas Burner	1	LS	55,000	55,000	
Gas Safety Equipment	1	LS	95,000	95,000	
Digested Sludge Solids Handling Tank	3	CY	140,000	420,000	
Digester Feed and Recirculation Pumps	3	CY	25,000	75,000	
Wastewater Equipment Allowances					
Shipping Allowance	6%	of	1,210,000	72,600	
Installation Labor	6%	of	1,210,000	72,600	
Instrumentation Equipment Allowance	6%	of	1,210,000	72,600	
Instrumentation Labor	3%	of	1,210,000	36,300	
Process Piping Allowance	6%	of	1,210,000	72,600	
Process Piping Labor	3%	of	1,210,000	36,300	
Electrical Equipment Allowance	20%	of	1,210,000	242,000	
Electrical Labor	15%	of	1,210,000	181,500	
Buildings					
None	0	SF	160	0	
Civil and Foundations (for 3 Digestors)					
Mass Excavation	13,050	CY	4.00	52,200	
Structural Fill	7,050	CY	24.00	169,200	
Concrete, Formed, Poured In-Place, Structural	1,500	CY	850.00	1,275,000	
Spiral Guided Gas Holder Cover	3	EA	330,000	990,000	

Regional CAS WWTP Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
CONVENTIONAL ACTIVATED SLUDGE PROCESS..					$20,640,000
Equipment					
Conventional Activated Sludge Equipment	3	LS	$466,667	$1,400,000	
Blowers	5	EA	$150,000	$750,000	
Anoxic Mixers	12	EA	$14,000	$168,000	
Fine Bubble Diffusers Below Water Manifolds	1	LS	$150,000	$150,000	
Aeration Piping Systems Including Control Valves	1	LS	$100,000	$100,000	
Na_2CO_3 Bulk Feeder/Dissolver Tk to Supplement Alk	1	LS	$35,000	$35,000	
Rapid Mixer for Na_2CO_3 Solution Dispersion	1	EA	$40,000	$40,000	
Na_2CO_3 Dosing for Supplemental Alkalinity	1	LS	$32,000	$32,000	
Blower Main Control Panel (MCP)	1	LS	$60,000	$60,000	
Equipment Allowances					
Shipping Allowance	6%	of	2,735,000	164,100	
Installation Labor	6%	of	2,735,000	164,100	
Instrumentation Equipment Allowance	6%	of	2,735,000	164,100	
Instrumentation Labor	3%	of	2,735,000	82,050	
Process Piping Allowance	6%	of	2,735,000	164,100	
Process Piping Labor	3%	of	2,735,000	82,050	
Electrical Equipment Allowance	20%	of	2,735,000	547,000	
Electrical Labor	15%	of	2,735,000	410,250	
Buildings					
CAS Building (570'x175' plus chemical/thickener room)	104,550	SF	$115	$12,023,250	
Misc Metals Allowance (Stairs, Handrails, and Platforms	5%	of	12,023,250	601,163	
Civil and Foundations					
Mass Excavation	43400	CY	$4.00	173,600	
Backfill	13670	CY	$3.50	47,845	
Structural Fill	5680	CY	$24.00	136,320	
Load and Haul Excavated Material	29730	CY	$9.50	282,435	
Concrete, Formed, Poured In-Place, Structural	3235	CY	$850.00	2,749,750	
Epoxy Coating (Interior Only)	45000	SF	$2.50	112,500	

Regional CAS WWTP Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
SECONDARY CLARIFICATION…					$3,899,000
Equipment					
Secondary Clarifier Scraper Drive and Bridge Equipmen	3	EA	$147,350	$442,050	
Secondary Scum Pumps	2	EA	$16,000	$32,000	
RAS Pumps	3	EA	$20,000	$60,000	
WAS Pumps	2	EA	$20,000	$40,000	
RAS and WAS Meters	2	EA	$4,500	$9,000	
Secondary Clarifier Drain Pumps	2	EA	$16,000	$32,000	
Secondary Process Piping and Valve Systems	1	LS	$350,000	$350,000	
MLSS Ammonia Probes	3	EA	$9,000	$9,000	
MLSS DO Probes	3	EA	$6,000	$6,000	
NaOCl RAS Dosing for Bulking Control	All Req'd	LS	$15,000	$15,000	
Equipment Allowances					
Shipping Allowance	6%	of	995,050	59,703	
Installation Labor	6%	of	995,050	59,703	
Instrumentation Equipment Allowance	6%	of	995,050	59,703	
Instrumentation Labor	3%	of	995,050	29,852	
Process Piping Allowance	6%	of	995,050	59,703	
Process Piping Labor	3%	of	995,050	29,852	
Electrical Equipment Allowance	20%	of	995,050	199,010	
Electrical Labor	15%	of	995,050	149,258	
Buildings					
None					
Civil and Foundations (3 Basins)					
Mass Excavation	21664	CY	$4.00	86,656	
Backfill	9415	CY	$3.50	32,953	
Structural Fill	3050	CY	$24.00	73,200	
Load and Haul Excavated Material	12249	CY	$9.50	116,366	
Concrete, Formed, Poured In-Place, Structural	2225	CY	$850.00	1,891,250	
Epoxy Coating (Interior Only)	22500	SF	$2.50	56,250	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
TERTIARY FILTRATION……					$1,542,000
Equipment					
Tertiary Filter	1	EA	$630,000	$630,000	
Coagulant Bulk Feeder and Dissolver Tank for Filter	All Req'd	LS	$35,000	$35,000	
Rapid Mixer for Coagulant Dosing into SE	1	EA	$40,000	$40,000	
Coagulant Dosing for SE Flow to Filter	All Req'd	LS	$20,000	$20,000	
Equipment Allowances					
Shipping Allowance	6%	of	725,000	43,500	
Installation Labor	6%	of	725,000	43,500	
Instrumentation Equipment Allowance	6%	of	725,000	43,500	
Instrumentation Labor	3%	of	725,000	21,750	
Process Piping Allowance	6%	of	725,000	43,500	
Process Piping Labor	3%	of	725,000	21,750	
Electrical Equipment Allowance	20%	of	725,000	145,000	
Electrical Labor	15%	of	725,000	108,750	
Buildings					
None					
Civil and Foundations					
Mass Excavation	2800	CY	$4.00	11,200	
Backfill	1200	CY	$3.50	4,200	
Structural Fill	560	CY	$24.00	13,440	
Load and Haul Excavated Material	1600	CY	$9.50	15,200	
Concrete, Formed, Poured In-Place, Structural	340	CY	$850.00	289,000	
Epoxy Coating (Interior Only)	5000	SF	$2.50	12,500	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
ULTRAVIOLET DISINFECTION…					$1,205,000
Equipment					
W2 Pumps	3	EA	$18,000	$54,000	
UV Bulb Assembly	1	LS	$481,000	$481,000	
Parshall Flume	1	EA	$14,000	$14,000	
Equipment Allowances					
Shipping Allowance	6%	of	549,000	32,940	
Installation Labor	6%	of	549,000	32,940	
Instrumentation Equipment Allowance	6%	of	549,000	32,940	
Instrumentation Labor	3%	of	549,000	16,470	
Process Piping Allowance	6%	of	549,000	32,940	
Process Piping Labor	3%	of	549,000	16,470	
Electrical Equipment Allowance	20%	of	549,000	109,800	
Electrical Labor	15%	of	549,000	82,350	
Buildings					
None					
Civil and Foundations					
Mass Excavation	2800	CY	$4.00	11,200	
Backfill	1700	CY	$3.50	5,950	
Structural Fill	520	CY	$24.00	12,480	
Load and Haul Excavated Material	1100	CY	$9.50	10,450	
Concrete, Formed, Poured In-Place, Structural	290	CY	$850.00	246,500	
Epoxy Coating (Interior Only)	5000	SF	$2.50	12,500	

Regional CAS WWTP Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
DEWATERING AND SLUDGE THICKENING……					$3,407,000
Equipment					
Rotary Drum Thickener	2	EA	$110,000	$220,000	
Screw Press Dewatering Equipment	2	EA	$400,000	$800,000	
Screw Press Feed Pumps	2	EA	$6,500	$13,000	
W2 Wash Water Booster Pumps	2	EA	$5,000	$10,000	
Batch Polyelectrolyte Solution Prep/Dosing Equipment.	1	LS	$260,000	$260,000	
Instrument Air Compressor and Reciever/Dryer/Filters	2	EA	$20,000	$40,000	
Residuals Building Odor Control Towers and Fans	1	LS	$200,000	$200,000	
Residuals Building Drain Pumps	2	LS	$6,500	$13,000	
Equipment Allowances					
Shipping Allowance	6%	of	1,556,000	93,360	
Installation Labor	6%	of	1,556,000	93,360	
Instrumentation Equipment Allowance	6%	of	1,556,000	93,360	
Instrumentation Labor	3%	of	1,556,000	46,680	
Process Piping Allowance	6%	of	1,556,000	93,360	
Process Piping Labor	3%	of	1,556,000	46,680	
Electrical Equipment Allowance	20%	of	1,556,000	311,200	
Electrical Labor	15%	of	1,556,000	233,400	
Buildings					
Dewatering Building (50'x100')	5,000	SF	$160	$800,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms	5%	of	800,000	40,000	
Civil and Foundations					
Included in Building Costs					

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
ADMINISTRATION/LABORATORY EQUIPMENT……					$3,317,000
Equipment					
Hot Water Generator	1	LS	$6,500	$6,500	
Laboratory Equipment	1	Req'd	$60,000	$60,000	
Sampling Equipment	2	EA	$30,000	$60,000	
Equipment Allowances					
Shipping Allowance	6%	of	126,500	7,590	
Installation Labor	6%	of	126,500	7,590	
Instrumentation Equipment Allowance	6%	of	126,500	7,590	
Instrumentation Labor	3%	of	126,500	3,795	
Process Piping Allowance	6%	of	126,500	7,590	
Process Piping Labor	3%	of	126,500	3,795	
Electrical Equipment Allowance	20%	of	126,500	25,300	
Electrical Labor	15%	of	126,500	18,975	
Buildings					
Administrative/Laboratory Building	6,800	SF	$250	$1,700,000	
Equipment Storage Building	8,400	SF	$150	$1,260,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms	5%	of	2,960,000	148,000	
Civil and Foundations					
Included in Building Costs					
MISCELLANEOUS EQUIPMENT……					$559,000
Motor Control Center	1	EA	$150,000	$150,000	
Utility Water Pumps	3	EA	$3,500	$10,500	
Plant Drain Pumps	2	EA	$6,500	$13,000	
Standby Generator	1200	kW	$300	$360,000	
Generator Fuel Oil Storage	All Req'd	LS	$25,000	$25,000	
TOTAL - 1. SECONDARY TREATMENT SYSTEMS					$52,102,000
OH&P	23.00%				$11,984,000
TOTAL - 1. SECONDARY TREATMENT SYSTEMS					**$64,086,000**

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
2. SITE CIVIL WORK					
MISCELLANEOUS SITE DEVELOPMENT COSTS……					$405,000
Mobilization and Demobilization	1	LS	150,000	150,000	
Clearing and Grubbing	1	LS	80,000	80,000	
Construcftion Surveying	1	LS	100,000	100,000	
Stormwater Controls	1	LS	75,000	75,000	
YARD PIPING SYSTEMS……					$2,688,000
Raw Sewage (RS)	1000	LF	$375	$375,000	
Primary Influent (PI)	230	LF	$375	$86,250	
Primary Effluent (PE)	650	LF	$375	$243,750	
Primary Sludge (PS)	650	LF	$80	$52,000	
Drain Piping (D)	2700	LF	$65	$175,500	
Mixed Liquor (ML)	360	LF	$375	$135,000	
Secondary Effluent (SE)	340	LF	$375	$127,500	
Filtrate (FIL)	60	LF	$375	$22,500	
Potable Water (W1)	1200	LF	$65	$78,000	
Non-Potable Utility Water (W2)	1200	LF	$65	$78,000	
Waste Activated Sludge (WAS)	760	LF	$80	$60,800	
Return Activated Sludge (RAS)	1070	LF	$80	$85,600	
Final Effluent (FE)	1000	LF	$375	$375,000	
Thickened Waste Activated Sludge (TWAS)	650	LF	$80	$52,000	
Septage Effluent (SEPE)	180	LF	$100	$18,000	
Digested Sludge (DS)	1050	LF	$65	$68,250	
Biogas (BG)	500	LF	$45	$22,500	
Natural Gas (NG)	2000	LF	$45	$90,000	
Storm Drainage (S)	2000	LF	$150	$300,000	
Manholes	25	EA	$8,500	$212,500	
Sewage Bypass Pumping during Construction	All Req'd	LS	$30,000	$30,000	

Regional CAS WWTP Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
UTILITY SERVICES……					$210,000
Electrical Service	All Req'd	LS	$150,000	$150,000	
New 6" Gas Service	All Req'd	LS	$60,000	$60,000	
ACCESS ROADS AND PARKING……					$514,000
Access Roadways, 20 Foot Wide, Paved	3,225	LF	$60	$193,500	
Parking Areas	27,600	SF	$10	$276,000	
Curb and Gutter	1,200	LF	$24	$28,800	
Sidewalk	800	LF	$20	$16,000	
LANDSCAPING……					$50,000
Topsoil and Seed	All Req'd	LS	$50,000	$50,000	
SECURITY……					$171,000
Outdoor Lighting	8	EA	$13,500	$108,000	
Perimeter Security Fencing	3150	LF	$20	$63,000	
SUBTOTAL - 2. SITE CIVIL WORK					$4,038,000
OH&P	23.00%				929,000
TOTAL - 2. SITE CIVIL WORK					**$4,967,000**

TOTAL					**$69,053,000**

Regional WWTP - MBR

Initial Project Estimate Summary
Regional MBR Wastewater Treatment Plant Improvements
(4.0 MGD Average Daily Flow)

Date Prepared: 16-December-2009

ITEM	ESTIMATED QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
		SECONDARY TREATMENT SYSTEMS		
1	1	Septage Handling	4,775,000	4,775,000
2	1	Headworks and Screening	9,054,000	9,054,000
3	1	Primary Clarification	4,032,000	4,032,000
4	1	Anaerobic Digestion	5,514,000	5,514,000
5	1	Membrane Bioreactor Process	27,209,000	27,209,000
6	1	UV Disinfection	1,015,000	1,015,000
7	1	Dewatering and Sludge Thickening	4,272,000	4,272,000
8	1	Administration/Lab Equipment	4,080,000	4,080,000
9	1	Miscellaneous Equipment	688,000	688,000
		SITE CIVIL WORK		
10	1	Miscellaneous Site Development Costs	498,000	498,000
11	1	Yard Piping Systems	2,829,000	2,829,000
12	1	Utility Services	258,000	258,000
13	1	Access Roads and Parking	558,000	558,000
14	1	Landscaping	62,000	62,000
15	1	Security	202,000	202,000

Subtotal Construction		$65,046,000
Land Acquisition (20 Acres @ 50,000/acre)		1,000,000
City Administration	@ 2%	1,300,900
Design	@ 10%	6,504,600
Construction Management	@ 12%	7,805,500
Project Contingency	@ 20%	13,009,200
4 Years Inflation	@ 2.5%	6,752,600
Subtotal		$101,418,800

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
1. SECONDARY TREATMENT SYSTEMS					
SEPTAGE HANDLING……					$3,882,000
Equipment					
Screening, Degrit, Compaction and Dewatering	2	LS	$200,000	$400,000	
Bar Screens	2	LS	$20,000	$40,000	
Effluent Pumps	2	EA	$6,500	$13,000	
Flow Meters	2	EA	$7,000	$14,000	
Thickened Septage Pumps	2	EA	$3,000	$6,000	
Thickened Septage Scum Pumps	2	EA	$3,000	$6,000	
Booster Pump for Hot Wash Water	2	EA	$3,000	$6,000	
Thickener Basin Scraper Drive and Bridge Equipment	2	EA	$150,000	$300,000	
Holding Tank Blowers	2	EA	$3,000	$6,000	
Drain Pumps	2	EA	$3,000	$6,000	
Odor Control Towers and Fans	1	LS	$200,000	$200,000	
Equipment Allowances					
Shipping Allowance	6%	of	997,000	59,820	
Installation Labor	6%	of	997,000	59,820	
Instrumentation Equipment Allowance	6%	of	997,000	59,820	
Instrumentation Labor	3%	of	997,000	29,910	
Process Piping Allowance	6%	of	997,000	59,820	
Process Piping Labor	3%	of	997,000	29,910	
Electrical Equipment Allowance	20%	of	997,000	199,400	
Electrical Labor	15%	of	997,000	149,550	
Buildings					
F&I Septage Receiving Building (35'x50')	1,750	SF	$190	$332,500	
F&I Septage Thickener Pump Building (20'x20')	400	SF	$160	$64,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	5%	of	396,500	19,825	
Civil and Foundations					
Mass Excavation	13,560	CY	$4.00	54,240	
Backfill	3,940	CY	$3.50	13,790	
Structural Fill	3,120	CY	$24.00	74,880	
Load and Haul Excavated Material	9,620	CY	$9.50	91,390	
Concrete, Formed, Poured In-Place, Structural	1,605	CY	$850.00	1,364,250	
Epoxy Coating (Interior Only)	21,000	SF	$2.50	52,500	
Holding Tank Hatches	2	EA	$10,000	$20,000	
Thickener Covers	2	EA	$75,000	$150,000	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
HEADWORKS AND SCREENING……					$7,361,000
Equipment					
Static Raw Sewage Bar Screen	1	EA	$20,000	$20,000	
Raw Sewage LS Screw Pumps	3	EA	$350,000	$1,050,000	
Overhead Crane Rail System in Headworks	1	EA	$25,000	$25,000	
Raw Sewage Drum Screens, Appurtenant Equipment	3	EA	$237,000	$711,000	
Grit Removal Equipment and Appurtenances	2	EA	$334,500	$669,000	
Flow Metering (Influent, RAS, WAS)	3	EA	$7,000	$21,000	
Odor Control Towers and Fans	All Req'd	LS	$200,000	$200,000	
Equipment Allowances					
Shipping Allowance	6%	of	2,696,000	161,760	
Installation Labor	6%	of	2,696,000	161,760	
Instrumentation Equipment Allowance	6%	of	2,696,000	161,760	
Instrumentation Labor	3%	of	2,696,000	80,880	
Process Piping Allowance	6%	of	2,696,000	161,760	
Process Piping Labor	3%	of	2,696,000	80,880	
Electrical Equipment Allowance	20%	of	2,696,000	539,200	
Electrical Labor	15%	of	2,696,000	404,400	
Buildings					
F&I Grit and Headworks Building (75'x180')	13,500	SF	$160	$2,160,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	5%	of	2,160,000	108,000	
Civil and Foundations					
Mass Excavation	2150	CY	$4.00	8,600	
Backfill	1130	CY	$3.50	3,955	
Structural Fill	470	CY	$24.00	11,280	
Load and Haul Excavated Material	1020	CY	$9.50	9,690	
Concrete, Formed, Poured In-Place, Structural	610	CY	$850.00	518,500	
Epoxy Coating (Interior Only)	5000	SF	$2.50	12,500	
Headworks Channel Sluice Gates	4	EA	$20,000	$80,000	

Regional MBR WWTP Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
PRIMARY CLARIFICATION……					$3,278,000
Equipment					
Primary Clarifier Scraper Drive and Bridge Equipment	2	EA	$140,000	$280,000	
Primary Sludge Pump	3	EA	$15,000	$45,000	
Thickened Sludge Pump	3	EA	$6,500	$19,500	
Primary Scum Pump	2	EA	$6,500	$13,000	
Primary Basin Drain Pumps	2	EA	$6,500	$13,000	
Equipment Allowances					
Shipping Allowance	6%	of	370,500	22,230	
Installation Labor	6%	of	370,500	22,230	
Instrumentation Equipment Allowance	6%	of	370,500	22,230	
Instrumentation Labor	3%	of	370,500	11,115	
Process Piping Allowance	6%	of	370,500	22,230	
Process Piping Labor	3%	of	370,500	11,115	
Electrical Equipment Allowance	20%	of	370,500	74,100	
Electrical Labor	15%	of	370,500	55,575	
Buildings					
F&I Primary Clarifier Pump Building (60'x60')	3,600	SF	$160	$576,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	5%	of	576,000	28,800	
Civil and Foundations					
Mass Excavation	14615	CY	$4.00	58,460	
Backfill	4565	CY	$3.50	15,978	
Structural Fill	1950	CY	$24.00	46,800	
Load and Haul Excavated Material	10050	CY	$9.50	95,475	
Concrete, Formed, Poured In-Place, Structural	1765	CY	$850.00	1,500,250	
Epoxy Coating (Interior Only)	30000	SF	$2.50	75,000	
Primary Clarifier Covers	2	EA	$95,000.00	190,000	
Primary Clarifier Splitter Box Weir Gates	4	EA	$20,000	$80,000	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
ANAEROBIC DIGESTION…………………………………………					$4,482,900
<u>Wastewater Equipment</u>					
Equipment	6	EA	10,000	60,000	
Digester In-Tank Mixing Equipment	3	LS	120,000	360,000	
Heater/Heat Exchanger	1	EA	145,000	145,000	
Waste Gas Burner	1	LS	55,000	55,000	
Gas Safety Equipment	1	LS	95,000	95,000	
Digested Sludge Solids Handling Tank	3	CY	140,000	420,000	
Digester Feed and Recirculation Pumps	3	CY	25,000	75,000	
<u>Wastewater Equipment Allowances</u>					
Shipping Allowance	6%	of	1,210,000	72,600	
Installation Labor	6%	of	1,210,000	72,600	
Instrumentation Equipment Allowance	6%	of	1,210,000	72,600	
Instrumentation Labor	3%	of	1,210,000	36,300	
Process Piping Allowance	6%	of	1,210,000	72,600	
Process Piping Labor	3%	of	1,210,000	36,300	
Electrical Equipment Allowance	20%	of	1,210,000	242,000	
Electrical Labor	15%	of	1,210,000	181,500	
<u>Buildings</u>					
None	0	SF	160	0	
<u>Civil and Foundations (for 3 Digestors)</u>					
Mass Excavation	13,050	CY	4.00	52,200	
Structural Fill	7,050	CY	24.00	169,200	
Concrete, Formed, Poured In-Place, Structural	1,500	CY	850.00	1,275,000	
Spiral Guided Gas Holder Cover	3	EA	330,000	990,000	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
MEMBRANE BIOREACTOR PROCESS……					$22,121,000
Equipment					
Membrane Bioreactor Equipment	1	EA	$4,900,000	$4,900,000	
Blowers	6	EA	$150,000	$900,000	
Anoxic Mixers	3	EA	$14,000	$42,000	
BioBasin Fine Bubble Diffuser/Below Water Manifolds	1	LS	$150,000	$150,000	
Aeration Piping System including Control Valves	1	LS	$100,000	$100,000	
ML Return Pumps 3,500 gpm at 12 feet TDH, VFD	2	EA	$30,000	$60,000	
WAS Pumps 200 gpm at 50 ft, VFD	2	EA	$16,000	$32,000	
W2 Utility Water Pumps 100 gpm at 190ft VFD	3	EA	$15,000	$45,000	
Drain Pumps 125 gpm at 50 feet TDH Soft Start	2	EA	$10,000	$20,000	
MBR Process Piping and Valve Systems	1	LS	$350,000	$350,000	
Overhead Hoist and Rail, 5 ton	1	EA	$16,000	$16,000	
MBR Fill Storage Tank Below Main Floor, 10,000 gal	1	LS	$6,500	$6,500	
MLR and WAS Flow Meters	2	EA	$4,500	$9,000	
MLSS DO Probes	3	EA	$6,000	$18,000	
MLSS Ammonia Probes	3	EA	$9,000	$27,000	
Filtrate Flow Meters	6	EA	$6,000	$36,000	
Na_2CO_3 Bulk Feeder/Dissolver Tk to Supplement Alk	1	LS	$35,000	$35,000	
Rapid Mixer for Na_2CO_3 Solution Dispersion	1	EA	$40,000	$40,000	
Na_2CO_3 Dosing for Supplemental Alkalinity	1	LS	$32,000	$32,000	
Blower Main Control Panel (MCP)	1	LS	$60,000	$60,000	
Equipment Allowances					
Shipping Allowance	6%	of	6,878,500	412,710	
Installation Labor	6%	of	6,878,500	412,710	
Instrumentation Equipment Allowance	6%	of	6,878,500	412,710	
Instrumentation Labor	3%	of	6,878,500	206,355	
Process Piping Allowance	6%	of	6,878,500	412,710	
Process Piping Labor	3%	of	6,878,500	206,355	
Electrical Equipment Allowance	20%	of	6,878,500	1,375,700	
Electrical Labor	15%	of	6,878,500	1,031,775	
Buildings					
F&I MBR Building (130'x330')	42900	SF	$130	$5,577,000	
Civil and Foundations					
Mass Excavation	31820	CY	$4.00	127,280	
Backfill	9140	CY	$3.50	31,990	
Structural Fill	3510	CY	$24.00	84,240	
Load and Haul Excavated Material	22680	CY	$9.50	215,460	
Concrete, Formed, Poured In-Place, Structural	5395	CY	$850.00	4,585,750	
Epoxy Coating (Interior Only)	60000	SF	$2.50	150,000	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
UV DISINFECTION					$825,000
Equipment					
UV In-Vessel Disinfection Equipment	4	EA	$125,000	$500,000	
Equipment Allowances					
Shipping Allowance	6%	of	500,000	30,000	
Installation Labor	6%	of	500,000	30,000	
Instrumentation Equipment Allowance	6%	of	500,000	30,000	
Instrumentation Labor	3%	of	500,000	15,000	
Process Piping Allowance	6%	of	500,000	30,000	
Process Piping Labor	3%	of	500,000	15,000	
Electrical Equipment Allowance	20%	of	500,000	100,000	
Electrical Labor	15%	of	500,000	75,000	
Buildings					
None					
Civil and Foundations					
None					
DEWATERING AND SLUDGE THICKENING					$3,473,000
Equipment					
Rotary Drum Thickener	2	EA	$110,000	$220,000	
Screw Press Dewatering Equipment	2	EA	$400,000	$800,000	
Screw Press Feed Pumps	2	EA	$6,500	$13,000	
W2 Wash Water Booster Pumps	2	EA	$5,000	$10,000	
Batch Polyelectrolyte Solution Prep/Dosing Equipment.	1	LS	$260,000	$260,000	
Instrument Air Compressor and Reciever/Dryer/Filters	2	EA	$20,000	$40,000	
Odor Control Towers and Fans	1	LS	$200,000	$200,000	
TWAS Pumps	2	EA	$20,000	$40,000	
Drain Pumps	2	LS	$6,500	$13,000	
Equipment Allowances					
Shipping Allowance	6%	of	1,596,000	95,760	
Installation Labor	6%	of	1,596,000	95,760	
Instrumentation Equipment Allowance	6%	of	1,596,000	95,760	
Instrumentation Labor	3%	of	1,596,000	47,880	
Process Piping Allowance	6%	of	1,596,000	95,760	
Process Piping Labor	3%	of	1,596,000	47,880	
Electrical Equipment Allowance	20%	of	1,596,000	319,200	
Electrical Labor	15%	of	1,596,000	239,400	
Buildings					
F&I Dewatering Building (50'x100')	5000	SF	$160	800,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	5%	of	800,000	40,000	
Civil and Foundations					
Included in Building Costs					

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
ADMINISTRATION/LABORATORY EQUIPMENT					$3,317,000
Equipment					
Hot Water Generator	1	LS	$6,500	$6,500	
Laboratory Equipment	1	Req'd	$60,000	$60,000	
Sampling Equipment	2	EA	$30,000	$60,000	
Equipment Allowances					
Shipping Allowance	6%	of	126,500	7,590	
Installation Labor	6%	of	126,500	7,590	
Instrumentation Equipment Allowance	6%	of	126,500	7,590	
Instrumentation Labor	3%	of	126,500	3,795	
Process Piping Allowance	6%	of	126,500	7,590	
Process Piping Labor	3%	of	126,500	3,795	
Electrical Equipment Allowance	20%	of	126,500	25,300	
Electrical Labor	15%	of	126,500	18,975	
Buildings					
Administrative/Laboratory Building	6,800	SF	$250	$1,700,000	
Equipment Storage Building	8,400	SF	$150	$1,260,000	
Misc Metals Allowance (Stairs, Handrails, and Platforms)	5%	of	2,960,000	148,000	
Civil and Foundations					
Included in Building Costs					
MISCELLANEOUS EQUIPMENT					$559,000
Motor Control Center	1	EA	$150,000	$150,000	
Utility Water Pumps	3	EA	$3,500	$10,500	
Plant Drain Pumps	2	EA	$6,500	$13,000	
Standby Generator	1200	kW	$300	$360,000	
Generator Fuel Oil Storage	All Req'd	LS	$25,000	$25,000	
TOTAL - 1. SECONDARY TREATMENT SYSTEMS					$49,298,900
OH&P	23.00%				$11,339,000
TOTAL - 1. SECONDARY TREATMENT SYSTEMS					**$60,637,900**

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
2. SITE CIVIL WORK					
MISCELLANEOUS SITE DEVELOPMENT COSTS……					$405,000
Mobilization and Demobilization	1	LS	150,000	150,000	
Clearing and Grubbing	1	LS	80,000	80,000	
Construcftion Surveying	1	LS	100,000	100,000	
Stormwater Controls	1	LS	75,000	75,000	
YARD PIPING SYSTEMS……					$2,300,000
Raw Sewage (RS)	1000	LF	$375	$375,000	
Primary Influent (PI)	300	LF	$375	$112,500	
Primary Effluent (PE)	520	LF	$375	$195,000	
Primary Sludge (PS)	1020	LF	$80	$81,600	
Drain Piping (D)	2500	LF	$65	$162,500	
Potable Water (W1)	1500	LF	$65	$97,500	
Non-Potable Utility Water (W2)	1500	LF	$65	$97,500	
Waste Activated Sludge (WAS)	1980	LF	$80	$158,400	
Final Effluent (FE)	1000	LF	$375	$375,000	
Thickened Waste Activated Sludge (TWAS)	470	LF	$80	$37,600	
Septage Effluent (SEPE)	620	LF	$100	$62,000	
Digested Sludge (DS)	470	LF	$65	$30,550	
Biogas (BG)	500	LF	$45	$22,500	
Natural Gas (NG)	1500	LF	$45	$67,500	
Storm Drainage (S)	1500	LF	$150	$225,000	
Manholes	20	EA	$8,500	$170,000	
Sewage Bypass Pumping during Construction	All Req'd	LS	$30,000	$30,000	

Regional MBR WWTP Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
UTILITY SERVICES……					$210,000
Electrical Service	All Req'd	LS	$150,000	$150,000	
New 6" Gas Service	All Req'd	LS	$60,000	$60,000	
ACCESS ROADS AND PARKING……					$454,000
Access Roadways, 20 Foot Wide, Paved	2,790	LF	$60	$167,400	
Parking Areas	24,800	SF	$10	$248,000	
Curb and Gutter	1,200	LF	$24	$28,800	
Sidewalk	500	LF	$20	$10,000	
LANDSCAPING……					$50,000
Topsoil and Seed	All Req'd	LS	$50,000	$50,000	
SECURITY……					$164,000
Outdoor Lighting	8	EA	$13,500	$108,000	
Perimeter Security Fencing	2800	LF	$20	$56,000	
SUBTOTAL - 2. SITE CIVIL WORK					$3,583,000
OH&P	23.00%				824,000
TOTAL - 2. SITE CIVIL WORK					**$4,407,000**

TOTAL	**$65,044,900**

Regional WWTP

Wastewater Conveyance

Initial Project Estimate Summary
Conveyance Estimates to RWWTP Site A
(4.0 MGD Average Daily Flow)

Date Prepared: 11-December-2009

ITEM	ESTIMATED QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
1	1	Construct Influent Sewer from Wasilla	10,004,000	10,004,000
2	1	Construct Influent Sewer from SWX	2,632,000	2,632,000
3	1	Reverse Flow in SWX Force Main	5,567,000	5,567,000
4	1	Construct Outfall to Constructed Wetlands	1,642,000	1,642,000

Subtotal Construction		$19,845,000
Land Acquisition		0
City Administration	@ 2%	396,900
Design	@ 10%	1,984,500
Construction Management	@ 12%	2,381,400
Project Contingency	@ 15%	2,976,800
4 Years Inflation	@ 2.5%	2,060,200
Subtotal		$29,644,800

RWWTP-Site A Conveyance Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
1. CONSTRUCT INFLUENT MAIN FROM WASILLA……					$10,004,000
CONSTRUCT SANITARY SEWER (22,600 LF)					
Clearing and Grubbing	15	Acre	9,000	134,100	
Usable and Unusable Excavation	7,700	CY	12.00	92,400	
Trench Excavation & Backfill	18,900	LF	55.00	1,039,500	
Bedding Material, Class C	18,821	Ton	14.00	263,494	
F&I 30" HDPE SDR 17 Sewer Main - Gravity	18,986	LF	110.00	2,088,460	
F&I 12" HDPE SDR 17 Sewer Main - Pressure	3,622	LF	60.00	217,320	
F&I 16" HDPE SDR 17 Sewer Main - Pressure	3,622	LF	70.00	253,540	
F&I 20" HDPE SDR 17 Sewer Main - Pressure	3,622	LF	85.00	307,870	
Air/Vacuum Relief Valve	3	EA	60,000	180,000	
Construct Type A Manhole	48	EA	8,500	408,000	
Construction Surveying	1	LS	250,000.00	250,000	
Traffic Maintenance	1	LS	150,000.00	150,000	
Storm Water Pollution Prevention Plan	1	LS	50,000.00	50,000	
Directional Bore w/ Steel Casing (Alaska Railroad)	150	LF	750.00	112,500	
Directional Bore w/ Steel Casing (Wasilla Creek)	200	LF	750.00	150,000	
Topsoil	1,046	ksf	200.00	209,200	
Seeding	1,046	ksf	100.00	104,600	
Culvert Replacements	120	LF	75.00	9,000	
Utility Relocates	1	LS	120,000	120,000	
Salvage/Replace Signs	1	LS	15,000	15,000	
Driveway Crossings	2	EA	5,000	10,000	
Road Crossings	2	EA	12,000	24,000	
Force Main Cleanout Assembly	3	EA	17,500	52,500	
Reconstruct Residential Roadway	4,800	LF	250.00	1,200,000	
CONSTRUCT LIFT STATIONS (2)					
Excavation (Over 12 feet)	9,600	CY	12.00	115,200	
Lift Station Wet Well (Concrete)	650	CY	850.00	552,500	
Classified Fill	860	CY	24.00	20,640	
Backfill	7,160	CY	3.50	25,060	
Load and Haul Excavated Material	2,440	CY	9.50	23,180	
F&I Lift Station Pumps	8	EA	30,000	240,000	
Misc. Equipment	2	LS	150,000	300,000	
Construction Surveying	2	LS	15,000	30,000	
Storm Water Pollution Prevention Plan	2	LS	5,000	10,000	
Lift Station Pump Building (16' x 16')	768	SF	450.00	345,600	
Pump Controls, Misc. Electrical	2	LS	50,000	100,000	
Site Grading, Parking, Accessibility	2	LS	50,000	100,000	
F&I Lift Station Valve Vault	2	LS	150,000	300,000	
Backup Generator	2	LS	200,000	400,000	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
2. CONSTRUCT INFLUENT MAIN FROM SWX TO RWWTP……………………………………………………					$2,632,000
<u>CONSTRUCT SANITARY SEWER (5,875 LF)</u>					
Clearing and Grubbing	1	Acre	9,000	9,000	
Usable and Unusable Excavation	14,750	CY	12.00	177,000	
Trench Excavation & Backfill (8' depth, sewer)	5,500	LF	55.00	302,500	
Bedding Material, Class C	5,499	Ton	14.00	76,983	
F&I 30" HDPE SDR 17 Sewer Main-Gravity	3,375	LF	110.00	371,250	
F&I 12" HDPE SDR 17 Sewer Main-Pressure	2,500	LF	60.00	150,000	
F&I 16" HDPE SDR 17 Sewer Main-Pressure	2,500	LF	70.00	175,000	
F&I 20" HDPE SDR 17 Sewer Main-Pressure	2,500	LF	85.00	212,500	
Air/Vacuum Relief Valve	3	LS	60,000	180,000	
Construct Type A Manhole (all depths)	9	EA	8,500	76,500	
Construction Surveying	1	LS	30,000	30,000	
Traffic Maintenance	1	LS	10,000	10,000	
Storm Water Pollution Prevention Plan	1	LS	20,000	20,000	
Directional Bore w/ Steel Casing (Parks Hwy)	400	LF	750.00	300,000	
Topsoil	268	ksf	200.00	53,600	
Seeding, Schedule C Mix	268	ksf	100.00	26,800	
Culvert Replacements	20	LF	75.00	1,500	
Utility Relocates	1	LS	120,000	120,000	
Salvage/Replace Signs	1	LS	15,000	15,000	
Driveway Crossings	1	EA	5,000	5,000	
Force Main Cleanout Assembly	2	EA	17,500	35,000	
Reconstruct Residential Street (Gravel)	1,420	LF	200.00	284,000	
3. REVERSE FLOW IN SWX FORCE MAIN					
<u>CONVERT GRAVITY SEWER TO FORCE MAIN (11,240 LF)</u>					$5,567,000
Trench Excavation & Backfill (8' depth, sewer)	9,600	LF	55.00	528,000	
Bedding Material, Class C	13,038	Ton	14.00	182,538	
F&I 12" HDPE SDR 17 Sewer Main-Pressure	11,240	LF	60.00	674,400	
F&I 16" HDPE SDR 17 Sewer Main-Pressure	11,240	LF	70.00	786,800	
Air/Vacuum Relief Valve	6	LS	60,000	360,000	
Construction Surveying	1	LS	150,000	150,000	
Traffic Maintenance	1	LS	250,000	250,000	
Storm Water Pollution Prevention Plan	1	LS	40,000	40,000	
Directional Bore w/ Steel Casing (Alaska RR)	150	LS	500.00	75,000	
Topsoil	576	ksf	200.00	115,200	
Seeding, Schedule C Mix	576	ksf	100.00	57,600	
Culvert Replacements	60	LF	75.00	4,500	
Salvage/Replace Signs	1	LS	15,000	15,000	
Driveway Crossings	3	EA	5,000	15,000	
Road Crossings	1	EA	12,000	12,000	
Force Main Cleanout Assembly	8	EA	17,500	140,000	
<u>RETROFIT EXISTING SEWER LIFT STATIONS (3)</u>					
Excavation (Over 12 feet)	14,400	CY	12.00	172,800	
Lift Station Wet Well	975	CY	850.00	828,750	
Classified Fill	1,290	CY	24.00	30,960	
Backfill	10,740	CY	3.50	37,590	
Load and Haul Excavated Material	3,660	CY	9.50	34,770	
F&I Lift Station Pumps	12	EA	30,000	360,000	
Misc. Equipment	3	LS	150,000	450,000	
Pump Controls, Misc. Electrical	3	LS	50,000	150,000	
Construction Surveying	3	LS	15,000	45,000	
Storm Water Pollution Prevention Plan	3	LS	5,000	15,000	
Topsoil	120	ksf	200.00	24,000	
Seeding	120	ksf	100.00	12,000	

RWWTP-Site A Conveyance Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
4. OUTFALL TO CONSTRUCTED WETLANDS					$1,642,000
CONSTRUCT GRAVITY SEWER OUTFALL					
Usable and Unusable Excavation	2,000	CY	12.00	24,000	
Trench Excavation & Backfill (8' depth, sewer)	4,500	LF	55.00	247,500	
Trench Dewatering	4,500	LF	40.00	180,000	
Bedding Material, Class C	3,510	Ton	14.00	49,140	
F&I 30" HDPE SDR 17 Sewer Main-Gravity	4,500	LF	95	427,500	
Construction Surveying	1	LS	50,000	50,000	
Traffic Maintenance	1	LS	20,000	20,000	
Storm Water Pollution Prevention Plan	1	LS	50,000	50,000	
Directional Bore w/ Steel Casing (Alaska RR)	150	LF	500.00	75,000	
Topsoil	270	ksf	200.00	54,000	
Seeding, Schedule C Mix	270	ksf	100.00	27,000	
Construct Access Road	3,750	LF	50.00	187,500	
OUTFALL IMPROVEMENTS					
Earthwork, Riprap and Plantings	1	LS	250,000	250,000	
TOTAL					$19,845,000

Initial Project Estimate Summary
Conveyance Estimates to RWWTP Site A
(8.0 MGD Average Daily Flow)

Date Prepared: 11-December-2009

ITEM	ESTIMATED QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
1	1	Wasilla Conveyance Main Capacity Upgrades	1,787,000	1,787,000
2	1	Flow Upgrades in Reversed SWX Force Main	7,820,000	7,820,000
		Subtotal Construction		$9,607,000

Land Acquisition		0
City Administration	@ 2%	192,100
Design	@ 10%	960,700
Construction Management	@ 12%	1,152,800
Project Contingency	@ 15%	1,441,100
25 Years Inflation	@ 2.5%	8,203,800
Subtotal		$21,557,500

RWWTP-Site A Conveyance Improvements
Rough Order of Magnitude Cost Estimate
(8.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
1. WASILLA CONVEYANCE MAIN CAPACITY UPGRADES……………………………………………………					$1,787,000
UPGRADE LIFT STATION CAPACITIES (3)					
Earth Excavation	14,400	CY	4.00	57,600	
Lift Station Wet Well (Concrete)	975	CY	850.00	828,750	
Classified Fill	1,290	CY	24.00	30,960	
Backfill	10,740	CY	3.50	37,590	
Load and Haul Excavated Material	3,360	CY	9.50	31,920	
F&I Larger Lift Station Pumps	12	LS	60,000	720,000	
Site Grading	3	LS	5,000	15,000	
Construction Surveying	1	LS	10,000	10,000	
Storm Water Pollution Prevention Plan	1	LS	15,000	15,000	
Topsoil	135	ksf	200.00	27,000	
Seeding	135	ksf	100.00	13,500	
2. FLOW UPGRADES IN REVERSED SWX FORCE MAINS					$7,820,000
CONSTRUCT SANITARY SEWER (32,230 L.F.)					
Trench Excavation & Backfill (8' depth, sewer)	32,230	LF	55.00	1,772,650	
Bedding Material, Class C	37,387	Ton	14.00	523,418	
F&I 20" HDPE SDR 17 Sewer Main-Pressure	32,230	LF	85.00	2,739,550	
Air/Vacuum Relief Valve	6	LS	60,000	360,000	
Construction Surveying	1	LS	15,000	15,000	
Traffic Maintenance	1	LS	5,000	5,000	
Storm Water Pollution Prevention Plan	1	LS	50,000	50,000	
Directional Bore w/ Steel Casing (Alaska R.R.)	150	LF	500	75,000	
Topsoil	576	ksf	200.00	115,200	
Seeding, Schedule C Mix	576	ksf	100.00	57,600	
Culvert Replacements	60	LF	75.00	4,500	
Signs	1	LS	15,000	15,000	
Driveway Crossings	3	EA	5,000	15,000	
Road Crossings	1	EA	12,000	12,000	
Force Main Cleanout Assembly	8	EA	17,500	140,000	
UPGRADE LIFT STATION CAPACITY (2)					
Excavation (Over 12 feet)	14,400	CY	12.00	172,800	
Lift Station Wet Well (Concrete)	975	CY	850.00	828,750	
Classified Fill	1,290	CY	24.00	30,960	
Backfill	10,740	CY	3.50	37,590	
Load and Haul Excavated Material	3,660	CY	9.50	34,770	
F&I Larger Lift Station Pumps	12	LS	60,000	720,000	
Site Grading	3	LS	5,000	15,000	
Construction Surveying	2	LS	15,000	30,000	
Storm Water Pollution Prevention Plan	2	LS	5,000	10,000	
Topsoil	135	ksf	200.00	27,000	
Seeding	135	ksf	100.00	13,500	
TOTAL					$9,607,000

Initial Project Estimate Summary
Conveyance Estimates to RWWTP Site B
(4.0 MGD Average Daily Flow)

Date Prepared: 16-December-2009

ITEM	ESTIMATED QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
1	1	Construct Influent Sewer from Wasilla	13,157,000	13,157,000
2	1	Construct Influent Sewer from SWX	2,819,000	2,819,000
3	1	Reverse Flow in SWX Force Main	584,000	584,000
		Subtotal Construction		$16,560,000

Land Acquisition		0
City Administration	@ 2%	331,200
Design	@ 10%	1,656,000
Construction Management	@ 12%	1,987,200
Project Contingency	@ 15%	2,484,000
4 Years Inflation	@ 2.5%	1,719,100
Subtotal		$24,737,500

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
1. CONSTRUCT INFLUENT MAIN FROM WASILLA……					$13,157,000
CONSTRUCT SANITARY SEWER (26,960 LF)					
Clearing and Grubbing	15	Acre	9,000.00	131,400	
Usable and Unusable Excavation	18,000	CY	12.00	216,000	
Trench Excavation & Backfill (8' depth, sewer)	26,660	LF	55.00	1,466,300	
Bedding Material, Class C	26,585	Ton	14.00	372,190	
F&I 30" HDPE SDR 17 Sewer Main-Gravity	17,025	LF	110.00	1,872,750	
F&I 12" HDPE SDR 17 Sewer Main-Pressure	10,560	LF	60	633,600	
F&I 16" HDPE SDR 17 Sewer Main-Pressure	10,560	LF	70	739,200	
F&I 20" HDPE SDR 17 Sewer Main-Pressure	10,560	LF	85	897,600	
Air/Vacuum Relief Valve	3	LS	60,000	180,000	
Construct Type A Manhole (all depths)	37	EA	8,500	314,500	
Construction Surveying	1	LS	250,000	250,000	
Traffic Maintenance	1	LS	150,000.00	150,000	
Storm Water Pollution Prevention Plan	1	LS	50,000.00	50,000	
Directional Bore w/ Steel Casing (Parks Hwy)	400	LF	750.00	300,000	
Directional Bore w/ Steel Casing (Alaska RR)	150	LF	750.00	112,500	
Directional Bore w/ Steel Casing (Wasilla Crk)	200	LF	750.00	150,000	
Directional Bore w/ Steel Casing (Trunk Rd.)	175	LF	750	131,250	
Topsoil	1,201	ksf	200	240,200	
Seeding, Schedule C Mix	1,201	ksf	100	120,100	
Culvert Replacements	2,000	LF	75	150,000	
Utility Relocates	1	LS	120,000	120,000	
Salvage/Replace Signs	1	LS	15,000	15,000	
Driveway Crossings	35	EA	5,000.00	175,000	
Road Crossings	11	EA	12,000.00	132,000	
Force Main Cleanout Assembly	13	EA	17,500.00	227,500	
Reconstruct Bike Path	7,450	SF	30.00	223,500	
CONSTRUCT LIFT STATIONS (3)					
Earth Excavation (Over 12 feet)	14,400	CY	12.00	172,800	
Lift Station Wet Well (Concrete)	975	CY	850.00	828,750	
Classified Fill	1,290	CY	24.00	30,960	
Backfill	10,740	CY	3.50	37,590	
Load and Haul Excavated Material	3,660	CY	9.50	34,770	
F&I Lift Station Pumps	12	EA	30,000	360,000	
Construction Surveying	3	LS	10,000	30,000	
Misc. Equipment	3	LS	75,000	225,000	
Lift Station Pump Building	3	LS	200,000	600,000	
Pump Controls, Misc. Electrical	3	LS	50,000	150,000	
Site Grading, Parking, Accessibility	3	LS	50,000	150,000	
F&I Lift Station Valve Vault	3	LS	150,000	450,000	
Backup Generator	3	LS	200,000	600,000	
Electric Utility Extensions	3	LS	15,000	45,000	
Lift Station Access Road	1,200	LF	60	72,000	

RWWTP-Site B Conveyance Improvements
Rough Order of Magnitude Cost Estimate
(4.0 MGD Average Daily Flow)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
2. REVERSE FLOW DIRECTION IN SWX FORCE MAIN					$2,819,000
CONSTRUCT SANITARY SEWER (2,700 LF)					
Trench Excavation & Backfill (8' depth, sewer)	2,700	LF	55.00	148,500	
Bedding Material, Class C	3,132	Ton	14.00	43,848	
F&I 12" HDPE SDR 17 Sewer Main-Pressure	2,700	LF	60.00	162,000	
F&I 16" HDPE SDR 17 Sewer Main-Pressure	2,700	LF	70.00	189,000	
Air/Vacuum Relief Valve	1	LS	60,000.00	60,000	
Construction Surveying	1	LS	15,000	15,000	
Traffic Maintenance	1	LS	5,000	5,000	
Storm Water Pollution Prevention Plan	1	LS	50,000	50,000	
Topsoil	170	ksf	200	34,000	
Seeding, Schedule C Mix	170	ksf	100	17,000	
RETROFIT LIFT STATION (3)					
Earth Excavation (Over 12 feet)	14,400	CY	12.00	172,800	
Lift Station Wet Well	975	CY	850.00	828,750	
Classified Fill	1,290	CY	24.00	30,960	
Backfill	10,740	CY	3.50	37,590	
Load and Haul Excavated Material	3,660	CY	9.50	34,770	
F&I Lift Station Pumps	12	EA	30,000	360,000	
Construction Surveying	3	LS	10,000	30,000	
Misc. Equipment	3	LS	150,000	450,000	
Pump Controls, Misc. Electrical	3	LS	50,000	150,000	
3. CONSTRUCT OUTFALL TO MATANUSKA RIVER					
CONSTRUCT GRAVITY SEWER (2,350 LF)					$584,000
Clearing and Grubbing	2	Acre	9,000.00	17,100	
Usable and Unusable Excavation	2,000	CY	12.00	24,000	
Trench Excavation & Backfill (8' depth, sewer)	2,350	LF	55.00	129,250	
Trench Dewatering	900	LF	40.00	36,000	
Bedding Material, Class C	1,810	Ton	14.00	25,333	
F&I 42" HDPE SDR 17 Sewer Main-Gravity	2,350	LF	120.00	282,000	
Construction Surveying	1	LS	15,000	15,000	
Traffic Maintenance	1	LS	5,000	5,000	
Storm Water Pollution Prevention Plan	1	LS'	50,000.00	50,000	
TOTAL					$16,560,000

Initial Project Estimate Summary
Conveyance Estimates to RWWTP Site B
(8.0 MGD Average Daily Flow)

Date Prepared: 16-December-2009

ITEM	ESTIMATED QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
1	1	Wasilla Conveyance Main Capacity Upgrades	1,917,000	1,917,000
2	1	SWX Flow Upgrades	3,216,000	3,216,000
3	1	Flow Upgrades in Reversed SWX Force Mains	5,332,380	5,332,380
		Subtotal Construction		$10,465,380

Land Acquisition		0
City Administration	@ 2%	209,300
Design	@ 10%	1,046,500
Construction Management	@ 12%	1,255,800
Project Contingency	@ 15%	1,569,800
25 Years Inflation	@ 2.5%	8,936,800
Subtotal		$23,483,580

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
1. WASILLA CONVEYANCE MAIN CAPACITY UPGRADES……					$1,917,000
UPGRADE LIFT STATION CAPACITIES (3)					
Earth Excavation (Over 12 feet)	14,400	CY	12.00	172,800	
Lift Station Wet Well (Concrete)	975	CY	850.00	828,750	
Classified Fill	1,290	CY	24.00	30,960	
Backfill	10,740	CY	3.50	37,590	
Load and Haul Excavated Material	3,360	CY	9.50	31,920	
F&I Larger Lift Station Pumps	12	LS	60,000	720,000	
Site Grading	3	LS	5,000	15,000	
Construction Surveying	3	LS	8,000	24,000	
Storm Water Pollution Prevention Plan	3	LS	5,000	15,000	
Topsoil	135	ksf	200.00	27,000	
Seeding	135	ksf	100.00	13,500	
2. SWX FLOW UPGRADES……					$3,216,000
CONSTRUCT SANITARY SEWER (20,911 LF)					
Clearing and Grubbing	15	Acre	9,000	131,400	
Trench Excavation & Backfill (8' depth, sewer)	622	LF	55.00	34,210	
Bedding Material, Class C	9,400	Ton	14.00	131,600	
F&I 42" HDPE SDR 17 Sewer Main-Gravity	11,600	LF	120.00	1,392,000	
F&I 20" HDPE SDR 17 Sewer Main-Pressure	622	LF	85.00	52,870	
Construction Surveying	1	LS	15,000	15,000	
Storm Water Pollution Prevention Plan	1	LS	50,000	50,000	
Topsoil	733	ksf	200.00	146,600	
Seeding, Schedule C Mix	733	ksf	100.00	73,300	
RETROFIT LIFT STATION (2)					
Earth Excavation (Over 12 feet)	9,600	CY	12.00	115,200	
Lift Station Wet Well	650	CY	850.00	552,500	
Classified Fill	860	CY	24.00	20,640	
Backfill	7,160	CY	3.50	25,060	
Load and Haul Excavated Material	2,440	CY	9.50	23,180	
F&I Lift Station Pumps	8	EA	30,000	240,000	
Site Grading	2	LS	75,000	150,000	
Construction Surveying	2	LS	15,000	30,000	
Storm Water Pollution Prevention Plan	1	LS	5,000	5,000	
Topsoil	90	ksf	200	18,000	
Seeding	90	ksf	100	9,000	

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
3. FLOW UPGRADES IN REVERSED SWX FORCE MAINS……					$5,332,380
CONSTRUCT SANITARY SEWER (19,010 L.F.)					
Trench Excavation & Backfill (8' depth, sewer)	19,010	LF	55.00	1,045,550	
Bedding Material, Class C	11,600	Ton	14.00	162,400	
F&I 20" HDPE SDR 17 Sewer Main-Pressure	19,010	LF	85.00	1,615,850	
Air/Vacuum Relief Valve	2	LS	60,000	120,000	
Construction Surveying	1	LS	75,000	75,000	
Traffic Maintenance	1	LS	250,000	250,000	
Storm Water Pollution Prevention Plan	1	LS	20,000	20,000	
Topsoil	1,140	ksf	200.00	228,000	
Seeding, Schedule C Mix	1,140	ksf	100.00	114,000	
Culvert Replacements	40	LF	75.00	3,000	
Signs	1	LS	15,000	15,000	
Driveway Crossings	12	EA	5,000	60,000	
Road Crossings	5	EA	12,000	60,000	
Force Main Cleanout Assembly	16	EA	17,500	280,000	
UPGRADE LIFT STATION CAPACITY (2)					
Earth Excavation (Over 12 feet)	9,600	CY	12.00	115,200	
Lift Station Wet Well (Concrete)	650	CY	850.00	552,500	
Classified Fill	860	CY	24.00	20,640	
Backfill	7,160	CY	3.50	25,060	
Load and Haul Excavated Material	2,440	CY	9.50	23,180	
F&I Larger Lift Station Pumps	8	LS	60,000	480,000	
Site Grading	2	LS	5,000	10,000	
Construction Surveying	2	LS	10,000	20,000	
Storm Water Pollution Prevention Plan	2	LS	5,000	10,000	
Topsoil	90	ksf	200.00	18,000	
Seeding	90	ksf	100.00	9,000	
TOTAL					$10,465,380

APPENDIX B

O&M Cost Estimates

City of Palmer

Regional LAS

Labor	Number of Staff	Hrs per Day	Base Hourly Pay $/Hr	Raw Salary $/yr	Benefits Package % of Base 25%	Monthly Cost	Annual Cost
Operations							
Headworks							
Influent Composite Sampler Setup and Operation	1	0.1424658	$24.04	$50,000	$12,500	$130	$1,563
Lab Work for Inf Sample Analysis							
BOD	1	0.4273973	$24.04	$50,000	$12,500	$391	$4,688
COD	1	0.2849315	$24.04	$50,000	$12,500	$260	$3,125
TSS	1	0.2849315	$24.04	$50,000	$12,500	$260	$3,125
TKN (Commercial Lab)	1	0.1424658	$24.04	$50,000	$12,500	$130	$1,563
Temp, pH, DO	1	0.0712329	$24.04	$50,000	$12,500	$65	$781
Headworks Coarse Bar Screen Cleanup	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Headworks Screenings Disposal	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Grit Removal							
Grit Disposal	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Exercise Channel Gates	1	0.01	$24.04	$50,000	$12,500	$5	$60
Operate Scour Air in Grit Sump	1	0.04	$24.04	$50,000	$12,500	$33	$391
Primary Clairifcation and Pumping							
Exercise Splitter Box Gates	1	0.01	$24.04	$50,000	$12,500	$5	$60
Exercise Process Valves	1	0.03	$24.04	$50,000	$12,500	$30	$361
Hose down weirs and trough	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Probe Primary Clar for Sludge Depth	1	0.36	$24.04	$50,000	$12,500	$326	$3,917
Steam clean scum launderer/trough	1	0.05	$24.04	$50,000	$12,500	$43	$516
Lab Tests							
Primary Effluent pH Alkalinity	1	0.07	$24.04	$50,000	$12,500	$65	$781
Primary Sludge TS	1	0.07	$24.04	$50,000	$12,500	$65	$781
Secondary Treatment							
Check DO Profiles in Ponds	1	0.01	$24.04	$50,000	$12,500	$10	$120
Probe Ponds for Settled Sludge	1	0.03	$24.04	$50,000	$12,500	$30	$361
Lab Tests for MLSS							
TSS	1	0.11	$24.04	$50,000	$12,500	$98	$1,172
Microbiological Exam	1	0.05	$24.04	$50,000	$12,500	$43	$516
Settleability, SVI	1	0.07	$24.04	$50,000	$12,500	$65	$781
Lab Tests for WAS TSS	1	0.11	$24.04	$50,000	$12,500	$98	$1,172
Clean off MLSS DO and NH3 Analyzer Probes	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Hose Down Sec Clar Weirs and Water Surf	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Probe Secondary Clar for Sludge Depth/Inventory	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Top off Chemicals for Supplemental Alkalinity	1	0.36	$24.04	$50,000	$12,500	$326	$3,917
RAS Chlorination for Bulking Control	1	0.01	$24.04	$50,000	$12,500	$10	$120

Tertiary Filtration							
Periodic Filter Cleaning with Hypochlorite	1	0.07	$24.04	$50,000	$12,500	$60	$721
Clean out Feed and Filtrate Channels	1	0.03	$24.04	$50,000	$12,500	$30	$361
UV Disinfection							
Flush Out UV Lamp Channels	1	0.03	$24.04	$50,000	$12,500	$30	$361
Check UV Intensity Meters	1	0.05	$24.04	$50,000	$12,500	$49	$588
Perform Chemical Lamp Cleans	1	0.07	$24.04	$50,000	$12,500	$61	$731
Effluent Quality Lab Tests							
pH, DO	1	0.09	$24.04	$50,000	$12,500	$82	$979
BOD	1	0.28	$24.04	$50,000	$12,500	$260	$3,125
TSS	1	0.11	$24.04	$50,000	$12,500	$98	$1,172
NH3-N (Commercial Lab)	1	0.07	$24.04	$50,000	$12,500	$65	$781
Fecal Coliforms	1	0.14	$24.04	$50,000	$12,500	$130	$1,563
Residuals Building							
Top off Polyelectrolyte System	1	0.24	$24.04	$50,000	$12,500	$215	$2,585
Operate Gravity Drum Thickeners	1	0.50	$24.04	$50,000	$12,500	$457	$5,484
Operate Belt Filter Presses							
Digester Decant and Transfer Operations	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Dispose of Dewatered Digested Sludge	1	0.05	$24.04	$50,000	$12,500	$43	$517
Lab Analysis of Digested Sludge							
pH, Alkalinity	1	0.02	$24.04	$50,000	$12,500	$16	$195
VSS	1	0.18	$24.04	$50,000	$12,500	$163	$1,953
Septage Receiving							
Thickener Decant and Transfer Operations	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Clean up After Truck Haulers	1	0.50	$24.04	$50,000	$12,500	$457	$5,484
Clean Solids off of Coarse Bar screen	1	0.25	$24.04	$50,000	$12,500	$228	$2,742
Remove and Dispose of Septage Screenings	1	0.05	$24.04	$50,000	$12,500	$43	$517
Monitor and Report Dumper Activity	1	0.25	$24.04	$50,000	$12,500	$228	$2,742
Lab Tests for Spot Checking Septage Qual							
BOD	1	0.28	$24.04	$50,000	$12,500	$260	$3,125
COD	1	0.14	$24.04	$50,000	$12,500	$130	$1,563
TSS	1	0.11	$24.04	$50,000	$12,500	$98	$1,172
TKN (Commercial Lab)	1	0.1424658	$24.04	$50,000	$12,500	$130	$1,563
Plant Management							
Operations Data Collection, Reporting, Archiving	1	0.71	$24.04	$50,000	$12,500	$653	$7,834
Annual Chemicals Receipt and Stroage	2	0.02	$24.04	$50,000	$12,500	$42	$506
Annual Operator Training for CEU's	1	0.06	$24.04	$50,000	$12,500	$56	$675
Operations & Maintenance Foreman	1	5.71	$27.57	$57,342	$14,336	$5,990	$71,874
Operator	1	5.71	$39.45	$82,056	$20,514	$8,571	$102,852
Operations Administrative Support	1	5.71	$20.00	$41,600	$10,400	$4,345	$52,143

Maintenance							
Headworks							
Instrumentation Maintenance/Replacement	1	0.0054795	$24.04	$50,000	$12,500	$5	$60
Pump Preventative Maintenance	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Screen Preventative Maintenance	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Replace Brushes on Screen Equipment	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Comminuter Preventative Maintenance	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Replace Cutters on Comminuter	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Heat and Ventilation System Maintenance	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Grit Removal							
Grit Pump Preventative Maintenance	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Grit Cyclone Resurfacing	1	0.0109589	$24.04	$50,000	$12,500	$10	$120
Grit Classifier Screw Reconditioning	1	0.0219178	$24.04	$50,000	$12,500	$20	$240
Clear Blockages from Grit Piping	1	0.0876712	$24.04	$50,000	$12,500	$80	$962
Grit Paddle Drive Preventative Maintenance	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Primary Clarification & Pumping							
Pig Primary Effluent Pipelines	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Pig Scum Pipelines	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Drain, Clean and Inspect Basins	2	0.0146119	$24.04	$50,000	$12,500	$27	$321
Primary Clarifier Scraper Mechanism PM	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Primary Clarification Process Pump PM							
Primary Sludge Pumps	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Primary Scum Pumps	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Basin Drain Pumps	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Primary Clarification Process Valve PM							
Primary Sludge Valves	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Primary Scum Valves	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Primary Clarifier Pump Building H&V PM							
Boiler Maintenance	1	0.0054795	$24.04	$50,000	$12,500	$5	$60
Air and Fuel Filter Replacement	1	0.0027397	$24.04	$50,000	$12,500	$3	$30
Secondary Treatment							
Drain and Inspect Ponds and Diffusers	2	0.0219178	$24.04	$50,000	$12,500	$40	$481
Replace Aeration Diffusers	2	0.0054795	$24.04	$50,000	$12,500	$10	$120
Change Inlet Air Filters on Blowers	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Change Gearbox Oil on Turbine Blowers	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Blower Preventative Maintenance	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Low Press Air Modulated Valve Actuator PM	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Instrumentation Calibration and Repalcement							
RAS and WAS Flow Meters	1	0.0027397	$24.04	$50,000	$12,500	$3	$30
Thermal Mass Air Flow Meters	1	0.0027397	$24.04	$50,000	$12,500	$3	$30
DO and NH3-N MLSS Analyzers	1	0.0027397	$24.04	$50,000	$12,500	$3	$30
Secondary Clarifier Scraper Mechanism PM	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
RAS Pump Preventative Maintenance	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
WAS Pump Preventative Maintenance	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Secondary Scum Pump Preventative Maintenance	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Drain Pump Preventative Maintenance	1	0.0328767	$24.04	$50,000	$12,500	$30	$361

Tertiary Filtration							
Tertiary Filter Traveling Bridge Equipment PM	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Periodic Filter Media Replacement	2	0.0073059	$24.04	$50,000	$12,500	$13	$160
Filter Backwash Pump Maintenance	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
W2 Utility Water Pump Maintenance	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
UV Disinfection							
Replace Lamps	1	0.0109589	$24.04	$50,000	$12,500	$10	$120
Replace Cleaning Solution	1	0.0036164	$24.04	$50,000	$12,500	$3	$40
Replace Lamp Ballasts	1	0.0082192	$24.04	$50,000	$12,500	$8	$90
Residuals Building							
Process Equipment Preventative Maintenance							
Rotary Drum Thickeners	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Belt Filter Presses	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Odor Control System Fans and Media	1	0.0109589	$24.04	$50,000	$12,500	$10	$120
Biogas Scrubbers, Desiccants and Filters	1	0.0109589	$24.04	$50,000	$12,500	$10	$120
Process Valve Actuator PM							
Primary Sludge and Scum Valves	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Digested Sludge Valves	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
WAS and TWAS Valves	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Polyelectrolyte Solution Valves	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Biogas Valves	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Process Pump Preventative Maintenance							
Digester Pumps	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Drain Pumps	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Biogas Compressor	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
TWAS Pumps	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Polyelectrolyte Dosing Pumps	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Belt Press W2 Booster Pumps	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Polyelectrolyte Batch Transfer Pumps	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Clean out Digester Heat Exchanger	2	0.0219178	$24.04	$50,000	$12,500	$40	$481
Clean out Digesters	3	0.0219178	$24.04	$50,000	$12,500	$60	$721
Pig Digester Piping Systems	2	0.0109589	$24.04	$50,000	$12,500	$20	$240
Utility Hot Water Heater PM	1	0.0054795	$24.04	$50,000	$12,500	$5	$60
Septage Receiving							
Drain and Inspect Basins and Diffusers	2	0.0109589	$24.04	$50,000	$12,500	$20	$240
Receiving Station Basin Cleaning	2	0.0292237	$24.04	$50,000	$12,500	$53	$641
Septage Equipment Preventative Maintenance							
Screens	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Thickener Scraper Equipment	1	0.0164384	$24.04	$50,000	$12,500	$15	$180
Thickened Septage and Scump Pumps	1	0.1315068	$24.04	$50,000	$12,500	$120	$1,442
Receiving Station Odor Control Equip PM	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Station Infrastructure Repair and Upgrades	1	0.2849315	$24.04	$50,000	$12,500	$260	$3,125
Grounds							
Snow Plowing	1	0.1068493	$24.04	$50,000	$12,500	$98	$1,172
Landscaping	1	0.0712329	$24.04	$50,000	$12,500	$65	$781
Re-lamp Luminaries	1	0.0328767	$24.04	$50,000	$12,500	$30	$361
Painting and Building Repairs	1	0.1424658	$24.04	$50,000	$12,500	$130	$1,563

$350,704

Summary
Regional WWTP Operation and Maintenance
Lagoon Activated Sludge - 4.0 MGD ADF

Energy

	Number of Units	Unit Hp	Percent Run per Day	Hrs per Day	kWh per month	Demand Charge $/mo	Energy Charge ($/kWh)	Customer Charge ($/month)	Monthly Cost ($/mo)	Annual Cost ($/yr)
Electrical Power								$13.37	$13	$160
Headworks										
Screw Pumps	4	30	100	24.0	64,428		$0.12		$7,950	$95,401
Raw Sewage Comminuters	4	3	50	12.0	3,221		$0.12		$398	$4,770
Raw Sewage Channel Screens	4	2.5	65	15.6	3,490		$0.12		$431	$5,168
Screenings Dewatering/Conveyance	1	1	25	6.0	134		$0.12		$17	$199
Grit Pump	2	7.5	10	2.4	805		$0.12		$99	$1,193
Grit Basin Propeller and Agitator Drive	2	1.5	10	2.4	161		$0.12		$20	$239
Grit Classifier	1	2	10	2.4	107		$0.12		$13	$159
Grit Dewatering and Conveyance	1	1.33	25	6.0	179		$0.12		$22	$265
Grit Channel Gate Actuators	4	0.5	0.023	0.005	0.25		$0.12		$0	$0
Flow and Level Instrumentation	2	0.001341	100	24.000	1.44		$0.12		$0	$2
Influent Composite Sampler	1	0.25	0.14	0.034	0.19		$0.12		$0	$0
Headworks Ventilation Fans										
Headworks Building Ventilation Fan High Speed	1	18.627921	33	7.9	3,300		$0.12		$407	$4,887
Headworks Building Ventilation Fan Low Speed	1	2.3284901	67	16.1	838		$0.12		$103	$1,240
Primary Clarification										
Splitter Box Gate Actuators	4	0.5	0.023	0.005	0.25		$0.12		$0	$0
Basin Sludge and Scum Mechanism	3	5	50	12.000	4,026.78		$0.12		$497	$5,963
Primary Process Pumps										
Primary Sludge Pumps	3	7.5	50	12.000	6,040.17		$0.12		$745	$8,944
Primary Scum Pumps	2	5	25	6.000	1,342.26		$0.12		$166	$1,988
Primary Basin Drain Pumps	2	15	0.015	0.004	2.45		$0.12		$0	$4
Primary Building Ventilation										
Primary Building Vent Fan High Speed	1	74.418543	33	7.9	13,185		$0.12		$1,627	$19,524
Primary Building Vent Fan Low Speed	1	9.3023178	67	16.1	3,346		$0.12		$413	$4,955
Secondary Treatment										
Aeration Blowers	4	86	100	24.000	184,694.98		$0.12		$22,790	$273,484
Secondary Clarifier Drives	3	5	100	24.000	8,053.56		$0.12		$994	$11,925
Process Pumps										
RAS Pumps	2	15	100	24.000	16,107.12		$0.12		$1,988	$23,850
WAS Pumps	1	5	17	4.000	447.42		$0.12		$55	$663
Secondary Scum Pumps	1	10	10	2.400	536.90		$0.12		$66	$795
Basin Drain Pumps	1	20	0.015	0.004	1.63		$0.12		$0	$2
Secondary Process Building Ventilation Fans	1	16.541593	100	24.000	8,881.25		$0.12		$1,096	$13,151
Supplemental Alkalinity Equipment	1	5	2	0.480	53.69		$0.12		$7	$80
Tertiary Filtration										
Traveling Bridge	1	7.5	25	6.000	1,006.70		$0.12		$124	$1,491
Backwash Pump	1	4	25	6.000	536.90		$0.12		$66	$795
W2 Utility Water Pumps	2	3	40	9.600	1,288.57		$0.12		$159	$1,908
UV Disinfection										
UV Lamps	1	67.84	100	24.000	36,423.57		$0.12		$4,494	$53,934
Effluent Composite Sampler	1	0.25	0.14	0.034	0.19		$0.12		$0	$0

Residuals									
Process Equipment									
WAS Drum Thickeners	2	6	20	4.8	1,289		$0.12	$159	$1,908
Belt Filter Presses	2	7.5	20	4.8	1,611		$0.12	$199	$2,385
Polyelectrolyte Solution Batch Prep Equip	1	0.25	20	4.8	27		$0.12	$3	$40
Biogas Scrubber Equipment	1	0.5	20	4.8	54		$0.12	$7	$80
Process Pumping									
TWAS Pumps	2	5	10	2.4	537		$0.12	$66	$795
Polyelectrolyte Solution Transfer Pumps	1	0.5	10	2.4	27		$0.12	$3	$40
Polyelectrolyte Dosing Pumps	2	0.5	10	2.4	54		$0.12	$7	$80
Digester Pumps	2	10	50.00	12.0	5,369		$0.12	$663	$7,950
Digester Blowers	6	20	20	4.8	12,886		$0.12	$1,590	$19,080
Ventilation System									
Residuals Bldg Ventilation Fan High Speed	1	23.284901	33	7.9	4,126		$0.12	$509	$6,109
Residuals Bldg Ventilation Fan Low Speed	1	2.9106126	67	16.1	1,047		$0.12	$129	$1,550
Odor Control System	1	4.851021	100	24.0	2,605		$0.12	$321	$3,857
Septage Receiving Station									
Septage Screen	2	2	50	12.0	1,074		$0.12	$133	$1,590
Septage Screenings Dewatering/Conveyance	1	1	25	6.0	134		$0.12	$17	$199
Septage Screen Air Compressor	2	10	10	2.4	1,074		$0.12	$133	$1,590
Septage Holding Tank Transfer Pump	2	10	20	4.8	2,148		$0.12	$265	$3,180
Septage Holding Tank Aeration	2	5	25	6.0	1,342		$0.12	$166	$1,988
Septage Thickener Aeration	2	10	25	6.0	2,685		$0.12	$331	$3,975
Septage Thickener Sludge Pump	2	10	20	4.8	2,148		$0.12	$265	$3,180
Septage Thickener Scum Pump	2	5	10	2.4	537		$0.12	$66	$795
Ventilation System									
Septage Receiving Bldg Ventilation Fan High	1	12.224573	33	7.9	2,166		$0.12	$267	$3,207
Septage Receiving Bldg Ventilation Fan Low	1	1.5280716	67	16.1	550		$0.12	$68	$814
Odor Control System	1	9.702042	100	24.0	5,209		$0.12	$643	$7,713
Administration Building									
Administration Building Ventilation Fan	1	4	100	24.0	2,148		$0.12	$265	$3,180
Laboratory Equipment	1	1.34	33	7.9	238		$0.12	$29	$352
Office Computer	1	0.67	100	24.0	360		$0.12	$44	$533
SCADA and Instrumentation	1	0.67	100	24.0	360		$0.12	$44	$533
Equipment Storage Building									
Equipment Storage Building Ventilation Fan	1	9	100	24.0	4,832		$0.12	$596	$7,155
						4609.649		$4,610	$55,316

Lighting

	Lighting Intensity (Watts/sf)	Floor Area (sf)	Duration per Week (hours)	kWh per month	Rate per kWh ($/kWh)	Monthly Cost ($/mo)	Annual Cost ($/yr)
Headworks Building (50 x 80)	1.3	4,000	40	901	$0.12	$111	$1,334
Primary Clarifier Basins (included in the primary building)	1.3	0	40	0	$0.12	$0	$0
Primary Building (85x188)	1.3	15,980	40	3,598	$0.12	$444	$5,328
Secondary Process Building (192 x 296)	1.3	56,832	40	12,796	$0.12	$1,579	$18,948
Septage Receiving Building (75x35)	1.3	2,625	40	591	$0.12	$73	$875
Residuals Building (100x50)	1.3	5,000	40	1,126	$0.12	$139	$1,667
Administration Building (80x75)	1.3	6,000	40	1,351	$0.12	$167	$2,000
Equipment Storage Building (120x70)	1.3	8,400	40	1,891	$0.12	$233	$2,801
Site Outdoor Lighting (22 acres), winter only	0.25	958,320	28	29,047	$0.12	$3,584	$43,010

Process and Space Heating

Process Heating

		Flow Rate (gpm)	Temp Rise (deg F)	ours/Day U (hr)	Mechanical Efficiency (percent)	Btu Demand (Btu/yr)	Natural Gas eating Val (Btu/std cf)	Natural Gas onsumptio (std cf/yr)	Natural Gas Cost ($/100 std cf)	Monthly Customer Charge ($/month)	Monthly Cost ($/mo)	Annual Cost ($/yr)
Gas Monthly Service Charge										$64.00	$64	$768
Gas Regulatory Cost Charge										0.271%	$140	$1,683
Non-Potable Water Heating for Screening, gpd	500	0.09	100	24	60	63,418,750	1,020	62,175	$0.9995		$5,179	$62,146

Space Heating

		Area (sf)	Ave Annual Heating Temp Delta (oF)	Insulation R-Value Hr F sf)/BTU	Ventilation Rate (CFM)	Heating Mechanical Efficiency (Percent)	Hours Per Day	Annual Heating Load (Btu*10^6/y	Natural Gas Cost ($/100 std cf)	Gas Heating Value (Btu/std cf)	Monthly Cost ($/mo)	Annual Cost ($/yr)
Headworks												
Headworks Building - Assume Eve Clear, ft	16											
Conductive Heat Loss												
Walls		4,160	29	25		60		70	$0.9995	1,020	$58	$690
Roof -estimate		4,000	29	25		60		68	$0.9995	1,020	$55	$664
Ventilation Heat Loss												
12 AC per Hour (Class I, DIV II Space)	12		29		12,800	60	8	2,149	$0.9995	1,020	$1,755	$21,056
6 AC per Hour (Class I, DIV II Space)	6		29		6,400	60	16	2,149	$0.9995	1,020	$1,755	$21,056
Primary Building												
Pump Vault - clear height, ft	16											
Conductive Heat Loss												
Walls		8736	29	25		60		148	$0.9995	1,020	$121	$1,450
Roof -estimate		15,980	29	25		60		271	$0.9995	1,020	$221	$2,652
Ventilation Heat Loss												
12 AC per Hour (Class I, DIV II Space)	12		29		51,136	60	8	8,584	$0.9995	1,020	$7,010	$84,119
6 AC per Hour (Class I, DIV II Space)	6		29		25,568	60	16	8,584	$0.9995	1,020	$7,010	$84,119
Secondary Building												
Secondary Building - Assume Eve Clear, ft	16											
Conductive Heat Loss												
Walls		15,616	29	25		60		264	$0.9995	1,020	$216	$2,592
Roof -estimate		56,832	29	25		60		963	$0.9995	1,020	$786	$9,432
Ventilation Heat Loss												
Operation Area at 2 AC/hr	2		29		30,310	60	24	15,265	$0.9995	1,020	$12,465	$149,582

Septage Receiving Building														
Septage Receiving Building - Assume Eve Clear, ft	16													
Conductive Heat Loss														
Walls		3,520	29	25		60		60	$0.9995	1,020	$49	$584		
Roof -estimate		2,625	29	25		60		44	$0.9995	1,020	$36	$436		
Ventilation Heat Loss														
12 AC per Hour (Class I, DIV II Space)	12		29		8,400	60	8	1,410	$0.9995	1,020	$1,152	$13,818		
6 AC per Hour (Class I, DIV II Space)	6		29		4,200	60	16	1,410	$0.9995	1,020	$1,152	$13,818		
Residuals Building														
Residuals Building - Assume Eve Clear, ft	16													
Conductive Heat Loss														
Walls		4,800	29	25		60		81	$0.9995	1,020	$66	$797		
Roof -estimate		5,000	29	25		60		85	$0.9995	1,020	$69	$830		
Ventilation Heat Loss														
12 AC per Hour (Class I, DIV II Space)	12		29		16,000	60	24	8,058	$0.9995	1,020	$6,580	$78,960		
6 AC per Hour (Class I, DIV II Space)	6		29		8,000	60	24	4,029	$0.9995	1,020	$3,290	$39,480		
Administration Building														
Administration Building Assume Eve Clear, ft	9													
Conductive Heat Loss														
Walls		2,790	33	25		60		54	$0.9995	1,020	$44	$527		
Roof -estimate		6,000	33	25		60		116	$0.9995	1,020	$94	$1,133		
Ventilation Heat Loss														
Operation Area at 2 AC/hr	2		33		1,800	60	24	1,032	$0.9995	1,020	$842	$10,108		
Equipment Storage Building														
Equipment Storage Building - Assume Eve Clear, ft	16													
Conductive Heat Loss														
Walls		6,080	24	25		60		85	$0.9995	1,020	$70	$835		
Roof -estimate		8,400	24	25		60		118	$0.9995	1,020	$96	$1,154		
Ventilation Heat Loss														
Operation Area at 2 AC/hr	2		24		4,480	60	24	1,867	$0.9995	1,020	$1,525	$18,297	$1,375,060	

Consumables

	Quantity (1/yr)	Units	Unit Cost w/out Shippir ($/ea)	Estimated Weight (lbs/ea)	Shipping Cost ($/lb)	Cost Escalation Rate (%)	Capital Recovery Factor	Monthly Cost ($/mo)	Annual Cost ($/yr)
Headworks									
Screw Pump Bearings and Seals	0.2	ea	$500	5	$1.40	5	0.2309748	$10	$117
Screw Pump Lube Oil	4	ea	$375	150	$1.40	5	4.1242377	$195	$2,340
Comminuter Cutter Plates	1	ea	$1,200	100	$1.40	5	1.05	$112	$1,340
Replacement Brushes for Raw Sewage Screens	0.333333	ea	$2,000	75	$1.40	5	0.3672086	$64	$773
Pump Seals and Bearings	1	ea	$300	10	$1.40	5	1.05	$26	$314
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$520	88	$1.40	5	0.5378049	$29	$346
Major Equipment Amortization									
Raw Sewage Screens/Comminuters	0.033333	ea	$687,500	7500	$1.40	5	0.0650514	$3,784	$45,406
Grit Pumps	0.07	ea	$32,000	500	$1.40	5	0.0963423	$263	$3,150
Gate Actuators	0.07	ea	$20,000	400	$1.40	5	0.0963423	$165	$1,981
Composite Sampler	0.1	ea	$25,000	250	$1.40	5	0.1295046	$274	$3,283
Primary Building									
Lube Oil for Clarifier Scraper Drives	4	ea	$225	90	$1.40	5	4.1242377	$117	$1,404
Building Interior Lighting Replacement	0.5	ea	$2,077	110	$1.40	5	0.5378049	$100	$1,200
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228
Pump Seals and Bearings	1	ea	$1,200	16	$1.40	5	1.05	$102	$1,222
Valve Maintenance	1	ea	$1,200	80	$1.40	5	1.05	$109	$1,312
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$468	47	$1.40	5	0.5378049	$24	$287
Major Equipment Amortization									
Clarifier Scraper Equipment	0.033333	ea	$450,000	15000	$1.40	5	0.0650514	$2,553	$30,639
Gate Actuators	0.07	ea	$15,000	300	$1.40	5	0.0963423	$124	$1,486
Pumps									
Primary Sludge Pumps	0.066667	ea	$72,000	3600	$1.40	5	0.0963423	$619	$7,422
Primary Scum Pumps	0.066667	ea	$84,000	3600	$1.40	5	0.0963423	$715	$8,578
Primary Basin Drain Pumps	0.066667	ea	$36,000	2400	$1.40	5	0.0963423	$316	$3,792
Valve Actuators	0.1	ea	$40,000	600	$1.40	5	0.1295046	$441	$5,289
Secondary Treatment									
Aeration Blower Lube Oil	4	ea	$375	150	$1.40	5	4.1242377	$195	$2,340
Aeration Blower Intake Filters	4	ea	$500	100	$1.40	5	4.1242377	$213	$2,560
Soda Ash for Supplemental Alkalinity	1	ea	$91,323	365,292	$0.08	5	1.05	$10,046	$120,546
Pump Seals and Bearings	1	ea	$1,050	14	$1.40	5	1.05	$89	$1,070
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$14,079	1408	$1.40	5	0.5378049	$719	$8,632
Major Equipment Amortization									
Blowers	0.05	ea	$400,000	30000	$1.40	5	0.0802426	$2,956	$35,467
Diffusers	0.1	ea	$300,000	4500	$1.40	5	0.1295046	$3,306	$39,667
Clarifer Equipment	0.033333	ea	$450,000	15000	$1.40	5	0.0650514	$2,553	$30,639
Gate Actuators	0.07	ea	$30,000	600	$1.40	5	0.0963423	$248	$2,971
Pumps									
RAS Pumps	0.05	ea	$60,000	4500	$1.40	5	0.0802426	$443	$5,320
WAS Pumps	0.05	ea	$40,000	3000	$1.40	5	0.0802426	$296	$3,547
Scum Pumps	0.05	ea	$32,000	3600	$1.40	5	0.0802426	$248	$2,972
Drain Pumps	0.05	ea	$32,000	3000	$1.40	5	0.0802426	$242	$2,905

Tertiary Filtration									
Traveling Bridge Drive Lube	2	ea	$50	20	$1.40	5	2.0746951	$13	$156
Sodium Hypochlorite for Filter Cleaning	12	ea	$35	9	$1.40	5	12.322578	$48	$571
Sodium Bisulfite for Filter Cleaning	12	ea	$35	9	$1.40	5	12.322578	$48	$571
Pump Seals and Bearings	1	ea	$600	8	$1.40	5	1.05	$51	$611
Major Equipment Amortization									
Filter Media	0.07	ea	$166,560	402520	$0.25	5	0.0963423	$2,145	$25,742
Traveling Bridge Mechanism	0.033333	ea	$150,000	2500	$1.40	5	0.0650514	$832	$9,985
Pumps - W2 Non Potable Pumps	0.05	ea	$54,000	2400	$1.40	5	0.0802426	$384	$4,603
Gate Actuators	0.07	ea	$20,000	600	$1.40	5	0.0963423	$167	$2,008
Valve Actuators	0.1	ea	$15,000	225	$1.40	5	0.1295046	$165	$1,983
UV Disinfection									
Replacement UV Lamps	1	ea	$19,500	112.5	$1.40	5	1.05	$1,638	$19,658
UV Lamp Cleaning Chemical	3	gal	$17	16	$1.40	5	3.0994579	$10	$118
Major Equipment Amortization									
UV Lamp Assemblies	0.04	ea	$120,000	500	$1.40	5	0.0709525	$714	$8,564
Gate Actuators	0.07	ea	$40,000	800	$1.40	5	0.0963423	$330	$3,962
Composite Sampler	0.1	ea	$25,000	250	$1.40	5	0.1295046	$274	$3,283
Anaerobic Digestion									
Major Equipment Amortization									
Digester Mixing Equipment	0.05	ea	360000	6000	$1.40	5	0.0802426	$2,463	$29,561
Process Valves	0.066667	ea	24000	3600	$1.40	5	0.0963423	$233	$2,798
Valve Actuators	0.1	ea	$60,000	900	$1.40	5	0.1295046	$661	$7,933
Residuals Building									
Blower Lube	4	ea	$150	60	$1.40	5	4.1242377	$78	$936
Blower Filters	4	ea	$200	40	$1.40	5	4.1242377	$85	$1,024
Polyelectrolyte for Sludge Conditioning	1	ea	275000	100000	$0.25	5	1.05	$25,000	$300,000
Pump Seals and Bearings	1	ea	$1,050	14	$1.40	5	1.05	$89	$1,070
Valve Maintenance	1	ea	$1,350	90	$1.40	5	1.05	$123	$1,476
Belt Filter Press Belts	0.5	ea	1500	100	$1.40	5	0.5378049	$74	$882
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$650	65	$1.40	5	0.5378049	$33	$399
Major Equipment Amortization									
Pumps									
Digester Pumps	0.05	ea	$40,000	3000	$1.40	5	0.0802426	$296	$3,547
Digester Blowers	0.05	ea	$40,000	3000	$1.40	5	0.0802426	$296	$3,547
Biogas Compressor	0.05	ea	$20,000	1500	$1.40	5	0.0802426	$148	$1,773
TWAS Pumps	0.05	ea	$40,000	3000	$1.40	5	0.0802426	$296	$3,547
Poly Pumps	0.05	ea	$40,000	3000	$1.40	5	0.0802426	$296	$3,547
Valve Actuators	0.1	ea	$20,000	300	$1.40	5	0.1295046	$220	$2,644
Rotary Drum Thickeners	0.04	ea	300000	3000	$1.40	5	0.0709525	$1,799	$21,584
Belt Filter Presses	0.03	ea	400000	8000	$1.40	5	0.0650514	$2,229	$26,749
Septage Receiving									
Screen Drive Lube	4	ea	$150	60	$1.40	5	4.1242377	$78	$936
Thickener Equipment Lube	4	ea	$225	90	$1.40	5	4.1242377	$117	$1,404
Pump Seals and Bearings	1	ea	$900	12	$1.40	5	1.05	$76	$917
Valve Maintenance	1	ea	$600	40	$1.40	5	1.05	$55	$656
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$341	34	$1.40	5	0.5378049	$17	$209
Major Equipment Amortization									
Septage Mechanical Screens	0.033333	ea	400000	4000	$1.40	5	0.0650514	$2,199	$26,385
Thickened Septage Pumps	0.066667	ea	40000	1600	$1.40	5	0.0963423	$339	$4,069
Septage Scum Pumps	0.066667	ea	40000	1600	$1.40	5	0.0963423	$339	$4,069
Septage Thickener Equipment	0.04	ea	300000	4000	$1.40	5	0.0709525	$1,807	$21,683
Odor Control Media	0.1	ea	20000	1000	$1.40	5	0.1295046	$231	$2,771

Summary
Regional WWTP Operation and Maintenance
Lagoon Activated Sludge - 4.0 MGD ADF

Administration and Lab										
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228	
Building Interior Lighting Replacement	0.5	ea	$780	78	$1.40	5	0.5378049	$40	$478	
Major Equipment Amortization										
Lab Equipment	0.1	ea	35000	500	$1.40	5	0.1295046	$385	$4,623	
SCADA Equipment	0.1	ea	20000	250	$1.40	5	0.1295046	$220	$2,635	
Equipment Building										
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228	
Building Interior Lighting Replacement	0.5	ea	$109	109	$1.40	5	0.5378049	$12	$141	
Grounds										
Yard Lighting Replacement	0.5	ea	$6,534	653	$1.40	5	0.5378049	$334	$4,006	
Landscaping Equipment Replacement	0.25	ea	500	100	$1.40	5	0.2820118	$15	$180	
Fuels and Vehicle Maintenance										
	Vehicle Mile miles/yr	**Gasoline Mile/gal**	**Gasoline Gal/yr**	**Gasoline $/gal**	**Motor Oil Qt/yr**	**Motor Oil $/Quart**				
Gasoline	150	12	13	$3.40				$4	$43	
Motor Oil					16	$3.00		$4	$48	
Vehicle Insurance								$83	$1,000	
Vehicle License								$13	$150	
Vehicle Maintenance								$167	$2,000	$955,379

Services	**Quantity (1/yr)**	**Units**	**Unit Cost ($/unit)**	**Monthly Cost ($/mo)**	**Annual Cost ($/yr)**	
Screenings Disposal	912500	lbs	0.01	$760	$9,125	
Grit Disposal	365000	lbs	0.01	$304	$3,650	
Biosolids Disposal	2628000	lbs	0.01	$2,190	$26,280	
Internet Service	All Req'd	Lump Sum	$30	$30	$360	
Telephone Service	All Req'd	Lump Sum	$60	$60	$720	
Analytical Lab Services						
Weekly Influent TKN	52	ea	$60	$260	$3,120	
Weekly Effluent Ammonia	52	ea	$60	$260	$3,120	
Weekly Petroleum Hydrocarbons	52	ea	$250	$1,083	$13,000	
Whole Effluent Toxicity	0.6	ea	$1,800	$90	$1,080	$60,455

Conveyance Piping

Staff Costs

	Number of Staff	Hrs per Day	Base Hourly Pay $/Hr	Raw Salary $/yr	Benefits Package % of Base 25%	Monthly Cost ($/mo)	Annual Cost ($/yr)
Check/Maintain Lift Stations	1	6	$24.04	$50,000	$12,500	$5,484	$65,805
Vehicle Expenses	1	6	$5.00			$912.50	$10,950
Vactor Truck	1	0.0986301	$500.00			$1,500.00	$18,000.00
Misc. Materials and Supplies	1			$5,000		$416.67	$5,000

Electricity Costs

	Energy Per Gal.	Energy Cost	Cost per Gal.	Initial Flow Rate (gal)	Ultimate Flow Rate (gal)	Years to Ultimate Flow	Monthly Cost ($/mo)	Annual Cost ($/yr)@4MGD	Annual Cost Increase ($/yr)
Wasilla Force Main #1	0.000414	$0.061322	$0.000025	350,000	2,500,000	20	$1,930.49	$23,165.92	$996.13
Wasilla Force Main #2	0.000333	$0.061322	$0.000020	350,000	2,500,000	20	$1,552.79	$18,633.46	$801.24
Wasilla Force Main #3	0.000167	$0.061322	$0.000010	350,000	2,500,000	20	$778.73	$9,344.71	$401.82
								$0.00	
SWX Run #1	0.0006	$0.061322	$0.000037	350,000	2,500,000	20	$2,797.82	$33,573.80	$1,443.67
SWX Run #2	0.00059	$0.061322	$0.000036	350,000	1,500,000	20	$1,650.71	$19,808.54	$759.33
SWX Run #3	0.000171	$0.061322	$0.000010	350,000	1,500,000	20	$478.43	$5,741.12	$220.08
Subtotal							$17,502	$210,023	$4,622.27

Subtotal	$245,968	$2,951,621
Contingency of 20 percent	$49,194	$590,324
Total O&M	$295,162	**$3,541,946**

Regional WWTP - CAS

Initial Project Estimate Summary
Regional WWTP Operation and Maintenance
Conventional Activated Sludge - 4.0 MGD ADF

Labor	Number of Staff	Hrs per Day	Base Hourly Pay $/Hr	Raw Salary $/yr	Benefits Package % of Base 25%	Monthly Cost ($/mo)	Annual Cost ($/yr)
Operations							
Headworks							
Influent Composite Sampler Setup and Operation	1	0.142466	$24.04	$50,000	$12,500	$130	$1,563
Lab Work for Inf Sample Analysis							
BOD	1	0.427397	$24.04	$50,000	$12,500	$391	$4,688
COD	1	0.284932	$24.04	$50,000	$12,500	$260	$3,125
TSS	1	0.284932	$24.04	$50,000	$12,500	$260	$3,125
TKN (Commercial Lab)	1	0.142466	$24.04	$50,000	$12,500	$130	$1,563
Temp, pH, DO	1	0.071233	$24.04	$50,000	$12,500	$65	$781
Headworks Coarse Bar Screen Cleanup	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Headworks Screenings Disposal	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Grit Removal							
Grit Disposal	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Exercise Channel Gates	1	0.01	$24.04	$50,000	$12,500	$5	$60
Operate Scour Air in Grit Sump	1	0.04	$24.04	$50,000	$12,500	$33	$391
Primary Clairifcation and Pumping							
Exercise Splitter Box Gates	1	0.01	$24.04	$50,000	$12,500	$5	$60
Exercise Process Valves	1	0.03	$24.04	$50,000	$12,500	$30	$361
Hose down weirs and trough	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Probe Primary Clar for Sludge Depth	1	0.36	$24.04	$50,000	$12,500	$326	$3,917
Steam clean scum launderer/trough	1	0.05	$24.04	$50,000	$12,500	$43	$516
Lab Tests							
Primary Effluent pH Alkalinity	1	0.07	$24.04	$50,000	$12,500	$65	$781
Primary Sludge TS	1	0.07	$24.04	$50,000	$12,500	$65	$781
Secondary Treatment							
Check DO Profiles in A Basins	1	0.01	$24.04	$50,000	$12,500	$10	$120
Probe A Basins for Settled Sludge	1	0.03	$24.04	$50,000	$12,500	$30	$361
Lab Tests for MLSS							
TSS	1	0.11	$24.04	$50,000	$12,500	$98	$1,172
Microbiological Exam	1	0.05	$24.04	$50,000	$12,500	$43	$516
Settleability, SVI	1	0.07	$24.04	$50,000	$12,500	$65	$781
Lab Tests for WAS TSS	1	0.11	$24.04	$50,000	$12,500	$98	$1,172
Clean off MLSS DO and NH3 Analyzer Probes	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Hose Down Sec Clar Weirs and Water Surf	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Probe Secondary Clar for Sludge Depth/Inventory	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Top off Chemicals for Supplemental Alkalinity	1	0.36	$24.04	$50,000	$12,500	$326	$3,917
RAS Chlorination for Bulking Control	1	0.01	$24.04	$50,000	$12,500	$10	$120
Tertiary Filtration							
Periodic Filter Cleaning with Hypochlorite	1	0.07	$24.04	$50,000	$12,500	$60	$721
Clean out Feed and Filtrate Channels	1	0.03	$24.04	$50,000	$12,500	$30	$361

UV Disinfection							
Flush Out UV Lamp Channels	1	0.03	$24.04	$50,000	$12,500	$30	$361
Check UV Intensity Meters	1	0.05	$24.04	$50,000	$12,500	$49	$588
Perform Chemical Lamp Cleans	1	0.07	$24.04	$50,000	$12,500	$61	$731
Effluent Quality Lab Tests							
pH, DO	1	0.09	$24.04	$50,000	$12,500	$82	$979
BOD	1	0.28	$24.04	$50,000	$12,500	$260	$3,125
TSS	1	0.11	$24.04	$50,000	$12,500	$98	$1,172
NH3-N (Commercial Lab)	1	0.07	$24.04	$50,000	$12,500	$65	$781
Fecal Coliforms	1	0.14	$24.04	$50,000	$12,500	$130	$1,563
Residuals Building							
Top off Polyelectrolyte System	1	0.24	$24.04	$50,000	$12,500	$215	$2,585
Operate Gravity Drum Thickeners	1	0.50	$24.04	$50,000	$12,500	$457	$5,484
Operate Belt Filter Presses							
Digester Decant and Transfer Operations	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Dispose of Dewatered Digested Sludge	1	0.05	$24.04	$50,000	$12,500	$43	$517
Lab Analysis of Digested Sludge							
pH, Alkalinity	1	0.02	$24.04	$50,000	$12,500	$16	$195
VSS	1	0.18	$24.04	$50,000	$12,500	$163	$1,953
Septage Receiving							
Thickener Decant and Transfer Operations	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Clean up After Truck Haulers	1	0.50	$24.04	$50,000	$12,500	$457	$5,484
Clean Solids off of Coarse Bar screen	1	0.25	$24.04	$50,000	$12,500	$228	$2,742
Remove and Dispose of Septage Screenings	1	0.05	$24.04	$50,000	$12,500	$43	$517
Monitor and Report Dumper Activity	1	0.25	$24.04	$50,000	$12,500	$228	$2,742
Lab Tests for Spot Checking Septage Qual							
BOD	1	0.28	$24.04	$50,000	$12,500	$260	$3,125
COD	1	0.14	$24.04	$50,000	$12,500	$130	$1,563
TSS	1	0.11	$24.04	$50,000	$12,500	$98	$1,172
TKN (Commercial Lab)	1	0.142466	$24.04	$50,000	$12,500	$130	$1,563
Plant Management							
Operations Data Collection, Reporting, Archiving	1	0.71	$24.04	$50,000	$12,500	$653	$7,834
Annual Chemicals Receipt and Stroage	2	0.02	$24.04	$50,000	$12,500	$42	$506
Annual Operator Training for CEU's	1	0.06	$24.04	$50,000	$12,500	$56	$675
Operations & Maintenance Foreman	1	5.71	$27.57	$57,342	$14,336	$5,990	$71,874
Operator	1	5.71	$39.45	$82,056	$20,514	$8,571	$102,852
Operations Administrative Support	1	5.71	$20.00	$41,600	$10,400	$4,345	$52,143

Maintenance							
Headworks							
Instrumentation Maintenance/Replacement	1	0.005479	$24.04	$50,000	$12,500	$5	$60
Pump Preventative Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Screen Preventative Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Replace Brushes on Screen Equipment	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Comminuter Preventative Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Replace Cutters on Comminuter	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Heat and Ventilation System Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Grit Removal							
Grit Pump Preventative Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Grit Cyclone Resurfacing	1	0.010959	$24.04	$50,000	$12,500	$10	$120
Grit Classifier Screw Reconditioning	1	0.021918	$24.04	$50,000	$12,500	$20	$240
Clear Blockages from Grit Piping	1	0.087671	$24.04	$50,000	$12,500	$80	$962
Grit Paddle Drive Preventative Maintenance	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Primary Clarification & Pumping							
Pig Primary Effluent Pipelines	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Pig Scum Pipelines	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Drain, Clean and Inspect Basins	2	0.014612	$24.04	$50,000	$12,500	$27	$321
Primary Clarifier Scraper Mechanism PM	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Primary Clarification Process Pump PM							
Primary Sludge Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Primary Scum Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Basin Drain Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Primary Clarification Process Valve PM							
Primary Sludge Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Primary Scum Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Primary Clarifier Pump Building H&V PM							
Boiler Maintenance	1	0.005479	$24.04	$50,000	$12,500	$5	$60
Air and Fuel Filter Replacement	1	0.00274	$24.04	$50,000	$12,500	$3	$30
Secondary Treatment							
Drain and Inspect Basins and Diffusers	2	0.021918	$24.04	$50,000	$12,500	$40	$481
Replace Aeration Diffusers	2	0.010959	$24.04	$50,000	$12,500	$20	$240
Change Inlet Air Filters on Blowers	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Change Gearbox Oil on Turbine Blowers	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Blower Preventative Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Low Press Air Modulated Valve Actuator PM	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Anoxic Mixer Preventative Maintenance	1	0.005479	$24.04	$50,000	$12,500	$5	$60
Instrumentation Calibration and Repalcement							
RAS and WAS Flow Meters	1	0.00274	$24.04	$50,000	$12,500	$3	$30
Thermal Mass Air Flow Meters	1	0.00274	$24.04	$50,000	$12,500	$3	$30
DO and NH3-N MLSS Analyzers	1	0.00274	$24.04	$50,000	$12,500	$3	$30
Secondary Clarifier Scraper Mechanism PM	1	0.016438	$24.04	$50,000	$12,500	$15	$180
RAS Pump Preventative Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
WAS Pump Preventative Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Secondary Scum Pump Preventative Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Drain Pump Preventative Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361

Tertiary Filtration							
Tertiary Filter Traveling Bridge Equipment PM	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Periodic Filter Media Replacement	2	0.007306	$24.04	$50,000	$12,500	$13	$160
Filter Backwash Pump Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
W2 Utility Water Pump Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
UV Disinfection							
Replace Lamps	1	0.010959	$24.04	$50,000	$12,500	$10	$120
Replace Cleaning Solution	1	0.003616	$24.04	$50,000	$12,500	$3	$40
Replace Lamp Ballasts	1	0.008219	$24.04	$50,000	$12,500	$8	$90
Residuals Building							
Process Equipment Preventative Maintenance							
Rotary Drum Thickeners	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Belt Filter Presses	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Odor Control System Fans and Media	1	0.010959	$24.04	$50,000	$12,500	$10	$120
Biogas Scrubbers, Desiccants and Filters	1	0.010959	$24.04	$50,000	$12,500	$10	$120
Process Valve Actuator PM							
Primary Sludge and Scum Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Digested Sludge Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
WAS and TWAS Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Polyelectrolyte Solution Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Biogas Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Process Pump Preventative Maintenance							
Digester Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Drain Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Biogas Compressor	1	0.032877	$24.04	$50,000	$12,500	$30	$361
TWAS Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Polyelectrolyte Dosing Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Belt Press W2 Booster Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Polyelectrolyte Batch Transfer Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Clean out Digester Heat Exchanger	2	0.021918	$24.04	$50,000	$12,500	$40	$481
Clean out Digesters	3	0.021918	$24.04	$50,000	$12,500	$60	$721
Pig Digester Piping Systems	2	0.010959	$24.04	$50,000	$12,500	$20	$240
Utility Hot Water Heater PM	1	0.005479	$24.04	$50,000	$12,500	$5	$60
Septage Receiving							
Drain and Inspect Basins and Diffusers	2	0.010959	$24.04	$50,000	$12,500	$20	$240
Receiving Station Basin Cleaning	2	0.029224	$24.04	$50,000	$12,500	$53	$641
Septage Equipment Preventative Maintenance							
Screens	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Thickener Scraper Equipment	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Thickened Septage and Scump Pumps	1	0.131507	$24.04	$50,000	$12,500	$120	$1,442
Receiving Station Odor Control Equip PM	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Station Infrastructure Repair and Upgrades	1	0.284932	$24.04	$50,000	$12,500	$260	$3,125
Grounds							
Snow Plowing	1	0.106849	$24.04	$50,000	$12,500	$98	$1,172
Landscaping	1	0.071233	$24.04	$50,000	$12,500	$65	$781
Re-lamp Luminaries	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Painting and Building Repairs	1	0.142466	$24.04	$50,000	$12,500	$130	$1,563

$350,885

Initial Project Estimate Summary
Regional WWTP Operation and Maintenance
Conventional Activated Sludge - 4.0 MGD ADF

Energy

	Number of Units	Unit Hp	Percent Run per Day	Hrs per Day	kWh per month	Demand Charge $/mo	Energy Charge ($/kWh)	Customer Charge ($/month)	Monthly Cost ($/mo)	Annual Cost ($/yr)
Electrical Power								$13.37	$13	$160
Headworks										
Screw Pumps	4	30	100	24.0	64,428		$0.12		$7,950	$95,401
Raw Sewage Comminuters	4	3	50	12.0	3,221		$0.12		$398	$4,770
Raw Sewage Channel Screens	4	2.5	65	15.6	3,490		$0.12		$431	$5,168
Screenings Dewatering/Conveyance	1	1	25	6.0	134		$0.12		$17	$199
Grit Pump	2	7.5	10	2.4	805		$0.12		$99	$1,193
Grit Basin Propeller and Agitator Drive	2	1.5	10	2.4	161		$0.12		$20	$239
Grit Classifier	1	2	10	2.4	107		$0.12		$13	$159
Grit Dewatering and Conveyance	1	1.33	25	6.0	179		$0.12		$22	$265
Grit Channel Gate Actuators	4	0.5	0.023	0.005	0.25		$0.12		$0	$0
Flow and Level Instrumentation	2	0.001341	100	24.000	1.44		$0.12		$0	$2
Influent Composite Sampler	1	0.25	0.14	0.034	0.19		$0.12		$0	$0
Headworks Ventilation Fans										
Headworks Building Ventilation Fan High Speed	1	31.66746	33	7.9	5,611		$0.12		$692	$8,308
Headworks Building Ventilation Fan Low Speed	1	3.958433	67	16.1	1,424		$0.12		$176	$2,108
Primary Clarification										
Splitter Box Gate Actuators	4	0.5	0.023	0.005	0.25		$0.12		$0	$0
Basin Sludge and Scum Mechanism	3	5	50	12.000	4,026.78		$0.12		$497	$5,963
Primary Process Pumps										
Primary Sludge Pumps	3	7.5	50	12.000	6,040.17		$0.12		$745	$8,944
Primary Scum Pumps	2	5	25	6.000	1,342.26		$0.12		$166	$1,988
Primary Basin Drain Pumps	2	15	0.015	0.004	2.45		$0.12		$0	$4
Primary Basin Enclosure Ventilation										
Primary Basin Enclosure Vent Fan High Speed	1	39.48188	33	7.9	6,995		$0.12		$863	$10,358
Primary Basin Enclosure Vent Fan Low Speed	1	4.935235	67	16.1	1,775		$0.12		$219	$2,629
Primary Pump Building Ventilation Fan	1	0.698547	100	24.0	375		$0.12		$46	$555
Secondary Treatment										
Aeration Blowers	4	49	100	24.000	105,233.18		$0.12		$12,985	$155,822
Anoxic Mixers	6	3.4	100	24.000	10,952.84		$0.12		$1,352	$16,218
Secondary Clarifier Drives	3	5	100	24.000	8,053.56		$0.12		$994	$11,925
Process Pumps										
RAS Pumps	2	11	100	24.000	11,811.89		$0.12		$1,458	$17,490
WAS Pumps	1	3	17	4.000	268.45		$0.12		$33	$398
Secondary Scum Pumps	1	7.5	10	2.400	402.68		$0.12		$50	$596
Basin Drain Pumps	1	15	0.015	0.004	1.23		$0.12		$0	$2
Secondary Process Building Ventilation Fans	1	32.01674	100	24.000	17,189.91		$0.12		$2,121	$25,454
Supplemental Alkalinity Equipment	1	5	2	0.480	53.69		$0.12		$7	$80
Tertiary Filtration										
Traveling Bridge	1	7.5	25	6.000	1,006.70		$0.12		$124	$1,491
Backwash Pump	1	4	25	6.000	536.90		$0.12		$66	$795
W2 Utility Water Pumps	2	3	40	9.600	1,288.57		$0.12		$159	$1,908
UV Disinfection										
UV Lamps	1	67.84	100	24.000	36,423.57		$0.12		$4,494	$53,934
Effluent Composite Sampler	1	0.25	0.14	0.034	0.19		$0.12		$0	$0

Residuals									
Process Equipment									
WAS Drum Thickeners	2	6	20	4.8	1,289		$0.12	$159	$1,908
Belt Filter Presses	2	7.5	20	4.8	1,611		$0.12	$199	$2,385
Polyelectrolyte Solution Batch Prep Equip	1	0.25	20	4.8	27		$0.12	$3	$40
Biogas Scrubber Equipment	1	0.5	20	4.8	54		$0.12	$7	$80
Process Pumping									
TWAS Pumps	2	5	10	2.4	537		$0.12	$66	$795
Polyelectrolyte Solution Transfer Pumps	1	0.5	10	2.4	27		$0.12	$3	$40
Polyelectrolyte Dosing Pumps	2	0.5	10	2.4	54		$0.12	$7	$80
Digester Pumps	2	10	50.00	12.0	5,369		$0.12	$663	$7,950
Digester Blowers	6	20	20	4.8	12,886		$0.12	$1,590	$19,080
Ventilation System									
Residuals Bldg Ventilation Fan High Speed	1	23.2849	33	7.9	4,126		$0.12	$509	$6,109
Residuals Bldg Ventilation Fan Low Speed	1	2.910613	67	16.1	1,047		$0.12	$129	$1,550
Odor Control System	1	4.851021	100	24.0	2,605		$0.12	$321	$3,857
Septage Receiving Station									
Septage Screen	2	2	50	12.0	1,074		$0.12	$133	$1,590
Septage Screenings Dewatering/Conveyance	1	1	25	6.0	134		$0.12	$17	$199
Septage Screen Air Compressor	2	10	10	2.4	1,074		$0.12	$133	$1,590
Septage Holding Tank Transfer Pump	2	10	20	4.8	2,148		$0.12	$265	$3,180
Septage Holding Tank Aeration	2	5	25	6.0	1,342		$0.12	$166	$1,988
Septage Thickener Aeration	2	10	25	6.0	2,685		$0.12	$331	$3,975
Septage Thickener Sludge Pump	2	10	20	4.8	2,148		$0.12	$265	$3,180
Septage Thickener Scum Pump	2	5	10	2.4	537		$0.12	$66	$795
Ventilation System									
Septage Receiving Bldg Ventilation Fan High	1	12.22457	33	7.9	2,166		$0.12	$267	$3,207
Septage Receiving Bldg Ventilation Fan Low	1	1.528072	67	16.1	550		$0.12	$68	$814
Odor Control System	1	9.702042	100	24.0	5,209		$0.12	$643	$7,713
Administration Building									
Administration Building Ventilation Fan	1	4	100	24.0	2,148		$0.12	$265	$3,180
Laboratory Equipment	1	1.34	33	7.9	238		$0.12	$29	$352
Office Computer	1	0.67	100	24.0	360		$0.12	$44	$533
SCADA and Instrumentation	1	0.67	100	24.0	360		$0.12	$44	$533
Equipment Storage Building									
Equipment Storage Building Ventilation Fan	1	9	100	24.0	4,832		$0.12	$596	$7,155
						4037.099		$4,037	$48,445

Lighting

	Lighting Intensity (Watts/sf)	Floor Area (sf)	Duration per Week (hours)	kWh per month	Rate per kWh ($/kWh)	Monthly Cost ($/mo)	Annual Cost ($/yr)
Headworks Building (100 x 68)	1.3	6,800	40	1,531	$0.12	$189	$2,267
Primary Clarifier Basins (3 each 60 ft Diameter)	1.3	8,478	40	1,909	$0.12	$236	$2,827
Primary Pump Building (60x60)	1.3	3,600	40	811	$0.12	$100	$1,200
CAS Building (190 x 570)	1.3	110,000	40	24,768	$0.12	$3,056	$36,674
Septage Receiving Building (75x35)	1.3	2,625	40	591	$0.12	$73	$875
Residuals Building (100x50)	1.3	5,000	40	1,126	$0.12	$139	$1,667
Administration Building (80x75)	1.3	6,000	40	1,351	$0.12	$167	$2,000
Equipment Storage Building (120x70)	1.3	8,400	40	1,891	$0.12	$233	$2,801
Site Outdoor Lighting (6 acres), winter only	0.25	261,360	28	7,922	$0.12	$978	$11,730

Process and Space Heating

Process Heating

		Flow Rate (gpm)	Temp Rise (deg F)	Hours/Day Us (hr)	Mechanical Efficiency (percent)	Btu Demand (Btu/yr)	Natural Gas eating Val (Btu/std cf	Natural Gas Consumptior (std cf/yr)	Natural Gas Cost ($/100 std cf)	Monthly Customer Charge ($/month)	Monthly Cost ($/mo)	Annual Cost ($/yr)
Gas Monthly Service Charge										$64.00	$64	$768
Gas Regulatory Cost Charge										0.271%	$165	$1,983
Non-Potable Water Heating for Screening, gpd	500	0.09	100	24	60	63,418,750	1,020	62,175	$0.9995		$5,179	$62,146

Space Heating

		Area (sf)	Ave Annual Heating Temp Delta (oF)	Insulation R-Value (Hr F sf)/BTU	Ventilation Rate (CFM)	Heating Mechanical Efficiency (Percent)	Hours Per Day	Annual Heating Load (Btu*10^6/yr)	Natural Gas Cost ($/100 std cf)	Gas Heating Value (Btu/std cf)	Monthly Cost ($/mo)	Annual Cost ($/yr)
Headworks												
Headworks Building - Assume Eve Clear, ft	16											
Conductive Heat Loss												
Walls		5,376	29	25		60		91	$0.9995	1,020	$74	$892
Roof -estimate		6,800	29	25		60		115	$0.9995	1,020	$94	$1,129
Ventilation Heat Loss												
12 AC per Hour (Class I, DIV II Space)	12		29		21,760	60	8	3,653	$0.9995	1,020	$2,983	$35,795
6 AC per Hour (Class I, DIV II Space)	6		29		10,880	60	16	3,653	$0.9995	1,020	$2,983	$35,795
Primary Clarifier Enclosures												
Basin Enclosure Ave Height, ft	16											
Conductive Heat Loss												
Dome Enclosure, 3 each 60' Clarifiers		16,965	29	25		60		287	$0.9995	1,020	$235	$2,815
Ventilation Heat Loss												
12 AC per Hour (Class I, DIV II Space)	12		29		27,130	60	8	4,554	$0.9995	1,020	$3,719	$44,628
6 AC per Hour (Class I, DIV II Space)	6		29		13,565	60	16	4,554	$0.9995	1,020	$3,719	$44,628

Primary Pump Building													
Pump Vault - clear height, ft	16												
Conductive Heat Loss													
Walls		3840	29	25		60		65	$0.9995	1,020	$53	$637	
Roof -estimate		3,600	29	25		60		61	$0.9995	1,020	$50	$597	
Ventilation Heat Loss													
Operation Area, AC/hr	2		29		1,920	60	24	967	$0.9995	1,020	$790	$9,475	
CAS Building													
CAS Building - Assume Eve Clear, ft	16												
Conductive Heat Loss													
Walls		24,320	29	25		60		412	$0.9995	1,020	$336	$4,036	
Roof -estimate		110,000	29	25		60		1,863	$0.9995	1,020	$1,521	$18,256	
Ventilation Heat Loss													
Operation Area at 2 AC/hr	2		29		58,667	60	24	29,545	$0.9995	1,020	$24,127	$289,521	
Septage Receiving Building													
Septage Receiving Building - Assume Eve Clear, ft	16												
Conductive Heat Loss													
Walls		3,520	29	25		60		60	$0.9995	1,020	$49	$584	
Roof -estimate		2,625	29	25		60		44	$0.9995	1,020	$36	$436	
Ventilation Heat Loss													
12 AC per Hour (Class I, DIV II Space)	12		29		8,400	60	8	1,410	$0.9995	1,020	$1,152	$13,818	
6 AC per Hour (Class I, DIV II Space)	6		29		4,200	60	16	1,410	$0.9995	1,020	$1,152	$13,818	
Residuals Building													
Residuals Building - Assume Eve Clear, ft	16												
Conductive Heat Loss													
Walls		4,800	29	25		60		81	$0.9995	1,020	$66	$797	
Roof -estimate		5,000	29	25		60		85	$0.9995	1,020	$69	$830	
Ventilation Heat Loss													
12 AC per Hour (Class I, DIV II Space)	12		29		16,000	60	24	8,058	$0.9995	1,020	$6,580	$78,960	
6 AC per Hour (Class I, DIV II Space)	6		29		8,000	60	24	4,029	$0.9995	1,020	$3,290	$39,480	
Administration Building													
Administration Building Assume Eve Clear, ft	9												
Conductive Heat Loss													
Walls		2,790	33	25		60		54	$0.9995	1,020	$44	$527	
Roof -estimate		6,000	33	25		60		116	$0.9995	1,020	$94	$1,133	
Ventilation Heat Loss													
Operation Area at 2 AC/hr	2		33		1,800	60	24	1,032	$0.9995	1,020	$842	$10,108	
Equipment Storage Building													
Equipment Storage Building - Assume Eve Clear, ft	16												
Conductive Heat Loss													
Walls		6,080	24	25		60		85	$0.9995	1,020	$70	$835	
Roof -estimate		8,400	24	25		60		118	$0.9995	1,020	$96	$1,154	
Ventilation Heat Loss													
Operation Area at 2 AC/hr	2		24		4,480	60	24	1,867	$0.9995	1,020	$1,525	$18,297	$1,362,750

Consumables

	Occurrence Frequency (1/yr)	Units	Unit Cost w/out Shipping ($/ea)	Estimated Weight (lbs/ea)	Shipping Cost ($/lb)	Cost Escalation Rate (%)	Capital Recovery Factor	Monthly Cost ($/mo)	Annual Cost ($/yr)
Headworks									
Screw Pump Bearings and Seals	0.2	ea	$500	5	$1.40	5	0.2309748	$10	$117
Screw Pump Lube Oil	4	ea	$375	150	$1.40	5	4.12423769	$195	$2,340
Comminuter Cutter Plates	1	ea	$1,200	100	$1.40	5	1.05	$112	$1,340
Replacement Brushes for Raw Sewage Screens	0.333333	ea	$2,000	75	$1.40	5	0.36720856	$64	$773
Pump Seals and Bearings	1	ea	$300	10	$1.40	5	1.05	$26	$314
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$884	88	$1.40	5	0.53780488	$45	$542
Major Equipment Amortization									
Raw Sewage Screens/Comminuters	0.033333	ea	$687,500	7500	$1.40	5	0.06505144	$3,784	$45,406
Grit Pumps	0.07	ea	$32,000	500	$1.40	5	0.09634229	$263	$3,150
Gate Actuators	0.07	ea	$20,000	400	$1.40	5	0.09634229	$165	$1,981
Composite Sampler	0.1	ea	$25,000	250	$1.40	5	0.12950457	$274	$3,283
Primary Clarifiers									
Lube Oil for Clarifier Scraper Drives	4	ea	$225	90	$1.40	5	4.12423769	$117	$1,404
Building Interior Lighting Replacement	0.5	ea	$1,102	110	$1.40	5	0.53780488	$56	$676
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228
Major Equipment Amortization									
Clarifier Scraper Equipment	0.033333	ea	$450,000	15000	$1.40	5	0.06505144	$2,553	$30,639
Gate Actuators	0.07	ea	$15,000	300	$1.40	5	0.09634229	$124	$1,486
Primary Pump Building									
Pump Seals and Bearings	1	ea	$1,200	16	$1.40	5	1.05	$102	$1,222
Valve Maintenance	1	ea	$1,200	80	$1.40	5	1.05	$109	$1,312
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$468	47	$1.40	5	0.53780488	$24	$287
Major Equipment Amortization									
Pumps									
Primary Sludge Pumps	0.066667	ea	$72,000	3600	$1.40	5	0.09634229	$619	$7,422
Primary Scum Pumps	0.066667	ea	$84,000	3600	$1.40	5	0.09634229	$715	$8,578
Primary Basin Drain Pumps	0.066667	ea	$36,000	2400	$1.40	5	0.09634229	$316	$3,792
Valve Actuators	0.1	ea	$40,000	600	$1.40	5	0.12950457	$441	$5,289
Secondary Treatment									
Aeration Blower Lube Oil	4	ea	$375	150	$1.40	5	4.12423769	$195	$2,340
Aeration Blower Intake Filters	4	ea	$500	100	$1.40	5	4.12423769	$213	$2,560
Soda Ash for Supplemental Alkalinity	1	ea	$91,323	365,292	$0.08	5	1.05	$10,046	$120,546
Pump Seals and Bearings	1	ea	$1,050	14	$1.40	5	1.05	$89	$1,070
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$14,079	1408	$1.40	5	0.53780488	$719	$8,632
Major Equipment Amortization									
Blowers	0.05	ea	$400,000	30000	$1.40	5	0.08024259	$2,956	$35,467
Diffusers	0.1	ea	$300,000	4500	$1.40	5	0.12950457	$3,306	$39,667
Anoxic Mixers	0.05	ea	$90,000	1800	$1.40	5	0.08024259	$619	$7,424
Clarifer Equipment	0.033333	ea	$450,000	15000	$1.40	5	0.06505144	$2,553	$30,639
Gate Actuators	0.07	ea	$30,000	600	$1.40	5	0.09634229	$248	$2,971
Pumps									
RAS Pumps	0.05	ea	$60,000	4500	$1.40	5	0.08024259	$443	$5,320
WAS Pumps	0.05	ea	$40,000	3000	$1.40	5	0.08024259	$296	$3,547
Scum Pumps	0.05	ea	$32,000	3600	$1.40	5	0.08024259	$248	$2,972
Drain Pumps	0.05	ea	$32,000	3000	$1.40	5	0.08024259	$242	$2,905

Tertiary Filtration									
Traveling Bridge Drive Lube	2	ea	$50	20	$1.40	5	2.07469508	$13	$156
Sodium Hypochlorite for Filter Cleaning	12	ea	$35	9	$1.40	5	12.3225775	$48	$571
Sodium Bisulfite for Filter Cleaning	12	ea	$35	9	$1.40	5	12.3225775	$48	$571
Pump Seals and Bearings	1	ea	$600	8	$1.40	5	1.05	$51	$611
Major Equipment Amortization									
Filter Media	0.07	ea	$166,560	402520	$0.25	5	0.09634229	$2,145	$25,742
Traveling Bridge Mechanism	0.033333	ea	$150,000	2500	$1.40	5	0.06505144	$832	$9,985
Pumps - W2 Non Potable Pumps	0.05	ea	$54,000	2400	$1.40	5	0.08024259	$384	$4,603
Gate Actuators	0.07	ea	$20,000	600	$1.40	5	0.09634229	$167	$2,008
Valve Actuators	0.1	ea	$15,000	225	$1.40	5	0.12950457	$165	$1,983
UV Disinfection									
Replacement UV Lamps	1	ea	$19,500	112.5	$1.40	5	1.05	$1,638	$19,658
UV Lamp Cleaning Chemical	3	gal	$17	16	$1.40	5	3.09945791	$10	$118
Major Equipment Amortization									
UV Lamp Assemblies	0.04	ea	$120,000	500	$1.40	5	0.07095246	$714	$8,564
Gate Actuators	0.07	ea	$40,000	800	$1.40	5	0.09634229	$330	$3,962
Composite Sampler	0.1	ea	$25,000	250	$1.40	5	0.12950457	$274	$3,283
Anaerobic Digestion									
Major Equipment Amortization									
Digester Mixing Equipment	0.05	ea	360000	6000	$1.40	5	0.08024259	$2,463	$29,561
Process Valves	0.066667	ea	24000	3600	$1.40	5	0.09634229	$233	$2,798
Valve Actuators	0.1	ea	$60,000	900	$1.40	5	0.12950457	$661	$7,933
Residuals Building									
Blower Lube	4	ea	$150	60	$1.40	5	4.12423769	$78	$936
Blower Filters	4	ea	$200	40	$1.40	5	4.12423769	$85	$1,024
Polyelectrolyte for Sludge Conditioning	1	ea	275000	100000	$0.25	5	1.05	$25,000	$300,000
Pump Seals and Bearings	1	ea	$1,050	14	$1.40	5	1.05	$89	$1,070
Valve Maintenance	1	ea	$1,350	90	$1.40	5	1.05	$123	$1,476
Belt Filter Press Belts	0.5	ea	1500	100	$1.40	5	0.53780488	$74	$882
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$650	65	$1.40	5	0.53780488	$33	$399
Major Equipment Amortization									
Pumps									
Digester Pumps	0.05	ea	$40,000	3000	$1.40	5	0.08024259	$296	$3,547
Digester Blowers	0.05	ea	$40,000	3000	$1.40	5	0.08024259	$296	$3,547
Biogas Compressor	0.05	ea	$20,000	1500	$1.40	5	0.08024259	$148	$1,773
TWAS Pumps	0.05	ea	$40,000	3000	$1.40	5	0.08024259	$296	$3,547
Poly Pumps	0.05	ea	$40,000	3000	$1.40	5	0.08024259	$296	$3,547
Valve Actuators	0.1	ea	$20,000	300	$1.40	5	0.12950457	$220	$2,644
Rotary Drum Thickeners	0.04	ea	300000	3000	$1.40	5	0.07095246	$1,799	$21,584
Belt Filter Presses	0.03	ea	400000	8000	$1.40	5	0.06505144	$2,229	$26,749
Septage Receiving									

Screen Drive Lube	4	ea	$150	60	$1.40	5	4.12423769	$78	$936	
Thickener Equipment Lube	4	ea	$225	90	$1.40	5	4.12423769	$117	$1,404	
Pump Seals and Bearings	1	ea	$900	12	$1.40	5	1.05	$76	$917	
Valve Maintenance	1	ea	$600	40	$1.40	5	1.05	$55	$656	
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228	
Building Interior Lighting Replacement	0.5	ea	$341	34	$1.40	5	0.53780488	$17	$209	
Major Equipment Amortization										
Septage Mechanical Screens	0.033333	ea	400000	4000	$1.40	5	0.06505144	$2,199	$26,385	
Thickened Septage Pumps	0.066667	ea	40000	1600	$1.40	5	0.09634229	$339	$4,069	
Septage Scum Pumps	0.066667	ea	40000	1600	$1.40	5	0.09634229	$339	$4,069	
Septage Thickener Equipment	0.04	ea	300000	4000	$1.40	5	0.07095246	$1,807	$21,683	
Odor Control Media	0.1	ea	20000	1000	$1.40	5	0.12950457	$231	$2,771	
Administration and Lab										
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228	
Building Interior Lighting Replacement	0.5	ea	$780	78	$1.40	5	0.53780488	$40	$478	
Major Equipment Amortization										
Lab Equipment	0.1	ea	35000	500	$1.40	5	0.12950457	$385	$4,623	
SCADA Equipment	0.1	ea	20000	250	$1.40	5	0.12950457	$220	$2,635	
Equipment Building										
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	5	1.05	$19	$228	
Building Interior Lighting Replacement	0.5	ea	$109	109	$1.40	5	0.53780488	$12	$141	
Grounds										
Yard Lighting Replacement	0.5	ea	$6,534	653	$1.40	5	0.53780488	$334	$4,006	
Landscaping Equipment Replacement	0.25	ea	500	100	$1.40	5	0.28201183	$15	$180	
Fuels and Vehicle Maintenance										
	Vehicle Mile miles/yr	**Gasoline Mile/gal**	**Gasoline Gal/yr**	**Gasoline $/gal**	**Motor Oil Qt/yr**	**Motor Oil $/Quart**				
Gasoline	150	12	13	$3.40				$4	$43	
Motor Oil					16	$3.00		$4	$48	
Vehicle Insurance								$83	$1,000	
Vehicle License								$13	$150	
Vehicle Maintenance								$167	$2,000	$962,474

Services	**Quantity (1/yr)**	**Units**	**Unit Cost ($/unit)**	**Monthly Cost ($/mo)**	**Annual Cost ($/yr)**	
Screenings Disposal	912500	lbs	0.01	$760	$9,125	
Grit Disposal	365000	lbs	0.01	$304	$3,650	
Biosolids Disposal	2628000	lbs	0.01	$2,190	$26,280	
Internet Service	All Req'd	Lump Sum	$30	$30	$360	
Telephone Service	All Req'd	Lump Sum	$60	$60	$720	
Analytical Lab Services						
Weekly Influent TKN	52	ea	$60	$260	$3,120	
Weekly Effluent Ammonia	52	ea	$60	$260	$3,120	
Weekly Petroleum Hydrocarbons	52	ea	$250	$1,083	$13,000	
Whole Effluent Toxicity	0.6	ea	$1,800	$90	$1,080	$60,455

Conveyance Piping

Staff Costs

	Number of Staff	**Hrs per Day**	**Base Hourly Pay $/Hr**	**Raw Salary $/yr**	**Benefits Package % of Base 25%**	**Monthly Cost ($/mo)**	**Annual Cost ($/yr)**
Check/Maintain Lift Stations	1	6	$24.04	$50,000	$12,500	$5,484	$65,805
Vehicle Expenses	1	6	$5.00			$912.50	$10,950
Vactor Truck	1	0.09863	$500.00			$1,500.00	$18,000.00
Misc. Materials and Supplies	1			$5,000		$416.67	$5,000

Electricity Costs

	Energy Per Gal.	**Energy Cost**	**Cost per Gal.**	**Initial Flow Rate (gal)**	**Ultimate Flow Rate (gal)**	**Years to Ultimate Flow**	**Monthly Cost ($/mo)**	**Annual Cost ($/yr)@4MGD**	**Annual Cost Increase ($/yr)**
Wasilla Force Main #1	0.000414	$0.061322	$0.000025	350,000	2,500,000	20	$1,930.49	$23,165.92	$996.13
Wasilla Force Main #2	0.000333	$0.061322	$0.000020	350,000	2,500,000	20	$1,552.79	$18,633.46	$801.24
Wasilla Force Main #3	0.000167	$0.061322	$0.000010	350,000	2,500,000	20	$778.73	$9,344.71	$401.82
SWX Run #1	0.0006	$0.061322	$0.000037	350,000	2,500,000	20	$2,797.82	$33,573.80	$1,443.67
Reversed SWX Force Main	8.16E-05	$0.061322	$0.000005	350,000	1,500,000	20	$228.30	$2,739.62	$105.02
Subtotal							$15,601	$187,213	$3,748

	Monthly	Annual
Subtotal	$243,648	$2,923,777
Contingency of 20 percent	$48,730	$584,755
Total O&M	$292,378	**$3,508,532**

Regional WWTP - MBR

Summary
Regional WWTP Operation and Maintenance
Membrane Bioreactor - 4.0 MGD ADF

Labor	Number of Staff	Hours per Day	Base Hourly Pay $/Hr	Raw Salary $/yr	Benefits Package % of Base 25%	Monthly Cost	Annual Cost
Operations							
Headworks							
Influent Composite Sampler Setup and Operation	1	0.142466	$24.04	$50,000	$12,500	$130	$1,563
Lab Work for Inf Sample Analysis							
BOD	1	0.427397	$24.04	$50,000	$12,500	$391	$4,688
COD	1	0.284932	$24.04	$50,000	$12,500	$260	$3,125
TSS	1	0.284932	$24.04	$50,000	$12,500	$260	$3,125
TKN (Commercial Lab)	1	0.142466	$24.04	$50,000	$12,500	$130	$1,563
Temp, pH, DO	1	0.071233	$24.04	$50,000	$12,500	$65	$781
Headworks Cleanup	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Headworks Screenings Disposal	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Grit Removal							
Grit Disposal	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Exercise Channel Gates	1	0.01	$24.04	$50,000	$12,500	$5	$60
Operate Scour Air in Grit Sump	1	0.04	$24.04	$50,000	$12,500	$33	$391
Primary Clairifcation and Pumping							
Exercise Splitter Box Gates	1	0.01	$24.04	$50,000	$12,500	$5	$60
Exercise Process Valves	1	0.03	$24.04	$50,000	$12,500	$30	$361
Hose down weirs and trough	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Probe Primary Clar for Sludge Depth	1	0.36	$24.04	$50,000	$12,500	$326	$3,917
Steam clean scum launderer/trough	1	0.05	$24.04	$50,000	$12,500	$43	$516
Lab Tests							
Primary Effluent pH Alkalinity	1	0.07	$24.04	$50,000	$12,500	$65	$781
Primary Sludge TS	1	0.07	$24.04	$50,000	$12,500	$65	$781
Secondary Treatment							
Check DO Profiles in A Basins	1	0.01	$24.04	$50,000	$12,500	$10	$120
Probe A Basins for Settled Sludge	1	0.03	$24.04	$50,000	$12,500	$30	$361
Lab Tests for MLSS							
TSS	1	0.11	$24.04	$50,000	$12,500	$98	$1,172
Lab Tests for WAS TSS	1	0.11	$24.04	$50,000	$12,500	$98	$1,172
Clean off MLSS DO and NH3 Analyzer Probes	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Spray Down Foam on Bioreactors	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Pull Out Membrane Modules for Inspection	1	0.07	$24.04	$50,000	$12,500	$61	$731
Physical Membrane Cleaning	1	0.13	$24.04	$50,000	$12,500	$122	$1,462
Top off Chemicals for Membrane Cleaning	1	0.36	$24.04	$50,000	$12,500	$326	$3,917
Top off Chemicals for Supplemental Alkalinity	1	0.36	$24.04	$50,000	$12,500	$326	$3,917
UV Disinfection							
Check UV Intensity Meters	1	0.05	$24.04	$50,000	$12,500	$49	$588
Perform Chemical Lamp Cleans	1	0.07	$24.04	$50,000	$12,500	$61	$731
Effluent Quality Lab Tests							
pH, DO	1	0.09	$24.04	$50,000	$12,500	$82	$979
BOD	1	0.28	$24.04	$50,000	$12,500	$260	$3,125
TSS	1	0.11	$24.04	$50,000	$12,500	$98	$1,172
NH3-N (Commercial Lab)	1	0.07	$24.04	$50,000	$12,500	$65	$781
Fecal Coliforms	1	0.14	$24.04	$50,000	$12,500	$130	$1,563

Residuals Building							
Top off Polyelectrolyte System	1	0.24	$24.04	$50,000	$12,500	$215	$2,585
Operate Gravity Drum Thickeners	1	0.50	$24.04	$50,000	$12,500	$457	$5,484
Operate Belt Filter Presses							
Digester Decant and Transfer Operations	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Dispose of Dewatered Digested Sludge	1	0.05	$24.04	$50,000	$12,500	$43	$517
Lab Analysis of Digested Sludge							
pH, Alkalinity	1	0.02	$24.04	$50,000	$12,500	$16	$195
VSS	1	0.18	$24.04	$50,000	$12,500	$163	$1,953
Septage Receiving							
Thickener Decant and Transfer Operations	1	0.18	$24.04	$50,000	$12,500	$163	$1,958
Clean up After Truck Haulers	1	0.50	$24.04	$50,000	$12,500	$457	$5,484
Clean Solids off of Coarse Bar screen	1	0.25	$24.04	$50,000	$12,500	$228	$2,742
Remove and Dispose of Septage Screenings	1	0.05	$24.04	$50,000	$12,500	$43	$517
Monitor and Report Dumper Activity	1	0.25	$24.04	$50,000	$12,500	$228	$2,742
Lab Tests for Spot Checking Septage Qual							
BOD	1	0.28	$24.04	$50,000	$12,500	$260	$3,125
COD	1	0.14	$24.04	$50,000	$12,500	$130	$1,563
TSS	1	0.11	$24.04	$50,000	$12,500	$98	$1,172
TKN (Commercial Lab)	1	0.142466	$24.04	$50,000	$12,500	$130	$1,563
Plant Management							
Operations Data Collection, Reporting, Archiving	1	0.71	$24.04	$50,000	$12,500	$653	$7,834
Annual Chemicals Receipt and Stroage	2	0.02	$24.04	$50,000	$12,500	$42	$506
Annual Operator Training for CEU's	1	0.06	$24.04	$50,000	$12,500	$56	$675
Operations & Maintenance Foreman	1	4.29	$27.57	$57,342	$14,336	$4,492	$53,906
Operator	1	4.29	$39.45	$82,056	$20,514	$6,428	$77,139
Operations Administrative Support	1	4.29	$20.00	$41,600	$10,400	$3,259	$39,107

Maintenance

Headworks							
Instrumentation Maintenance/Replacement	1	0.005479	$24.04	$50,000	$12,500	$5	$60
Pump Preventative Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Screen Preventative Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Replace Brushes on Screen Equipment	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Heat and Ventilation System Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Grit Removal							
Grit Pump Preventative Maintenance	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Grit Cyclone Resurfacing	1	0.010959	$24.04	$50,000	$12,500	$10	$120
Grit Classifier Screw Reconditioning	1	0.021918	$24.04	$50,000	$12,500	$20	$240
Clear Blockages from Grit Piping	1	0.087671	$24.04	$50,000	$12,500	$80	$962
Grit Paddle Drive Preventative Maintenance	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Primary Clarification & Pumping							
Pig Primary Effluent Pipelines	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Pig Scum Pipelines	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Drain, Clean and Inspect Basins	2	0.014612	$24.04	$50,000	$12,500	$27	$321
Primary Clarifier Scraper Mechanism PM	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Primary Clarification Process Pump PM							
Primary Sludge Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Primary Scum Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Basin Drain Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Primary Clarification Process Valve PM							
Primary Sludge Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Primary Scum Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Primary Clarifier Pump Building H&V PM							
Boiler Maintenance	1	0.005479	$24.04	$50,000	$12,500	$5	$60
Air and Fuel Filter Replacement	1	0.00274	$24.04	$50,000	$12,500	$3	$30

Secondary Treatment							
Drain and Inspect Basins and Diffusers	2	0.021918	$24.04	$50,000	$12,500	$40	$481
Replace Aeration Diffusers	2	0.010959	$24.04	$50,000	$12,500	$20	$240
Change Inlet Air Filters on Blowers	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Change Gearbox Oil on Turbine Blowers	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Blower Preventative Maintenance	1	0.065753	$24.04	$50,000	$12,500	$60	$721
Low Press Air Modulated Valve Actuator PM	1	0.035616	$24.04	$50,000	$12,500	$33	$391
Anoxic Mixer Preventative Maintenance	1	0.005479	$24.04	$50,000	$12,500	$5	$60
Instrumentation Calibration and Repalcement							
RAS and WAS Flow Meters	1	0.00274	$24.04	$50,000	$12,500	$3	$30
Thermal Mass Air Flow Meters	1	0.00274	$24.04	$50,000	$12,500	$3	$30
DO and NH3-N MLSS Analyzers	1	0.00274	$24.04	$50,000	$12,500	$3	$30
MLSS TSS Analyzer	1	0.00274	$24.04	$50,000	$12,500	$3	$30
MBR Filtrate Flow Meters	1	0.00274	$24.04	$50,000	$12,500	$3	$30
MBR Filtrate DO Meters	1	0.00274	$24.04	$50,000	$12,500	$3	$30
MBR Filtrate Turbidity Meters	1	0.00274	$24.04	$50,000	$12,500	$3	$30
Lube MBR Overhead Crane	1	0.00411	$24.04	$50,000	$12,500	$4	$45
Replace MBR Membranes	2	0.021918	$24.04	$50,000	$12,500	$40	$481
Pump Preventative Maintenance							
ML Recycle Pumps	1	0.032877	$24.04	$50,000	$12,500	$144	$1,734
WAS Pumps	1	0.032877	$24.04	$50,000	$12,500	$144	$1,734
Secondary Scum Pumps	1	0.032877	$24.04	$50,000	$12,500	$144	$1,734
Secondary Basins' Drain Pumps	1	0.032877	$24.04	$50,000	$12,500	$144	$1,734
MBR Backpulse Pumps	1	0.032877	$24.04	$50,000	$12,500	$144	$1,734
MBR Filtrate Pumps	1	0.19726	$24.04	$50,000	$12,500	$867	$10,401
MBR CIP Hypochlorite Pumps	1	0.032877	$24.04	$50,000	$12,500	$144	$1,734
MBR Instrument Air Compressor	1	0.065753	$24.04	$50,000	$12,500	$289	$3,467
W2 Non-Potable Water Pumps	1	0.032877	$24.04	$50,000	$12,500	$144	$1,734
UV Disinfection							
Replace Lamps	1	0.010959	$24.04	$50,000	$12,500	$10	$120
Replace Cleaning Solution	1	0.003616	$24.04	$50,000	$12,500	$3	$40
Replace Lamp Ballasts	1	0.008219	$24.04	$50,000	$12,500	$8	$90
Residuals Building							
Process Equipment Preventative Maintenance							
Rotary Drum Thickeners	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Belt Filter Presses	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Odor Control System Fans and Media	1	0.010959	$24.04	$50,000	$12,500	$10	$120
Biogas Scrubbers, Desiccants and Filters	1	0.010959	$24.04	$50,000	$12,500	$10	$120
Process Valve Actuator PM							
Primary Sludge and Scum Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Digested Sludge Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
WAS and TWAS Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Polyelectrolyte Solution Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Biogas Valves	1	0.016438	$24.04	$50,000	$12,500	$15	$180
Process Pump Preventative Maintenance							
Digester Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Drain Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Biogas Compressor	1	0.032877	$24.04	$50,000	$12,500	$30	$361
TWAS Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Polyelectrolyte Dosing Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Belt Press W2 Booster Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Polyelectrolyte Batch Transfer Pumps	1	0.032877	$24.04	$50,000	$12,500	$30	$361
Clean out Digester Heat Exchanger	2	0.021918	$24.04	$50,000	$12,500	$40	$481
Clean out Digesters	3	0.021918	$24.04	$50,000	$12,500	$60	$721
Pig Digester Piping Systems	2	0.010959	$24.04	$50,000	$12,500	$20	$240
Utility Hot Water Heater PM	1	0.005479	$24.04	$50,000	$12,500	$5	$60

Septage Receiving								
Drain and Inspect Basins and Diffusers	2	0.010959	$24.04	$50,000	$12,500	$20	$240	
Receiving Station Basin Cleaning	2	0.029224	$24.04	$50,000	$12,500	$53	$641	
Septage Equipment Preventative Maintenance								
Screens	1	0.032877	$24.04	$50,000	$12,500	$30	$361	
Thickener Scraper Equipment	1	0.016438	$24.04	$50,000	$12,500	$15	$180	
Thickened Septage and Scump Pumps	1	0.131507	$24.04	$50,000	$12,500	$120	$1,442	
Receiving Station Odor Control Equip PM	1	0.032877	$24.04	$50,000	$12,500	$30	$361	
Station Infrastructure Repair and Upgrades	1	0.284932	$24.04	$50,000	$12,500	$260	$3,125	
Grounds								
Snow Plowing	1	0.106849	$24.04	$50,000	$12,500	$98	$1,172	
Landscaping	1	0.071233	$24.04	$50,000	$12,500	$65	$781	
Re-lamp Luminaries	1	0.032877	$24.04	$50,000	$12,500	$30	$361	
Painting and Building Repairs	1	0.142466	$24.04	$50,000	$12,500	$130	$1,563	
								$319,635

Energy

	Number of Units	Unit Hp	Percent Run per Day	Hrs per Day	kWh per month	Demand Charge $/mo	Rate per ($/KWH)	Monthly Customer Charge ($/month)	Monthly Cost	Annual Cost	
Electrical Power								$13.37	$13	$160	
Headworks											
Screw Pumps	4	30	100	24.0	64,428		$0.12		$7,950	$95,401	
Raw Sewage Comminuters	4	3	50	12.0	3,221		$0.12		$398	$4,770	
Raw Sewage Drum Screens	3	2	50	12.0	1,611		$0.12		$199	$2,385	
Screenings Dewatering/Conveyance	1	1	25	6.0	134		$0.12		$17	$199	
Grit Pump	2	7.5	10	2.4	805		$0.12		$99	$1,193	
Grit Basin Propeller and Agitator Drive	2	1.5	10	2.4	161		$0.12		$20	$239	
Grit Classifier	1	2	10	2.4	107		$0.12		$13	$159	
Grit Dewatering and Conveyance	1	1.33	25	6.0	179		$0.12		$22	$265	
Grit Channel Gate Actuators	4	0.5	0.023	0.005	0.25		$0.12		$0	$0	
Flow and Level Instrumentation	2	0.001341	100	24.000	1.44		$0.12		$0	$2	
Influent Composite Sampler	1	0.25	0.14	0.034	0.19		$0.12		$0	$0	
Headworks Ventilation Fans											
Headworks Building Ventilation Fan High Speed	1	62.86923	33	7.9	11,139		$0.12		$1,374	$16,494	6
Headworks Building Ventilation Fan Low Speed	1	7.858654	67	16.1	2,827		$0.12		$349	$4,186	1.5
Primary Clarification											
Splitter Box Gate Actuators	4	0.5	0.023	0.005	0.25		$0.12		$0	$0	
Basin Sludge and Scum Mechanism	3	5	50	12.000	4,026.78		$0.12		$497	$5,963	
Primary Process Pumps											
Primary Sludge Pumps	3	7.5	50	12.000	6,040.17		$0.12		$745	$8,944	
Primary Scum Pumps	2	5	25	6.000	1,342.26		$0.12		$166	$1,988	
Primary Basin Drain Pumps	2	15	0.015	0.004	2.45		$0.12		$0	$4	
Primary Basin Enclosure Ventilation											
Primary Basin Enclosure Vent Fan High Speed	1	39.48188	33	7.9	6,995		$0.12		$863	$10,358	6
Primary Basin Enclosure Vent Fan Low Speed	1	4.935235	67	16.1	1,775		$0.12		$219	$2,629	1.5
Primary Pump Building Ventilation Fan	1	0.698547	100	24.0	375		$0.12		$46	$555	1.5
Secondary Treatment											
Aeration Blowers	4	49	100	24.000	105,233.18		$0.12		$12,985	$155,822	
Anoxic Mixers	6	3.4	100	24.000	10,952.84		$0.12		$1,352	$16,218	
MBR Air Scour Blowers	4	48	100	24.000	103,085.57		$0.12		$12,720	$152,642	
Process Pumps											
ML Recycle Pumps	2	7	100	24.000	7,516.66		$0.12		$928	$11,130	
WAS Pumps	1	3	17	4.000	268.45		$0.12		$33	$398	
Secondary Scum Pumps	1	7.5	10	2.400	402.68		$0.12		$50	$596	
Secondary Basins' Drain Pumps	1	15	0.015	0.004	1.23		$0.12		$0	$2	
MBR Backpulse Pumps	2	5	50	12.000	2,684.52		$0.12		$331	$3,975	
MBR Filtrate Pumps	6	4.5	100	24.000	14,496.41		$0.12		$1,789	$21,465	
MBR CIP Hypochlorite Pumps	1	0.25	1	0.250	1.40		$0.12		$0	$2	
MBR Instrument Air Compressor	1	7.5	10	2.400	402.68		$0.12		$50	$596	
Secondary Process Building Ventilation Fans	1	12.48653	100	24.000	6,704.07		$0.12		$827	$9,927	2.25
Supplemental Alkalinity Equipment	1	5	2	0.480	53.69		$0.12		$7	$80	
W2 Utility Water Pumps	2	3	40	9.600	1,288.57		$0.12		$159	$1,908	
UV Disinfection											
UV Lamps	1	67.84	100	24.000	36,423.57		$0.12		$4,494	$53,934	
Effluent Composite Sampler	1	0.25	0.14	0.034	0.19		$0.12		$0	$0	

Residuals										
Process Equipment										
WAS Drum Thickeners	2	6	20	4.8	1,289		$0.12	$159	$1,908	
Belt Filter Presses	2	7.5	20	4.8	1,611		$0.12	$199	$2,385	
Polyelectrolyte Solution Batch Prep Equip	1	0.25	20	4.8	27		$0.12	$3	$40	
Biogas Scrubber Equipment	1	0.5	20	4.8	54		$0.12	$7	$80	
Process Pumping										
TWAS Pumps	2	5	10	2.4	537		$0.12	$66	$795	
Polyelectrolyte Solution Transfer Pumps	1	0.5	10	2.4	27		$0.12	$3	$40	
Polyelectrolyte Dosing Pumps	2	0.5	10	2.4	54		$0.12	$7	$80	
Digester Pumps	2	10	50.00	12.0	5,369		$0.12	$663	$7,950	
Digester Blowers	6	20	20	4.8	12,886		$0.12	$1,590	$19,080	
Ventilation System										
Residuals Bldg Ventilation Fan High Speed	1	23.2849	33	7.9	4,126		$0.12	$509	$6,109	6
Residuals Bldg Ventilation Fan Low Speed	1	2.910613	67	16.1	1,047		$0.12	$129	$1,550	1.5
Odor Control System	1	4.851021	100	24.0	2,605		$0.12	$321	$3,857	4
Septage Receiving Station										5000
Septage Screen	2	2	50	12.0	1,074		$0.12	$133	$1,590	
Septage Screenings Dewatering/Conveyance	1	1	25	6.0	134		$0.12	$17	$199	
Septage Screen Air Compressor	2	10	10	2.4	1,074		$0.12	$133	$1,590	
Septage Holding Tank Transfer Pump	2	10	20	4.8	2,148		$0.12	$265	$3,180	
Septage Holding Tank Aeration	2	5	25	6.0	1,342		$0.12	$166	$1,988	
Septage Thickener Aeration	2	10	25	6.0	2,685		$0.12	$331	$3,975	
Septage Thickener Sludge Pump	2	10	20	4.8	2,148		$0.12	$265	$3,180	
Septage Thickener Scum Pump	2	5	10	2.4	537		$0.12	$66	$795	
Ventilation System										
Septage Receiving Bldg Ventilation Fan High	1	12.22457	33	7.9	2,166		$0.12	$267	$3,207	6
Septage Receiving Bldg Ventilation Fan Low	1	1.528072	67	16.1	550		$0.12	$68	$814	1.5
Odor Control System	1	9.702042	100	24.0	5,209		$0.12	$643	$7,713	4
Administration Building										10000
Administration Building Ventilation Fan	1	4	100	24.0	2,148		$0.12	$265	$3,180	
Laboratory Equipment	1	1.34	33	7.9	238		$0.12	$29	$352	
Office Computer	1	0.67	100	24.0	360		$0.12	$44	$533	
SCADA and Instrumentation	1	0.67	100	24.0	360		$0.12	$44	$533	
Equipment Storage Building										
Equipment Storage Building Ventilation Fan	1	9	100	24.0	4,832		$0.12	$596	$7,155	
						4834.333		$4,834	$58,012	

Lighting

	Lighting Intensity (Watts/sf)	Floor Area (sf)	Duration per Week (hours)	kWh per month	Rate per KWH ($/KWH)	Monthly Cost	Annual Cost
Headworks Building (75 x 180)	1.3	13,500	40	3,040	$0.12	$375	$4,501
Primary Clarifier Basins (3 each 60 ft Diameter)	1.3	8,478	40	1,909	$0.12	$236	$2,827
Primary Pump Building (60x60)	1.3	3,600	40	811	$0.12	$100	$1,200
MBR Building (130 x 330)	1.3	42,900	40	9,659	$0.12	$1,192	$14,303
Septage Receiving Building (75x35)	1.3	2,625	40	591	$0.12	$73	$875
Residuals Building (100x50)	1.3	5,000	40	1,126	$0.12	$139	$1,667
Administration Building (80x75)	1.3	6,000	40	1,351	$0.12	$167	$2,000
Equipment Storage Building (120x70)	1.3	8,400	40	1,891	$0.12	$233	$2,801
Site Outdoor Lighting (4 acres), winter only	0.25	174,240	28	5,281	$0.12	$652	$7,820

Process and Space Heating

Process Heating

		Flow Rate (gpm)	Temp Rise (deg F)	ours/Day Us (hr)	Mechanical Efficiency (percent)	Btu Demand (Btu/yr)	Natural Gas eating Valu (Btu/std cf)	Natural Gas onsumptio (std cf/yr)	Natural Gas Cost ($/100 std cf)	Monthly Customer Charge ($/month)	Monthly Cost ($/mo)	Annual Cost ($/yr)
Gas Monthly Service Charge										$64.00	$64	$768
Gas Regulatory Cost Charge										0.271%	$126	$1,515
Process Heating												
Non-Potable Water Heating for Screening, gpd	500	0.09	100	24	60	63,418,750	1,020	62,175	$0.9995		$5,179	$62,146

Space Heating

		Area (sf)	Ave Annual Heating Temp Delta (oF)	Insulation R-Value (Hr F sf)/BTU	Ventilation Rate (CFM)	Heating Mechanical Efficiency (Percent)	Hours Per Day	Annual Heating Load (Btu*10^6/y	Natural Gas Cost ($/100 std cf)	Gas eating Value (Btu/std cf)	Monthly Cost ($/mo)	Annual Cost ($/yr)
Headworks												
Headworks Building - Assume Eve Clear, ft	16											
Conductive Heat Loss												
Walls		8,160	29	25		60		138	$0.9995	1,020	$113	$1,354
Roof -estimate		13,500	29	25		60		229	$0.9995	1,020	$187	$2,240
Ventilation Heat Loss												
12 AC per Hour (Class I, DIV II Space)	12		29		43,200	60	8	4,351	$0.9995	1,020	$3,553	$42,639
12 AC per Hour (Class I, DIV II Space)	6		29		21,600	60	16	4,351	$0.9995	1,020	$3,553	$42,639
Primary Clarifier Enclosures												
Basin Enclosure Ave Height, ft	16											
Conductive Heat Loss												
Dome Enclosure, 3 each 60' Clarifiers		16,965	29	25		60		287	$0.9995	1,020	$235	$2,815
Ventilation Heat Loss												
12 AC per Hour (Class I, DIV II Space)	12		29		27,130	60	8	4,554	$0.9995	1,020	$3,719	$44,628
6 AC per Hour (Class I, DIV II Space)	6		29		13,565	60	16	4,554	$0.9995	1,020	$3,719	$44,628
Primary Pump Building												
Pump Vault - clear height, ft	16											
Conductive Heat Loss												
Walls		3840	29	25		60		65	$0.9995	1,020	$53	$637
Roof -estimate		3,600	29	25		60		61	$0.9995	1,020	$50	$597
Ventilation Heat Loss												
Operation Area, AC/hr	2		29		1,920	60	24	967	$0.9995	1,020	$790	$9,475

MBR Building													
MBR Building - Assume Eve Clear, ft	16												
Conductive Heat Loss													
Walls		14,720	29	25		60		249	$0.9995	1,020	$204	$2,443	
Roof -estimate		42,900	29	25		60		727	$0.9995	1,020	$593	$7,120	
Ventilation Heat Loss													
Operation Area at 2 AC/hr	2		29		22,880	60	24	11,523	$0.9995	1,020	$9,409	$112,913	
Septage Receiving Building													
Septage Receiving Building - Assume Eve Clear, ft	16												
Conductive Heat Loss													
Walls		3,520	29	25		60		60	$0.9995	1,020	$49	$584	
Roof -estimate		2,625	29	25		60		44	$0.9995	1,020	$36	$436	
Ventilation Heat Loss													
12 AC per Hour (Class I, DIV II Space)	12		29		8,400	60	8	1,410	$0.9995	1,020	$1,152	$13,818	
12 AC per Hour (Class I, DIV II Space)	6		29		4,200	60	16	1,410	$0.9995	1,020	$1,152	$13,818	
Residuals Building													
Residuals Building - Assume Eve Clear, ft	16												
Conductive Heat Loss													
Walls		4,800	29	25		60		81	$0.9995	1,020	$66	$797	
Roof -estimate		5,000	29	25		60		85	$0.9995	1,020	$69	$830	
Ventilation Heat Loss													
12 AC per Hour (Class I, DIV II Space)	12		29		16,000	60	24	8,058	$0.9995	1,020	$6,580	$78,960	
6 AC per Hour (Class I, DIV II Space)	6		29		8,000	60	24	4,029	$0.9995	1,020	$3,290	$39,480	
Administration Building													
Administration Building Assume Eve Clear, ft	9												
Conductive Heat Loss													
Walls		2,790	33	25		60		54	$0.9995	1,020	$44	$527	
Roof -estimate		6,000	33	25		60		116	$0.9995	1,020	$94	$1,133	
Ventilation Heat Loss													
Operation Area at 2 AC/hr	2		33		1,800	60	24	1,032	$0.9995	1,020	$842	$10,108	
Equipment Storage Building													
Equipment Storage Building - Assume Eve Clear, ft	16												
Conductive Heat Loss													
Walls		6,080	24	25		60		85	$0.9995	1,020	$116	$1,392	
Roof -estimate		8,400	24	25		60		118	$0.9995	1,020	$160	$1,923	
Ventilation Heat Loss													
Operation Area at 2 AC/hr	2		24		4,480	60	24	1,120	$0.9995	1,020	$1,525	$18,297	$1,325,115

Consumables	Quantity (1/yr)	Units	Unit Cost w/out Shippin ($/ea)	Estimated Weight (lbs/ea)	Shipping Cost ($/lb)	Cost Escalation Rate (%)	Capital Recovery Factor	Monthly Cost ($/mo)	Annual Cost ($/yr)
Headworks									
Screw Pump Bearings and Seals	0.2	ea	$500	5	$1.40	5	0.230975	$10	$117
Screw Pump Lube Oil	4	ea	$375	150	$1.40	$5	4.124238	$195	$2,340
Replacement Brushes for Raw Sewage Screens	0.333333	ea	$2,000	75	$1.40	$5	0.367209	$64	$773
Pump Seals and Bearings	1	ea	$300	10	$1.40	$5	1.05	$26	$314
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	$5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$1,755	88	$1.40	$5	0.537805	$84	$1,010
Major Equipment Amortization									
Raw Sewage Screens	0.033333	ea	$600,000	7500	$1.40	$5	0.065051	$3,309	$39,714
Grit Pumps	0.07	ea	$32,000	500	$1.40	$5	0.096342	$263	$3,150
Gate Actuators	0.07	ea	$20,000	400	$1.40	$5	0.096342	$165	$1,981
Composite Sampler	0.1	ea	$25,000	250	$1.40	$5	0.129505	$274	$3,283
Primary Clarifiers									
Lube Oil for Clarifier Scraper Drives	4	ea	$225	90	$1.40	$5	4.124238	$117	$1,404
Building Interior Lighting Replacement	0.5	ea	$1,102	110	$1.40	$5	0.537805	$56	$676
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	$5	1.05	$19	$228
Major Equipment Amortization									
Clarifier Scraper Equipment	0.033333	ea	$450,000	15000	$1.40	$5	0.065051	$2,553	$30,639
Gate Actuators	0.07	ea	$15,000	300	$1.40	$5	0.096342	$124	$1,486
Primary Pump Building									
Pump Seals and Bearings	1	ea	$1,200	16	$1.40	$5	1.05	$102	$1,222
Valve Maintenance	1	ea	$1,200	80	$1.40	$5	1.05	$109	$1,312
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	$5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$468	47	$1.40	$5	0.537805	$24	$287
Major Equipment Amortization									
Pumps									
Primary Sludge Pumps	0.066667	ea	$72,000	3600	$1.40	$5	0.096342	$619	$7,422
Primary Scum Pumps	0.066667	ea	$84,000	3600	$1.40	$5	0.096342	$715	$8,578
Primary Basin Drain Pumps	0.066667	ea	$36,000	2400	$1.40	$5	0.096342	$316	$3,792
Valve Actuators	0.1	ea	$40,000	600	$1.40	$5	0.129505	$441	$5,289
Secondary Treatment									
Aeration Blower Lube Oil	4	ea	$750	300	$1.40	$5	4.124238	$390	$4,680
Aeration Blower Intake Filters	4	ea	$1,000	200	$1.40	$5	4.124238	$427	$5,120
Soda Ash for Supplemental Alkalinity	1	ea	$91,323	365,292	$0.08	$5	1.05	$10,046	$120,546
Pump Seals and Bearings	1	ea	$2,850	38	$1.40	$5	1.05	$242	$2,903
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	$5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$5,577	1408	$1.40	$5	0.537805	$338	$4,059
Major Equipment Amortization									
Blowers	0.05	ea	$800,000	30000	$1.40	$5	0.080243	$5,630	$67,564
Diffusers	0.1	ea	$300,000	4500	$1.40	$5	0.129505	$3,306	$39,667
Anoxic Mixers	0.05	ea	$90,000	1800	$1.40	$5	0.080243	$619	$7,424
MBR Membranes	0.2	ea	$2,090,000	24000	$1.40	$5	0.230975	$40,875	$490,498
Gate Actuators	0.07	ea	$45,000	600	$1.40	$5	0.096342	$368	$4,416
Valve Actuators	0.1	ea	$100,000	225	$1.40	$5	0.129505	$1,083	$12,991
Pumps									
ML Recycle Pumps	0.05	ea	$56,000	4500	$1.40	$5	0.080243	$417	$4,999
WAS Pumps	0.05	ea	$40,000	4500	$1.40	$5	0.080243	$310	$3,715
Secondary Scum Pumps	0.05	ea	$48,000	4500	$1.40	$5	0.080243	$363	$4,357
Secondary Basins' Drain Pumps	0.05	ea	$40,000	4500	$1.40	$5	0.080243	$310	$3,715
MBR Backpulse Pumps	0.05	ea	$32,000	4500	$1.40	$5	0.080243	$256	$3,073
MBR Filtrate Pumps	0.05	ea	$108,000	4500	$1.40	$5	0.080243	$764	$9,172
MBR CIP Hypochlorite Pumps	0.05	ea	$10,000	4500	$1.40	$5	0.080243	$109	$1,308
MBR Instrument Air Compressor	0.05	ea	$10,000	4500	$1.40	$5	0.080243	$109	$1,308
W2 Non-Potable Water Pumps	0.05	ea	$48,000	4500	$1.40	$5	0.080243	$363	$4,357

UV Disinfection									
Replacement UV Lamps	1	ea	$19,500	112.5	$0.08	$5	1.05	$1,626	$19,509
UV Lamp Cleaning Chemical	3	gal	$17	16	$0.08	$5	3.099458	$5	$55
Major Equipment Amortization									
UV Lamp Assemblies	0.04	ea	$120,000	500	$0.08	$5	0.070952	$710	$8,517
Composite Sampler	0.1	ea	$25,000	250	$1.40	$5	0.129505	$274	$3,283
Anaerobic Digestion									
Major Equipment Amortization									
Digester Mixing Equipment	0.05	ea	360000	6000	$1.40	$5	0.080243	$2,463	$29,561
Process Valves	0.066667	ea	24000	3600	$1.40	$5	0.096342	$233	$2,798
Valve Actuators	0.1	ea	$60,000	900	$1.40	$5	0.129505	$661	$7,933
Residuals Building									
Blower Lube	4	ea	$150	60	$1.40	$5	4.124238	$78	$936
Blower Filters	4	ea	$200	40	$1.40	$5	4.124238	$85	$1,024
Polyelectrolyte for Sludge Conditioning	1	ea	275000	100000	$0.25	$5	1.05	$25,000	$300,000
Pump Seals and Bearings	1	ea	$1,050	14	$1.40	$5	1.05	$89	$1,070
Valve Maintenance	1	ea	$1,350	90	$1.40	$5	1.05	$123	$1,476
Belt Filter Press Belts	0.5	ea	1500	100	$1.40	$5	0.537805	$74	$882
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	$5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$650	65	$1.40	$5	0.537805	$33	$399
Major Equipment Amortization									
Pumps									
Digester Pumps	0.05	ea	$40,000	3000	$1.40	$5	0.080243	$296	$3,547
Digester Blowers	0.05	ea	$40,000	3000	$1.40	$5	0.080243	$296	$3,547
Biogas Compressor	0.05	ea	$20,000	1500	$1.40	$5	0.080243	$148	$1,773
TWAS Pumps	0.05	ea	$40,000	3000	$1.40	$5	0.080243	$296	$3,547
Poly Pumps	0.05	ea	$40,000	3000	$1.40	$5	0.080243	$296	$3,547
Valve Actuators	0.1	ea	$20,000	300	$1.40	$5	0.129505	$220	$2,644
Rotary Drum Thickeners	0.04	ea	300000	3000	$1.40	$5	0.070952	$1,799	$21,584
Belt Filter Presses	0.03	ea	400000	8000	$1.40	$5	0.065051	$2,229	$26,749
Septage Receiving									
Screen Drive Lube	4	ea	$150	60	$1.40	$5	4.124238	$78	$936
Thickener Equipment Lube	4	ea	$225	90	$1.40	$5	4.124238	$117	$1,404
Pump Seals and Bearings	1	ea	$900	12	$1.40	$5	1.05	$76	$917
Valve Maintenance	1	ea	$600	40	$1.40	$5	1.05	$55	$656
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	$5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$341	34	$1.40	$5	0.537805	$17	$209
Major Equipment Amortization									
Septage Mechanical Screens	0.033333	ea	400000	4000	$1.40	$5	0.065051	$2,199	$26,385
Thickened Septage Pumps	0.066667	ea	40000	1600	$1.40	$5	0.096342	$339	$4,069
Septage Scum Pumps	0.066667	ea	40000	1600	$1.40	$5	0.096342	$339	$4,069
Septage Thickener Equipment	0.04	ea	300000	4000	$1.40	$5	0.070952	$1,807	$21,683
Odor Control Media	0.1	ea	20000	1000	$1.40	$5	0.129505	$231	$2,771
Administration and Lab									
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	$5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$780	78	$1.40	$5	0.537805	$40	$478
Major Equipment Amortization									
Lab Equipment	0.1	ea	35000	500	$1.40	$5	0.129505	$385	$4,623
SCADA Equipment	0.1	ea	20000	250	$1.40	$5	0.129505	$220	$2,635
Equipment Building									
Heat and Ventilation Equipment Maintenance	1	ea	$200	20	$1.40	$5	1.05	$19	$228
Building Interior Lighting Replacement	0.5	ea	$109	109	$1.40	$5	0.537805	$12	$141
Grounds									
Yard Lighting Replacement	0.5	ea	$4,356	653	$1.40	$5	0.537805	$236	$2,835
Landscaping Equipment Replacement	0.25	ea	500	100	$1.40	$5	0.282012	$15	$180

Summary
Regional WWTP Operation and Maintenance
Membrane Bioreactor - 4.0 MGD ADF

Fuels and Vehicle Maintenance

	Vehicle Mile miles/yr	Gasoline Mile/gal	Gasoline Gal/yr	Gasoline $/gal	Motor Oil Qt/yr	Motor Oil $/Quart			
Gasoline	150	12	13	$3.40			$4	$43	
Motor Oil					16	$3.00	$4	$48	
Vehicle Insurance							$83	$1,000	
Vehicle License							$13	$150	
Vehicle Maintenance							$167	$2,000	$1,434,103

Services	Quantity (1/yr)	Units	Unit Cost ($/unit)	Monthly Cost ($/mo)	Annual Cost ($/yr)	
Screenings Disposal	912500	lbs	0.01	$760	$9,125	
Grit Disposal	365000	lbs	0.01	$304	$3,650	
Biosolids Disposal	2628000	lbs	0.01	$2,190	$26,280	
Internet Service	All Req'd	Lump Sum	$30	$30	$360	
Telephone Service	All Req'd	Lump Sum	$60	$60	$720	
Analytical Lab Services						
Weekly Influent TKN	52	ea	$60	$260	$3,120	
Weekly Effluent Ammonia	52	ea	$60	$260	$3,120	
Weekly Petroleum Hydrocarbons	52	ea	$250	$1,083	$13,000	
Whole Effluent Toxicity	0.6	ea	$1,800	$90	$1,080	$60,455

Conveyance Piping

Staff Costs

	Number of Staff	Hrs per Day	Base Hourly Pay $/Hr	Raw Salary $/yr	Benefits Package % of Base 25%	Monthly Cost ($/mo)	Annual Cost ($/yr)
Check/Maintain Lift Stations	1	6	$24.04	$50,000	$12,500	$5,484	$65,805
Vehicle Expenses	1	6	$5.00			$912.50	$10,950
Vactor Truck	1	0.09863	$500.00			$1,500.00	$18,000.00
Misc. Materials and Supplies	1			$5,000		$416.67	$5,000

Electricity Costs

	Energy Per Gal.	Energy Cost	Cost per Gal.	Initial Flow Rate (gal)	Ultimate Flow Rate (gal)	Years to Ultimate Flow	Monthly Cost ($/mo)	Annual Cost ($/yr)@4MGD	Annual Cost Increase ($/yr)
Wasilla Force Main #1	0.000414	$0.061322	$0.000025	350,000	2,500,000	20	$1,930.49	$23,165.92	$996.13
Wasilla Force Main #2	0.000333	$0.061322	$0.000020	350,000	2,500,000	20	$1,552.79	$18,633.46	$801.24
Wasilla Force Main #3	0.000167	$0.061322	$0.000010	350,000	2,500,000	20	$778.73	$9,344.71	$401.82
SWX Run #1	0.0006	$0.061322	$0.000037	350,000	2,500,000	20	$2,797.82	$33,573.80	$1,443.67
Reversed SWX Force Main	8.16E-05	$0.061322	$0.000005	350,000	1,500,000	20	$228.30	$2,739.62	$105.02
Subtotal							$15,601	$187,213	$3,748

Subtotal	$277,210	$3,326,521
Contingency of 20 percent	$55,442	$665,304
Total O&M	$332,652	**$3,991,825**

APPENDIX C

Population and Flow Forecasting

Data for population and flow forecasting was gathered from a variety of sources, including United States census data, State of Alaska population estimates, and various growth studies performed in recent years. Because the design year for this report goes beyond the scope of any previous projections, HDL developed several population models based on these sources. These models are intended to project the populations and flows that can be expected in the next fifty years. This data was presented to the Mat-Su Borough, Palmer and Wasilla in a technical review document and a consensus for design flow rates was determined to be 1.0 MGD for Wasilla short term improvements, 2.0 MGD for Palmer short term improvements, and 4.0 MGD for initial sizing of a Regional WWTP with expansion capacity to 8.0 MGD.

1.1 Population Projections

Initial population projections came from UAA's Institute of Social and Economic Research (ISER), which performed a study in 2005 on the impact of building a bridge across Knik Arm to connect the Mat-Su Borough to Anchorage. This study looked at six population growth scenarios by analyzing 84 separate parameters that affect the region's economy. The ISER study projects growth through the year 2030 assuming a low, base, and high scenario for a Knik Arm Bridge and no Knik Arm Bridge.

Growth rates after 2030 were based on current growth rates within the Municipality of Anchorage, as the land available in the Anchorage Bowl is nearly full, similar to the situation the Palmer-Wasilla area will be in after the current building boom. There will be less available land, thus increasing land values, and lowering building rates. Projected growth rates suggest that the study area will grow from the current estimated population of 29,000 to approximately 120,000 in the year 2059. The following two figures illustrate the projected growth in the Palmer-Wasilla area over the next 50 years:

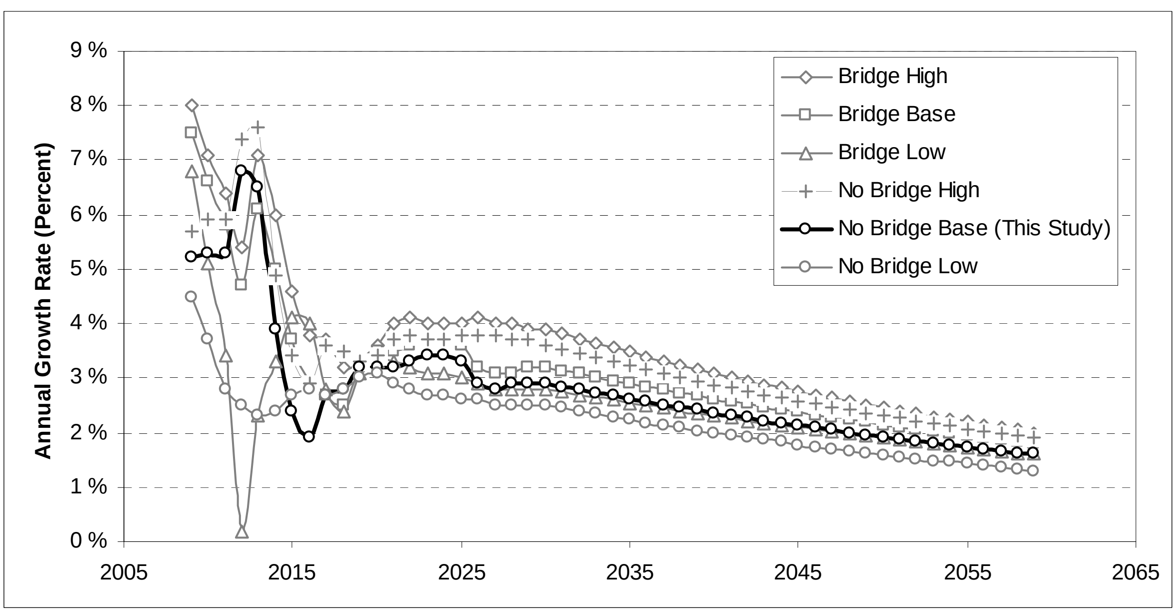


Figure C-1: Projected Growth Rates in the MSB

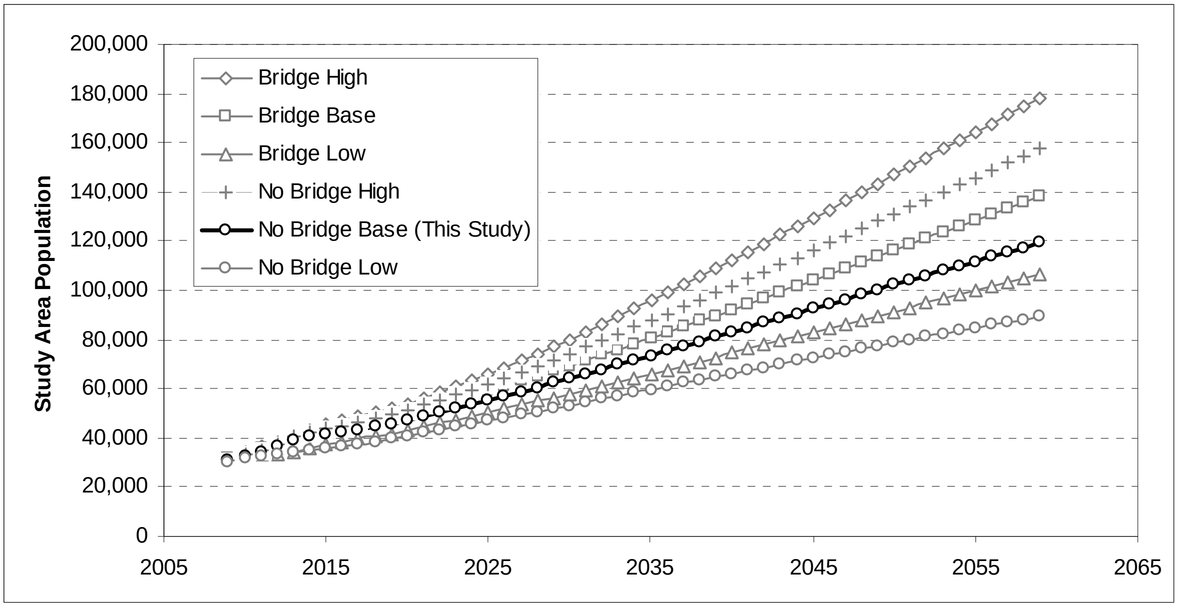


Figure C-2: Projected Population in the Palmer-Wasilla Area

To aid in prediction of septage production values, a projection of Mat-Su Borough total population was also conducted. Septage flows are discussed further in Section 1.3 of Appendix B.

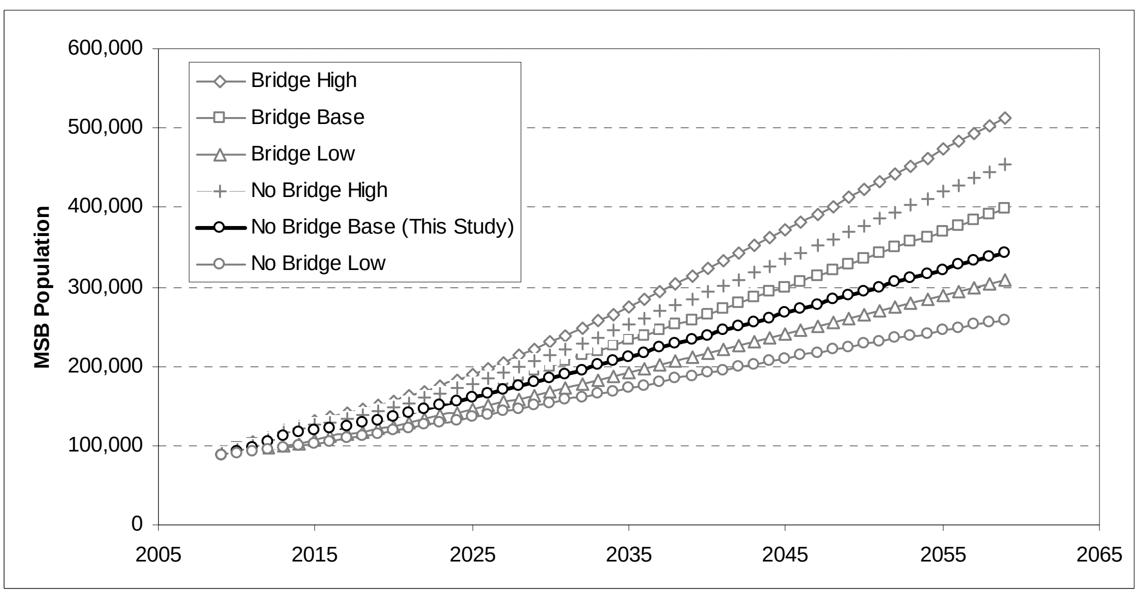


Figure C-3: Projected Population in the Matanuska-Susitna Borough

For the purposes of this study, we have used the “Base Case, No Knik Arm Bridge” as the “most likely” growth scenario for this report. This base case assumes that exploratory drilling in the Arctic National Wildlife Refuge (ANWR) will begin in 2010 and will result in a production rate of 400 million barrels per day by the year 2020; and that an Alaska Natural Gas Pipeline would be built on the highway route through Canada between 2012 and 2015. The “Low Case, No Knik

Arm Bridge" is also used as the low growth scenario in this study. It assumes that there is no drilling in ANWR, no gas pipeline, and lower growth rates in other sectors of the economy such as mining and tourism.

In addition to a population growth rate model, a land use model was generated to forecast wastewater flows from the anticipated ultimate build-out. This model identified commercial, educational, industrial, and residential lands that have been developed but not connected to the collection system, as well as lands that are anticipated to be developed. The projections anticipated that commercial growth corridors would develop along the arterial roads between Palmer and Wasilla, and in the current city centers of each town. Residential growth was anticipated to be developed in a similar manner to nearby developed parcels. Many portions of the build out projection have already been zoned and developed.

Residential lots were grouped into four categories: 10,000-square foot lots, 0.25 to 1-acre lots, 1 to 5-acre lots and lots larger than 5 acres. The average household was assumed to contain 2.9 persons[1]. Population and sewer flows from this model are discussed further in Section 1.2.2 of this Appendix.

1.2 Wastewater Flow Projections

1.2.1 Population Model Wastewater Flows

To more accurately predict wastewater flows within the Palmer and Wasilla service areas, they were broken into distinct zones, based on the most likely routes for service extensions, drainage areas, and population expansion. A map of the sewer collection zones is shown in Figure C-4.

Current populations were determined with the help of US census data and current State of Alaska Department of Community and Economic Development projections. This population growth model was then applied to the current populations and projected out to the year 2059. After populations had been projected out to 2059, a sewer build out schedule was applied to each zone estimating the percentage of people who will be connected to the system each year. This build out schedule is presented in Table C-1 below.

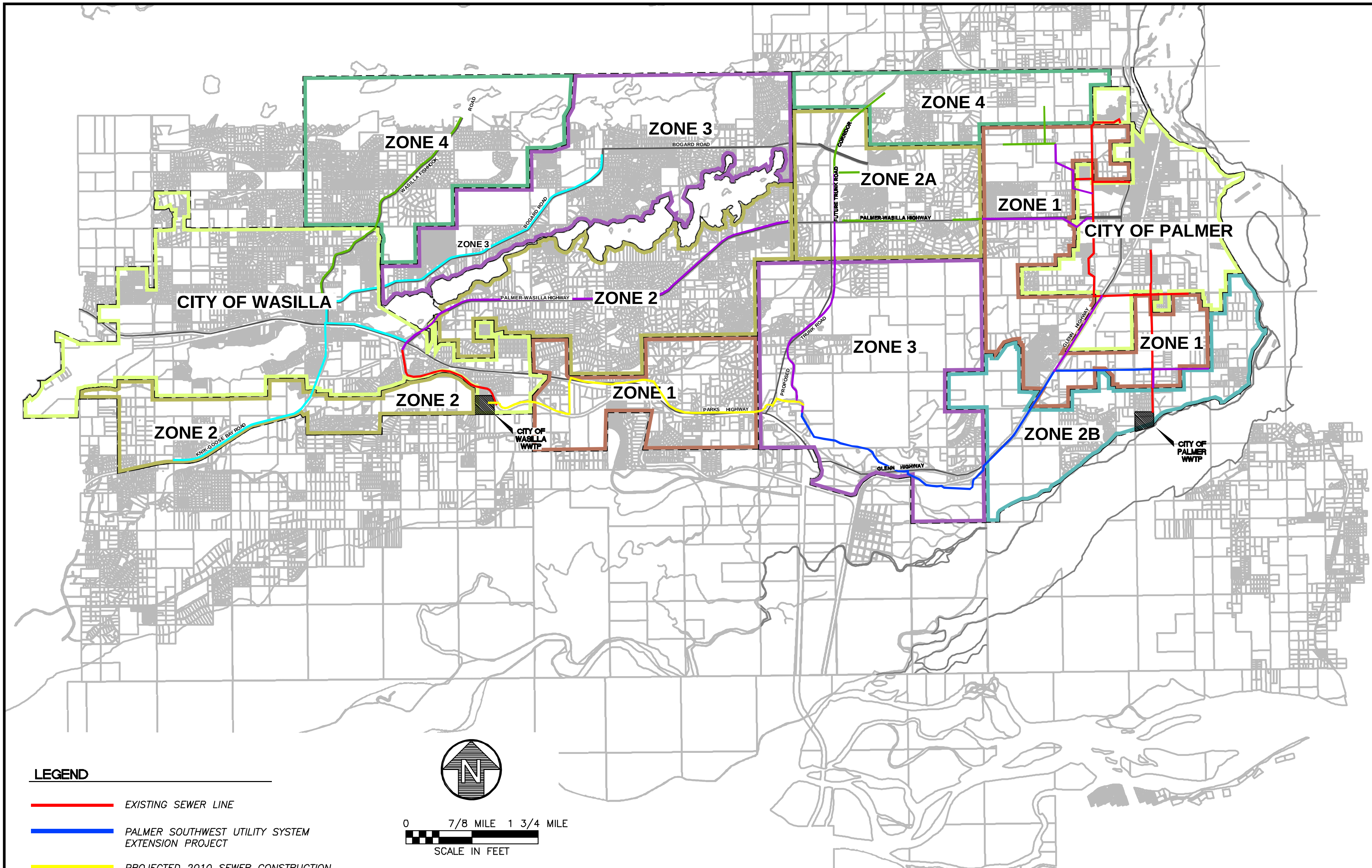
Assumptions. Flow projections based on population modeling rely on a number of key assumptions, including:

1. Wastewater flows in the City of Palmer will be phased in over time as the wastewater collection system is extended into new areas. It is assumed that the City of Palmer will keep up with its current facilities master plan, as laid out in the Southwest Utility Extension, Phase I Preliminary Engineering Report.
2. Wastewater flows in the City of Wasilla will follow a similar progression as the City of Palmer. Although there has not been an extensive study on how to provide service to the entire Wasilla Utility Service Area, in 1999 LCMF, Inc. developed a plan to provide a gravity sewer collection system which would serve a large portion of the service area. It is possible that this plan could be expanded upon to provide service to the entire service area. This study assumes that collection service will eventually be extended in this manner.

3. Average daily sewage flows for the population growth model are anticipated to be approximately 125 gallons per capita per day and include incidental industrial, commercial and educational flows.
4. "The Ranch Subdivision" will be connected to the wastewater collection system only if a regional wastewater treatment plant is built. Because portions of this subdivision have already been developed, it is assumed that only 2/3 of the ultimate projected population will be connected to the system[2].

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure C-4 Breakdown of Service Areas by Zone, 1=100, 06/08/10 at 09:36 by tlc
LAYOUT: Layout

XREF: 04016_00_XDENS, 04016_00_XLAKES, 04016_00_XLAND_OWN, 04016_00_XMAP, 04016_00_XOTHER



HATTENBURG DILLEY & LINNELL Engineering Consultants

GV Jones & Associates, Inc. WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
SEWER BUILDOUT SCHEDULE AND POPULATION ZONES

MATANUSKA-SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE C-4
SCALE:	1" = 1 3/4 MILE	CHECKED BY:	SLH	JOB NO.:	08-039

Table C-1, Percentage of population on public sewer

year	Palmer	P1	P2A	P2B	P3	P4	Wasilla	W1	W2	W3	W4
2007	90.0%	0.0%	0.0%	5.0%	2.0%	0.0%	35.0%	0.0%	0.0%	0.0%	0.0%
2008	91.0%	0.0%	0.0%	5.0%	2.0%	0.0%	35.0%	0.0%	0.0%	0.0%	0.0%
2009	92.0%	0.0%	0.0%	5.0%	2.0%	0.0%	35.0%	0.0%	0.0%	0.0%	0.0%
2010	93.0%	0.0%	0.0%	5.0%	2.0%	0.0%	38.0%	25.0%	0.0%	0.0%	0.0%
2011	94.0%	0.0%	0.0%	5.0%	2.0%	0.0%	41.0%	35.0%	0.0%	0.0%	0.0%
2012	95.0%	0.0%	0.0%	5.0%	2.0%	0.0%	44.0%	45.0%	0.0%	0.0%	0.0%
2013	96.0%	0.0%	0.0%	5.0%	2.0%	0.0%	47.0%	50.0%	0.0%	0.0%	0.0%
2014	97.0%	0.0%	0.0%	5.0%	2.0%	0.0%	50.0%	55.0%	0.0%	0.0%	0.0%
2015	98.0%	7.0%	4.0%	7.0%	9.0%	0.0%	55.0%	60.0%	15.0%	0.0%	0.0%
2016	98.0%	14.0%	8.0%	10.0%	16.0%	0.0%	60.0%	65.0%	20.0%	0.0%	0.0%
2017	99.0%	21.0%	12.0%	12.0%	23.0%	0.0%	65.0%	70.0%	25.0%	0.0%	0.0%
2018	99.0%	28.0%	16.0%	14.0%	30.0%	0.0%	70.0%	75.0%	30.0%	0.0%	0.0%
2019	100.0%	35.0%	20.0%	16.0%	35.0%	0.0%	75.0%	80.0%	35.0%	0.0%	0.0%
2020	100.0%	38.0%	25.0%	18.0%	40.0%	0.0%	80.0%	85.0%	40.0%	5.0%	0.0%
2021	100.0%	41.0%	27.0%	18.5%	41.0%	0.0%	82.0%	86.0%	45.0%	10.0%	0.0%
2022	100.0%	44.0%	29.0%	19.0%	42.0%	0.0%	84.0%	87.0%	50.0%	15.0%	0.0%
2023	100.0%	47.0%	31.0%	19.5%	43.0%	0.0%	86.0%	88.0%	53.0%	17.0%	0.0%
2024	100.0%	50.0%	33.0%	20.0%	44.0%	0.0%	88.0%	89.0%	56.0%	19.0%	0.0%
2025	100.0%	53.0%	35.0%	20.5%	45.0%	0.0%	90.0%	90.0%	59.0%	21.0%	0.0%
2026	100.0%	56.0%	37.0%	21.0%	46.0%	0.0%	92.0%	91.0%	62.0%	23.0%	0.0%
2027	100.0%	59.0%	39.0%	21.5%	47.0%	0.0%	93.0%	92.0%	65.0%	25.0%	0.0%
2028	100.0%	62.0%	41.0%	22.0%	48.0%	0.0%	94.0%	93.0%	68.0%	27.0%	0.0%
2029	100.0%	65.0%	43.0%	22.5%	49.0%	0.0%	95.0%	94.0%	71.0%	29.0%	0.0%
2030	100.0%	68.0%	49.0%	23.0%	50.0%	2.0%	96.0%	95.0%	73.0%	30.0%	2.0%
2031	100.0%	71.0%	55.0%	23.5%	51.0%	4.0%	97.0%	96.0%	75.0%	31.0%	4.0%
2032	100.0%	74.0%	61.0%	24.0%	52.0%	6.0%	98.0%	97.0%	76.0%	32.0%	6.0%
2033	100.0%	77.0%	67.0%	24.5%	53.0%	8.0%	99.0%	98.0%	77.0%	33.0%	8.0%
2034	100.0%	80.0%	70.0%	25.0%	54.0%	10.0%	100.0%	99.0%	78.0%	34.0%	10.0%
2035	100.0%	83.0%	73.0%	25.5%	55.0%	10.0%	100.0%	100.0%	79.0%	35.0%	12.0%
2036	100.0%	86.0%	76.0%	27.0%	56.0%	10.0%	100.0%	100.0%	80.0%	36.0%	14.0%
2037	100.0%	89.0%	79.0%	28.5%	57.0%	10.0%	100.0%	100.0%	81.0%	37.0%	16.0%
2038	100.0%	90.0%	82.0%	30.0%	58.0%	10.0%	100.0%	100.0%	82.0%	38.0%	18.0%
2039	100.0%	91.0%	85.0%	31.5%	59.0%	10.0%	100.0%	100.0%	83.0%	39.0%	20.0%
2040	100.0%	92.0%	88.0%	33.0%	60.0%	10.0%	100.0%	100.0%	84.0%	40.0%	20.5%
2041	100.0%	93.0%	90.0%	34.5%	61.0%	10.0%	100.0%	100.0%	85.0%	40.5%	21.0%
2042	100.0%	94.0%	92.0%	36.0%	62.0%	10.0%	100.0%	100.0%	86.0%	41.0%	21.5%
2043	100.0%	95.0%	94.0%	37.5%	63.0%	10.0%	100.0%	100.0%	87.0%	41.5%	22.0%
2044	100.0%	96.0%	95.0%	39.0%	64.0%	10.0%	100.0%	100.0%	88.0%	42.0%	22.5%
2045	100.0%	97.0%	96.0%	40.5%	65.0%	10.0%	100.0%	100.0%	89.0%	42.5%	23.0%
2046	100.0%	98.0%	97.0%	42.0%	66.0%	10.0%	100.0%	100.0%	90.0%	43.0%	23.5%
2047	100.0%	99.0%	98.0%	43.5%	67.0%	10.0%	100.0%	100.0%	90.0%	43.5%	24.0%
2048	100.0%	100.0%	99.0%	45.0%	68.0%	10.0%	100.0%	100.0%	90.0%	44.0%	24.5%
2049	100.0%	100.0%	100.0%	46.5%	69.0%	10.0%	100.0%	100.0%	90.0%	44.5%	25.0%
2050	100.0%	100.0%	100.0%	48.0%	70.0%	10.0%	100.0%	100.0%	90.0%	45.0%	25.0%

2051	100.0%	100.0%	100.0%	49.5%	71.0%	10.0%	100.0%	100.0%	90.0%	45.5%	25.0%
2052	100.0%	100.0%	100.0%	51.0%	72.0%	10.0%	100.0%	100.0%	90.0%	46.0%	25.0%
2053	100.0%	100.0%	100.0%	52.5%	73.0%	10.0%	100.0%	100.0%	90.0%	46.5%	25.0%
2054	100.0%	100.0%	100.0%	54.0%	74.0%	10.0%	100.0%	100.0%	90.0%	47.0%	25.0%
2055	100.0%	100.0%	100.0%	55.5%	75.0%	10.0%	100.0%	100.0%	90.0%	47.5%	25.0%
2056	100.0%	100.0%	100.0%	57.0%	76.0%	10.0%	100.0%	100.0%	90.0%	48.0%	25.0%
2057	100.0%	100.0%	100.0%	58.5%	77.0%	10.0%	100.0%	100.0%	90.0%	48.5%	25.0%
2058	100.0%	100.0%	100.0%	60.0%	78.0%	10.0%	100.0%	100.0%	90.0%	49.0%	25.0%
2059	100.0%	100.0%	100.0%	61.5%	79.0%	10.0%	100.0%	100.0%	90.0%	49.5%	25.0%

To arrive at the forecast wastewater flows, we multiply the forecast population times the percent of population sewered times the average per capita flow rate of 125 gallons per capita per day. Figures C-5 through C-7 show the estimated future flows of wastewater in millions of gallons per day for the two population models used in this report, as well as a "Base Case, No Further Expansion" scenario.

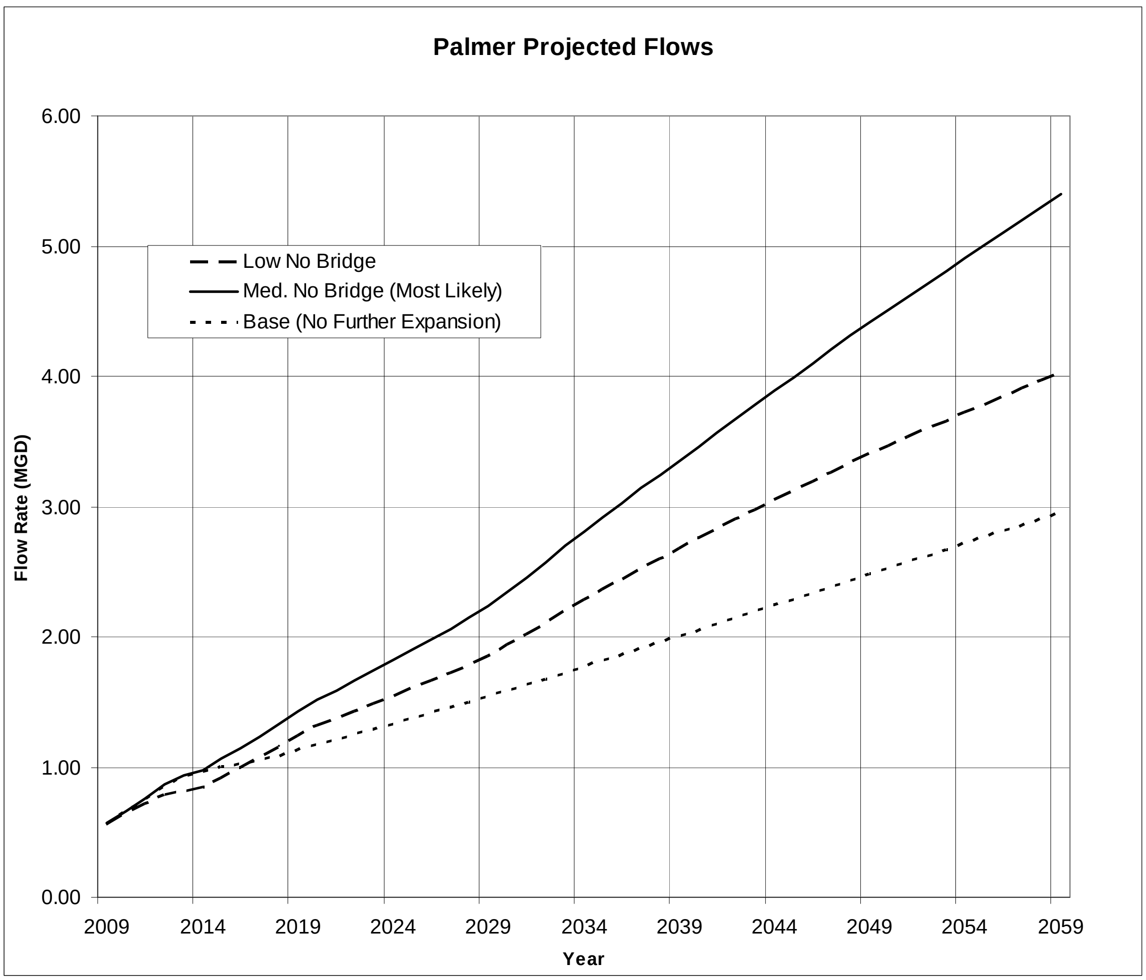


Figure C-5: Projected Flow Contributions from Palmer Service Area

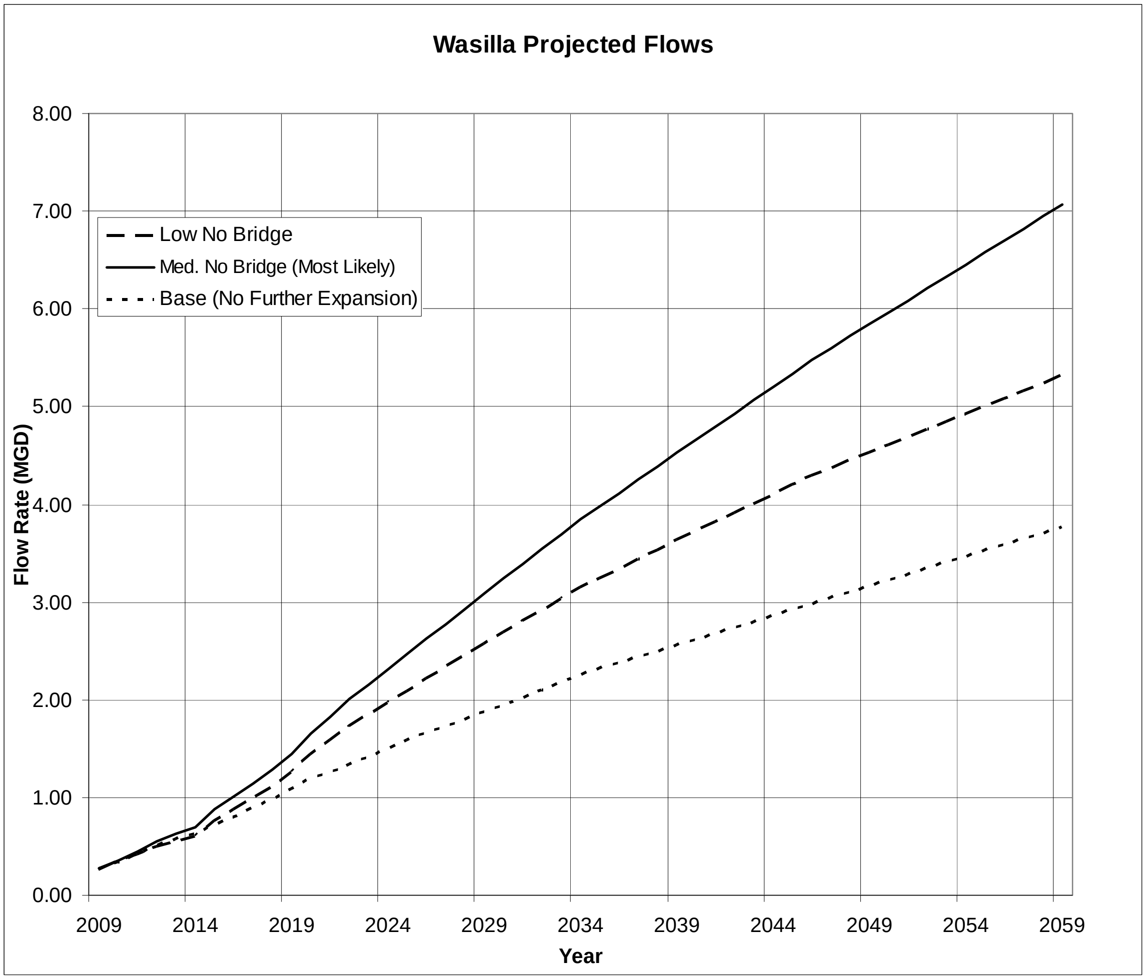


Figure C-6: Projected Flow Contributions from Wasilla Service Area

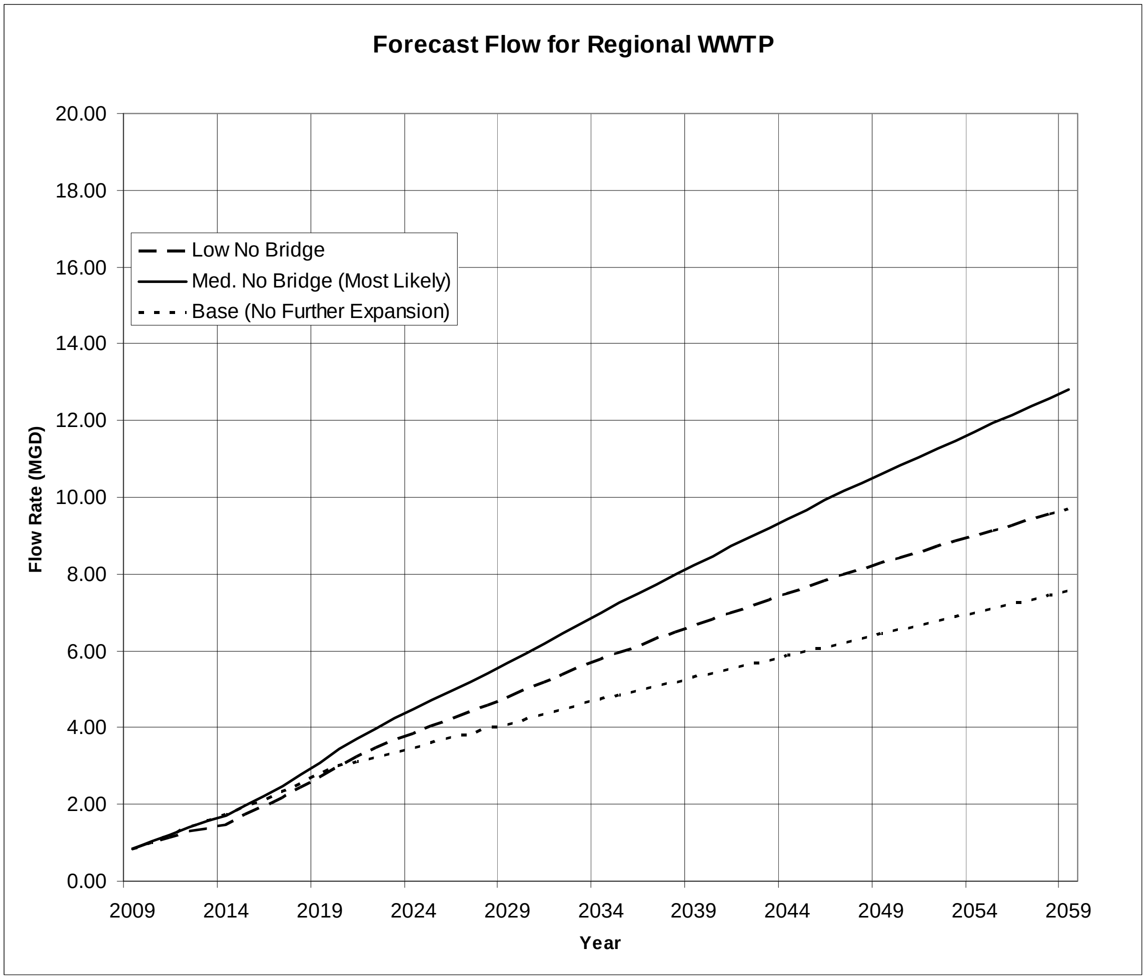


Figure C-7: Projected Flow Contributions from Combined Service Areas

1.2.2 Land Use Model Flows

The second model developed for determining projected flow rates within the study area was the land use model. This model utilized a map of projected ultimate build-out, developed by HDL. In order to determine the usage for each land area, current zoning maps, comprehensive plans, projected development plans, and current land usage maps were studied. Data from these maps was compiled into the ultimate land use map shown in Figure C-8.

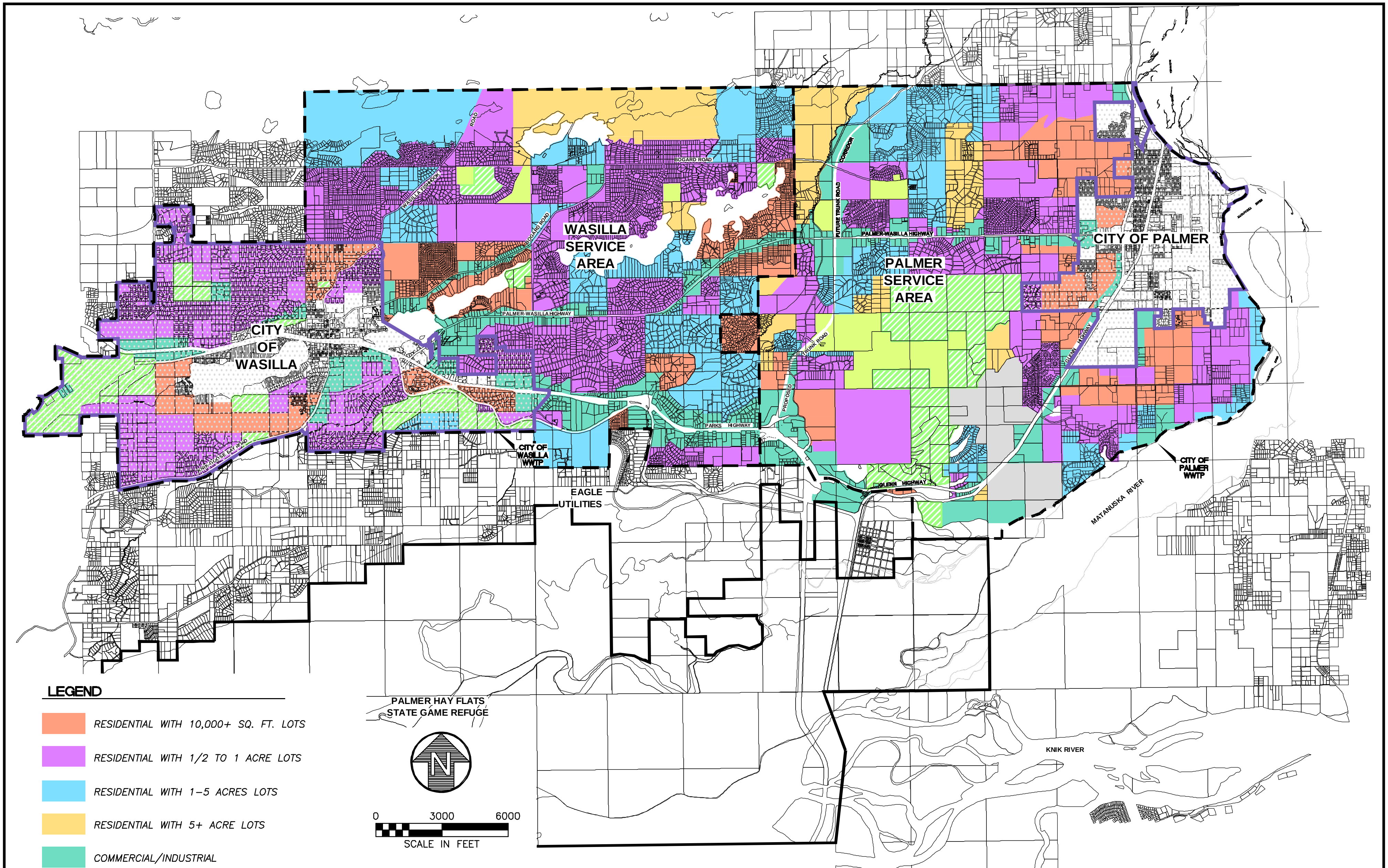
Assumptions. Flow projections based on the land use model rely on a number of key assumptions including:

1. Wastewater flows will increase in a linear manner, meaning that flow will increase at a steady rate every year during the projection.

2. The area being studied will be 100% developed by the year 2059, and connection rates will be as illustrated in the table below. Wastewater flow rates will be 125 gallons per capita per day.

H:\jobs\08-039 Regional Wastewater Septage Study (MSB)\CAD\Drawings\Report Figures\Figure C-8 Ultimate Buildout Map, 1=100, 06/08/10 at 09:37 by tlc
LAYOUT: Layout

XREF: 04016_00_XDENS, 04016_00_XLAKES, 04016_00_XLAND_OWN, 04016_00_XMAP, 04016_00_XOTHER



HATTENBURG DILLEY & LINNELL
Engineering Consultants

GV Jones & Associates, Inc.
WATER AND WASTEWATER PROCESS ENGINEERS

HDR ALASKA

MSB REGIONAL WASTEWATER/SEPTAGE STUDY
ULTIMATE LAND USE MAP

MATANUSKA-SUSITNA BOROUGH, ALASKA

DATE:	JULY, 2010	DRAWN BY:	CJB	SHEET:	FIGURE C-8
SCALE:	1" = 1 3/4 MILE'	CHECKED BY:	SLH	JOB NO.:	08-039

Table C-2: Projected Residential Area in the Study Area in 2059

Lot Size by Category	Buildable Acreage	Development	Density (people/acre)	Percent Sewered	Population Sewered
~ 10,000 ft^2	4,367	100%	11.8	100%	55,169
0.5 to 1 acres	13,069	100%	3.6	80%	40,426
1 to 5 acres	6,448	100%	1.0	23%	1,433
>5 acres	2,842	100%	0.36	0%	0
Total					97,028

3. Commercial and industrial lands will contribute wastewater at 900 gallons per acre per day. 100 percent of the 3,989 commercial/industrial acres will be connected to the sewer collection system by the year 2059.

4. Educational wastewater flows were calculated based on the following table:

Table C-3: Educational Flows by Institution

Type of Institution	Number of Schools	Number of Students	Flow per Student*	Total Flow (GPD)
Elementary School	11	350	20	77,000
Middle School	4	700	25	70,000
High School	2	2000	30	120,000
Mat-Su College	1	5000	15	75,000

*Wastewater Engineering: Treatment and Reuse, Fourth Edition; Metcalf and Eddy

5. Flows from "The Ranch Subdivision" will only be added to the regional wastewater flows. These flows are expected to be approximately 0.35 MGD at ultimate buildout and will be phased in over 5-10 years, beginning in about 2013[2].

Flows were calculated based on the assumptions above. The following graph illustrates the projected flow rate increases over the next fifty years.

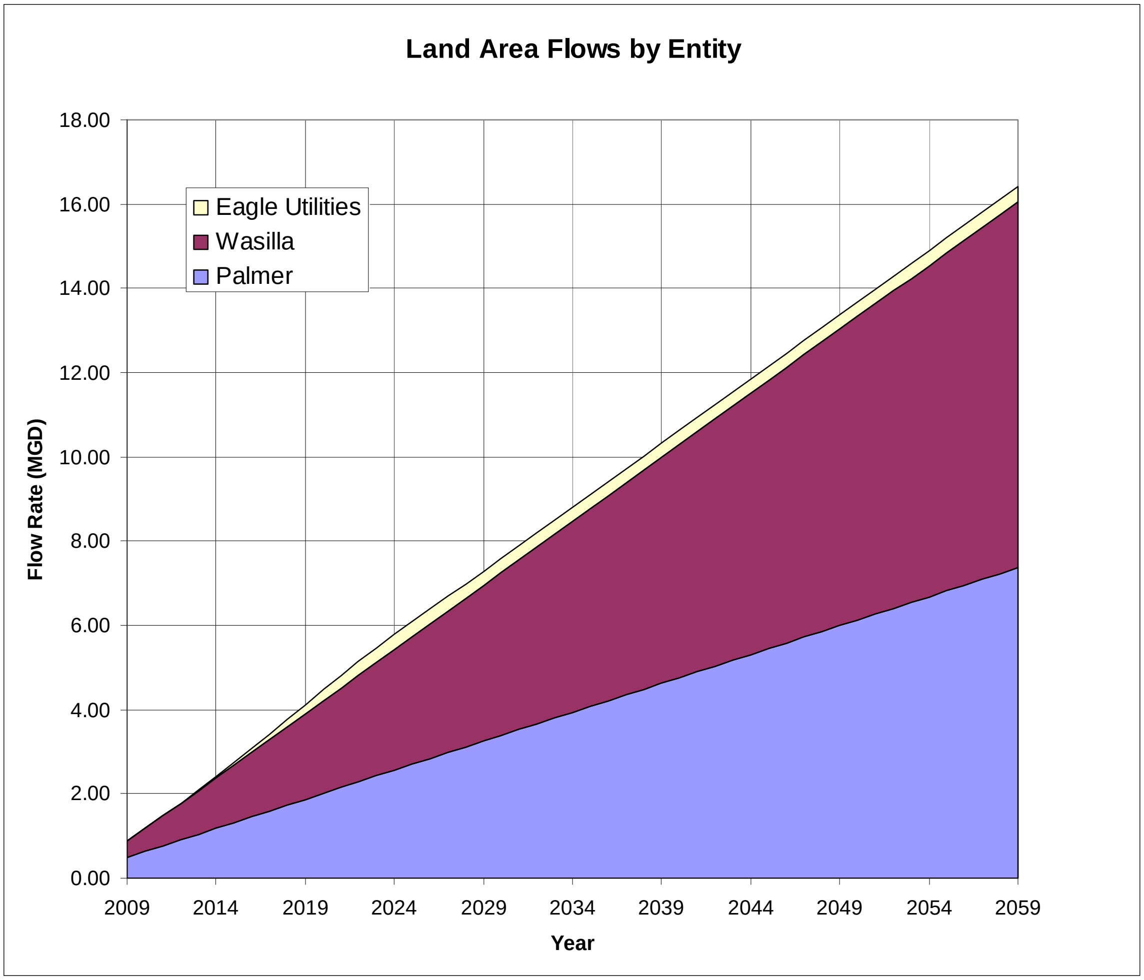


Figure C-9: Projected Flow Contributions by Entity (Land Use Model)

1.2.3 Combined Models

The two models presented above were combined to form the final projections which infrastructure improvements will be based on. Four separate flow rates are used to determine a High, Low, Base, and Most Likely flow rate. The anticipated flow rate used for projections will be the "Most Likely" rate. Two are used as a reference, giving a potential minimum and maximum design life for the system. The base curve shows projected flow rates within the system if a minimum of expansion were to occur. The flows which will be used are as follows:

- High Flow: Land Use Model
- Most Likely Flow: Population Model, Medium Growth, Without Bridge
- Low Flow: Population Model, Low Growth, Without Bridge
- Base Flow: Population Model, Medium Growth, Without Bridge, No service extensions

The following graphs illustrate the four cases which have been used in the study report for each respective entity; the range between years for each entity's respective design capacity is shown as a reference:

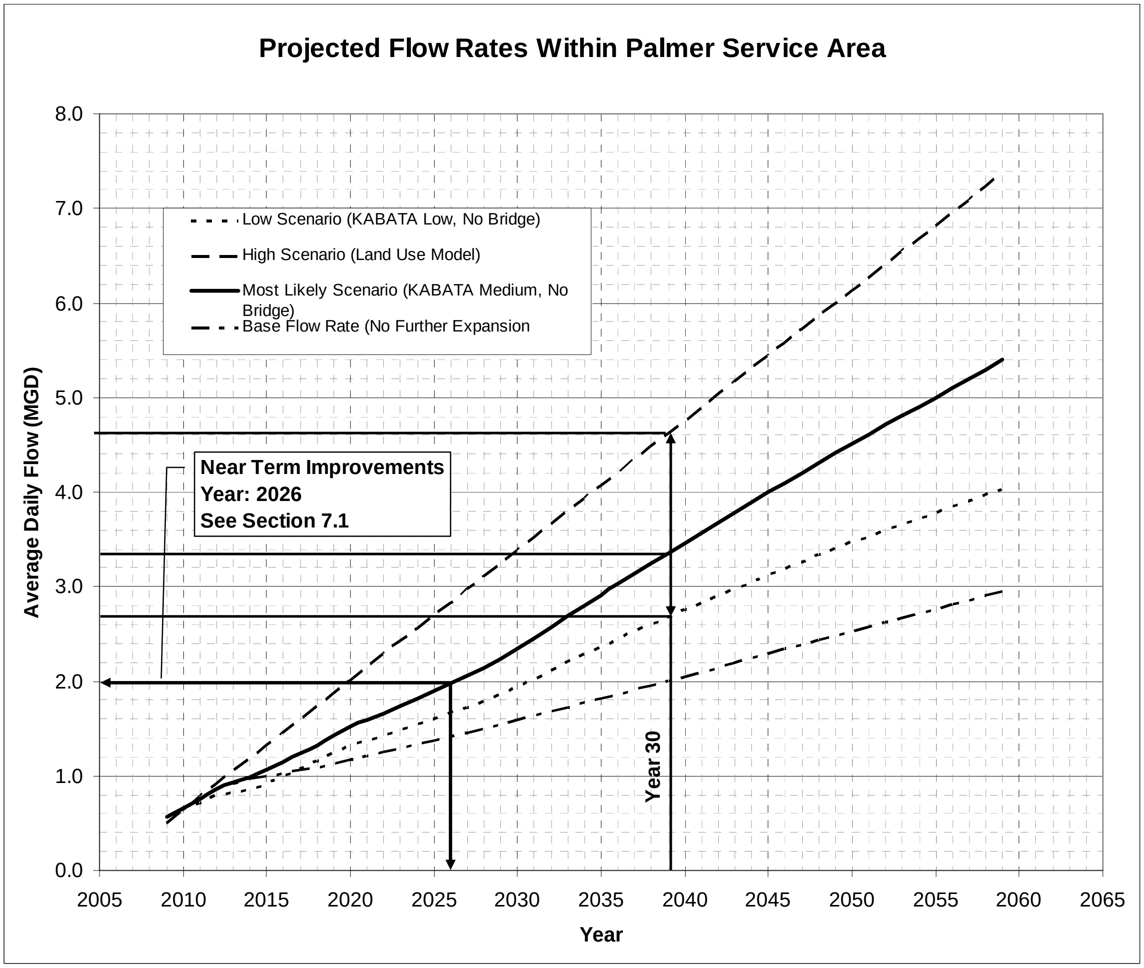


Figure C-10: Combined Model Flow Rates, Palmer

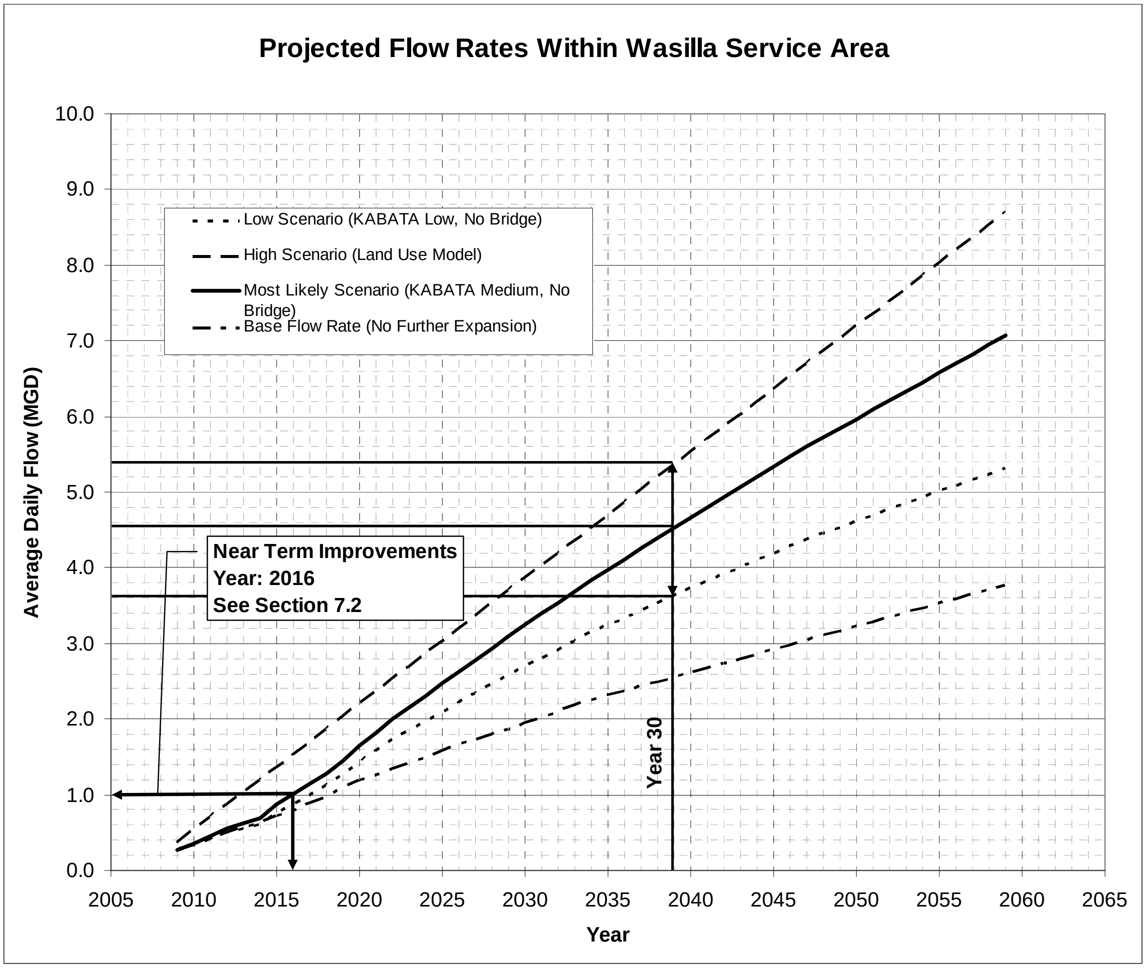


Figure C-11: Combined Model Flow Rates, Wasilla

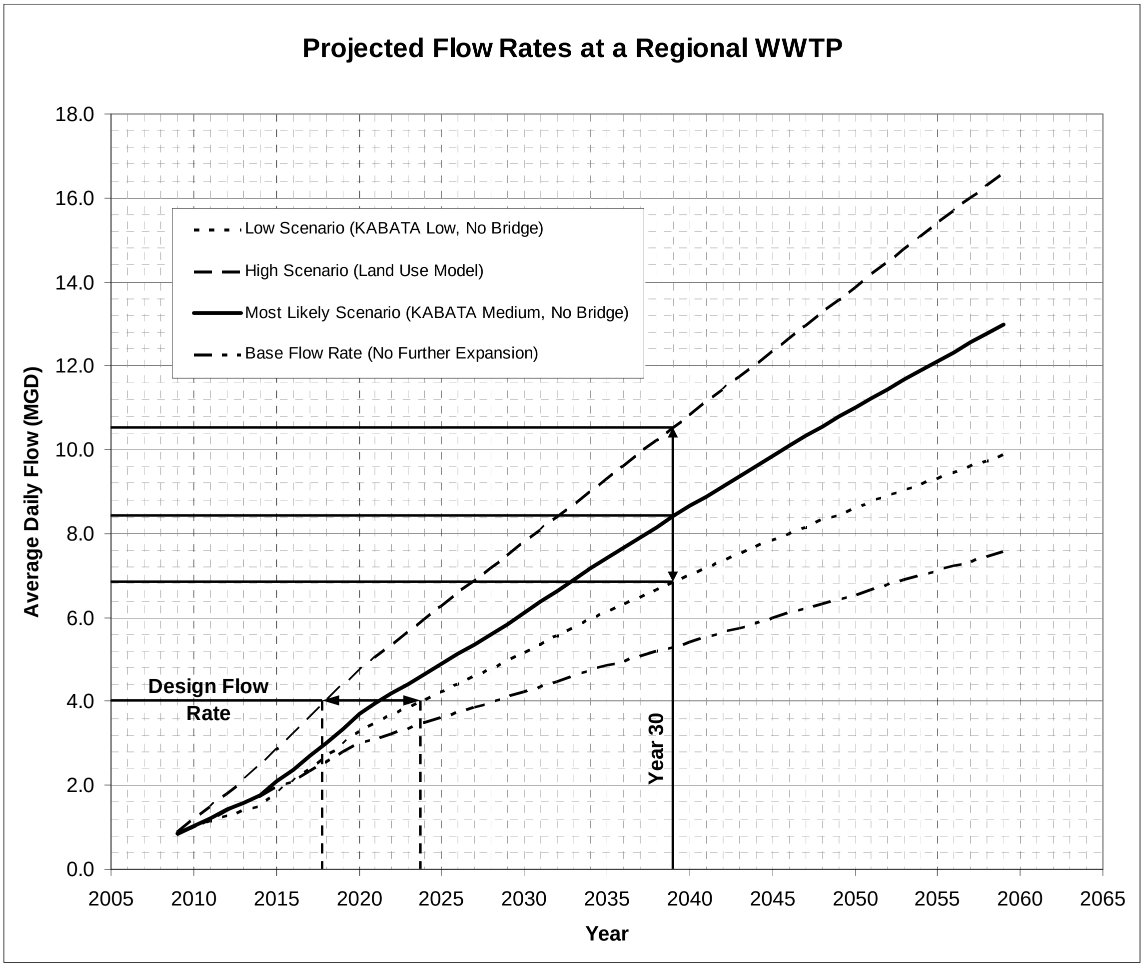


Figure C-12: Combined Model Flow Rates, Regional WWTP

Future wastewater flows will depend on a number of factors including actual population growth, economic growth of the Alaska and regional economy, the timing of residential and commercial development, the timing of utility extensions, septic system failure rates, groundwater quality issues and availability of funding for various infrastructure improvements. These factors can not be known at the time, however, a reasonable estimate for planning future plant improvements can be made by establishing the high and low cases and realizing that the actual flows will likely range in between the two values.

1.3 Septage Flows

Projections for septage quantities were largely based on the MSB Septage Handling and Disposal report compiled by HDR Alaska in 2007. Only a population model was used in this projection, as developing a land use model for the entire Borough would be unrealistic. There are currently three active wastewater treatment plants in the Borough, (Palmer, Wasilla, and Talkeetna) so customers who are currently served, or are included in the sewer buildout projections were subtracted from the overall septage numbers. It is also assumed that 9% of homes constructed will have pit privies[3].

The process of determining the average daily septage flows is done in the following manner:

1. Subtract population of MSB served by sewer from total MSB population
2. Subtract population of MSB with pit privies from MSB population not on sewer
3. Divide population of MSB served by septic by average household size of 2.9 people
4. Multiply number of households by average septic tank size
5. Multiply gallons of septage by frequency of septic tank pumping (60% every year) to determine amount of septage produced yearly
6. Divide by 365 to determine average daily septage production

It is also assumed that septic tank pumping is more frequent in the summer than in the winter. On average, the pumping rate in the summer is three times what it is in the winter. The peak flows were calculated as the highest flow anticipated in the summer. The following graph illustrates the peak summer flow rates which can be expected as the Borough grows for the next 50 years:

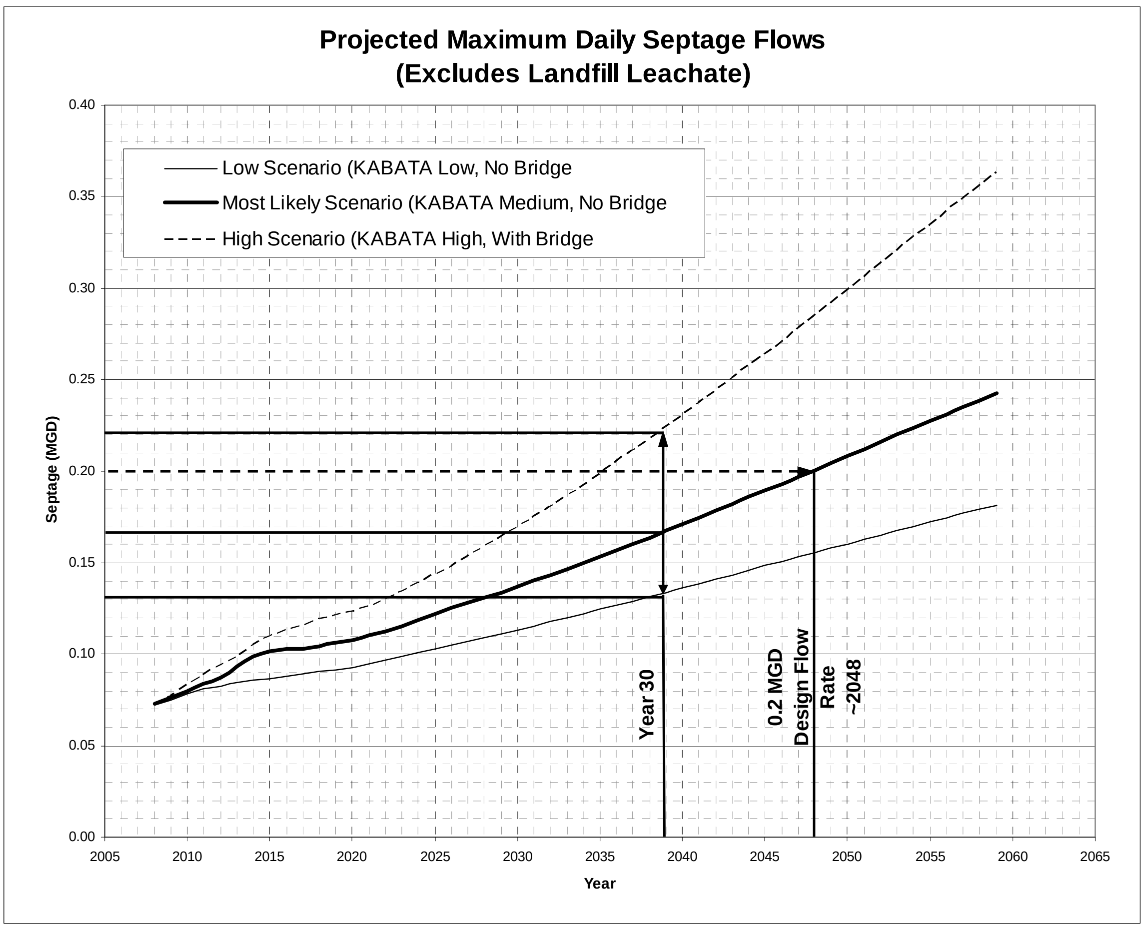


Figure C-13: Projected Maximum Daily Septage Flows

[1] U.S. Census Bureau, State and County Quick Facts sheet for Matanuska-Susitna Borough, Alaska, 2007

[2] Study of Impact of Connecting The Ranch Subdivision to the City of Palmer WWTP, HDL, 2008 (Modified to 66% of projected flow based on conversation with Rex Turner, owner of "The Ranch")

[3] Matanuska-Susitna Borough Septage Handling and Disposal Plan, HDR Alaska, Inc., April 2007

APPENDIX D

Equipment/Process Information

Lagoon Activated Sludge

Equipment Information

PARKSON CORPORATION
...the environmental technology company

BIOLAC® WASTEWATER TREATMENT SYSTEM

Biolac® Wastewater Treatment System
Extended sludge age biological technology

This innovative process features

- **Low-loaded activated sludge technology**
- **High oxygen transfer efficiency delivery system**
- **Exceptional mixing energy from controlled aeration chain movement**
- **Simple system construction**

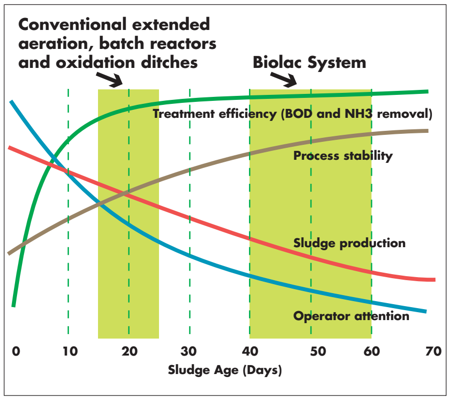
The Biolac System is an innovative activated sludge process using extended retention of biological solids to create an extremely stable, easily operated system.

The capabilities of this unique technology far exceed ordinary extended aeration treatment. The Biolac process maximizes the stability of the operating environment and provides high efficiency treatment. The design ensures the lowest-cost construction and guarantees operational simplicity. Over 500 Biolac Systems are installed throughout North America treating municipal wastewater and many types of industrial wastewater.

The Biolac system utilizes a longer sludge age than other aerobic systems. Sludge age, also known as SRT (solids retention time) or MCRT (mean cell residence time), defines the operating characteristics of any aerobic biological treatment system. A longer sludge age dramatically lowers effluent BOD and ammonia levels. The Biolac long sludge age process produces BOD levels of less than 10 mg/L and complete nitrification (less than 1 mg/L ammonia). Minor modifications to the system will extend its capabilities to denitrification and biological phosphorus removal.

While most extended aeration systems reach their maximum mixing capability at sludge ages of approximately 15-25 days, the Biolac System efficiently and uniformly mixes the aeration volumes associated with 30-70 day sludge age treatment.

The large quantity of biomass treats widely fluctuating loads with very few operational changes. Extreme sludge stability allows sludge wasting to non-aerated sludge ponds or basins and long storage times.



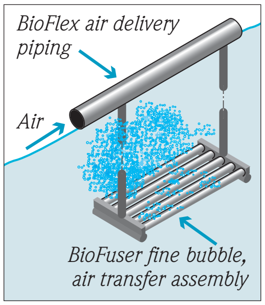
Aeration Components

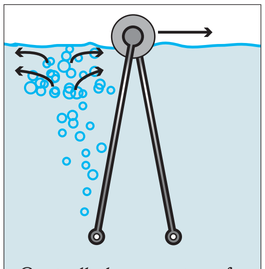
SIMPLE PROCESS CONTROL AND OPERATION

The control and operation of the Biolac® process is similar to that of conventional extended aeration. Parkson provides a very basic system to control both the process and aeration. Additional controls required for denitrification, phosphorus removal, dissolved oxygen control and SCADA communications are also available.

AERATION SYSTEM COMPONENTS

The ability to mix large basin volumes using minimal energy is a function of the unique BioFlex moving aeration chains and the attached BioFuser® fine bubble diffuser assemblies. The gentle, controlled back and forth motion of the chains and diffusers distributes the oxygen transfer and mixing energy evenly throughout the basin area. No additional airflow is required to maintain mixing.




Controlled oxygen transfer and mixing energy

Stationary fine-bubble aeration systems require 8-10 CFM of air per 1000 cu. ft. of aeration basin volume. The Biolac System maintains the required mixing of the activated sludge and suspension of the solids at only 4 CFM per 1000 cu.ft. of aeration basin volume. Mixing of a Biolac basin typically requires 35-50 percent of the energy of the design oxygen requirement. Therefore, air delivery to the basin can be reduced during periods of low loading without the risk of solids settling out of the wastewater.

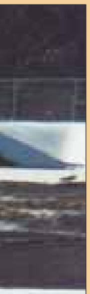
SYSTEM CONSTRUCTION

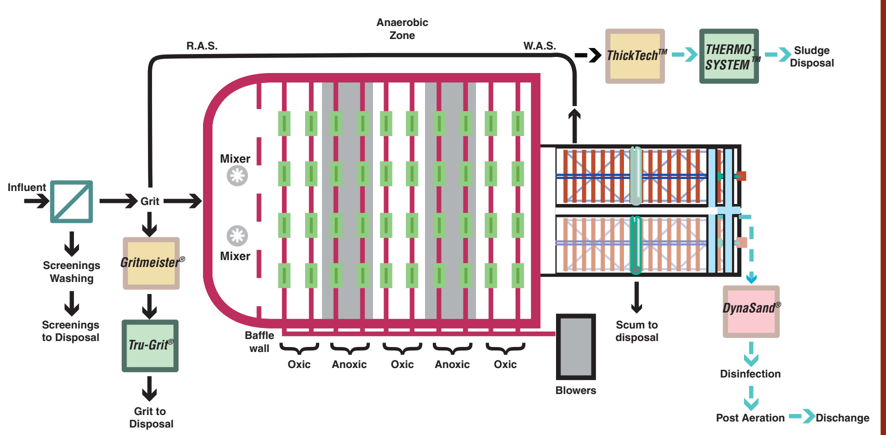
A major advantage of the Biolac system is its low installed cost. Most systems require costly in-ground concrete basins for the activated sludge portion of the process. A Biolac system can be installed in earthen basins, either lined or unlined. The BioFuser fine bubble diffusers require no mounting to basin floors or associated anchors and leveling. These diffusers are suspended from the BioFlex aeration chains above the basin floor. The only concrete structural work required is for the simple internal clarifier(s) and blower/control buildings.

Biological Nutrient Removal

Simple control of the air distribution to the BioFlex chains creates moving waves of oxic and anoxic zones within the basin. This repeated cycling of environments nitrifies and denitrifies the wastewater without recycle pumping or additional external basins. This mode of Biolac operation is known as the Wave Oxidation process. No additional in-basin equipment is required and simple timer-operated actuator valves regulate manipulation of the air distribution.

Biological phosphorus removal can also be accomplished by incorporating an anaerobic zone.

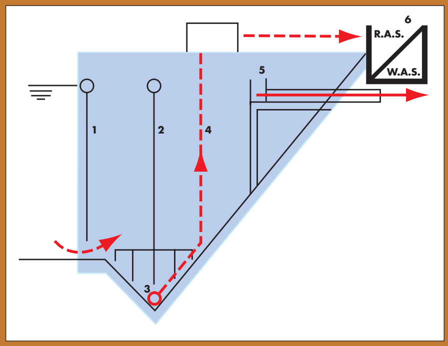




Wave Oxidation Process

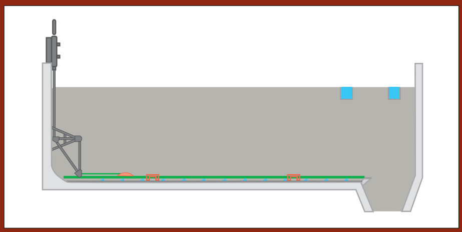
Type "R" Clarifier

Land space and hydraulic efficiencies are maximized using the type "R" clarifier. The clarifier design incorporates a common wall between the clarifier and aeration basin. The inlet ports in the bottom of the wall create negligible hydraulic headloss and promote efficient solids removal by filtering the flow through the upper layer of the sludge blanket. The hopper-style bottom simplifies sludge concentration and removal, and minimizes clarifier HRT. The sludge return airlift pump provides important flexibility in RAS flows with no moving parts. All maintenance is performed from the surface without dewatering the clarifier.



Type "SS" Clarifier

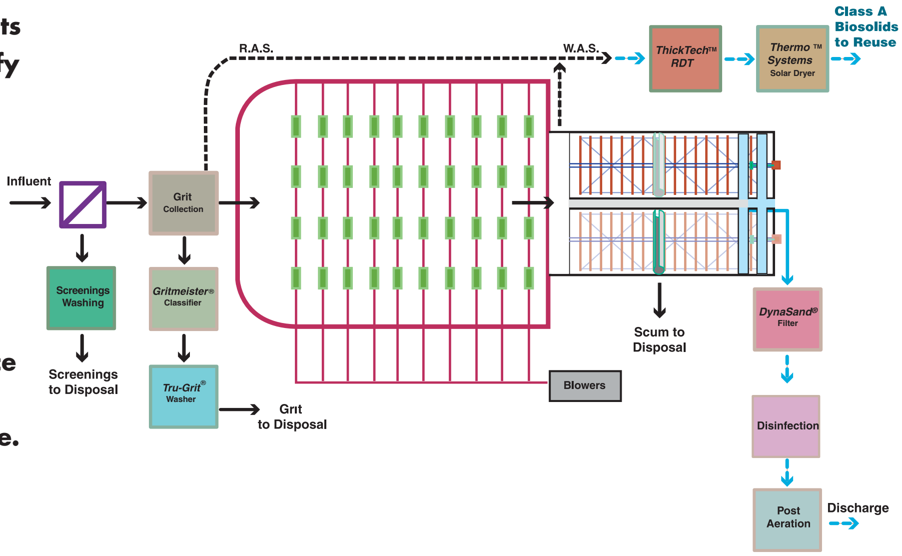
Higher flow systems incorporate a flat-bottom internal clarifier utilizing the Parkson SuperScraper™ sludge removal system. This clarifier design maintains the efficiencies of the common wall layout while providing ample clarification surface area within the footprint of the aeration basin width. The SuperScraper system moves settled solids along the bottom of the clarifier to an integral collection trough. The unique design of the scraper blades and gentle forward movement of the SuperScraper system concentrates the biological solids as they are moved along the bottom of the clarifier without disturbing the sludge blanket.



A Parkson *Complete* Wastewater Treatment System

The Parkson "Complete" system featured here utilizes the Biolac® process with two flat-bottom internal Type SS clarifiers. SuperScraper™ units are installed in the clarifier bottoms to simplify sludge removal. Influent screening with grit removal and appropriate residuals management such as washing, dewatering and conveying are included.

Sludge from the clarifiers is sent to the ThickTech rotary drum thickener and on to a THERMO-SYSTEM® solar sludge dryer to reduce the volume of sludge by 50% and produce a Class "A" product suitable for beneficial reuse. Clarifier effluent is polished by a DynaSand® filter followed by disinfection and post-aeration as the final steps prior to discharge.



PARKSON CORPORATION

ISO 9001:2000 Certified
Quality Management System

www.parkson.com

AN AXEL JOHNSON INC. COMPANY

Parkson Florida
Corporate
2727 NW 62nd Street
Fort Lauderdale FL
33309-1721
P.O. Box 408399
Fort Lauderdale FL
33340-8399
P 954.974.6610
F 954.974.6182

Parkson Illinois
562 Bunker Court
Vernon Hills IL
60061-1831
P 847.816.3700
F 847.816.3707

Parkson Michigan
2001 Waldorf St. NW
Suite 300
Grand Rapids MI
49544-1437
P 616.791.9100
F 616.453.1832

Parkson Canada
205-1000 St-Jean
Pointe-Claire QC
H9R 5P1
Canada
P 514.636.4618
F 514.636.9718

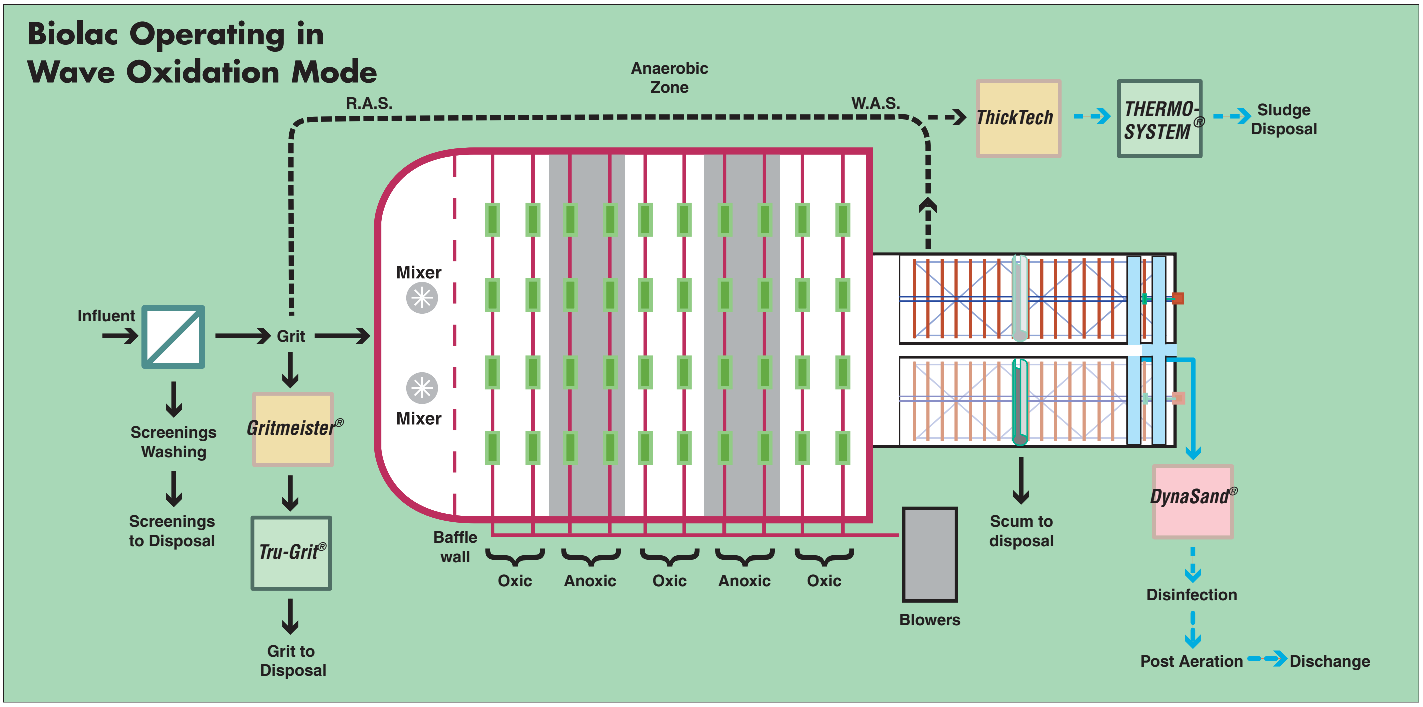
Parkson do Brasil Ltda.
Calçada dos Mirtilos, 15
Barueri Sao Paulo
CEP 06453-000
Brazil
P/F 55.11.4195.5084
P/F 55.11.4688.0336

BL011007

PARKSON CORPORATION
…the environmental technology company

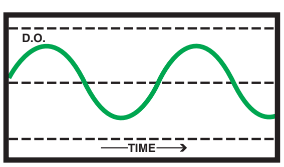
Biolac® Wave Oxidation System

Biological Nutrient Removal



High Quality Effluent at an Affordable Price

Biological Nutrient Removal (BNR) is simplified and affordable with the Biolac Wave Oxidation process. Simple control of the air flow distribution to the Biolac's moving aeration chains varies the basin dissolved oxygen content by creating a unique moving wave of multiple oxic and anoxic zones. This repeated cycling of environments nitrifies and denitrifies the wastewater without recycle pumping or additional external basins. Nitrogen removal to 8 mg/L is standard, with many installations achieving <3-4 mg/L Total N.



Biological phosphorous removal can also be accomplished by incorporating an anaerobic zone or Bio-P zone. With the Bio-P zone, phosphorus levels of <2 mg/L are standard.

The Biolac Wastewater Treatment System is an activated sludge process utilizing a longer sludge age that reduces BOD to <10 mg/L and produces complete nitrification. The system is extremely stable and able to treat widely fluctuating loads with few operating changes.

Fine bubble diffuser assemblies are suspended above the basin floor by the BioFlex moving aeration chains. The motion of the chains and diffusers distributes the oxygen transfer and mixing energy evenly throughout the basin. Depending on customer preference and budget considerations, Biolac systems can be installed in concrete basins or lined earthen basins

Expandable Systems

Parkson combines the best biological and filtration technologies into an enhanced nutrient removal system that will meet or exceed any mandated effluent quality. There is no effluent requirement too tough for this process.

If nitrogen and phosphorus removal requirements become more stringent, Parkson can expand your Biolac Wave Oxidation system to meet those requirements. The addition of a DynaSand® filter to polish the Biolac Wave Oxidation effluent will reduce nitrogen to <1 mg/L and phosphorus to <0.1 mg/L. Dual phase filtration in the DynaSand D2™ can reduce phosphorus to <0.03 mg/L.

Building a total wastewater treatment plant around the Biolac system ensures a versatile, expandable facility from influent screening to final discharge.

Features

- **BNR in a single basin**
- **Multiple treatment zones**
- **Reduced energy consumption**
- **High quality effluent**
- **Affordable price**

Benefits

- **Guaranteed process results**
- **90+% total nutrient removal**
- **25-30% lower energy costs**
- **Minimal operator attention**
- **Simple, low-cost construction**
- **Available as lined earthen basins and concrete basins**
- **No internal MLSS recycle required**
- **Alkalinity recovery**

Biolac® basins with rectangular, flat bottom clarifiers under construction in California. Each clarifier will be fitted with Parkson's SuperScraper™ and SuperSkimmer sludge and scum removal systems

A single basin Biolac Wave Oxidation system in Arizona

PARKSON CORPORATION

ISO 9001:2000 Certified
Quality Management System

www.parkson.com

AN AXEL JOHNSON INC. COMPANY

Parkson Florida
Corporate
2727 NW 62nd Street
Fort Lauderdale FL
33309-1721
P.O. Box 408399
Fort Lauderdale FL
33340-8399
P 954.974.6610
F 954.974.6182

Parkson Illinois
562 Bunker Court
Vernon Hills IL
60061-1831
P 847.816.3700
F 847.816.3707

Parkson Michigan
2001 Waldorf St. NW
Suite 300
Grand Rapids MI
49544-1437
P 616.791.9100
F 616.453.1832

Parkson Canada
205-1000 St-Jean
Pointe-Claire QC
H9R 5P1
Canada
P 514.636.4618
F 514.636.9718

Parkson do Brasil Ltda.
Calçada dos Mirtilos, 15
Barueri, Sao Paulo
CEP 06453-000
Brazil
P/F 55.11.4195.5084
P/F 55.11.4688.0336

BLWO011007

Conventional Activated Sludge

Equipment Information

Basis of Design

VertiCel Biological Nutrient Removal System
Tow-Bro Circular Clarifiers

Matanuska Susitna (AK)

SIEMENS
Water Technologies

VertiCel, Tow-Bro @ Forty-X Filter Basis of Design

Matanuska Susitna (AK)

SIEMENS
Water Technologies

June 5, 2009

Re: Matanuska Susitna (AK) VertiCel^{TM} BNR Design Summary

To Whom It May Concern:

Siemens Water Technologies is pleased to provide this updated Basis of Design book which summarizes the proposed design of our VertiCel/Tow-Bro BNR Nutrient Removal System for the Matanuska Susitna (AK) WWTP project.

The following document summarizes the design status as it exists today. If you have comments or require changes, it is possible to make adjustments at this time. On the following pages you will find much information, including the items listed below.

- Design summary for proposed system
- Suggested Specifications
- Preliminary Drawings
- VertiCel Basin Hydraulics
- Equipment Lists (including concrete estimates)
- Budget Pricing

We hope this document will continue to be used as a living mechanism for compiling design information for this project. Please contact me if there are any questions.

Sincerely,

John E. Olson

John E. Olson, P.E.
Technical Sales Manager – Biological Products
Biological / Clarification Group
Siemens Water Technologies Corp.
1901 S. Prairie Avenue
Waukesha, WI 53189
Phone: (262) 521-8495
Cell: (262) 488 - 5996
Fax: (262) 521-8552

TABLE OF CONTENTS

SIEMENS

Water Technologies

1 - DESIGN BASIS

SIEMENS

Water Technologies

Design of Circular Collector

Project:	Matanuska-Susitna	Date:	27-May-2009
Engineer:	GV Jones	Designer:	DCR

Design Basis

Type of Clarification	Secondary Clarifier
Project Total Average Design Flow	4.000 MGD
Number of Units	2
Secondary Effluent TSS	15 mg/L
Influent Mixed Liquor Concentration	5,000 mg/L

Selected Design

Selected Tank Diameter	65.00 ft
Side Water Depth	16.00 ft
Type of Clarifier	Rim-Flo Tow-Bro Clarifier
Siemens Drive Model No.	H-30-LT
Number of Units	2

Sizing Criteria

	Solids Loading Rate		Hydraulic Overflow Rate	
Parameter	lbs/ft²/Day	Required Surface Area (ft²)	gpd/ft²	Required Surface Area (ft²)
Average	20	8,340	600	3,333
Maximum	35	8,340	1,200	3,333
Peak	45	10,193	2,400	3,333
Required Surface Area (Largest)		10,193		3,333
Required Tank Diameter (ft)		113.92		65.15

Design Based on Selected Design: (per Clarifier)

Parameter	Minimum	Design Average	Max. Month	1hr Hyd. Peak
Forward Flow (MGD)	1.000	2.000	4.000	8.000
Return Flow (MGD)	1.000	2.000	3.000	3.000
Total Flow into the Basin (MGD)	2.000	4.000	7.000	11.000
Overflow Rate (gpd/ft²)	301	603	1,205	2,411
Solids Loading Rate (lbs/ft²/Day)	-	50	88	138

Half Bridge Tank Design

Center Support Pier Diameter	24 Inches
Rim Flo Inlet Skirt Diameter	60.00 ft
Rim Flo Inlet Skirt Depth	1.75 ft

Drive

Recommended Siemen Drive Model No.	H-30-LT
Drive Motor Size, HP	0.50 HP
Rotational Speed	0.04 RPM
Tip Speed	8.17 ft/min
Calculated Running Torque	6,338 ft-lbs
Torque Rating of Selected Drive	12,100 ft-lbs

Volume of Concrete (Each Tank)

Wall Thickness	1.00 ft		
Freeboard	2.00 ft	Bottom Slope (Expressed as 1/n)	192
Side Water Depth	16.00 ft	Floor Thickness	1.00 ft
Concrete Volume of Walls	190 yds³	Concrete Volume of Floor	145 yds³

Total Estimated Concrete 335 yds³

Installation

Estimated installation labor of all tanks 500 Man Hrs

SIEMENS Water Technologies

Rim-Flo Tow-Bro Clarifier Equipment List

Project:	Matanuska-Susitna	Date:	27-May-2009
Engineer:	GV Jones	Designer:	DCR

Clarifier Mechanism

Scope	Qty	Description
Siemens	2	H-30-LT Drive Assembly; 0.50HP 240/480V, 60Hz, 3 Phase Motor
Siemens	2	Influent Feed Well
Siemens	2	Center Support Pier and Cage
Siemens	2	Rotating Tow-Bro Equipment
Siemens	2	Half Bridge Walkway with Center Platform - Wide Flange Beam Design
Siemens		1 1/2" dia Double Rail Handrails
Siemens		1 1/4" Grating for Walkway Decking
Siemens	2	(1) Conventional Skimming Assemblies per Tank with Flushing Device
Siemens	2	(1) 4'-0" Scum Trough per Tank
Siemens	6	Siemens Standard Service Manuals
Siemens		316 SS Anchor Bolts
Siemens		Freight
Siemens		Weirs, Baffles and Associated Supports
By Others		Current Density Baffles
By Others	2	Concrete Tank; 65.00ft Diameter with 18.00ft Walls
By Others		Effluent Troughs
By Others		Finish Paint
By Others		

Materials of Construction

Submerged Equipment:	HDG Carbon Steel
Non-Submerged Equipment:	HDG Carbon Steel
Handrail:	Aluminum
Walkway Decking:	Aluminum
Weirs and Baffles:	FRP

Items NOT Included

Electrical Controls

General Items

- Compliance permitting and approval (Federal, State and/or local).
- Detail shop fabrication drawings.
- Electrical, hydraulic, or pneumatic controls unless specifically noted.
- Engineering and supervision of all equipment and labor for civil works.
- Laboratory, shop, or field testing other than supervision of start-up testing.
- Taxes, bonds, fees, permits, lien waivers, licenses, etc.
- Tools or spare parts.
- Unloading of equipment and protected storage of equipment at jobsite.
- Utilities connections.

Civil Works and Mechanical Items

- Adhesives, adhesive dispensers, grout, mastic & anti-seize compounds.
- Anchor bolts and/or expansion anchors unless otherwise noted.
- Base slabs, equipment mounting pads, or shims.
- Concrete work of any sort, grout, mastic, sealing compounds, shims.
- Demolition, removal, or transfer of anything that is existing.
- Engineering, permitting, and surveying.
- Equipment lifting hoists, cranes, or other lifting devices.
- Field surface preparation and/or painting.
- Floor grating, stairways, ladders, platforms, handrailing unless noted.
- Installation of equipment.
- Interconnecting materials external to enclosures such as cable, pressure taps, tubing, etc.
- Labor for field testing.
- Lubricants, grease piping, grease guns.

- Modifications to existing equipment or structures.
- Pipe supports and hangers for piping.
- Piping, pumps, valves, wall sleeves, gates, drains, weirs, baffles not mentioned.
- Plumbing associated with waste disposal, floor drains, and/or emergency and safety wash stations.
- PVC solvent weld materials.

Electrical Items

- Conduit or wiring in the field.
- Cable trays, fittings, and supports.
- Influent instrumentation including, but not limited to flowmeters, pH analyzers, temperature transmitters and/or pressure transducers.
- Instrumentation required for post treatment monitoring.
- Power to Siemens supplied equipment.
- Motor control centers.
- Plant lighting.
- Supply and installation of building power, lighting, main service disconnects and control panels.
- Supply, installation and control of a remote telemetry system (SCADA) to monitor and control the operation of the system and overall plant operation other than mentioned Siemens controls.
- Underwriters Laboratory inspection of electrical controls.
- Variable frequency drives unless specifically noted.

Budget Price

Clarifier Mechanisms	$275,000
Weirs & Baffles (FRP)	$19,700
Total Considered Cost	$294,700

1 DESIGN BASIS

Detailed within this section is the design basis of the VertiCel™ nutrient removal process offered.

1.1 Influent and Effluent Specifications

The proposed system design is based on wastewater influent conditions with the following characteristics:

Table 1.1 – *Design flow requirements*

PARAMETER	UNITS	AVERAGE
Design Flow	MGD	4.0
Peak Daily Flow	MGD	8.0
Maximum Recycle Flow	MGD	16.0
Maximum RAS Flow	MGD	4.0

Table 1.2 - Influent Water Quality

PARAMETER	UNITS	AVERAGE
Temperature	Deg C	10
BOD_5	mg/L	350
COD	mg/L	700
Total Suspended Solids	mg/L	350
NH_3	mg/L	40
TKN	mg/L	50
Total Phosphorous (TP)	mg/L	8
pH	-	6 to 8
Alkalinity	mg/L as $CaCO_3$	350

Note: Customer must confirm influent loading conditions for any associated process warranty.

Based on the specified influent water quality, Siemens Water Technologies has designed the system to provide the following effluent quality:

Table 1.3 - *Effluent Water Quality*

PARAMETER	UNITS	QUALITY
BOD_5	mg/L	15
Total Suspended Solids	mg/L	15
NH_3	mg/l	0.5
NO_3-N	mg/L	5

SIEMENS

Water Technologies

2 - VERTICEL

SIEMENS
Water Technologies

INTRODUCTION
VERTICEL BNR PROCESS

The SIEMENS Water Technologies VertiCel process is a suspended growth activated sludge process designed for energy efficiency and biological nutrient removal (BNR) performance. The VertiCel activated sludge system is a series of Vertical Loop Reactor (VLR) tanks, operated as aerated-anoxic reactors, followed by a 2-stage series of fine bubble reactors maintained in an aerobic state. For very low effluent total nitrogen (TN) limits, nitrates are recirculated from the aerobic fine bubble tanks to the anoxic VLR tanks, and a secondary anoxic zone, where a small amount of methanol is added for nitrate polishing along with a downstream reaeration stage to oxidize any residual methanol.

The system will consist of adjacent basins with common intermediate walls. Under normal conditions at the design flow of 4 MGD, the VertiCel would operate as two parallel trains with (1) VLR tank and (2) fine bubble tanks in each train. The two trains will discharge into a common effluent channel passing the mixed liquor on to the final clarifiers. Flow controls are to be arranged so that either of the two VLR tanks, or either of the fine bubble trains can be taken out of service, and at least three (3) tanks could still be operated in series.

The VertiCel system optimizes the performance of each type of aerator equipment used in the design. The major component in wastewater affecting the transfer of oxygen into water is surfactants. Surfactants decrease the surface tension of the gas-liquid interface making it more difficult to transfer oxygen from the gas phase to the liquid phase. For fine bubble diffusers, the surfactants will result in lower efficiencies. However, with mechanical aerators, the reverse may be true: surfactants reduce the size of the liquid droplet formed by the mechanical aerator allowing for greater oxygen transfer efficiencies.

As the surfactants are broken down through the process, their influence on aerator performance is diminished. Therefore, the fine bubble diffusers are located at the “second half” of the process. This optimizes the performance of the fine bubble diffusers which are the most efficient device in clean water.

The VLR portion of the system placed ahead of the fine bubble diffuser portion, using completely mixed reactors in series, provides economy, flexibility and reliable treatment performance, while the series reactor arrangement minimizes cost by using multi-wall construction techniques. There is no need for mixers in the anoxic VLR tanks. The VLR followed by fine bubble aeration will offer superior nitrification-denitrification performance. The designs using aerated anoxic reactors can achieve greater TN removal than non-aerated anoxic reactors. With these two benefits, the power savings of the VertiCel design is considerable

Some advantages of the VertiCel system and its combination disc and diffused aeration are:

- Retention time of the diffused coarse bubbles is increased several times, compared to conventional tankage, as the bubbles traverse the basin beneath the mid-depth tank divider. Therefore, oxygen transfer efficiency is improved and power costs are reduced.

- Non-corrosive discs, with highly effective mixing characteristics, provide rapid turnover of the complete tank contents and further improves oxygen transfer characteristics of the disc and diffuser aeration minimizing maintenance and power costs.

- Changes in oxygen demand are easily met by varying air flow to the various tanks while the discs provide mixing and fairly constant oxygen input.

- The use of series reactors allows the D.O. level to be varied from tank to tank. Because the majority of the system operates at low D.O., oxygen transfer is efficient, resulting in reduced power cost. Still, the system will never be oxygen deficient as the final tank D.O. will be maintained at a relatively high level (2-5 mg/l). Also, by maintaining a D.O. level at or near zero in the first tank, oxygen recovery through denitrification occurs. This also reduces power cost for the user.

- Surge flows can be handled by the VertiCel system without solids washout in the secondary clarifiers. The end result is the elimination of peak flow facilities and the realization of an economical final clarifier design.

- The system can be fine-tuned by adding raw flow and/or recycle options to any or all of the tanks.

Each VLR basin will consist of a rectangular concrete structure in which the equipment will be installed. The horizontal concrete baffle is to be provided by the contractor as part of each VLR basin, and should be designed to split the water depth to create an over-under flow arrangement. The baffle is to terminate at a distance from each end-wall equal to one-half (1/2) of the total water depth.

The mechanical disc aerator assemblies installed in the upper section of the basin will provide oxygen, mixing and directional velocity for the system. An array of coarse bubble diffusers installed in the lower section of the basin will provide additional oxygen when the requirements exceed the amount of oxygen supplied by the disc aerators.

Raw wastewater, after entering the system, will pass progressively through the VLR basins and the fine bubble basins before passing on to the final clarifiers. The raw sewage may be introduced into either of the VLR basins or the fine bubble tanks, depending on operating conditions. Recycled sludge will always be returned to the VLR tanks. The flow from one aeration basin to another will be by displacement of the mixed liquor circulating in each basin through submerged ports interconnecting each adjacent aeration basin. The displaced flow will be equal to the volume of raw waste and recycled sludge introduced into the aeration system.

The fine bubble tanks will need to be taken out of service periodically to inspect and/or replace the diffuser membranes. With one fine bubble train out of service, the two VLR tanks are operated in series and the VLR effluent is directed through the remaining fine bubble train. Although it is rare that VLR tanks would need to be taken out of service, bypass pipes or channels can be constructed to allow the effluent of a single VLR tank to be split between the two fine bubble trains.

The fine bubble equipment in each tank includes a drop leg, manifold distribution headers, fine bubble diffusers, moisture blow-off assembly's, supports and anchors.

Oxygenation and mixing of the mixed liquor for each VLR tank is provided by disc aerator assemblies. Each individual disc aeration device is 54" in diameter. Each disc consists of two (2) identical halves which are bolted together on the supporting shaft. Additional oxygen demand in the VLR tanks is satisfied with coarse bubble diffusers.

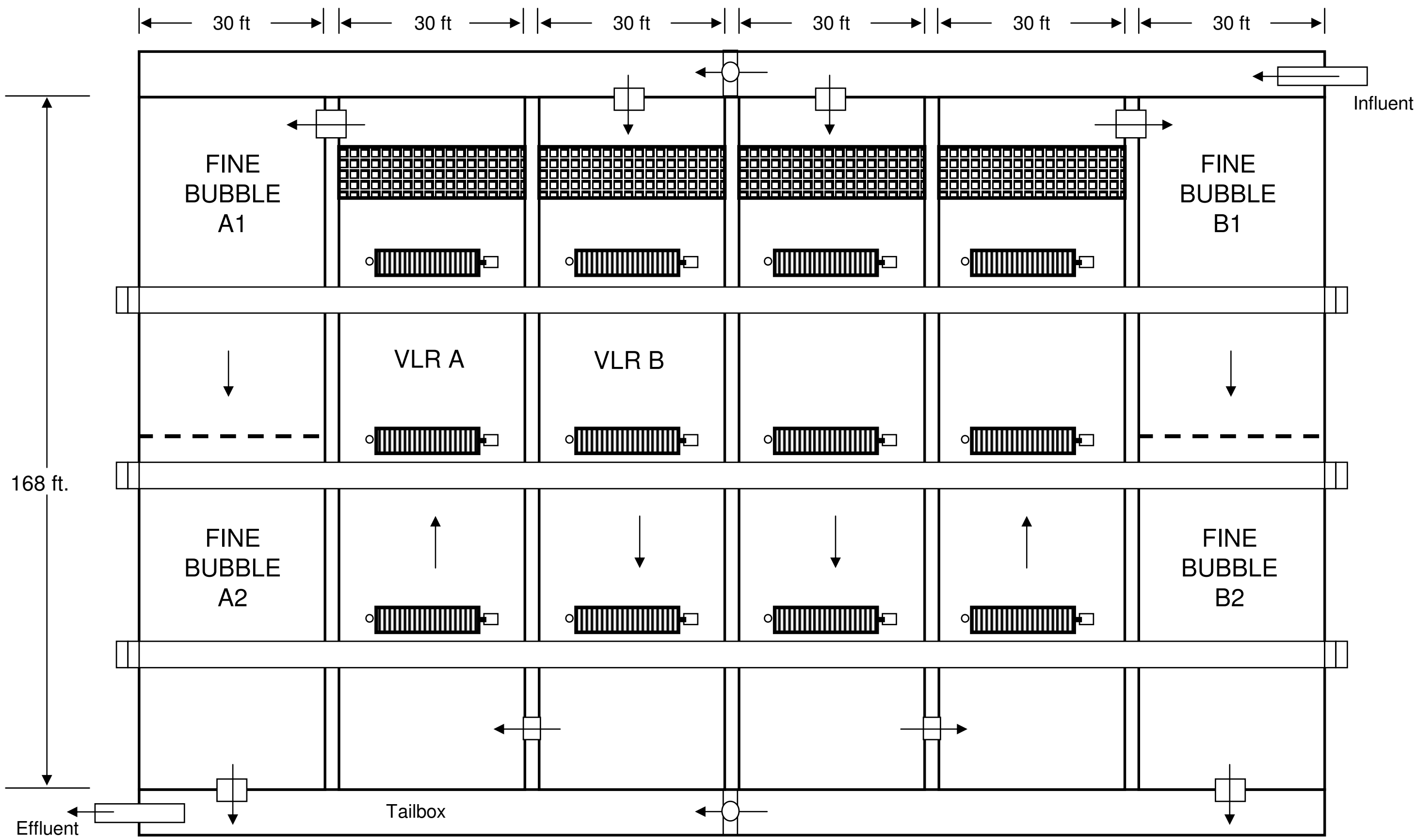
Blowers for the coarse bubble diffusers in the VLR tanks and the fine bubble diffusers should be the centrifugal type. If desired, a Smart BNR™ control panel can be furnished for automatic control of the air supply to the VLR and fine bubble reactors based on ORP probes in the anoxic VLR tanks and DO probes in the fine bubble tanks.

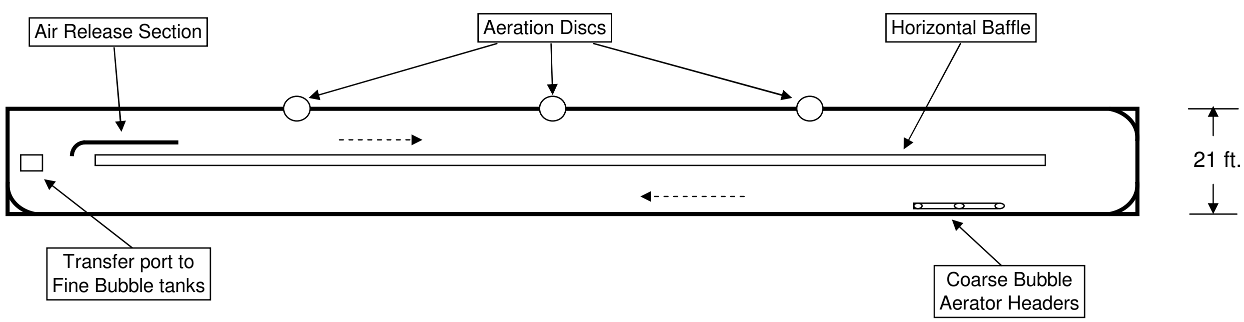
The return activated sludge pumps for the VertiCel process would be sized for 50 to 150% of the average design flow.

VERTICEL LAYOUT SKETCH

Project: Matanuska, AK
Engineer: GV Jones

Prepared: 5/27/2009
Designer: J Olson





SIEMENS
Water Technologies

VERTICEL DESIGN OUTLINE
Project: Matanuska / Susitna, AK - Verticel
Engineer: GV Jones

Prepared: 05/26/2009
Designer: J Olson

Design Flow, MGD: 4.0

	Influent		Effluent
	mg/l	lbs/day	mg/l
BOD	350.0	11,676	15.0
TSS	350.0	11,676	15.0
NH3-N	40.0	1,334	0.5
TKN	50.0	1,668	
NO3-N			5.0
TN	50.0	1,668	
TP	8.0	267	

lbs BOD/1,000 cf/day	17.39
Solids aerated, lb/train	208,497
Sludge Age, days	22.0
Sludge Yield	0.81
WAS lb/day	9,477

Number of Identical Trains in Parallel: 1

			Aeration			
Volume/train, MG			5.0			
HDT, hours			30.1			
MLSS, mg/l			4,977			

PUMPING REQUIREMENTS

RAS pumping rate at 100% of Q (where Q is the average design flow rate)
Pump MLSS containing Nitrates from Aerobic VLR tanks to Anoxic VLR tanks at 200% of Q

BASIN DIMENSIONS (per train) Freeboard, ft. 2.0

			VLR	Fine Bubble		
Quantity			4	2		
Length, ft.			182.0	182.0		
Width, ft.			30.0	30.0		
Depth, ft.			21.0	21.0		
Floor thickness, in.			9	9		
End wall thickness, in.			18	18		
Side wall thickness, in.			12	18		
Horizontal baffle thickness, in.			9			

AERATION EQUIPMENT (per train)

Disc Aerators
(12) at 20.0 Hp
36 discs / assembly

Diffusers
Coarse Bubble 160
Fine Bubble 600

Blowers (by others)
(3) at 40.0 Hp

TOTAL POWER REQUIREMENTS

	Design	Maximum
Disc Speed	43 rpm	49 rpm
Disc Immersion, in.	15.0	17.0
Disc Aerators, Hp	175.1	240.0
Blowers, Hp	43.6	120.0
Wall Pumps, Hp	5.4	5.4
Mixers, Hp		
Total	224.0	365.4

*blower efficiency = 65% motor efficiency = 90% blower discharge at 9.4 psig

ADDITIONAL COSTS			VertiCel Tanks	
		Unit price	cubic yards	
CONCRETE	Walls	$750	1489	$1,116,618
	Floors	$700	910	$637,000

INSTALLATION

Hourly Rate	VLR		Smart BNR		$46,000
$60	668	man-hrs	100	man-hrs	

Total Additional Costs $1,799,618

Influent Characteristics		Ave. design flow, MGD		4.0	
BOD5, mg/L	350	NH3-N, mg/L	40	TP, mg/L	8
TSS, mg/L	350	TKN, mg/L	50		

A) Determine Basin Volume

Basin volume is determined by minimum sludge age required to maintain a healthy population of nitrifying organisms at the minimum wastewater temperature. SRTmin=1/(μmax*EXP(0.098*(Tmin-15)))*TPF*SF, where:

Minimum wastewater temperature, T_{min} =	42.8	degrees F
Maximum growth rate, μ_{max} =	0.47	$days^{-1}$
Diurnal Peak Factor, DPF =	1.2	
Monthly Peak Factor, MPF =	1.43	
DPF x MPF = Total Process Peak Factor, TPF =	1.716	
Safety Factor, SF =	2.5	
Minimum Solids Residence Time, θ_{min} =	22.0	days
Selected Solids Residence Time, θx =	22.0	days

Use McCarty kinetic equations to calculate basin volume required:

1) Inert solids: $M_{o\text{-}IS} = (M_{o\text{-}TSS})(1 - f_{VSSo})$ =

(11676 lb/day influent TSS)(100 - 80% VSS) / (100%) = 2335 lb/day

2) Nonbiodegradable VSS: $M_{o\text{-}NS} = (M_{o\text{-}TSS})(f_{VSSo})(f_{NS})$ =

(11676 lb/day influent TSS)(80% VSS),(40% NBVSS) / (100%) 3736 lb/day

3) Heterotropic Kinetic Parameters

Growth Rate, $Y_{true,\,15}$ =	0.6	lb VSS/lb BOD5
Decay rate, b_{15} =	0.06	d^{-1}
BOD Half-saturation coefficient, K_{BOD} =	20	
Adjusting for temperature, $b_T = b_{15}(1.04)^{(T-15)}$ =	0.049	d^{-1}
Maximum Growth Rate, $\mu_{MAX,h}$ =	6	

Estimate Effluent BOD_5:

Soluble BOD, $S_e = [K_{BOD}(1+b_T\,\theta_x)]/[\theta_x(\mu_{MAX,h} - b_T) - 1]$ =	0.36	mg/l
Effluent VSS concentration, f =	40%	
$BOD_{5,total} = S_e + (TSS \times f)$ =		
0.36 + (15mg/l effluent TSS)(40% VSS) / (100%)	6.36	mg/l

Observed yield of heterotrophs: $Y_{OBS\,H} = Y_{true}/(1 + b_T 1_c)$ = 0.288

Heterotrophic Biomass Produced: $M_H = (M_{o\text{-}BOD} - M_{e\text{-}BOD})(Y_{OBS\text{-}H})$ = 3299 lb/day

4) Autotrophic Kinetic Parameters

Growth Rate, $Y_{true,\,15}$ =	0.15	lb VSS/lb NH3-N
Decay Rate, b =	0.05	$days^{-1}$
Ammonia half-saturation coefficient, K_{sn} =	1	mg NH_3-N/L
Oxygen half-saturation coefficient, Ko =	0.5	mg DO/L
Maximum growth rate, μ_{max} =	0.47	$days^{-1}$
Adjusting for temperature: $\mu_{max\,T} = \mu_{max}\,15e^{0.098(T-15)}$ =	0.195	$days^{-1}$
$b_T = b_{15}(1.04)^{(T-15)}$ =	0.035	$days^{-1}$

Calculate observed yield of autotrophs: $Y_{OBS\,A} = Y_{true}/(1 + b_T\theta_c)$ = 0.08

Nitrogen assimilated by heterotrophic biomass:

Nitrogen content of biomass: N_{bm} =	12%	
Nitrogen assimulated: $M_{NA\text{-}H} = (M_H)(N_{bm})$ =	396	lb/day

Nitrogen assimilated by autotrophic biomass (1st iteration):

TKN oxidized: $M_{TKN\text{-}o} = M_{o\text{-}TKN} - M_{NA\text{-}H}$ =	1272	lb/day
Autotrophic Biomass Produced: $M_A = (M_{TKN\text{-}o})(Y_{OBS\ A})$ =	108	lb/day
Nitrogen assimilated by autotrophic biomass: $M_{NA\text{-}A} = (M_A)(N_{bm})$ =	13	lb/day

Nitrogen assimilated by autotrophic biomass (2nd iteration):

TKN oxidized: $M_{TKN\text{-}o} = M_{o\text{-}TKN} - M_{NA\text{-}H} - M_{NA\text{-}A}$ =	1259	lb/day
Autotrophic Biomass Produced: $M_A = (M_{TKN\text{-}o})(Y_{OBS\ A})$ =	107	lb/day
Nitrogen assimilated by autotrophic biomass: $M_{NA\text{-}A} = (M_A)(N_{bm})$ =	13	lb/day
TKN oxidized: $M_{TKN\text{-}o} = M_{o\text{-}TKN} - M_{NA\text{-}H} - M_{NA\text{-}A}$ =	1259	lb/day
Oxidized TKN Concentration = $(M_{TKN\text{-}o})(1000)/Q$ =	37.75	mg/l

5) Total Solids Production Rate:

$P_x = M_{0\text{-}IS} + M_{o\text{-}NS} + M_H + M_A$ =	9477	lb/day
Overall Yield: $Y_N = P_x/M_{o\text{-}BOD}$ =	0.81	
MLVSS: (Mo-NS + MH + MA) / Px =	75.36%	

6) VertiCel Basin Volume Calculations:

Calculate required volume, based on MLSS concentration of	5000	mg/l
Required Volume, V = $(\theta x)(P_x)(1000)$/MLSS =	4999916	gallons
Selected effective VertiCel basin volume =	5023418	gallons
Actual MLSS: $X = (1_c)(P_x)(1000)/V$ =	4977	mg/l

7) Waste Activated Sludge:

WAS TSS: $X_W = (1 + F_R)(X)/(F_R)$ =	9953	mg/l
WAS Flow: QW = (Px)(1000000)/(XW)/8.34 =	114169	gal/day

B. Determine Actual Oxygen Transfer Rate (AOTR) to be satisfied in VertiCel

1) Carbonaceous O2 demand

oxygen equivalent of cell mass, B =	1.42	kg O_2/kg VSS
Influent BOD_{ULT}:BOD5 RATIO:	1.46	
Effluent BOD_{ULT}:BOD5 RATIO:	1.2	
Carbonaceous oxygen demand design factor, $f_{c\text{-}o2}$:	1.16	

a) Mass of BOD_5 O_2 demand equivalents entering the system:

kg BOD_5/d x Influent BOD_{ULT}:BOD_5 RATIO = 17047 lb/day

b) Mass of BOD_5 O_2 demand equivalents leaving the system:

kg BOD_5/day x Effluent BOD_{ULT}:BOD_5 RATIO = 255 lb/day

c) Mass of O_2 equivalents leaving the system as biomass:

heterotrophic VSS/d + autotrophic VSS/d x kg O_2/kg VSS = 4836 lb/day

d) Carbonaceous O_2 demand: $_{co2}$(a - b - c) = 13870 lb/day

e) Carbonaceous O_2 demand (selected): 13870 lb/day

2) Nitrification oxygen demand:

Nitrification oxygen equivalent: 4.6 kg O2/kg NH3-N

Denitrification oxygen credit: 2.86 kg O_2/kg NO_3-N

Nitrification oxygen demand: kg O2/kg NH_3-N x kg TKN oxidized/day = 5793 lb/day

3) Denitrification oxygen credit:

As long as that the organic loading is high enough and the O2 supply is distributed to multiple locations, the initial VLR tank(s) can be maintained in an anoxic state by limiting the percentage of the overall system AOR satisfied in each anoxic VLR to a value close to the percentage of the overall system volume in that tank, resulting in simultaneous nitrification and denitrification. Ammonia oxidation will occur at a rate proportional to the percentage of AOR satisfied in each VLR tank. With a strong oxygen deficit (DO = near zero mg/l), 100% of the ammonia oxidized will be denitrified. With a mild oxygen deficit condition (DO = near 0.5 mg/l), 65% of ammonia oxidized will be denitrified. Based on the process split listed in the table below, we can calculate the rate of denitrification for the VLR system:

		Fine Bubble		
	VLR	Stage 1	Stage 2	Total
Volume Split	65.9%	17.1%	17.1%	100.0%
AOR Split	73.2%	13.6%	13.2%	100.0%
DO, mg/l	0.0	0.5	2.0	
Denite Rate	100%	65%	0%	

Nitrogen Mass Balance

Nitrogen components in clarifier return activated sludge, with RAS flow at 100% of design flow

Ammonia-N: $M_{R\text{-}NH3} = (C_{e\text{-}NH3})(Q)(F_R)/1000 =$ 10 lb/day

Nitrate-N: $M_{R\text{-}Nox} = (C_{e\text{-}Nox})(Q)(F_R)/1000 =$ 61 lb/day

Total-N: $M_{R\text{-}TN} = (C_{e\text{-}TN})(Q)(F_R)/1000 =$ 150 lb/day

Nitrogen components in MLSS recycle stream, with recycle at 200% of design flow

Ammonia-N: $M_{IR\text{-}NH3} = (C_{e\text{-}NH3})(Q)(F_{IR})/1000 =$ 20 lb/day

Nitrate-N: $M_{IR\text{-}Nox} = (C_{e\text{-}Nox})(Q)(F_{IR})/1000 =$ 122 lb/day

Total-N: $M_{IR\text{-}TN} = (C_{e\text{-}TN})(Q)(F_{IR})/1000 =$ 300 lb/day

Nitrogen components in VLR influent:

Ammonia-N: $M_{i\text{-}NH3} = M_{o\text{-}NH3} + M_{R\text{-}NH3} + M_{IR\text{-}NH3} =$ 1289 lb/day

Nitrate-N: $M_{i\text{-}NOx} = M_{o\text{-}Nox} + M_{R\text{-}Nox} + M_{IR\text{-}NOx} =$ 183 lb/day

Total-N: $M_{i\text{-}TN} = M_{o\text{-}TN} + M_{R\text{-}Nox} + M_{IR\text{-}Nox} =$ 2117 lb/day

Nitrogen Components in VLR Effluent:

Ammonia-N: $M_{1\text{-}NH3} = M_{i\text{-}NH3} - (M_{o\text{-}NH3} - M_{e\text{-}NH3})(f_{N1}) =$ 375 lb/day

Nitrate-N: $M_{1\text{-}Nox} = (M_{i\text{-}NH3} - M_{1\text{-}NH3} + M_{i\text{-}NOx})(1\text{-}f_{D1}) =$ 0 lb/day

Nitrogen Components in Fine Bubble Stage 1 Effluent:

Ammonia-N: M2-NH3 = M1-NH3 - (Mo-NH3 - Me-NH3)(fN2) = 205 lb/day

"Nitrate-N: M2-Nox = (M1-NH3 - M2-NH3 + N1-NOx)(1-fD2) = 59 lb/day

Nitrogen Components in Fine Bubble Stage 2 Effluent:

Ammonia-N: M3-NH3 = M2-NH3 - (Mo-NH3 - Me-NH3)(fN3) = 20 lb/day
Nitrate-N: M3-NOx = (M2-NH3 - M3-NH3 + N2-NOx)(1-fD3) = 122 lb/day

Nitrogen Components in Clarifier Effluent:

Ammonia-N: $M_{e\text{-}NH3} = M_{4\text{-}NH3} - M_{R\text{-}NH3}$ = 10 lb/day
Nitrate-N: $M_{e\text{-}NOx} = M_{4\text{-}NOx} - M_{R\text{-}NOx}$ = 61 lb/day
Effluent NH_3-N Concentration = $(M_{e\text{-}NH3})(1000)/Q$ = 0.3 mg/l
Effluent NO_3-N Concentration = (Me-Nox)(1000)/Q = 1.8 mg/l

Denitrification oxygen credit:
kg O2/kg NO3-N x kg TKN oxidized/d - kg effluent NO3-N/day = 3427 lb/day

Net oxygen demand, AOR:
kg Carb. O2/d + kg Nit. O2/d - kg Denit. Credit/day = 16236 lb/day

C) Determine disc quantity per VLR tank required for mixing.

Disc quantity required = basin volume / mixing efficiency / brake-Hp per disc
Use 0.36 bHp per disc, based on 43 rpm and 15 inch immersion

	Basin volume in gallons	Mixing efficiency gal. per brake-Hp	Disc Quantity Required	Disc Quantity Provided	Number of Aerators	Disc Quantity per Aerator
VLR #1	827,026	21,000	109	109	3	36
VLR #2	827,026	21,000	109	109	3	36
VLR #3	827,026	21,000	109	109	3	36
VLR #4	827,026	21,000	109	109	3	36

D) Determine Standard Oxygen Transfer Rate to be satisfied in by coarse bubble diffusers in VLR tanks

SOTR = AOTR / FCF

$FCF = \alpha \times (\beta \times ACF \times C_s \times SCF - DO) \times TCF / 9.092$

Coarse bubble Alpha, α = 0.85 Disc Alpha, α = 0.95 Beta, β = 0.98
Elevation = 100 feet Altitude Correction Factor (ACF) = 0.996
Design water temperature = 10° C Temperature Correction Factor (TCF) = 0.789
Saturation Concentration of Oxygen at Design Water Temperature, Cs = 11.29 mg/l
Saturation Correction Factor: Coarse Bubble SCF = 1.161 Disc SCF = 1.000

1) Calculate SOR to be satisfied by coarse bubble in VLR tanks in each train

Coarse bubble SOR = (Total AOR - Disc AOR) / FCF

Total AOR, lb/hr	494
Disc SOR, lb/hr	544
Disc FCF	0.909
Disc AOR, lb/hr	494
Coarse bubble AOR, lb/hr	0
Coarse bubble FCF	0.813
Coarse bubble SOR, lb/hr	0

2) **Calculate air flow required for coarse bubble in VLR tanks in each train**

SCFM = SOR / 60 / (0.01725 x SOTE)

(Note that SOTE of coarse bubble diffusers are increased by detention time beneath horizontal baffle)

SOTE	18.6%
SCFM	0
SCFM per diffuser	0.0
Diffuser Quantity per train	40

E) **Determine Standard Oxygen Transfer Rate (SOTR) to be satisfied in by fine bubble diffusers**

SOTR = AOTR / FCF   FCF = α x (β x ACF x C_s x SCF – DO) x TCF / 9.092

Fine bubble stage 1 Alpha, α = 0.74   Fine bubble stage 2 Alpha, α = 0.81

Elevation = 100 feet   Altitude Correction Factor (ACF) = 0.996

Design water temperature = 10 ° C   Temperature Correction Factor (TCF) = 0.789

Saturation Concentration of Oxygen at Design Water Temperature, Cs = 11.29 mg/l

Beta, β = 0.98   Fine Bubble SCF = 1.206

1) **Calculate scfm required for fine bubble tanks in each train**

Fine bubble SOR = AOR/FCF   SCFM = SOR / 60 / (0.01725 x SOTE)

Fine Bubble Stage	1	2	Total
AOR, lb/hr	92	89	181
FCF	0.677	0.660	
SOR, lb/hr	135	135	270
SOTE	38%	38%	
SCFM	336	337	673
SCFM per diffuser	1.1	1.1	
Diffuser Quantity	300	300	600

F) **Check for Reserve Oxygen Transfer Capacity**

Use 6.00 brake-Hp per disc, at 49 rpm and 17.0 in. max. disc immersion

Use 11 SCFM per diffuser maximum coarse bubble airflow rate with all blowers operating

Use 2.4 SCFM per diffuser maximum fine bubble airflow rate with all blowers operating

	Max.	Largest disc aerator out	(1) of (3) blowers in each train out
Disc SOR Provided per train, lb/hr	755.4	692.5	755.4
Coarse Bubble SOR per train, lb/hr	577.1	577.1	384.8
Total SOR per train, lb/hr	1332.6	1269.6	1140.2
Reserve Over Design Load, %	63.73	55.99	40.09

Std. O2 delivery req'd with no denitrification & 2 mg/L DO in all channels: 1146.0 lb/hr

SIEMENS

Water Technologies

VertiCel BNR Process

Project: Matanuska / Susitna, AK - Verticel — Prepared: 5/26/2009

Engineer: GV Jones — Designer: J Olson

EQUIPMENT LIST

Item		Scope of Supply

In the absence of detailed project specifications and a specific purchase date, this budgetary pricing is intended to be a guide based on current costs. Budget prices include freight and field service unless noted otherwise. A request for updated pricing can be made every six months throughout the project evaluation and design stage in order to keep the project cost estimation accurate and up to date.

VLR Tanks

Qty	Item	Scope of Supply
(4)	Concrete VLR tanks 3.308 million gallons total volume	Others
(12)	20.0 Hp Disc Aerators	SIEMENS
	Aerators include discs, shafts, drives, & bearings with base plates & anchors, aerator support tubes, & fiberglass weather hoods & walkway support tubes.	
	Handrail and grating for aerator access walkways are not included	
(4)	Sets of Galvanized steel air release sections and turning vanes	SIEMENS
(4)	Coarse bubble diffuser grids	SIEMENS
(4)	Sets of fiberglass air distribution baffles	SIEMENS
(2)	2.7 Hp wall pumps for recycle of nitrates from aerobic final VLR to anoxic initial VLR	SIEMENS
	Wall pumps include pump, SS support mast or guide pipe, power cable, & HDG hoist	
	301 mm to 10 inch adapter pipe is not included.	

Fine Bubble Tanks

Qty	Item	Scope of Supply
(2)	Concrete fine bubble tanks 1.715 million gallons total volume	Others
(2)	Fine bubble grids 600 diffusers total	SIEMENS

Smart BNR Instrumentation and Controls

Qty	Item	Scope of Supply
	Motor Control Center (MCC)	Others
	Flow meters for influent, RAS, and WAS	Others
(4)	Dissolved Oxygen Probes	SIEMENS
(2)	Oxidation Reduction Potential (ORP) probes	SIEMENS
(1)	Programmable Logic Controller (PLC)	SIEMENS
	Control Logic	SIEMENS
	I/O points for all instruments, starters, etc.	SIEMENS
(1)	Control Panel with Operator Interface	SIEMENS
(1)	Software & Graphics	SIEMENS

Miscellaneous

Item	Scope of Supply
Domestic freight and field service	SIEMENS
Piping, valves, gates, effluent troughs, weirs, baffles and associated supports	Others
Walkways, handrail, grating, stairs, ladders, etc.	Others
RAS / IAS pumps	Others
Installation labor and finish painting	Others
Blowers, blower controls, air valves, air main piping	Others

BUDGET PRICING

VertiCel Equipment	with Weather hoods & walkways	[redacted]
Smart BNR Process Controls		[redacted]
	[redacted]	[redacted]

SIEMENS
Water Technologies

Functional Description – SmartBNR™ Controls

The SmartBNR Control System is a PLC based process control system that provides for partial or complete process control of multi-stage reactor systems using aerated anoxic processes. These include the Orbal®, Vertical Loop Reactor®, VertiCel™, BioNutre™, and Cannibal™ processes.

1. Aeration Control

The first stage reactor (aerated-anoxic) condition is monitored by an ORP analyzer. A dissolved oxygen analyzer monitors the final stage reactor (aerobic). In systems with more than two stages, both a DO analyzer and an ORP analyzer monitor the second stage.

The PLC evaluates the condition of the entire system and adjusts aeration to continuously optimize all reactor conditions. The system does not control the reactors independently and the PLC does not operate a simple PID control loop. Rather, it runs a proprietary algorithm based on both our extensive research and development and our unique understanding of aerated-anoxic processes.

Disc aerators are controlled by means of variable frequency drives (VFD's). Positive displacement blowers are controlled by means of VFD's and an airflow distribution valve system. Centrifugal blowers are controlled by means of inlet throttling and an airflow distribution valve system.

2. Wasting Control

A suspended solids analyzer in the final stage reactor allows the PLC to calculate the solids inventory. A suspended solids analyzer and flow meter in the WAS pipe allow the PLC to calculate the mass flow rate of solids wasted. The mass flow is controlled by means of an actuated valve, control valve, or WAS pump VFD. The PLC continuously adjusts wasting to achieve the selected MCRT (sludge age).

3. Stormflow Mode of Operation

The plant flow meter provides signals to the PLC. Actuated influent valves on the first and final stage reactors allow the PLC to operate stormflow mode of operation without operator attention. This prevents the loss of solids in extreme flow events.

1.2 Selected Design Parameters

The VertiCel BNR treatment system equipment offered has been designed to operate in conjunction with Siemens Tow-Bro clarification processes and is based upon the following design parameters:

- Design suspended MLSS: 5,000 mg/L
- Design HDT: 30.1 hours
- Design SRT in each Orbal Basin: 22.0 days
- Design Organic Loading 17.4 lbs BOD/day/1000 ft^3
- Disc aerators / basin 3 @ 20 Hp ea.
- Aeration discs / basin 108 (36 per drive)

2. VERTICEL SYSTEM DESCRIPTION

The VertiCel System is a suspended growth activated sludge process designed to minimize energy consumption and designed to accomplish biological nutrient removal (BNR).

A unique aspect of the VertiCel System is its ability to reduce aeration energy requirements by effectively dealing with the effects of surfactants in wastewater on the oxygen transfer efficiency of aeration devices. Fine bubble diffusers are very efficient in clean water but surfactants reduce this efficiency by forming a viscous film on the surface of the air bubbles. Devices that rely on turbulence to transfer oxygen to the mixed liquor like Disc Aerators are less efficient in clean water; however, they deal much more effectively with surfactants. When computing aeration oxygen transfer requirements, alpha (α) is a measure of how effectively a device transfers oxygen in mixed liquor as opposed to clean water. The higher the value of α for an oxygen transfer device, the less impact surfactants will have upon its oxygen transfer efficiency. Surface aeration devices such as the Disc Aerators used in the VertiCel System have substantially higher α values than diffused aeration devices.

The VertiCel System uses a combination of aeration devices to take advantage of the strengths of each device. Initial aeration and mixing in the VertiCel System is accomplished using Disc Aerators because of their relative insensitivity to the presence of surfactants. A unique coarse bubble aeration grid is used in combination with turning vanes to augment the disc aeration by releasing compressed air beneath the horizontal baffle in the VLR. By releasing air at this location, the coarse bubbles obtain maximum bubble contact time to maximize oxygen transfer efficiency. The VLR is designed to operate under aerated/anoxic conditions where an oxygen deficit occurs and simultaneous nitrification and denitrification can take place.

Once the surfactants have been dissipated due to treatment in the VLR with its Disc Aerators and coarse bubble aeration, fine bubble aeration can be applied much more efficiently in the downstream fine bubble aeration tanks.

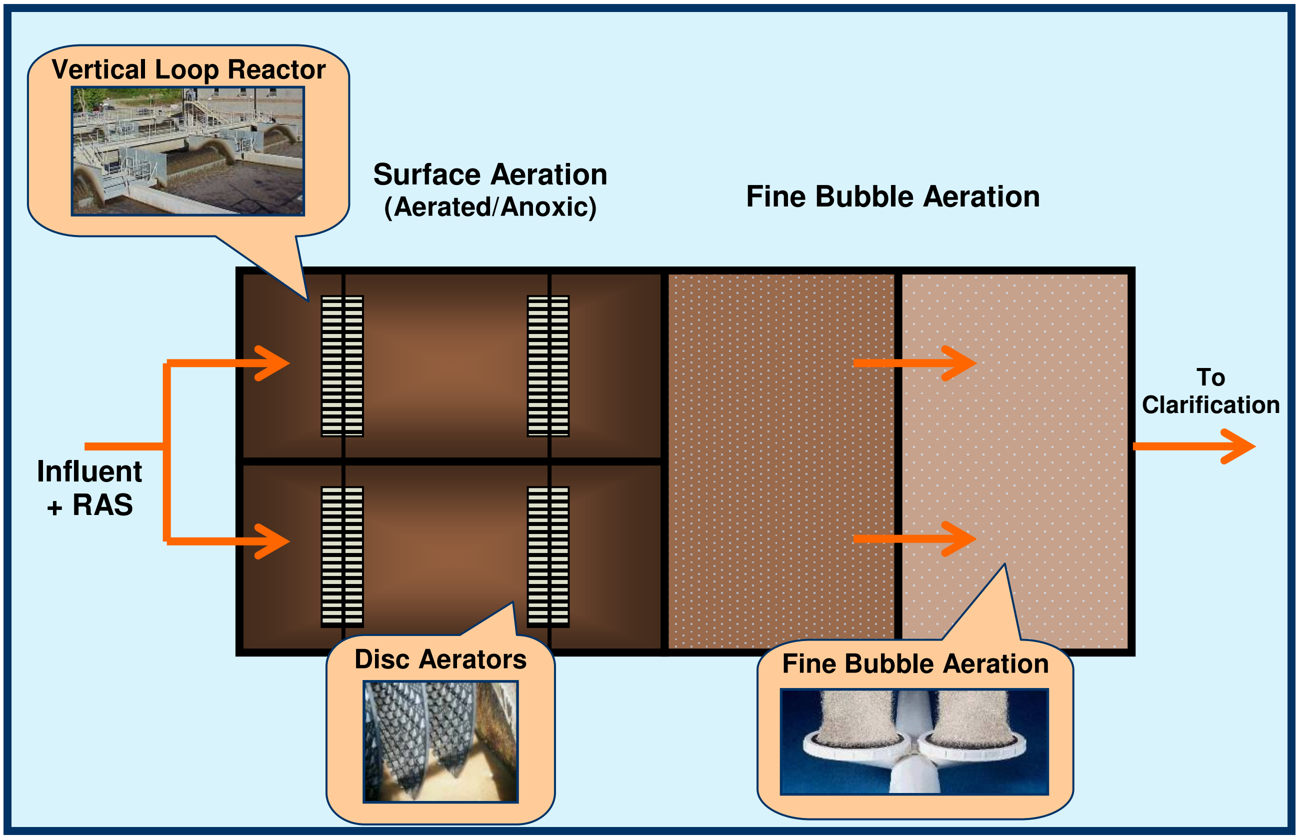


Figure 1 – Typical VertiCel System layout

VLR tanks and fine bubble aeration tanks are arranged to make use of common intermediate walls. Flow controls are arranged for independent operation of any single tank or operation in conjunction with an adjacent tank. Aeration grids consist of an air distribution manifold, diffuser header piping, fine bubble diffusers, moisture blow-off assemblies, supports and related hardware.

Raw wastewater passes progressively though the VLR Tanks (aerated/anoxic tanks) and the fine bubble aeration tanks before passing on to secondary clarification. Return activated sludge (RAS) is recycled back to the VLR tanks.

2.1 Vertical Loop Reactor (VLR)

VLR tanks are rectangular concrete structures in which disc aeration equipment and a grid of coarse bubble diffusers are installed. A horizontal concrete baffle is constructed in the VLR tank splitting it in half to create an over/under flow arrangement. The configuration is essentially an oxidation ditch turned on its side.

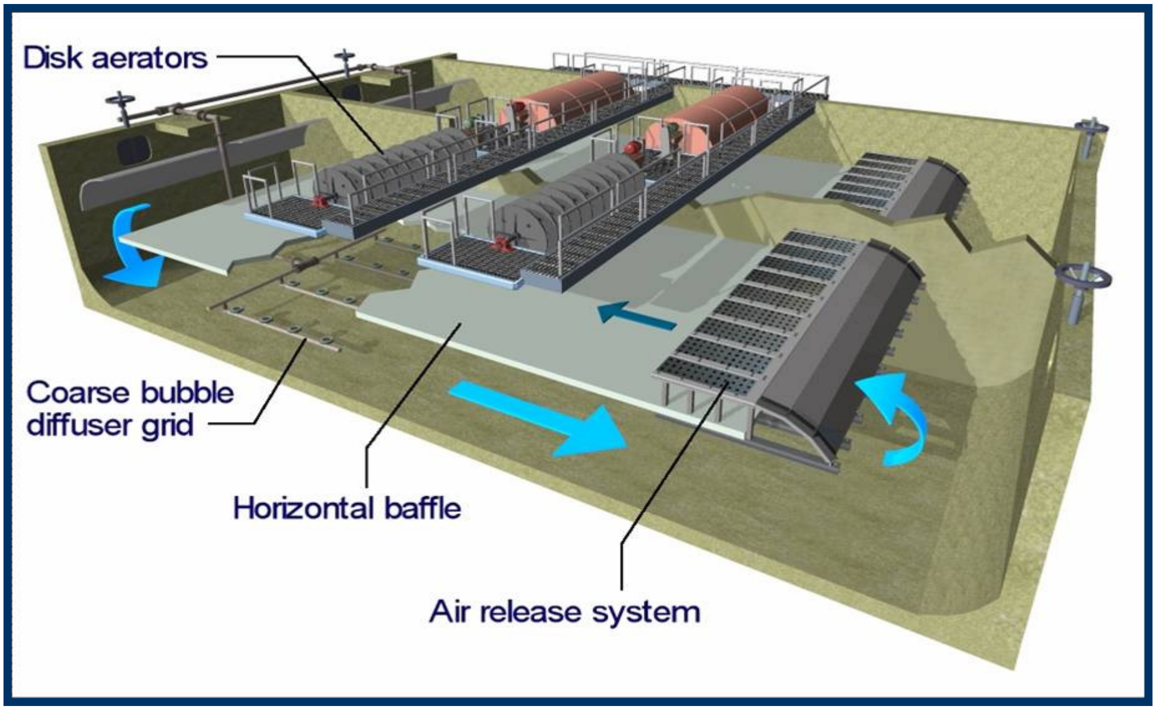


Figure 2 – Perspective view of a Vertical Loop Reactor

VLR tanks are equipped with multiple Disc Aerators. The Disc Aerator assemblies installed in the upper section of the tank provide oxygen, mixing, and directional velocity for the system. The VLR tanks are typically maintained in an oxygen deficient state by limiting the oxygen delivered to a fraction of the total oxygen demand to promote aerated-anoxic conditions and achieve simultaneous nitrification and denitrification.

VERTICAL LOOP REACTOR

VLR basins are typically designed with side water depths of 20 feet or more. The horizontal baffle divides the tank vertically into upper and lower segments that are of equal depth. The Disc Aerators establish an over/under mixing pattern with the flow in the upper segment in the opposite direction from the flow in the lower portion.

The horizontal baffle prevents the coarse bubbles released by the coarse bubble aeration grid from immediately rising to the surface. The air bubbles must travel almost the full length of the VLR tank before being released through a special perforated air release plate. The result of this long contact time is increased oxygen transfer efficiency.

2.1.1 Disc Aerators

The mechanical backbone of the VertiCel System is the unique aeration capabilities of the Disc Aerator. Aeration and mixing are provided by triangular nodules on the surface of each disc. Disc aerators offer the ultimate in flexibility because mixing and aeration characteristics can be altered by changing the direction of rotation, disc immersion (variable from 9 to 21 inches inches), number of discs on a rotor shaft and/or the speed of rotation (variable from 30 to 60 rpm).

DISC AERATORS

The disc itself is split in two half sections and can be attached to the shaft at any location along the shaft length. As a result, discs are easy to add when future expansions in capacity are contemplated. Disc shaft assemblies span one or more channels with the number of discs per channel based upon the aeration and mixing requirements in that channel.

Daily fluctuations in oxygen demand are readily handled by changing disc immersion or by changing the speed of rotation using a variable frequency drive (VFD). Longer periods of low oxygen demand can be dealt with by turning selected Disc Aerators off for a period of time.

Mechanical components of Disc Aerators are simple, rugged, and easy to maintain. Shaft sections are solid steel with no machined ends, welded stub ends, or welded collars to concentrate mechanical stress and invite structural failure. Each shaft is supported by oversized conventional split-housing pillow block bearings. Multiple shaft sections are connected using a non-lubricated flexible coupling.

Splash shields are included at each bearing location to maintain a dry environment for bearings, couplings, and drives. In cold weather applications, fiberglass weather hoods are used to cover the Disc Aerators to prevent icing.

2.1.2 Coarse Bubble Aeration

A grid of coarse bubble diffusers is installed in the lower section of the VLR tank beneath the horizontal baffle to provide additional oxygen when the oxygen requirements exceed the amount of oxygen supplied by the Disc Aerators. The retention time of the coarse bubbles is increased several times in comparison with conventional tankage as the bubbles traverse the tank beneath the mid-depth horizontal baffle.

VALVED ORIFICE COARSE BUBBLE DIFFUSED AERATION SYSTEM

The coarse bubble diffuser grid for the VLR includes piping drop legs, distribution manifolds and headers, coarse bubble diffusers, piping supports, and anchors.

2.1.3 Diffused Air Management Systems

Each VLR System Tank includes components for managing the air released from the coarse bubble aeration system in order to maximize the oxygen transfer efficiency of the coarse bubble aeration system and minimize headloss due to turbulence.

Air distribution baffles attach to the underside of the horizontal concrete baffle. These rectangular molded fiberglass baffles provide even distribution of the air released from the coarse bubble diffusers along the bottom of the horizontal concrete baffle. The air bubbles are conveyed to the downstream air release system.

The air release distribution system is located at the far end of the horizontal concrete baffle away from the coarse bubble diffusers. A turning vane section insures a smooth change in the direction of flow minimizing headloss. Perforated release section plates provide for even distribution and release of air from the coarse bubble diffusers across the entire width of the VLR System tank.

2.2 Fine Bubble Aeration

Aeration in the first and second stage fine bubble aeration tanks is accomplished using DualAir® Fine Bubble Diffuser Systems. A DualAir diffuser assembly includes two diffuser bases mounted on either side of the aeration piping molded together with a curved saddle formed between them.

The DualAir design is extremely economical because it mounts two diffusers at each diffuser location rather than a single diffuser. This configuration results in less aeration piping and fewer pipe supports. The saddle arrangement provides greater contact area between the saddle and PVC aeration piping to insure a stronger bond with greater holding power.

The EPDM diffuser membrane media is high pressure injection molded using a time tested formula that provides superior rebound memory. The result is membrane durability – a design life of up to ten years - even at high air flow rates. The membrane includes precision perforated "I" slits that effectively resist both tearing and fouling. The slits open with increasing air flow and seal closed when the flow of air is stopped to minimize fouling. A thick diffuser center prevents ballooning and a unique tapered membrane cross section insures even fine bubble distribution across the entire membrane surface.

FINE BUBBLE DIFFUSED AERATION INFORMATION

The DualAir Fine Bubble Aeration System typically includes piping drop legs, distribution manifolds and headers, DualAir Fine Bubble Diffusers, piping supports, and anchors.

2.3 SmartBNR® Control System

The VertiCel System creates the aerated/anoxic conditions that favor simultaneous nitrification-denitrification through energy efficient biochemical pathways. These pathways are different than the typical pathway described in text books. Aerated/anoxic conditions are created using oxidation-reduction potential (ORP) control through a SmartBNR Control system.

The SmartBNR Control System keeps a VertiCel System operating efficiently, regardless of varying load conditions. Designed by Siemens biological treatment experts, the software of the SmartBNR Control System encodes their unique process knowledge to ensure optimum system performance.

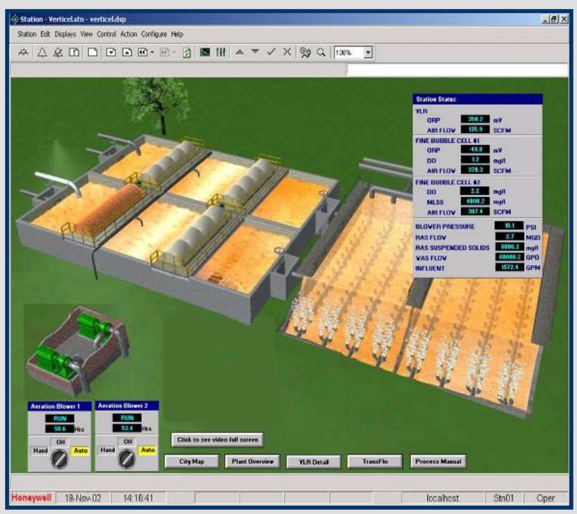
The VertiCel System is monitored by ORP and dissolved oxygen (DO) probes that continuously assess the mixed liquor environment in the VLR reactors and fine bubble aeration cells, enabling the system to carefully control the amount of oxygen delivered to each of the tanks.

A key aspect of the SmartBNR System is its ability to create and maintain the aerated/anoxic conditions necessary for simultaneous nitrification/denitrification in a single tank. SmartBNR can also create conditions that lead to enhanced biological phosphorus removal without the expense of including additional anaerobic tankage in the facility design.

Ordinarily a rainstorm in the middle of the night would command almost immediate operator attention to prevent solids from washing out of the biological treatment system. SmartBNR overcomes this problem by automatically switching the VertiCel System to stormflow mode of operation to insure that excessive loss of solids does not occur.

Excessive flows during storms are the bane of many wastewater treatment plants overloading the secondary clarification step and potentially resulting in solids washout from the system. The result can be long term loss of treatment. With the VertiCel Process, storm flow rates five times average flow can flow through the tanks without danger of solids washout. The SmartBNR System redirects influent flow during a peak flow event to a downstream tank in the VertiCel System while keeping the return activated sludge (RAS) flow in the first VLR tank. The result is a quick increase in mixed liquor suspended solids (MLSS) concentration in the first tank and a dramatic drop in MLSS in the later aeration tanks. This allows the solids loading in the clarification step to drop below design levels. When the facility flow rate returns to normal, the SmartBNR System returns operation to conventional mode.

SMARTBNR SYSTEM
Brochure Link
SmartBNR™ Process Control System



SmartBNR Technology provides the operator with easy-to-use tools for the most efficient plant control. The SmartBNR control system features programmable logic controller (PLC) based controls that utilizes a graphical interface and can readily interact with a SCADA system designed for an entire treatment facility.

2.3 Tow-Bro Clarifiers

We are proposing two (2) 65-ft diameter Tow-Bro Clarifiers along with this VertiCel Process Design. We have designed these units based on the highest peak daily flow expected through the system and the maximum RAS rate.

The Siemens Tow-Bro Unitube header design assures an active biomass is returned to the aeration tank of activated sludge plants at the highest possible concentration. Field observations indicate a Tow-Bro header can produce return solids concentration 50% to 100% higher than scraper clarifiers can and 50 % to 75% higher than competitive hydraulic removal devices. This results in a volumetric reduction in sludge pumped of 25% to 50% for an equivalent amount of solids returned. A conservative present worth analysis shows the operating cost savings for the Tow-Bro to be $10,000 (USD) per million gallons (3,785 m^3) of sludge pumped. Further, rapid sludge removal reduces air requirements in the activated sludge process and limits rising solids problems associated with nitrogen gas release when solids sit too long in the final clarifier. Rapid removal offers an additional benefit of limiting phosphate release to the final effluent.

Tow-Bro Clarifiers are not subject to sludge transport failures and short-circuiting of the influent flow to the return sludge. The problem of sludge rising over a spiral scraper blade is not limited to attack angle of the blade but is also dependent on mass loading, depth of blade, floor slope, speed of rotation, sludge settling characteristics (SVI) and sludge hopper design. To assure adequate sludge transport and thickening without short-circuiting in spiral scraper clarifiers, an adequate sludge blanket needs to be maintained over the center hopper. In his article "Energy Considerations in Circular Clarifier Design", WEF 65th Annual Conference, Sept. 1992, Orris Albertson points out the need for a minimum 1.5 m (5 ft) center depth beneath the base of the sidewall. This extra depth increases capital costs when compared flat floor Tow-Bro designs.

3 DESIGN TEAM MEMBERS

Your Siemens Design Team contacts are as follows:

NAME	FUNCTION	PHONE	EMAIL
John Olson *	Technical Sales Manager (Orbal/VLR/VertiCel)	262.528.4951	John.e.olson@siemens.com
Bryan Davis *	Technical Sales Manager (Clarifier)	262.521.8490	Bryan.n.davis@siemens.com
Dave Dubey	E&I Team Leader (SmartBNR)	262.521.8541	david.dubey@siemens.com

* Primary contacts

SIEMENS

Water Technologies

3 - SECONDARY CLARIFIERS

SIEMENS
Water Technologies

INTRODUCTION
TOW-BRO® HYDRAULIC REMOVAL CLARIFIER

HISTORY

SIEMENS Water Technologies (SWT), as Rex Chain Belt, installed the first hydraulic removal device for use in activated sludge plants in 1929. Mr. Darwin W. Townsend originally conceived the idea to eliminate the disturbance caused by scraping mechanism. His concept was to provide a "specially designed apparatus consisting essentially of horizontally revolving pipe headers equipped with multiple sludge suction nozzles". Townsend working with Mr. James Brower, Superintendent at Milwaukee Jones Island STP, developed the first plans for a patented suction removal header which would later be known as the *Tow-Bro* (Townsend-Brower).

The benefits of hydraulic removal were immediately demonstrated. In their article "New Sludge-Removal Apparatus Developed at Milwaukee" Townsend and Brower report increased solids concentration, higher return rates and a 35% reduction in plant air requirements compared to the originally installed scraper collectors. The widespread applicability of this design attests to its benefits. U.S. Filter/Envirex has furnished more than 2,500 Tow-Bro clarifiers in over 500 installations.

The first Tow-Bro Clarifiers used individual vacuum cleaner style nozzles spaced along the rotating pipe header. This design was replaced in 1955 by the current Unitube header. This design was demonstrated in side-by-side tests at Ann Arbor, MI to offer improved solids concentration and increased flexibility. The orifice design for Unitube headers is based on a mathematical model developed for The Chain Belt Co. by J.R. Villemonte and G.A. Rohlich of the University of Wisconsin. Critical to the design are header and orifice coefficients obtained from field data at Ann Arbor and later verified at Racine, WI. The Rexnord Project Report "Unitube Tow-Bro Header Hydraulic Verification" summarizes the field work at Racine. This testing confirmed that, as postulated by Villemonte and Rohlich, orifice coefficients will vary along the header. It is important for the specifying Engineer to realize this and to require manufacturers to submit documentation of field dye verification. We have investigated many competitors' designs which fail to perform adequately in the field due to improper orifice design.

TOW-BRO HYDRAULICS

Important to proper design of a hydraulic removal device is an understanding of how activated sludge settles in a circular clarifier. U.S. Filter/Envirex has always contended that the distribution of solids along the radius of the tank is fairly uniform and should be picked up uniformly. When looking at solids concentration in a tank plan view as done in the article "Sludge Blanket In Activated Final Clarifiers" by William H. Boyle, we found that variations which do occur in the sludge blanket are random and, thus, it is impractical to deviate from uniform pick-up. This differs from the theory that heavier activated sludge solids drop out at the center of the tank and thus, the operator should adjust the device based on solids concentration tests.

Solids distribution and dye tests conducted by Robert Crosby and reported in the EPA publication 600/2-84-131, "Hydraulic Characteristics of Activated Sludge Secondary Clarifiers" give a clear picture of how solids move in a tank. These studies show that influent flow travels along a rather narrow band along the top of the sludge blanket at a solids concentration of about 2,000 mg/l. Solids distribution profiles do show uniformly stratified layers across the full diameter, in the absence of turbulence, with heavier solids near the tank floor. Illustrations are also presented which show vortexing and turbulence created in the sludge blanket from passage of in-balanced "riser pipe" suction headers. It is interesting to note the author concludes that "hydraulic sludge headers do not perform ideally; sludge distribution and removal is not uniform; some riser pipes tend to clog" - five of the six suction devices investigated were riser pipe designs.

The Unitube header is engineered for uniform sludge pick-up and maximum solids concentration without clogging. Its rectangular shape positioned at a 45^{o} angle to the floor and a fluidizing vane behind the orifices physically traps the bottom layer of solids for removal. A 30" (0.8 m) maximum orifice spacing limits solids travel to 15" (0.4 m). A constantly increasing cross section maintains a constant velocity thus eliminating the possibility of clogging and minimizing underwater structures which disturb the upper sludge layer. The 1954 report and video titled "Studies on Sludge Removal Equipment for the Chain Belt Company" clearly demonstrate the very fragile nature of submerged activated sludge and demonstrates why scraping is not recommended.

Uniform pick-up of sludge along a flat floor maximizes the mass loading capability (#/sq ft/day) (kg/m^2 h) of the final clarifier by utilizing the full floor surface area. Riser pipe and scraper collectors designed to move solids to the center of the tank disturb the sludge blanket, thus limiting allowable influent flow and increasing effluent suspended solids. The article "Upgrading Existing Secondary Clarifiers to Enhance Process Controllability to Support Nitrification", G.P. Wheeler and R.A. Hegg, WEFTEC'99 Proceedings, notes that the higher tip speeds recommended by proponents of spiral scraper collectors, and often required for adequate solids transport, cannot be maintained without a subsequent increase in effluent TSS.

The SWT Tow-Bro Unitube header design assures an active biomass is returned to the aeration tank of activated sludge plants at the highest possible concentration. Field observations indicate a Tow-Bro header can produce return solids concentration 50% to 100% higher than scraper clarifiers and 50 % to 75% higher than competitive hydraulic removal devices. This results in a volumetric reduction in sludge pumped of 25% to 50% for an equivalent amount of solids returned. A conservative present worth analysis shows the operating cost savings for the Tow-Bro to be $10,000 (USD) per million gallons (3,785 m^3) of sludge pumped. Further, rapid sludge removal reduces air requirements in the activated sludge process and limits rising solids problems associated with nitrogen gas release when solids sit too long in the final clarifier. Rapid removal offers an additional benefit of limiting phosphate release to the final effluent.

Recent research in the area of activated sludge secondary clarifier design is summarized in the IAWQ Technical Report No. 6 "Secondary Settling Tanks: Theory, Modeling, Design and Operations", October, 1997. Notable references to the Tow-Bro Clarifier design are:

Page 32: High sludge blankets increase the likelihood of denitrification and rising sludge in the Secondary Clarifier. This can occur even if the incoming mixed liquor has a positive DO due to "In-floc denitrification". Crabtree points out that denitrification can begin from 5 minutes to 1 hour after the mixed liquor leaves the aeration basin with an average of 35 minutes.

Conclusion: Design for rapid sludge removal to prevent denitrification and rising sludge in the Secondary Clarifier. Remove all sludge in one revolution of the clarifier mechanism.

SWT Side Note: The Tow-Bro Clarifier is typically operated with less than a 1.5 ft sludge blanket and removes the complete sludge blanket in less than 30 minutes. Since the Tow-Bro header is designed for a flat floor it is the only "zero blanket" design available.

Page 169: Sludge blankets need to be kept low to limit loss of solids to the effluent. High rotational speed of Pipe Organ collectors disturb the density currents in the tank and result in loss of solids to the effluent. Even deep blade scraper collectors develop higher sludge blankets than suction removal collectors. Actual sludge blanket level measured at Sacramento, CA in a suction removal clarifier was 0.6 ft (0.18 m) compared to a predicted blanket depth of 3.5 ft (1.07 m) with deep scraper blades.

Conclusion: Suction removal devices offer higher effluent suspended solids removal efficiency by limiting the depth of the sludge blanket.

SWT Side Note: The Tow-Bro Clarifier prevents disruption of the density currents in the tank by the use of multiple orifices on a maximum spacing of 2.5 ft along the Unitube header (compared to 12 to 15 ft for Organ Pipes); by use of a submerged manifold rather than riser pipes which pass in front of the center pier influent ports; by minimizing underwater structure and by use of slow rotational speeds.

Page 170: A flat floor clarifier design with a suction removal device is superior to a sloping "conical bottom" tank equipped with scraper collectors (even deep blade scrapers). Scraper clarifiers in sloping bottom tanks have limited thickening area. Scraper clarifiers in sloping bottom tanks have limited solids loading rate capacity. Tow-Bro Clarifier design is considered superior to Organ Pipe suction removal.

Conclusion: Flat floor suction removal design maximizes the solids loading and thickening capabilities of the Secondary Settling Tank. Higher mass loadings are possible with suction removal clarifiers as well as higher return solids concentrations.

SWT Side Note: A testimonial for the SWT Tow-Bro Clarifier installed at the Weyerhaueser installation in Longview, WA is available. This is typical of other sites which have had both Organ Pipe and Tow-Bro clarifiers. If requested, return solids concentration data from Denton, TX and Chesterfield, VA is available. A curve showing effluent suspended solids improvement at Durham (OR) when poorly designed Eimco suction removal headers were replaced with SWT Tow-Bro headers is also available. Average ESS dropped from 30 mg/l to less than 15 mg/l with a properly designed sludge removal device.

Page 171: Spiral scrapers with extreme attack angles do not assure positive sludge transport and result in long sludge retention time and high sludge blankets. Information from Germany dating back to 1951 points out the need for a significant floor slope with spiral scraper collectors. Influent mixed liquor feed can short circuit into center sludge hoppers if sludge transport is not adequate.

SWT Side Note: Tow-Bro Clarifiers are not subject to sludge transport failures and short circuiting of the influent flow to the return sludge. The problem of sludge rising over a spiral scraper blade is not limited to attack angle of the blade but is also dependent on mass loading, depth of blade, floor slope, speed of rotation, sludge settling characteristics (SVI) and sludge hopper design. To assure adequate sludge transport and thickening without short circuiting in spiral scraper clarifiers an adequate sludge blanket needs to be maintained over the center hopper. In his article "Energy Considerations in Circular Clarifier Design", WEF 65th Annual Conference, Sept. 1992, Orris Albertson points out the need for a minimum 1.5 m (5 ft) center depth beneath the base of the sidewall. This extra depth increases capital costs when compared to flat floor Tow-Bro designs.

Page 172: Claims that scraper clarifiers are capable of higher return sludge concentrations than suction removal clarifiers are not substantiated.

SWT Side Note: When looking at side-by-side comparisons of Tow-Bro clarifiers vs. Riser Pipe designs it is apparent that return sludge concentration is highly influenced by pumping routine. It is also apparent that a Tow-Bro header designed for minimum sludge agitation and uniform sludge remove will yield the highest solids concentration achievable for any pumping routine. Similar claims for spiral scraper collectors have not been substantiated. Published results claiming plant improvements with spiral scraper collectors are inconclusive due to simultaneous improvements in the activated sludge process.

Page 178: Further results of lower RAS rates and higher return solids concentrations with Tow-Bro clarifier design.

Membrane Bioreactor

Equipment Information

BioFlowsheet Solutions+ System Proposal

For the Matanuska Susitna Borough, AK

Proposal #09P-0906M
June 8, 2009

Water Technologies

SIEMENS

SIEMENS

Water Technologies

June 8, 2009

To: Ms. Lisa Woolard / GV Jones Engineers

Subject: BioFlowsheet Solutions+ System Proposal for Matanuska Susitna Borough, AK

Dear Ms. Woolard:

Siemens Water Technologies welcomes the opportunity to offer a biological treatment and membrane filtration solution for this project. Based on a review of your wastewater application, we feel that the Siemens MemPulse™ Membrane Bioreactor System, with Vertical Loop Reactors will provide a cost effect solution that will reliably meet your treatment needs. We look forward to continuing discussions with you as you evaluate our offering.

Key aspects of the MemPulse™ System we would like to draw your attention to include:

- <u>MemPulse™ Technology</u> – Siemens MemPulse™ technology increases membrane scouring effectiveness, reduces energy consumption and decreases operation and maintenance costs.
- <u>Small footprint</u> – Siemens MBR system is designed at elevated mixed liquor suspended solids concentrations which decreases overall site footprint requirements.
- <u>Advanced Process</u> – Siemens MBR system uses Title 22 approved membrane modules ensuring high quality effluent from the MBR that will meet the most demanding effluent requirements.
- <u>Aerated Anoxic Nitrification</u> – Siemens MBR System utilizes the VertiCel® system, which promotes nitrification through alternate pathways at near zero dissolved oxygen levels. The aerated anoxic nitrification concept was pioneered by Siemens and its advantages in terms of aeration power savings and biological nutrient removal will be addressed in the Proposal.
- <u>Two-phase MemPulse™ technology</u> – prolongs membrane life and provides a stable operating environment.
- <u>Service Support</u> – Siemens offers a number of service programs which can be customized to the individual needs of the application. Periodic inspection and full membrane cleaning programs are available through our nationwide service network.
- <u>Remote Monitoring</u> – The Siemens MBR is equipped with the ability to monitor critical operating parameters via the internet, allowing trained Siemens process engineers to easily support local service people in troubleshooting any problems which may occur.

1901 South Prairie Avenue, Waukesha, WI 53189 · telephone: 800/524-6324 · facsimile: 262/547-4120

We hope that you will find all of the information necessary to evaluate the MBR System in this Proposal; however, should you require additional information or wish to discuss the contents of this Proposal further, please contact:

Nathan Antonneau

Telephone: 262-521-8401

E-mail: Nathan.Antonneau@Siemens.com

We appreciate your interest in Siemens Water Technologies Products and trust that as you review this offering, you will find the information provided to be helpful in your decision making process.

Regards,

Nathan Antonneau
Siemens Water Technologies

cc: Bill Reilly, Jr. / WH Reilly & Co. – Portland, OR

Taking care of the world's water

SIEMENS

Water Technologies

BioFlowsheet Solutions+ System Proposal

to

GV Jones Engineers

for

For the Matanuska Susitna Borough, AK

June 8, 2009

Contents[1]

[1] Note that the page numbers above are hyperlinks – press "ctrl" and click a page number to go to that page. Throughout the document in the header, you will find "Contents". Pressing "ctrl" and clicking on "Contents" will bring you back to this Table of Contents. Occasionally, you will find other blue, underlined "Hyperlinks" which you can press along with "crtl" to go to the link and view the desired information.

1 DESIGN BASIS

The design basis for our solution is summarized in this section. Please review these design criteria carefully to insure that they reflect your latest project needs.

1.1 Influent Flows

Design influent flows are shown in the table that follows:

Influent Flows		
Parameter	**Value**	**Units**
Average Daily Flow (ADF)	4	million gallons per day (MGD)
Peak Daily Flow (PDF)	8	MGD
Peak Hourly Flow (PHF)[2]	9	MGD

1.2 Influent Water Quality

Influent parameters that form the basis of the information contained in this proposal are shown in the table that follows:

Influent Water Quality[3]		
Parameter	**Value**	**Units**
Biochemical Oxygen Demand (BOD_5)	350	milligrams/liter (mg/L)
Chemical Oxygen Demand (COD)	700	mg/L
Total Suspended Solids (TSS)	350	mg/L
Ammonia Nitrogen (NH_3-N)	40	mg/L
Total Kjeldahl Nitrogen (TKN)	50	mg/L
Alkalinity[4]	> 250	mg/L as $CaCO_3$
Fats, Oils & Grease (FOG)	< 50	mg/L
Maximum Influent Temperature	15	degrees Celsius (^oC)
Minimum Influent Temperature	6	degrees Celsius (^oC)

[2] Flow equalization is recommended to reduce peak hourly flow to this level.

[3] Customer must confirm influent water quality for any associated process guarantee and membrane warranty.

[4] If the influent alkalinity is less than the value listed, supplemental alkalinity may be required.

1.3 Effluent Requirements

The proposed MemPulse™ MBR system is designed to meet the following effluent requirements:

Effluent Requirements		
Parameter	**Value**	**Units**
BOD_5	< 15	mg/L
Total Suspended Solids	< 15	mg/L
NH_3-N	< 5	mg/L
NO_3-N	< 5	mg/L

2 PROCESS FLOW DIAGRAM

The proposed Membrane Bioreactor Treatment System consists of the following unit processes which operate in series:

- Flow equalization
- Primary treatment using fine screening
- VertiCel® Biological treatment system
- MemPulse™ Membrane Operating System (MOS)

The process train flow diagram of the Siemens MBR System is as follows.

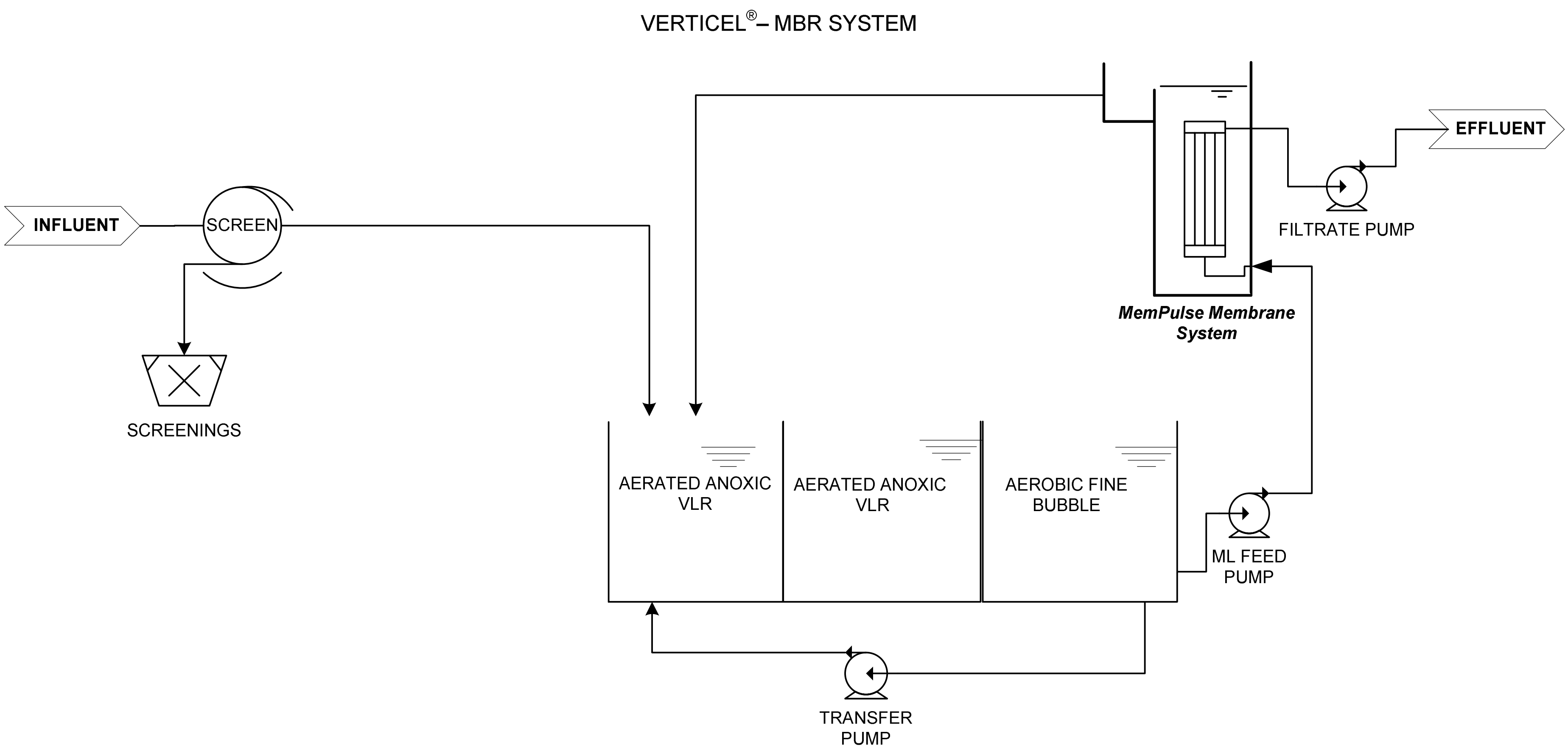


Figure 1 – Membrane Bioreactor System block flow diagram.

3 PROCESS DESCRIPTION

3.1 Biological Process

The VertiCel System is a suspended growth activated sludge process designed to minimize energy consumption and designed to accomplish biological nutrient removal (BNR).

VERTICEL SYSTEM

A unique aspect of the VertiCel System is its ability to reduce aeration energy requirements by effectively dealing with the effects of surfactants in wastewater upon the oxygen transfer efficiency of aeration devices. Fine bubble diffusers are very efficient in clean water but surfactants reduce this efficiency by forming a viscous film on the surface of air bubbles. Devices that rely upon turbulence to transfer oxygen to the mixed liquor like Disc Aerators are less efficient in clean water; however, they deal much more effectively with surfactants. When computing aeration oxygen transfer requirements, alpha (α) is a measure of how effectively a device transfers oxygen in mixed liquor as opposed to clean water. The higher the value of α for an oxygen transfer device, the less impact surfactants will have upon its oxygen transfer efficiency. Surface aeration devices such as the Disc Aerators used in the VertiCel System have substantially higher α values than diffused aeration devices.

The VertiCel System uses a combination of aeration devices to take advantage of the strengths of each device. Initial aeration and mixing in the VertiCel System is accomplished using Disc Aerators due to their relative insensitivity to the presence of surfactants. A unique coarse bubble aeration grid is used in combination with turning vanes to augment the disc aeration by releasing compressed air beneath the horizontal baffle in the VLR. By releasing air at this location, the coarse bubbles obtain maximum bubble contact time to maximize oxygen transfer efficiency. The VLR is designed to operate under aerated/anoxic conditions where an oxygen deficit occurs and simultaneous nitrification and denitrification can take place.

Once the surfactants have been dissipated due to treatment in the VLR with its Disc Aerators and coarse bubble aeration, fine bubble aeration can be applied much more efficiently in the down stream fine bubble aeration tanks.

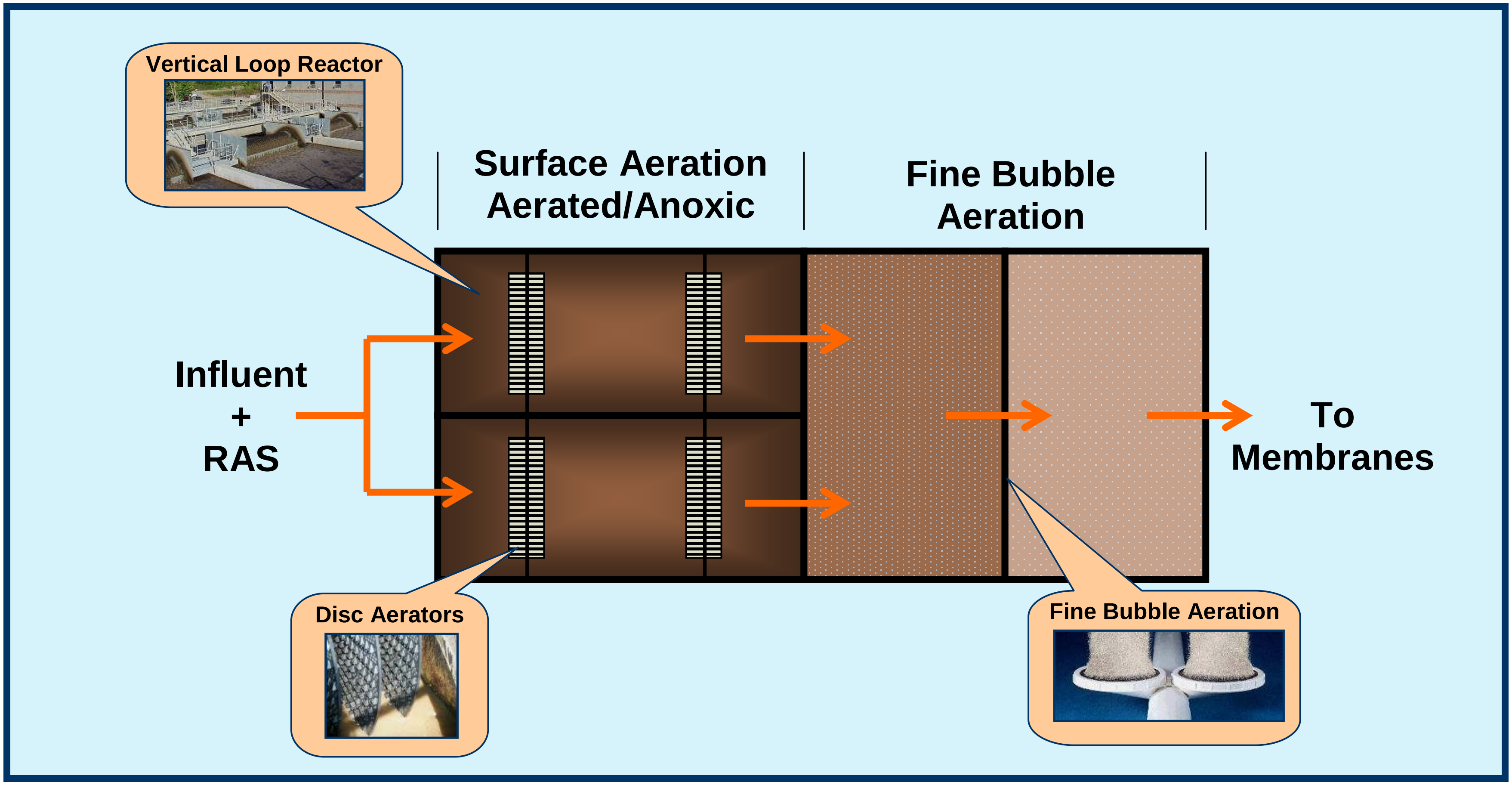


Figure 2 - VertiCel System layout.

VLR tanks and fine bubble aeration tanks are arranged to make use of common intermediate walls. Flow controls are arranged for independent operation of any single tank or operation in conjunction with an adjacent tank. Aeration grids consist of an air distribution manifold, diffuser header piping, fine bubble diffusers, moisture blow-off assemblies, supports and related hardware.

Raw wastewater passes progressively though the VLR tanks (aerated/anoxic tanks) and the fine bubble aeration tanks before passing on to membrane filtration. Return activated sludge (RAS) is recycled back to the VLR tanks.

3.2 Vertical Loop Reactor (VLR)

VLR tanks are rectangular concrete structures in which disc aeration equipment and a grid of coarse bubble diffusers are installed. A horizontal concrete baffle is constructed in the VLR tank splitting it in half to create an over/under flow arrangement. The configuration is essentially an oxidation ditch turned on its side.

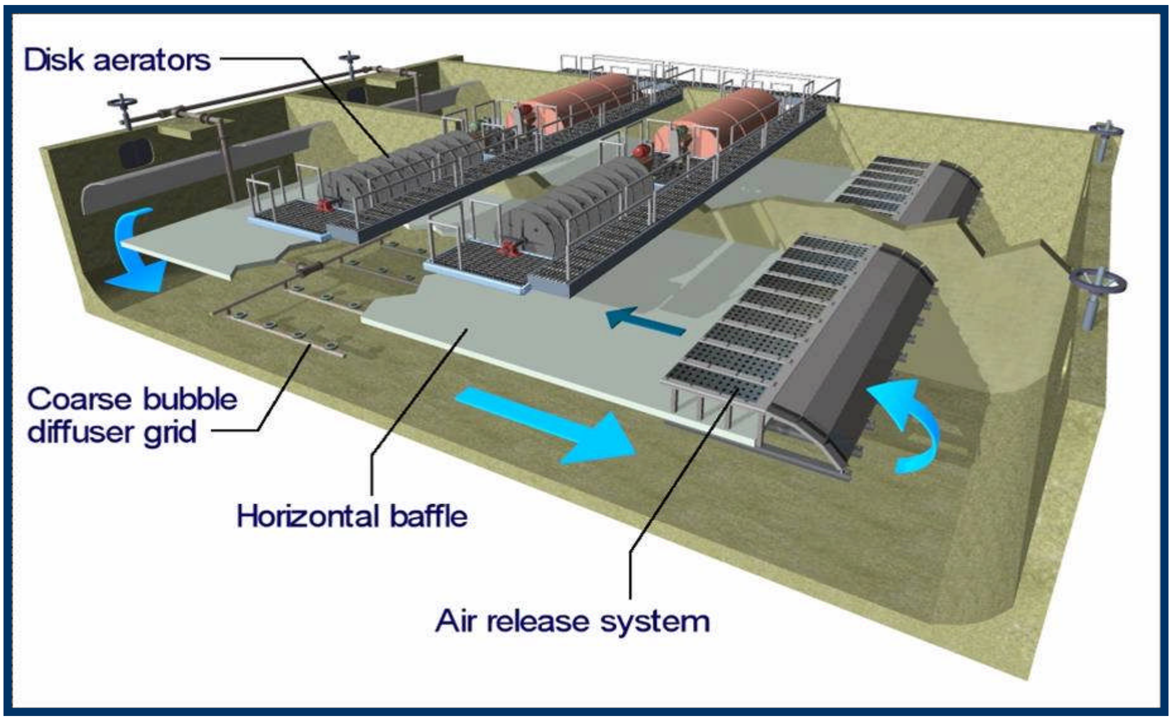


Figure 3 – Perspective view of a Vertical Loop Reactor.

VLR tanks are equipped with multiple Disc Aerators. The Disc Aerator assemblies installed in the upper section of the tank provide oxygen, mixing, and directional velocity for the system. The VLR tanks are typically maintained in an oxygen deficient state by limiting the oxygen delivered to a fraction of the total oxygen demand to promote aerated-anoxic conditions and achieve simultaneous nitrification and denitrification.

VERTICAL LOOP REACTOR

VLR's are typically designed with side water depths of 20 feet or more. The horizontal baffle divides the tank vertically into upper and lower segments that are of equal depth. The Disc Aerators establish an over/under mixing pattern with the flow in the upper segment in the opposite direction from the flow in the lower portion.

The horizontal baffle prevents the coarse bubbles released by the coarse bubble aeration grid from immediately rising to the surface. The air bubbles must travel almost the full length of the VLR tank before being released through a special perforated air release plate. The result of this long contact time is increased oxygen transfer efficiency.

MEMPULSE™ MBR SYSTEM

3.3 Membrane Operating System (MOS)

The membrane operating system replaces secondary clarifiers used in conventional wastewater treatment systems and provides a more stable and advanced treatment process within a much smaller footprint. Membrane fibers provide an absolute barrier to all wastewater solids greater than 0.1 micron in size, ensuring a consistently high quality effluent.

3.3.1 Membrane Module

The central component of the Siemens MBR system is the B40N membrane module. The B40N membrane module consists of thousands of hollow fibers fabricated from polyvinylidene fluoride (PVDF) sealed with polyurethane "pots" at both ends. The individual modules are configured into a rack assembly in manifolds of 16 which are then installed within the membrane tank.

MEMBRANE MODULE AND RACK ASSEMBLY

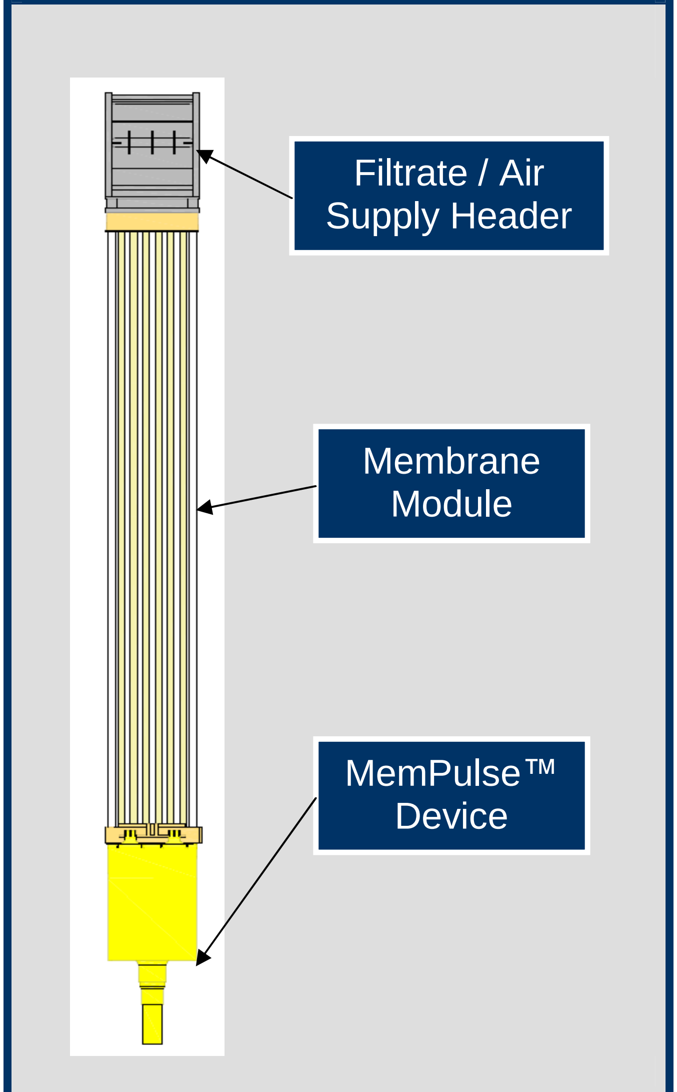
During filtration, wastewater is drawn through the membranes using the vacuum developed by the suction of the filtrate pump. As water flows through the porous membrane, particulate matter is retained at the surface of the membrane.

3.3.2 MemPulse™ Technology

MemPulse™ Technology is Siemens latest advancement in membrane bioreactor systems. Siemens MemPulse™ technology uses a simple non-mechanical device at the base of each membrane module which provides significant energy reduction, lowers maintenance costs, and preserves Siemens proven Two Phase Jet concept from previous MBR advancements.

The MemPulse™ technology can be used in a wide range of municipal and industrial wastewater treatment applications and can be easily retrofitted to existing plants. The following diagram shows the MemPulse™ device located at the base of a membrane module.

MEMPULSE™ DEVICE



3.3.3 MemPulse™ Technology – How it Works

The MemPulse™ device works by converting continuous airflow into irregular pulses of air at the base of each membrane module which creates and "airlift effect". This results in an increase in scouring effectiveness, and an overall reduction in air scour energy consumption.

The "airlift effect" created by the MemPulse™ device is also used to draw mixed liquor into the bottom of each membrane module which mixes the air bubbles with mixed liquor to create a Two Phase Jet effect.

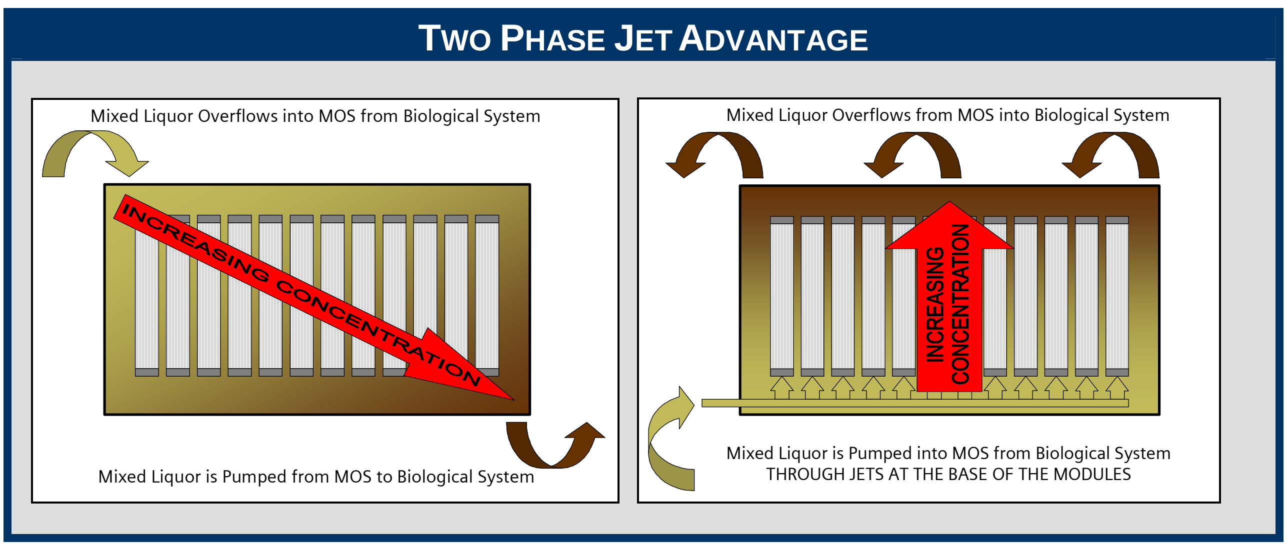
The Two-Phase Jet effect is an important part of Siemens membrane systems and performs the following critical functions:

- The combination of air and mixed liquor introduced at the base of each sub-module provides an enhanced scouring effect (turbulence) across the membrane surface, which is more effect than air alone.

- The two phase jet system provides uniform distribution of mixed liquor and air across the entire membrane tank ensuring a consistent mixed liquor environment for each sub-module preventing preferential fouling of membranes.

- The two phase jet effect prevents unnecessary cake formation on the membrane fibers caused by concentration polarization.

The following diagram highlights the affect of the Two Phase Jet effect.



3.4 Membrane System Cleaning Protocol

3.4.1 Relaxation

During normal operation of any membrane filtration system the membrane fibers develop a filter cake layer which causes an increase in the hydraulic resistance of the membrane system. To minimize this resistance, the MemPulse™ membrane system is set up to automatically initiate a relaxation process for each membrane tank after every 12 minutes of filtration. The relaxation process lasts for 1 minute and is initiated in a sequential manner, ensuring that only one tank is in relaxation at any given time. During this 1 minute relaxation period the filtrate pump for the tank in relaxation stops drawing water through the membranes. Mixed liquor and air scour continue to be introduced through the MemPulse™ during the relaxation period. By shutting off the filtrate pump, the filter cake layer is allowed to decompress which improves the efficiency of the jet scrubbing action of the MemPulse™ as the solids are swept from the membrane fibers.

3.4.2 Maintenance Clean

Maintenance cleans are performed to provide interim disinfection of the membrane modules and filtrate pipe work between scheduled chemical cleans. They are less comprehensive and require less downtime than full chemical cleans, but more effective than regular relaxations and backwashes at removing particles from the membrane surface.

During a maintenance clean, filtration is paused and chlorinated filtrate is pumped backwards (inside to out) through the fibers. The solution flows through the fiber in the mixed liquor and any residual chlorine is consumed. The mixed liquor feed pump and aeration continue throughout the maintenance clean.

Maintenance cleans are performed on a weekly basis in normal conditions. In periods of abnormally high organic loading, the maintenance clean can be conducted more frequently.

3.4.3 Clean-In-Place (CIP)

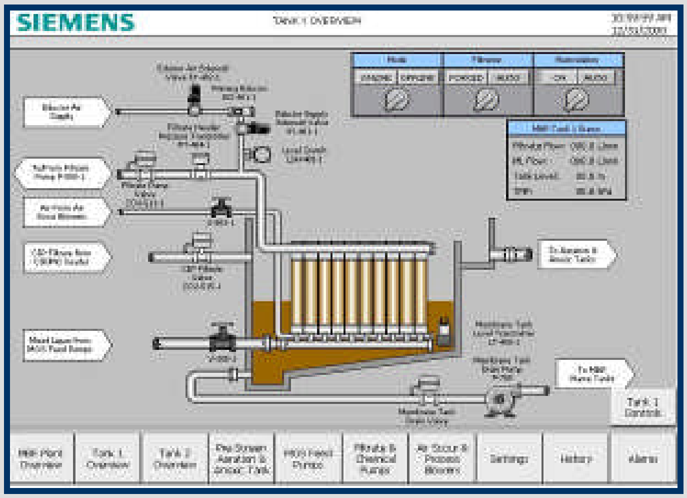
Over a period of time, some fouling of the membranes may occur which cannot be removed by physical processes alone. CIP is an intensive chemical clean used to restore a membrane's permeability. A CIP uses a chemical solution, either sodium hypochlorite or citric acid to degrade and destroy the fouling layer. During the acid CIP procedure, a mineral acid (i.e. sulfuric acid) will be added to adjust the pH of the cleaning solution to 2. The modules are soaked in chemical solution for several hours to oxidize the fouling layer on the membrane surface.

3.5 SmartMBR™ Control System

The Siemens SmartMBR™ control system is designed with reliability and ease of use in mind. The system will be equipped with a programmable logic controller (PLC) operated, pre-programmed process control panel utilizing conventional I/O.

The Master control panel (MCP), houses a Siemens S7-300 PLC. The PLC executes all control functions required for operation of the biological and membrane system, including individual tank items as well as common equipment.

SIEMENS SIMATIC MP 377 HMI



The MCP operates the equipment according to a preset treatment strategy that is field adjustable to meet changing conditions or requirements. Included in the control design are :

- DO, ORP and pH probes that monitor the environment of the aeration basins, enabling the system to apply aeration and mixing at the optimum rate and time for biological treatment and energy conservation.
- Complete diagnostic capabilities
- Automated membrane maintenance sequences

The MCP houses the main communications interfaces, including a local human/machine interface (HMI). The HMI is based on the Siemens MP377 touch panel and provides for the ability to control and monitor all aspects of the MBR system including equipment status, alarms, set point entry and maintenance cleaning. The HMI communicates directly with the PLC via a Ethernet connection. The operator interface uses a graphical PID overview of the entire MBR system incorporating easily recognizable icons for each component. Direct coordination with the contractor will be required to ensure a system that is both functional and cost effective.

In addition, a “slave” control panel is provided to house the I/O cards for each pair of membrane tanks.

Additional interface would also be accomplished in the areas of software. Software coordination would involve the review of operator screens, I/O naming standards as established by the client and coordination of tag name interface for the SCADA system.

In addition to the local control panels and the MCP, a motor control center (MCC) and SCADA system can be provided upon request. The MCC will contain all motor starters and variable frequency drives. The SCADA system will consolidate system information and coordinate control of the facility.

4 PROCESS DESIGN

The equipment offered has been designed around the following parameters:

4.1 Biological Design Information

The following sections outline the design basis for the biological system. The parameters detailed below are based on average daily flow conditions and the average wastewater concentrations outline in Section 1 of this proposal.

4.1.1 Biological Design Parameters

The following design parameters were used as the basis of design for sizing the proposed biological system.

Design Parameters		
Parameter	**Value**	**Units**
Design Mixed Liquor Suspended Solids (MLSS)	8,000	mg/l
Site Elevation	70	feet above sea level

4.1.2 Biological System Configuration

The proposed biological system is designed with the following configuration:

System Configuration	
Parameter	**Value**
Number of Parallel Trains	1[5]
Number of Tanks per train	5

4.1.3 Biological Process Information

The following design parameters were used as the basis of design for sizing the proposed biological system:

[5] Flow controls will be provided to allow any one or two of the reactor tanks to be taken off-line with the other tanks remaining in service.

Process Information		
Parameter	**Value**	**Units**
MOS Overflow Rate	178%	of ADF
Nitrate Recycle Rate	200%	Of ADF

4.1.4 VLR Tank Information

The dimensions of the proposed VLR tanks are:

Anoxic Information		
Parameter	**Value**	**Units**
Total Number of VLR tanks	3	per train
Volume (per tank)	618,000	gallons
Basic Length (inside dimension)	136	ft
Basic Width (inside dimension)	30	ft
Basin Side Water Depth	21	ft

4.1.5 Fine Bubble Tank Information

The dimensions of the proposed fine bubble tanks are:

Orbal Information		
Parameter	**Value**	**Units**
Total Number of Fine Bubble tanks	2	per train
Total Volume	641,000	gallons
Basic Length (outside dimension)	136	ft
Basic Width (outside dimension)	30	ft
Basin Side Water Depth	21	ft

4.2 Membrane Operating System Design

This section outlines the design basis for the MemPulse™ membrane system.

4.2.1 MemPulse™ Membrane System Layout

The total number of membrane tanks, modules per tank and the dimensions of each membrane tank are described in the following table.

Membrane System Layout		
Parameter	**Value**	**Units**
Total Number of Membrane Tanks	4	-
Installed Membrane Modules per tank	320	-
Surface Area per Membrane Module	320	ft^2
Membrane tank width (inner dimension)	26.1	ft
Membrane tank Length (inner dimension)	15.4	ft
Membrane tank sidewater depth	10	ft

4.2.2 MemPulse™ Membrane System Design Information

The proposed membrane system is designed to operate at the following flux rates.

Membrane System Design Information				
Parameter	**ADF**	**PDF**	**PHF**	**Units**
No. of Membrane Tanks in operation	4	4	4	-
No. of Membrane Tanks in standby	0	0	0	-
Number of Modules per Tank	320	320	320	-
Number of Racks per Tank	20	20	20	-
Net Flux	7.7	15.4	17.4	gfd

4.2.3 Membrane System Air Scour Requirements

The following table summarizes the air scour requirements during average and peak flow events.

Air Scour Information			
Parameter	**Average**	**Peak**	**Units**
No. of Blowers in operation	1	1	-
Air Flow per Tank	957	1,524	SCFM
Discharge pressure	4.0	4.7	psi

4.2.4 Membrane System Mixed Liquor Feed Requirements

The following table summarizes the mixed liquor feed flow requirements for average and peak flow events. The feed pump requirements are based on maintaining a MLSS concentration below the maximum allowable concentration in the membrane tank.

Mixed Liquor Feed Requirements				
Parameter	**ADF**	**PDF**	**PHF**	**Units**
Max MLSS in Membrane Tank	12,500	13,500	14,500	mg/L
No. of Pumps in Operation	4	4	4	-
Flow per Tank	1,929	3,409	3,486	gpm
Head Requirement	9.2	9.6	9.6	ft

5 OPERATIONAL COSTS

5.1 Power Requirements

The following table lists the power consumption associated with the proposed membrane operating system at average flow conditions:

Estimated Power Requirements At Average Flow Conditions		
Equipment	**Annual Power Requirement**	**Units**
VLR Disc Aerators	826,068	kW-hr/yr
Nitrate Recycle Pump	145,635	kW-hr/yr
Process Aeration Blower	689,850	kW-hr/yr
ML Feed Pump	201,480	kW-hr/yr
Filtration Pump	118,260	kW-hr/yr
Membrane Blower	697,515	kW-hr/yr
TOTAL	**2,678,808**	**kW-hr/yr**

5.2 Labor Costs

Labor Costs are dependent on the specific site. As a general guide, the operator would be required to do the following:

- Testing of the biological samples from the plant including but not limited to MLSS, nitrates, ammonia, TSS and phosphates on a site specific frequency.
- Collection of samples from various locations in the plant including but not limited to the membrane tanks, aeration basins, raw feed.
- Monitor clean-in-place of membrane system
- Maintenance of mechanical equipment of the system

6 BUDGET PRICING

In order to assist in the evaluation of this Siemens offering, budgetary pricing is provided below for the MBR System.

MBR Budgetary Pricing	
Equipment Offering	**Price**
VertiCel System as described in this Proposal	[redacted]
Membrane System as described in this Proposal	[redacted]

In the absence of detailed project specifications and a specific purchase date, this pricing is intended to be conservative in nature making the assumption that the equipment in question will be purchased approximately one year in the future. If circumstances dictate, firm pricing can readily be provided for a contemplated purchase within the next sixty (60) days.

6.1 Equipment Provided by Siemens with the MBR System

When supplying a Siemens MBR System, the items noted in this section are typically provided by Siemens and are included in the budgetary pricing found in this Proposal.

6.1.1 VertiCel Process Equipment

VLR Process Equipment	
Qty.	**Description**
6	Disc aerators for VLR tanks, including shafts, drives, bearings, baseplates & anchors, support tubes, and fiberglass weather hoods and supports
3	Galvanized steel air release sections and turning vanes for VLR tanks
3	Coarse bubble grids for VLR tanks, each with 40 DiscFuser diffusers
3	Sets of fiberglass air distribution baffles
2	Wall pumps for recirculation of nitrates from fine bubble tanks to VLR tanks, including SS guide mast, power cable, and galvanized steel hoist
2	Fine bubble diffuser grids, each with 550 DualAir diffusers
1 lot	Instrumentation integral to the biological system including level transmitters, oxidation reduction potential (ORP) sensors, dissolved oxygen (DO) sensors, and pressure gauges.

6.1.2 Membrane Operating System Equipment

Membrane Operating System Equipment	
Qty.	**Description**
1,280	B40N membrane submodules fabricated of oxidant-resistant polyvinylidene fluoride (PVDF) membrane material.
80	Rack assembly (16 module capacity) consisting of header assemblies, guide racks, mixing skirt, air dropper tube, and MemPulse™ devices.
8	Stainless Steel wall support guides.
5	Rotary lobe filtrate suction pump controlled by Variable Frequency Drive (4 duty and 1 shelf spare).
5	Submersible mixed liquor feed pump designed to feed mixed liquor to the membrane tanks (4 duty + 1 standby).
5	Positive displacement membrane air scour blower designed to meet average and peak air flow requirements (4 duty + 1 standby).
4 lot	Instrumentation integral to monitor and control the membrane system including level transmitters, level switches, flow meters, pressure transmitters, and pressure gauges.
4 lot	Valves required for equipment isolation and control of the membrane system including manual and automated valves with pneumatic actuators, check valves, and solenoid valves.
4	Filtrate air release systems.
1	Compressed air system to operate Siemens supplied valves and leak testing with one air receiver and lead/lag rotary screw compressors.

6.1.3 CIP Chemical Dosing System Equipment

CIP Chemical Dosing System Equipment	
Qty.	**Description**
1	Sodium hypochlorite dosing system skid. Includes two (2) dosing pumps and valves and instruments necessary for proper operation and calibration.
1	Citric acid dosing system skid. Includes one (1) dosing pump and valves and instruments necessary for proper operation and calibration.
1	Sulfuric acid dosing system skid. Includes one (1) dosing pump and valves and instruments necessary for proper operation and calibration.
1 lot	All valves and instruments necessary to monitor and control the CIP process, including: pneumatic valves, chemical injection quills, turbidimeter, pH probe analyzer, etc.

6.1.4 BioFlowsheet Solutions+ System Control System Equipment

MBR System Control System Equipment	
Qty.	**Description**
1	Siemens S7-300C PLC.
1	Siemens MP 370 touch screen Human Machine Interface (HMI) with 512MB compact flash data storage card.
1	Master Control Panel (MCP).
1	Remote I/O panel
1	UPS sized for the PLC and HMI.
1	Remote monitoring system (i.e. Memlog). Includes modem, software, and hardwarer.
1 lot	Digital and Analog I/O (Input/Output) modules.

6.1.5 Engineering Support

In addition to the mechanical components, instruments, electrical components and control system supplied, the proposed MemPulse™ MBR will be supported by Siemens Water Technologies' experienced engineering team. The following table details the personal support your MemPulse™ MBR project will receive.

Engineering Support	
Qty.	**Description**
N/A	MemPulse™ MBR drawings.
3 sets	MemPulse™ MBR O&M manuals in English language.
1	Siemens Water Technologies Project Engineer assigned to the project to ensure that the supplied system is engineered to perfectly fit the needs of the customer.
1	Siemens Water Technologies Project Manager assigned to the project to successfully execute the project.

6.1.6 Field Service

A Siemens Water Technologies Field Service Technician will be on site to supervise the installation, commissioning and start up of the proposed MBR system and train operators. This would include:

Field Service Support		
Man-days	**Trips**	**Description**
12	3	System inspection and verification.
10	3	Membrane installation supervision.

Field Service Support		
Man-days	**Trips**	**Description**
18	5	Start-up and commissioning.
10	3	Operator training.
6	2	Process testing.

6.2 Optional Equipment/Services

In addition to the supplied equipment mentioned above, Siemens can also supply the following equipment and/or services.

Optional Equipment/Services	
Qty.	**Description**
1 lot	Recommended spare parts package for critical equipment components, instruments, and valves.
1	Supplemental alkalinity (sodium hydroxide) dosing system skid. Includes two (2) dosing pumps and valves and instruments necessary for proper operation and calibration.
1	Motor control center, included all motor starters and variable frequency drives (VFDs).
1	Supervisory Control And Data Acquisition (SCADA) computer.

7 ITEMS TYPICALLY NOT PROVIDED BY SIEMENS

When supplying an MBR System, there are items associated with construction of a complete facility that are typically provided by the constructor rather than Siemens.

7.1 General Items Not Included

General Items not Included
• Compliance permitting and approval (Federal, State and/or local).
• Detail shop fabrication drawings.
• Electrical, hydraulic, or pneumatic controls unless specifically noted.
• Engineering and supervision of all equipment and labor for civil works.
• Laboratory, shop, or field testing other than supervision of start-up testing.
• Taxes, bonds, fees, permits, lien waivers, licenses, etc.
• Tools or spare parts.
• Unloading of equipment and protected storage of equipment at jobsite.
• Utilities connections.

7.2 Civil Works and Mechanical Items Not Included

Civil Works and Mechanical Items not Included
• Adhesives, adhesive dispensers, grout, mastic & anti-seize compounds.
• Anchor bolts and/or expansion anchors unless otherwise noted.
• Base slabs, equipment mounting pads, or shims.
• Building for equipment (if required to prevent freezing)
• Chemical drums or totes for bulk storage
• Concrete work of any sort, grout, mastic, sealing compounds, shims.
• Demolition, removal, or transfer of anything that is existing.
• Engineering, permitting, and surveying.
• Flow control gates
• Headworks Equipment (Grit removal and fine screen)
• Effluent disinfection
• Waste activated sludge (WAS) equipment or solids handling system.
• Equipment lifting hoists, cranes, or other lifting devices.
• Field surface preparation and/or painting.
• Filtrate storage tank to supply water to membrane cleaning processes
• Floor grating, stairways, ladders, platforms, handrailing unless noted.
• Installation of equipment.
• Interconnecting materials external to enclosures such as cable, pressure taps, tubing, etc.
• Labor for field testing.
• Lubricants, grease piping, grease guns.
• Modifications to existing equipment or structures.
• Pipe supports and hangers for piping.
• Piping, pumps, valves, wall sleeves, gates, drains, weirs, baffles not mentioned.

Civil Works and Mechanical Items not Included
• Plumbing associated with waste disposal, floor drains, and/or emergency wash stations.
• PVC solvent weld materials.

7.3 Electrical Items Not Included

Electrical Items not Included
• Conduit or wiring in the field.
• Cable trays, fittings, and supports.
• Influent instrumentation including, but not limited to flowmeters, pH analyzers, temperature transmitters and/or pressure transducers.
• Instrumentation required for post treatment monitoring.
• Power to Siemens supplied equipment.
• Motor control centers.
• Plant lighting.
• Supply and installation of building power, lighting, main service disconnects and control panels.
• Supply, installation and control of a remote telemetry system (SCADA) to monitor and control the operation of the system and overall plant operation other than SmartBNR.
• Underwriters Laboratory inspection of electrical controls.
• Variable frequency drives unless specifically noted.

SIEMENS

Water Technologies

APPENDIX A – MEMBRANE WARRANTY TERMS

MEMBRANE WARRANTY TERMS

SIEMENS WATER TECHNOLOGIES CORP.
MEMBRANE MODULE WARRANTY

Section 1 – Membrane Module Warranty

Subject to the terms of this Membrane Module Warranty (the "Warranty"), Siemens Water Technologies Corp. ("Siemens") warrants that the membrane modules shall materially conform to Warranty conditions specified in Section 4 below. This Warranty shall commence on the earlier of (i) Start-Up of the membrane modules, or (ii) 6 months after the delivery of the membrane modules to the OWNER ("Commencement Date"), and shall thereafter continue for a period of five (5) years from such Commencement Date (the "Warranty Period"). If influent characteristics, other than those specified, deviate from the parameters given in section 4 and cause damage or irreversible fouling (such as high levels of oil, grease, etc.), the Warranty will be subject to review by Siemens and may nullify a claim.

Section 2 –Warranty Claim Procedures

To report a claim during the Warranty Period, the OWNER shall provide written notification to Siemens detailing the nature and basis of the claim, and shall also contact the Siemens Installation Support Center at +1-229-227-8718 (or their designated project manager) within 30 days of their discovery of the claim. Siemens will initiate the evaluation of the claim within 14 business days of such notification. At Siemens discretion, the claim evaluation may consist of data analysis, an on-site audit, and/or membrane fiber analysis.

If such claim evaluation results in a valid and legitimate Warranty claim, Siemens shall provide a Warranty remedy as set forth and detailed in Section 3 below. If the findings of Siemens' evaluation of the membrane module do not constitute a Warranty claim, Siemens reserves the right to invoice the OWNER at our standard rates for the services rendered for the Warranty claim evaluation.

Section 3 –Warranty Remedy

At Siemens' option and discretion, and as OWNER'S sole remedy under this Warranty, Siemens' sole liability for a valid and legitimate Warranty claim shall be as follows:

(a) If, as a result of such investigation, a membrane module shall prove to be defective within sixty (60) months of the Warranty Commencement Date, and not due to one or more of the Warranty exclusions set forth and detailed in Section 4 below, Siemens shall repair the membrane module if possible, or replace the membrane module, at no charge to OWNER.

Section 4 –Warranty Limitations

The Warranty is subject to the following conditions:

(a) Siemens shall furnish replacement membrane modules per the repair or replacement schedule set forth and detailed in Section 3 above under the following conditions:

- If the membrane module(s) cannot be repaired
- If the membrane modules fail to meet the plant production capacity, as outlined in the Design Basis in the proposal
- If the membrane module(s) causes the system to exceed the effluent turbidity and/or total suspended solids requirements for this project, as outlined in the Design Basis in the proposal.

(b) Siemens shall not be liable under this Warranty in the case of any of the following conditions:

a. Unless written notice of any claim is received within 30 days of the claim event and the claim event occurs within the Warranty Period; or
b. If any person other than an employee or representative of Siemens has altered the membrane operating system without prior written approval by Siemens; or
c. For any damages caused by the OWNER causing or permitting the membrane modules to dry or to have moisture content below that specified in the operating instructions either during storage or operation. Shutdown, storage, maintenance and start-up procedures of membranes must be as specified in the Operation & Maintenance Manual; or
d. In the even the mixed liquor suspended solids concentration exceeds a maximum of 14,500 mg/L in the membrane tank; or
e. If evidence exists of (1) unusual plant upsets, (2) other potential transients, or (3) other undefined operating conditions that can affect membrane performance or life. This includes but is not limited to polymer “dumps”, fats, oil and grease content in excess of 100 mg/L entering the biological system, the use, malfunction or by-pass of any equipment which allows the accumulation of non-biodegradable material in the membrane tanks, any bypass of the pre-screen ahead of the aeration basins and/or basket strainers on the membrane tank inlet, rags or debris that fall into the biological or membrane tanks, toxic wastes entering the plant that upset the biological process; or
f. For any damage/defect caused by chemical or physical conditions such as (but not limited to) pH, temperature, chemicals, effluent COD is greater than 50 mg/L or climatic factors outside the recommended operating parameters in the appropriate section of the Operation & Maintenance Manual; or
g. Unless the total membrane permeability and influent and effluent flow rates are continuously monitored and recorded; or
h. Unless the membranes undergo periodical chemical cleans as specified in the appropriate section of the Operation & Maintenance Manual; or
i. If neutralization and/or reduction of chemical cleaning solutions are performed in the membrane tank without written authorization from Siemens; or

j. If the sludge retention time (SRT) is less than 6 days or greater than 80 days over a 2-day history; or

k. Unless the influent, effluent, and mixed liquor parameters are monitored as per the Operation & Maintenance Manual; or

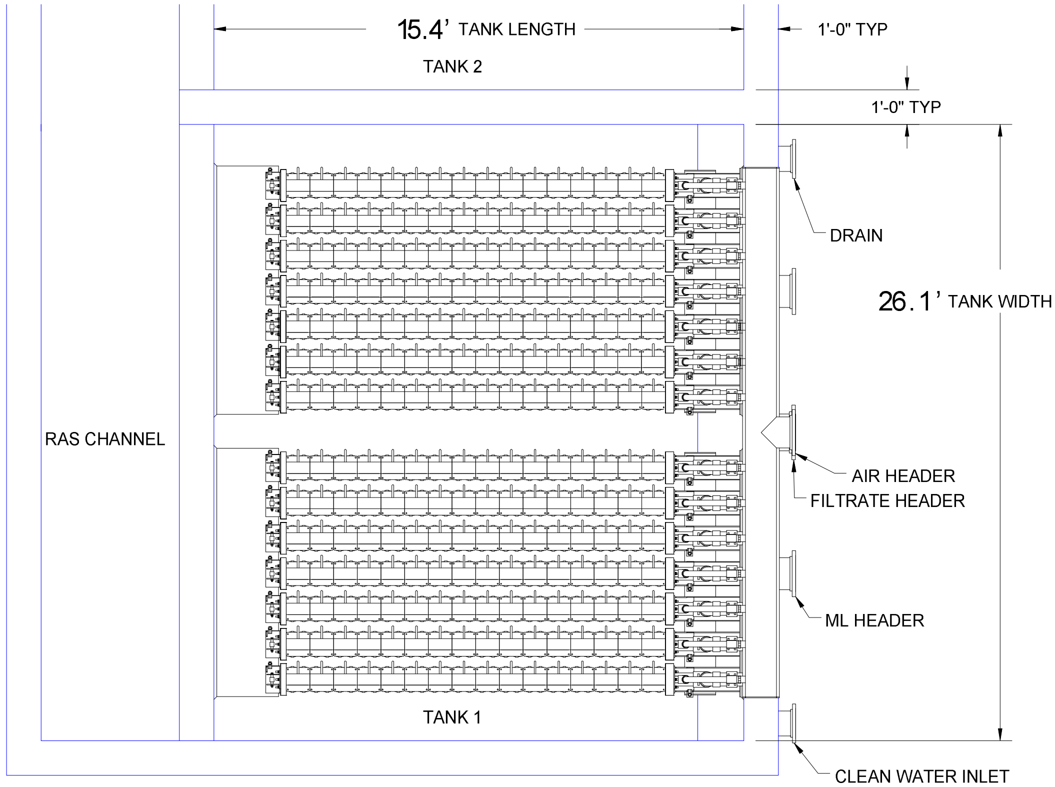
l. Unless the capillary suction time (CST) is less than 100 seconds for municipal mixed liquor before the membrane tank.

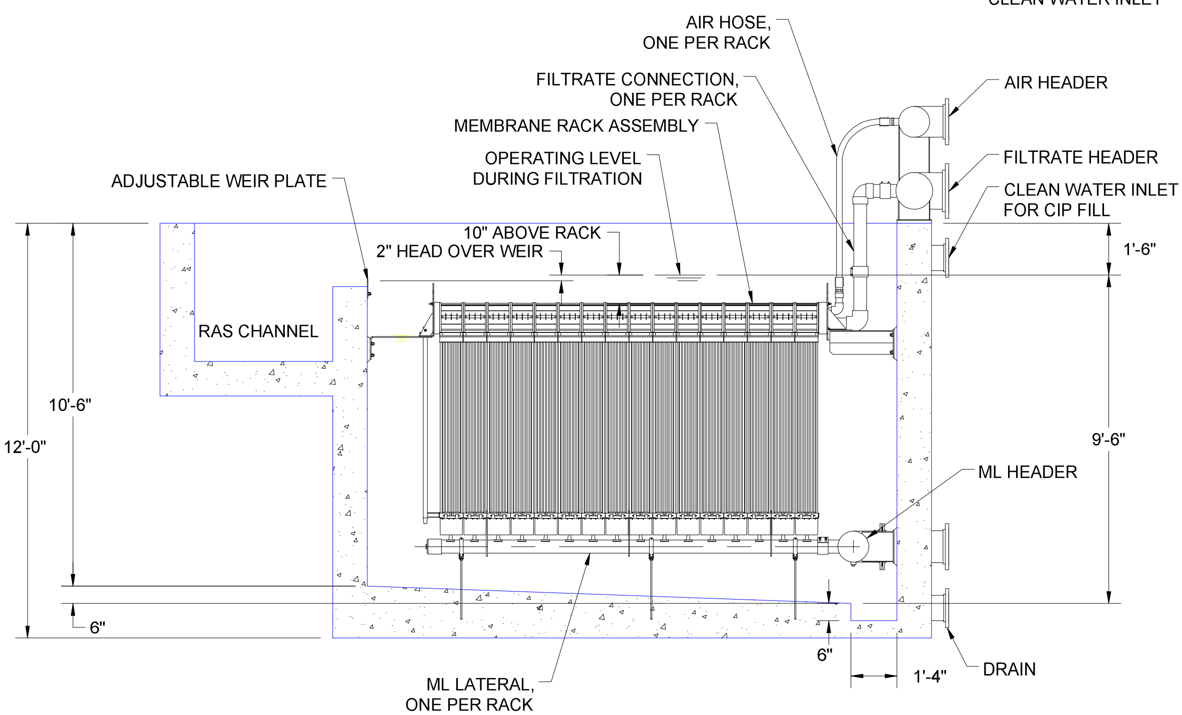
(c) THE WARRANTIES SET FORTH HEREIN ARE SIEMENS' SOLE AND EXCLUSIVE WARRANTIES. SIEMENS MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE. FULFILLMENT BY SIEMENS OF ITS OBLIGATIONS UNDER SECTION 2, SHALL BE THE OWNER'S SOLE AND EXCLUSIVE REMEDY FOR ANY FAILURE BY SIEMENS TO SATISFY ANY REQUIREMENT OF THIS WARRANTY. EXCEPT FOR SUCH OBLIGATIONS, IN NO EVENT SHALL SIEMENS BE LIABLE FOR ANY DAMAGES OF ANY NATURE WHATSOEVER FOR ANY BREACH OF THIS WARRANTY, INCLUDING WITHOUT LIMITATION ANY DIRECT, INDIRECT, CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER DAMAGES. SIEMENS' TOTAL LIABILITY UNDER THIS WARRANTY, WHEN ADDED TO ALL LIABILITY OF SIEMENS TO OWNER AND TO PURCHASER UNDER THE EQUIPMENT SALE CONTRACT, INCLUDING WITHOUT LIMITATION ANY LIABILITY FOR MECHANICAL WARRANTY CLAIMS OR FOR ANY BREACH OR FAILURE TO PERFORM UNDER THE EQUIPMENT SALE CONTRACT, SHALL NOT EXCEED THE LIABILITY LIMITATION SET FORTH IN THE EQUIPMENT SALE CONTRACT. THE FOREGOING LIMITATIONS APPLY REGARDLESS OF WHETHER THE LIABILITIES OR DAMAGES ARISE OR ARE ALLEGED TO ARISE UNDER CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY. The Warranty is expressly excluded from all bonding requirements, such as performance and payments bonds or bid bonds, which may be associated with the execution or completion of the referenced project.

SIEMENS
Water Technologies

APPENDIX B – DRAWINGS

SIEMENS WATER TECHNOLOGIES	MemJet® Membrane Operating System	PROJECT: MSB - 1 of 4 tanks shown ENGINEER: GV Jones DATE: 05/27/09





NOTES:

1) DRAWING ABOVE MAY NOT REFLECT MODEL DESCRIBED IN PROPOSAL

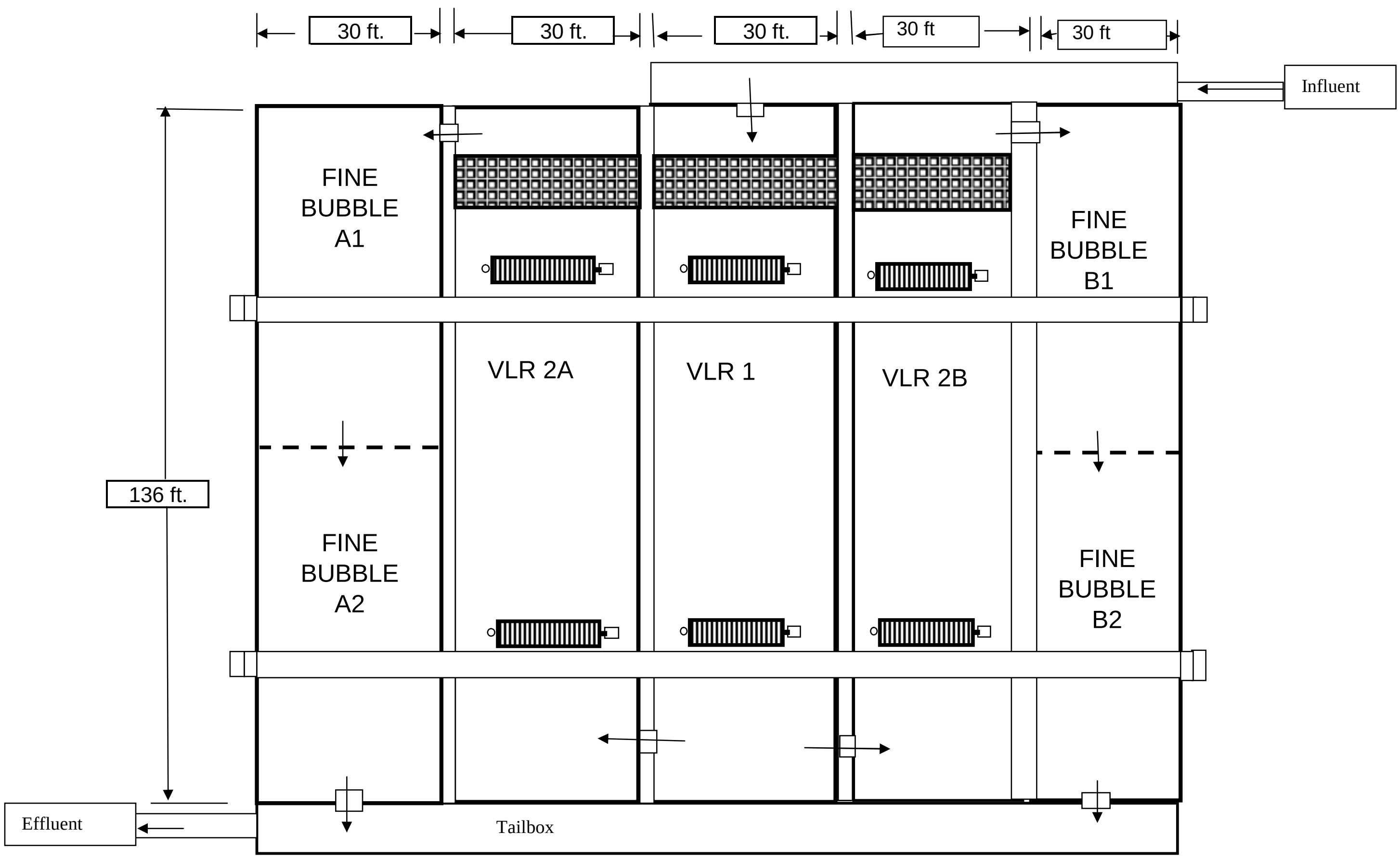
Number of Tanks	4
Number of Modules Installed	1,280
Total Number of Modules / Tank	320
Number of Modules / Rack	16

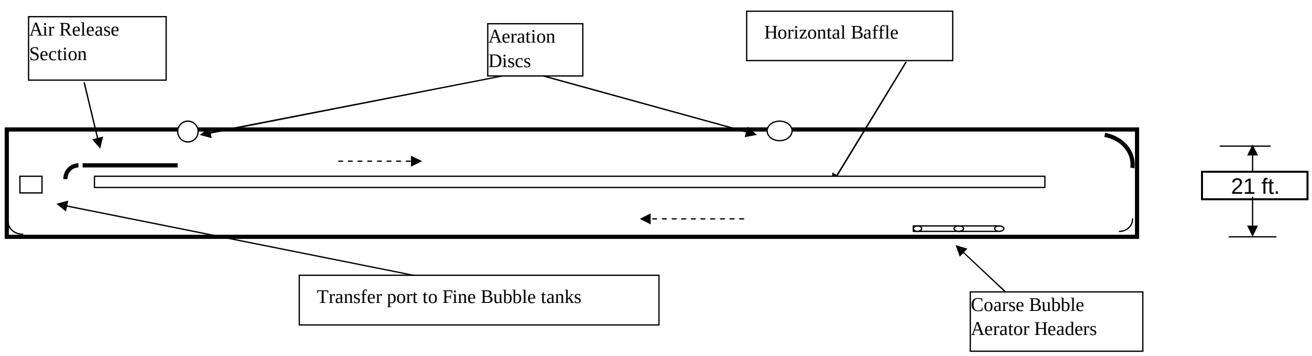
SIEMENS

Water Technologies

VERTICEL LAYOUT SKETCH

Project:	Matanuska, AK	Prepared:	5/29/2009
Engineer:	GV Jones	Designer:	D. Barnes / J. Olson





APPENDIX E

Funding Information

1.1 Federal Funding

Direct Federal Appropriation. At this time, the majority of federal funding goes through the Clean Water State Revolving Fund (CWSRF). Some earmarks are still made, but usually for amounts of $500,000 or less. Requests for direct appropriations are made by the facility managing entity to Congressman Don Young or Senator Mark Begich for inclusion in legislation.

USDA Grants and Loans. USDA Rural Development has Water and Wastewater grants and loans available. The loans are available to areas with populations of less than 10,000 and for public or non-profit applicants that were unable to obtain the needed funding from commercial lenders. The loan or grant applicant must also be the owner and operator of the treatment plant and any partnerships with financial agreements must be fully explained and disclosed. The grant amount and loan terms are based on the median income of the service area according to the latest census. For this reason, it would be advantageous to apply for these funds before the next census results are available. The service area includes households on sewer systems as well as those from which septage is collected for disposal at the treatment plant.

Loans are secured by General Obligation Bonds, Revenue Bonds, Special Assessment Bonds, Promissory Notes, Deeds of Trust or other sources of reliable income. Complete loan applications must include:

1. Form SF-424.2, "Application for Federal Assistance, Construction"
2. Preliminary engineering report
3. Cost breakdown for all construction and related costs
4. Copy of current and proposed operating budget
5. Number of users to be served by the proposed project
6. Form RD 1940-20 "Request for Environmental information"
7. Copy of latest financial statements
8. Present and proposed user rates
9. Written certification that other credit is not available

Guides are available on the USDA website, or by contacting the local USDA office in Palmer. These guides discuss the preliminary engineering and environmental reports required. While the exact format of the guide does not need to be followed, the application must include all of the required information.
Other Federal Grants. The Catalog of Federal Domestic Assistance (CFDA, www.cfda.gov) is a searchable database with detailed information on all federal financial assistance programs.

Another federal grants search tool is Grants.gov (www.grants.gov), a searchable database with comprehensive information on over 1,000 grant programs offered by all federal grant making agencies.

At this date, there were no funding opportunities available from either of these sources, but new grants are listed frequently.

1.2 State Funding

Legislative Appropriation. Direct state appropriations requests are generated by local managing departments and agencies and sent to the Governor. Once the Governor has reviewed the request, he or she will send it to the legislature where adjustments may be made in the request before final approval. The amount appropriated is determined by the governor and legislature, but requests can be for the full amount of funding needed.

Alaska Department of Environmental Conservation (ADEC) Municipal Matching Grants (MMG). The ADEC MMG are for communities who have received funding through the legislature, and are eligible to apply for a ADEC Municipal Matching Grant. This grant can be used to assist with planning, design, and construction costs related to wastewater collection, treatment, or discharge. Applicants to the program are reviewed by the ADEC, scored, and prioritized based on financial need and public health concerns, and then sent to the governor and legislature for approval. The funding for this program is limited per year and is dependent on the governor and how many project funding requests are submitted.

Alaska Clean Water Fund (EPA Clean Water State Revolving Fund). The Alaska Clean Water Fund (18 AAC76.080) replaced the long-standing federal Construction Grants program. Alaska now has the State Revolving Fund (SRF) to provide independent and permanent sources of low-cost loan financing for water quality infrastructure projects. These terms of repayment and finance charges for these loans include:

(1) for a contract term of five to 20 years, accrual of finance charges begins one year after the date of the first payment to the borrower; the department will assess a finance charge at a rate of one and one-half (1.5) percent of the total amount of financial assistance disbursed, or 18.75 percent of the current bond rate as defined by the Municipal Bond Index, whichever is higher;

(2) for a contract term of less than five years, accrual of finance charges begins one year after the date of the first payment to the borrower; the department will assess a finance charge of one (1.0) percent of the total amount of financial assistance disbursed, or 12 *1*/2 percent of the current bond rate as defined by the Municipal Bond Index, whichever is higher;

(3) for financial assistance that is repaid within one year after the first payment to the borrower, the department will assess a finance charge equal to one-half of one (0.5) percent of the total amount of financial assistance disbursed.

Loans can only be made to incorporated cities and boroughs. While there is still a large amount of funds available in the SRF, demand for funds in the state has been high in the recent past.

1.3 Bonds

General Obligation Bonds. General Obligation (GO) bonds are backed with the guarantee that the issuing government will use its taxing power to repay them. GO bonds are regarded as safer than bonds backed by a single revenue source, and generally command lower interest rates and lower reserve fund requirements. GO bonds are suitable for financing projects that require large amounts of capital up-front and benefit the entire community over a long period of time. Voter approval is frequently required for GO bonds[1]. An election is required to obtain voter approval prior to the issuing process. The bond issue election is caused by the presentation of a petition signed by a percentage of voters (usually 15%) or by the unanimous agreement of the governing body.

Certain advantages and disadvantages are associated with general obligation bonds. Since the issuing government pledges its unlimited taxing power and its full faith and credit, general obligation bond issues are considered to be secure investments. This fact makes general obligation bond offerings attractive both to underwriters and other investors; however, interest rates on these bonds are frequently lower than other bond types. The primary advantage of issuing general obligation bonds over other bond types is that non-revenue producing projects may be financed over long periods of time. Since voter approval is necessary prior to the issuance of general obligation bonds, the expense is generally acceptable to local citizens. Some disadvantages exist as well. A default on the bond issue may require the issuing government to levy additional taxes on local residents. The process of issuing general obligation bonds may be quite lengthy due to bond election procedures and the complex credit analysis required to market bonds. This time lag may push back project completion dates and result in increased construction costs. Local governments may pay fees to underwriters or financial consultants for assistance in putting financing programs together. This may allow local governments to avoid procedural errors and ultimately speed up the process.

Revenue Bonds. “Revenue bond” is a broad term used to describe bonds on which the debt service is payable mainly from revenue generated through the operation of the project being financed, or from other non-property tax sources. They may be issued by state and local governments, or by an authority, commission, special district, or other unit created by a legislative body for the purpose of issuing bonds for facility construction. Revenue bonds now account for the clear majority of municipal bonds used to finance water, sewer, and solid waste infrastructure in the United States. Revenue bonds are usually tax-exempt. Bond interest rates may be higher for revenue bonds compared to general obligation bonds, and even higher for taxable revenue bonds. Revenue bonds do not count against debt ceilings, but the national rating agencies take them into account in financial capability analyses. State Revolving Fund (SRF) bonds, private-activity industrial development bonds, and mortgage lease-backed bonds are examples of revenue bonds[1].

1.4 Local and Municipal Funding

To raise revenue for localities and municipalities, taxes and fees can be used, including general taxes, selective sales taxes, and fees. The process of gaining voter approval for dedication or earmarking of taxes for environmental protection initiatives is often difficult, especially in light of the recent rejection by voters to initiate a MSB sales tax. Some taxes and fees have dual purposes in that they raise revenue in addition to acting as market devices to alter polluting behavior by requiring the polluter to pay for engaging in that behavior.

1.5 Commercial Loans

Commercial loans are available to both public and private entities (depending on what type is chosen for this project). A commercial loan may be used for the whole project, but it would be prudent to apply for state and federal grants and loans before applying for commercial loans. In the

[1] US Environmental Protection Agency (EPA). 2008. Guidebook of Financial Tools: Paying for Environmental Systems.

case of grant programs that require matching funds, but the entity is unable to produce the full matching amount required, a commercial loan may serve as a supplement.

Different loan programs are available depending on the amount requested, what collateral will be used, the type of managing entity (public or private), and whether or not there will be a need for a construction to completion loan (a loan in which the terms under construction change once the facility is completed). Each of these factors will determine the loan rate, the terms, and whether or not tax credits may be used.

Most commercial banks and financial institutions in the United States have public finance departments that provide state and local governments with loans to finance a wide variety of capital projects and purchases. States and local governments tend to use commercial loans when lower-interest financing is unavailable and/or to fill short-term financing needs in anticipation of revenues from other sources (i.e., so-called bridge loans). Commercial loans are usually provided at set costs keyed within a range of market-based interest rates. They tend to have higher interest rates and less favorable payback terms as compared to government loans. Commercial lenders such as banks are very low-risk lenders and they usually seek to protect themselves and their loans by securing collateral in one or more of three ways: primary collateral in the form of assets (preferably liquid), secondary collateral such as guarantees, and cash flow. For governments, a portion of future revenues or taxes often represents the ultimate security for commercial loans. The application process for commercial loans tends to be much faster than for government loan programs. Commercial lenders usually have no set eligibility criteria and may have no predetermined limits on the total amounts of loan capital that they make available.

STATE OF ALASKA
ADEC Municipal Matching Grants

Rural Utilities Service
Water & Waste - Project Selection Criteria
Bulletin 1780-1

&

UNITED STATES DEPARTMENT OF AGRIGULTURE
Rural Utilities Service
Bulletin 1780-3

STATE OF ALASKA
ADEC MUNICIPAL MATCHING GRANTS

GRANT APPLICATION

The attached application is to be completed by communities who have received funding through the legislature, and are eligible to apply for a State of Alaska, Department of Environmental Conservation (ADEC) Municipal Matching Grant. This grant can be used to assist with planning, design, and construction costs related to: water quality enhancement; water supply, treatment and distribution; wastewater collection, treatment, or discharge; solid waste processing, and disposal or resource recovery projects.

Under changes to Alaska Statute (A.S.) 46.03.030, construction projects funded through appropriations made by the legislature after July 1, 1994 can receive grants varying from 50% to 85% of eligible project costs. Funding up to 85% of eligible costs will be allowed for communities with less than 1,000 persons. For 1,001 to 5,000 persons, 70% funding is possible, with 50% grants for communities over 5,000 persons. In addition, after July 1, 1994 the local match required for this program can include federal funds, but disallows the use of Department of Administrative A.S. 37.06 monies as match to ADEC Municipal Matching Grants.

To apply for an ADEC Municipal Matching Grant, please complete the attached application form and submit it to either:

Alaska Department of Environmental Conservation
Facility Construction & Operation
Municipal Grants & Loans
555 Cordova Street
Anchorage, AK 99501-2617
(907) 269-7502

or

Alaska Department of Environmental Conservation
Facility Construction & Operation
Municipal Grants & Loans
410 Willoughby Avenue, Suite 105
Juneau, AK 99801-1795
(907) 465-5180

All the established program procedures and eligibility conditions are detailed in both Alaska Statute 46.03.030 and under Construction Grants Regulation 18 AAC 73. For further information please write or call the office located nearest to you.

Upon receipt of a completed application form, the Department will review the application and determine project eligibility or request additional information. If the Department certifies the project as grant eligible, and funding is available, a formal grant offer will be extended to a community for signature and formal acceptance.

The following "ATTACHMENTS" shall be included as part of the completed grant application, when required or as applicable, to fully describe the project:

A. A brief narrative statement describing the project, discussing the need for the facility and the benefits to be received. This narrative should discuss the location and scope of the project, the number of people and lots benefiting, the existence and/or condition of present water and sewerage services, the adequacy of existing water supplies and sewage treatment facilities to handle increased demand and, if the project consists of service line extensions, whether this is an existing or future need, and any other data pertinent to the project.

B. A set of engineering plans and specifications, if they are prepared at the time the grant application is submitted. If plans are not completed, provide the estimated date of submission and a plot plan showing the location of the proposed project. If the plans and specifications have been previously approved by the Department, please provide a copy of the approval letter.

C. Copies of grant applications or notices of grant awards from other state or federal agencies participating in project funding.

D. For waterbody enhancement or protection projects, a program plan needs to be completed which describes the project to be funded; why the project is needed; how the project will enhance or protect the waterbody or waterbodies involved; how the project will be accomplished; an estimate of the costs for the project, along with a projection of future costs caused by or related to the project; and the specific results expected from the project.

E. If work is to be done on a force account basis, all labor positions and equipment rates must be submitted for approval. Department provided “Force Account Approval” forms, and a listing of equipment descriptions and rates should be completed.

F. A copy of the applicant's contract with the engineering firm designing or supervising construction of the project.

G. An itemized construction cost estimate.

H. A list describing and providing justification for any new equipment to be purchased.

I. An itemized list of any other costs.

STATE OF ALASKA
ADEC MUNICIPAL MATCHING GRANTS

GRANT APPLICATION FORM

GENERAL INFORMATION

Name of Community____

Address____

Contact Name ____________________Title ____________Telephone (907)__________

PROJECT INFORMATION

Project Name________________________________Location____________________

Application Type: Initial_________ Revised__________
Project Type: Water_____Sewer______ Solid Waste_____Water Quality Enhancement_____

Number of Lots__________ and Persons_______ benefiting from this Project.
Estimate Construction Period: Start____________ Finish___________

Description of Project____

ASSISTANCE AMOUNT

Estimated Total Project Costs $______________ADEC Participation in Costs _____%
Amount of Grant Funds requested from ADEC $ _____________

Please identify all source(s) of funding that the Grantee will use for project costs. If other state grants are to be used as a match, please attach a copy of the grant (DOA etc.)_______________

PROJECT CERTIFICATION

The applicant, through it's authorized representative, certifies to the best of its knowledge and belief that the data contained in this application is true and correct, and that all titles and easements necessary to provide clear title or authority to construct and maintain the proposed project shall be obtained. Failure to comply with this certification will be cause for the Department to withhold a grant award or withdraw a grant offer that may have been extended.

Typed Name	Title	Date

Signature

STATE OF ALASKA
ADEC MUNICIPAL MATCHING GRANTS

PROJECT COST SUMMARY

COST CLASSIFICATION	TOTAL ESTIMATED PROJECT COSTS	REQUIRED ATTACHMENT
ELIGIBLE COSTS:		A, B, D or G
1. Administrative Expenses [1]		-
2. Planning Reports and Feasibility Studies		E or F
3. Waterbody Enhancement or Protection		D, E or F
4. Engineering Design Fees [2]		E or F
5. Construction Engineering & Management [2]		E or F
6. Construction [2]		E or G
7. Equipment		H
8. Other Costs [3]		I
9. Project Contingencies		-
10. SUBTOTAL (Lines 1-9)		
11. Amount of Line 10 provided by applicant		
12. Amount of existing ADEC Grant or ACWF Loan		
13. Amount of Line 10 currently requested from ADEC		
INELIGIBLE COSTS:		
14. Land & Easement Acquisition Costs		
15. Interest and Finance Charges		
16. Grant Application & Other Ineligible Costs		
17. SUBTOTAL (Lines 14-16)		
19. TOTAL PROJECT COSTS (Lines 10 plus 17)		

1. Eligibility of expenses is limited to direct costs incurred as a result of the project such as telephone charges, photocopying costs, and advertising expenses.

2. Requests for approval of force account rates must be supported by “FA Approval Forms” and must follow procedures established in 18 AAC 73.010 (g) (2).

3. The cost of land when used as an integral part of a treatment process, such as spray irrigation and solid waste landfill sites, may be considered grant eligible.

STATE OF ALASKA
ADEC MUNICIPAL MATCHING GRANTS

FORCE ACCOUNT APPROVAL FORM

This form presents force account expenses. You are under no obligation to claim all costs or to fill out the entire form. Sections A, B, G and H must be completed for each job classification. However, sections C, D, E and F are provided to assist you in computing your force account expenses and are not required. In addition, a list of equipment and charge rates for any city owned equipment which will be charged to the project will need to be submitted for eligibility consideration.

Job Classification: ____________________________ Project Name___________________________

A. Calculate Monthly Workhours

Working Hours Per Month = ___________________________
(work hours per week x 52 weeks per year divided by months per year)

B. Calculate Hourly Pay Rate

Monthly Pay Rate Ranges from $ _______________ to $ _________________
Hourly Pay Rate Ranges from $ _______________ to $ _________________
(monthly pay rate divided by working hours per month = Pay Rate Per Hour)

C. Calculate Hourly Benefit Rate

Social Security (FICA)	____________ %
Workers Compensation (W/C)	____________ %
Retirement Contribution (PERS)	____________ %
Unemployment Insurance (SUI)	____________ %
Total Benefits Percentage	**____________ %**

Hourly Benefit Rate Ranges from $ _________________ to $ __________________
(hourly pay rate x total benefits percentage = Hourly Benefit Rate)

D. Calculate Hourly Insurance Rate

Health and Dental Ranges from	$ ________ to $ ________
Accidental Death	$ ________ to $ ________
Basic Life or Other:_________	$ ________ to $ ________
Total Insurance Benefits	**$ ________ to $ ________**

Hourly Insurance Rate from $ ______________ to $ ______________
(total insurance benefits divided by working hours per month = Insurance Rate Per Hour)

E. **Calculate Hourly Leave Rate**

Vacation Leave days per month ranges from _________ days to ________ days

Sick Leave days per month ranges from _________ days to _________ days

Leave Hours Per Month Ranges From ________ hours to ________ hours
(vacation plus sick leave days per month x working hours per day = Leave Hours Per Month)

Leave Rate Per Hour Ranges from $_________ to $_________ hours
(pay rate per hour x leave hours per month divided by working hours per month = Leave Rate Per Hour)

F. **Calculate Hourly Holiday Rate**

Paid Holidays Per Year = _______ days

Holiday Rate Per Hour Ranges from $ ____________ to $ ____________
(paid holidays per year divided by 12 months divided by working hours per month x working hours per day x pay per hour = Holiday Rate Per Hour)

G. **Calculate Hourly Charge Rate**

	Hourly Low Rate	Hourly High Rate
Pay Rate	$ ___________	$ ___________
Benefit Rate	$ ___________	$ ___________
Insurance Rate	$ ___________	$ ___________
Leave Rate	$ ___________	$ ___________
Holiday Rate	$ ___________	$ ___________
Total:	$ ___________	$ ___________

H. **Certification**

Based on the details shown above, we request approval of a low rate of $_______ per hour, and a high rate of $ ________ per hour inclusive for all employees in this job classification engaged in force account work for the subject grant.

______________________________ ________________ ________________
Signature Title Date

STATE OF ALASKA
ADEC MUNICIPAL MATCHING GRANTS

MODEL RESOLUTION

Resolution No. ______________________________ Date ______________________________

A RESOLUTION OF THE [ASSEMBLY/COUNCIL] OF THE [MUNICIPALITY/CITY/ BOROUGH], FORMALLY ACCEPTS GRANT NO. [ASSIGNED GRANT NUMBER] FROM THE STATE OF ALASKA, DEPARTMENT OF ENVIRONMENTAL CONSERVATION (ADEC) IN THE AMOUNT OF [GRANT AMOUNT] FOR THE PROJECT ENTITLED [PROJECT NAME].

WHEREAS, the State of Alaska, Department of Environmental Conservation has appropriated a Municipal Matching Grant in the amount of [GRANT AMOUNT] to the [MUNICIPALITY/CITY/ BOROUGH] to be applied towards the [PROJECT NAME]; and

WHEREAS the [MUNICIPALITY/CITY/ BOROUGH] must formally apply for the grant and thereby agrees to the terms and conditions of the grant, and to adhere to any governing state regulations;

WHEREAS the [MUNICIPALITY/CITY/ BOROUGH] agrees to operate and maintain the completed project constructed with said grant;

NOW, THEREFORE, BE IT RESOLVED by the [COUNCIL/ASSEMBLY] of [MUNICIPALITY/CITY/ BOROUGH] that the grantee formally accepts the State of Alaska, Department of Environmental Conservation's Grant No. [Assigned Grant Number] in the amount of [Grant Amount] and accepts the conditions of the grant agreement.

____
Mayor/City Manager (Authorizing Signature)

Attested by ______________________________________
City Clerk

WATER & WASTE
PROJECT SELECTION CRITERIA

Name of Applicant____

PRIORITIES	POINTS
Population priorities:	
1. Project primarily serves a rural area equal to or less than 1,000 population.	25
2. Project primarily serves a rural area between 1,001 and 2,500 population.	15
3. Project primarily serves a rural area between 2,501 and 5,500 population.	5
B. Health priorities	
1. Project alleviates emergency situation, corrects unanticipated diminution or deterioration of a water supply or to meet Safe Drinking Water Act requirements which pertain to a water system.	25
2. Project to correct inadequacies of a wastewater disposal system or to meet health or sanitary standards which pertain to a wastewater disposal system.	25
3. Projects which are required to meet administrative orders issued to correct local, State or Federal violations pertaining to solid waste.	15
C. Median household income (MHI) priorities.	
1. MHI less than the poverty line if the poverty line is less than 80% of state nonmetropolitan household income (SNMHI).	30
2. Less than 80% of the SNMHI.	20
3. Equal to or more than the poverty line and between 80% & 100% inclusive, of the SNMHI.	15

D. Other priorities:

1. Project to merge ownership, management, and operations of smaller systems for more efficient management and economic service.	15
2. Project to enlarge, extend, or otherwise modify existing facilities to serve additional rural residents.	10
3. Applicant is a public body or Indian tribe.	5
4. Amount of other funds committed to project is:	
a. 50% or more	15
b. 20-49%	10
c. 5-19%	5
5. Project will serve an Agency identified target area.	10
6. Project will primarily recycle solid waste products thereby limiting the need for solid waste disposal.	5
7. The proposed project will serve an area that has an unreliable quality or supply of drinking water.	10

E. State Program Director's discretionary points. Up to 15 Points may be awarded to projects to improve compatibility/coordination between RUS's and other agencies' selection systems and to assist those projects that are most cost effective and that provides for effective RUS fund utilization. ______

F. Total Points. ______

G. Administrator's discretionary points. ______

State Program Directors should recommend and provide written justification for assignment of Administrator's point under this paragraph.

____
STATE PROGRAM DIRECTOR

______
Date

UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Utilities Service

BULLETIN 1780-3

SUBJECT: **<u>Preliminary Engineering Report – Wastewater Facilities</u>**

TO: Rural Development State Directors, RUS Program Directors, State Engineers

EFFECTIVE DATE: Date of approval.

OFFICE OF PRIMARY INTEREST: Environmental and Engineering Staff, Water and Environmental Programs.

INSTRUCTIONS: This bulletin replaces previous RUS Bulletin 1780-3, Preliminary Engineering Report – Sewerage Systems.

AVAILABILITY: This bulletin is available on the Rural Utilities Services' website at www.usda.gov/rus/water.

PURPOSE: This Bulletin provides applicants and their consultants with instructions on how to prepare a Preliminary Engineering Report for a wastewater system application.

October 2, 2003

GARY J. MORGAN
Assistant Administrator
Water and Environmental Programs

Date

TABLE OF CONTENTS

INDEX:

ABBREVIATIONS

O&M – Operations and Maintenance
PER – Preliminary Engineering Report
RUS – Rural Utilities Service

1 GENERAL

A Preliminary Engineering Report (PER) should clearly describe the owner's present situation, analyze alternatives, and propose a specific course of action from an engineering perspective. The level of effort required to prepare the report and the depth of analysis within the report are proportional to the size and complexity of the proposed project. Rural Utilities Service (RUS) projects must be modest in design, size and cost, and be constructed and operated in an environmentally responsible manner. Pursuant to 7 CFR Part 1794, guidance in RUS Bulletin 1794A-602, "Guide for Preparing the Environmental Report for Water and Waste Projects", and the Agency's environmental State Supplement, the applicant shall perform the environmental review concurrently with the project engineering planning. This document must indicate that environmental issues were considered as part of the engineering planning. Information provided in the PER will be used to process the funding request, therefore completeness and accuracy are essential for timely processing of the application. Other outlines may be utilized, but the essential information must be readily identifiable. Contact the Rural Development office for further guidance. The following should be used as a guide for the preparation of PERs for RUS financed wastewater systems.

2 PROJECT PLANNING AREA

Describe the area under consideration. The project planning area may be larger than the service area determined to be economically feasible. Service may be provided by a combination of central, cluster, or individual facilities. The description should include information on the following:

a Location Maps, photographs, and sketches. These materials should indicate legal and natural boundaries, major obstacles, elevations, etc.

b Environmental Resources Present. Maps, photographs, studies and narrative. This section should provide information on the location and significance of important land resources (farmland, rangeland, forestland, wetlands and 100/500 year floodplains, including stream crossings), historic sites, endangered species/critical habitats, etc., that were identified in the applicant's environmental information (normally an Environmental Report) and that must be considered in project planning. A narrative summary with reference to the applicant's environmental submittal is adequate.

c Growth Areas and Population Trends. Specific areas of concentrated growth should be identified. Population projections for the project planning area and concentrated growth areas should be provided for the project design period (typically 20-years). These projections should be based on historical records with justification from recognized sources.

3 EXISTING FACILITIES

Describe the existing facilities including at least the following information:

a Location Map. Provide a schematic layout and general service area map (may be identified on project planning area maps).

b History. Provide a brief description of when major system components were constructed or renovated.

c Condition of Facilities. Describe present condition; suitability for continued use; adequacy of current facilities; and, if any existing central facilities, the treatment, storage, and disposal capabilities. Note the quantity of inflow and infiltration/exfiltration associated with the existing collection system. Also, describe compliance with Clean Water Act and applicable State requirements.

d Financial Status of any Existing Facilities. (Note: Owner will be submitting most recent audit or financial statement as part of the application package.) Provide information regarding current rate schedules, annual operations and maintenance (O&M) cost, other capital improvement programs, and tabulation of users by monthly usage categories for the most recent typical fiscal year. Give status of existing debts and required reserve accounts.

4 NEED FOR PROJECT

Describe the needs in the following order of priority:

a Health, Sanitation, and Security. Describe concerns and include relevant regulations and correspondence from/to Federal, and State regulatory agencies.

b System O&M. Describe the concerns and indicate those with the greatest impact. Investigate infiltration and inflow, management adequacy, inefficient designs, and problem elimination prior to adding additional capacity.

c Growth. Describe the reasonable growth capacity that is necessary to meet needs during the planning period. Facilities proposed to be constructed to meet future growth needs should generally be supported by additional revenues. Consideration should be given to designing for phased capacity increases. Provide number of new customers committed to this project.

5 ALTERNATIVES CONSIDERED

This section should contain a description of the reasonable alternatives that were considered in planning a solution to meet the identified need. Documentation of alternatives considered is often a PER weakness. The following alternatives should be considered, if practicable: building new centralized facilities, optimizing the current facilities (no construction), interconnecting with other existing systems, and developing centrally managed small cluster or individual facilities. These alternatives should be consistent with those considered in the environmental review. Mitigation measures necessary to avoid or minimize any adverse environmental effects must be integrated into project design. The description should include the following information on each alternative:

a Description. Describe the facilities associated with the alternative. Describe all feasible wastewater treatment technologies and provide comparison of such. Also, describe collection facilities. A feasible system may include a combination of centralized and decentralized (on-site or cluster) units.

b Design Criteria. State the design parameters used for evaluation purposes. These parameters must comply with RUS design policies (7 CFR 1780.57) and state regulatory requirements.

c Map. Schematic layout.

d Environmental Impacts. Do not duplicate the information in the applicant's submittal of environmental information. Describe only those unique direct and indirect impacts on floodplains, wetlands, other important land resources, endangered species, historical and archaeological properties, etc., as they relate to a specific alternative. RUS must conduct an environmental assessment prior to project approval.

e Land Requirements. Identify sites and easements required. Further specify whether these properties are currently owned, to be acquired, or leased.

f Construction Problems. Discuss concerns such as subsurface rock, high water table, limited access, or other conditions which may affect cost of construction or operation of facility.

g Cost Estimates. Provide cost estimates for each alternative, including a breakdown of the following costs:

(1) Construction.

(2) Non-Construction.

(3) Annual Operations and Maintenance.

h Advantages/Disadvantages. Describe how the specific alternative meets the owner's needs with respect to financial, managerial, and operational resources. Explain how the proposal complies with regulatory requirements and existing comprehensive area-wide development plans. Explain how the proposal satisfies public and environmental concerns.

6 SELECTION OF AN ALTERNATIVE

a Present Worth (life cycle) cost analysis (an engineering economics technique to evaluate present and future costs for comparison of alternatives) should be

completed to compare the feasible alternatives. All of the items from the cost estimate should be included in the analysis. The "real" federal discount rate from Appendix C of OMB Circular A-94 should be used for determining the present worth of the uniform series of O & M values (in today's dollars) and the salvage value. This rate may be found at:
www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html

b A matrix rating system could be useful in displaying the information on each alternative.

c Note that if the range of present worth values is small, then non-monetary factors should be considered in determining which alternative should be selected.

7 PROPOSED PROJECT (RECOMMENDED ALTERNATIVE)

This section should contain a fully developed description of the proposed project based on the preliminary description under the evaluation of alternatives. At least the following information should be included:

a Project Design.

(1) Collection System Layout. Identify general location of line improvements: lengths, sizes, and key components.

(2) Pumping Stations. Identify size, type, site location, and any special power requirements.

(3) Treatment. Describe process in detail and identify location of any treatment units and site of any discharges.

b Total Project Cost Estimate. Provide an itemized estimate of the project cost based on the stated period of construction. Include development and construction, land and rights, legal, engineering, interest, equipment, contingencies, refinancing, and other costs associated with the proposed project. The engineer may rely on the owner for estimates of cost for items other than construction, equipment, and engineering. (For projects containing both water and waste disposal systems, provide a separate cost estimate for each system.)

c Annual Operating Budget. Provide itemized annual operating budget information. The owner has primary responsibility for the annual operating budget, however, there are other parties that provide assistance. This information will be used to evaluate the financial capacity of the system. The engineer will incorporate information from the owner's accountant and other known technical service providers.

(1) Income. Provide a proposed rate schedule. Project income realistically for existing and proposed new users separately, based on existing user billings, wastewater treatment contracts, and other sources of income. In the absence of historic data or other reliable information, for budget

purposes, base residential wastewater generation on 60 gallons per capita per day, or 150 gallons per residential-sized connection per day, or 4,500 gallons per residential-sized connection per month. Higher per person or per EDU flows may be used with adequate justification. When large agricultural or commercial users are projected, the report should identify those users and include facts to substantiate such projections and evaluate the impact of such users on the economic viability of the project.

(2) Operations and Maintenance (O&M) Costs. Project costs realistically. Provide actual costs for existing systems and projected costs for operating the system as improved. In the absence of other reliable data, base on actual costs of other existing facilities of similar size and complexity. Include facts in the report to substantiate operation and maintenance cost estimates. Include salaries, benefits, water purchase, taxes, accounting and auditing fees, legal fees, interest, utilities, oil and fuel, insurance, annual repairs and maintenance, supplies, chemicals, office supplies and printing , and miscellaneous.

(3) Debt repayments. Describe existing and proposed financing from all sources. All estimates of RUS funding should be based on loans, not grants. RUS will evaluate the proposed project for the possible inclusion of RUS grant funds.

(4) Reserves. Describe the existing and proposed loan obligation reserve requirements for the following:

- Debt Service Reserve - Unless otherwise required by State statute the debt service reserve should be established at one-tenth (1/10) of annual debt repayment requirement (amount of debt that must be repaid to government in a given fiscal year).

- Short-Lived Asset Reserve - Additional reserve amounts may be needed to provide for timely replacement of short-lived assets. Prepare a schedule of short-lived assets and a recommended annual reserve deposit recommended to fund replacement of short-lived assets. Examples of short-lived assets include pump/motor overhaul or replacement, painting, and small equipment replacement. Short-lived assets include those items not included under O&M, however, it should not include long-lived assets such as pump station or treatment facility replacement that should be funded with long-term financing.

8 CONCLUSIONS AND RECOMMENDATIONS

Provide any additional findings and recommendations that should be considered in development of the project. This may include recommendations for special studies, highlight the need for special coordination, a recommended plan of action to expedite project development, etc.

APPENDIX F

Rate Payer Analysis

Costs

Numerous factors will contribute to the overall cost of the alternatives presented. In order to provide accurate information for planning of future budgets, and ultimately the implementation of a rate structure to make proposed improvements sustainable, the study team prepared cost estimates for up-front capital costs, ongoing operation and maintenance (O&M) costs and administrative costs associated with formation of a regional wastewater authority. These costs were ultimately combined into a potential rate impact analysis to compare the proposed improvements.

The various proposed improvements were developed for a 30 year life-cycle cost beginning in 2013. The life-cycle costs were compared by calculating the net present value (NPV) of each alternative so that the costs could be truly comparative. The present year chosen for the purposes of this study was 2009, therefore all of the values presented in this section of the report are given in 2009 dollars.

Overview of the Scenarios

As discussed previously, the proposed alternatives include both short-term and long-term solutions. The alternatives are based on the combined needs of Wasilla, Palmer, and the septic haulers in the Borough.

There are two near-term individual solutions, one for Wasilla and one for Palmer. The near-term solution for Wasilla provides up to 1 MGD of capacity to meet the short-term needs. The near-term solution for Palmer is an upgrade of its treatment facility to provide up to 2 MGD of capacity. Each of these upgrades will provide adequate service for Wasilla through 2015 and through 2025 for Palmer.

The long-term alternatives provide a 4 MGD regional solution to meet the needs of the three entities. The first alternative is an upgrade to the City of Palmer's treatment facility. This upgrade will expand the capacity of the existing lagoon activated sludge plant. The second alternative is a centrally located regional conventional activated sludge treatment plant. The third alternative is a regional membrane bioreactor plant.

For each of these alternatives the capital and operating costs were estimated, a summary of these costs can be found in Tables F-1 and F-2, respectively. The following paragraphs provide an overview of the estimated O&M and capital costs for each of the alternatives.

Capital Costs

Capital costs include the costs associated with construction of new infrastructure. For this analysis, the capital costs include the costs of either increasing capacity at the existing treatment facilities or building new regional treatment facilities. In addition, in order to convey the wastewater to the regional alternatives additional conveyance facilities are necessary. Each of the long-term alternatives include the capital cost associated with the conveyance requirements for the appropriate treatment alternative. Once the capital costs were been determined the annual debt service payment for each alternative was calculated to determine the annual cash requirements to fund these projects. The annual debt service is dependent on the amount of grant funding acquired for capital construction projects. Construction costs which are not covered through grants are assumed to be funded through 30 year bonds at a 5.0% interest rate. The following table provides a summary of the debt service for each alternative at the various grant funding rates. Only the regional solutions are included in this table as conversations with local funding agencies indicate that funding for independent treatment plant upgrades would not be evaluated favorably.

Table F-1: Breakdown of Capital Cost Debt Service

		Amount of Grant Funding Received				
		0%	25%	50%	75%	100%
LAS	Bonded Capital Cost	$122,902,965	$92,177,223	$61,451,482	$30,725,741	$0
	Yearly Debt Service	$7,995,014	$5,996,261	$3,997,507	$1,998,754	$0
CAS	Bonded Capital Cost	$137,823,866	$103,367,900	$68,911,933	$34,455,967	$0
	Yearly Debt Service	$8,965,640	$6,724,230	$4,482,820	$2,241,410	$0
MBR	Bonded Capital Cost	$139,068,589	$104,301,442	$61,780,320	$30,890,160	$0
	Yearly Debt Service	$9,046,611	$6,784,958	$4,523,306	$2,261,653	$0

O&M

Operations and maintenance expenses were estimated for each of the alternatives. These include all labor, supplies, chemicals, electricity, etc. to operate the treatment plants properly. Additional pumping costs were also included for the alternatives to pump the wastewater to the regional facilities. Provided below is a summary of the O&M costs for each of the regional alternatives.

Table F-2: Summary of O&M Costs

	Long-Term		
	Regional LAS	Regional CAS	Regional MBR
O&M Costs	$2,270,294	$2,265,079	$2,699,073
Labor Costs	350,704	350,885	319,635
Additional Pumping Costs	210,023	187,213	210,023
Septage Receiving Costs	137,300	137,300	137,300
20% Contingency	590,324	584,755	665,304
Total Capital Costs	$3,558,645	$3,525,232	$4,008,525

The costs were adjusted incrementally throughout the first several years of the review in an attempt to mimic the flows and provide a more accurate measure of the operating costs in the initial startup years.

Net Present Value

After capital and O&M costs were determined the net present value of each alternative was determined over the 30 year life cycle. As noted above, the net present value analysis assumed the portion of the costs not covered by grants would be made up through bond financing. Therefore, the net present value was based on the annual debt service payments plus annual O&M costs over the 30 year life cycle. Provided below is a summary of the net present value of the alternatives.

Table F-3: Net Present Value of Alternatives

	Amount of Grant Funding Received				
	0%	25%	50%	75%	100%
LAS	$176,954,722	$150,412,671	$123,870,621	$97,328,571	$70,786,520
CAS	$189,493,644	$159,729,284	$129,964,925	$100,200,566	$70,436,206
MBR	$200,539,602	$170,506,433	$140,473,264	$110,440,095	$80,406,926

Cost to Rate Payer

Based on the operating and capital costs, an impact to the rate payers can be determined. The first step is to determine the total flows in 2022 when the combined flows reach the 4 MGD level. This was accomplished through the flow projections previously developed. Utilizing these flows and the projected wastewater strength from each entity (Palmer, Wasilla, Septage Haulers) the costs for each alternative can be allocated between the entities. Because the cost to treat the various waste streams is not equal, the costs were allocated based on volume (50% of cost), TSS and BOD (25% of cost for each). For example, while septage flows make up only a small portion of the total flow to the plant, the waste discharged is high in strength (TSS and

BOD), as a result it costs more to treat this waste. Flows from each entity are variable, but are expected to increase based on the population projections presented in Appendix C of this report.

Once the costs are allocated between the entities, the costs can be broken down further between the equivalent residential units (ERUs) on each collection system. In this case, it was assumed that the flows for an ERU connected to a wastewater collection system are equal to 125 gallons per capita per day (GPCD), with 2.9 persons per household. Additionally, an ERU for the MSB was determined as one load of septage with an average load size of 3,000 gallons.

Next, the projected flows for each entity at a given year are divided by the ERU volumes to determine the number of ERUs at that year. Using the projected ERUs, the monthly rate impact per ERU can be developed at a given year. Table F-4 presents the projected monthly rate that an ERU could expect to pay at a given year, based on the cost and population estimates developed for this report.

Table F-4: Breakdown of Potential Monthly Rate Payer Costs

	Amount of Grant Funding Received														
Estimated Rate at Year	0%			25%			50%			75%			100%		
	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR	LAS	CAS	MBR
Wasilla, 2015	$177	$192	$198	$148	$159	$165	$118	$126	$131	$89	$93	$98	$60	$59	$65
Wasilla, 2020	$121	$130	$137	$103	$110	$116	$86	$90	$96	$68	$70	$76	$50	$50	$55
Wasilla, 2025	$93	$100	$105	$80	$85	$90	$68	$71	$76	$55	$56	$61	$42	$42	$47
Palmer, 2015	$137	$148	$154	$115	$124	$129	$94	$99	$105	$72	$74	$80	$50	$50	$55
Palmer, 2020	$103	$130	$117	$103	$94	$100	$74	$78	$84	$60	$62	$68	$46	$46	$52
Palmer, 2025	$83	$88	$94	$80	$76	$81	$61	$64	$69	$51	$52	$57	$40	$40	$45
MSB, 2015	$166	$175	$182	$138	$146	$152	$111	$116	$122	$84	$86	$92	$57	$57	$62
MSB, 2020	$141	$148	$155	$120	$125	$132	$100	$103	$110	$79	$80	$87	$58	$58	$64
MSB, 2025	$121	$126	$132	$104	$108	$114	$87	$90	$96	$70	$72	$77	$54	$54	$59

The information which follows is the breakdown which was used to develop the rates presented for this study. This breakdown details the amount of money which each portion of the rate goes to. For instance, in the Lagoon Activated Sludge Scenario, with 0% grant funding, at year 2015, a ratepayer in Wasilla could expect to pay at rate of $177/month. Of this $177, $2 would go to pay for administrative costs, $33 would go to pay WWTP O&M costs, $8 would pay for WWTP labor, $77 would pay for WWTP debt, $41 would pay for collection/conveyance system debt and $17 would pay for collection/conveyance system O&M.

0 % Grant Funded - LAS

Palmer-4mgd LAS

LAS_4mgd

2015 — Estimated 2015 Flows (MGD)

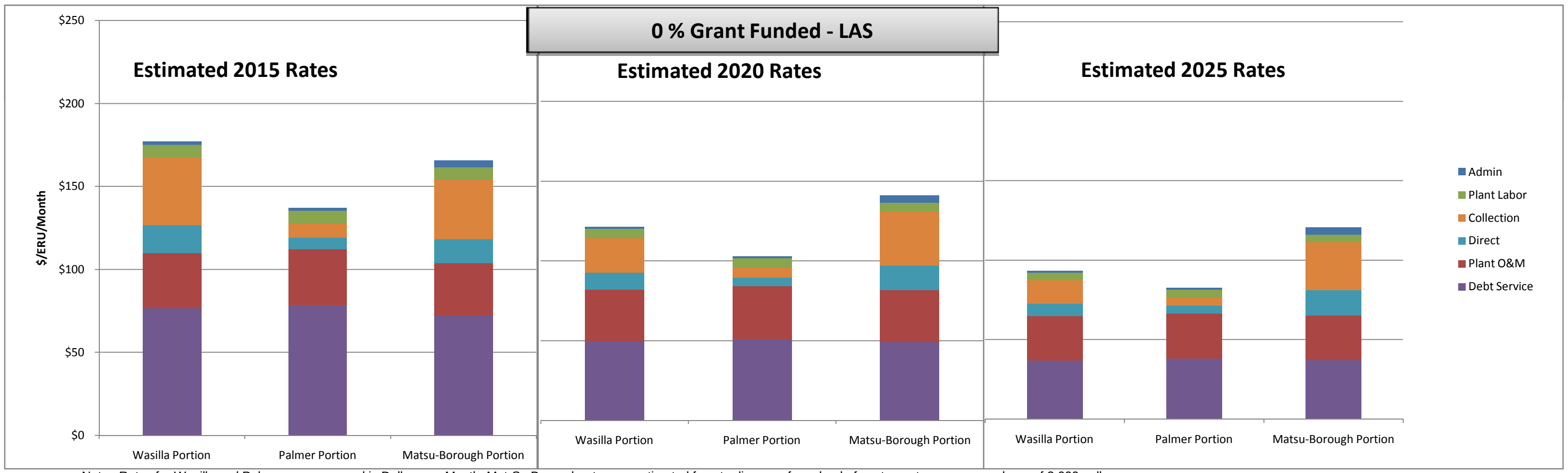
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$33	$8	$77	$41	$17	$177
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	34	8	78	9	7	137
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	4	31	7	72	36	14	166
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$8	$99	$23	$228	$86	$38	$480

2020 — Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$32	$6	$50	$22	$11	$121
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	1	33	6	51	6	5	103
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	4	32	6	49	34	16	141
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$7	$98	$17	$150	$62	$32	$365

2025 — Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$28	$5	$37	$15	$8	$93
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	29	5	38	5	5	83
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	28	5	37	30	16	121
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$7	$85	$15	$112	$49	$29	$297



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

0 % Grant Funded - CAS

CAS ALternative

CAS_4mgd

2015 — Estimated 2015 Flows (MGD)

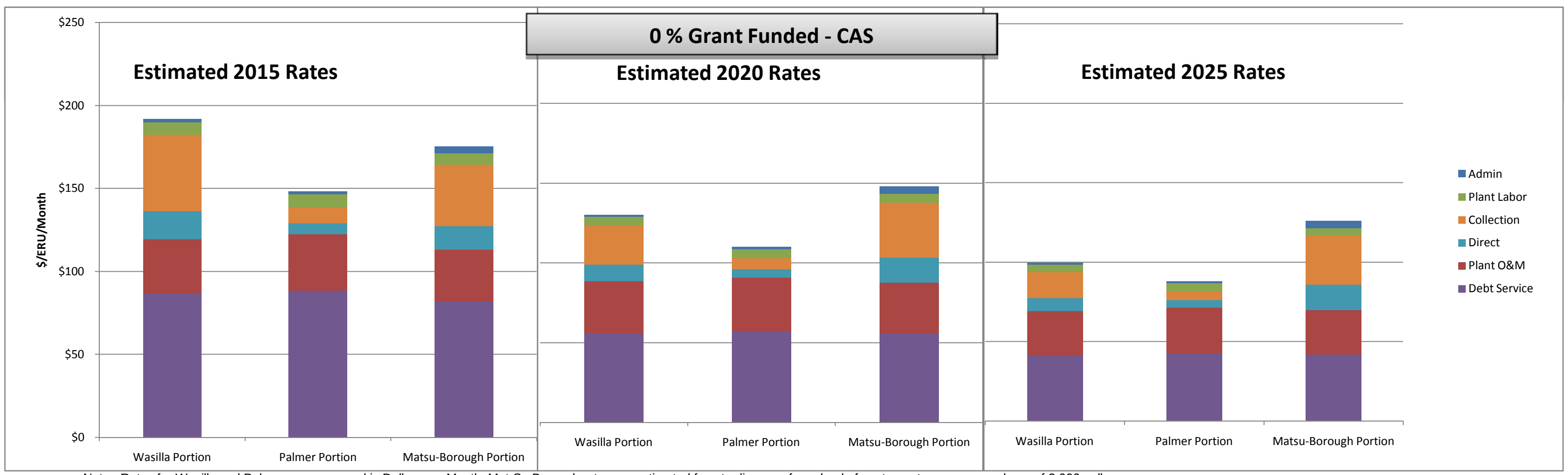
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$33	$8	$87	$46	$17	$192
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	34	8	89	10	7	148
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	4	31	7	82	37	14	175
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$8	$98	$22	$257	$92	$38	$515

2020 — Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$32	$6	$56	$24	$11	$130
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	1	33	6	58	7	5	110
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	4	32	6	56	35	16	148
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$7	$98	$17	$169	$66	$32	$388

2025 — Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$28	$5	$42	$16	$8	$100
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	29	5	43	5	5	88
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	28	5	42	31	16	126
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$7	$84	$15	$126	$52	$29	$313



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

0 % Grant Funded - MBR

MBR Alternative

MBR_4mgd

2015 — Estimated 2015 Flows (MGD)

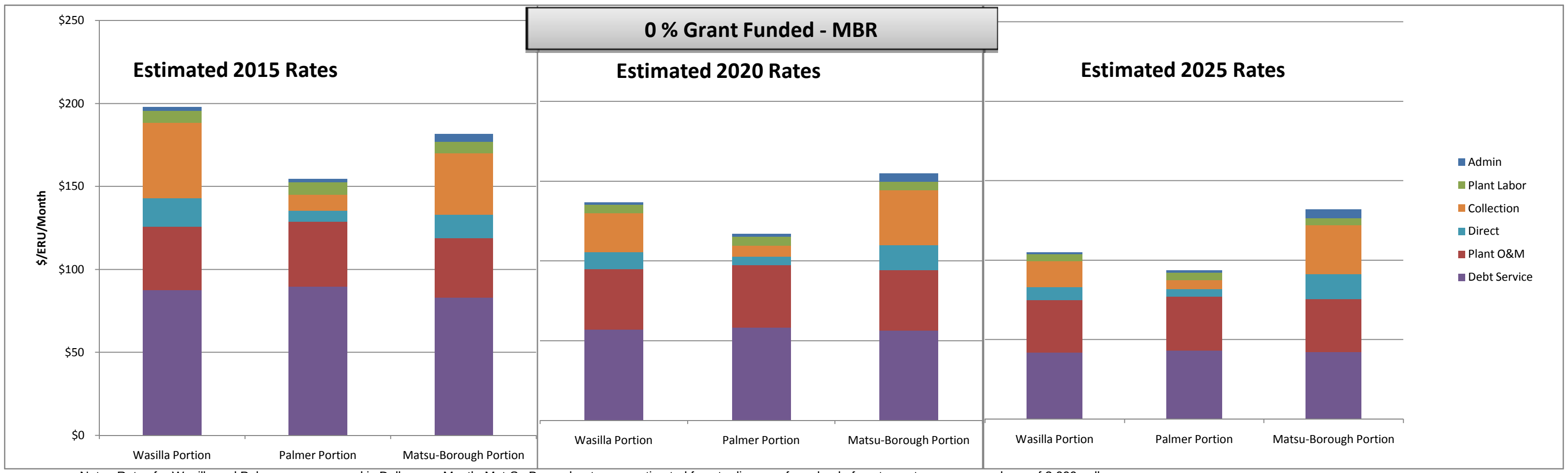
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$38	$7	$88	$46	$17	$198
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	39	7	90	10	7	154
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	5	36	7	83	37	14	182
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$9	$113	$21	$260	$92	$38	$534

2020 — Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$38	$5	$57	$24	$11	$137
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	2	39	5	58	7	5	117
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	5	38	5	56	35	16	155
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$8	$115	$16	$171	$66	$32	$408

2025 — Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$33	$5	$42	$16	$8	$105
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	34	5	43	5	5	94
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	33	5	42	31	16	132
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$8	$100	$14	$128	$52	$29	$331



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

25 % Grant Funded - LAS
Palmer-4mgd LAS
LAS_4mgd

2015 — Estimated 2015 Flows (MGD)

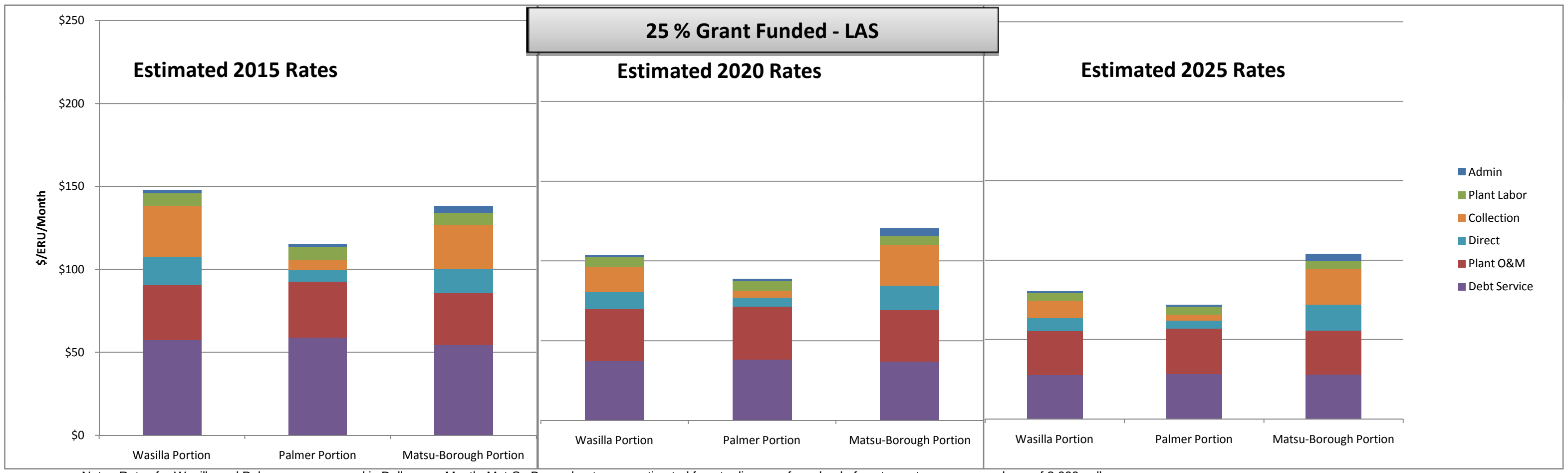
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$33	$8	$57	$31	$17	$148
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	34	8	59	7	7	115
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	4	31	7	54	27	14	138
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$8	$99	$23	$171	$64	$38	$402

2020 — Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$32	$6	$37	$16	$11	$103
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	1	33	6	38	5	5	89
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	4	32	6	37	25	16	120
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$7	$98	$17	$112	$46	$32	$313

2025 — Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$28	$5	$28	$11	$8	$80
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	29	5	28	4	5	72
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	28	5	28	22	16	104
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$7	$85	$15	$84	$37	$29	$256



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

25 % Grant Funded - CAS
CAS ALternative
CAS_4mgd

2015 Estimated 2015 Flows (MGD)

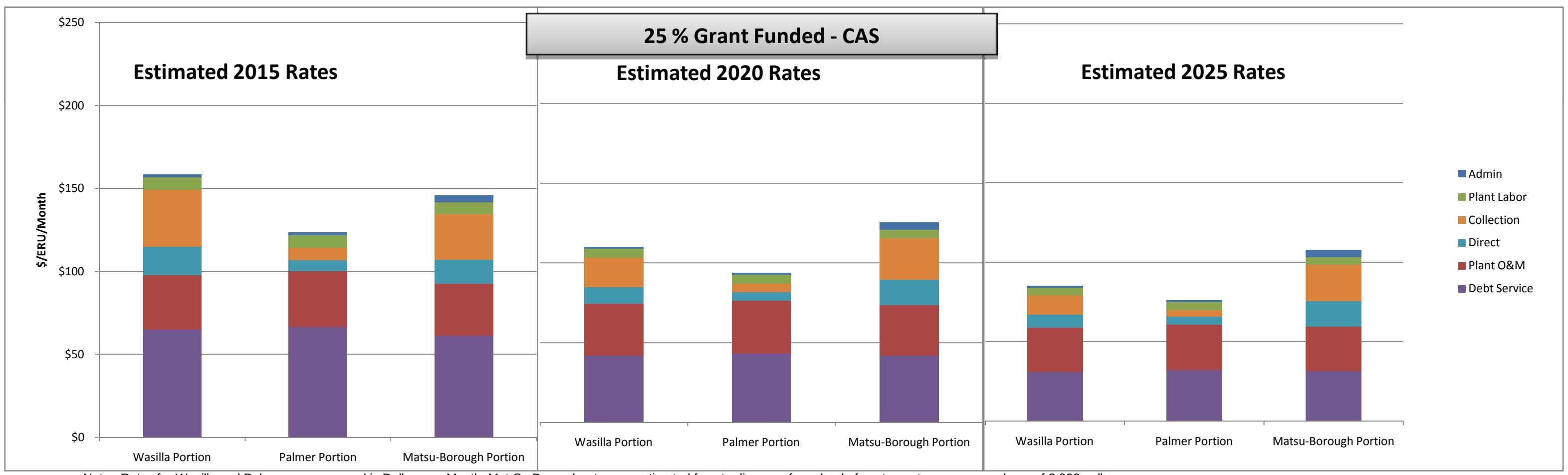
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$33	$8	$65	$34	$17	$159
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	34	8	66	7	7	124
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	4	31	7	61	28	14	146
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$8	$98	$22	$193	$69	$38	$428

2020 Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$32	$6	$42	$18	$11	$110
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	1	33	6	43	5	5	94
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	4	32	6	42	26	16	125
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$7	$98	$17	$127	$49	$32	$330

2025 Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$28	$5	$31	$12	$8	$85
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	29	5	32	4	5	76
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	28	5	31	23	16	108
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$7	$84	$15	$95	$39	$29	$269



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

25 % Grant Funded - MBR
MBR Alternative
MBR_4mgd

2015 Estimated 2015 Flows (MGD)

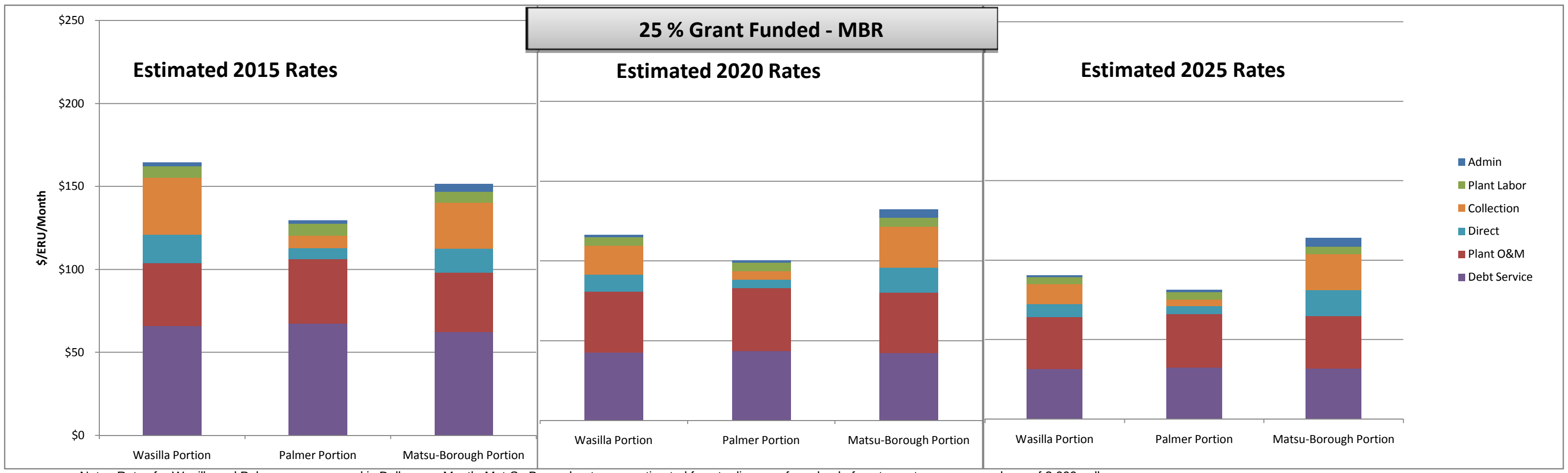
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$38	$7	$66	$34	$17	$165
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	39	7	67	7	7	129
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	5	36	7	62	28	14	152
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$9	$113	$21	$195	$69	$38	$446

2020 Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$38	$5	$43	$18	$11	$116
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	2	39	5	44	5	5	100
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	5	38	5	42	26	16	132
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$8	$115	$16	$128	$49	$32	$349

2025 Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$33	$5	$32	$12	$8	$90
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	34	5	32	4	5	81
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	33	5	32	23	16	114
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$8	$100	$14	$96	$39	$29	$286



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

50 % Grant Funded - LAS

Palmer-4mgd LAS

LAS_4mgd

2015 Estimated 2015 Flows (MGD)

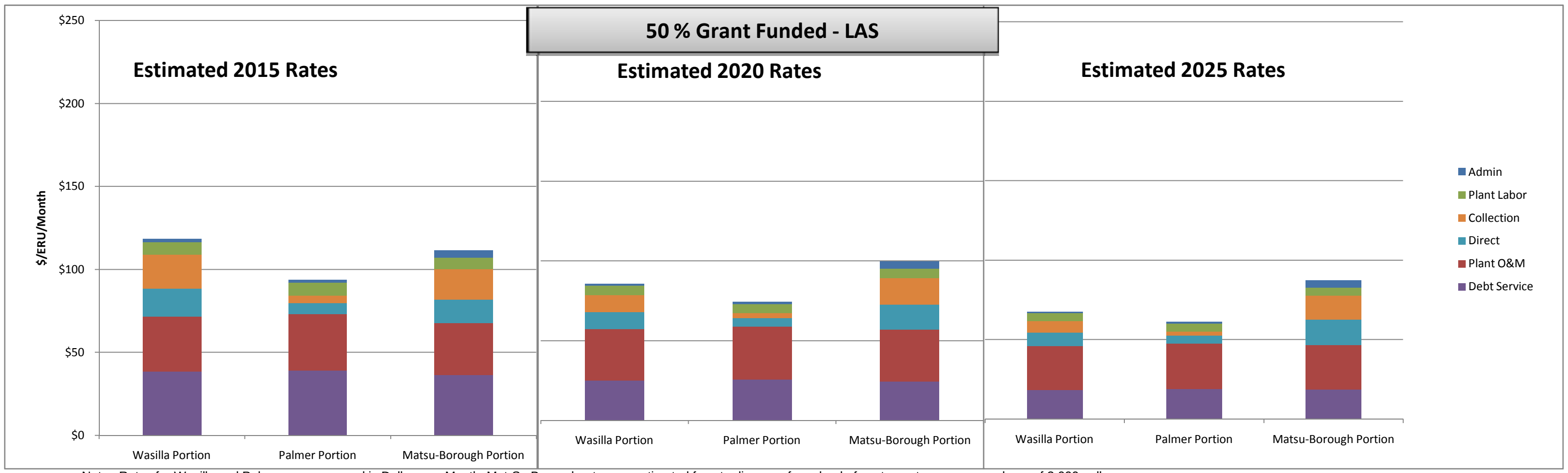
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$33	$8	$38	$20	$17	$118
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	34	8	39	4	7	94
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	4	31	7	36	18	14	111
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$8	$99	$23	$114	$43	$38	$323

2020 Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$32	$6	$25	$11	$11	$86
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	1	33	6	25	3	5	74
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	4	32	6	25	17	16	100
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$7	$98	$17	$75	$31	$32	$260

2025 Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$28	$5	$18	$7	$8	$68
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	29	5	19	2	5	61
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	28	5	19	15	16	87
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$7	$85	$15	$56	$25	$29	$216



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

50 % Grant Funded - CAS
CAS ALternative
CAS_4mgd

2015 Estimated 2015 Flows (MGD)

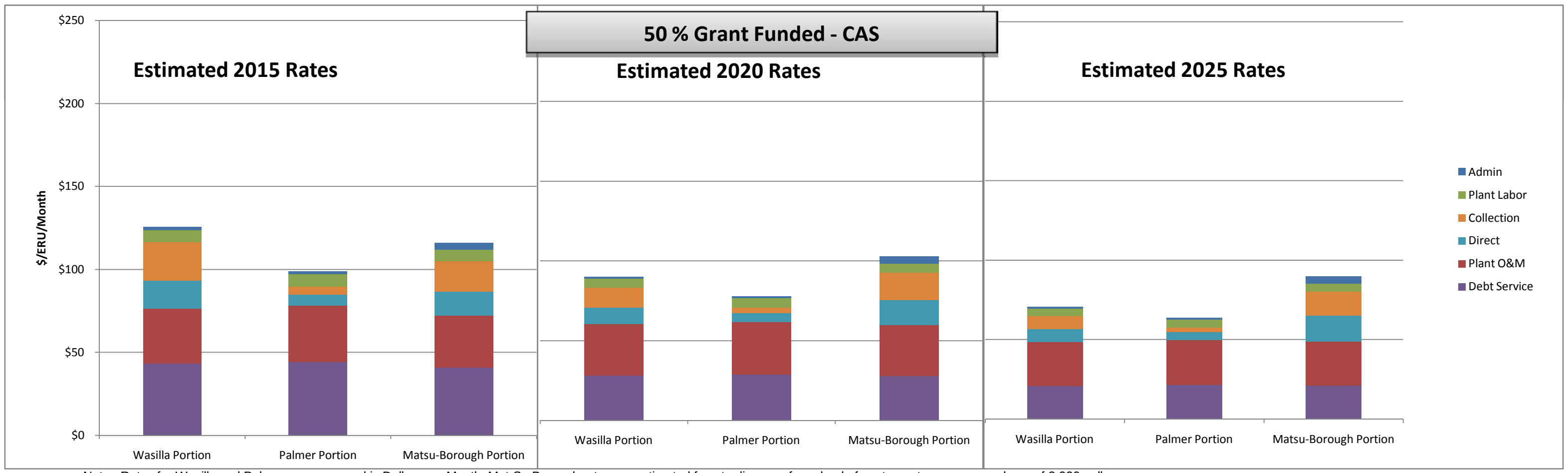
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$33	$8	$43	$23	$17	$126
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	34	8	44	5	7	99
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	4	31	7	41	18	14	116
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$8	$98	$22	$128	$46	$38	$341

2020 Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$32	$6	$28	$12	$11	$90
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	1	33	6	29	3	5	78
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	4	32	6	28	17	16	103
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$7	$98	$17	$85	$33	$32	$271

2025 Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$28	$5	$21	$8	$8	$71
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	29	5	21	3	5	64
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	28	5	21	15	16	90
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$7	$84	$15	$63	$26	$29	$224



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

50 % Grant Funded - MBR
MBR Alternative
MBR_4mgd

2015 Estimated 2015 Flows (MGD)

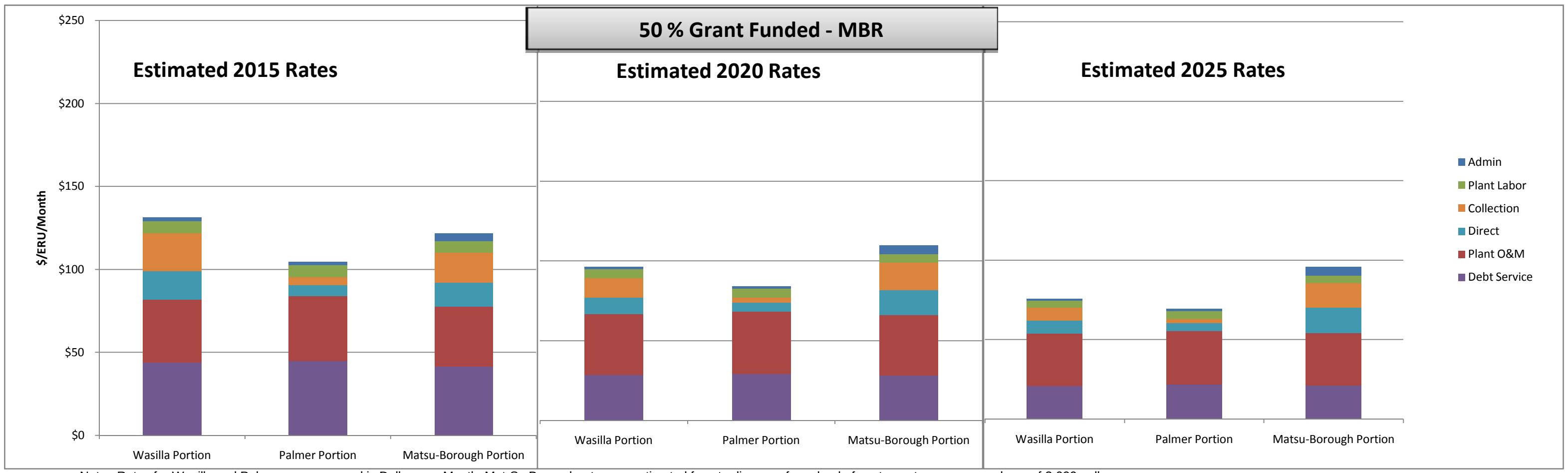
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$38	$7	$44	$23	$17	$131
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	39	7	45	5	7	105
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	5	36	7	41	18	14	122
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$9	$113	$21	$130	$46	$38	$358

2020 Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$38	$5	$28	$12	$11	$96
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	2	39	5	29	3	5	84
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	5	38	5	28	17	16	110
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$8	$115	$16	$86	$33	$32	$290

2025 Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$33	$5	$21	$8	$8	$76
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	34	5	22	3	5	69
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	33	5	21	15	16	96
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$8	$100	$14	$64	$26	$29	$241



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

75 % Grant Funded - LAS

Palmer-4mgd LAS

LAS_4mgd

2015 Estimated 2015 Flows (MGD)

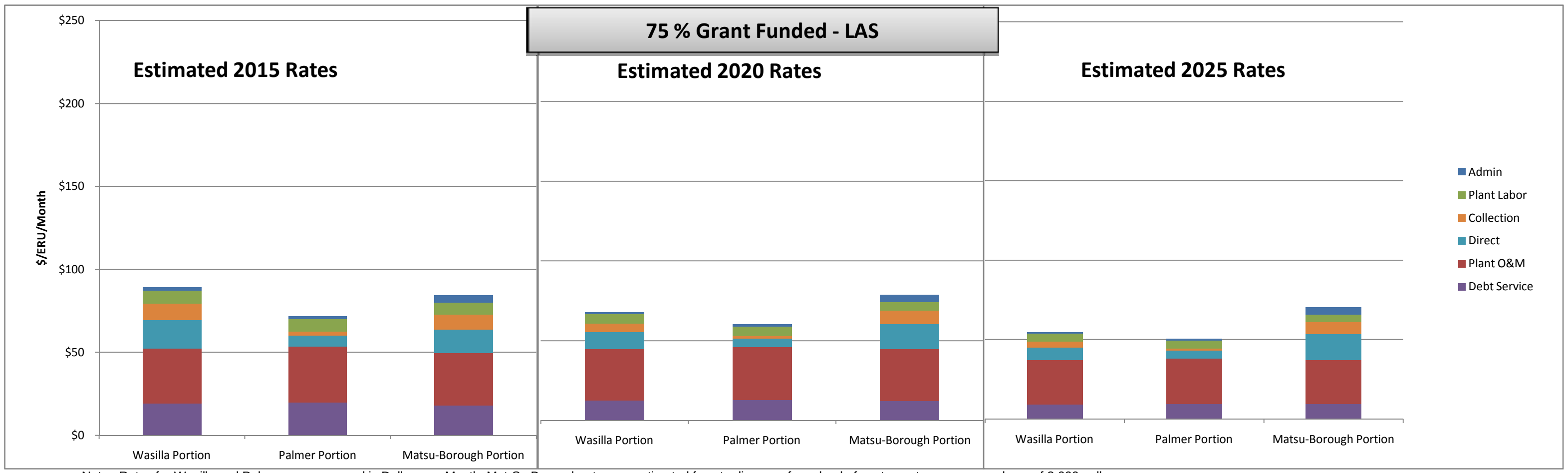
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$33	$8	$19	$10	$17	$89
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	34	8	20	2	7	72
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	4	31	7	18	9	14	84
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$8	$99	$23	$57	$21	$38	$245

2020 Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$32	$6	$12	$5	$11	$68
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	1	33	6	13	2	5	60
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	4	32	6	12	8	16	79
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$7	$98	$17	$37	$15	$32	$207

2025 Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$28	$5	$9	$4	$8	$55
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	29	5	9	1	5	51
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	28	5	9	7	16	70
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$7	$85	$15	$28	$12	$29	$176



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

75 % Grant Funded - CAS
CAS ALternative
CAS_4mgd

2015 — Estimated 2015 Flows (MGD)

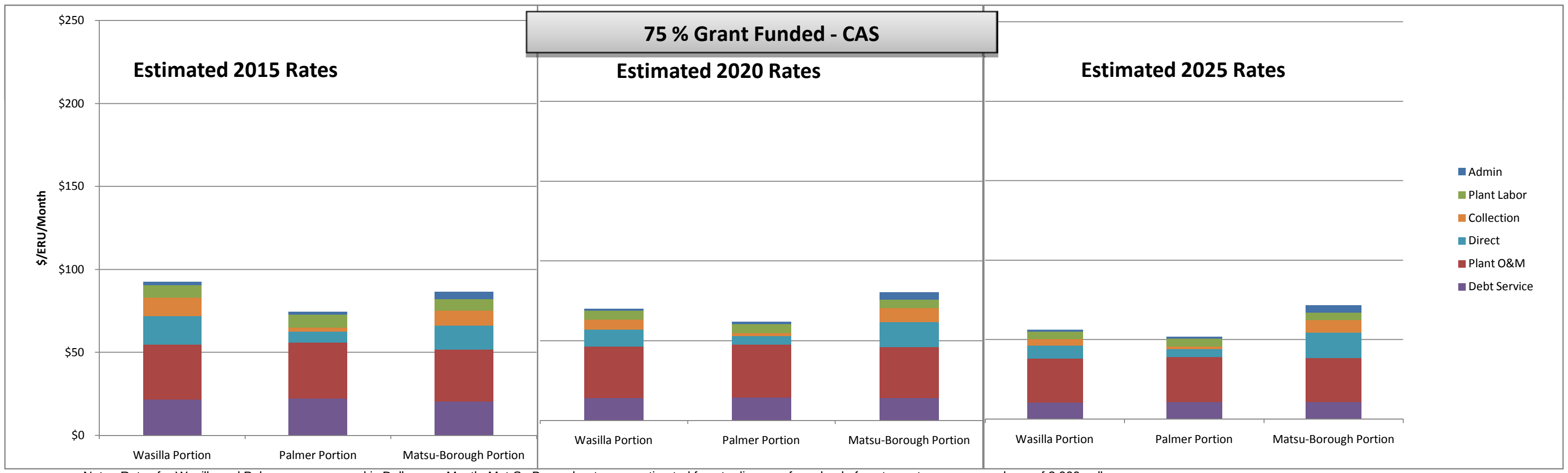
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$33	$8	$22	$11	$17	$93
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	34	8	22	2	7	74
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	4	31	7	20	9	14	86
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$8	$98	$22	$64	$23	$38	$253

2020 — Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$32	$6	$14	$6	$11	$70
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	1	33	6	14	2	5	62
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	4	32	6	14	9	16	80
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$7	$98	$17	$42	$16	$32	$212

2025 — Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$28	$5	$10	$4	$8	$56
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	29	5	11	1	5	52
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	28	5	10	8	16	72
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$7	$84	$15	$32	$13	$29	$180



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

75 % Grant Funded - MBR
MBR Alternative
MBR_4mgd

2015 — Estimated 2015 Flows (MGD)

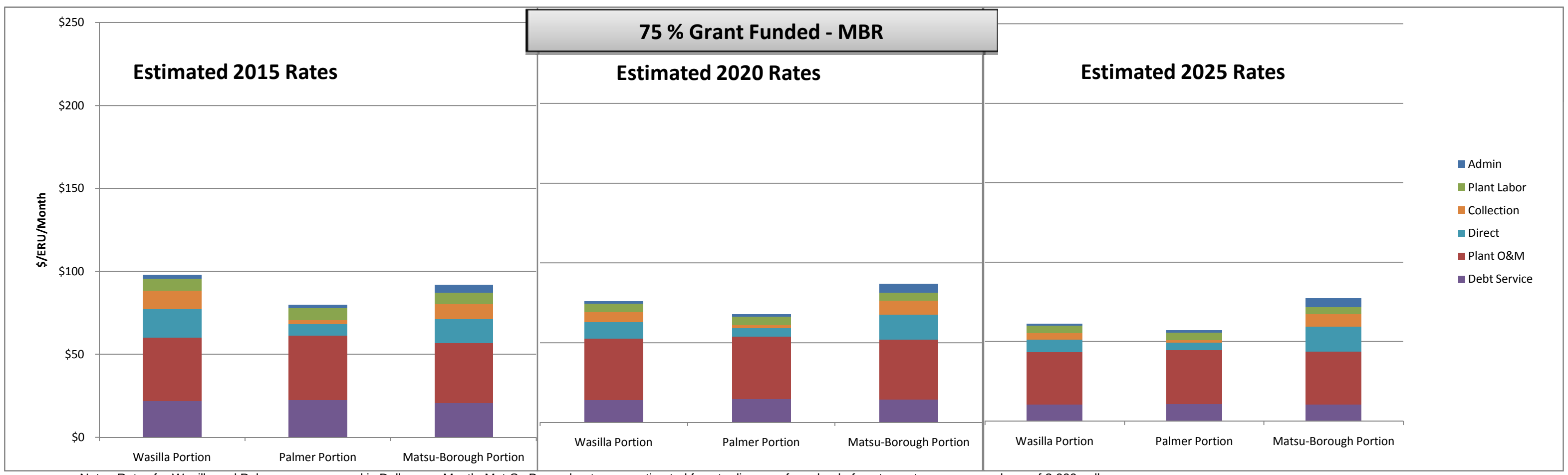
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$38	$7	$22	$11	$17	$98
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	39	7	22	2	7	80
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	5	36	7	21	9	14	92
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$9	$113	$21	$65	$23	$38	$270

2020 — Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$38	$5	$14	$6	$11	$76
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	2	39	5	15	2	5	68
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	5	38	5	14	9	16	87
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$8	$115	$16	$43	$16	$32	$230

2025 — Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$33	$5	$11	$4	$8	$61
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	34	5	11	1	5	57
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	33	5	11	8	16	77
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$8	$100	$14	$32	$13	$29	$196



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

100 % Grant Funded - LAS
Palmer-4mgd LAS
LAS_4mgd

2015 Estimated 2015 Flows (MGD)

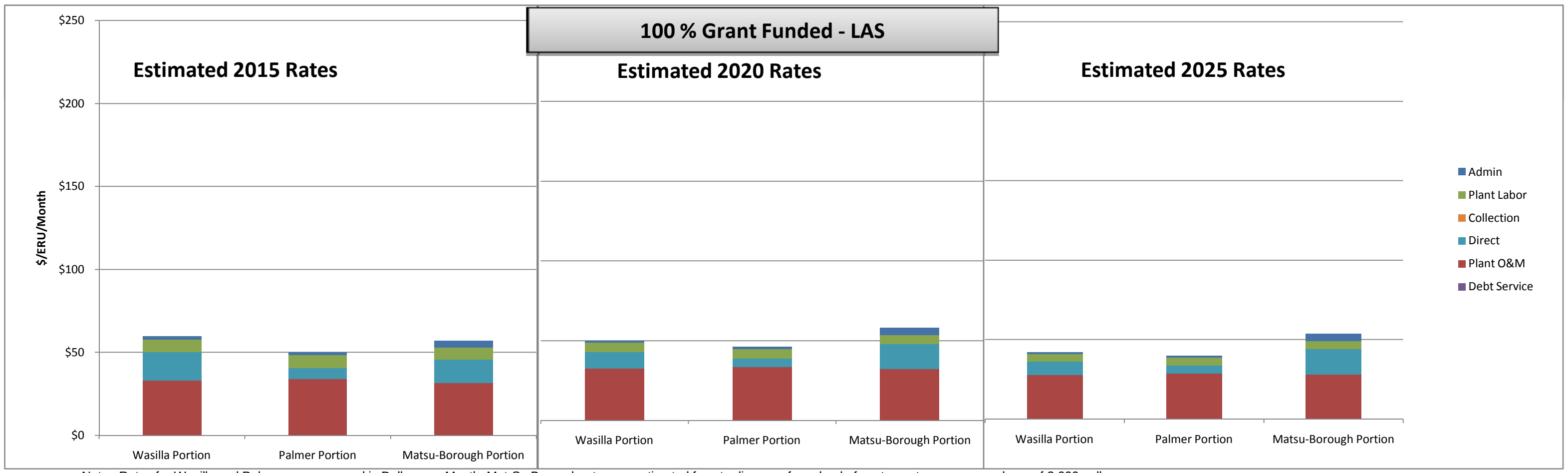
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$33	$8	$0	$0	$17	$60
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	34	8	0	0	7	50
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	4	31	7	0	0	14	57
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$8	$99	$23	$0	$0	$38	$167

2020 Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$32	$6	$0	$0	$11	$50
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	1	33	6	0	0	5	46
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	4	32	6	0	0	16	58
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$7	$98	$17	$0	$0	$32	$154

2025 Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$28	$5	$0	$0	$8	$42
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	29	5	0	0	5	40
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	28	5	0	0	16	54
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$7	$85	$15	$0	$0	$29	$135



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

100 % Grant Funded - CAS
CAS ALternative
CAS_4mgd

2015 Estimated 2015 Flows (MGD)

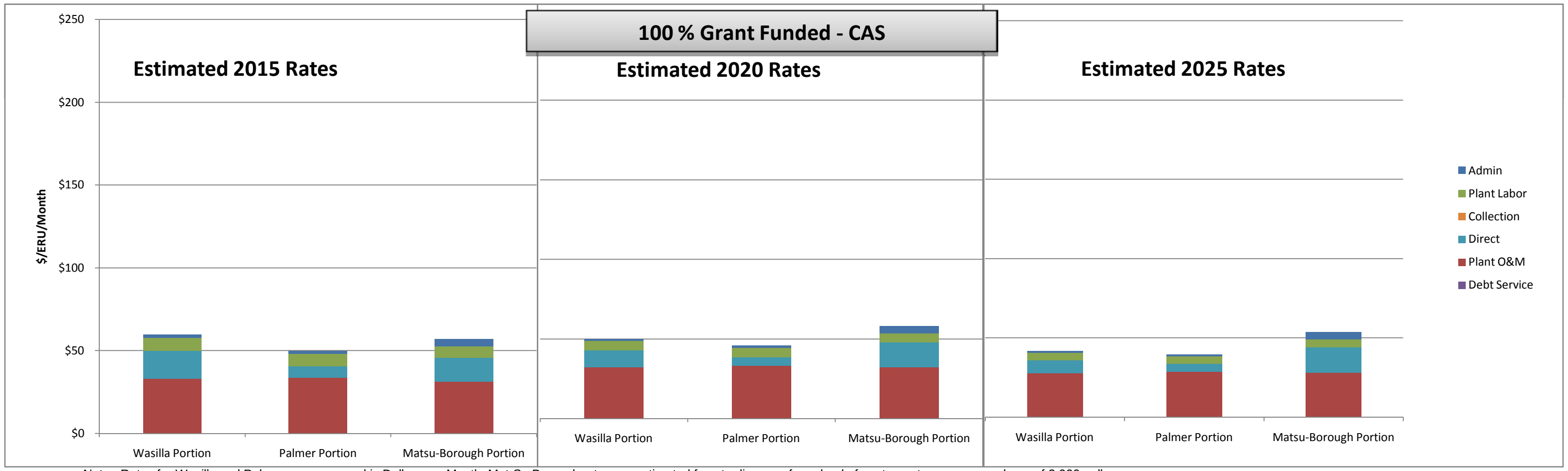
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$33	$8	$0	$0	$17	$59
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	34	8	0	0	7	50
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	4	31	7	0	0	14	57
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$8	$98	$22	$0	$0	$38	$166

2020 Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$32	$6	$0	$0	$11	$50
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	1	33	6	0	0	5	46
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	4	32	6	0	0	16	58
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$7	$98	$17	$0	$0	$32	$153

2025 Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$28	$5	$0	$0	$8	$42
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	29	5	0	0	5	40
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	28	5	0	0	16	54
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$7	$84	$15	$0	$0	$29	$135



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.

100 % Grant Funded - MBR
MBR Alternative
MBR_4mgd

2015 Estimated 2015 Flows (MGD)

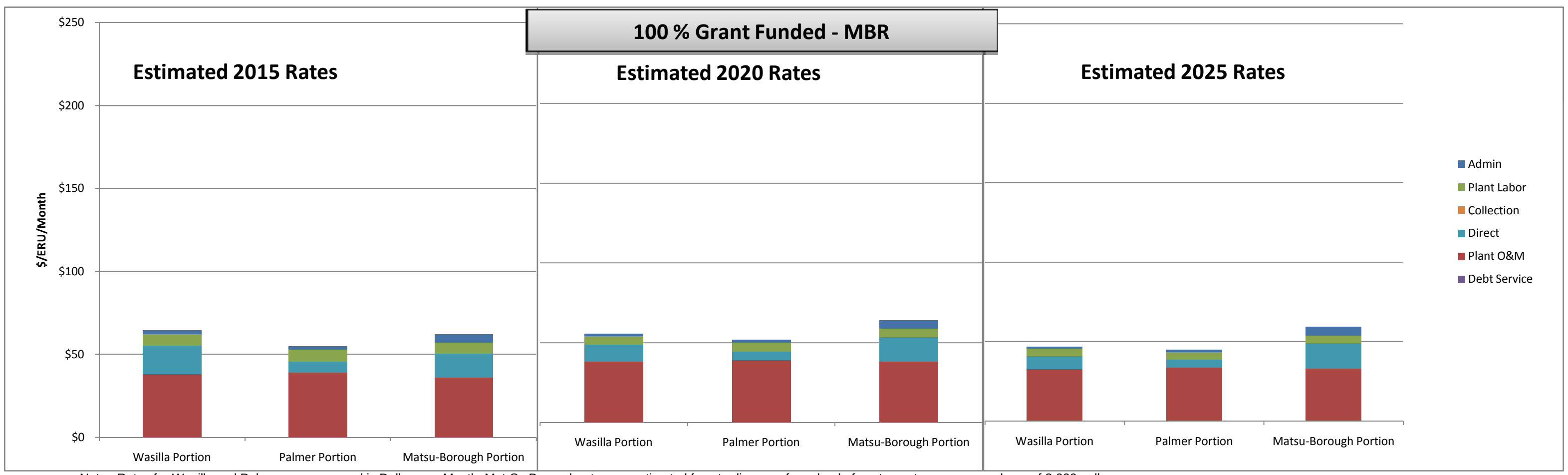
Strength Allocation	ERU Est.	Estimated 2015 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct O&M Costs	Total
Wasilla Portion	2,438	0.88	44%	196	527,210	25%	500	1,344,924	37%	37%	79%	$2	$38	$7	$0	$0	$17	$65
Palmer Portion	2,940	1.07	53%	325	1,052,769	50%	321	1,041,414	28%	46%	21%	2	39	7	0	0	7	55
Matsu-Borough Portion	13,699	0.07	3%	2,475	508,973	24%	6275	1,290,426	35%	17%	0%	5	36	7	0	0	14	62
	19,076	2.02	100%	2,996	2,088,952	100%	7096	3,676,765	100%	100%	100%	$9	$113	$21	$0	$0	$38	$181

2020 Estimated 2020 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2020 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	4,564	1.65	51%	196	987,191	33%	500	2,518,344	47%	45%	79%	$1	$38	$5	$0	$0	$11	$55
Palmer Portion	4,194	1.52	47%	325	1,501,880	50%	321	1,485,681	28%	43%	21%	2	39	5	0	0	5	52
Matsu-Borough Portion	14,571	0.07	2%	2,475	541,385	18%	6275	1,372,602	26%	12%	0%	5	38	5	0	0	16	64
	23,330	3.25	100%	2,996	3,030,456	100%	7096	5,376,627	100%	100%	100%	$8	$115	$16	$0	$0	$32	$171

2025 Estimated 2025 Flows (MGD)

Strength Allocation	ERU Est.	Estimated 2025 Flows (MGD)	% Vol	BOD mg/l	BOD lbs	% BOD	TSS mg/l	TSS lbs	%TSS	50/25/25 Weighted	Collection Upgrades	Admin Costs	Plant O&M Costs	Plant Labor Cost	Plant Debt Service	Collection Debt Service	Direct Costs	Total
Wasilla Portion	6,822	2.47	55%	196	1,475,535	37%	500	3,764,121	52%	50%	79%	$1	$33	$5	$0	$0	$8	$47
Palmer Portion	5,249	1.90	43%	325	1,879,734	47%	321	1,859,459	26%	40%	21%	1	34	5	0	0	5	45
Matsu-Borough Portion	16,468	0.08	2%	2,475	611,879	15%	6275	1,551,329	22%	10%	0%	5	33	5	0	0	16	59
	28,540	4.46	100%	2,996	3,967,148	100%	7096	7,174,909	100%	100%	100%	$8	$100	$14	$0	$0	$29	$151



Note: Rates for Wasilla and Palmer are expressed in Dollars per Month, Mat-Su Borough rates are estimated fees to dispose of one load of septage at an average volume of 3,000 gallons.