Palmer

Alaska

Engineer
HDR

Represented by
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Furnished by
Adrian Williams
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WesTech Opportunity Number: 1660654
Friday, August 19, 2016

Item A: Secondary Clarifier Model Number COPC1G

Equipment

Description	*Unit*	*Dimension/Capacity*
Application	Municipal Waste Water	Activated Sludge
Number of Mechanisms	each	1
Tank Diameter	ft	55
Tank Side Water Depth	ft	13
Tank Bottom Slope	in/ft	1/1

WesTech Drive Unit(s)

Description	*Unit*	*Dimension/Capacity*
Drive Type		Cage
Continuous Rated Torque	ft·lbs	14,700
Momentary Peak Torque	ft·lbs	29,400
Rake Tip Speed	FPM	10
Motor Size	HP	1/2

Equipment Description

Item	*Unit/Size*	*Quantity*	*Description*	*Material*
Bridge Structures	-		Beam Half Span	Steel
Walkway Handrail	-		2 Rail Component	Aluminum
Walkway Flooring	in		1-1/4" Grating	Aluminum
Platform Handrail	-		2 Rail Component	Aluminum
Platform Flooring	in		1/4" Checker Plate	Aluminum
Center Column	in		24" Center Column	Steel
EDI	ft		6' Dual Gate EDI	Steel
Feedwell	ft		12' Flat Panel	Steel
Full Radius Rake Arms	each	2	Box Truss	Steel
Sludge Removal Type			Spiral Scraper Blades	Steel
Sludge Scraper Squeegee				304SS
Sludge Ring		1	Non Rotating	Steel
Scum Box	3 ft	1	Standard Scum Box	Steel
Scum Flushing Valve		1		
Skimming	each	2	Hinged Skimmer Assembly	Aluminum
Anchor Bolts & Fasteners	-		-	304SS

Coatings

All steel items, with the exception of the drive mechanism, will be shipped to the jobsite bare metal with no surface blasting for complete preparation and painting in the field in order to ensure unit responsibility. The drive mechanism will be finished painted in the shop with the manufacturer's recommended paint system.

Field Service

Item	*Quantity*
Number of Trips	1
Days per Trip	1

For inspection, startup, instruction of plant personnel, and observation of torque testing.

Comments and Clarifications

Any item not listed above to be furnished by others.
The information provided above is for budgetary purposes only. The equipment sizes listed may vary depending on the design criteria and plant flows.

Items Not Included in WesTech's Base Scope of Supply

- Electrical control panel
- Lubricants
- FRP weirs
- Scum baffle
- Scum baffle supports
- Steel preparation
- Steel priming
- Steel painting

Optional Equipment

Item A-1

Item	*Unit/Size*	*Quantity*	*Description*	*Material*
Weirs	9"	-	V-Notch	FRP
Scum Baffles	12"	-	-	FRP

This proposal has been reviewed and is approved for issue by ***Jim Olsen*** *on August 19, 2016.*

The WesTech Drive

Direct Coupling

Direct coupling of motor/reducer/pinion shaft assembly eliminates chain or belt drive transmissions and increases efficiency. This arrangement also allows for direct and accurate torque monitoring with WesTech's Load Cell torque control.

Cage Drive.

Custom Design

One of the unique advantages of WesTech drives is the great flexibility of design. This allows the engineer to select a drive that will closely match the process and mechanical requirements. Using precision components manufactured by the foremost manufacturers in the industry, WesTech can guarantee the best quality.

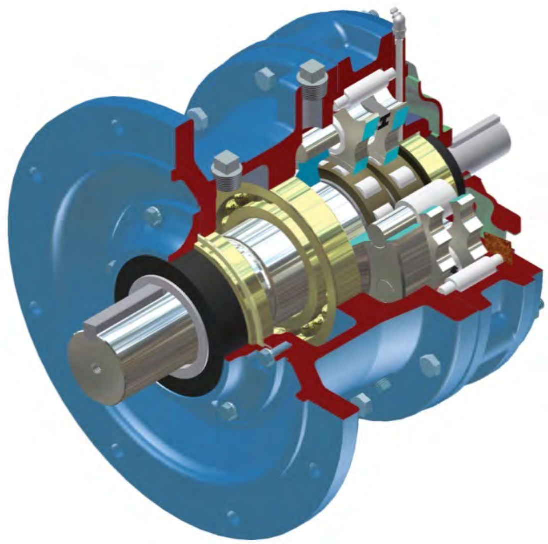
The drive unit consists of electric motor, speed reducer, drive torque control, external gear with integral bearing, and an all steel housing.

Electric Motor

The electric motor, direct coupled to a speed reducer, operates the external gear by means of a pinion fastened to the output shaft of the speed reducer. The drive control pointer indicates the torque loading in percentages. The electric motor is totally enclosed, suitable for outdoor installation, but other commercially available motors to suit environment or service such as explosion proof, can be furnished.

Input Speed Reducer

The speed reducer, driven by the motor, is completely sealed oil or grease lubricated unit. It is of a cycloidal type, which combines extremely high ratios with high efficiency and low wear in a compact unit. Torque transmitting elements roll, do not grind or slide, and because of this, the efficiency reaches 90 percent. Virtually, no wear failures have occurred in properly sized WesTech drives. Even after 30 years of operation, many WesTech Reducers are still in use.



Cycloidal Reducer.

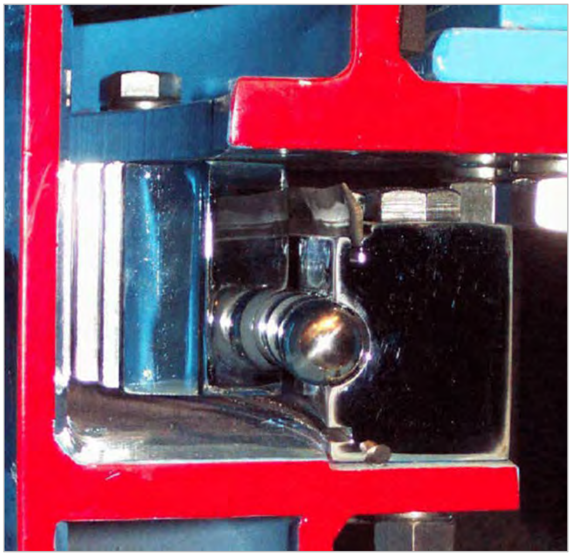
Torkmatic™ Drive Control

The Torkmatic drive control indicates and senses the output torque of the drive main gear. At excessively high torques, an alarm will sound or the motor will stop, thus protecting the drive unit and mechanism as well as the process. The Load Cell torque control is extremely accurate at reading torque and is protected by a NEMA 4x outdoor enclosure. The drive control comes with a 4-20mA signal output for customer ease and control of the process from a remote location.

Precision Bearing Advantages

Precision Manufacturing Tolerances

The bearings utilized are acceptable for high load, high speed applications and are manufactured by recognized bearing companies. The use of these precision bearings is widespread among larger and more heavily loaded mechanisms common to the metallurgical industries.



Precision Bearing.

Exceptional Long Life and Load Capacities of Precision Bearings

Instead of applying the bearing load in four points on the bearing balls as with standard strip liners, the precision bearing utilizes a full band contact race with hardness equal to that of the strip liners.

Calculated bearing life is at least five times that for standard strip liners of the same ball size and diameter. The need for splitting gears and housings is eliminated because of superior service life.

Overturning Load Capacity

Strip liner bearings have no inherent overturning load capacity and must rely only on mechanism weight for this feature. This capacity of the precision bearing makes the possible tank setting, misalignment, and lack of precision leveling of the drive during installation and operation a far less determining factor in premature bearing failure.

Main Bearing Protection

WesTech gear housings protect from dirt and contamination by use of designed neoprene seals and gaskets, whereas strip liners can only use a loose susceptible felt seal. WesTech precision gears also allow the ability to have a separate sealed grease cavity for just the bearing which creates additional protection from contamination.

Item B: Circular Dissolved Air Flotation Unit

General Scope of Supply

Description	Dimension/Capacity	Unit
Number of Units	1	Each
Application	WAS	-
DAF Diameter	36	ft
DAF Side Wall Depth	11	ft
Design Flow Rate	2.2	MGD
Design Recycle Rate	370	gpm
Feed Suspended Solids	400	mg/L
Air to Solids Ratio	0.061	lb/lb
Hydraulic Loading Rate	1.97	gpm/ft^2
Solids Loading Rate	0.32	$lb/hr/ft^2$

Equipment Description

The system shall be designed to recirculate a portion of the clean effluent through a pressurization system. This pressurization system shall saturate the recycle with pressurized air and then inject the mixed solution into the DAF tank at the influent point of entry. Introduction of the air saturated liquid, influent feed, and the collection of floated solids shall be all accomplished in a single tank.

Detailed Scope of Supply

Item	Description	Material of Construction
Tank	Circular with external launders	Concrete (By Others)
Bridge Structures	Tank wall supported	Carbon Steel
Walkway/Platform Handrail	2 row	Aluminum
Walkway/Platform Flooring	1-1/4" I-bar grating	Aluminum
Center Shaft	8" Diameter Shaft	Carbon Steel
Feedwell Diameter	6 ft	Carbon Steel
Feedwell Total Height	5 ft	-
Float Box Width	6 ft	Carbon Steel
Skimmer Arms	4 full radius arms	Carbon Steel
Skimmer Blade Assembly	-	Aluminum
Rake Arms	2 full radius arms	Carbon Steel
Sludge Scraper Squeegee	-	304 Stainless Steel
Weirs	V-Notch	FRP
Baffles	5' Deep	Carbon Steel
Anchor Bolts & Fasteners	-	304 Stainless Steel

Segmented Rake Blades

The segmented rake blades provide rapid solids removal. The rake arms have been designed to eliminate the need for underwater seals and bearings. The mechanical movement of sludge means that there are no orifices or pipes to plug.

Skimmer Arms and Float Box

Float skimmer mechanism arms designed to support the skimmer assembly components. Skimmers are supported from the center shaft and do not require the use of an end caster rolling on the float baffle.

Float Box

A float trough is provided with a beach at an optimal angle to maximize the amount of float removed with each skimmer pass.

Feedwell

WesTech's feedwell is designed to dissipate the energy in the inlet flow, creating an even distribution of flow over the entire area of the separator as well as eliminating the potential for scouring of the sludge blanket. The feedwell also serves as a baffle to prevent short circuiting through the basin, eliminating dead spots and utilizing the entire basin volume.

Recycle System

Back Pressure Valve

Back Pressure Valve	
Valve Type	Haymore
Diameter	6"
Pipe Material	Steel
Back Pressure Plate Material	304 SS
Hand Wheel Material	Aluminum

Air Flow Control Panel

Air Control Panel	
Dimensions	2' x 2' x 6"
Material	304 SS
Component List	Quantity
Pressure Regulator	1
Needle Valve	1
Isolation Ball Valves	7
Air Flow Meter	1
Solenoid Valve	1
Check Valve	1

Recycle Pump

Recycle Pump		
Quantity	1	
Type	ANSI	
Flow Rate (per pump)	370	gpm
TDH	175 (76)	ft H_2O (psi)
Motor	TEFC	
Power	40	HP
Voltage	230/460	V
Phase	3	
Frequency	60	Hz

Air Compressor

Air Compressor		
Qty	1	
Type	Reciprocating	
Air feed rate	16	scfm
Discharge Pressure	80	psi
Motor	TEFC	
Power	5	HP
Voltage	230/460	V
Phase	3	
Frequency	60	Hz

Saturation Tank

Saturation Tank		
Material of Construction	Carbon Steel	
Diameter	42	in
Shell Height	60	in
Total Height	108	in
Total Volume	417	gal
Recycle Flow	370	gpm
Theoretical Retention Time	1.13	min
Level Control Valve	Sewage Air Release	
Sight Glass	2	ft
Pressure Relief Valve	100	psi

Saturation Tank Nozzle Schedule		
Description	**Quantity**	**Size**
Influent	1	6”
Effluent	1	6”
Manway	1	24”
PRV air connection	1	¾”
PRV Water Connection	1	2”
Pressure Gauge Connection	1	½”
Air Inlet	1	¾”
Sight Glass Connections	2	½”
Drain	1	2”

Drive Unit

WesTech drive units are delivered to the job site as a single, completely assembled and shop-tested unit, ready to be installed on the DAF center column. The result of a thorough design and meticulous component selection is a strong, reliable, high-quality drive that will provide a long service life with minimum maintenance.

Drive Unit		
Description	**Dimension/Capacity**	**Unit**
Drive Type	43"	Shaft
Continuous-Rated Torque	15000	ft-lb
Rake Tip Speed	23	FPM
Motor	TEFC	-
Power	1	HP
Voltage	460	V
Phase	3	
Frequency	60	Hz
Overload Levels	100%	Alarm
	120%	Motor Cutout
	140%	Backup Motor Cutout
Main Gear and Pinions Lubrication	Oil bath	-
Main Bearing and Reducers Lubrication	Grease	-

Controls and Instrumentation

Control Panel

The control panel will include rake drive stop-start push buttons, alarm light, alarm horn, alarm reset, heater, contacts for remote indication and control. Installation in the field will be by others.

Controls and Instrumentation

Description	Type	Included
Control Panel Type	NEMA 4X	Yes
Torque Control	Electromechanical	Yes
Rake Arm Drive	VFD	Yes
Recycle pump	Starters	Yes
Air Compressor	Starter	Yes

Additional Information

Paint

Coating Area	SSPC	Brand	Product #	mils DFT per Coat	Coats
Submerged Steel	SP10	Tnemec	Series N140	4-6	2
Non Submerged Steel	SP6	Tnemec	Series N140	4-6	1
			Series 73	3-5	1

Weight

Mechanism Shipping Weight	21,000	lb
Drive Shipping Weight	3,000	lb
Heaviest Component (Walkway)	3,500	lb

On-Site Services

Field Services

Number of Trips	2	-
Time per Trip	2	Days

Included field service is for mechanical checkout and commissioning. Any additional trips that the customer may request can be purchased at the standard WesTech daily rates plus travel and living expenses.

Clarifications and Exclusions

Any item not listed above to be furnished by others.

Submittals: Submittals will be made approximately **8 to 10 weeks** after purchase order is received in our office.

Shipment: Estimated shipment time is **18 to 20 weeks** after approved submittal drawings are received in our office.

Items Not By WesTech:

Electrical wiring, conduit or electrical equipment; piping, valves, or fittings; fireproofing; fire and gas detection and alarming systems; oxygen analyzers or other similar analyzers; lubricating oil or grease; utilities; nitrogen for blanketing system; shop or field painting; field welding; erection; detail shop fabrication drawings; performance testing; unloading; storage; concrete work; foundation design; field service; (except as specifically noted).

This proposal has been reviewed and is approved for issue by ***Travis Zurcher*** *on August 19, 2016.*

Item C: Rectangular Dissolved Air Flotation Unit

General Scope of Supply		
Number of Units	1	
Application	WAS	
DAF Length	68	ft
DAF Width	15	ft
DAF Depth	8	ft
Design Flow Rate	2.2	MGD
Design Recycle Rate	370	gpm
Feed Suspended Solids	400	mg/L
Air to Solids Ratio	0.061	lb/lb
Hydraulic Loading Rate	1.98	gpm/ft^2
Solids Loading Rate	0.32	$lb/hr/ft^2$

Equipment Description

The system shall be designed to recirculate a portion of the clean effluent through a pressurization system. This pressurization system shall saturate the recycle with pressurized air and then inject the mixed solution into the DAF tank at the influent point of entry. Introduction of the air saturated liquid, influent feed, and the collection of floated solids shall be all accomplished in a single tank.

Detailed Scope of Supply

Description	Size	Material of Construction
Tank	¼” thick minimum	Carbon Steel
Cover	3/16” thick minimum	Carbon Steel
Chain & Flight	1 HP	-
Shafts	3-7/16” Diameter	Carbon Steel
Sprockets	6” Pitch	UHMW PE with Nylon Hubs
Chain	6” Pitch	Acetal Resin with Nylon Pins
Flights	5’ Spacing, 8” deep	FRP Extruded Channel
Wear Strips	-	UHMW PE
Float Box	20” Beach length	Carbon Steel
Gaskets	Various	Buna-N
Packing	Various	Graphite
Non Submerged Fasteners	Various	307/325 HDG
Submerged Fasteners	Various	304 Stainless Steel
Anchor Bolts	-	By Others

Tank

Tank will be suitable for the installation of a WesTech DAF mechanism. The tank shall consist of a flotation zone, clearwell, and all necessary baffling for proper operation of the unit. The side shell will be reinforced and fitted with attachments for support of the internal mechanisms.

The tank will include the following nozzles:

Tank Nozzle Schedule		
Description	**Quantity**	**Size**
Influent	1	16”
Effluent	1	16”
Recycle inlet	1	6”
Recycle outlet	1	6”
Float Box	1	6”
Sludge Draw Off / Drains	3	6”

Chain and Flight Mechanism

An inverter duty drive unit will be provided. The drive motor will be a TEFC motor along with a standard WesTech torque box for overload protection. Drive and idler shafts, complete with keyways and fitted keys as well as bearings and sprockets will be included. The chain will be provided with links to accommodate the attachment of flights.

The skimmer flights will include hardware for the attachment of wear shoes, filler blocks, and side wipers. Flight monitoring sensors that indicate chain and flight misalignment shall be provided. Flight carrying and return rails provide tracks for the flight wear shoes to ride against and offer wear protection for the tank.

Float Box

A float trough is provided with a beach at an optimal angle to maximize the amount of float removed with each skimmer pass.

Recycle System

Back Pressure Valve

Back Pressure Valve	
Valve Type	Weir Diaphragm
Diameter	6"

Air Flow Control Panel

Air Control Panel	
Dimensions	2’ x 2’ x 6”
Panel Material	304 SS
Piping Material	Hot Dip Galvanized
Component List	**Quantity**
Pressure Regulator	1
Needle Valve	1
Isolation Ball Valves	5
Air Flow Meter	1
Solenoid Valve	1
Check Valve	1

Recycle Pump

Recycle Pump		
Quantity	2	1 duty, 1 standby
Type	ANSI	
Flow Rate (per pump)	370	gpm
TDH	175 (75)	ft H_2O (psi)
Motor	TEFC	
Power	40	HP
Voltage	230/460	V
Phase	3	
Frequency	60	Hz

Air Compressor

Air Compressor		
Qty	1	
Type	Reciprocating	
Air feed rate	16	scfm
Discharge Pressure	80	psi
Motor	TEFC	
Power	5	HP
Voltage	230/460	V
Phase	3	
Frequency	60	Hz

Saturation Tank

Saturation Tank		
Material of Construction	Carbon Steel	
Diameter	42	in
Shell Height	60	in
Total Height	108	in
Total Volume	417	gal
Recycle Flow	370	gpm
Theoretical Retention Time	1.13	min
Level Control Valve	Sewage Air Release	
Sight Glass	2	ft
Pressure Relief Valve	100	psi

Saturation Tank Nozzle Schedule		
Description	**Quantity**	**Size**
Influent	1	6”
Effluent	1	6”
Manway	1	24”
PRV Air Connection	1	¾”
PRV Water Connection	1	2”
Pressure Gauge Connection	1	½”
Air Inlet	1	¾”
Sight Glass Connections	2	½”
Drain	1	2”

Controls and Instrumentation

The control panel will include push buttons, alarm light, alarm horn, alarm reset, heater, contacts for remote indication and control. Installation in the field will be by others.

Controls and Instrumentation		
Description	**Type**	**Included**
Control Panel Type	NEMA 4X	Yes
Torque Transmitter	Electromechanical	Yes
Chain and Flight Drive	VFD	Yes
Recycle Pump	Starter	Yes
Air Compressor	Starter	Yes

Additional Information

Paint					
Coating Area	**SSPC**	**Brand**	**Product #**	**mils DFT per Coat**	**Coats**
Tank Interior	SP10	Tnemec	Series N140	4-6	2
Tank Exterior	SP6	Tnemec	Series N140	4-6	1
			Series 73	3-5	1

Shipping Dimensions and Weights		
Description	**Size**	**Units**
Estimated Shipping Dimensions	16 x 68 x 10	
Estimated Shipping Weight	40,000	lb
Operating Capacity	460,000	lb

On-Site Services

Field Service		
Number of Trips	2	-
Time per Trip	2	Days

Included field service is for mechanical checkout and commissioning. Any additional trips that the customer may request can be purchased at the standard WesTech daily rates plus travel and living expenses.

Clarifications and Exclusions

Any item not listed above to be furnished by others.

Submittals: Submittals will be made approximately **8 to 10 weeks** after purchase order is received in our office.

Items Not By WesTech:

Electrical wiring, conduit or electrical equipment; piping, valves, or fittings; fireproofing; fire and gas detection and alarming systems; oxygen analyzers or other similar analyzers; lubricating oil or grease; utilities; nitrogen for blanketing system; shop or field painting; field welding; erection; detail shop fabrication drawings; performance testing; unloading; storage; concrete work; foundation design; field service; (except as specifically noted).

*This proposal has been reviewed and is approved for issue by **Travis Zurcher** on August 19, 2016.*

Item D: Zickert Shark™ Model Number ZSED

Phase 1 General Scope of Supply		
Description	**Unit**	**Dimension/Capacity**
Total Number of Basins		1
Number of Main Scrapers per Basin		1
Number of Cross Collectors per Basin		1
Basin Dimensions	each	24.5’ W x 97.5’ L x 13’ H
Peak Flow Rate	MGD	2.2
Rise Rate at Peak Flow	gpm/ft^2	0.64
Main Scraper Dimension	feet	24.5’ W x 91’ L
Cross Collector Dimension	feet	6.5’ W x 24.5’ L
Drive Type		Electric

Equipment Description

The ZICKERT Shark™ sludge scraper is specially designed for continuous sludge removal without disturbing the sludge blanket or interrupting the sedimentation process. Thousands of customers worldwide have seen the benefits of applying this system.

The ZICKERT Shark™ is designed for the efficient removal of surface scum without the excessive use of transport water.*Surface skimmer shown in the image above is not included with this quote.

Detailed Scope of Supply (per Basin)			
Item	**Quantity**	**Description**	**Material**
		Main Scraper Equipment	
Primary Scraper	1 per basin	Includes scraper profiles, push/pull rod, guide and guide tubes, and other components	304 Stainless steel
Primary Motor	2 hp	Electric motor, 1800 rpm, 60 Hz, 3 phase, 230/460 V, TEFC	
Link Arm	-	Connects drive to scraper mechanism	304 Stainless steel
Flat Sliding Bars	-	Provides guides and structure for scraper profiles	304 Stainless steel
Glide Strips	-	Mounted to the basin floor	UL approved
Motion Flag	1	Mounted to scraper to easily identify scraper motion	304 Stainless Steel
Anchor Bolts and Fasteners	-	-	304 Stainless steel
		Cross Collector Equipment	
Cross Collector Scraper	1 per basin	Includes scraper profiles, push/pull rod, guide and guide tubes, and other components	304 Stainless steel
Cross Collector Motor	0.75 hp	Electric motor, 1800 rpm, 60 Hz, 3 phase, 230/460 V, TEFC	
Motion Flag	1	Mounted to scraper to easily identify scraper motion	304 Stainless Steel
Anchor Bolts and Fasteners	-	-	304 Stainless steel

Control Panel

Controls & Instrumentation		
Description	**Type**	**Notes**
Control Panel	NEMA 4X 304 stainless steel enclosure	One (1) panel per two basins. Includes door mounted hand/off/auto switch, indicating lights and pushbuttons. Includes emergency stop. Local and Remote control of each scraper. A programmable relay will provide the logical functioning of the system
Alarm	Top mounted strobe beacon	Top mounted strobe beacon light and alarm horn for over-torque indication.
Power Supply		Accepts 480 V, Three Phase, 60 Hz control Power Feed. 480/120 step down transformer for control voltage in panel

On-Site Service

WesTech Trips to the Site		
Number of Trips	**Number of Days per Trip**	**Includes**
Two (2)	Three (3)	Installation inspection, startup, instruction of plant personnel, and observation of torque testing

Clarification Comments

- All connecting piping, valves and controls other than those specified in this proposal BY OTHERS.
- The Zickert Shark Sludge Scraper is shipped unassembled for transport. The unit is designed for onsite assembly and welding.
- The scrapers are sized for the primary collector to drive solids to a sump at the inlet of the basin where a cross collector will push the solids to a final collection sump for removal. Basin sizes listed above are based on a peak rise rate or 0.63 gpm/ft^2, and can be altered as necessary as the project progresses.
- Sludge removal not included in this scope. A typical approach is to include a corner sump at the end of the cross collector with underground piping for sludge blowdown. Alternatively a sludge lift pump can be used. WesTech can also offer options if a cross-collect and sump are not the ideal approach.
- Installation not by WesTech.

Note: Any Item Not Listed Above To Be Furnished By Others.

Items Not By WesTech

Electrical wiring, conduit or electrical equipment, piping, valves, or fittings, lubricating oil or grease, shop or field painting, field welding, erection, detail shop fabrication drawings, performance testing, bonds, unloading, storage, concrete work, field service, (except as specifically noted).

This proposal has been reviewed and is approved for issue by ***Chelsea Stewardson*** *on August 19, 2016.*

Pricing

Proposal Name: Palmer, Alaska
Proposal Number: 1660654
Friday, August 19, 2016

1. Bidder's Contact Information

Company Name	WesTech Engineering, Inc.
Contact Name	Adrian Williams
Phone	801.265.1000
Email	awilliams@westech-inc.com
Address: Number/Street	3665 S West Temple
Address: City, State, Zip	Salt Lake City, UT 84115

2. Pricing

Currency		US Dollars
A	(1) 55' Diameter Clarifier Mechanism Model COPC1G	$108,200
A-1	FRP Effluent Weirs & Baffles	$9,700
B	Circular Dissolved Air Flotation Unit	$295,000
C	Rectangular Dissolved Air Flotation Unit	$465,000
D	Zickert Shark™ Model Number ZSED	$125,000
Field Service		US Dollars
Daily Rate		$960.00

Prices do not include field service unless noted, but it is available at the daily rate plus expenses. The customer will be charged for a minimum of three days for time at the jobsite. Travel will be billed at the daily rate. Any canceled charges due to the customer's request will be added to the invoice. The greater of visa procurement time or a two week notice is required prior to trip departure date.

Taxes (sales, use, VAT, IVA, IGV, duties, fees, import, etc.)	Not Included

3. Payment Terms

Submittal Approval	15%
Release for Fabrication	35%
Net 30 days from Shipment	50%

4. Schedule

Submittals, after PO receipt	6 to 8 weeks
Ready to Ship, after Submittal approval	18 to 20 weeks

WesTech

Terms & Conditions: This proposal, including all terms and conditions contained herein, shall become part of any resulting contract or purchase order. Changes to any terms and conditions, including but not limited to submittal and shipment days, payment terms, and escalation clause shall be negotiated at order placement, otherwise the proposal terms and conditions contained herein shall apply.

Freight: Prices quoted are **F.O.B. shipping point** with freight allowed to a readily accessible location nearest to jobsite. All claims for damage or loss in shipment shall be initiated by purchaser.

Paint: If your equipment has paint included in the price, please take note to the following. Primer paints are designed to provide only a minimal protection from the time of application (usually for a period not to exceed 30 days). Therefore, it is imperative that the finish coat be applied within 30 days of shipment on all shop primed surfaces. Without the protection of the final coatings, primer degradation may occur after this period, which in turn may require renewed surface preparation and coating. If it is impractical or impossible to coat primed surfaces within the suggested time frame, WesTech strongly recommends the supply of bare metal, with surface preparation and coating performed in the field. All field surface preparation, field paint, touch-up, and repair to shop painted surfaces are not by WesTech.

KRÜGER

HDR

Palmer, AK

1/20/2016

Hydrotech Discfilter

Kruger Project No.: 5700102502

Submitted to:

Jim Wodrich
HDR

Submitted by:

Brandon Ray
Hydrotech Filtration Applications Engineer
I Kruger Inc.
4001 Weston Parkway
Cary, NC 27513

VEOLIA WATER
Solutions & Technologies

Introduction

I Kruger Inc is pleased to present this budgetary Hydrotech Discfilter System proposal for Palmer, AK.

The Discfilter system, one (1) unit (one duty) of model HSF2212/6-1C, will filter a peak flow of 0.975 MGD (677 gpm) and max day flow of 0.65 MGD (451 gpm) for Phase 1 flows. With the addition of 6 more discs for a total of 12 discs, the unit will filter a peak flow of 1.83 MGD (1,271 gpm) and a peak day flow of 1.22 MGD (847 gpm) for Phase 2 flows. The system is designed to provide solids removal to a final effluent average concentration of ≤30 mg/L TSS. The Discfilter unit will be constructed of stainless steel and will include stainless steel tankage.

We appreciate the opportunity to provide this proposal to you. If you have any questions or need further information, please contact our local Representative, Bill Reilly of W. H. Reilly & Co, or our Regional Sales Manager, Brad Mrdjenovich at 412-352-0975 (brad.mrdjenovich@veolia.com)

cc: Mark Stewart, Brad Mrdjenovich, Matt Cotton, project file (Kruger)
Bill Reilly (W. H. Reilly & Co)

Revision	Date	Process Eng.	Comments
0	11/9/15	CIW	Initial budgetary proposal
1	1/20/16	BF	Updated budgetary proposal

We Know Water

I. Kruger Inc. (Kruger) is a water and wastewater solutions provider specializing in advanced and differentiating technologies. Kruger provides complete processes and systems ranging from biological nutrient removal to mobile surface water treatment. The ACTIFLO® Microsand Ballasted Clarifier, BioCon® Dryer, BIOSTYR® Biological Aerated Filter (BAF) and NEOSEP™ MBR are just a few of the innovative technologies offered by Kruger. Kruger is a subsidiary of Veolia Water, a world leader in engineering and technological solutions in water treatment for industrial companies and municipal authorities.

Veolia Water Solutions & Technologies, the fully-owned subsidiary of **Veolia Water**, is the world leader in water and wastewater treatment with over 155 years of experience. As an experienced design-build company and a specialized provider of technological solutions in water treatment, Veolia combines proven expertise with unsurpassed innovation to offer technological excellence to our industrial customers. Based on this expertise, we believe that we have developed the best solution for your application. Below is a brief description of the proposed project.

Energy Focus

Kruger, along with Veolia Water Solutions & Technologies (VWS) is dedicated to delivering sustainable and innovative technologies and solutions.

We offer our customers integrated solutions which include resource-efficient technology to improve operations, reduce costs, achieve sustainability goals, decrease dependency on limited resources, and comply with current and anticipated regulations.

Veolia's investments in R&D outpace that of our competition. Our focus is on delivering

- neutral or positive energy solutions
- migration towards green chemicals or zero chemical consumption
- water-footprint-efficient technologies with high recovery rates

Our carbon footprint reduction program drives innovation, accelerates adoption and development of clean technologies, and offers our customers sustainable solutions.

Kruger is benchmarking its technologies and solutions by working with our customers and performing total carbon cost analysis over the lifetime of the installation.

By committing to the innovative development of clean and sustainable technologies and solutions worldwide, Kruger and VWS will continue to maximize the financial benefits for every customer.

Process Description

Hydrotech Discfilter

The Kruger/Hydrotech Discfilter presents several advantages compared to other filtration technologies. These advantages include:

- Compact footprint.
- Minimal mechanical equipment.
- Simple automated control system.
- Easy maintenance without the need to drain the system.
- Minimal backwash requirements

The influent flows by gravity into the filter discs from the center drum. Solids are separated from the water by the filter media mounted on the two sides of the discs, which are partially submerged. With this arrangement, the solids are retained within the filter discs while only the clean water flows to the outside of the discs and into the collection tank. This allows for the effective removal of large solids and floatable material. Maintenance is reduced since there is no accumulation of solids in the tank.

During normal operation, the discs remain static until the water level in the inlet channels rises to a specific point, which then automatically initiates the backwash cycle. The filtered effluent provides a perfect source of backwash water, eliminating the need for a separate source of cleaning water or an additional clean water collection tank. Clean effluent is pumped to the backwash spray header and nozzles, washing solids into the collection trough as the discs rotate.

Design Summary

The following Kruger/Hydrotech Discfilter design is based on the information listed below.

Table 1: Influent Design Basis

Parameter	Phase 1	Phase 2	Phase 3
Influent Source	MBBR Effluent		
Peak Flow, MGD (gpm)	0.975 (677)	1.83 (1,271)	2.75 (1,910)
Average Flow, MGD (gpm)	0.65 (451)	1.22 (847)	1.83 (1,270)
Peak Influent TSS, mg/L	404		
Average Influent TSS, mg/L	305		
Monthly Average Effluent TSS, mg/L	≤ 30		

*Assumed

Table 2: Tertiary Coagulation/Flocculation Zone

Parameter	Retention Time (min)	Mixer Power (HP)
Rapid Mix Zone	~0.5	5
Coagulation Zone	~4	2
Flocculation Zone	~4	1

Scope of Supply

Kruger is pleased to present our scope of supply which includes process engineering design, equipment procurement, and field services required for the proposed treatment system, as related to the equipment specified. The work will be performed to Kruger's high standards under the direction of a Project Manager. All matters related to the design, installation, or performance of the system shall be communicated through the Kruger representative giving the Engineer and Owner ready access to Kruger's extensive capabilities.

Process and Design Engineering

Kruger will provide process engineering and design support for the system as follows:

- Equipment specifications for equipment supplied by Kruger
- Technical instructions for operation and start-up of the system
- Equipment location drawings and installation plans
- Project specific O&M manuals

Field Services

Kruger will furnish a Service Engineer as specified at the time of start-up to inspect the installation of the completed system, place the system in initial operation, and to instruct operating personnel on the proper use of the equipment. Specifically, Kruger will provide:

- Field Service Engineer/Technician – Four (4) days on site in not more than two (2) site visits to assist with inspection check-out, start-up, and operator training.
- I&C Field Service Engineer/Technician – Four (4) days on site in not more than one (1) site visit to assist with inspection and I/O check-out, start-up, and operator training.

Equipment Supply

Table 3: Equipment Supply

Proposed Discfilter System	Phase 1	Phase 2	Phase 3
Example Photograph (for information only; not necessarily actual unit)			
Discfilter Model Number	HSF 2212/7-1C	HSF 2212-1C	HSF 2212-1C
Total units (duty/standby)	1 (1/0)	1 (1/0)	2 (2/0)
Total filter area per unit, ft^2	422	723	723
Submerged filter area per unit, ft^2	274	470	470
Peak hydraulic loading rate, gpm/ft^2	2.47	2.70	2.03
Number of Discs per unit	7	12	12
Media Pore Size, µm	40	40	40
Chassis Material	304 SS	304 SS	304 SS
Cover Material	GRP	GRP	GRP
Self Enclosed Tank Material	304 SS	304 SS	304 SS
SEW drive motor, hp	1.5	1.5	1.5
Backwash water pump, hp	7.5	10	10
Backwash pump rated flow, gpm	46	79	79
Influent and Effluent Flange	ANSI 12"	ANSI 12"	ANSI 12"
Ancillary Equipment	**Qty**		
Mobile Automated Cleaning System	1		
Coagulant Feed Skid	1		
Polymer Feed Skid	1		
Rapid Mixer	1		
Coagulant Mixer	1		
Flocculation Mixer	1		
Pre-Fab Carbon Steel Tankage for Chem Feed/Mixers	1		

* Hydraulic loading rate does not include standby unit.

A mobile Automated Cleaning System (ACS) is included as part of the equipment supply. The mobile ACS consists of a polyethylene tank, mag drive centrifugal pump, and chemical resistant hose mounted on movable trolley unit. The ACS unit is designed to connect via hose to the chemical spray header within a Discfilter unit, and the ACS connects via 480V receptacle to the control system. The control system will allow for operator initiation of the chemical clean process. Once initiated, the control system provides automatic operation and control of the cleaning process.

An instrumentation and control system will be included with the Kruger equipment. The control system will be designed and supplied according to Kruger standards. It will include the following:

- NEMA4X local control panel for each Discfilter unit
- NEMA4X local control panel for Coagulation/Flocculation System

Scope of Supply BY INSTALLER/PURCHASER

The following items will be installed by the Contractor/Others:

- Control panel(s)
- Interconnecting wiring and/or conduit between the supplied control panel(s) and Discfilter equipment
- Any junction or pull boxes or any other like device needed to supply the interconnecting wiring
- All field connections/terminations to the supplied control panels, the Discfilter equipment and between the Discfilter and supplied control panels
- All supports and anchoring required to install the Discfilter unit
- Plumbing/interconnecting piping, electrical connections, access platforms, grating & handrails

Design Options

In addition to the proposed system as detailed herein, Kruger is able to further incorporate our process and controls expertise into wastewater treatment plants, allowing municipalities to meet stringent effluent requirements and future plant upgrades. Kruger is also able to offer our instrumentation and controls expertise to build upon the proposed system by providing a **customized plant-wide SCADA system** or designing a **Motor Control Center (MCC)**, providing clients a single source responsibility for plant controls. Please contact Kruger if the options above are of interest or to be included in the current proposed system or future upgrades. ***Please note that the design options listed above are not included in the pricing noted herein.*

Schedule

- Shop drawings will be submitted within 6-8 weeks of receipt of an executed contract by all parties.

- All equipment will be delivered within 18-20 weeks after receipt of written approval of the shop drawings.
- Installation manuals will be furnished upon delivery of equipment.
- Operation and Maintenance Manuals will be submitted within 90 days after receipt of approved shop drawings.

Pricing

The pricing for the Phase 1 Hydrotech Discfilter systems, as defined herein, including process and design engineering, field services, and equipment supply is: **$464,200.00.**

Pricing is FOB shipping point, with freight allowed to the job site. This pricing does not include any sales or use taxes. In addition, pricing is valid for ninety (90) days from the date of issue and is subject to negotiation of a mutually acceptable contract.

Please note that the above pricing is expressly contingent upon the items in this proposal and are subject to I. Kruger Inc. Standard Terms of Sale detailed herein.

Kruger Standard Terms of Payment

The terms of payment are as follows:

- 10% on receipt of fully executed contract
- 15% on submittal of shop drawings
- 75% on the delivery of equipment to the site

Payment shall not be contingent upon receipt of funds by the Contractor from the Owner. There shall be no retention in payments due to I. Kruger Inc. All other terms per our Standard Terms of Sale are attached.

All payment terms are net 30 days from the date of invoice. Final payment not to exceed 120 days from delivery of equipment.

I. Kruger Inc. Standard Terms of Sale

1. Applicable Terms. These terms govern the purchase and sale of the equipment and related services, if any (collectively, "Equipment"), referred to in Seller's purchase order, quotation, proposal or acknowledgment, as the case may be ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.

2. Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval.

3. Delivery. Delivery of the Equipment shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, Delivery terms are F.O.B. Seller's facility.

4. Ownership of Materials. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Equipment. Buyer shall not disclose any such material to third parties without Seller's prior written consent.

5. Changes. Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Buyer and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.

6. Warranty. Subject to the following sentence, Seller warrants to Buyer that the Equipment shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. If Buyer gives Seller prompt written notice of breach of this warranty within 18 months from delivery or 1 year from beneficial use, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Buyer's sole remedy, repair or replace the subject parts or refund the purchase price therefore. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). THE WARRANTIES SET FORTH IN THIS SECTION ARE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO SECTION 10 BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

7. Indemnity. Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.

8. Force Majeure. Neither Seller nor Buyer shall have any liability for any breach (except for breach of payment obligations) caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, act of government or any other cause beyond such party's reasonable control.

9. Cancellation. If Buyer cancels or suspends its order for any reason other than Seller's breach, Buyer shall promptly pay Seller for work performed prior to cancellation or suspension and any other direct costs incurred by Seller as a result of such cancellation or suspension.

10. LIMITATION OF LIABILITY. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE EQUIPMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE EQUIPMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

Miscellaneous. If these terms are issued in connection with a government contract, they shall be deemed to include those federal acquisition regulations that are required by law to be included. These terms, together with any quotation, purchase order or acknowledgement issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Buyer may not assign or permit any other transfer of the Agreement without Seller's prior written consent. The Agreement shall be governed by the laws of the State of North Carolina without regard to its conflict of laws

APPENDIX D: HDR SAGR REVIEW TECHNICAL MEMORANDUM

Memo

Date:	Friday, November 20, 2015
Project:	Palmer WWTP – EPA/DOJ CWA Negotiations
To:	Tom Healy - City of Palmer Director of Public Works
From:	HDR
Subject:	**SAGR Review – Reference Installations and Questionnaire**

One of the treatment alternatives being evaluated for improved ammonia removal at the Palmer WWTP is the Horizontal Flow Submerged Attached Growth Reactor ® (SAGR). The SAGR has been developed by Nelson Environmental, Inc. to specifically target cold –weather nitrification (ammonia removal), BOD, and TSS polishing following secondary treatment. The SAGR process has been around since 2007-2008 but is not widely known in the US. As such, EPA/DOJ has asked for additional information on the process including references/information from facilities that have installed and are operating the units. This memo provides a summary of HDR's review of the SAGR process, a questionnaire developed to obtain information from other SAGR installations, and responses from the survey calls to other facilities that have the SAGR process.

Introduction

The SAGR technology is a patented technology developed by Nelson Environmental Inc. The system consists of an aerated gravel bed with horizontal flow distribution chamber at the front-end to distribute influent wastewater across the width of the entire cell. The aggregate is submerged, providing the necessary surface area for growth and attachment of nitrifying biomass within the bed. It is sized to optimize bacterial growth and hydraulic flow. A horizontal collection chamber at the back end of the treatment zone collects the process effluent. For Palmer, the proposed SAGR process is a fixed film process added to nitrify the effluent from the existing aerated lagoon process.

The first wastewater treatment plant to have the SAGR technology is located in Manitoba, Canada. Performance data has been evaluated at this facility and is discussed in the following section.

Steinbach, Manitoba SAGR Study Report

Nelson Environmental Inc. conducted a pilot test of its SAGR technology at a wastewater facility in Steinbach, Manitoba. A report titled, "Statistical probability analysis of TAN effluent data from SAGR at the Stenbach MB site" summarizes a two year (July 2008 – April 2010) study effort conducted through the University of Manitoba, Winnipeg to determine a 95% to 99% confidence level of effluent Total Ammonia Nitrogen (TAN) from the SAGR process. A copy of this report has been included as **Attachment A** to this memo. In addition, the study also evaluated the relationship between incoming Total Kjeldahl Nitrogen (TKN) loading and effluent TAN from the SAGR process.

Generally, TAN in the effluent was 0.3 mg/L or less at temperatures similar to those encountered at the Palmer WWTP over winter months; however, at a higher TKN loading, higher TAN in the final effluent was observed. The following table from the report summarizes results of the study including the impact of influent TKN loading on the effluent.

Table 1. Steinbach, MB SAGR Study: Confidence Level of Final Effluent TAN Concentration

Influent TKN Loading to SAGR	95% Confidence Level for SAGR Effluent	99% Confidence Level for SAGR Effluent
< 1 lbs./d•1000 ft^3	4.5 mg/L	6.0 mg/L
< 0.8 lbs./d•1000 ft^3	1.7 mg/L	4.7 mg/L
< 0.52 lbs./d•1000 ft^3	0.3 mg/L	1.6 mg/L
< 0.25 lbs./d•1000 ft^3	0.1 mg/L	0.1 mg/L

In addition to the TKN loading, the effects of influent temperature of the wastewater on TAN in the SAGR effluent was also investigated. The two variables impacting effluent quality are two variables impacting effluent quality, the study limited the temperature effect to data where the load was below 0.7 lbs./d•1000 ft^3. The results suggested that the TAN in the effluent was consistent regardless of the temperature when the loading was lower than 0.7 lbs/d•1000 ft^3. Using the same loading, when temperatures were higher than 40°F, 95% of effluent data was less than 0.17 mg/L. When temperatures were lower than 40°F, 95% of the effluent data was less than 2.2 mg/L.

The results of this study support the performance capabilities of the SAGR process for removing ammonia in a cold weather climate.

Surveyed Locations

The SAGR process has been implemented at other cold weather climate locations in Canada and the US including installations in Iowa, Indiana, Wyoming, and South Dakota. Table 2 shows some installations and references for cold weather climate facilities with the SAGR process that were provided by Nelson Environmental Inc. A more detailed reference list has been included as **Attachment B**. The utilities listed below were surveyed about the ability of the SAGR process to nitrify in a cold climate and overall performance of the process. A copy of the questionnaire developed for surveying the other facilities and notes from the survey calls are provided in **Attachment C** to this memo.

Table 2. SAGR Installation References from Nelson Environmental Inc.

Location	Commissioned	Flow Capacity	Notes
Glencoe, Ontario	2011	0.46 MGD	
Long Plain FN, MB	2012	0.26 MGD	
Mentone, IN	2011	0.12 MGD	
Walker, IA	2012	0.22 MGD	First installation in Iowa
Kingsley, IA	2013	0.30 MGD	
Kennard, IN	2014	0.10 MGD	
Berne, IN	2015	1.92 MGD	

All of the surveyed facilities have had success with the SAGR technology and ammonia removal performance. Effluent ammonia levels have remained fairly constant and are well below the permitted limits for each facility. The performance of these has been certified by others to demonstrate the ability to nitrify. However, the installations do not provide guidance on the process operational criteria that should be followed. Also of note:

- Most of the surveyed facilities are significantly smaller than the Palmer facility. Only the Berne, IN facility is larger than the Palmer WWTP and it has not been in operation very long.
- All of the surveyed facilities have not been operating for a significant amount of time (5 years or less) and solids accumulation in the SAGR process at these facilities over time is unknown.

SAGR Performance Discussion

Two of the surveyed utilities are the first SAGR technology facilities constructed in Iowa. Installation of the new SAGR technology in Iowa led the State of Iowa Department of Natural Resources (Iowa DNR) to publish a detailed assessment of the SAGR process. A review of their guidance criteria compared against Palmer is shown in Table 3. None of the Palmer values are more aggressive than the Iowa DNR values. The full Iowa DNR assessment has been attached to this memo (**Attachment D**).

Table 3. Iowa Department of Natural Resources SAGR Design Criteria and Conditions versus Palmer

SAGR Parameter	Units	Iowa DNR Value	Palmer Value	Notes
Nitrogen Loading Rate	lb. N/1,000 cf/d	0.4	0.48	Loading based on lagoon influent TKN for cold temperatures in Manitoba, Canada.
BOD Loading Rate	lb./100 sf/d	2.5	2.3	Based on cross-sectional area.
HRT	hr.	24	?	HDR needs information on the aggregate specification to determine.
Influent BOD		< 25 mg/L	< 25 mg/L	Maintain low to avoid competition with nitrifiers.
Influent TSS		< 50 mg/L	< 50 mg/L	Low limit to avoid plugging of SAGR.
Temperature		Low	Proposal based on minimum of 1.0ºC	The Glencoe, Ontario SAGR installation appears to meet discharge ammonia limits as low as 0.5 deg. C.
Alkalinity	mg/L as $CaCO_3$	--	--	Need 7.1 lb. Alk/lb. Ammonia oxidized. A residual of 75 mg/L as $CaCO_3$ is also recommended.
Blower Unit Demand	scfm/hp	--	16.1	Mechanical plants conservatively assume about 17 scfm/hp. The Palmer value appears to be conservatively sized with sufficient redundancy (1 standby for 2 duty blowers).
Dissolved Oxygen Level	mg/L	--	3	Value seems sufficient to ensure aerobic conditions for nitrification.
Feed Distribution per Cell	Number	2	3	DNR recommends 1 at the head and 1 at the midpoint.

SAGR Parameter	Units	Iowa DNR Value	Palmer Value	Notes
Short-Circuiting	--	Recommend baffling curtains	Recommend baffling curtains	To reduce short-circuiting upstream in the lagoons, baffling curtains are recommended.
Ability to Clean	--	Recommend fully redundant SAGR	Recommend fully redundant SAGR	A fully redundant unit provides operators a means to isolate cells to exchange/clean aggregate and cells.
Redundancy	--	Full SAGR redundancy	Full SAGR redundancy	Each of the two cells can treat all the flow.

Note that the nitrogen loading rate guidance criteria is based on lagoon influent, not SAGR influent. There was no nitrogen loading data to the SAGR cells to compare against during this review and this is a risk. It is recommended that the data from Nelson Environmental Inc. be collected to compare against nitrogen loading in Palmer.

The ability to meet the Palmer treatment objectives with a SAGR technology is the primary objective of this evaluation. Based on the other operational SAGR technologies listed in Table 2, the SAGR technology has shown that it can meet low level ammonia limits (similar to those of Palmer) at low temperatures. Furthermore, the Palmer design criteria appear to be similar or more conservative for all parameters listed in Table 3. The permit limits for Palmer are a monthly average limit of 1.7 mg/L during July and August and 8.7 mg/L of ammonia the rest of the year. Data provided by the utility references has indicated that the SAGR technology is capable of meeting Palmer's limits for ammonia.

For the SAGR technology to reliably meet such low limits, there are several operational considerations to address that are discussed below.

1. SAGR Feed: It is recommended that historical lagoon effluent from Palmer be reviewed to confirm that the levels meet the SAGR feed requirements (<25 mg/L BOD and <30 mg/L TSS).
2. Nonbiodegradable Solids Buildup: There is a concern over solids buildup (especially inerts) in the SAGR cells over time. Specifically, how would Palmer clean the aggregate to remove nonbiodegradable solids build up over time? The reference utilities indicated that there have been no issues with solids or inert buildup in the SAGR process; however, all of the utilities have been operating the SAGR technology for five years or less and significant buildup in this short period is unlikely. It is recommended that a discussion with the vendor should occur about buildup concerns. A white paper has been attached to this memo (Attachment E) that attempts to address the solids accumulation issue.
3. Alkalinity: Historical alkalinity data should be reviewed to confirm that there is sufficient alkalinity. Nitrification has an alkalinity demand of 7.1 lb. Alk/lb. Ammonia removed. Additionally, an alkalinity residual of at least 75 mg/L as $CaCO_3$ is recommended on SAGR effluent.
4. pH: Nitrification is enhanced at higher pH level. pH levels of 7.5 to 8.5 are ideal, although nitrifying bacteria can adapt outside of this range. As part of the Interim Measures being evaluated for this project, a small lime feed unit is being recommended to ensure optimum pH and alkalinity levels for nitrification.

5. Peak Flows and Loads: For such low level ammonia limits, there is typically a concern with high flows and loads peaking factors. For Palmer, the aerated lagoons should be evaluated for the ability to dampen any influent flows and load variability.

Conclusion

The SAGR technology has been proposed to treat the aerated lagoon effluent for Palmer. A survey of SAGR installations revealed that this technology is primarily used to retrofit lagoons for meeting low level ammonia limits such as at Palmer. Overall, the SAGR technology is a viable technology that should be able to meet the discharge objectives of Palmer. This evaluation is based on a review of the prior SAGR installations ammonia removal performance coupled with a comparison against an independent third party SAGR design guidance document.[1] Specifically, the Iowa DNR SAGR Guidance Document lists several design criteria parameters. The existing facilities with the SAGR technology are smaller sized wastewater treatment facilities and have a shorter duration of winter than Palmer. In addition, the effects of solids accumulation in the SAGR process are unknown at this time. It is recommended that Palmer address the following concerns before selecting the SAGR technology:

- Review historical lagoon performance data from Palmer for effluent BOD and TSS concentrations. The SAGR technology is prone to fouling above 25 and 30 mg/L, respectively. Typically, Palmer lagoon effluent is less than 25 mg/l for both BOD and TSS.
- Review historical performance data from other SAGR installations to confirm the ability to meet low level maximum day ammonia limits such as those for Palmer.
- Compare the Palmer design nitrogen loading values against other SAGR installations.

References

1. Evans, E.A. and Bryant, L (2011) Iowa DNR New Wastewater Treatment Technology Assessment No. 11-1.

ATTACHMENT A:

Statistical probability analysis of TAN effluent data from the SAGR at the Steinbach MB site

SAGR operated by Nelson Environmental Inc

Jan A. Oleszkiewicz, PhD, PEng, BCEE;
Jong Hyuk Hwang , PhD, PEng
University of Manitoba, Winnipeg

2 November 2011

Jan A Oleszkiewicz, Jong Hyuk Hwang

Statistical probability analysis of effluent total ammonia nitrogen (TAN) data from the Steinbach wastewater lagoon site

1. Objective

Weekly collected incoming TKN data and effluent TAN data from Steinbach SAGR (east train) in a period between July 30, 2008 to April 28, 2010 have been analyzed to determine 95% or 99% confidence level of effluent TAN from SAGR process. Every data point was analyzed except one data from February 17, 2010 as the result on that day was an artefact of deliberate test to investigate the effect of a power failure on the effluent quality.

2. Effect of incoming TKN loading on TAN in the final effluent

Figure 1 shows the relationship between incoming TKN loading (lbs/d·1000 ft^3) and effluent TAN (Total Ammonia Nitrogen) in the final effluent.

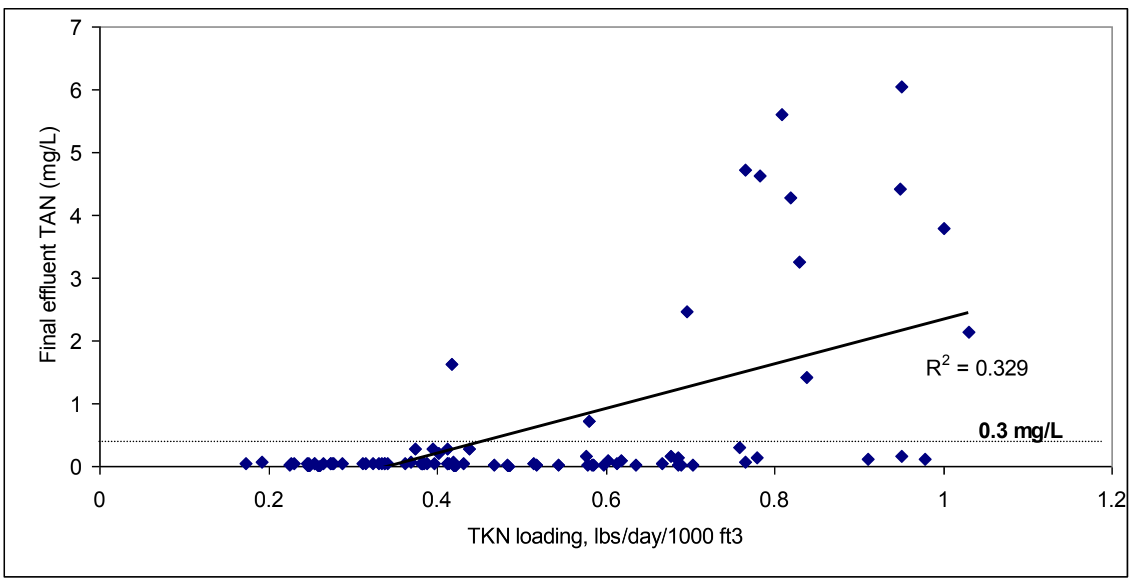


Figure 1. Effect of TKN loading on TAN in the final effluent

Generally, TAN in the final effluent kept 0.3mg/L or less. However, at higher TKN loading, higher TAN in the final effluent was observed.
Although regression line in Figure 1 shows a linear relationship, its coefficient of determination, R^2, was very low at 0.33, indicating that TKN loading was not the governing factor for the removal of ammonia nitrogen.

3. Probability analysis – incoming TKN loading

Probability analysis was conducted. Four data sets were generated based on the incoming TKN loading.

1) All effluent TAN data
2) Effluent TAN data when TKN loading was less than 0.8 lbs/d·1000 ft^3
3) Effluent TAN data when TKN loading was less than 0.52 lbs/d·1000 ft^3
4) Effluent TAN data when TKN loading was less than 0.25 lbs/d·1000 ft^3.

Figure 2 shows the probability graph with 95% confidence level of final effluent TAN from each case. Probability graph does not look like a typical probability graph, because the data was highly skewed to lower concentrations and was not equally distributed.

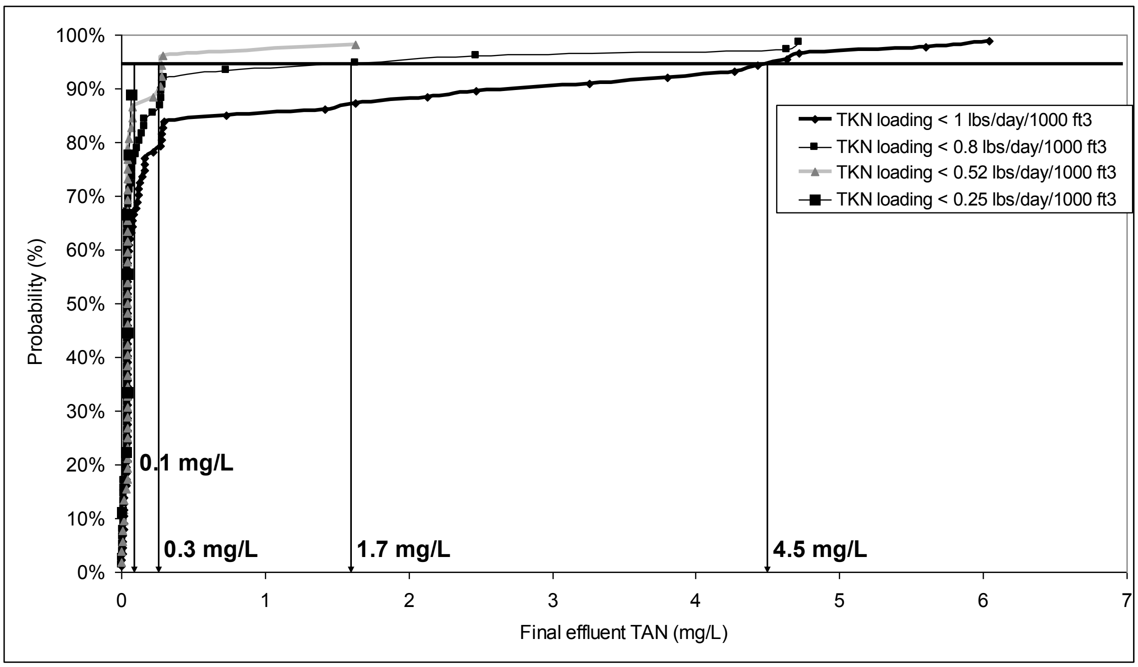


Figure 2. Result of probability analysis

When all effluent TAN data were included for the statistical probability analysis, 95% of effluent TAN data were less than 4.5 mg/L.
When effluent TAN data when incoming TKN loading was less than 0.8 lbs/d·1000 ft^3 were included, 95% of effluent TAN data were less than 1.7 mg/L.
When effluent TAN data when incoming TKN loading was less than 0.52 lbs/d·1000 ft^3 were included, 95% of effluent TAN data were less than 0.3 mg/L.
When effluent TAN data when incoming TKN loading was less than 0.25 lbs/d·1000 ft^3 were included, 95% confidence level could not be found because of a limited number of data. However, the extrapolation of probability line gives 0.1 mg/L.

Table 1 shows the 95% and 99% confidence levels for each case.

Table 1. Confidence level of final effluent TAN concentration

	95%	99%
Incoming TKN loading < 1 lbs/d·1000 ft^3	4.5 mg/L	6.0 mg/L
Incoming TKN loading < 0.8 lbs/d·1000 ft^3	1.7 mg/L	4.7 mg/L
Incoming TKN loading < 0.52 lbs/d·1000 ft^3	0.3 mg/L	1.6 mg/L
Incoming TKN loading < 0.25 lbs/d·1000 ft^3	0.1 mg/L	0.1 mg/L

4. Effect of temperature on TAN in the final effluent

Effect of temperature of incoming wastewater on TAN in the final effluent was investigated. Since there are two variables impacting effluent quality - load and temperature - only the data for loads below 0.7 lbs/d·1000ft^3 was analyzed –Fig. 1

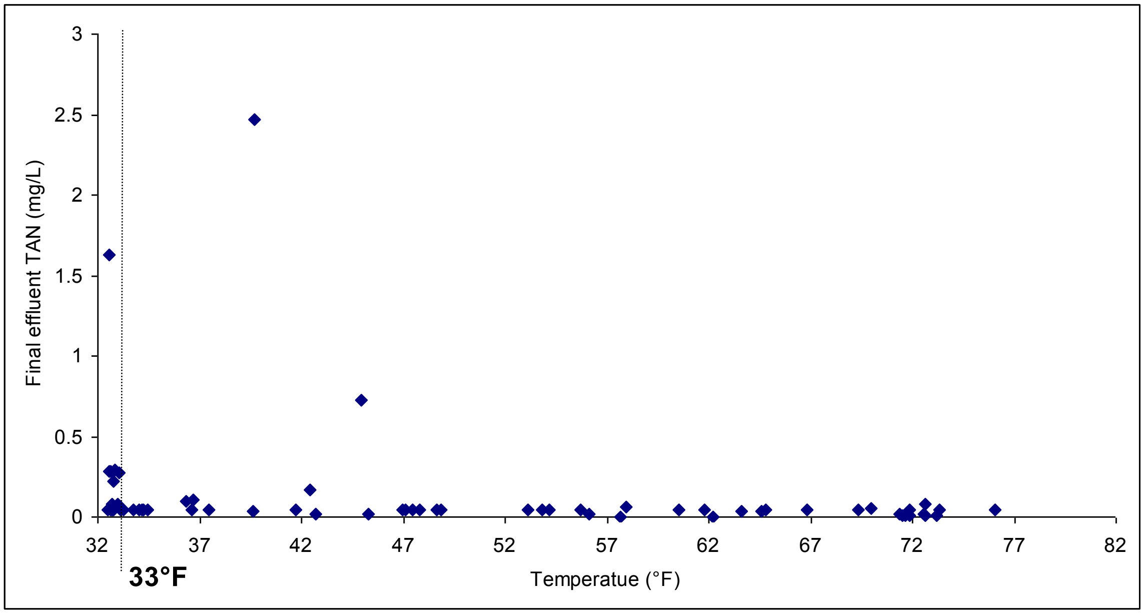


Figure 3. Effect of temperature on TAN in the final effluent

Figure 3 shows that less than 0.1 mg/L of TAN in the final effluent was consistently observed, regardless of incoming TKN loading, except for a few outliers.

The results also suggest that the TAN in the final effluent was consistent regardless of temperature when the loading was lower than 0.7 lbs/d·1000ft^3.

5. Probability analysis – temperature

Probability analysis was conducted with temperature as a variable. Only the data for loads below 0.7 lbs/d·1000ft^3 was analyzed as well. Two data sets were generated based on the incoming wastewater temperature.

1) Effluent TAN data when the incoming wastewater temperature was higher than 40^{o}F

2) Effluent TAN data when the incoming wastewater temperature was lower than 40^{o}F.

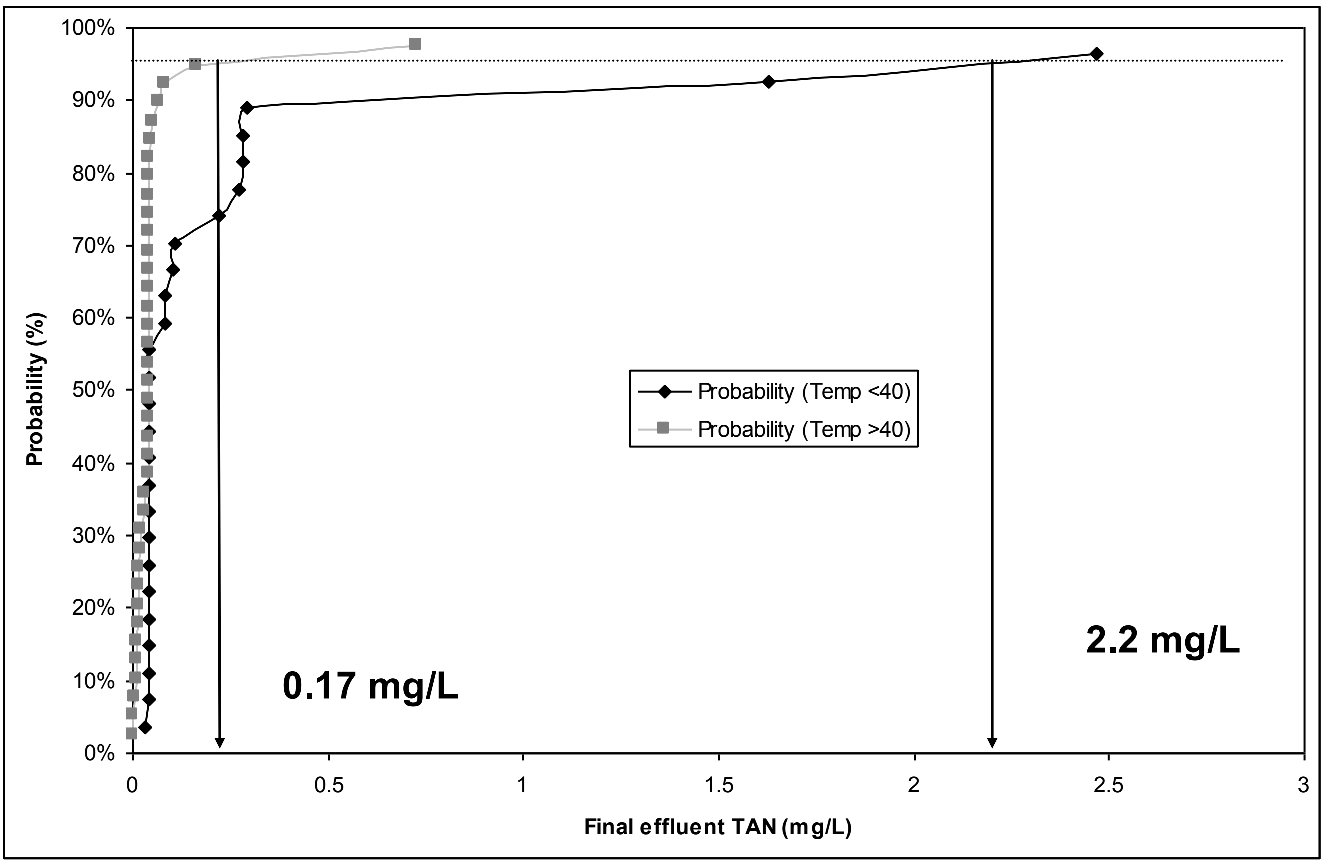


Figure 4. Result of probability analysis

When the incoming wastewater temperature was higher than 40^{o}F, 95% of data were less than 0.17 mg/L.
When the incoming wastewater temperature was lower than 40^{o}F, 95% of data were less than 2.2 mg/L.

ATTACHMENT B:

Location	Address	Contact	Design Flow	Avg Winter (Nov - Mar) Influent	Average Winter Effluent	Commissioned
Canada						
Glencoe, ON	Ontario Clean Water Agency 9210 Graham Road West Lorne, ON N0L 2P0	Cindy Sigurdson (519) 768-9925 CSigurdson@ocwa.com	1742 m3/day (0.456 MGD)	3.6 degrees C (1.0 degrees C Jan-Feb) BOD not recorded 22.3 mg/L TSS 5.9 mg/L TAN	4.8 degrees C 1.9 mg/L cBOD5 (non-detect) 6.3 mg/LTSS 0.28 mg/L TAN	2011
Long Plain FN, MB	Long Plain First Nation 141 Yellowquill Trail E. Portage La Prarie, MB R0H 1N0	Ken Mattes (204) 832-2312 kmattes@mts.net	998 m3/day (0.264 MGD)	1.14 degrees C 5.0 mg/L cBOD5 5 mg/L TSS 5.4 mg/L TAN	1.3 mg/L BOD (non-detect) 2.4 mg/L TSS (non-detect) 0.2 mg/L TAN	2012
USA						
Mentone, IN	105 East Main St. Mentone, IN 46539	Josh Sheppard (574) 328-0089 mwd@ncsbroadband.com	453 m3/day (0.120 MGD)	6.3 degrees C (3.1 degrees C Jan-Feb) 25.0 mg/L cBOD5 39.7 mg/L TSS 8.8 mg/L TAN	7.0 degrees C (4.2 degrees C Jan-Feb) 6.7 mg/L cBOD5 3.2 mg/L TSS 0.18 mg/L TAN	2011
Walker, IA	408 Rowley St. Walker, IA 52352	Kevin Shoop (319) 310-6685	839 m3/day (0.222 MGD)	6.2 degrees C (4.2 degrees C Jan-Feb) 9.5 mg/L cBOD5 9.9 mg/L TSS 11.1 mg/L TAN	4.3 mg/L cBOD5 3.5 mg/L TSS 0.8 mg/L TAN	2012
Kingsley, IA	Kingsley, IA	Steve Janz 712-378-3741	1134 m3/day (0.300 MGD)	23.4 mg/L cBOD5 32.5 mg/L TSS 16.1 mg/L TAN	7.5 degrees C (6.5 degrees C Jan-Feb) 6.1 mg/L cBOD5 9.9 mg/L TSS 0.19 mg/L TAN	2013
Kennard, IN	3806 S Grant City Rd. Shirley, IN 47384	James Turpin (765) 730-5564 turpinjle@yahoo.com	378 m3/day (0.100 MGD)	Temp not recorded (lagoon Influent) 138.7 mg/L cBOD5 (lagoon Influent) 137.3 mg/L TSS (lagoon Influent) 22.7 mg/L TAN	1.8 mg/L cBOD5 4.5 mg/L TSS 0.2 mg/L TAN	2014
Berne, IN	158 West Franklin Street Berne, IN 46711	Terry Kongar (260) 589-8526	7258 m3/day (1.92 MGD)	Started up in summer 2015 no winter data available	Started up in summer 2016 no winter data available	2015

ATTACHMENT C:

SAGR Facilities Questionnaire

Date:	Monday, November 16, 2015
Project:	City of Palmer Wastewater Treatment Plant
Reviewer:	Name:________________/HDR
Facility Contacted:	Facility Contact Name:____; Facility Name and Location:____ Telephone Number:____

The following is a list of proposed questions that will be asked of each facility that currently uses or previously used the SAGR process at its wastewater treatment plant. During the interview, additional questions may also be asked and documented in the meeting notes.

Background Information:

1. Please describe your treatment system prior to adding the SAGR process (Headworks?/Lagoons?/ Type of aeration?/type of disinfection?). Do you have any process flow diagrams or site plans you can send?
2. Did you complete a facility plan prior to the upgrades? Can we get a copy?
3. What are your facility's minimum, maximum, peak, and average flow rates?
4. What are the permit limits for your facility: BOD/TSS/Ammonia or Total Nitrogen/Metals?
5. Do you have an NPDES Permit?
6. Into what water body do you discharge?
7. Is it an anadromous stream?
8. Do you have a mixing zone?
9. Do you have an effluent diffuser?
10. What are your wastewater influent and effluent temperatures: Max/Min?
11. What are typical ambient winter temperatures?
12. How do you remove solids from your plant?
13. How is your facility staffed on a regular basis? Is it an automated system or manual?

Prior to SAGR Process:

14. What initiated the process change that resulted with SAGR (ie compliance issues, capacity increases, etc.)
15. What other alternatives were considered before SAGR was selected?
16. What was the permitting process like for the SAGR system? Was this a new technology for the permitting/plan review agency and did they have any special requirements prior to approving the technology?
17. Who is the regulatory agency in your area?
18. Please describe your treatment system after the SAGR process was added. Do you have any SAGR operations manuals, figures or drawings you can send us?

SAGR Process:

19. When was the SAGR process installed? Is it still in operation?
20. Has the new system required any additional maintenance? Planned or not? Please describe.
21. Have there been appreciable increases in O&M costs since installing the SAGR? Any specialty equipment, parts, etc. that have been hard to replace/costly/take a long time to get?
22. Has the SAGR process worked well for your facility?
23. Has it met the performance criteria?
24. Did you have a performance guarantee from Nelson Environmental?
25. Have you seen any decrease in performance of the SAGR over the years since installing the units?
26. Have there been any operational issues with the SAGR process?
27. Please explain if the SAGR process has been beneficial to overall operations.
28. We are concerned with any solids build-up and the ability to remove solids from the SAGR is also concern - Have you had any issues with solids build-up in the SAGR units?
29. What is the influent flow/BOD/TSS/Ammonia to the SAGR system?
30. How has the SAGR process performed during the winter? Have you gotten consistent year-round nitrification? How often has the unit not maintained nitrification/ammonia removal?
31. Is there anything you would want to change with your SAGR process or integration with your system? Please explain.
32. Have there been any other changes since the SAGR process was added to your facility? Please describe why these changes were required, when they occurred after installation of the SAGR process, and how it has changed the treatment system.
33. Would you recommend the SAGR process? Do you have any suggestions, comments, or concerns?

Nelson Environmental:

34. How was it to work with Nelson Environmental before, during, and after construction? Are they responsive to questions and concerns regarding operation of the SAGR?
35. How has Nelson Environmental responded if issues arise?

Reference Utilities General Notes

Location	Commissioned	Flow Capacity	Notes
Glencoe, Ontario	2011	0.46 MGD	• Before SAGR: 2 cells of lagoons – discharged in spring • Current: Aerated lagoons→SAGR →Alum/Polymer addition→Plate Settling Clarifiers→Disk filters→Discharge (solids go to old non-aerated lagoons and ultimately are disposed of) • Flows (2014): o Average: 0.192 MGD o Minimum: 0.079 MGD o Maximum: 0.528 MGD (I&I Issues) • Permit Limits: o cBOD = 13.7 mg/L o TSS = 13.7 mg/L o TAN = 3.0 mg/L o E.coli = 200 cfu/100mL o pH = 6 – 9.5 • Permit is called Environmental Compliance Approval (ECA) in Canada • Discharge into Newbiggen Creek. o Anadromous stream: No o Mixing Zone: No o Effluent Diffuser: No • Wastewater Temperatures (from 2014) o Influent: 2.5°C to 20°C (36.5°F to 68°F) o Effluent: 0.5°C to 25°C (32.9°F to 77°F) • Wastewater Ambient Temperatures (Jan.- Feb. -10°C to -5°C (14°F to 23°F) • Solids Removal: o Add alum (phosphorus removal) and polymer in a clarifier after the SAGR process. Solids are then removed with disk filters and sent to the existing non-aerated lagoons for accumulation and eventually disposal. • Staffing: Checked 3 times a week. Mostly automated. • Reasons for Change to SAGR: o Capacity issues o Discharge issues due to waiting for thawing in spring to discharge. Very little treatment capabilities with non-aerated lagoons. • Other Considered Alternatives: N/A • Permitting Process: unknown

- Regulatory Agency: Ontario Ministry of the Environment and Climate Change
- Additional Maintenance Required?
  - Issues have occurred with the disk filters and clarifier: due to the clarity of the effluent from the SAGR – it is very difficult to create floc. Facility will be trying different locations for addition of alum and polymer. Facility has a very stringent phosphorus removal limit and is having some difficulties meeting it.
- Nelson Environmental experimented at facility during startup to check performance. Addition of urea at 50 mg/L and other concentrations were tested. Effluent was excellent.
- Increase to O&M Costs: yes – due to alum and polymer addition. No significant costs or changes have been made to the SAGR beds in the past 5 years.
- Baffles had ice damage occur two winters ago. (photo and brief description sent to HDR)
- Has the SAGR process worked well for the facility? Yes
- Has it met the performance criteria? Yes
- Was there a performance guarantee? Unsure
- Has there been a decrease in performance? No
- Any operational issues? No
- Has it been beneficial to operations? Yes. It is very simple to operate.
- Has your SAGR system had any solids buildup? No, but we are concerned about how the facility will know if there is an issue.
- Influent to Plant:
  - BOD = 225 mg/L
  - TSS = 240 mg/L
  - TKN = 47 mg/L
- How has the SAGR system performed during the winter? Has there been consistent nitrification? How often has the unit not maintained nitrification?
  - It has performed very well.
  - Effluent from SAGR: consistently 1.5 mg/L ammonia during overly cold winter.
  - Typical effluent: 0.25 mg/L – 1.03 mg/L
- Would you change anything to the SAGR system or your facility since the upgrade?
  - Remove clarifier – put alum in the raw wastewater and let phosphorus be removed in the aerated lagoon process.
  - No changes to SAGR.
- Would you recommend the SAGR process? Yes
- Do you have any suggestions/comments/concerns? Yes – how do you tell if there is an issue before it is a major problem? Would like more information on how to tell.
- How has it been to work with Nelson Environmental? Good, they continue to collect our data and offer assistance if they notice a concerning trend. In addition, they have been very

			responsive when there has been an issue (mainly startup). They have generally sent someone to the site if there is an issue.
Long Plain FN, MB	2012	0.26 MGD	Could not reach for survey. Will continue to try to contact the reference and include notes from survey in final draft of memo.
Mentone, IN	2011	0.12 MGD	Could not reach for survey. Will continue to try to contact the reference and include notes from survey in final draft of memo.
Walker, IA	2012	0.22 MGD	• Before SAGR: 2 cells with no aeration with 180 day detention time. Cells were treated as primary and secondary. In the spring – cell 2 would be drained and then filled with cell 1 contents. No headworks. No disinfection. • Current: 2 aerated lagoons→settling pond→splitter box→SAGR units (2)→splitter box→secondary set of SAGR (2)→UV disinfection→discharge • Flows: o Average: 55,000-57,000 gpd o Minimum: 45,000 gpd o Maximum: 65,000 gpd • Permit Limits: o cBOD = 40 mg/L (7-day average), 25 mg/L (30-day average) o TSS = 120 mg/L (7-day average), 80 mg/L (30-day average) o TAN = 7,391 lbs./year o pH = 6.0 – 9.0 • NPDES Permit • Discharge into West Otter Creek (tributary to Cedar River Basin) o Anadromous stream: Yes o Mixing Zone: No o Effluent Diffuser: No • Wastewater Temperatures o Influent: ▪ Summer: 75°F to 76°F ▪ Winter: 32°F o Effluent: ▪ Summer: 77°F ▪ Winter: 32°F to 34°F • Winter Ambient Temperatures: A week of sub-zero temperatures, typical: 10-20°F avg. • Solids Removal: none • Staffing: Manual with alarms. 1 FTE • Reasons for Change to SAGR:

- Department of Natural Resources compliance order. Facility was dumping 3-4 times a year and not meeting permit.
  - Capacity issues
  - Not meeting ammonia limits in the winter. Ok in the summer.
- Other Considered Alternatives: Adding an additional aeration lagoon (third) to increase detention time.
- Permitting Process:
  - First SAGR in Iowa.
  - Process was challenging – Nelson Environmental had to provide a significant amount of information to the DNR.
  - Daily testing required for the past three years for DO, pH, and ammonia. Nitrite and nitrate are required biweekly.
  - Took two years for approval process.
- Regulatory Agency: Iowa Department of Natural Resources
- Additional Maintenance Required?
  - Startup required priming the SAGR with ammonia chloride for two weeks.
  - Low maintenance – typical maintenance required for blowers.
- Increase to O&M Costs: No
- Has the SAGR process worked well for the facility? Yes
- Has it met the performance criteria? Yes
- Was there a performance guarantee? Unsure
- Has there been a decrease in performance? No – stable process overall
- Any operational issues?
  - Two years ago – operators did not complete the step process (change over in fall for cold weather) properly and had some issues with the effluent ammonia spiking. Nelson Environmental helped troubleshoot the issue and the facility returned to normal operations.
- Has it been beneficial to operations? Yes.
  - Has met all limits.
  - Provided more capacity for the facility.
  - 2 years ago – the facility experiences a flash flood to 1 MG and was able to function with no backups in the system or at the facility. Prior years, this would have caused a backup in the system.
- Overall – City has significant I&I issues.
- Has your SAGR system had any solids buildup? No issues to date.
- Influent to Plant: (no data available for influent directly to SAGR)
  - BOD = 190 mg/L

			o TSS = 276 mg/L o TKN = 29-30 mg/L • How has the SAGR system performed during the winter? Has there been consistent nitrification? How often has the unit not maintained nitrification? o Excellent performance. o Effluent from SAGR: consistently 0.5 mg/L ammonia or lower. • Would you change anything to the SAGR system or your facility since the upgrade? o No changes to SAGR. • Would you recommend the SAGR process? Yes. • Do you have any suggestions/comments/concerns? This is a low maintenance, affordable process. We are happy. We recommend it for other similar facilities. • How has it been to work with Nelson Environmental? Great. They are responsive – even responding within a day. If an issue has come up – they have even sent someone to us. We continue to send water quality data and if they see an issue – they will call to help us through it.
Kingsley, IA	2013	0.30 MGD	• Before SAGR: 2 cell with curtain into 3 cells (aerated lagoons with 10 submersible aerators). 1 lift station into a pre-fabricated flume into lagoons. o 6 foot deep lagoons • Current: 2 cells with aeration→curtain for settling into third cell→SAGR→UV (March-November)→discharge • Flows: o Average: 160,000MGD o Maximum: 230,000 MGD (I&I Issues) • Permit Limits: (7 day average yearly) o cBOD = 43 mg/L o TSS = 30 mg/L (75 lbs./day) o TAN = January: 11.9 mg/L (30 day avg.) / 20.8 mg/L (daily max.) June: 4.6 mg/L (30 day avg.) / 2.6 mg/L (daily max.) o Required BOD/TSS removal: 85% of influent amounts • Typically effluent ammonia is 0.2 mg/L or less. • NPDES Permit • Discharge into West Fork Little Sioux River (3-4 feet deep) o Anadromous stream: No o Mixing Zone: No (discharge pipe is 40 feet back from river) o Effluent Diffuser: No • Wastewater Temperatures o Influent: 65°F (minimum 58°F, maximum 68°F)

- Effluent: 50°F min., 68°F max., 60°F avg.0
- Winter Ambient Temperatures: 25°F avg. (December –March)
- Solids Removal: No
- Staffing: 2 FTE: tasks include reading and recording flow meter data once a day. Relatively automated system with alarms. Staff are also assigned to water and parks department duties.
- Reasons for Change to SAGR:
  - Capacity issues
  - Ammonia limits were more stringent than what the facility could meet.
- Other Considered Alternatives: covered lagoon (10'deep), controlled discharge lagoon
- Permitting Process:
  - Second SAGR in Iowa.
  - Nelson Environmental had to provide a significant amount of information to the DNR.
  - SAGR Design manual from Iowa DNR was released shortly after facility was online.
- Regulatory Agency: Iowa DNR Region 3: Sheila Tule 712.262.4177
- Grade 1 plant before upgrade to SAGR, now considered a Grade 2 facility.
- Additional Maintenance Required?
  - Cleaning of aerators (normal operations)
  - Bleed out of air from SAGR to prevent freezing.
  - Occasionally a line in the SAGR will plug from algae issues. Cleaned out about once a year. Facility had algae plugging issues before SAGR.
- Increase to O&M Costs: No (about the same)
- Has the SAGR process worked well for the facility? Yes (end of Feb. 2015 less than 0.2 mg/L of ammonia in effluent)
- Has it met the performance criteria? Yes
- Was there a performance guarantee? Unsure
- Has there been a decrease in performance? No
- Any operational issues? No – only at startup.
- Has it been beneficial to operations? Yes. It is very simple to operate and reliable.
- Has your SAGR system had any solids buildup? No
- Influent to Plant:
  - BOD = 200 mg/L
  - TSS = 220 mg/L
  - TKN = 21 mg/L
- How has the SAGR system performed during the winter? Has there been consistent nitrification? How often has the unit not maintained nitrification?
  - It has been working well. No issues so far.

			• Would you change anything to the SAGR system or your facility since the upgrade?
			  o No changes to SAGR.
			  o Would be nice to have bleed off valves on the aeration lagoon lines.
			• Would you recommend the SAGR process? Yes. Absolutely recommend this process. It is low maintenance and the worst part is the blower maintenance – which is very simple and minimal.
			• Do you have any suggestions/comments/concerns? No comments – they send data to Nelson Environmental still and occasionally Nelson will call with a heads up that an issue may need to be addressed – before it is an issue. This has not occurred on a regular basis and has only required a minimal change to operations.
			• How has it been to work with Nelson Environmental? Great to work with them. They are very responsive. When the facility first started, there were a few issues and ammonia nitrate had to be added to prime the SAGR. The operators had questions about the process and Nelson Environmental sent an individual to be there for four days to help (no charge). Overall, it was a very smooth and easy design process.
			  o Response time from Lloyd (Nelson Enviro.) is very quick and is typically 4-5 hours within sending an email or text message.
			  o Nelson Enviro. left additional spare parts after construction was completed (not sure if they were part of the contract or not).

Kennard, IN	2014	0.10 MGD	• Before SAGR: Influent grinder pump station with primary, secondary, and a polishing lagoons (built in 1974). Followed by a slow sand filter then discharging.
			• Current: A SAGR system was added after the lagoons and a UV system (for April through October) followed by a deaeration tank were added after the slow sand filter. (No DO control)
			• Flows:
			  o Average: 30,000 gpd
			  o Minimum: 21,000 gpd
			  o Maximum: 100,000 gpd (design capacity and I&I Issues)
			• Permit Limits Summer (monthly average):
			  o DO limit: 6 mg/L
			  o cBOD = 10 mg/L
			  o TSS = 12 mg/L
			  o TAN = 1.5 mg/L
			  o pH = 6.9
			• Permit Limits Summer (max. weekly):
			  o DO limit: 6 mg/L
			  o cBOD = 15 mg/L

- TSS = 18 mg/L
  - TAN = 2.3 mg/L
  - pH = 6.9
- Permit Limits Winter (monthly average):
  - DO limit: 5 mg/L
  - cBOD = 20 mg/L
  - TSS = 24 mg/L
  - TAN = 3.0 mg/L
  - pH = 6.9
- Permit Limits Winter (max. weekly):
  - DO limit: 5 mg/L
  - cBOD = 30 mg/L
  - TSS = 36 mg/L
  - TAN = 4.5 mg/L
  - pH = 6 – 9.5
- Permit Limit: Ecoli. : April to October 31st: 125 cfu (monthly average), 235 cfu (max. weekly)
- NPDES Permit
- Discharge into Montgomery Creek, 0 CFS rated creak – very stringent requirements.
  - Anadromous stream: No
  - Mixing Zone: No
  - Effluent Diffuser: Perforated aeration diffuser for DO limit
- Wastewater Temperatures
  - Influent: 4°C to 16°C (39.2°F to 60.8°F)
  - Effluent: 4°C to 16°C (39.2°F to 60.8°F)
- Winter Ambient Temperatures: 25°F avg., avg. high in summer 80°F
- Solids Removal: No issues yet. No system building or signs of buildup.
- Staffing: Automated SCADA with alarms. Facility is staffed by a contractor who has other facilities to check. Checked 2 times a week, 1 lab person checks once a week, maintenance person checks 5 days a week for 1 hour (10 hours total a week)
- Reasons for Change to SAGR:
  - Capacity issues
  - Ammonia limits – agreed to meet order to fix permit violations.
- Other Considered Alternatives: yes, nine years of analyzing system occurred.
- Permitting Process: easy process with design manual from DNR.
- Regulatory Agency: Indiana Dept. of Environmental Management
- Additional Maintenance Required?
  - No. Highest ammonia level in effluent that has been detected is 1 mg/L – otherwise it

			has been non-detect. • Increase to O&M Costs: No • Has the SAGR process worked well for the facility? Yes – no violations have occurred since the facility started. • Has it met the performance criteria? Yes • Was there a performance guarantee? Yes – performance bond was required • Has there been a decrease in performance? No • Any operational issues? No • Has it been beneficial to operations? Yes – absolutely. Almost fool proof. • Has your SAGR system had any solids buildup? No, but we are unsure how it could not be in the future with no solids process. • Influent to Plant: o Flow: 40,000 gpd avg. o BOD = 110 mg/L avg. 145 mg/L max., 85 mg/L min. o TSS = 90 avg. mg/L, 130 mg/L max., 70 mg/L min. o TKN = 41 mg/L avg., 60 mg/L max., 32 mg/L min. • How has the SAGR system performed during the winter? Has there been consistent nitrification? How often has the unit not maintained nitrification? Yes • Would you change anything to the SAGR system or your facility since the upgrade? o No changes to SAGR. o Overall – there was too much control equipment for the plant that made it overly complicated. We would remove most of it. • Would you recommend the SAGR process? Yes • Do you have any suggestions/comments/concerns? We are happy with the system. It is maintenance free. We could not iterate more how happy we have been with the system. • How has it been to work with Nelson Environmental? Pretty good. We had some minor differences (as to be expected working with a supplier). There was a small communication breakdown with the changeover of three different contract managers. It was resolved very quickly after we asked for a new person. Overall, Nelson Environmental has been very responsive and helpful since we had the small initial issues resolved. When we have had an issue – they will send a team to help us.
Berne, IN	2015	1.92 MGD	Could not reach for survey. Will continue to try to contact the reference and include notes from survey in final draft of memo.

ATTACHMENT D:

Iowa DNR New Wastewater Technology Assessment No. 11-1

Process Description: Lagoon Based ammonia removal – OPTAER^{TM} Submerged Attached Growth Reactor (SAGR^{TM})

STATEMENT:
Small scale, affordable treatment facilities capable of nitrification of wastes enabling effluent to meet low ammonia levels is a challenge for small communities faced with NPDES permit limits of low single digit values. End-of-pipe limits in the range of 1 mg/l (summer) and 5-10 mg/l (winter) are common results of current water quality standards in Iowa.

Aerated lagoon systems show the capability to provide some ammonia removal in warmer months but are generally incapable of meeting ammonia limits during periods of low water temperatures. The Submerged Attached Growth Reactor (SAGR) is proposed to address this issue and has been presented and evaluated as a retrofit to existing aerated lagoons, and the SAGR system may be applicable to new facilities that meet the study criteria (designed in accordance with Chapter 18C of the Iowa Wastewater Facilities Design Standards). Nelson Environmental, Inc. has provided results from test studies that demonstrated consistent performance at low ammonia effluent levels. Based on these studies, the following guidance is provided for design criteria for SAGR systems to provide year-round nitrification in Iowa wastewater treatment systems.

Iowa's Wastewater Facilities Design Standards did not adequately address the SAGR type process specifically, therefore approvals are done as provided in Section 14.4.3 "Required Engineering Data for New Process Evaluation". This assessment in addition to applicable design standards will provide guidance to designers for DNR approval based on current empirical information relative to capabilities of the SAGR process following aerated lagoons. This document is not a design standard but is an indication of what may be considered acceptable for DNR approval. Future information may result in modification of this assessment. Further, modification to individual systems may be required based on monitoring data collected over the first two years.

The DNR recognized the importance of feasible alternatives. This process was evaluated for technical capability for compliance rather than affordability.

EVALUATION:
Nelson, Environmental, Inc. has submitted a data presentation to support the proposal that would provide a system to accomplish the low ammonia values (less than 5 mg/l). This is based on data from a large-scale pilot project at Steinbach, Manitoba, Canada. The SAGR pilot system that was studied followed an existing aerated lagoon treatment system which provided effluent containing ammonia concentrations over an acceptable period of time to demonstrate cold weather operation.

The SAGR process is an insulated below-grade gravel bed with a distribution chamber at the front end that distributes secondary wastewater across the width of the cell, and a collection system at the back end. An aeration system throughout the floor provides aerobic conditions in the bed. Performance test results are attached. Consistent effluent ammonia concentrations below 1 mg/l were demonstrated in both warm and cold months. The Iowa DNR accepts the piloting information and data from Nelson Environmental, Inc. The method of study of the system was reasonable and important criteria were addressed.

REFERENCES:

Nelson, Environmental, Inc. submittals for the pilot project and their resulting design guidance include:

1. August 22, 2008, Lagoon Based Cold Climate Ammonia Removal – OPTAER SAGR Pilot System, Steinbach, Manitoba, Year 1 Data Summary.
2. Design Guidance and Criteria for Submerged Attached Growth Reactor (SAGR) provided by Nelson Environmental, Inc.
3. June 8, 2009, Lagoon Based Cold Climate Ammonia Removal - OPTAER SAGR Demonstration System, Steinbach, Manitoba, Year 2 Data Summary.
4. August 7, 2009 email transmitting latest data summary and SAGR bed design criteria to provide bed sizing detail based on the pilot project.
5. July 16, 2010 Lagoon Based Cold Climate Ammonia Removal – OPTAER SAGR Demonstration System, Steinbach Manitora, Year 3 Data Summary.
6. August 23, 2010 Volumetric Design Criteria for Stienbach and Lloydminster's Demonstration Submerged Attached Growth Reactors (SAGR); submitted by Nelson Environmental to the Iowa DNR
7. November 2, 2011 Statistical probability analysis of TAN effluent data from the SAGR at the Steinbach MB site; submitted by Nelson Environmental to the Iowa DNR.

ADDITIONAL REFERENCES

Due diligence conducted by the DNR included independent research into the SAGR process. The references used as part of that research include the following:

1. Missouri Construction Permit Number CP 0000807 – SAGR installation in Lamar, Missouri
2. Wyoming Construction Permit Number 10-334R – SAGR installation in Mountain View, Wyoming
3. Indiana Construction Permit Number 19722 – SAGR installation in Mentone, Indiana
4. Metcalf and Eddy, 4th ed. (2003). Attached Growth and Combined Biological Processes. *Wastewater Engineering Treatment and Reuse*. Boston, McGraw Hill.

QUALIFICATIONS:

Similar conditions to the piloted system are necessary to assure replication of results similar to the pilot effluent; this system has been evaluated strictly as a nitrification unit following lagoon treatment. Optimal $CBOD_5$ influent concentrations to the SAGR is 50 mg/L or less. Influent ammonia concentrations is expected to fall in the range from 10 to 25 mg-N/L consistently. It should be noted that the pilot experienced ammonia concentrations in this range consistently year-round, including warmer months, however, stress tests were conducted using zero flow conditions.

RELIABILITY AND REDUNDANCY:

A minimum dual train system is required. Each train in the system must have two feed zones; one at the head of the system and one at the midpoint of the system. The system shall be designed to treat 75 percent of the design volume and waste loading rates with the largest zone out of service with all zones designed to operate fully independently.

The power supply for the system is essential to maintaining aeration. Redundancy to ensure adequate aeration shall be provided by following the requirements of IDNR Wastewater Design Standard 14.5.3 – Power Source Reliability such that adequate power capacity is provided to power maximum wet weather pumping and to power aeration system requirements based on maximum month loading by either:

a. Dedicated standby generator.
b. Alternative power feed from a separate utility substation.

DESIGN CRITERIA:

Hydraulic Retention Time
The minimum design hydraulic retention time (HRT) for the system shall be 24 hours. The design HRT for the SAGR shall be calculated as follows:

$HRT = V_p/Q_{AWW} = (V \bullet \eta)/Q_{AWW}$ Equation 1

V_p = Pore Volume, MG
V = Effective System Volume, MG
η = Porosity of aggregate (ratio of volume of voids to total volume)
Q_{AWW} = Flow, MGD (design flow based on the projected average wet weather flow rate)

Depth Requirements:
The depth of the system shall meet aeration system requirements. A minimum media depth of four (4) feet excluding cover and liner is required.

System Loading:
The total suspended solids (TSS) concentration for flow feeding into the SAGR system shall be less than 50 mg/L (Developed based on 95% confidence interval for mean of TSS from Steinbach and Lloydminster Projects Data). To maintain a sufficiently low TSS concentration for the SAGR influent, treatment to reduce TSS from lagoon effluent may be needed. Approval of SAGR systems may require modification to the existing system or a stand-alone or dedicated process for TSS removal.

The system shall be designed based on a $CBOD_5$ concentration of 25 mg/L and based on a maximum month design loading for TKN loading criteria as follows:

$CBOD_5$ Loading:
$CBOD_5$ Loading = $Q_{AWW} \bullet 25\ mg/L \bullet 8.34 \bullet 100/(A_x) \leq 2.5\ lb\text{-}CBOD_5/(100ft^2 \bullet d)$

Q_{AWW} = Average Wet Weather Flow, MGD
A_x = SAGR cross-sectional area based on depth by width

Notes: $CBOD_5$ loading is based on lagoon effluent $CBOD_5$, $CBOD_5$ loading is per 100 ft^2 cross-sectional area (depth by width)

Total Kjeldahl Nitrogen (TKN) Loading:
TKN Loading $\leq$ 0.40 lb-TKN/(1,000$ft^3 \bullet d$)

Note: TKN loading is per 1,000 ft^3 total system volume based on lagoon influent TKN concentration

Wastewater Distribution:
Wastewater distribution shall be designed with a system to provide even distribution across the entire cross-sectional area with appropriate measures to minimize short-circuiting through the system. A tracer study may be required if the maximum dimension ratio exceeds 4:1 for either width to length or length to depth.

Aeration Requirements:
The aeration system shall be designed to provide a minimum dissolved oxygen concentration of 3.0 mg/L. The system shall incorporate monitoring locations with probes to verify that a minimum 3.0 mg/L is provided. At least two blowers, each sized to handle and treat design TKN loading, shall be installed to support the SAGR process. Diffusers shall be designed to be directly buried in gravel.

Engineered Media
Aggregate media shall meet the following requirements:

Table 1. Sieve Analysis

Sieve Size	Percent Passing
1”	80-100
¾”	30-80
½”	10-30
⅜”	0-2
¼”	0-1

Table 2. Aggregate Mechanical Requirements

Test	Maximum Value	ASTM Reference
Abrasion	35% Loss	C 131
Soundness	8% Loss	C 88
Micro-Deval	25% Loss	D 6928

The aggregate shall have a minimum porosity of 38%. The sphericity of the media should not be less than 0.8. The uniformity coefficient shall be less than 4.

Liner
A 60 mil HDPE liner, or equivalent barrier, shall be installed between the treatment system and the native soils.
Insulation

An insulating mulch layer shall be provided not less than eight (8) inches thick using dried peat mulch defined in accordance with ASTM D4427-92 or approved compost material. Peat mulch shall meet the following conditions

Table 3. Allowable Peat Composition

Parameter	Value	Reference
Moisture Content	25-75%	ASTM D2974
Ash Content	≤25%	ASTM D2974
pH	3.5-7.5	ASTM D2976
Fiber Content	≥33%	ASTM D1997-91

Compost materials shall comply with IAC Chapter 567-105 and shall meet the following:

Table 4. Allowable Compost Composition

Parameter	Value	Reference
pH	5.0-8.5	ASTM D2976
Soluble Salts	< 5 mS/cm	ASTM D2973-71
Nutrient Content	N – 0.50-2% P – 0.20-2% K – 0.30-1.5%	
Bulk Density	700-1,200 lb/yd^3	ASTM D4531-86
Moisture Content	30-60%	ASTM D2974
Organic Matter Content	25-65%	ASTM D2974
Particle Size	3 inch (100% passing) 1 inch (90-100% passing)	
Heavy Metals	Arsenic < 41 mg/kg Cadmium < 39 mg/kg Copper < 1,500 mg/kg Lead < 300 mg/kg Mercury < 17 mg/kg Nickel < 420 mg/kg Selenium < 36 mg/kg Zinc < 2,800 mg/kg	EPA Part 503
Growth Screening (Plant Growth Test)	80-100%	ASTM D5975
Stability	Stable to Very Stable	

Wood chips may be considered an acceptable alternative but must also meet the requirements for pH, soluble salts, nutrient content, and heavy metals shown in Table 4.

CONSTRUCTION DETAILS

The construction details from the Iowa Wastewater Facilities Design Standards listed below are incorporated by reference into this technology assessment.

- 18C.7.2.1 Material
- 18C.7.2.2 Top Width
- 18C.10 Miscellaneous

ADDITIONAL MONITORING REQUIREMENTS FOR THE SAGR UNIT PROCESS:
Monitoring and sampling
Figure 1 depicts an example of a four-zone system used to identify sample collection points. The system shall be designed to allow for water depth measurement and sample collection from the head of the system at the midpoint (between zones) of the system , and at the end of the system near the effluent.

The monitoring plan outlined in Table 5 shall be followed for a period of two years. All trains may be composited or measured independently, but all trains, if operational, shall be represented; provide a description of the sample to identify it as Zone 1, Zone 2, Zone 3, Zone 4, or a composite therof. As a condition of facility plan approval, a Memorandum of Agreement (see attached sample) shall be signed by the owner that commits the owner to additional monitoring in accordance with this section for not less than two years. Based on the results shown by the monitoring data, additional modification to individual systems may be required.

Table 5. Monitoring Plan

Parameter	Units	Sampling Frequency	Location		
			Influent	Midpoint	Effluent
Total Kjeldahl Nitrogen	mg-N/L	Once monthly	X	X	X
Ammonia	mg-N/L	Once every two weeks	X	X	X
Nitrite plus Nitrate	mg-N/L	Once every two weeks with ammonia	X	X	X
pH[A]	S.U.	Daily	X	X	X
Alkalinity	$mgCaCO_3/L$	Once every two weeks with ammonia	X		X
Dissolved Oxygen[A]	mgO_2/L	Daily		X	X
Water Temperature[A]	°F	Daily	X	X	X
TSS	mg/L	Once every two weeks	X		
$CBOD_5$	mg/L	Once every two weeks	X		
Flow Volume[A,B]	MGD	Daily	X		X
Water Depth	feet	Once every two weeks	X	X	X

[A]Autologging is acceptable for pH, D.O., and temperature, and flow volume provided calibration is performed in accordance with the manufacturer's recommendations.
[B]The volumetric flow rate may be measured in the influent or effluent, but flow must be measured for each train independently.

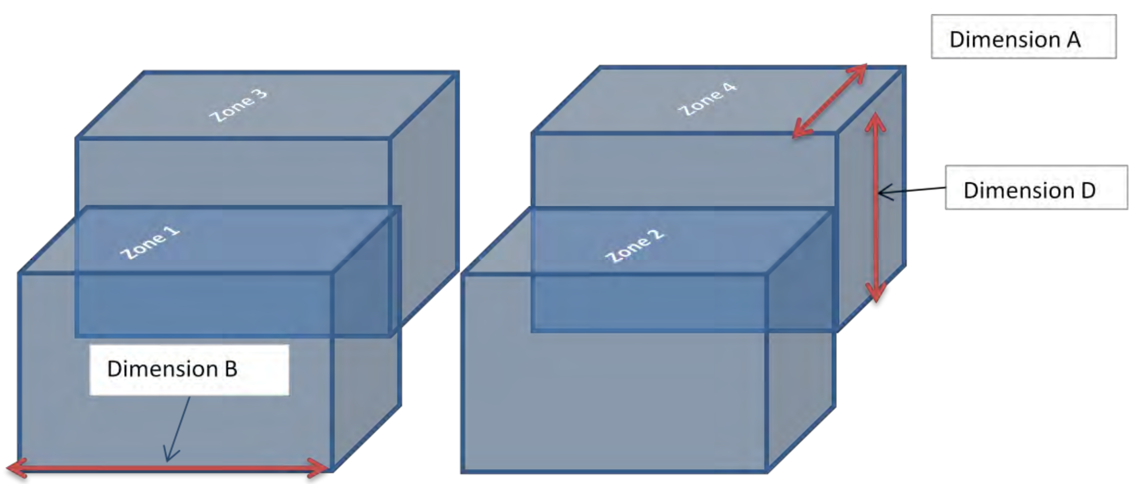


Figure 1. Representation of a four zone SAGR System

CONCLUSION:
The Iowa DNR accepts the design criteria for the SAGR process for application to similar situations and loading conditions. Iowa DNR will accept for approval proposed projects that utilize the design procedure presented by this technology analysis. Specific project details will depend on the loadings for individual applications and are subject to further review by Iowa DNR.

Primary Contact: Eric A. Evans (Phone: 515-281-6253)
Secondary Contact: Larry Bryant (Phone: 515-281-6759)

Last updated: December 8, 2011

SAMPLE MEMORANDUM OF AGREEMENT
Additional Wastewater Treatment System Monitoring

POTW OWNER **City – Sewage File**

The Iowa Department of Natural Resources is in agreement the proposed wastewater treatment process concept for the City and the Department is currently reviewing the submitted facility plans. However, as the proposed system is considered to be innovative, documentation of the performance of the treatment units will be required. The following table outlines the monitoring and sampling plan for the proposed SAGR wastewater treatment system:

Parameter	Units	Sampling Frequency	Location		
			Influent	Midpoint	Effluent
Total Kjeldahl Nitrogen	mg-N/L	Once monthly	X	X	X
Ammonia	mg-N/L	Once every two weeks	X	X	X
Nitrite plus Nitrate	mg-N/L	Once every two weeks with ammonia	X	X	X
pH[A]	S.U.	Daily	X	X	X
Alkalinity	$mgCaCO_3/L$	Once every two weeks with ammonia	X		X
Dissolved Oxygen[A]	mgO_2/L	Daily		X	X
Water Temperature[A]	°F	Daily	X	X	X
TSS	mg/L	Once every two weeks	X		
$CBOD_5$	mg/L	Once every two weeks	X		
Flow Volume[A,B]	MGD	Daily	X		X
Water Depth	feet	Once every two weeks	X	X	X

[A]Autologging is acceptable for pH, D.O., and temperature, and flow volume provided calibration is performed in accordance with the manufacturer's recommendations.
[B]The volumetric flow rate may be measured in the influent or effluent, but flow must be measured for each train independently.

Monitoring and sampling shall be initiated within one month of the startup of the treatment system.

The monitoring and sampling program shown above shall be conducted **for a period of two years** from the date of the first sampling event. This monitoring and sampling are to be performed in addition to the sampling and reporting required by the National Pollution Discharge Elimination System (NPDES) Permit for the facility. Samples with the same sampling points and parameters as those in the NPDES Permit may not need to be duplicated. The monitoring described in this agreement is subject to the same signatory and laboratory certification requirements as described in the NPDES Permit and shall be included in the NPDES monitoring report.

Memo.

Contact XXXX at (515) 281-XXXX with any questions or comments.

FOR THE DEPARTMENT OF NATURAL RESOURCES

ROGER LANDE, DIRECTOR

By ______________________________

ENVIRONMENTAL SERVICES DIVISION

Date: XXXX

The undersigned agrees to perform the monitoring described above as a condition of the Facility Plan and Construction Permit approval for the above referenced project.

FOR POTW

By ______________________________

Date: ______________________________

cc:

ATTACHMENT E:

Naturally Wallace Consulting, LLC
4276 Greenhaven Court
White Bear Lake, Minnesota 55127

Tel: +16128022329
Email: contact@naturallywallace.com

Biomass Accumulation in Submerged Attached Growth Reactors

White Paper Prepared for Nelson Environmental

PROJECT NO. 001

REPORT TO

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DATE

January 24, 2010

Executive Summary

The SAGR technology is a tertiary aerated attached growth reactor which utilizes gravel for media. The technology is an innovative concept particularly for achieving high rates of nitrification in water temperatures that are <1 C. While the SAGR process is relatively new, biomass accumulation in SAGR systems can be inferred based on the performance history of other gravel-bed treatment reactors - notably, horizontal subsurface flow wetlands (HSSFs). The primary difference between the two processes is the lack of vegetation utilized in the SAGR process.

One body of knowledge on biomass accumulation is empirical, and is based on the observed long-term performance of gravel-bed treatment systems as a function of media size and organic cross-sectional loading. This data indicates that there is an upper limit of about 250 g/m^2-d of BOD loading (as applied to the inlet cross-section). Systems loaded above this limit display a tendency to exhibit biomass clogging; systems loaded more lightly than this have greatly reduced clogging tendencies.

The other approach to assessing the dynamics of biomass accumulation is through modeling the growth response of microbial biofilms. This analysis also indicates that there is a threshold limit, which can be measured as a Damköhler number (Da) less than 0.09.

Interestingly, when the two approaches are compared, the results are almost identical, and indicate that for the gravel media used in SAGR systems, the loading should be kept less than 250 g/m^2-d of BOD loading (as applied to the inlet cross-section).

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INTRODUCTION

The submerged attached growth reactor (SAGR) process has been proven to be an effective cold-weather nitrification process for the polishing of lagoon effluents. One aspect of long-term SAGR operation is the potential for accumulation of mineral or biological particulate matter that could lead to a reduction in hydraulic conductivity and eventual clogging of the SAGR bed.

The SAGR process represents a refinement and advance of existing technology based on subsurface flow wetlands. A considerable body of knowledge of bed clogging processes in subsurface flow wetlands has been developed over the last 10 years, and this information is directly applicable to the SAGR process. Therefore, it is useful to examine how this existing data set can be used to define loading parameters that would avoid clogging in a SAGR reactor.

PARTICULATE PROCESSES IN SAGR REACTORS

SAGR reactors are very effective at removing TSS associated with the inlet flow. One of the primary mechanisms is gravitationally-driven particulate settling. Because the bed porosity in HSSF wetlands is low (porosity = 0.30 to 0.40), it is useful to consider gravitational settling in terms of the actual flow velocity, *v*, rather then the superifical flow velocity, *u*. Thus, Equation 1 can be presented Kadlec and Wallace (2008)as:

$$t_{\text{travel}} = \frac{L}{v} \tag{1}$$

where: L = wetland length, m

t_{travel} = time to traverse wetland, s

v = actual flow velocity, m/s ($v = u/\varepsilon$)

u = superficial flow velocity, m/s

ε = bed porosity, dimensionless

Theoretically, all particles of a size corresponding to a given fall velocity will be removed by settling if the travel time exceeds the settling time. In SAGR systems, the reactor is filled with a granular bed. The porosity of this bed increases the flow velocity ($v > u$), but decreases the fall distance, since the particle only has to fall the distance of the average pore space before hitting an intercepting surface, not the entire depth of the wetland bed. In most instances, the pore size within a SAGR bed can be approximated by the d_{10} of the bed media (90% of the particles within the bed are larger than the d_{10}). Thus, Equation 1 can be rewritten as:

$$\text{When } \frac{L}{v} > \frac{d_{10}}{w}$$
$$N_{\text{fall}} = \frac{Lw}{vd_{10}} > 1 \tag{2}$$

where: L = wetland length, m

v = actual flow velocity, m/s

d_{10} = particle size representing the smallest 10% of the bed media

w = terminal solids settling velocity, m/s

N_{fall} = particle falling number, dimensionless

As a practical matter, generally the falling rate, *w*, is much greater than the actual flow velocity, *v*, ($w >> v$). As a result, virtually all of the particles associated with the influent wastewater are settled out, generally within the first 5% of the gravel bed Puigagut et al. (2006).

Filtration and Interception

The principal mechanisms of granular bed filtration are well-known and documented in handbooks Crites and Tchobanoglous (1998),see for instance, Metcalf and Eddy Inc. (1991). These include:

1. Inertial deposition, or impaction - particles moving fast enough that they impact bed particles rather than being swept past by the flowing water.
2. Diffusional deposition - random processes at either micro-scale (Brownian motion) or macro-scale (bioturbation) which move a particle to an immersed surface.
3. Flow line interception - particles moving with the water and avoiding head-on collisions, but passing close enough to graze the stem and its biofilm, and sticking.

Media size in HSSF wetlands around the world (analogous to SAGR reactors) range from soils (d_{10} < 0.1 mm) up to coarse gravels (d_{10} > 4 mm). This size range in bed media spans the dominant scale factors of Mechanisms 1 – 3 listed above. For fine-grained bed media, Mechanisms 1 and 2 will predominate. For gravel media, Mechanism 3 will be the most important.

As a practical matter, these mechanisms all combine to preferentially remove incoming TSS in the inlet region of the SAGR bed. For fine-grained media, Mechanisms 1 and 2 remove particles almost immediately. In coarser bed (gravel) systems, Mechanism 3 will predominate, and will work in conjunction with the particulate settling mechanisms just described.

Resuspension

Resuspension mechanisms are strongly minimized in SAGR reactors due to the physical configuration of the SAGR bed. Flow velocities within the SAGR are low, and generally do not generate shear stresses sufficient to scour particulate matter. Since flow in SAGR reactors occurs below the top of the bed, resuspension mechanism such as wind mixing and turbulence are not factors. Similarly, bioturbation (from burrowing rodents) and gas lift, while theoretically possible, occurs at such small localized scales, that their effect on the overall wetland is nil. As a result of these factors, resuspension is generally not a significant phenomenon in SAGR systems.

Chemical Precipitation

Reaction chemistry can occur in SAGR reactors. One use of analogous HSSF wetlands has been as sulfate-reducing systems to induce the precipitation of copper, nickel and other metals Eger (1992). Many metals form highly insoluble sulfide precipitates Palmer et al. (1988) which are deposited with the wetland bed. A peat-bed HSSF wetland has been used since 1986 to remove copper and nickel from mine drainage at the LTV Dunka Mine near Hoyt Lakes, Minnesota Eger and Lapakko (1989),Frostman (1993).

Other than HSSF wetlands treating mine wastes Younger et al. (2002), accumulation of chemical precipitates generally does not occur at a rate significant enough to impact the hydraulic conductivity of gravel-bed systems, including SAGRs.

PRODUCTION OF BIOLOGICAL SOLIDS

While SAGR systems are effective in removing influent suspended solids through settling, interception, and filtration, and may generate small amounts of solids through chemical precipitation, the majority of the particulate matter present in a SAGR bed consists of biological solids that are generated internally within the system. These microbial films present on bed media particles are the primary concern with respect to accumulation of biomass on the bed media.

The solids in SAGR beds originate from particulates (filtration) and from living and dead microbial biomass (biosolids = sludge). Microbial biomass forms in response to both particulate and soluble organic loading rates. These biofilms further entrap both organic and inorganic solids Winter and Goetz (2003), forming a composite material. In soil absorption systems, this material is contained in a layer commonly termed a *biomat* Beal et al. (2004),Crites and Tchobanoglous (1998). Others have designated it as *sludge* Cooper et al. (2006) or *biosolids* Ragusa et al. (2004). Internal solids accumulation can also be affected by chemical phenomena such as sulfide precipitation Liebowitz et al. (2000), and varies in different applications depending on the nature of the waste being treated. Acknowledging that internal solids are often mostly organic, and are spatially distributed in at least two dimensions, we suggest calling these internal bed materials *biosolids*.

Biosolids formation is greatest at the inlet end of the SAGR where the organic loading is highest Ragusa et al. (2004), especially during periods of high BOD loading. The loss of pore volume due to biomat formation reduces the hydraulic conductivity in this inlet zone Zhao et al. (2004). Organic matter is removed as wastewater flows through the wetland, resulting in declining biosolids growth. At the outlet, where only small quantities of soluble organic matter are available to the microbes and fungi, biosolids formation is minimal. The non-uniform distribution of internal biosolids along the length of the bed results in a non-uniform distribution of hydraulic conductivity throughout the bed. Conceptually, this is illustrated in Figure 1, which is further borne out by the real-world hydraulic profile measured in analogous HSSF wetlands (Figure 2).

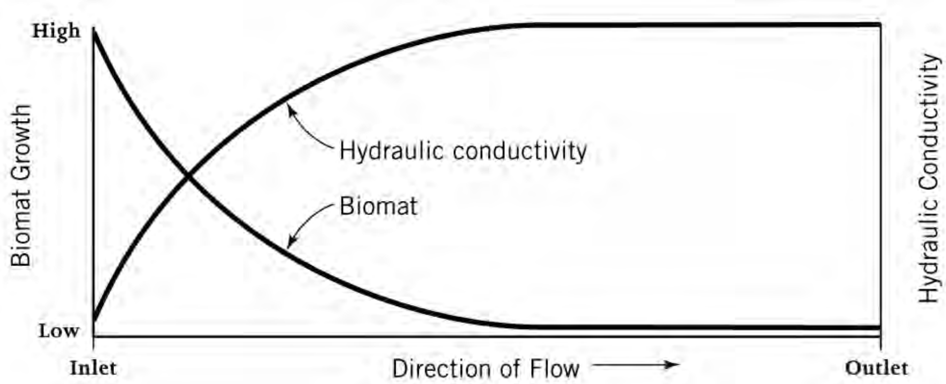

Figure 1: Relationship Between Hydraulic Conductivity and Biomat Formation (Wallace & Knight, 2006)

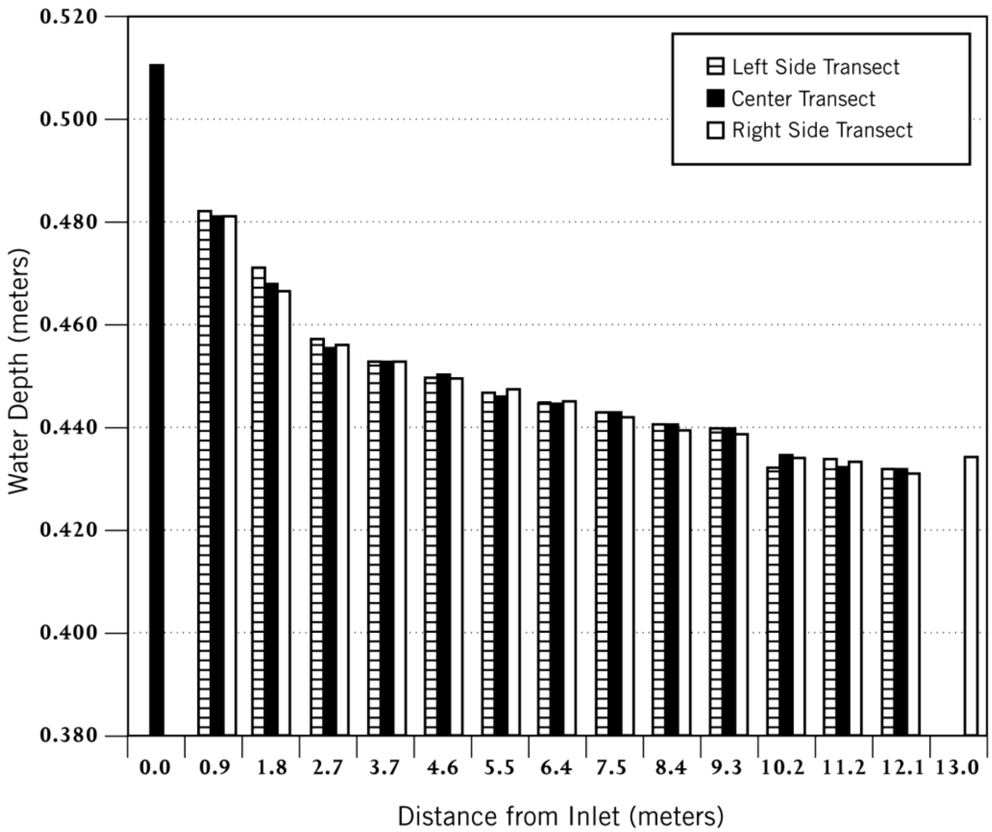

Figure 2: Water Surface Profile of a Single-Home HSSF Wetland in Alabama (Watson & Choate, 2001)

BIOMASS ACCUMULATION AND BED CLOGGING

The combined effects of particulate settling, filtration, and interception result in highly efficient trapping of TSS within the inlet region of a SAGR bed. The loading of organic matter, for systems treating domestic wastewater, in both soluble and particulate forms, results in the preferential development of microbial biomats in the inlet region of a SAGR bed. The net result of these mechanisms is a highly non-uniform distribution of solids, microbial activity, and associated reductions in hydraulic conductivity. Eventually, this inlet zone may become clogged, and the bed will develop overland flow in this region.

Clogging can occur just from deposited particulate (mineral + organic) material. In a laboratory experiment, Sun (1998) was able to demonstrate that when enough sawdust was added to a flume containing pea rock (effectively reducing the porosity from 39.5% to 33.4%), the resulting head loss was controlled by the particulate matter, not the bed media Sun et al. (1998). Porosity reduction due to particle trapping provides reasonable estimates of the time to clogging Blazejewski and Murat-Blazejewska (1997).

Most organic matter is removed in the inlet zone of a SAGR bed. This is the zone of heaviest biosolids accumulation, where the greatest reductions in hydraulic conductivity occur. This zone can be termed the *biosolids clogging distance* and is analogous to the clogging mat that develops in soil infiltration systems treat septic tank effluent U.S. EPA (2002). A schematic of the clogging phenomenon is shown in Figures 3 and 4.

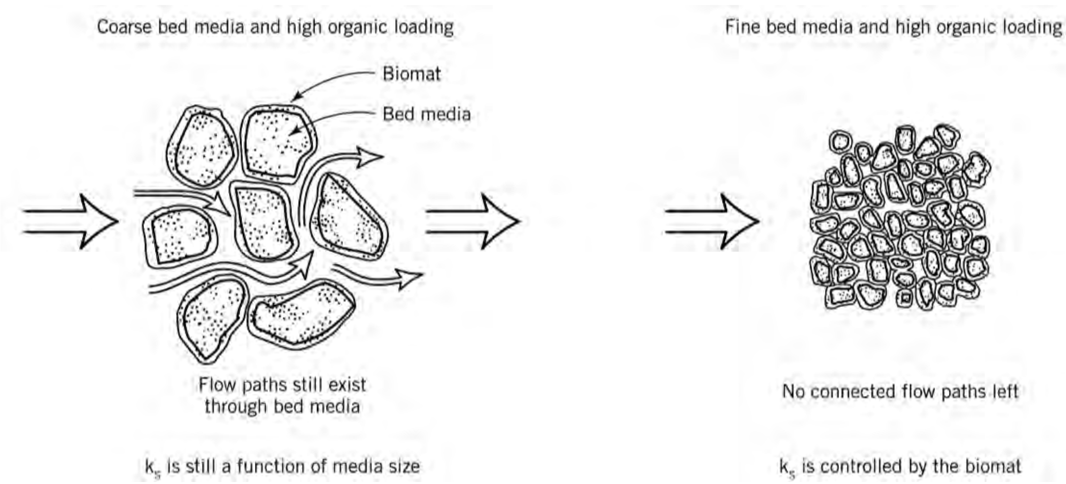

Figure 3 Relationship of media size to bed clogging. From Wallace and Knight (2006).

In fine-grained materials, there is greater bed particle surface area available per unit length of flow path. As a result, more microbial biofilm can form in response to the organic loading. Because the pore size is smaller, the biosolids are more effective in entrapping organic and inorganic solids (as discussed under the Filtration and Interception section above). If the resulting accumulation completely fills the pore spaces, the hydraulic conductivity is controlled (reduced) by the characteristics of the biosolids and not by the characteristics of the media (Figure 3). In this case, the wastewater will likely surface. As a consequence, fine grained media such as soil filters are unlikely to avoid clogging and the associated flooding, and overland flow.

With coarse bed materials, there is less surface area available for biofilm formation per unit length of flow path. Due to the larger pore spaces, the biosolids cannot completely fill the pore volume, and effective flow paths through the media still exist. The net effect lengthens the biosolids penetration distance but decreases the potential for plugging Zhao et al. (2004). This concept is illustrated in Figure 4.

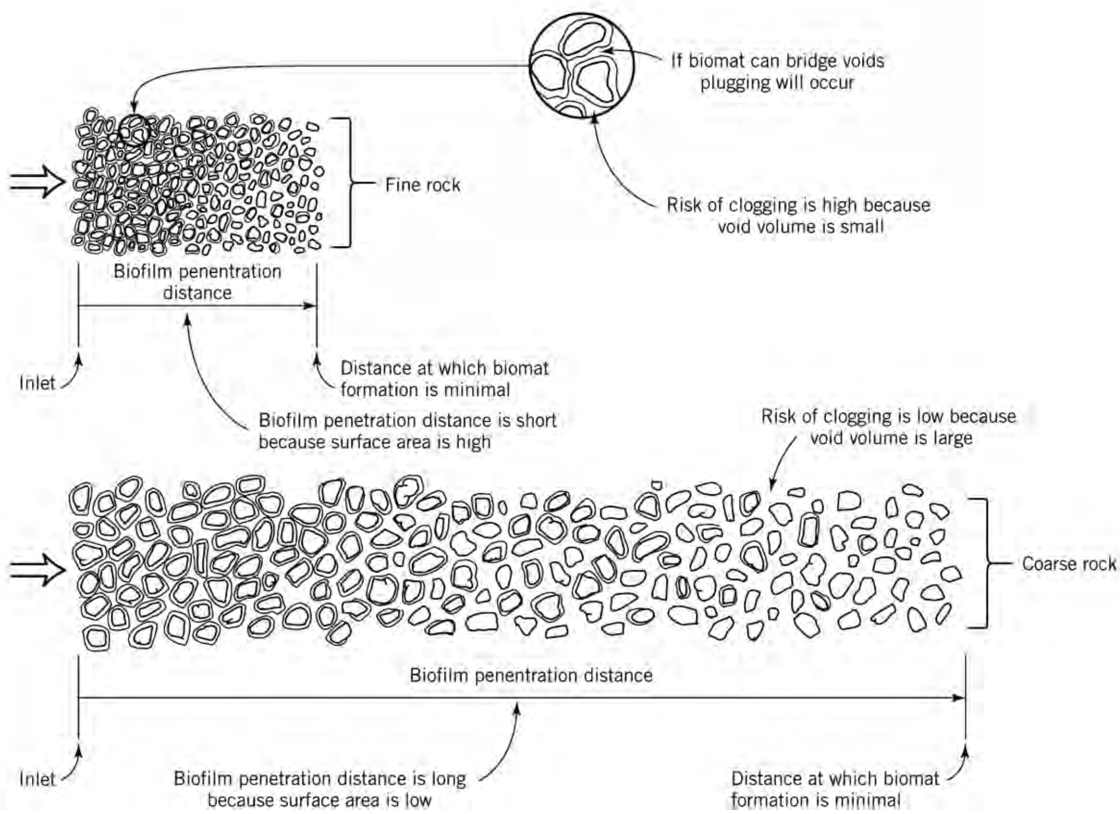

Figure 4 Biofilm penetration distance as a function of media size. From Wallace and Knight (2006).

The current understanding of design does not allow a quantitative determination of the biomat penetration distance. Studies on sand clogging indicate that the clogging distance D_c, can be related to the d_{10} of the media: $D_c \approx 150d_{10}$ within the range of 5×10^{-3} mm < d_{10} < 3×10^{-2} mm Blazejewski et al. (1994). Since this d_{10} is much smaller than the media sizes used in SAGR systems, the usefulness of this relationship is limited. Blazejewski (1994) suggested a clogging thickness of 3 cm (1 in) for fine-grained beds. Bavor Bavor et al. (1989) noted that clogging within a series of very long, narrow VSB trenches (L:W ratio of 25:1) was remedied by excavating the first 5 m (16 ft) of the bed and replacing with coarse rock. Watson *et al*. (1989) provided evidence from the Benton, Kentucky system that the farthest biofilm penetration distance stretched 100 m (330 ft) into a 300 m (980 ft) bed Watson et al. (1989). If biomat plugging occurs, the hydraulic conductivity is no longer a function of the size of the bed media; instead, the hydraulic conductivity is controlled by the biomat. This can lead to a progressive clogging failure of the wetland bed, and the system can end up functioning as an overland flow treatment system, as illustrated in Figure 5.

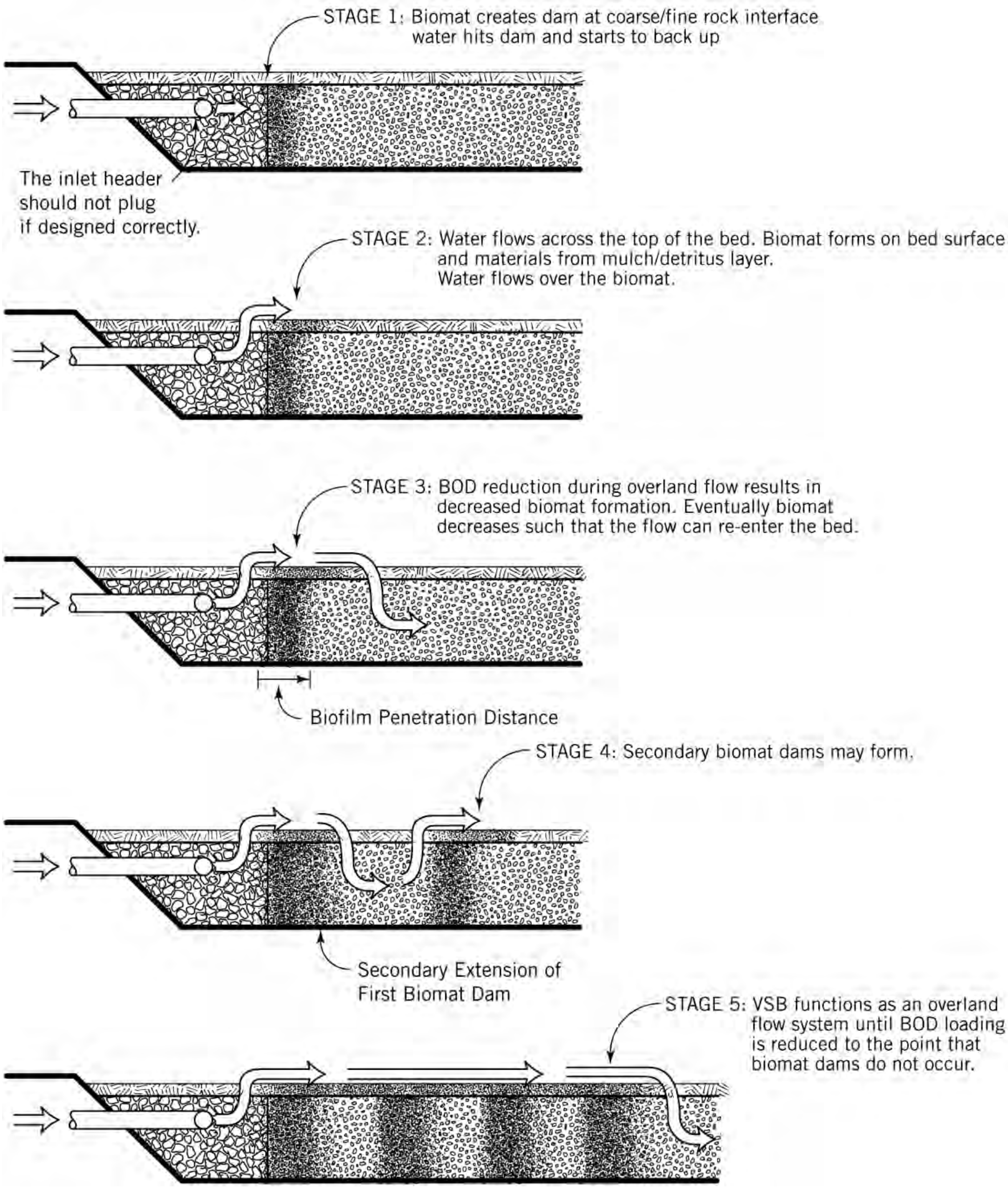

Figure 5 Stages of bed clogging in gravel-bed treatment systems. From Wallace and Knight (2006).

CROSS-SECTIONAL LOADING RATES

The flow through a SAGR is governed by Darcy's Law. The primary design consideration when using Darcy's law is the hydraulic conductivity, k_s. In the initial stage of SAGR operation, the hydraulic conductivity is simply a function of the size of the selected media. As the SAGR continues to operate, a "biomat", which is a microbial biofilm with entrapped organic and inorganic solids, forms. This biomat reduces the hydraulic conductivity of the media. Due to the high organic loading, biomat formation is greatest at the inlet end. As a result, the hydraulic conductivity is lowest in the inlet region. Coarser materials allow for greater suspended solids loadings since the pore spaces are larger, as was indicated in Figure 3. This results in greater penetration of biomat and suspended solids into the bed, as was depicted in Figure 4.

The extent and rate of biomat formation is determined by two factors: (1) the organic loading on the inlet cross-section of the wetland, and (2) the size of the bed media. Lmited information is available on how these factors interact. Nine HSSF wetland systems in Minnesota were assessed for inlet clogging due to biomat formation, as indicated by ponding and/or overland flow.

At each system, rock samples were taken at the center line of the wetland, approximately 1 m from the inlet header at the interface between the coarse distribution rock and the main bed media. Samples were screened to determine the d_{10} of the media (diameter at which 10% of the bed particles are finer by weight). Organic loading rates were also determined based on operating data. This information was compared against available information from the United States, Austria, and Germany Gesellschaft zur Förderung der Abwassertechnik d.V (GFA) (1998),ÖNORM B 2505 (1997),Steiner and Watson (1993),Steinmann et al. (2003). The results are shown in Figure 5.

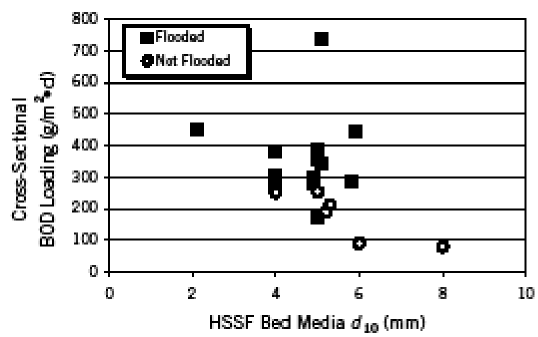

Figure 5 Flooding status of HSSF wetlands as a function of cross-sectional organic loading and bed media size. *Data sources:* Steinmann *et al.* (2003) Wallace and Knight (2006) Puigagut *et al.* (2006); reprinted from Kadlec & Wallace, 2008.

There is very limited information on the factors that contribute to biomat clogging in the inlet regions of gravel-bed treatment systems. Analysis of clogging problems is complicated by the fact that it may take several years for a problem to develop, and factors such as improper operation of primary treatment devices can also induce clogging problems. Figure 5 represents the current state-of the art in relating cross-sectional organic loading and media size to performance.

Data presented in Figure 5 indicates that SAGR systems should be loaded at less than 250 g BOD/$m^2 \cdot d$ (of cross-sectional area) to avoid hydraulic problems in the d_{10} size range of 4 to 6 mm. Presumably larger media sizes would work effectively at this loading rate as well. Loadings greater than 250 g/$m^2 \cdot d$ should be possible with coarser bed media, but data to extrapolate beyond Figure 5 are not currently available. German HSSF wetland systems, which often use finer bed medias, appear to function acceptably partly because the cross-sectional BOD loading is so low (generally less than 100 g BOD/$m^2 \cdot d$).

Monod Kinetics

Biofilm growth in an a SAGR system (and analogous treatment reactors) can also be analyzed by means of the Damköhler number (*Da*), which is a dimensionless ratio of reaction rate to mass transport. The wetland is reaction (growth) rate limited if $Da \ll 1$ and mass transport limited if $Da \gg 1$. Most SAGR treatment processes are a function of biochemically active surface areas in contact with wastewater. If *Da* is defined in terms of specific surface area (*SSA*) of biofilms growing on treatment media (Equation 3). This formulation of *Da* can be used as a design tool to avoid clogging from excess biofilm growth in a SAGR systems. These results can then be applied to a cross-sectional loading criterion for a horizontal flow SAGR.

$$Da = \frac{Rate_{reaction}}{Rate_{masstransport}} = \frac{kX_a}{k_A t \cdot M_{LA}} \qquad \text{Equation 3}$$

Where: k = maximum specific substrate utilization rate, g substrate/g *VS* ·d (M/M ·T)
X_a = maximum specific concentration of active cells, g *VS*/m^2 medium (M/L^2)
VS = volatile solids (biofilms), g (M)
M_{LA} = specific mass loading rate, g substrate /m^2 ·d medium (M/L^2 ·T)
$k_A t$ = one-dimensional advective mass transport coefficient, $1/\tau_\theta$ (unitless)
τ_θ = normalized mean hydraulic residence time (unitless)

When the *SSA* is known (from the size of the bed media), kX_a is determined from data by converting g *VS*/kg aggregate to g *VS*/m^2 aggregate and then dividing by the substrate utilization rate, g COD_u/g *VS* ·d. Because the COD utilization rate can be measured from mature biofilms , apparent kX_a in the aggregate samples was skewed by experimental methods until sample biofilms were mature. Observed kX_a used was 0.0185 g COD/m^2 ·d. In mature biofilms, kX_a is constant if wastewater characteristics do not change (Figure 6).

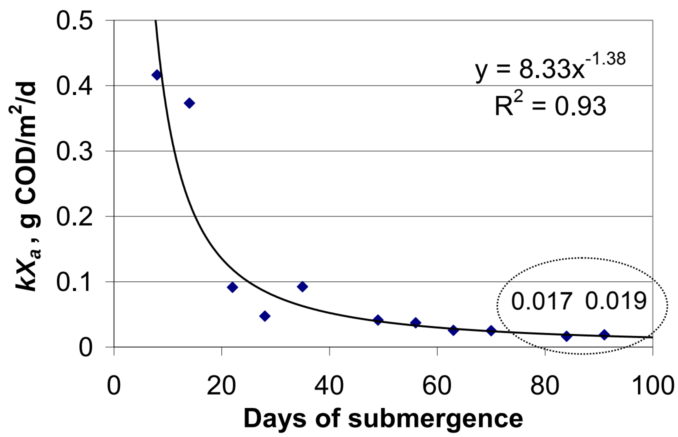

Figure 6 Growth rate of microbial biomass vs. time in a gravel-bed reactor (Austin et. al, 2006)

Modeling of biofilm film growth uses an incremental addition of growth to the existing biofilm mass. The net biomass growth, r_g, can be directly calibrated to *VS* measurements to produce a Monod model fit to *VS* data. This model was built with the observed yield, Y = 0.068 g *VS*/g COD, and COD loading data, S. Other values, k = 3.30, K_s = 25, and k_r = 0.020, were established from literature and visual model fitting.

$$X_t = X_{t-i} + t_i r_g \qquad \text{Equation 4}$$

Where: X_t = biomass at time t, g/m^3 r_g = growth rate, g/m^3 ·d t_i = time, d.

$$r_g = \frac{YkXS}{K_s + S} - k_r ln(X) X \qquad \text{Equation 5}$$

Where: Y = yield, g *VS* / g COD_u — COD_u = COD utilized, g/m³ ·d

k = substrate utilization rate, 1/d — S = utilized substrate, g COD_u/m^3

X = biomass concentration, g/m³ — K_s = half-velocity constant, g/m³

k_r = endogenous respiration coefficient, 1/d

$ln(X)$ = density dependent decay cofactor for k_r, unitless

The biomass decay cofactor *ln(X)* in Equation 5 merits attention. Biofilms encounter lateral spatial limitations growing on aggregate surfaces. The extremely long mean cell residence time of mature biofilms also provides a stable environment for biofilm grazing organisms. The cofactor *ln(X)* is used to represent these spatial density and age dependent phenomena. The Monod model can not fit data without it.

The close fit of Equations 4 and 5 to data (Figure 7) demonstrate the utility of Monod kinetics to modeling system behavior. By "growing" virtual biofilms and extracting kX_a, this model and *Da* calculation of can be extended to other SAGR systems.

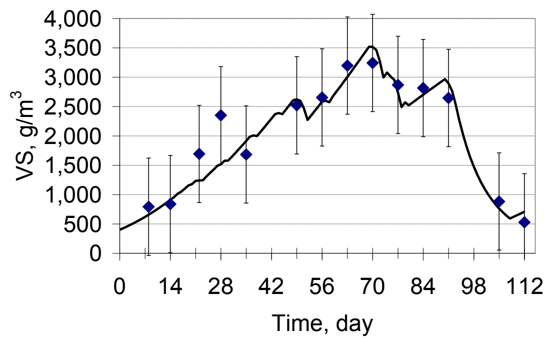

Figure 7 Measured vs. predicted amounts of microbial biomass over time in a gravel-bed reactor (Austin et. al, 2006)

DAMKÖHLER NUMBER

There is a transition value *Da* between tendencies to clog from excess biofilm growth or be free from clogging. The Damköhler number must be correlated to observed clogging at a given COD or BOD mass loading. Over nearly three years of pilot operations (conducted by Living Systems Group in Taos, NM), a mass loading of 150 g COD/m³ aggregate ·d (approximately 100 g BOD_5/m^3 ·d) induced clogging, which was reversible at lower loadings. This loading rate corresponded to a specific surface area mass loading rate, M_{LA}, of 0.18 g COD/m² ·d. With kX_a = 0.0185 g COD/m² ·d and k_At = 1.18, *Da* = 0.09 per Equation 3. At $Da > 0.09$ there is little to no tendency to clog, while $Da < 0.09$ induces clogging; $Da = 0.09$ is a transition value

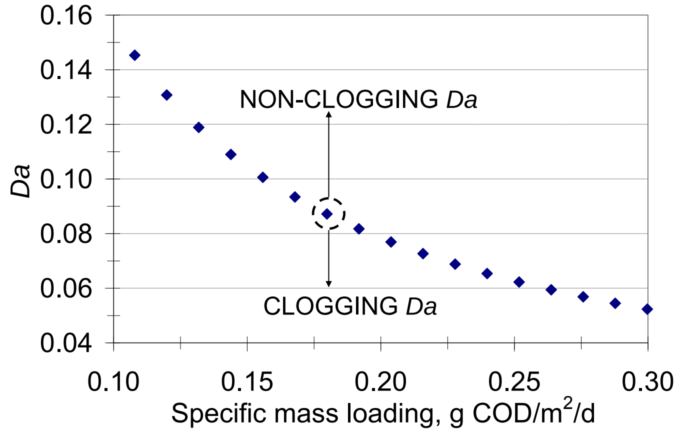

Figure 7 Specific mass loading vs. *Da*. *Da* = 0.09 is transition between non-clogging tendencies (Austin et. al, 2006)

If this Damköhler analysis is applied to a hypothetical SAGR system using the following assumptions:

1. Inlet cross sectional loading is 250 BOD_5 g/m^2
2. Flow, Q = 100 m^3/d; influent BOD_5 = 150 mg/L
3. BOD_5 removal follows 1st order kinetics
4. Aggregate specifications: d_m = 15 mm, $UC \leq 4$, and SSA = 234 m^2/m^3
5. kX_a = 0.0185 g COD/m^2 ·d

Per assumed parameter values, system HRT, τ, is 4.5 days.

$$\tau = -\ln\left[\frac{C_e}{C_o}\right] \div \eta k_v$$ Equation 6

Where: C_o = influent concentration, 150 mg/L C_e = effluent concentration, 20 mg/L
η = mean pore fraction, 0.3 k_v = volumetric rate coefficient, 1.5/d

Mass flux is 15,000 g BOD_5/d, requiring an inlet cross sectional area of 60 m^2. With aggregate depth, h, of 1 meter, the inlet zone is 60 meters wide. The wetland area, $A_w = \tau Q/\eta h$ = 1,500 m^2, and length is 25 meters. Specific mass loading, M_{LA}, in the first meter of the inlet zone is 1.07 g BOD_5/m^2 ·d (15,000 g/d ÷ [234 m^2/m^3 × 60 m^3]).

The SAGR was modeled as four reactors in series, using normalized concentration and time to obtain $k_A t = 1/\tau_\theta = 1.59$. The inlet zone occupies 1/25 (4.0%) of system length, but is assumed to have twice the flow velocity because of reduction of pore diameters by growth of biofilm. Thus the effective hydraulic length of the inlet zone is 8.0% of system length, giving $k_A t_{inlet} = 0.08 k_A t = 0.13$. Per Equation 1, Da = 0.10. Close agreement to the pilot transition Da (0.09) suggests that this method of clogging analysis can be applied across gravel-bed treatment systems, including SAGRs.

Conclusions

The SAGR technology is a tertiary aerated attached growth reactor which utilizes gravel for media. The technology is an innovative concept particularly for achieving high rates of nitrification in water temperatures that are <1 C. While the SAGR process is relatively new, biomass accumulation in SAGR systems can be inferred based on the performance history of other gravel-bed treatment reactors.

One body of knowledge is empirical, and is based on the observed long-term performance of gravel-bed treatment systems as a function of media size and organic cross-sectional loading. This data indicates that there is an upper limit of about 250 g/m^2-d of BOD loading (as applied to the inlet cross-section). Systems loaded above this limit display a tendency to clog; systems loaded more lightly than this have greatly reduced clogging tendencies.

The other approach to assessing clogging dynamics is through modeling the growth response of microbial biofilms. This analysis also indicates that there is a threshold limit, which can be measured as a Damköhler number (Da) less than 0.09.

Interestingly, when the two approaches are compared, the results are almost identical, and indicate that for the gravel media used in SAGR systems, the loading should be kept less than 250 g/m^2-d of BOD loading (as applied to the inlet cross-section). The standard design loading for the SAGR system is 125 g/m^2-d, which provides a factor of safety of 2.0 over the clogging threshold. This conservative approach provides sufficient capacity for handling transient loads or temporary loadings above design values.

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APPENDIX E: GEOTECHNICAL REPORT FOR SUBSURFACE DISPOSAL

Infiltration Evaluation Report
Palmer Waste Water Treatment Plant
Facility Plan Update
Palmer, Alaska

February 2016

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32-1-02475-002

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FACILITY PLAN UPGRADE
ANCHORAGE, ALASKA

1.0 INTRODUCTION

This report presents the results of subsurface explorations, laboratory testing, pumping test, and engineering evaluations conducted by Shannon & Wilson, Inc. at the Waste Water Treatment Plant (WWTP) in Palmer, Alaska. The purpose of this work was to observe and document subsurface conditions and provide an analysis of slope stability and estimate aquifer properties. To accomplish this, we advanced five geotechnical borings within the project area. The borings were advanced to between 50 and 65 feet below ground surface (bgs) to for the purpose of exploring subsurface conditions and placing piezometers to facilitate groundwater monitoring. We also advanced a water well to a depth of 104 feet bgs for the purpose of conducting a pumping test. Selected soil samples recovered from the borings were tested in our Anchorage laboratory. Presented in this report are descriptions of the site and project, subsurface explorations, laboratory test results, pumping test results, an interpretation of subsurface conditions, and an evaluation of slope stability and estimated aquifer properties.

Authorization to proceed with this work was received in the form of signed contract by Mr. Tim Gallagher of HDR Alaska, Inc. on January 8, 2016. Our work was conducted in general accordance with our December 23, 2015 proposal.

2.0 SITE AND PROJECT DESCRIPTION

The project is located in Palmer, Alaska, at the Palmer WWTP which is located approximately 330 feet south of the intersection of East Icy Lane and South Brooks Road. A vicinity map indicating the general project location is presented as Figure 1. The southwest quarter of the property is a shooting range utilized by law enforcement personnel and the remainder of the property is utilized for the WWTP facilities. A site plan, included as Figure 2, shows prominent site features and the approximate boring locations.

3.0 SUBSURFACE EXPLORATIONS

Subsurface explorations for this study consisted of drilling and sampling five borings to depths ranging between 50 and 65 feet bgs, designated Borings B-1 through B-5, on January 11 through

January 14, 2016. The general boring locations were selected prior to mobilizing to the site. The final boring locations shown on Figure 2 were recorded by CRW during their site survey.

Drilling services for this project were provided by Discovery Drilling using a truck mounted CME 75 drill rig. An experienced representative from our firm was present during drilling to locate the holes, observe drill action, collect samples, log subsurface conditions, and observe groundwater conditions. Prior to mobilizing to the site we contacted the Call Locate Center to locate buried utilities in the project area.

The borings were advanced with 3¼-inch inner diameter (ID), continuous flight, hollow-stem augers to a depth of approximately 50 feet bgs or until the boring was believed to have been advanced 5 feet below the groundwater table. As the borings were advanced, samples were typically recovered using Modified Penetration Test (MPT) methods at 2.5-foot intervals to 10 feet bgs and 5-foot intervals thereafter. In the MPT method, samples are recovered by driving a 3-inch outer diameter (OD) split-spoon sampler into the bottom of the advancing hole with blows of a 340-pound hammer free falling 30 inches onto the drill rod. The number of blows required to advance the sampler the final 12 inches of an 18-inch penetration is termed the penetration resistance. Blow counts are shown graphically on the boring log figures as “penetration resistance” and are displayed adjacent to sample depth. The penetration resistance values give a measure of the relative density (compactness) or consistency (stiffness) of cohesionless or cohesive soils, respectively. In addition to the split-spoon samples, a grab sample of the near-surface soils was collected from the auger cuttings in the upper 1.5 to 2 feet of each boring.

The soils were observed and described in the field in general accordance with the classification system described by ASTM International (ASTM) D2488. Selected samples recovered during drilling were tested in our laboratory to refine our soil descriptions in general accordance with the Unified Soil Classification System, which is described in Appendix A, Figure A-1. The frost classifications included on the logs are followed by “P-200” to indicate that the classification was based on P-200 data. The frost classification system is presented in Appendix A, Figure A-2. Summary logs of the borings are presented in Appendix A, Figures A-3 through A-7.

Upon completion, machine-slotted, 2-inch PVC riser pipe were inserted into the open borehole annulus of the borings to facilitate measuring groundwater levels. Piezometers are numbered according to the boring they were placed in.

4.0 LABORATORY TESTING

Laboratory tests were performed on selected soil samples recovered from the borings to support our soil descriptions and to estimate the index properties of the typical materials encountered at the site. The laboratory testing was formulated with emphasis on determining gradation properties, natural water content, and frost characteristics.

Water content tests were performed on the samples returned to our laboratory. Water content tests were performed in general accordance with ASTM D2216. The results of the water content measurements are presented graphically on the boring logs in Appendix A, Figures A-3 through A-7.

Grain size classification (gradation) testing was performed on the sample recovered from the soil below 12 feet bgs to estimate the particle size distribution. The gradation testing generally followed the procedures described in ASTM C117/C136. The test results are presented in Appendix A, Figure A-8 and summarized on the boring log as percent gravel, percent sand, and percent fines. Percent fines on the boring log are equal to the sum of the silt and clay fractions indicated by the percent passing the No. 200 sieve.

5.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered in Borings B-1 through B-5 are presented graphically on the boring logs included as Appendix A, Figures A-3 through A-7. The borings were advanced through 3 to 9.5 feet of silt to silty sand fill and native material. When not frozen, the predominately fine grained surficial soils were very loose to medium dense with penetration resistance values ranging from 3 to 28 blows per foot (bpf). The fines content of these surficial soils, based on our laboratory testing, ranged from approximately 29 to 91 percent. Based on our laboratory testing, the moisture contents ranged from 8 to 33 percent. Note the upper 2 to 4 feet of soil encountered in the borings were frozen during the time of drilling.

Below the predominately fine grained surficial soils, the underlying soils consisted of poorly to well-graded sands and gravels with varying amounts of fines to the bottom of the borings. The sands and gravels were medium dense to very dense with blow counts ranging from 17 to 70 bpf with occasional sampler refusal. The fines content of these sands and gravels, based on our laboratory testing, ranged from approximately 3 to 9 percent. Based on our laboratory testing, the moisture contents ranged from 1 to 4 percent when above the water table and 7 to 22 percent when below the water table.

Groundwater was encountered in Boring B-1 at approximately 35.5 feet bgs during drilling and Borings B-2 through B-5 encountered groundwater at approximately 53 to 57 feet bgs during drilling. Static groundwater measurements were also conducted on January 22, 2016 and groundwater was encountered in Boring B-1 at 31.4 feet bgs and in Borings B-2 through B-5 at 51.5, 51.1, 53.4, and 53.7 feet bgs respectively. Using the static groundwater measurements and the surveyed elevations of the piezometers, the groundwater contours were estimated in Surfer 12, which is a three dimensional gridding software, using the Kriging method and plotted on Figure 3. Manual adjustments were conducted based on professional judgment. Boring B-5 was not used in estimating the groundwater contours due to an assumed incorrect reading. It should be noted that groundwater levels may fluctuate by several feet seasonally.

6.0 AQUIFER EVALUATION

The aquifer evaluation consisted of a pumping test conducted at the newly drilled Pumping Well (PW) located at the Palmer Waste Water Treatment Plan in Palmer, Alaska. Wheaton Water Wells (Wheaton, under sub-contract to Shannon & Wilson, Inc., installed the Well in January 2016. The testing the consisted of a brief step test and a long-term pumping test. A summary of well drilling, installation, pumping and well decommissioning activities are presented below.

6.1 Well Drilling and Installation

In January 2016, Wheaton drilled and advanced 10-inch diameter well casing to a depth of 102 feet below ground surface. The final well log, provided by Wheaton, is included in Attachment B. The final well location shown on Figure 2 was recorded by CRW during their site survey.

The well screen was set at a depth of 91 to 101 feet bgs. The screen was a 10-inch diameter telescoping screen with a slot opening size of 0.030 inches. The 10-inch casing pulled back to expose the well screen. The screen was then developed for 6 hours using over-pumping, air surge, and air lifting techniques.

6.2 Pumping Test

Prior to conducting the pumping tests, Shannon & Wilson obtained a Temporary Water Use Authorization (TWUA A2015-136) to discharge water on the surface to the southwest of the well near Piezometer P-3. Prior to the pumping test the static water level in the pumping well was 55.26 feet bgs. A step-drawdown test was performed for approximate pumping rates of 50, 240, and 320 gallons per minute (gpm), which resulted in drawdowns of approximately 5, 13, and 20 feet in the pumping well. The rate of pumping test was performed at 320 gpm for a 24-hour period.

During the pumping test the water levels were recorded with Levelogger®, self-contained water-level dataloggers, manufactured by Solinst Canada, Ltd., to measure and record water pressure and temperature to determine the height of water above the datalogger. For specific capacity measurements, the datalogger was placed in the well being pumped. The datalogger in the pumping well was equipped with a cable to allow for direct reading at the ground surface so field personnel could observe water level changes during the step test. We also placed dataloggers in Piezometers P-1, P-2, P-3, P-4, and P-5 to monitor drawdown.

A review of the data plotted on Chart 1 indicates that the test data appears reasonable and that problems with data collection were not encountered. It also appears that the water levels at the site were not impacted by nearby pumping wells. Chart 2 shows the drawdown observed in the pumping well and piezometers.

6.3 Well Efficiency

We performed well-efficiency calculations for the pumping well (PW) and the five piezometers tested for hydraulic properties using the straight-line method applied to a distance-drawdown plot. The distance-drawdown is plotted on semi-log paper. A straight line is plotted between the drawdown in the observations wells and extended to intercept the radius of the pumping well. The pumping well was assumed to have a 6-inch radius. The efficiency was calculated by dividing the intercept of the extended line by the measured drawdown and multiplying by 100 percent. The drawdown values were taken approximately 100 minutes into testing.

According to Sterrett (2007), an efficiency of 70 percent to 80 percent is usually obtainable if good design, construction, and development practices are followed. Inefficiency can be caused by design considerations (insufficient open area, poor distribution of screen openings, insufficient screen length, and improperly sized filter pack) and construction factors (inadequate development or improper placement of well screens over low-water-bearing formations). The pumping well was calculated to have an efficiency of about 20-percent. We attribute this low efficiency to the high entrance velocity (approximately 0.2 feet per second). Due to this inefficiency the Pumping Well was not included in the evaluation of hydraulic properties.

6.4 Hydraulic Properties Testing

We evaluated data developed during the pumping test using the same procedures for each well. First, datalogger files were imported into Microsoft Excel and plotted on a semi-log scale. We used straight-line methods plotted on a semi-logarithmic scale (Cooper-Jacobs, 1946) to estimate transmissivity (T). Datalogger data were also imported into the AQTESOLV software program for processing. For Piezometer P-2, P-4, and P-5, we evaluated pumping-well water levels for impacts from pumping rate changes. If we observed no water-level changes, we used the average pumping rate to evaluate drawdown curves for each observation well.

As previously mentioned the Pumping Well was not included in the evaluation of hydraulic properties. Piezometers P-1 and P-3 were also excluded from the evaluation. Piezometer P-3 was near the pumping discharge and shows effects of recharge even though the immediate discharge area was covered with visqueen. Piezometer P-1 shows the potential impact of an unknown positive recharge boundary between approximately 300 and 600 minutes into the test. This boundary is suspected to by the nearby surface water body.

Using AQTESOLV we then evaluated Piezometers P-2, P-4, and P-5 using straight-line methods (Cooper-Jacob, 1946) to estimate T and Storage Coefficient (S). Each piezometer was evaluated individually. We used both visual and automatic matching to develop the best fit. The T estimates from this method were within an order of magnitude of the hand estimates. We also evaluated the three piezometers using the Neuman (1974) method.

Because none of the wells were fully penetrating, and the pumping test did not reach steady-state conditions, it is our opinion that the values for Storage, Specific Yield, and Anisotropic ratio are unreliable. Towards the conclusion of the test it appears that the initial dewatering of the cone of depression had occurred and the continued flow appears to be contributed from a more permeable layer. It is our opinion that the below estimates of transmissivity are therefore conservative for the long-term situation.

Piezometer	Transmissivity Hand Cooper-Jacob	Transmissivity AQTESOLV Cooper-Jacob	Transmissivity AQTESOLV Neuman	Units
P-2	650,000	650,000	610,000	Gpd/ft
P-4	310,000	310,000	314,000	Gpd/ft
P-5	365,000	365,000	377,000	Gpd/ft

Gpd/ft = gallons per day per foot

Transmissivity is equal to the hydraulic conductivity multiplied by the thickness of the aquifer. Because the pumping well did not fully penetrate the aquifer, and the pumping test was relatively short, the full extent of the aquifer was not tested. Based on the length of test, the vertical extent of the aquifer can be estimated as 1.3 times the depth below water of the lowest part of the screen in the pumping well. Based on this we estimate the aquifer thickness contributing to the flow as 60 feet.

7.0 INFILTRATION EVALUATION

As part of this project we evaluated the potential physical and water quality impacts associated with infiltrating the wastewater on the site. This included conducting an evaluation to predict the change in groundwater depth due to infiltrating the wastewater and an evaluation of the subsequent increase in nitrate loading downgradient of the infiltration area.

7.1 Mounding Evaluation

We performed a groundwater mounding analysis to predict the mounding height that would result from three different discharge volumes to the proposed infiltration gallery. For this preliminary analysis, we assumed the following:

- An infiltration area of 302,500 square feet.
- Discharge volumes of 0.5, 1.0 and 2.0 MGD.

The preferred method of modeling groundwater interactions is a three-dimensional, finite difference model developed by USGS (MODFLOW). This method requires developing a three-dimensional mesh that represents the saturated and unsaturated flow at the site and requires a large amount of site-specific subsurface information. We performed the mounding analysis using a spreadsheet model based on a solution of the general two-dimensional groundwater flow equation developed by Hantush (1967). A study by USGS (2010) compared this analytical method with MODFLOW. The study concluded that the simplified Hantush model slightly over-predicted the height of the mound beneath the center of the basin (approximately 10 percent) but the results were very similar further away from the center of the infiltration basin. We have used this simplified method on numerous infiltration basins in Alaska and the Pacific Northwest. We have observed that the actual mounds developed beneath the infiltration basins are usually lower than predicted by the Hantush model.

Our mounding analysis included the following input values and assumptions:

- Infiltration rates: 0.22, 0.44, and 0.89 feet per day.
- Specific yield: 0.20 (dimensionless).
- Horizontal hydraulic conductivity: 500 feet per day (based on February 2016 pumping test).
- Duration of infiltration period: 1 year.
- Initial thickness of saturated zone: 60 feet (based on February 2016 pumping test).

The results of our mounding analysis are summarized below:

Application Rate (MGD)	Area (ft^2)	Hydraulic Conductivity (ft/day)	Maximum Mound (ft)	Mound at 400 feet from center (ft)
0.5	302,500	500	1.4	1.2
1.0	302,500	500	2.8	2.5
2.0	302,500	500	5.5	4.9

As summarized above the mound created under the first two, and possibly third, scenarios are likely within the natural seasonal variation in groundwater elevation. The predicted mounds are also likely conservative due to the assumption that the aquifer is only 60 feet thick. The mound 400 feet from the center of the infiltration is intended to approximate the increase in groundwater level under the toe of the slope for the stability evaluation.

7.2 Nitrate Evaluation

Shannon & Wilson conducted simplified evaluation of potential nitrate impacts to the regional aquifer. We used the procedures developed by the Minnesota Pollution Control Agency in 1984. The evaluation assumes that the concentration of ammonia (primarily nitrogen source) in the wastewater transforms to nitrate before the effluent reaches the groundwater. In actuality some nitrogen is transformed to (and remains) nitrite, some enters the groundwater as ammonium, and some is transformed to nitrogen gas. This introduces conservatism in the evaluation.

A calculation is then conducted using the loading of nitrate from the wastewater and inflow from the groundwater. The calculation assumes that by the time the nitrate reaches the property boundary full mixing of the wastewater and groundwater has occurred. The calculation can also include the impact of precipitation on the overall mass balance. We elected to neglect the effect of infiltrating precipitation at the site. The following table indicates the input parameters, and source, that were used in the calculation.

Input Parameter Name	Input Parameter Value	Source
Background Nitrate Concentration	0.5 mg/L	ADEC's Drinking Water Watch
Septic Effluent Nitrate (Ammonia) Concentration	44.7 and 34.9 mg/L	HDR (existing and with additional treatment)
Hydraulic Conductivity of Aquifer	500 feet/day	February 2016 pumping test
Hydraulic Gradient of Aquifer	0.001	February 2016 measurement
Flow from Septic System	0.5 MGD	HDR
Effective Width of Leach Field	550 feet	HDR prelim information and February 2016 water level measurement
Depth of Water Table Above Well Intake	45 feet	Assumed based on general well depths in area.

Using the above input parameters we calculate a nitrate concentration at the property boundary of 35.1 and 27.4 milligrams per liter (mg/L) for loadings of 0.5 MGD at the two nitrate loading rates provided. The depth of water table above the shallowest well intake is unclear for this site. No downgradient drinking water wells were identified during this project. Based on the water level measurements obtained during this project the groundwater beneath the site flows towards the Matanuska River.

8.0 SEISMIC CONDITIONS

The site class most representative of the project area according to the 2012 International Building Code (IBC) will be Site Class D for a stiff soil profile. This is based on the blow count (N) method with typical blow counts in the 15 to over 50 blows per foot range. Based on the ground motions in Figures 1613.3.1(4) and 1613.3.1(5) contained in IBC 2012, S_s and S_1 for the Maximum Considered Earthquake (return period of 2,475 years) were estimated at 1.500 and 0.701, respectively. The site specific modifying coefficients for the spectral response accelerations are $F_A = 1.0$ and $F_v = 1.5$ for the short and long periods, respectively. The S_{MS} and S_{M1} were calculated to be 1.500 and 1.051 respectively. The computed S_{DS} and S_{D1} are 1.000 and 0.701.

Based on the ground motions in Figure 12 contained in *Revision of Time-Independent Probabilistic Seismic Hazard Maps for Alaska* by the United States Geological Survey (USGS), the peak ground acceleration (PGA) was found to be 0.59 times the gravitational coefficient (g). This value is roughly equivalent to what would be calculated using probabilistic estimates of ground motions with a 2 percent probability of exceedence in 50 years (2,475-year return period).

9.0 SLOPE STABILITY EVALUATION

To evaluate stability conditions, analyses were performed using the computer program Slope/W from GeoStudios. This is a two-dimensional, limit equilibrium slope stability program that is used to model a slope and estimate the factor of safety against sliding by the simplified Janbu, simplified Bishop, Spencer, and Morgenstern-Price methods. The program features random techniques for generating potential failure surfaces and identifies the most critical failure surfaces and their respective factors of safety. Techniques include generating circular, sliding block, or irregular failure surfaces. The program allows for heterogeneous soils systems, anisotropic soil strength properties, excess pore water pressure due to shear, static groundwater and surface water forces, pseudo-static earthquake loading, and surcharge boundary loading. To estimate the external stability evaluation of the slope, we assumed the soil cross section shown on Figure 4. The assumed soil strength properties for the soil units shown on these figures are presented on the following page. This evaluation does not include evaluating undercutting of the toe of the slope by the Matanuska River.

General geometric conditions for the slope were estimated from the preliminary topographic drawing provided by CRW after their initial site survey. Native soil conditions and strength properties were estimated based on results of our explorations and laboratory testing. Our analysis generally concentrated on relatively deep failure planes that would extend beyond the fence on the south side of the property. Therefore, the near surface organics and silts were disregarded and treated like the soils typically encountered throughout the remainder of the borings.

Factors of safety were calculated using the Morgenstern-Price method for the project site as it currently exists and with the mounded groundwater level that would result from an application rate of 2.0 MGD. Along with static slope conditions, we modeled dynamic (seismic) loading conditions for each stability analysis using a pseudo-static analysis and acceleration coefficients consistent with the seismic events outlined in Section 8.0. Typically, slopes with factors of safety of at least 1.5 and 1.1 are considered stable for static and seismic conditions, respectively.

PALMER WWTP SOIL PROPERTIES

Soil Classification	Angle of Internal Friction (degrees)	Unit Weight (pcf)*	Cohesion (psf)*
Medium dense to very dense Sand with Silt and Gravel to Gravel with Silt and Sand*	35	130	0

The values in the above table are appropriate for static and dynamic loading conditions.
*   pcf - pounds per cubic foot, psf - pounds per square foot.

In general, the analysis indicates that the existing slope along the bluff of the Matanuska River drainage is generally externally stable under static conditions. However, when the slope is subjected to the analyzed shaking event, it will likely fail.

The Slope/W analysis method makes it difficult to predict the specific amount of movement that could be experienced. Deflection under seismic loading is predicted using a finite element model. The actual movement will be dependent on the seismic event magnitude and duration. Given the relatively short height of the slope, we would not expect that deflections under a design earthquake would be such that the fence and other possible structures would be totally lost and in need of reconstruction.

9.1 Stability Analysis 1 – Shallow/Raveling Failure Plane for the Existing Slope and Groundwater Conditions

In order to evaluate the external stability of the existing slope, we developed a generalized soil profile based on the soils encountered by our borings, particularly Boring B-1, and assumed the groundwater depth estimated by our pumping test. Geometric conditions for the ground surface of the slope were estimated from the preliminary topographic contours provided by CRW.

Our first stability analysis evaluated the shallow/raveling external stability of the existing slope and groundwater conditions. The minimum depth of the failure plane was set at 5 feet bgs. The results of our analysis indicate the minimum shallow/raveling factor of safety against sliding during in the static condition to be approximately 1.2. This same failure plane was analyzed under the design seismic event for the area. With a horizontal acceleration factor of 0.3g (approximately ½ of the PGA for the site during the design earthquake) applied to the potential failure plane from our static analysis, an existing shallow/raveling seismic factor of safety was approximately 0.6. Based on the results of our analysis, we believe that the slope, with existing soil and groundwater conditions, would fail during the shaking associated with the design earthquake. Under static conditions it is marginally stable. Where the slope did not have vegetation, progressive raveling failures were observed in the field. Our existing slope model geometry and the approximate location of the predicted failure surface is presented on Figure 4.

9.2 Stability Analysis 2 – Deep-Seated Failure Plane for the Existing Slope and Groundwater Conditions

Our second stability analysis evaluated the deep-seated external stability of the existing slope and groundwater conditions. This analysis forced the top of the failure plane to be at least as far Boring B-1 was away from the top of the slope.

The results of our analysis indicate the minimum deep-seated factor of safety against sliding during in the static condition to be approximately 1.8. This same failure plane was analyzed under the design seismic event for the area. With a horizontal acceleration factor of 0.3g applied to the potential failure plane from our static analysis, an existing deep-seated seismic factor of safety was approximately 0.9. Based on the results of our analysis, we believe that the slope, with existing soil and groundwater conditions, would fail during the shaking associated with the design earthquake. Our existing slope model geometry and the approximate location of the predicted failure surface is presented on Figure 4.

9.3 Stability Analysis 3 – Deep-Seated Failure Plane for the Existing Slope and Mounded Groundwater Conditions

To evaluate the external stability of the existing slope after an application rate of 2.0 MGD is added to the site, we used the same geometric conditions used for the first two stability analyses, but increased the elevation of the groundwater table by between 5.5 (north end) and 4.9 feet (south end) from the observed depth at the time of our pumping test.

The results of our analysis indicate the minimum factor of safety against sliding during in the static condition to be approximately 1.7. This same failure plane was analyzed under the design seismic event for the area. With a horizontal acceleration factor of 0.3g applied to the potential failure plane from our static analysis, the seismic factor of safety was approximately 0.9. Based on the results of our analysis, we believe that the slope, with mounded groundwater conditions, would fail during the design earthquake. The approximate location of the predicted failure surface is also presented on Figure 4.

10.0 CONCLUSIONS/RECOMMENDATIONS

Our geotechnical explorations and pumping test indicate that the site of the proposed infiltration area is underlain by permeable sand and gravel. Our mounding evaluation indicates that a small groundwater mound will form under the design loading. However this mound appears to be generally within the expected natural groundwater elevation variation at loadings up to 1 MGD.

Our evaluation of potential nitrate concentration in the groundwater indicates that little reduction from initial concentration is expected. This is primarily due to the relatively flat groundwater gradient at the project site.

Our slope stability evaluation indicates that the existing slope is marginally stable under static conditions and predicted to fail under the design event seismic loading. While the mounding analysis indicates that the groundwater level at the toe of the slope will rise, this rise has minimal effect on the stability of the slope.

We recommend further studies be conducted to evaluate this site for suitability. At this time the biggest unknown is the seasonal variation in groundwater elevation and flow direction. It is possible that at times of year both the depth to groundwater and the flow direction could vary substantially from what we observed in February.

While the slope stability and nitrate reduction evaluation both predict unfavorable results the methods used were simplistic for this site. A more refined analytical method would reduce overly-conservative assumptions built into the simplistic methods used. We recommend developing a three-dimensional, finite difference model to better reflect the groundwater flow at the site. This evaluation would help refine estimates and shape of the groundwater mound below the infiltration area and groundwater elevation at the slope interface. A particle-tracking evaluation should then be conducted to evaluate horizontal and vertical groundwater flow. A fate-and-transport evaluation could then be conducted for nitrate to not only predict how it will flow through the system but also how it will be transformed to other forms in the groundwater.

11.0 CLOSURE AND LIMITATIONS

This report was prepared for the exclusive use of our client and their representatives for evaluating the site as it relates to the geotechnical aspects discussed herein. The conclusions contained in this report are based on site conditions as they presently exist. It is assumed that the exploratory borings and piezometers are representative of the subsurface conditions throughout the site and aquifer, i.e., the subsurface conditions everywhere are not significantly different from those disclosed by the explorations.

If there is a substantial lapse of time between the submittal of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the conclusions considering the changed conditions and time lapse. Unanticipated soil conditions are commonly encountered and cannot fully be determined by merely taking soil samples or advancing borings. Shannon & Wilson has prepared the attachments in Appendix C *Important Information About Your Geotechnical/Environmental Report* to assist you and others in understanding the use and limitations of the reports.

Copies of documents that may be relied upon by our client are limited to the printed copies (also known as hard copies) that are signed or sealed by Shannon & Wilson with a wet, blue ink signature. Files provided in electronic media format are furnished solely for the convenience of the client. Any conclusion or information obtained or derived from such electronic files shall be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, or you question the authenticity of the report please contact the undersigned.

We appreciate this opportunity to be of service. Please contact the undersigned at (907) 561-2120 with questions or comments concerning the contents of this report.

SHANNON & WILSON, INC.

Brentton Leeper, EIT
Geotechnical Engineer II

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Stafford Glashan, PE
Vice President

12.0 REFERENCES

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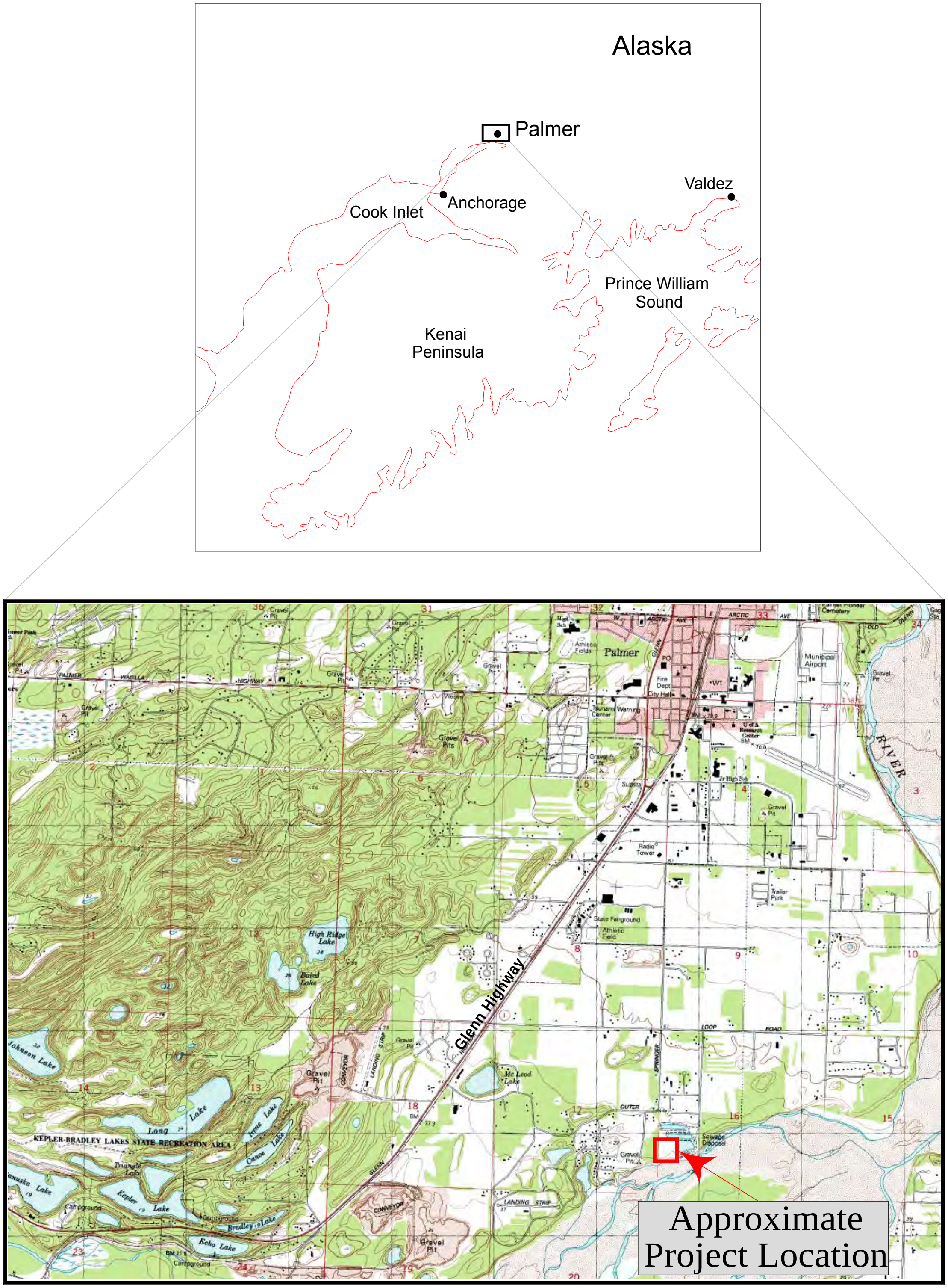
Hantush, M.S., 1967, Growth and decay of groundwater mounds in response to uniform percolation: Water Resources Research, v. 3, p. 227-234.

Sterrett, R.J., ed., 2007, Groundwater and Wells (3rd Edition): St. Paul, MN, Johnson Screens, 812 pages.



Adapted from AllTopo Maps USGS Anchorage C-6 SW 25K Quadrangle

0 1 2

APPROXIMATE SCALE IN MILES

N

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VICINITY MAP

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FIG. 1

LEGEND

B-1 — Approximate Location of Boring B-1, Advanced by Shannon & Wilson, January 2016

PW — Approximate Location of Pumping Well (PW), Advanced by Wheaton Water Well, January 2016

A — A' — Approximate Location of Slope Profile Used for Slope Stability Analysis

120 / 110 — Topographic Contours (Feet NAD 83). 2-foot Interval.

0 50 100 200

APPROXIMATE SCALE IN FEET

N

NOTES

1. Basemap imagery (April 2011) provided by Google Earth Pro, reproduced by permission granted by Google Earth™ Mapping Service.

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SITE PLAN

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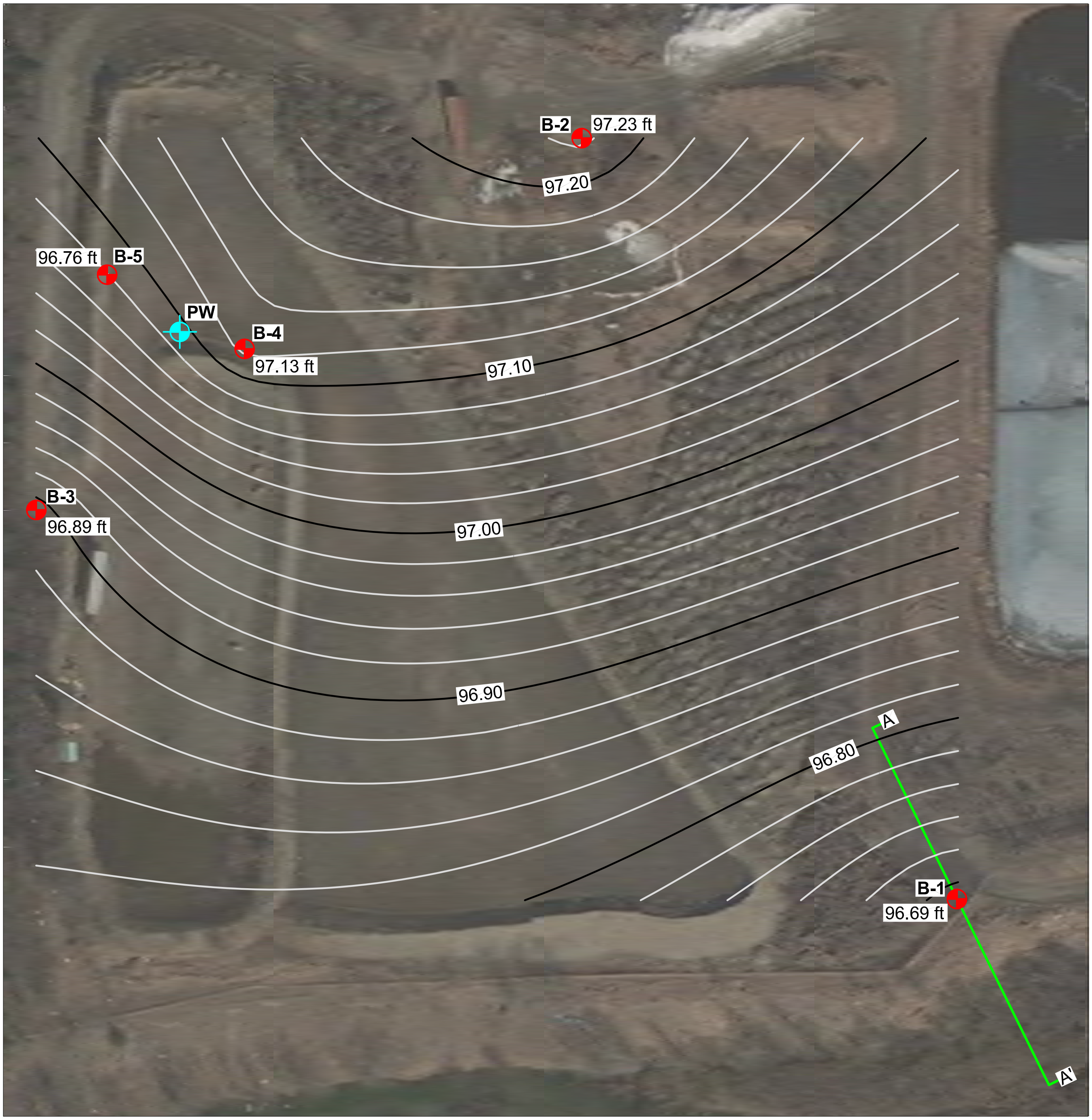
FIG. 2



LEGEND

B-1 Approximate Location of Boring B-1, Advanced by Shannon & Wilson, January 2016

PW Approximate Location of Pumping Well (PW), Advanced by Wheaton Water Well, January 2016

A A' Approximate Location of Slope Profile Used for Slope Stability Analysis

B-1 96.69 ft Static Groundwater Measurement for Boring B-1, Measured on January 22, 2016.

Groundwater Flow Contours. 0.02-foot Interval.

0 50 100 200
APPROXIMATE SCALE IN FEET

N

NOTES

1. Basemap imagery (April 2011) provided by Google Earth Pro, reproduced by permission granted by Google Earth™ Mapping Service.
2. Boring B-5 was not used in estimating the groundwater flow contours.

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GROUNDWATER CONTOUR MAP

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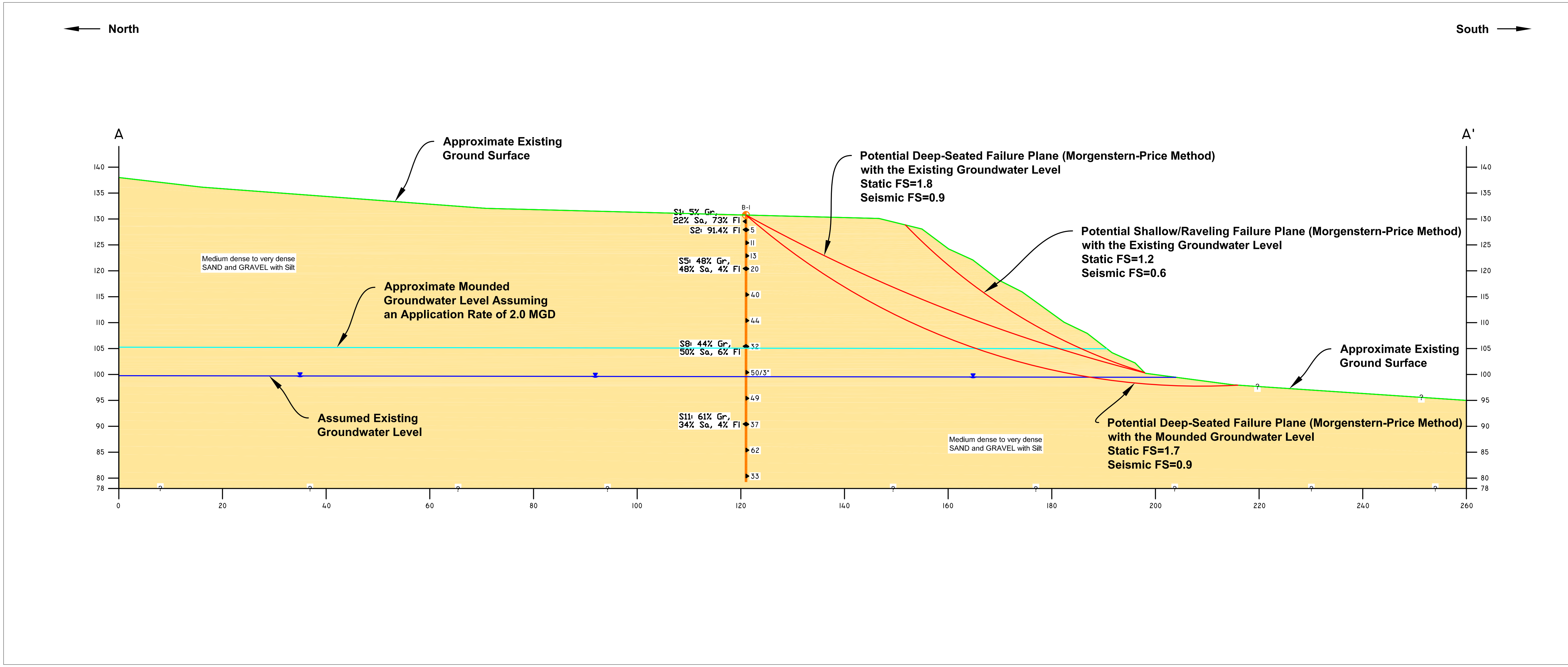
FIG. 3



NOTES

1. Model only includes the existing slope adjacent to the Matanuska River drainage. Does not include potential failures due to erosion of the toe of the slope.
2. See Figure 2 for profile location.
3. Assumed soil properties provided in Section 9.0 of report text.
4. Near surface organics and silts were disregarded to simplify the model. These soils were treated like the soils typically encountered in the deeper portions of our borings.

LEGEND

B-1 — Approximate Location of Boring B-1, Advanced by Shannon & Wilson, January 2016.

S11: 61% Gr, 34% Sa, 4% Fl — Sample S11 laboratory testing results indicating 61 percent gravel, 34 percent sand, and 4 percent fines (silt and clay) by weight.

▶33 — SPT Values (blows per foot at approximate sample depth).

Approximate static water level measured on January 22, 2016.

0 10 20 40
APPROXIMATE SCALE IN FEET

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EXISTING SLOPE MODEL AND GENERAL LAYOUT

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FIG. 4

CHART 1 - WATER LEVELS BEFORE AND DURING TEST

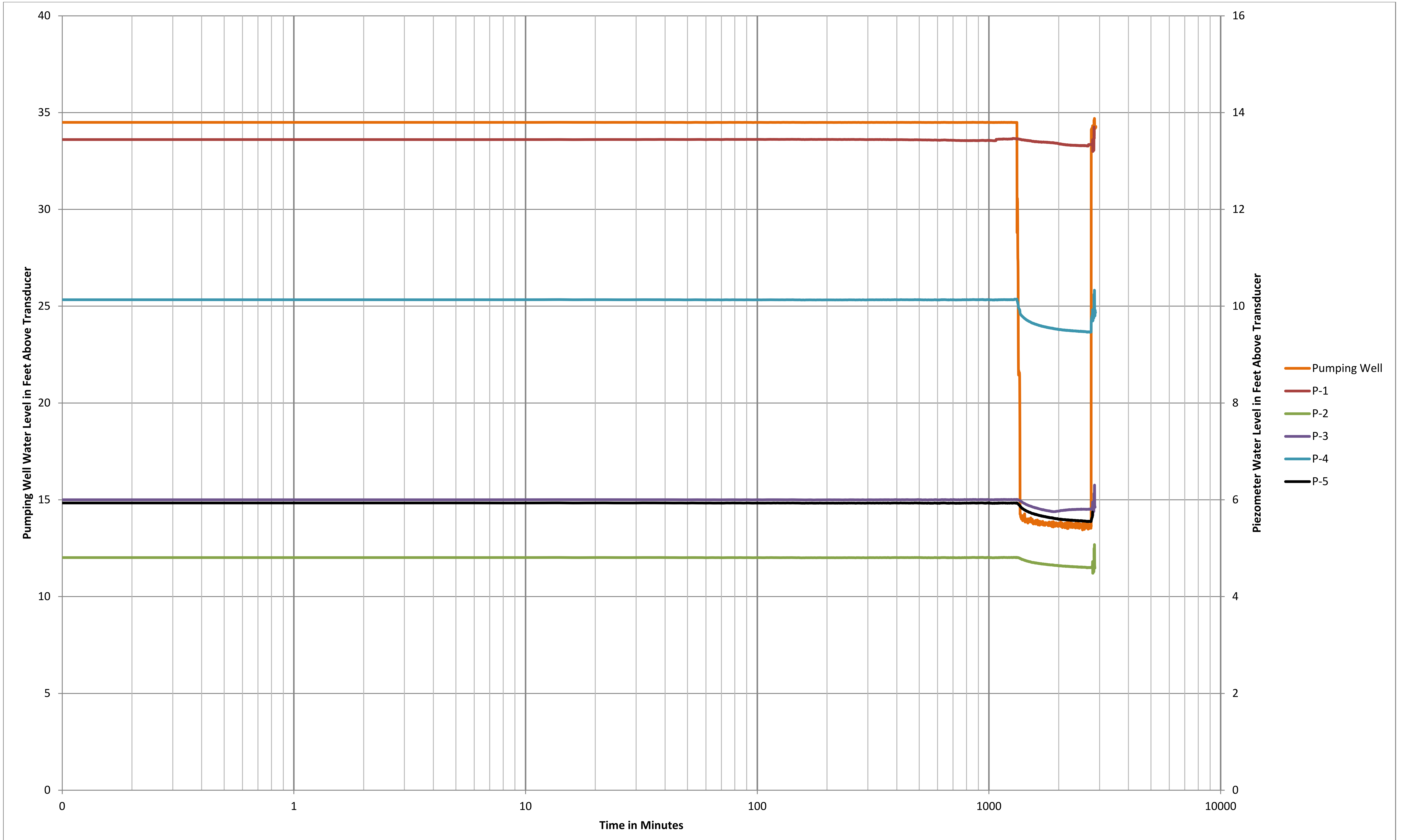
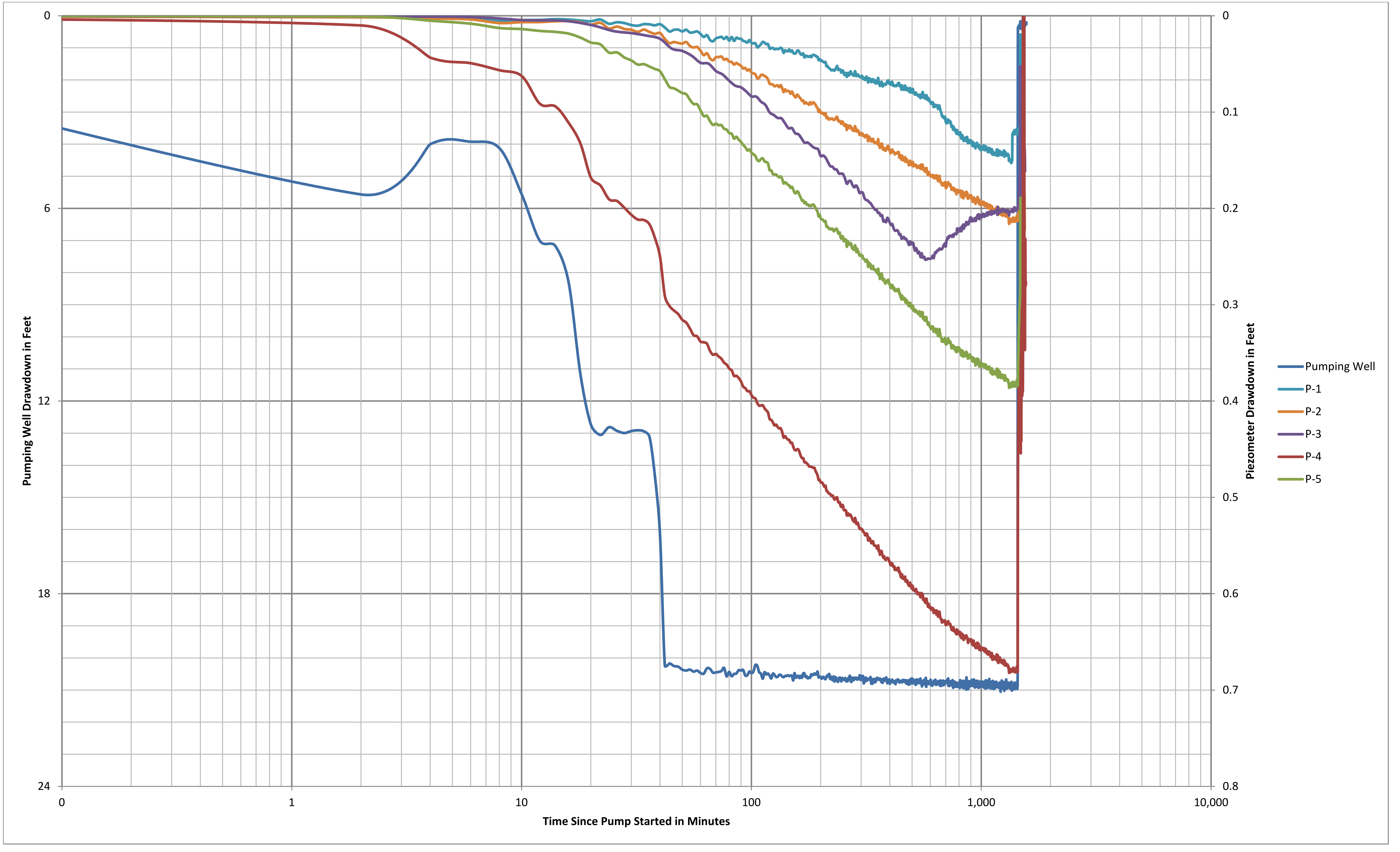


CHART 2 - DRAWDOWN OBSERVED DURING PUMPING TEST



APPENDIX A

SOIL BORINGS AND TEST RESULTS

Shannon & Wilson, Inc. (S&W), uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following pages. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.

S&W INORGANIC SOIL CONSTITUENT DEFINITIONS

CONSTITUENT[2]	FINE-GRAINED SOILS (50% or more fines)[1]	COARSE-GRAINED SOILS (less than 50% fines)[1]
Major	***Silt, Lean Clay, Elastic Silt,*** or ***Fat Clay***[3]	***Sand*** or ***Gravel***[4]
Modifying (Secondary) Precedes major constituent	30% or more coarse-grained: ***Sandy*** or ***Gravelly***[4]	More than 12% fine-grained: ***Silty*** or ***Clayey***[3]
Minor Follows major constituent	15% to 30% coarse-grained: ***with Sand*** or ***with Gravel***[4]	5% to 12% fine-grained: ***with Silt*** or ***with Clay***[3]
	30% or more total coarse-grained *and* lesser coarse-grained constituent is 15% or more: ***with Sand*** or ***with Gravel***[5]	15% or more of a second coarse-grained constituent: ***with Sand*** or ***with Gravel***[5]

[1]All percentages are by weight of total specimen passing a 3-inch sieve.
[2]The order of terms is: *Modifying Major with Minor*.
[3]Determined based on behavior.
[4]Determined based on which constituent comprises a larger percentage.
[5]Whichever is the lesser constituent.

MOISTURE CONTENT TERMS

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

STANDARD PENETRATION TEST (SPT) SPECIFICATIONS

Hammer:	140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diam. cathead 2-1/4 rope turns, > 100 rpm NOTE: If automatic hammers are used, blow counts shown on boring logs should be adjusted to account for efficiency of hammer.
Sampler:	10 to 30 inches long Shoe I.D. = 1.375 inches Barrel I.D. = 1.5 inches Barrel O.D. = 2 inches
N-Value:	Sum blow counts for second and third 6-inch increments. Refusal: 50 blows for 6 inches or less; 10 blows for 0 inches.

NOTE: Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.

PARTICLE SIZE DEFINITIONS

DESCRIPTION	SIEVE NUMBER AND/OR APPROXIMATE SIZE
FINES	< #200 (0.075 mm = 0.003 in.)
SAND	
Fine	#200 to #40 (0.075 to 0.4 mm; 0.003 to 0.02 in.)
Medium	#40 to #10 (0.4 to 2 mm; 0.02 to 0.08 in.)
Coarse	#10 to #4 (2 to 4.75 mm; 0.08 to 0.187 in.)
GRAVEL	
Fine	#4 to 3/4 in. (4.75 to 19 mm; 0.187 to 0.75 in.)
Coarse	3/4 to 3 in. (19 to 76 mm)
COBBLES	3 to 12 in. (76 to 305 mm)
BOULDERS	> 12 in. (305 mm)

RELATIVE DENSITY / CONSISTENCY

COHESIONLESS SOILS		COHESIVE SOILS	
N, SPT, BLOWS/FT.	RELATIVE DENSITY	N, SPT, BLOWS/FT.	RELATIVE CONSISTENCY
< 4	Very loose	< 2	Very soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium dense	4 - 8	Medium stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very dense	15 - 30	Very stiff
		> 30	Hard

WELL AND BACKFILL SYMBOLS

Bentonite Cement Grout	Surface Cement Seal
Bentonite Grout	Asphalt or Cap
Bentonite Chips	Slough
Silica Sand	Inclinometer or Non-perforated Casing
Perforated or Screened Casing	Vibrating Wire Piezometer

PERCENTAGES TERMS [1, 2]

Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

[1]Gravel, sand, and fines estimated by mass. Other constituents, such as organics, cobbles, and boulders, estimated by volume.

[2]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

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SOIL DESCRIPTION AND LOG KEY

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FIG. A-1
Sheet 1 of 3

2013 BORING CLASS1 02475 LOGS.GPJ SWNEW.GDT 2/11/16

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
(Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488)

MAJOR DIVISIONS			GROUP/GRAPHIC SYMBOL	TYPICAL IDENTIFICATIONS
COARSE-GRAINED SOILS *(more than 50% retained on No. 200 sieve)*	Gravels *(more than 50% of coarse fraction retained on No. 4 sieve)*	Gravel *(less than 5% fines)*	GW	Well-Graded Gravel; Well-Graded Gravel with Sand
			GP	Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel *(more than 12% fines)*	GM	Silty Gravel; Silty Gravel with Sand
			GC	Clayey Gravel; Clayey Gravel with Sand
	Sands *(50% or more of coarse fraction passes the No. 4 sieve)*	Sand *(less than 5% fines)*	SW	Well-Graded Sand; Well-Graded Sand with Gravel
			SP	Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand *(more than 12% fines)*	SM	Silty Sand; Silty Sand with Gravel
			SC	Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS *(50% or more passes the No. 200 sieve)*	Silts and Clays *(liquid limit less than 50)*	Inorganic	ML	Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL	Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
		Organic	OL	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
	Silts and Clays *(liquid limit 50 or more)*	Inorganic	MH	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
			CH	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
		Organic	OH	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
HIGHLY-ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat or other highly organic soils (see ASTM D4427)

NOTE: No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

2013 BORING_CLASS2 02475 LOGS.GPJ SWNEW.GDT 2/11/16

NOTES

1. Dual symbols *(symbols separated by a hyphen, i.e., SP-SM, Sand with Silt)* are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart. Graphics shown on the logs for these soil types are a combination of the two graphic symbols (e.g., SP and SM).

2. Borderline symbols *(symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand)* indicate that the soil properties are close to the defining boundary between two groups.

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SOIL DESCRIPTION AND LOG KEY

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FIG. A-1
Sheet 2 of 3

GRADATION TERMS

Poorly Graded	Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested.
Well-Graded	Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested.

CEMENTATION TERMS[1]

Weak	Crumbles or breaks with handling or slight finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

PLASTICITY[2]

DESCRIPTION	VISUAL-MANUAL CRITERIA	APPROX. PLASITICTY INDEX RANGE
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.	< 4
Low	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.	4 to 10
Medium	A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.	10 to 20
High	It take considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.	> 20

ADDITIONAL TERMS

Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

PARTICLE ANGULARITY AND SHAPE TERMS[1]

Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width/thickness ratio > 3.
Elongated	Length/width ratio > 3.

[1]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.
[2]Adapted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

ACRONYMS AND ABBREVIATIONS

ATD	At Time of Drilling
Diam.	Diameter
Elev.	Elevation
ft.	Feet
FeO	Iron Oxide
gal.	Gallons
Horiz.	Horizontal
HSA	Hollow Stem Auger
I.D.	Inside Diameter
in.	Inches
lbs.	Pounds
MgO	Magnesium Oxide
mm	Millimeter
MnO	Manganese Oxide
NA	Not Applicable or Not Available
NP	Nonplastic
O.D.	Outside Diameter
OW	Observation Well
pcf	Pounds per Cubic Foot
PID	Photo-Ionization Detector
PMT	Pressuremeter Test
ppm	Parts per Million
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
rpm	Rotations per Minute
SPT	Standard Penetration Test
USCS	Unified Soil Classification System
q_u	Unconfined Compressive Strength
VWP	Vibrating Wire Piezometer
Vert.	Vertical
WOH	Weight of Hammer
WOR	Weight of Rods
Wt.	Weight

STRUCTURE TERMS[1]

Interbedded	Alternating layers of varying material or color with layers at least 1/4-inch thick; singular: bed.
Laminated	Alternating layers of varying material or color with layers less than 1/4-inch thick; singular: lamination.
Fissured	Breaks along definite planes or fractures with little resistance.
Slickensided	Fracture planes appear polished or glossy; sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

Palmer Waste Water Treatment Plant
Facility Plan Update
Palmer, Alaska

SOIL DESCRIPTION AND LOG KEY

February 2016 32-1-02475-002

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FIG. A-1
Sheet 3 of 3

2013_BORING_CLASS3 02475 LOGS.GPJ SWNEW.GDT 2/11/16

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FROST CLASSIFICATION

(after Municipality of Anchorage, 2007)

GROUP		0.02 Mil.	P-200*	USC SYSTEM (based on P-200 results)
NFS	Sandy Soils	0 to 3	0 to 6	SW, SP, SW-SM, SP-SM
	Gravelly Soils	0 to 3	0 to 6	GW, GP, GW-GM, GP-GM
F1	Gravelly Soils	3 to 10	6 to 13	GM, GW-GM, GP-GM
F2	Sandy Soils	3 to 15	6 to 19	SP-SM, SW-SM, SM
	Gravelly Soils	10 to 20	13 to 25	GM
F3	Sands, except very fine silty sands**	Over 15	Over 19	SM, SC
	Gravelly Soils	Over 20	Over 25	GM, GC
	Clays, PI>12			CL, CH
F4	All Silts			ML, MH
	Very fine silty sands**	Over 15	Over 19	SM, SC
	Clays, PI<12			CL, CL-ML
	Varved clays and other fined grained, banded sediments			CL and ML CL, ML, and SM; SL, SH, and ML; CL, CH, ML, and SM

PI = Plasticity Index
P-200 = Percent passing the number 200 sieve
0.02 Mil. = Percent material below 0.02 millimeter grain size

*Approximate P-200 value equivalent for frost classification.
Value range based on typical, well-graded soil curves.

** Very fine sand : greater than 50% of sand fraction passing the number 100 sieve

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FROST CLASSIFICATION LEGEND

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FIG. A-2

MATERIAL DESCRIPTION	Depth, Ft.
Approx. Elevation: 128.089 Ft.	
S1: 5% Gravel, 22% Sand, 73% Fines (F4 (P200)) Frozen, brown, Silt with Sand (ML); moist; trace organics [FILL]	2.0
Loose, brown Silt (ML); moist; trace organics S2: 91.4% Fines (F4 (P200))	5.7
Medium dense, brown, Silty Sand (SM); moist	9.5
Medium dense to dense, brown, Well-Graded Sand with Gravel (SW); moist S5: 48% Gravel, 48% Sand, 4% Fines (NFS (P200))	23.0
Dense to very dense, brown, Poorly Graded Sand with Silt and Gravel (SP-SM); moist S8: 44% Gravel, 50% Sand, 6% Fines (NFS (P200))	33.0
Dense to very dense, brown, Well-Graded Gravel with Sand (GW); moist to wet	

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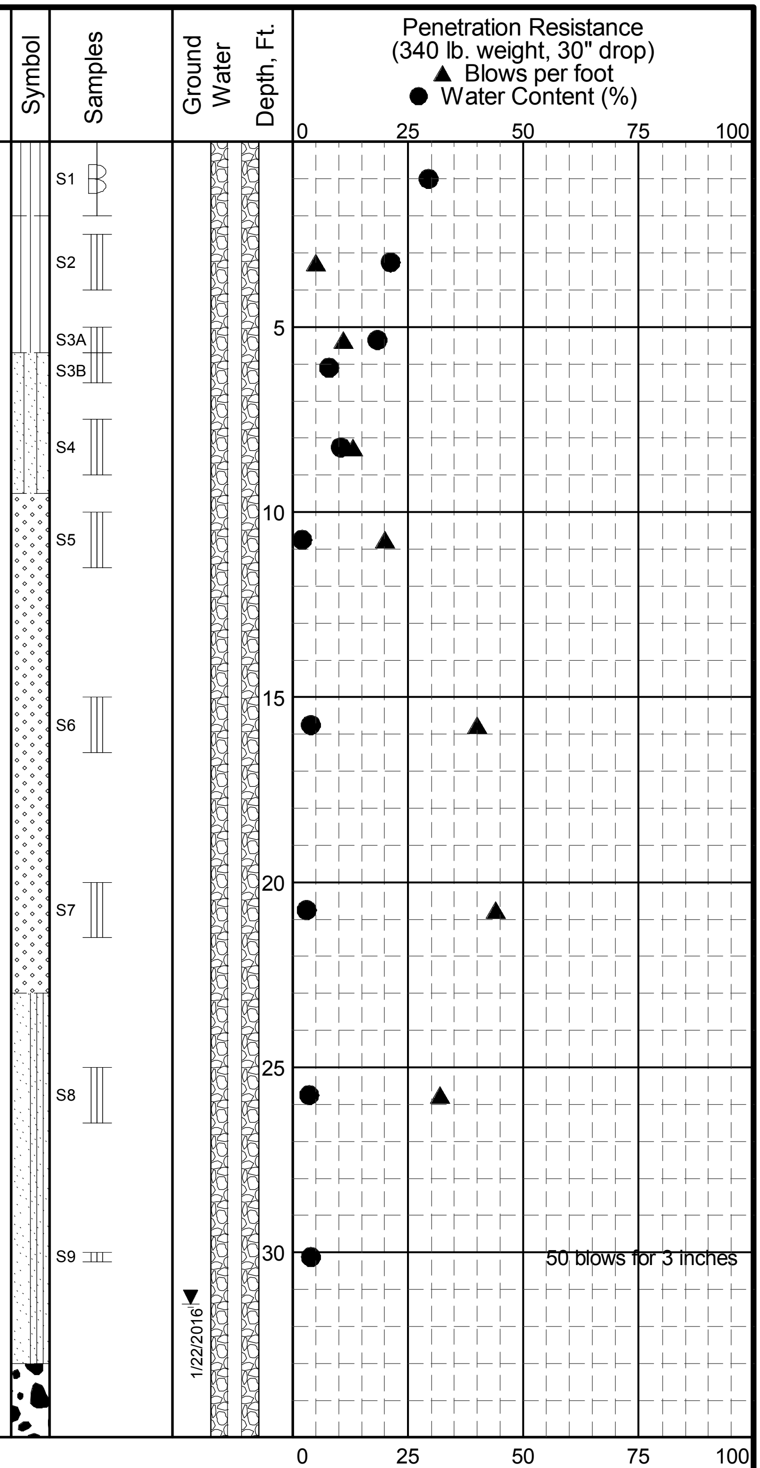

LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Static Water Level
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

Palmer Waste Water Treatment Plant
Facility Plan Update
Palmer, Alaska

LOG OF BORING B-1

February 2016 32-1-02475-002

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FIG. A-3
Sheet 1 of 2

REV 3 - Approved for Submittal

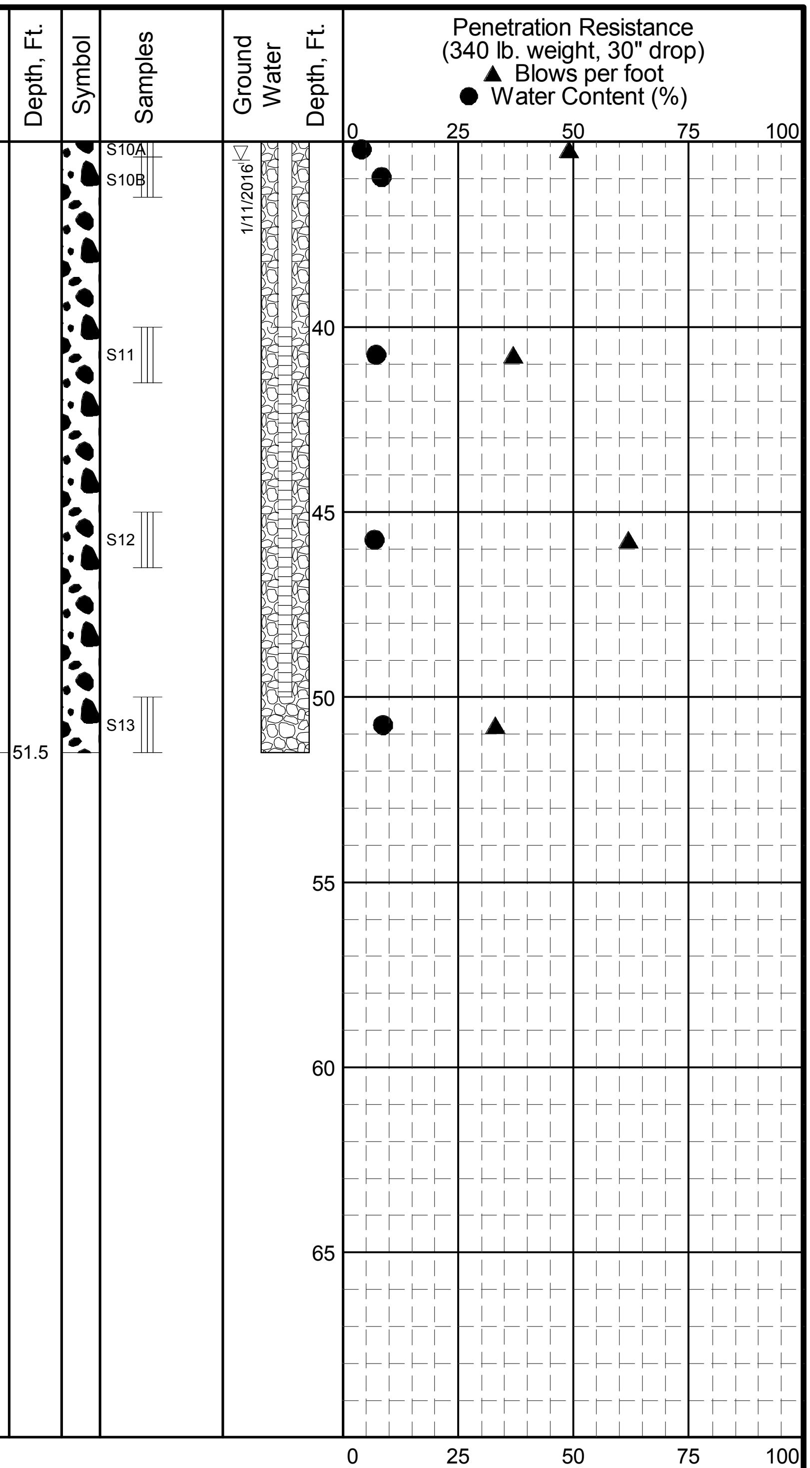
MATERIAL DESCRIPTION

Approx. Elevation: 128.089 Ft.

Dense to very dense, brown, Well-Graded Gravel with Sand (GW); moist to wet

S11: 61% Gravel, 34% Sand, 4% Fines (NFS (P200))

Bottom of Boring
Boring Completed 1/11/2016



LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Static Water Level
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-1

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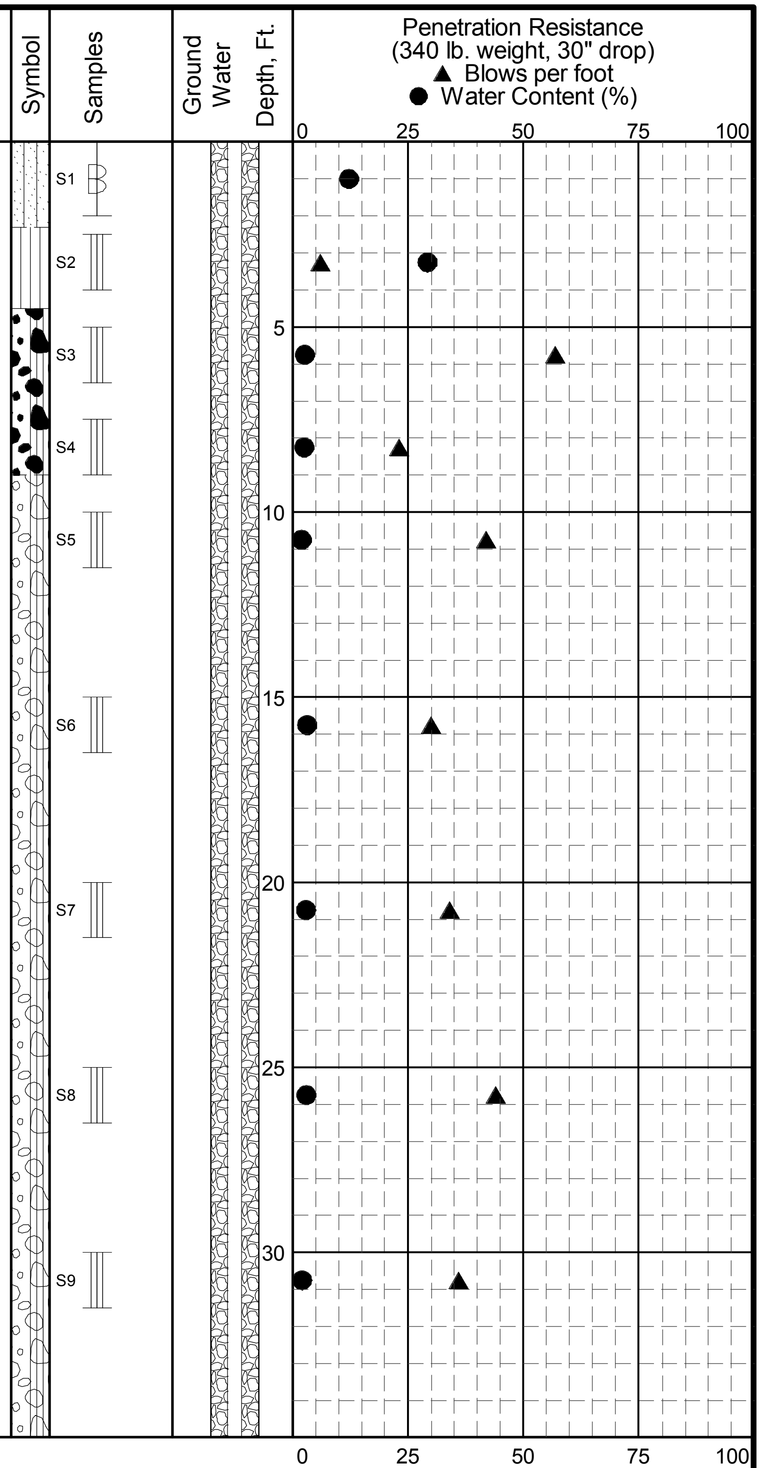
FIG. A-3
Sheet 2 of 2

GEOTECHNICAL LOG 02475 LOGS.GPJ S&W GEO1.GDT 2/17/16

REV 3 - Approved for Submittal

MATERIAL DESCRIPTION	Depth, Ft.
Approx. Elevation: 148.695 Ft.	
S1: 13% Gravel, 58% Sand, 29% Fines (F3 (P200))	
Frozen to loose, brown, Silty Sand (SM); moist; trace organics	2.3
S2: 78.2% Fines (F4 (P200))	
Frozen to loose, brown, Sandy Silt (ML); moist; trace organics	4.5
Medium dense to very dense, brown, Well-Graded Gravel with Silt and Sand (GW-GM); moist	
S4: 54% Gravel, 38% Sand, 8% Fines (F1 (P200))	9.0
Dense to very dense, brown, Poorly Graded Gravel with Silt and Sand (GP-GM); moist	



CONTINUED NEXT PAGE

LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Static Water Level
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-2

February 2016 32-1-02475-002

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FIG. A-4
Sheet 1 of 2

MATERIAL DESCRIPTION

Approx. Elevation: 148.695 Ft.

Dense to very dense, brown, Poorly Graded Gravel with Silt and Sand (GP-GM); moist

S11: 55% Gravel, 40% Sand, 6% Fines (NFS (P200))

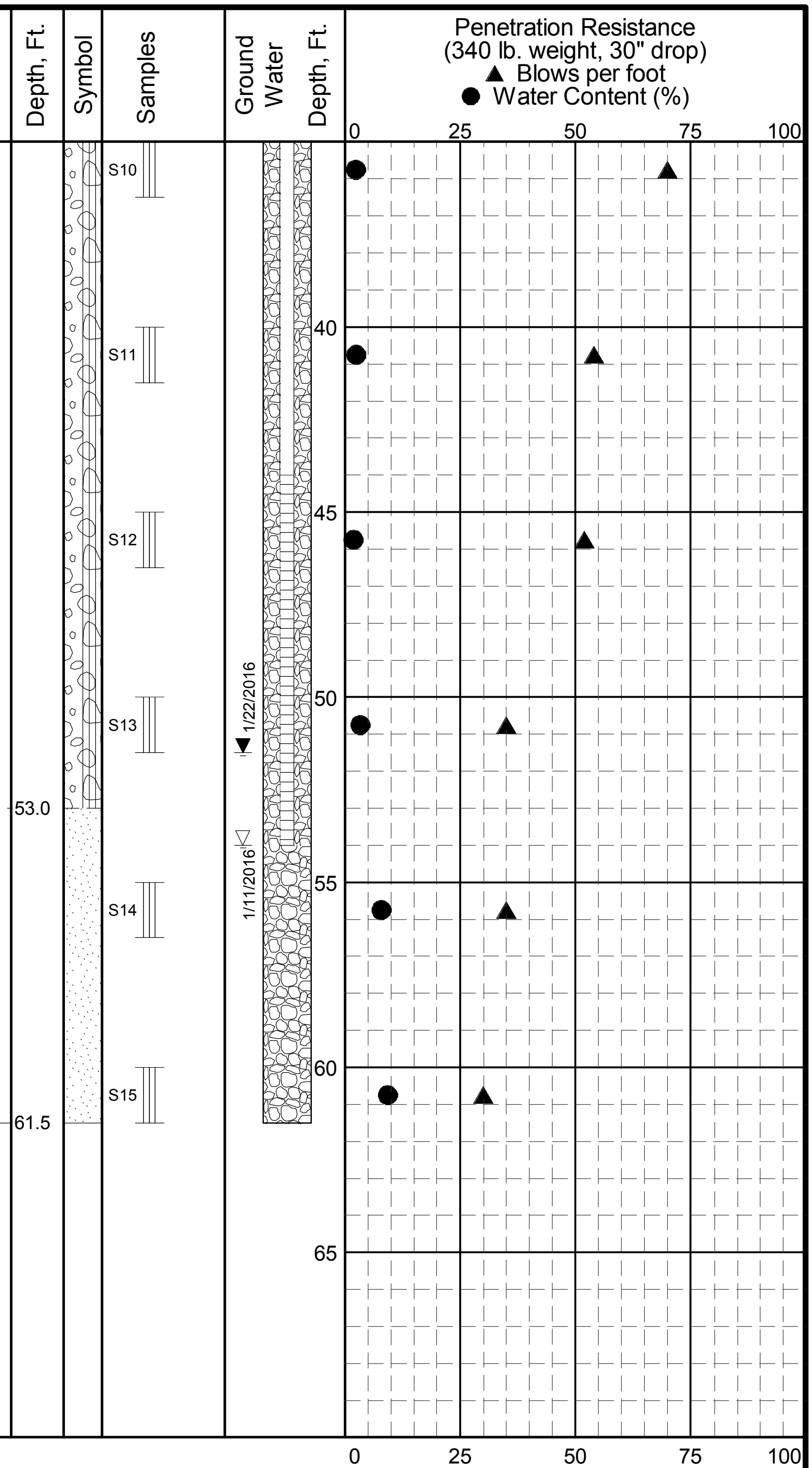
53.0

Dense, brown, Poorly Graded Sand with Gravel (SP); moist to wet

S15: 46% Gravel, 51% Sand, 4% Fines (NFS (P200))

61.5

Bottom of Boring
Boring Completed 1/11/2016



LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Static Water Level
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-2

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FIG. A-4
Sheet 2 of 2

GEOTECHNICAL LOG 02475 LOGS.GPJ S&W_GEO1.GDT 2/17/16

REV 3 - Approved for Submittal

MATERIAL DESCRIPTION	Depth, Ft.
Approx. Elevation: 147.979 Ft.	
S1: 22% Gravel, 42% Sand, 36% Fines (F3 (P200)) Frozen, brown, Silty Sand with Gravel (SM); moist; trace organics [FILL]	2.0
S2A: 55.2% Fines (F4 (P200)) Loose, brown, Sandy Silt (ML); moist; trace organics	2.8
Medium dense to dense, brown, Poorly Graded Gravel with Silt and Sand (GP-GM); moist; trace organics in upper 2 feet	18.0
Dense to very dense, brown, Well-Graded Gravel with Silt and Sand to Well-Graded Gravel with Sand (GW-GM/GW); moist S7: 58% Gravel, 36% Sand, 6% Fines (F1 (P200))	

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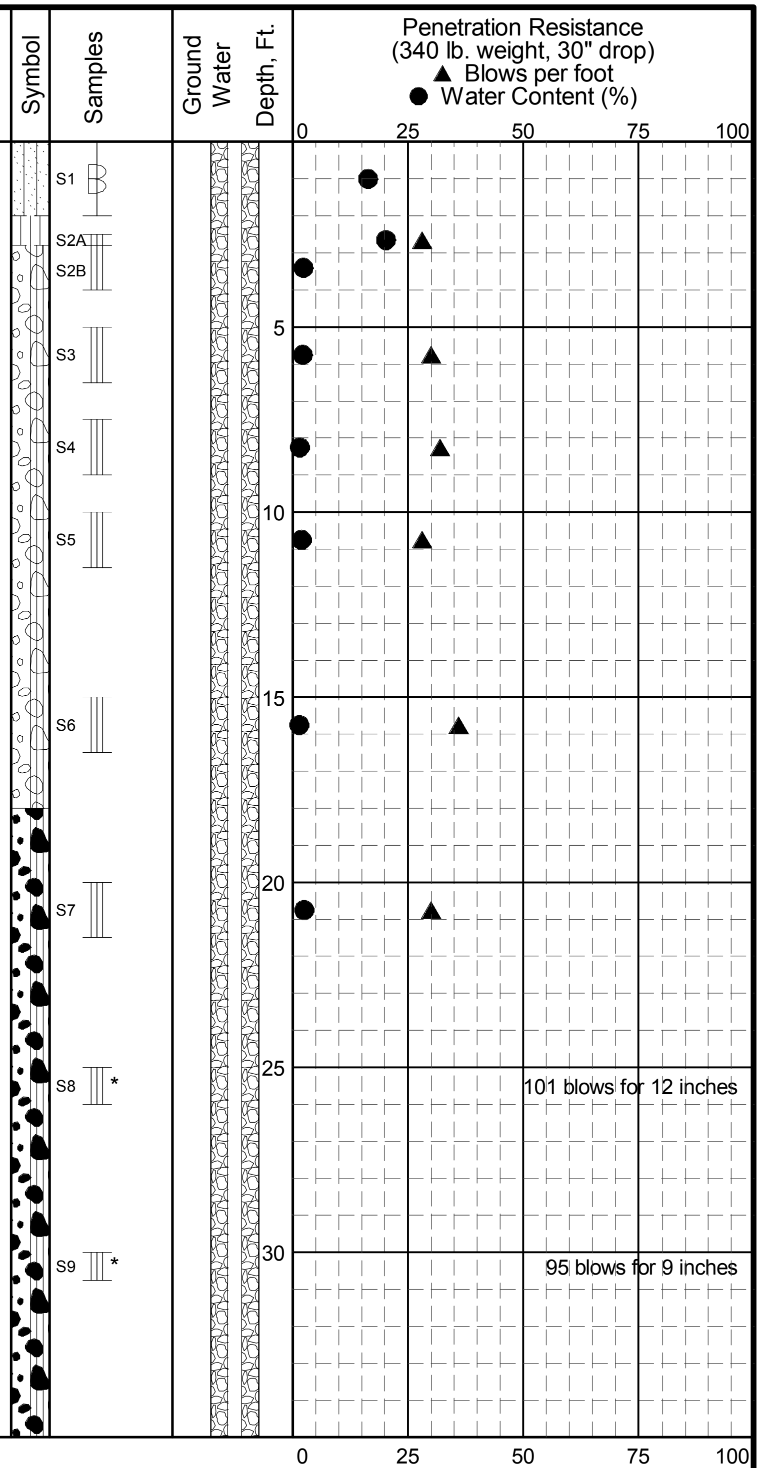

LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Static Water Level
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-3

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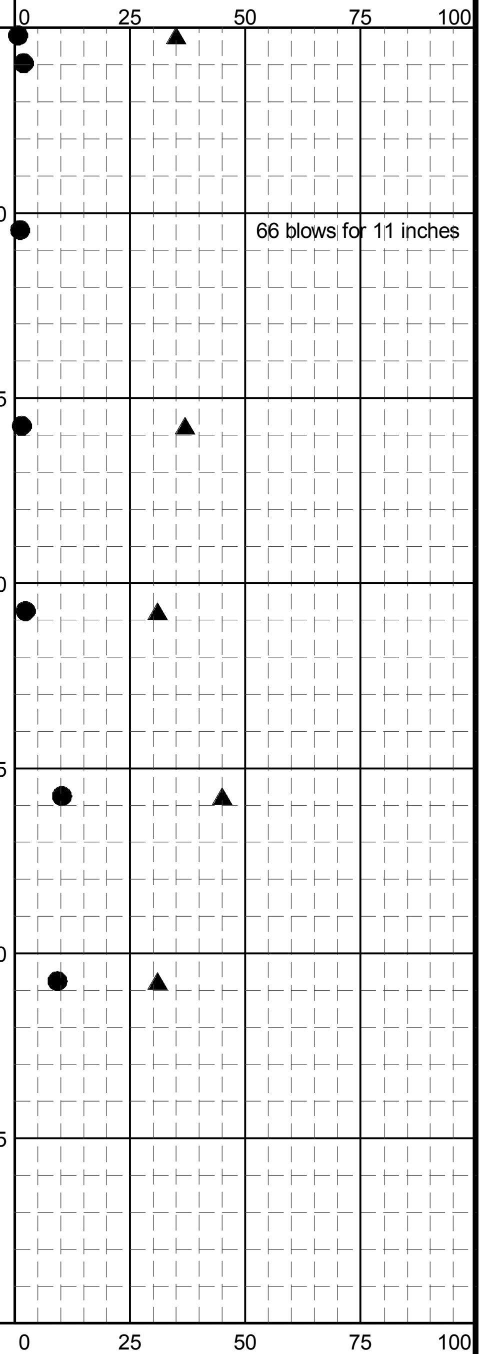
FIG. A-5
Sheet 1 of 2

GEOTECHNICAL LOG 02475 LOGS.GPJ S&W_GEO1.GDT 2/17/16

REV 3 - Approved for Submittal

MATERIAL DESCRIPTION Approx. Elevation: 147.979 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.	Penetration Resistance (340 lb. weight, 30" drop) ▲ Blows per foot ● Water Content (%)
Dense to very dense, brown, Well-Graded Gravel with Silt and Sand to Well-Graded Gravel with Sand (GW-GM/GW); moist			S10A, S10B			
			S11		40	66 blows for 11 inches
S12: 62% Gravel, 35% Sand, 3% Fines (NFS (P200))			S12		45	
Dense, brown, Poorly Graded Sand with Gravel (SP); moist to wet	48.0					
			S13	▼ 1/22/2016	50	
				▽ 1/12/2016		
S14: 29% Gravel, 66% Sand, 5% Fines (NFS (P200))			S14		55	
			S15		60	
Bottom of Boring Boring Completed 1/12/2016	61.5				65	



LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample
- Frozen
- ▽ Ground Water Level At Time Of Drilling
- ▼ Static Water Level
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

● Water Content (%)

Plastic Limit |—●—| Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-3

February 2016 32-1-02475-002

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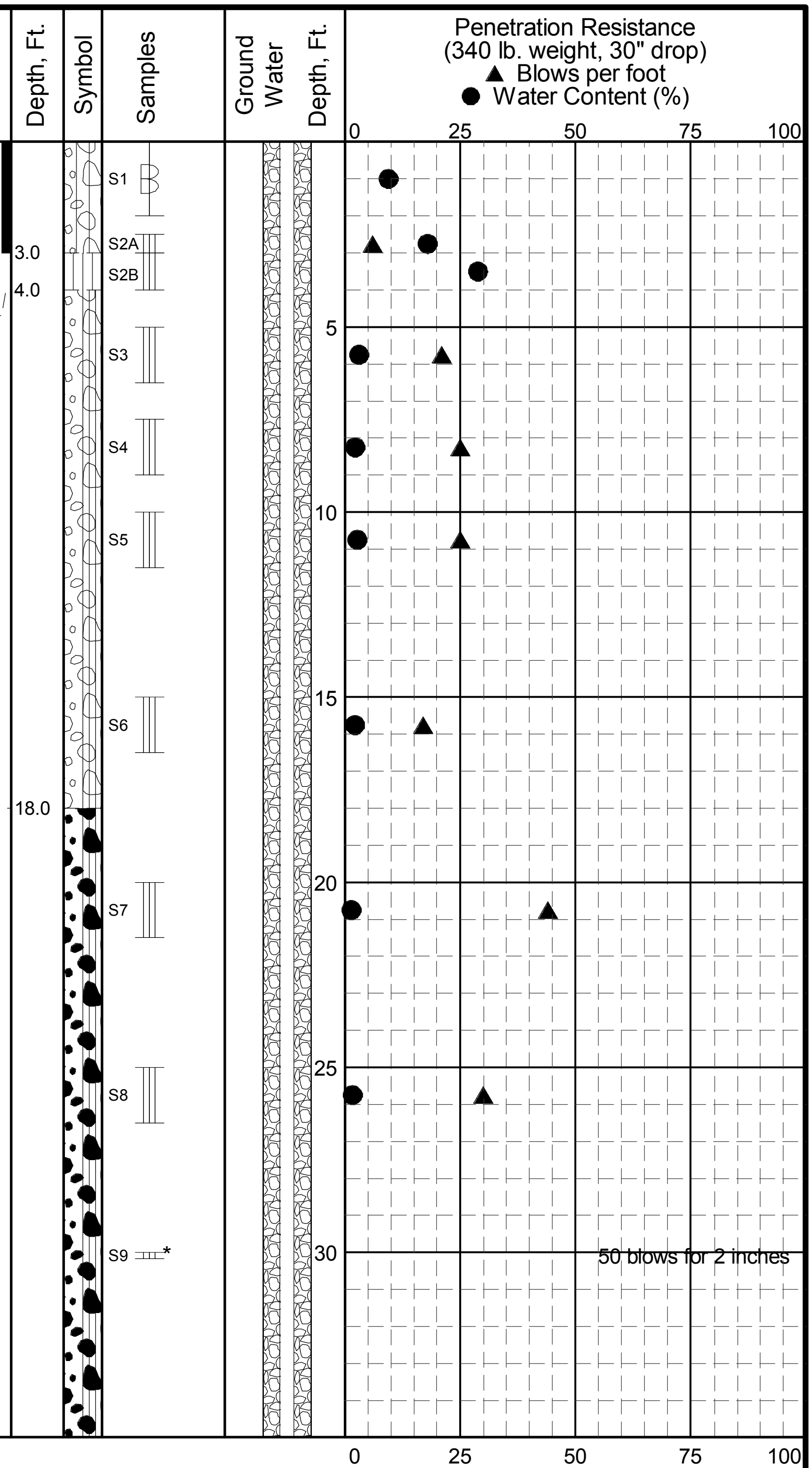
FIG. A-5
Sheet 2 of 2

GEOTECHNICAL LOG 02475 LOGS.GPJ S&W_GEO1.GDT 2/17/16

REV 3 - Approved for Submittal

MATERIAL DESCRIPTION	Depth, Ft.
Approx. Elevation: 150.506 Ft.	
S1: 39% Gravel, 35% Sand, 26% Fines (F3 (P200)) Frozen, brown, Silty Gravel with Sand (GM); moist; trace organics	3.0
S2B: 87.9% Fines (F4 (P200)) Loose, brown Silt (ML); moist; trace organics	4.0
Medium dense to dense, brown, Poorly Graded Gravel with Silt and Sand (GP-GM); moist	18.0
Medium dense to very dense, brown, Well-Graded Gravel with Silt and Sand (GW-GM); moist S7: 59% Gravel, 33% Sand, 8% Fines (F1 (P200))	



CONTINUED NEXT PAGE

LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Static Water Level
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-4

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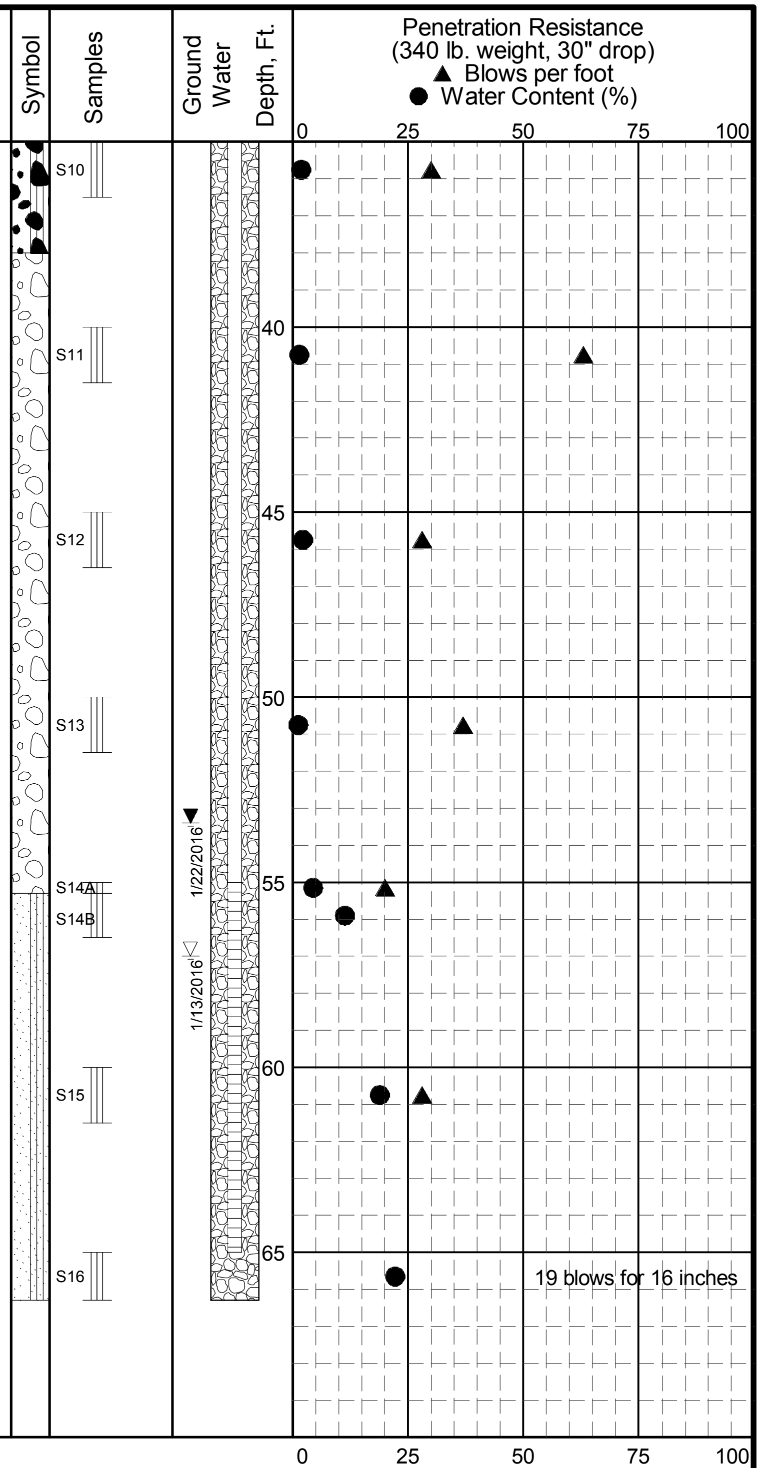
FIG. A-6
Sheet 1 of 2

REV 3 - Approved for Submittal

MATERIAL DESCRIPTION	Depth, Ft.
Approx. Elevation: 150.506 Ft.	
Medium dense to very dense, brown, Well-Graded Gravel with Silt and Sand (GW-GM); moist	
Medium dense to very dense, brown, Poorly Graded Gravel with Sand (GP); moist	38.0
S13: 54% Gravel, 43% Sand, 3% Fines (NFS (P200))	
Medium dense, brown, Poorly Graded Sand with Silt (SP-SM); moist to wet	55.3
S15: 3% Gravel, 90% Sand, 8% Fines (F2 (P200))	
S16: Stopped sampler early to prevent overfilling sampler.	66.3
Bottom of Boring Boring Completed 1/13/2016	



LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Static Water Level
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

Palmer Waste Water Treatment Plant
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LOG OF BORING B-4

February 2016 32-1-02475-002

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FIG. A-6
Sheet 2 of 2

MATERIAL DESCRIPTION	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.	Penetration Resistance (340 lb. weight, 30" drop) ▲ Blows per foot ● Water Content (%)

Approx. Elevation: 150.462 Ft.

Frozen to loose, brown Silt (ML); moist; trace organics [FILL]

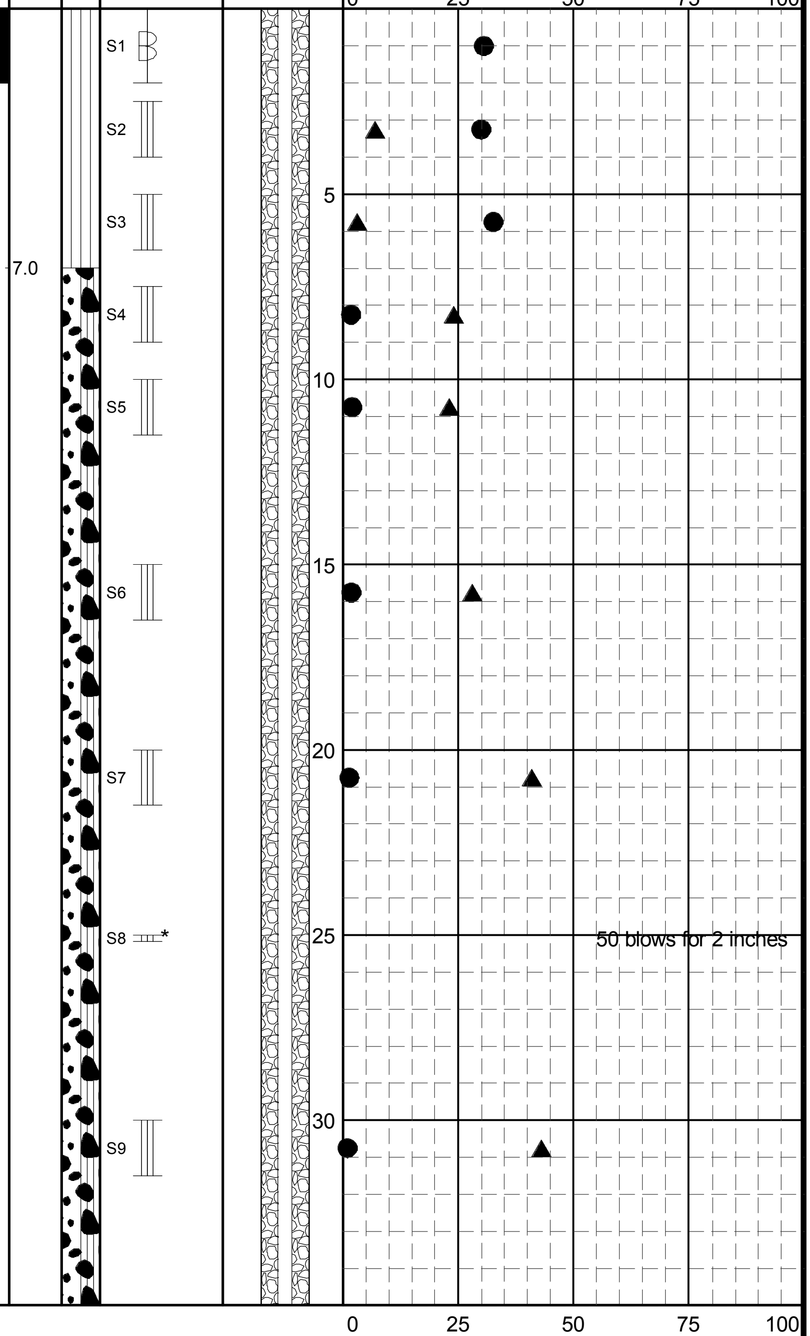
S2: 0% Gravel, 12% Sand, 88% Fines (F4 (P200))

S3: 89.1% Fines (F4 (P200))

7.0

Medium dense to very dense, brown, Well to Poorly Graded Gravel with Silt and Sand (GW-GM/GP-GM); moist

S5: 60% Gravel, 35% Sand, 5% Fines (NFS (P200))



CONTINUED NEXT PAGE

LEGEND

- * Sample Not Recovered
- 3" O.D. Split Spoon Sample
- Grab Sample
- Frozen
- Ground Water Level At Time Of Drilling
- Static Water Level
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill

● Water Content (%)

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-5

February 2016 32-1-02475-002

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FIG. A-7
Sheet 1 of 2

GEOTECHNICAL LOG 02475 LOGS.GPJ S&W GEO1.GDT 2/17/16

REV 3 - Approved for Submittal

MATERIAL DESCRIPTION

Approx. Elevation: 150.462 Ft.

S10: 53% Gravel, 40% Sand, 7% Fines (F1 (P200))

Medium dense to very dense, brown, Well to Poorly Graded Gravel with Silt and Sand (GW-GM/GP-GM); moist

47.0

Dense, brown, Poorly Graded Sand (SP); moist

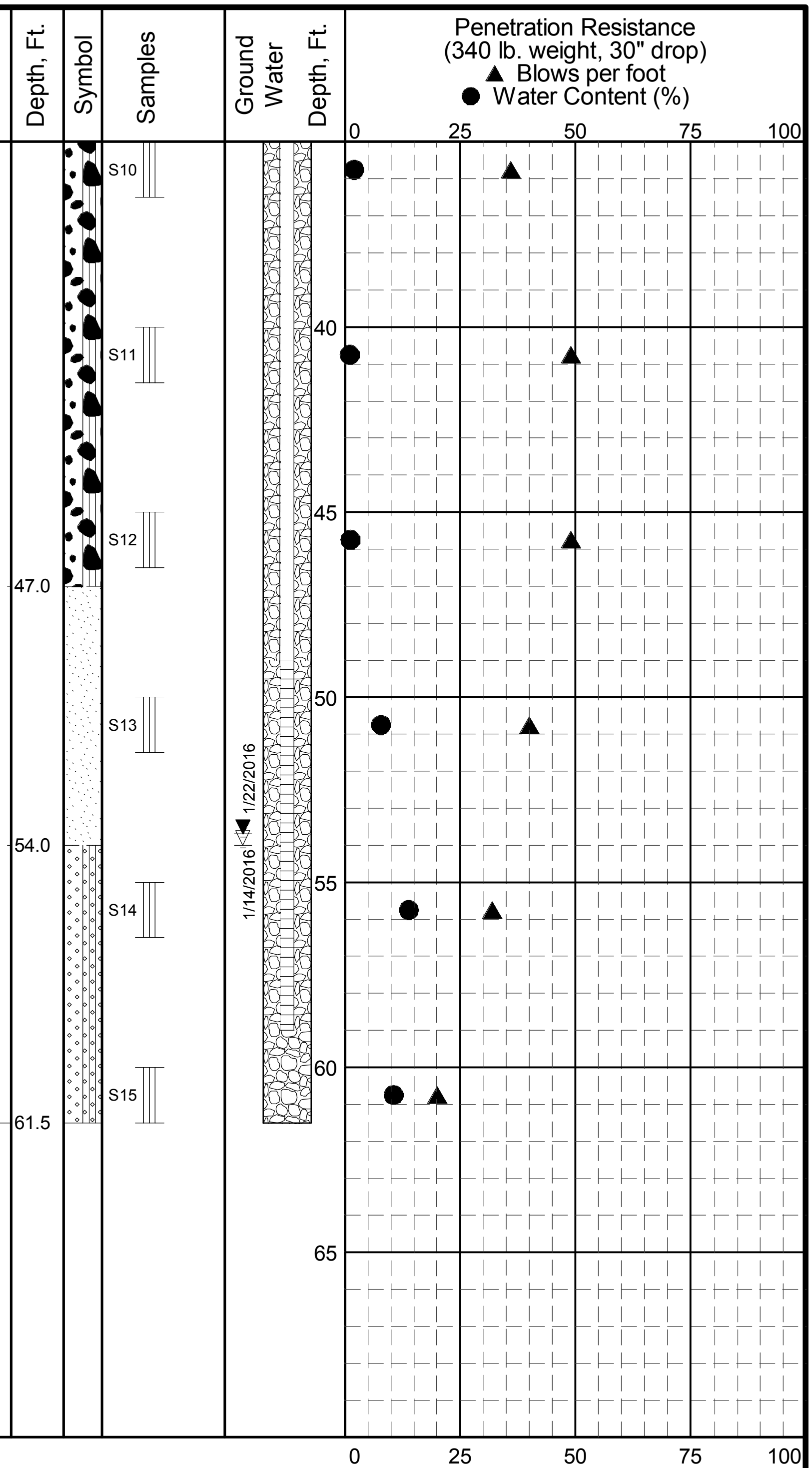
54.0

Medium dense to dense, gray, Well-Graded Sand with Silt and Gravel (SW-SM); wet

S14: 15% Gravel, 76% Sand, 9% Fines (F2 (P200))

61.5

Bottom of Boring
Boring Completed 1/14/2016



LEGEND

* Sample Not Recovered	Ground Water Level At Time Of Drilling
3" O.D. Split Spoon Sample	Static Water Level
Grab Sample	Blank Section, Cuttings Backfill
Frozen	Slotted Section, Cuttings Backfill

● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-5

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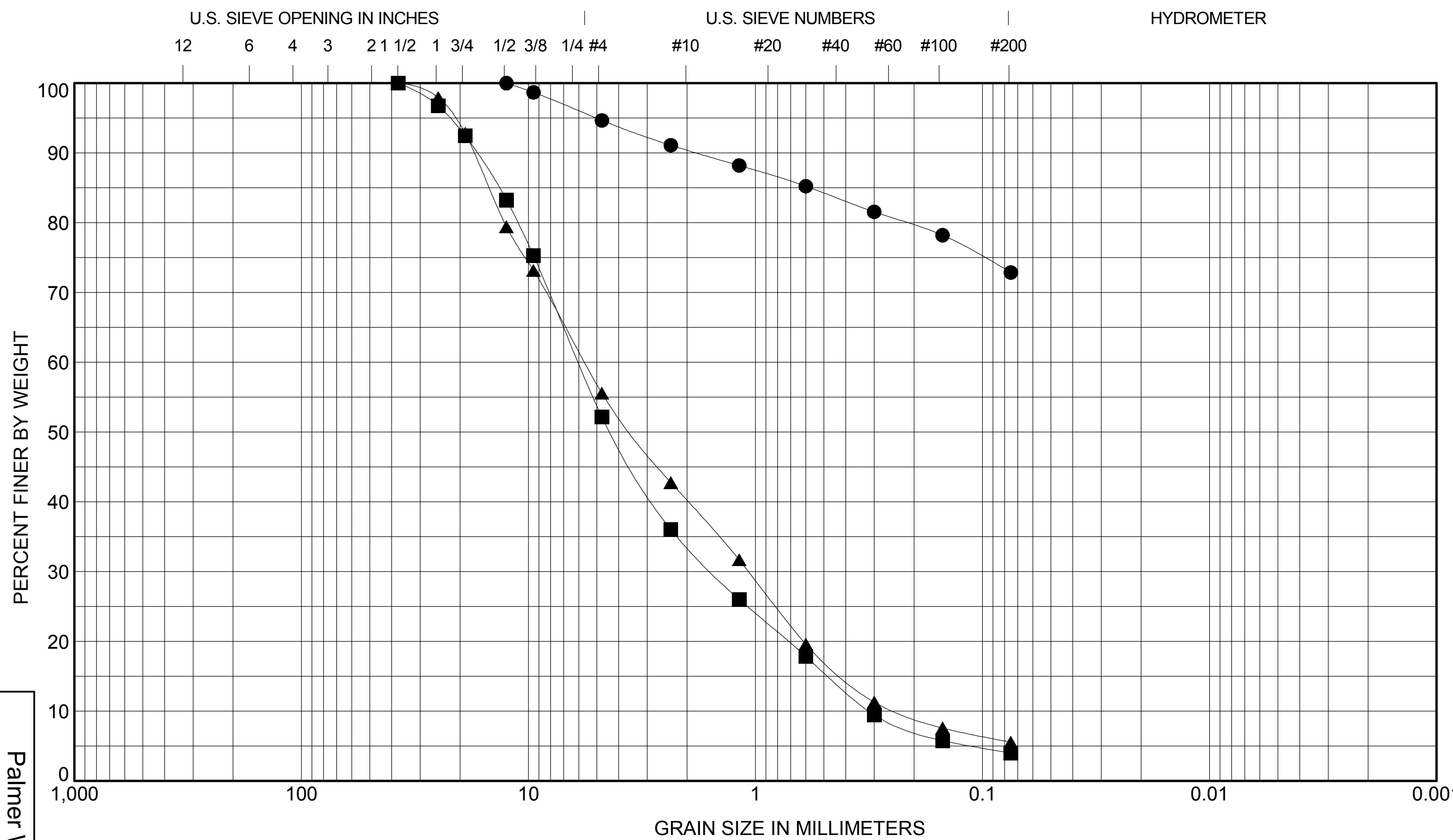
FIG. A-7
Sheet 2 of 2

GEOTECHNICAL LOG 02475 LOGS.GPJ S&W GEO1.GDT 2/17/16

REV 3 - Approved for Submittal



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-1 S1**	**0.0 - 2.0**	**Silt with Sand (ML)**					
■	**B-1 S5**	**10.0 - 11.5**	**Well-Graded Sand with Gravel (SW)**				**1.3**	**19.1**
▲	**B-1 S8**	**25.0 - 26.5**	**Poorly Graded Sand with Silt and Gravel (SP-SM)**				**0.9**	**24.0**

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt / %Clay
●	**B-1 S1**	**0.0 - 2.0**	**12.5**				**5**	**22**	**73**
■	**B-1 S5**	**10.0 - 11.5**	**37.5**	**6.01**	**1.55**	**0.31**	**48**	**48**	**4**
▲	**B-1 S8**	**25.0 - 26.5**	**37.5**	**5.66**	**1.07**	**0.24**	**44**	**50**	**6**

Palmer Waste Water Treatment Plant
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GRAIN SIZE CLASSIFICATION

February 2016

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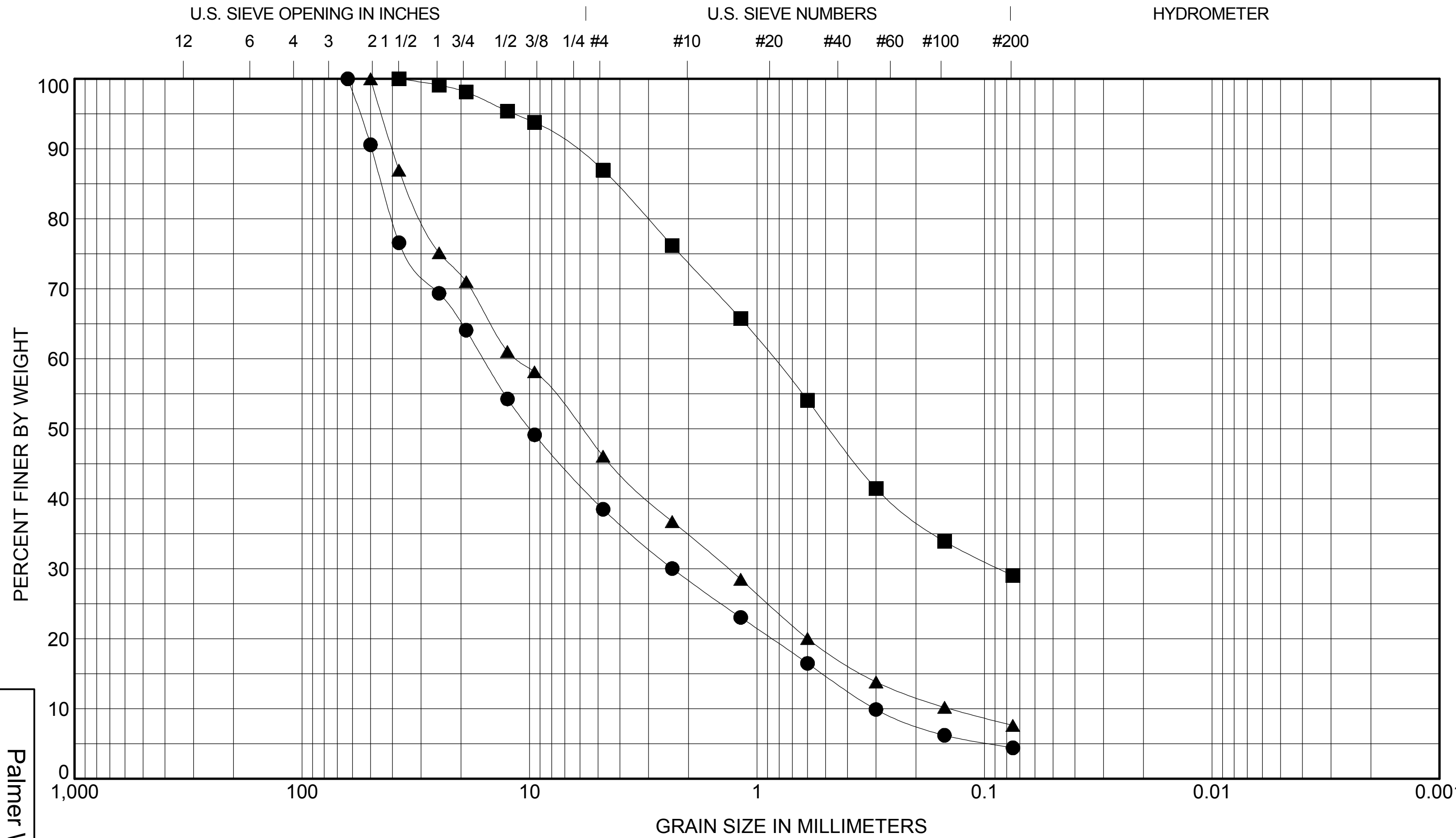
FIG. A-8
Sheet 1 of 7



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-1 S11**	**40.0 - 41.5**	**Well-Graded Gravel with Sand (GW)**				**1.1**	**52.6**
■	**B-2 S1**	**0.0 - 2.0**	**Silty Sand (SM)**					
▲	**B-2 S4**	**7.5 - 9.0**	**Well-Graded Gravel with Silt and Sand (GW-GM)**				**1.1**	**79.6**

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt / %Clay
●	**B-1 S11**	**40.0 - 41.5**	**63**	**15.96**	**2.35**	**0.3**	**61**	**34**	**4**
■	**B-2 S1**	**0.0 - 2.0**	**37.5**	**0.85**	**0.09**		**13**	**58**	**29**
▲	**B-2 S4**	**7.5 - 9.0**	**50**	**11.33**	**1.34**	**0.14**	**54**	**38**	**8**

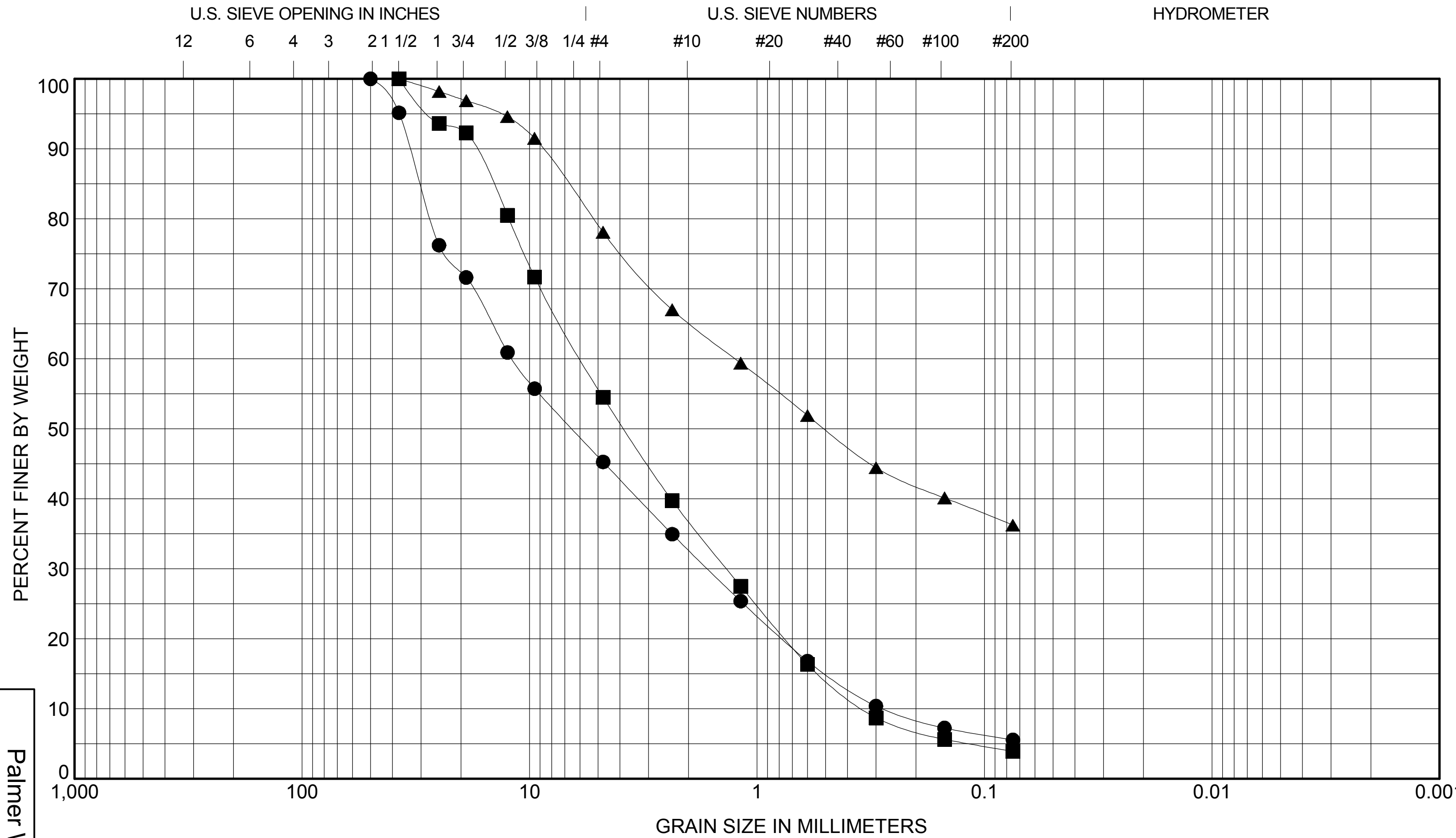
Palmer Waste Water Treatment Plant
Facility Plan Update
Palmer, Alaska

GRAIN SIZE CLASSIFICATION

February 2016 32-1-02475-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-8
Sheet 2 of 7



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-2 S11**	**40.0 - 41.5**	**Poorly Graded Gravel with Silt and Sand (GP-GM)**				**0.8**	**43.2**
■	**B-2 S15**	**60.0 - 61.5**	**Poorly Graded Sand with Gravel (SP)**				**0.9**	**17.6**
▲	**B-3 S1**	**0.0 - 2.0**	**Silty Sand with Gravel (SM)**					

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-2 S11**	**40.0 - 41.5**	**50**	**11.91**	**1.65**	**0.28**	**55**	**40**	**6**	
■	**B-2 S15**	**60.0 - 61.5**	**37.5**	**5.93**	**1.36**	**0.34**	**46**	**51**	**4**	
▲	**B-3 S1**	**0.0 - 2.0**	**37.5**	**1.25**			**22**	**42**	**36**	

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SHANNON & WILSON, INC.
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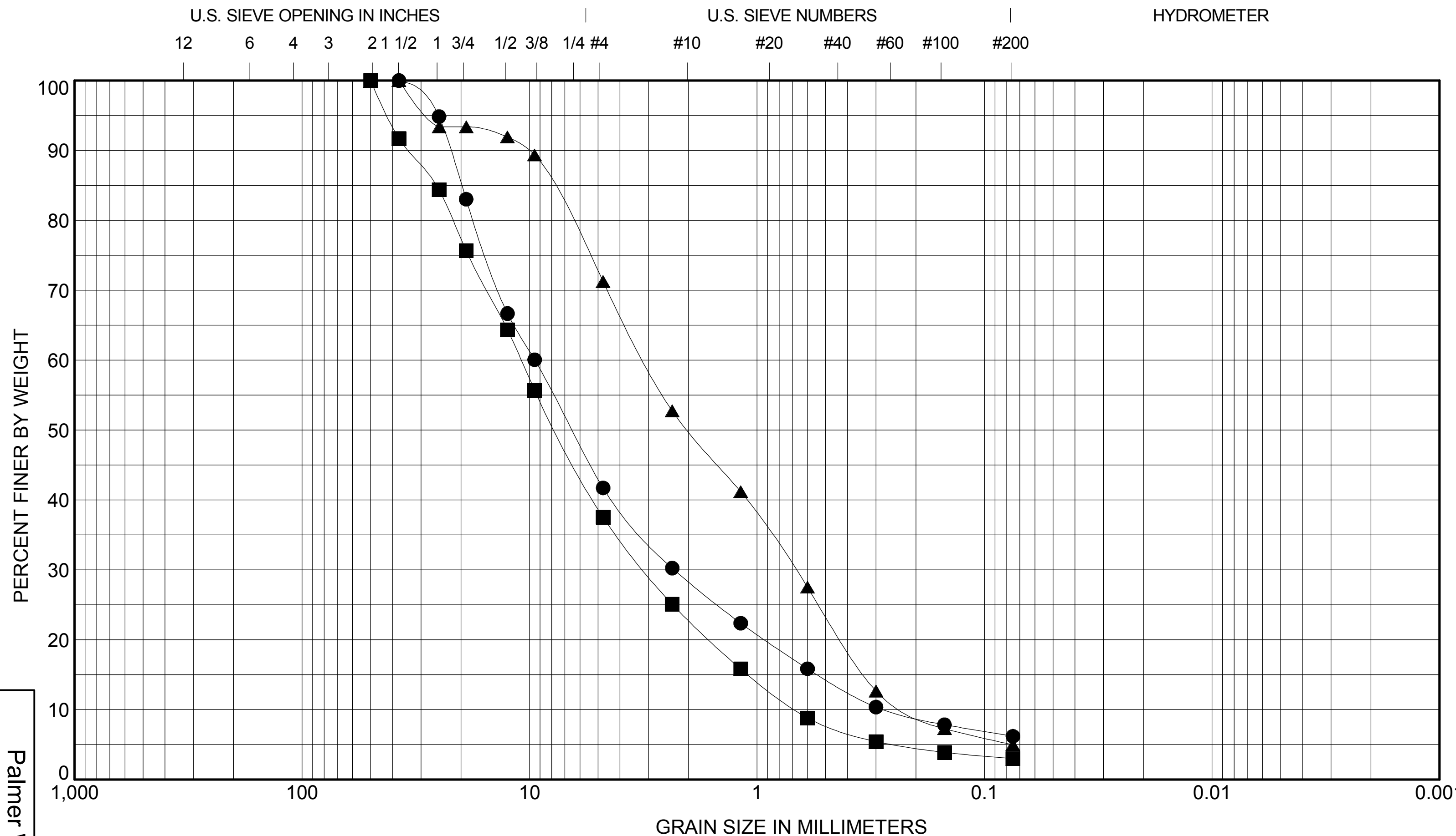
FIG. A-8
Sheet 3 of 7



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	B-3 S7	20.0 - 21.5	**Well-Graded Gravel with Silt and Sand (GW-GM)**				2.1	35.0
■	B-3 S12	45.0 - 46.5	**Well-Graded Gravel with Sand (GW)**				1.3	16.2
▲	B-3 S14	55.0 - 56.5	**Poorly Graded Sand with Gravel (SP)**				0.7	14.6

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-3 S7	20.0 - 21.5	37.5	9.48	2.31	0.27	58	36	6	
■	B-3 S12	45.0 - 46.5	50	10.89	3.11	0.67	62	35	3	
▲	B-3 S14	55.0 - 56.5	37.5	3.1	0.68	0.21	29	66	5	

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SHANNON & WILSON, INC.
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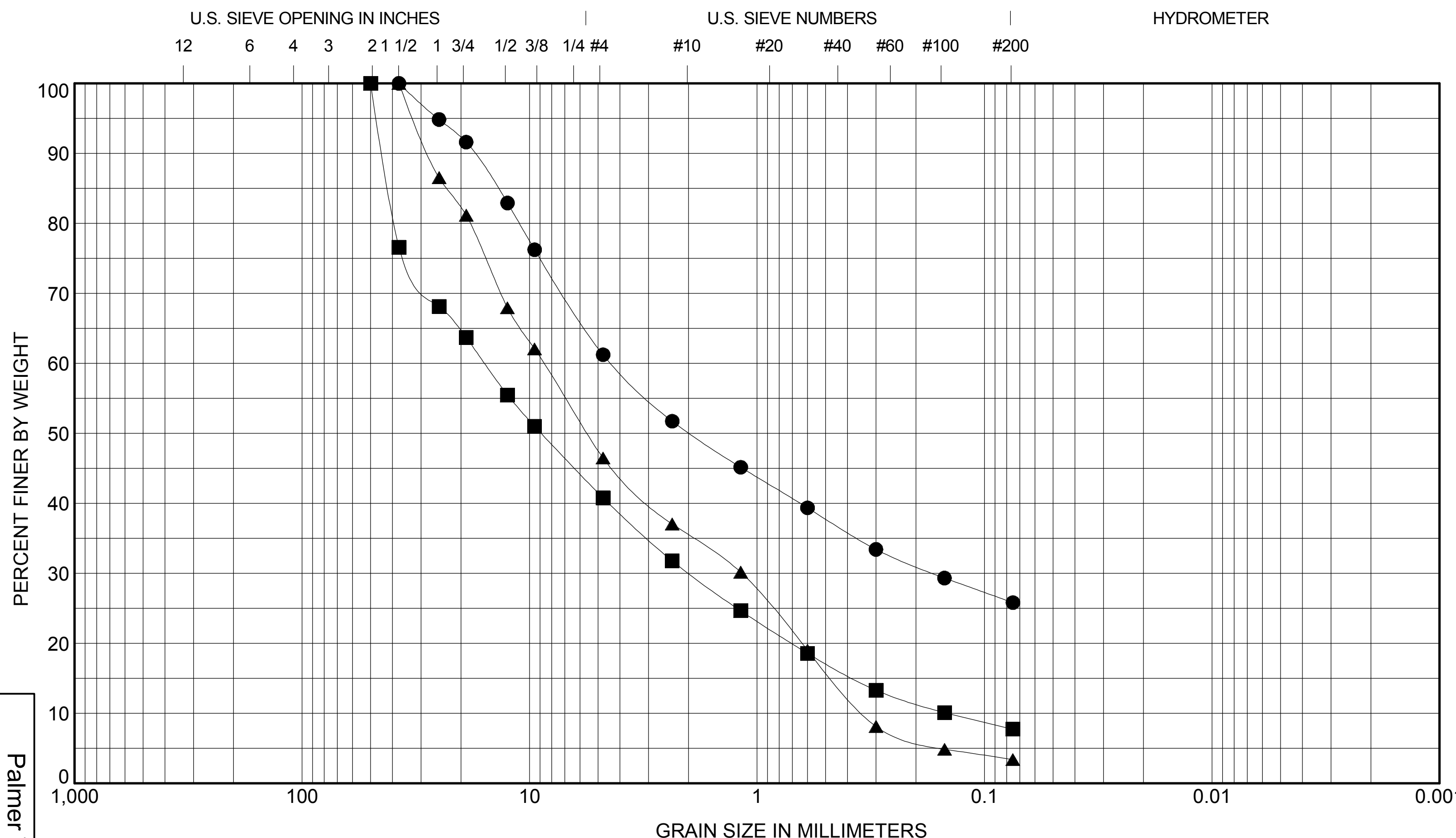
FIG. A-8
Sheet 4 of 7



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-4 S1**	**0.0 - 2.0**	**Silty Gravel with Sand (GM)**					
■	**B-4 S7**	**20.0 - 21.5**	**Well-Graded Gravel with Silt and Sand (GW-GM)**				**1.7**	**107.8**
▲	**B-4 S13**	**50.0 - 51.5**	**Poorly Graded Gravel with Sand (GP)**				**0.5**	**25.6**

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt / %Clay
●	**B-4 S1**	**0.0 - 2.0**	**37.5**	**4.34**	**0.17**		**39**	**35**	**26**
■	**B-4 S7**	**20.0 - 21.5**	**50**	**15.73**	**1.99**	**0.15**	**59**	**33**	**8**
▲	**B-4 S13**	**50.0 - 51.5**	**37.5**	**8.67**	**1.17**	**0.34**	**54**	**43**	**3**

Palmer Waste Water Treatment Plant
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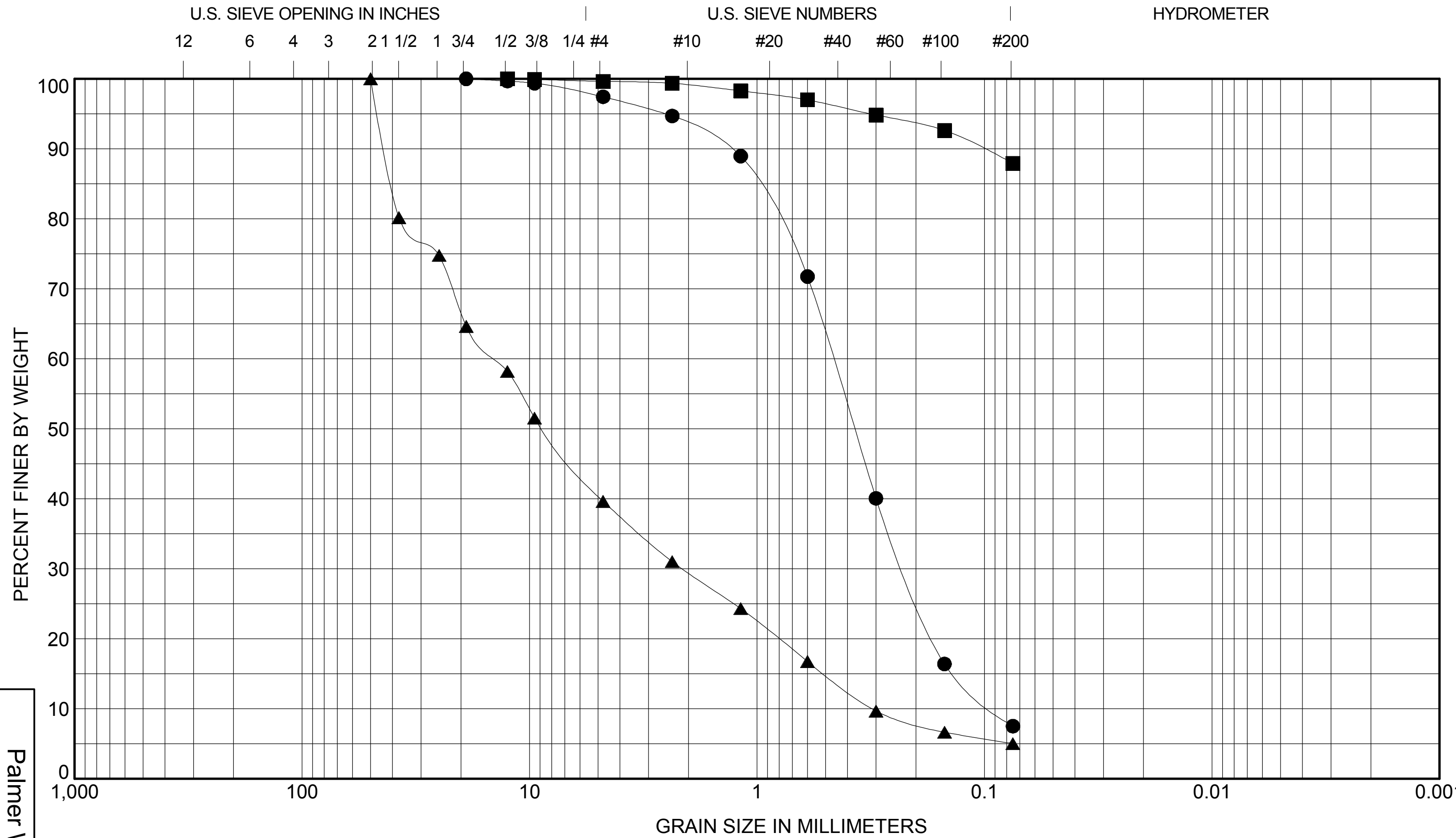
FIG. A-8
Sheet 5 of 7



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-4 S15**	**60.0 - 61.5**	**Poorly Graded Sand with Silt (SP-SM)**				**1.2**	**5.1**
■	**B-5 S2**	**2.5 - 4.0**	**Silt (ML)**					
▲	**B-5 S5**	**10.0 - 11.5**	**Well-Graded Gravel with Silt and Sand (GW-GM)**				**1.0**	**45.4**

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-4 S15**	**60.0 - 61.5**	**19**	**0.46**	**0.22**	**0.09**	**3**	**90**	**8**	
■	**B-5 S2**	**2.5 - 4.0**	**12.5**				**0**	**12**	**88**	
▲	**B-5 S5**	**10.0 - 11.5**	**50**	**14.07**	**2.13**	**0.31**	**60**	**35**	**5**	

Palmer Waste Water Treatment Plant
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FIG. A-8
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GRAIN SIZE CLASSIFICATION

Palmer Waste Water Treatment Plant
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Palmer, Alaska

February 2016

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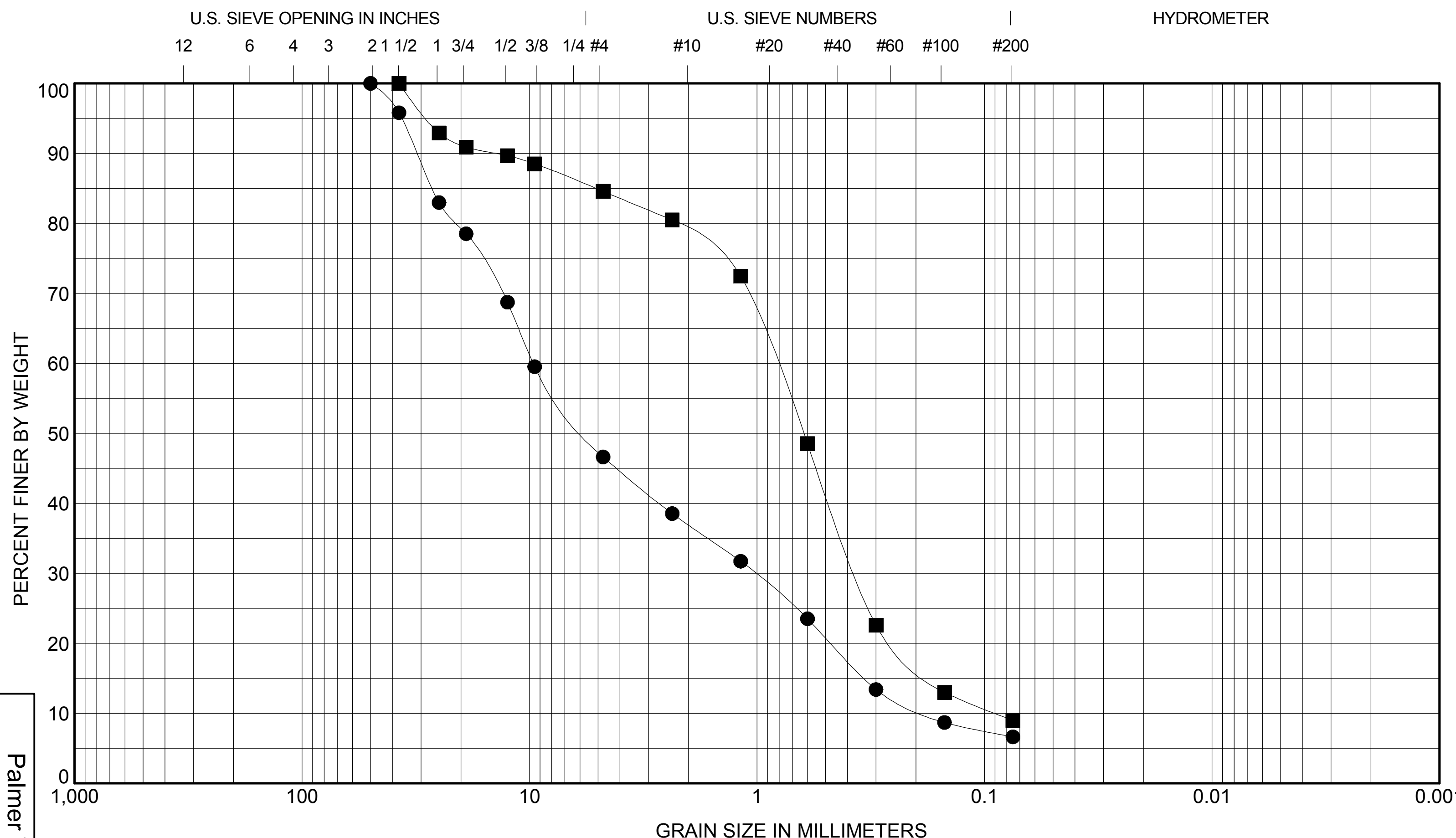
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-8
Sheet 7 of 7



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-5 S10**	**35.0 - 36.5**	**Poorly Graded Gravel with Silt and Sand (GP-GM)**				**0.6**	**53.0**
■	**B-5 S14**	**55.0 - 56.5**	**Well-Graded Sand with Silt and Gravel (SW-SM)**				**1.8**	**9.3**

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-5 S10**	**35.0 - 36.5**	**50**	**9.64**	**1.02**	**0.18**	**53**	**40**	**7**	
■	**B-5 S14**	**55.0 - 56.5**	**37.5**	**0.83**	**0.37**	**0.09**	**15**	**76**	**9**	

APPENDIX B

PUMPING WELL LOG

32-1-02475-002

Wheaton Water Well, Inc.

1190 N. Wasilla-Fishhook Road
Wasilla, AK 99654
(907)376-2041

Name: City of Palmer
Address: 231 W. Evergreen
City: Palmer **State:** AK **Zip Code:** 99645

Well Site: **Lot:** **Block:**
Additional: Wastewater Treatment Facility

Well Depth:	102 ft.
Below Ground:	100 ft.
Above Ground:	2 ft.
Gal/Min:	see flow test
Static Level:	57 ft.
Casing:	92' of 10" ID Steel
Liner Pipe:	none
Screened:	91' to 101'
Perforated:	none
Grouted:	Bentonite
Depth:	20' +
Develop. Method:	Air
Use of Well:	Commercial
Drilling Method:	Rotary
Fluids Used:	none
Pump Installed:	none
Other:	none

From:	To:	Formation:
0	1	gravel
1	9	topsoil
9	60	3/4" gravel, sand (gray)
60	82	wet silty gravel (brown silt)
82	104	silty sand, gravel, water brown (medium to fine sand)

SCREEN:
10' of 30 slot with 1' sump and 2' riser

Date Drilled: 12-18-2015 **Driller:** Ben Mattson

APPENDIX C

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

Attachment to 32-1-02475-002

Date: February 2016
To: HDR Alaska, Inc.
Re: Palmer Waste Water Treatment Plant, Facility Plan Update, Palmer, Alaska

Important Information About Your Geotechnical/Environmental Report

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors, which were considered in the development of the report, have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland

APPENDIX F: SEWER RATE STUDY EXHIBITS

City of Palmer
Sewer Rate Study - Opt. A
Summary of the Revenue Requirement
Exhibit 1

	Budget	Budget	Projected									
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Revenues:												
Rate Revenues	$979,910	$1,055,868	$1,066,427	$1,077,091	$1,087,862	$1,098,740	$1,109,728	$1,120,825	$1,132,033	$1,143,354	$1,154,787	$1,166,335
Miscellaneous Revenues	21,750	22,000	22,220	22,442	22,667	22,893	23,122	23,353	23,587	23,823	24,061	24,302
Total Source of Funds	**$1,001,660**	**$1,077,868**	**$1,088,647**	**$1,099,533**	**$1,110,528**	**$1,121,634**	**$1,132,850**	**$1,144,179**	**$1,155,620**	**$1,167,177**	**$1,178,848**	**$1,190,637**
Expenses												
Total Operations & Maintenance	**$878,273**	**$886,870**	**$913,476**	**$940,880**	**$1,094,252**	**$1,170,046**	**$1,205,147**	**$1,241,302**	**$1,278,541**	**$1,316,897**	**$1,356,404**	**$1,397,096**
Total Taxes	**$61,405**	**$65,992**	**$77,156**	**$92,095**	**$98,974**	**$106,372**	**$112,208**	**$118,367**	**$119,550**	**$120,746**	**$121,953**	**$123,173**
Rate Funded Capital	**$25,000**	**$50,000**	**$75,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**
Net Debt Service	**$102,537**	**$102,537**	**$102,537**	**$419,635**	**$419,635**	**$405,515**	**$405,515**	**$405,515**	**$405,515**	**$405,515**	**$405,515**	**$405,515**
Change in Working Capital +/-	**($65,555)**	**($27,531)**	**$117,766**	**($17,690)**	**($63,297)**	**($9,068)**	**$47,260**	**$107,595**	**$88,900**	**$69,273**	**$48,683**	**$27,097**
Total Revenue Requirement	**$1,001,660**	**$1,077,868**	**$1,285,936**	**$1,534,920**	**$1,649,564**	**$1,772,865**	**$1,870,130**	**$1,972,778**	**$1,992,505**	**$2,012,431**	**$2,032,555**	**$2,052,880**
Bal./(Def.) of Funds Before Added Tax	**$0**	**$0**	**($197,289)**	**($435,387)**	**($539,035)**	**($651,231)**	**($737,280)**	**($828,599)**	**($836,885)**	**($845,254)**	**($853,706)**	**($862,244)**
Balance as a % of Rate Adj. Required	**0.0%**	**0.0%**	**18.5%**	**40.4%**	**49.5%**	**59.3%**	**66.4%**	**73.9%**	**73.9%**	**73.9%**	**73.9%**	**73.9%**
Proposed Rate Adjustment	**0.0%**	**0.0%**	**18.5%**	**18.5%**	**6.5%**	**6.5%**	**4.5%**	**4.5%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Add'l Revenue with Rate Adj.	**$0**	**$0**	**$197,289**	**$435,387**	**$539,035**	**$651,231**	**$737,280**	**$828,599**	**$836,885**	**$845,254**	**$853,706**	**$862,244**
Bal./Def. After Rate Adjustment	**$0**	**$0**	**($0)**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Additional Rate Adjustment Required	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Debt Service Coverage Ratio (all debt)												
Before Rate Adjustment	0.60	1.22	0.96	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
After Needed Rate Adjustment	0.60	1.22	2.88	1.20	1.09	1.22	1.36	1.51	1.47	1.42	1.37	1.31
After Proposed Rate Adjustment	0.60	1.22	2.88	1.20	1.09	1.22	1.36	1.51	1.47	1.42	1.37	1.31
Average Residential Customer Bill	$21.80	(Current rates; Customer charge + 4,000 gal)										
Customer Bill on Proposed Adjustment	$21.80	$21.80	$25.83	$30.61	$32.60	$34.72	$36.28	$37.92	$37.92	$37.92	$37.92	$37.92
Bill Difference - Monthly	$0.00	$0.00	$4.03	$4.78	$1.99	$2.12	$1.56	$1.63	$0.00	$0.00	$0.00	$0.00
Cumulative Bill Difference	$0.00	$0.00	$4.03	$8.81	$10.80	$12.92	$14.48	$16.12	$16.12	$16.12	$16.12	$16.12
Ending Fund Balance	$234,445	$206,914	$323,680	$305,990	$242,693	$233,626	$280,886	$388,480	$477,380	$546,653	$595,335	$622,432
Target Ending Minimum Fund Bal./(Def.)	*451,368*	*453,087*	*458,408*	*463,889*	*494,563*	*509,722*	*516,742*	*523,973*	*531,421*	*539,092*	*546,994*	*555,132*

City of Palmer
Sewer Rate Study - Opt. A
Escalation Factors
Exhibit 2

	Budget	Budget	Projected										
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Revenues:													
Customer Growth	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
Miscellaneous Revenues	Budget	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
Expenses:													
Labor	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Benefits - Medical	Budget	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	
Benefits - Other	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Purchased Water	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Materials & Supplies	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Equipment	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Miscellaneous	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Other Utilities	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Electricity	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Insurance	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Interest:	0.5%	0.8%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
New Debt Service:													
ADEC Loan													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	
USDA Loan													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	
Revenue Bond													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	

City of Palmer
Sewer Rate Study - Opt. A
Revenue Requirement
Exhibit 3

	Budget	Budget	Projected										
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Revenues													
Rate Revenues													
Residential	$0	$0	$498,776	$503,764	$508,801	$513,889	$519,028	$524,218	$529,461	$534,755	$540,103	$545,504	Customer Growth
Commercial	0	0	555,480	561,035	566,645	572,312	578,035	583,815	589,653	595,550	601,505	607,520	Customer Growth
Sewer Non Dependent	0	0	3,743	3,780	3,818	3,856	3,895	3,934	3,973	4,013	4,053	4,093	Customer Growth
Sewer Flat Rate	0	0	8,428	8,512	8,597	8,683	8,770	8,858	8,947	9,036	9,126	9,218	Customer Growth
Total Retail Rate Revenues	$979,910	$1,055,868	$1,066,427	$1,077,091	$1,087,862	$1,098,740	$1,109,728	$1,120,825	$1,132,033	$1,143,354	$1,154,787	$1,166,335	
Other Revenues													
Grants Admin Overhead	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	Flat
Service Fees	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Penalty	9,750	10,000	10,100	10,201	10,303	10,406	10,510	10,615	10,721	10,829	10,937	11,046	Miscellaneous Revenues
Connection Fee	12,000	12,000	12,120	12,241	12,364	12,487	12,612	12,738	12,866	12,994	13,124	13,255	Miscellaneous Revenues
Interest/Invest Earnings	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Miscellaneous Income	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Insurance Reimbursement	0	0	0	0	0	0	0	0	0	0	0	0	One Time Revenue
Total Other Revenues	$21,750	$22,000	$22,220	$22,442	$22,667	$22,893	$23,122	$23,353	$23,587	$23,823	$24,061	$24,302	
Total Revenues	**$1,001,660**	**$1,077,868**	**$1,088,647**	**$1,099,533**	**$1,110,528**	**$1,121,634**	**$1,132,850**	**$1,144,179**	**$1,155,620**	**$1,167,177**	**$1,178,848**	**$1,190,637**	
Expenses													
Operational Expenses													
Regular Salaries	$150,801	$152,994	$157,584	$162,311	$167,181	$172,196	$177,362	$182,683	$188,163	$193,808	$199,622	$205,611	Labor
Regular Benefits	115,528	124,838	128,583	132,441	136,414	140,506	144,721	149,063	153,535	158,141	162,885	167,772	Benefits - Other
Regular Overtime	3,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Labor
Personal Leave Expense	10,000	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Audit	5,497	7,296	7,515	7,740	7,973	8,212	8,458	8,712	8,973	9,242	9,520	9,805	Miscellaneous
Advertising	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Training	4,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Miscellaneous
Legal Fees	2,000	20,000	20,600	21,218	21,855	22,510	23,185	23,881	24,597	25,335	26,095	26,878	Miscellaneous
Engineering	5,000	7,000	7,210	7,426	7,649	7,879	8,115	8,358	8,609	8,867	9,133	9,407	Labor
Services	30,000	30,000	30,900	31,827	32,782	33,765	34,778	35,822	36,896	38,003	39,143	40,317	Miscellaneous
Contractual Services	15,000	40,000	41,200	42,436	43,709	45,020	46,371	47,762	49,195	50,671	52,191	53,757	Miscellaneous
Telephone	6,500	6,500	6,695	6,896	7,103	7,316	7,535	7,761	7,994	8,234	8,481	8,735	Miscellaneous
Power	175,000	175,000	180,250	185,658	191,227	196,964	202,873	208,959	215,228	221,685	228,335	235,185	Other Utilities
Heat	23,100	20,000	20,600	21,218	21,855	22,510	23,185	23,881	24,597	25,335	26,095	26,878	Other Utilities
Fuel	7,000	6,000	6,180	6,365	6,556	6,753	6,956	7,164	7,379	7,601	7,829	8,063	Materials & Supplies
Rental & Lease	4,000	4,000	4,120	4,244	4,371	4,502	4,637	4,776	4,919	5,067	5,219	5,376	Miscellaneous
Insurance	6,378	5,600	5,768	5,941	6,119	6,303	6,492	6,687	6,887	7,094	7,307	7,526	Insurance
Vehicle Insurance	3,901	3,801	3,915	4,032	4,153	4,278	4,406	4,539	4,675	4,815	4,959	5,108	Insurance
Office Supplies	1,600	1,600	1,648	1,697	1,748	1,801	1,855	1,910	1,968	2,027	2,088	2,150	Materials & Supplies
Operating Supplies	16,000	15,000	15,450	15,914	16,391	16,883	17,389	17,911	18,448	19,002	19,572	20,159	Materials & Supplies
Repair & Maintenance	25,000	27,000	27,810	28,644	29,504	30,389	31,300	32,239	33,207	34,203	35,229	36,286	Miscellaneous
Small Tools & Equipment	3,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Equipment
Chemicals	0	0	0	0	0	0	0	0	0	0	0	0	Materials & Supplies
Equipment	44,000	5,000	5,150	5,305	5,464	5,628	5,796	5,970	6,149	6,334	6,524	6,720	Equipment
Office Equipment	3,500	0	0	0	0	0	0	0	0	0	0	0	Equipment
Postage	4,000	4,000	4,120	4,244	4,371	4,502	4,637	4,776	4,919	5,067	5,219	5,376	Materials & Supplies
Interest	16,572	15,282	15,740	16,213	16,699	17,200	17,716	18,248	18,795	19,359	19,940	20,538	Miscellaneous
Alaska RR Permits	10,000	11,000	11,330	11,670	12,020	12,381	12,752	13,135	13,529	13,934	14,353	14,783	Miscellaneous
Safety Equipment	500	500	515	530	546	563	580	597	615	633	652	672	Miscellaneous
General Admin Exp	187,396	195,459	201,323	207,362	213,583	219,991	226,591	233,388	240,390	247,602	255,030	262,681	Miscellaneous
Computer Services	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Additional WWTP O&M Expenses	$0	$0	$0	$0	$125,145	$171,866	$177,022	$182,332	$187,802	$193,436	$199,240	$205,217	Materials & Supplies
Total Operations & Maintenance	**$878,273**	**$886,870**	**$913,476**	**$940,880**	**$1,094,252**	**$1,170,046**	**$1,205,147**	**$1,241,302**	**$1,278,541**	**$1,316,897**	**$1,356,404**	**$1,397,096**	

City of Palmer
Sewer Rate Study - Opt. A
Revenue Requirement
Exhibit 3

	Budget	Budget	Projected										
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Taxes													
Payment In Lieu of Taxes	$61,405	$65,992	$77,156	$92,095	$98,974	$106,372	$112,208	$118,367	$119,550	$120,746	$121,953	$123,173	*6% of Revenues*
Total Taxes	$61,405	$65,992	$77,156	$92,095	$98,974	$106,372	$112,208	$118,367	$119,550	$120,746	$121,953	$123,173	
Rate Funded Capital	$25,000	$50,000	$75,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	
Debt Service													
671011 - Sewer Repairs	$14,120	$14,120	$14,120	$14,120	$14,120	$0	$0	$0	$0	$0	$0	$0	Debt Schedule
671071 - SW Sanitary Sewer Extension	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	Debt Schedule
ADEC Loan	0	0	0	102,621	102,621	102,621	102,621	102,621	102,621	102,621	102,621	102,621	Calc'd @ 2% for 20 yrs.
USDA Loan	0	0	0	214,477	214,477	214,477	214,477	214,477	214,477	214,477	214,477	214,477	Calc'd @ 3.4% for 20 yrs.
New Revenue bonds	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 5% for 20 yrs.
New Low interest loans	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 2% for 20 yrs.
Total Debt Service	$102,537	$102,537	$102,537	$419,635	$419,635	$405,515	$405,515	$405,515	$405,515	$405,515	$405,515	$405,515	
Less: Debt Service Funding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Total Less Debt Service Funding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Net Debt Service	$102,537	$102,537	$102,537	$419,635	$419,635	$405,515	$405,515	$405,515	$405,515	$405,515	$405,515	$405,515	
Change in Working Capital +/-	($65,555)	($27,531)	$117,766	($17,690)	($63,297)	($9,068)	$47,260	$107,595	$88,900	$69,273	$48,683	$27,097	
Total Revenue Requirement	**$1,001,660**	**$1,077,868**	**$1,285,936**	**$1,534,920**	**$1,649,564**	**$1,772,865**	**$1,870,130**	**$1,972,778**	**$1,992,505**	**$2,012,431**	**$2,032,555**	**$2,052,880**	
Bal./(Def.) of Funds Before Added Tax	**$0**	**$0**	**($197,289)**	**($435,387)**	**($539,035)**	**($651,231)**	**($737,280)**	**($828,599)**	**($836,885)**	**($845,254)**	**($853,706)**	**($862,244)**	
Balance as a % of Rate Adj. Required	**0.0%**	**0.0%**	**18.5%**	**40.4%**	**49.5%**	**59.3%**	**66.4%**	**73.9%**	**73.9%**	**73.9%**	**73.9%**	**73.9%**	
Proposed Rate Adjustment	**0.0%**	**0.0%**	**18.5%**	**18.5%**	**6.5%**	**6.5%**	**4.5%**	**4.5%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	
Add'l Revenue with Rate Adj.	**$0**	**$0**	**$197,289**	**$435,387**	**$539,035**	**$651,231**	**$737,280**	**$828,599**	**$836,885**	**$845,254**	**$853,706**	**$862,244**	
Bal./Def. After Rate Adjustment	**$0**	**$0**	**($0)**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	
Additional Rate Adjustment Required	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	

City of Palmer
Sewer Rate Study - Opt. A
Revenue Requirement
Exhibit 3

	Budget	Budget			Projected								
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Average Residential Customer Bill	**$21.80**	*(Current rates; Customer charge + 4,000 gal)*											
Customer Bill after Rate Adj. Req'd	$21.80	$21.80	$25.83	$30.61	$32.60	$34.72	$36.28	$37.92	$37.92	$37.92	$37.92	$37.92	
Bill Difference - Monthly	0.00	0.00	4.03	4.78	1.99	2.12	1.56	1.63	0.00	0.00	0.00	0.00	
Cumulative Bill Difference	0.00	0.00	4.03	8.81	10.80	12.92	14.48	16.12	16.12	16.12	16.12	16.12	
Customer Bill on Proposed Adjustment	$21.80	$21.80	$25.83	$30.61	$32.60	$34.72	$36.28	$37.92	$37.92	$37.92	$37.92	$37.92	
Bill Difference - Monthly	0.00	0.00	4.03	4.78	1.99	2.12	1.56	1.63	0.00	0.00	0.00	0.00	
Cumulative Bill Difference	0.00	0.00	4.03	8.81	10.80	12.92	14.48	16.12	16.12	16.12	16.12	16.12	
Debt Service Coverage Ratio (all debt)													
Before Rate Adjustment	0.60	1.22	0.96	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
After Needed Rate Adjustment	0.60	1.22	2.88	1.20	1.09	1.22	1.36	1.51	1.47	1.42	1.37	1.31	
After Proposed Rate Adjustment	0.60	1.22	2.88	1.20	1.09	1.22	1.36	1.51	1.47	1.42	1.37	1.31	
Cash Reserves													
Operating Fund													
Beginning Balance	$300,000	$234,445	$206,914	$323,680	$305,990	$242,693	$233,626	$280,886	$388,480	$477,380	$546,653	$595,335	
Plus: Additions	0	0	117,766	0	0	0	47,260	107,595	88,900	69,273	48,683	27,097	
Less: EPA Fees	0	0	0	0	0	0	0	0	0	0	0	0	
Less: Uses of Funds	(65,555)	(27,531)	(1,000)	(17,690)	(63,297)	(9,068)	0	0	0	0	0	0	
Ending Balance	$234,445	$206,914	$323,680	$305,990	$242,693	$233,626	$280,886	$388,480	$477,380	$546,653	$595,335	$622,432	
Target: 20% of O&M	$175,655	$177,374	$182,695	$188,176	$218,850	$234,009	$241,029	$248,260	$255,708	$263,379	$271,281	$279,419	
Target: 50% of Annual Depreciation	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	
Target Minimum Fund Balance	**$451,368**	**$453,087**	**$458,408**	**$463,889**	**$494,563**	**$509,722**	**$516,742**	**$523,973**	**$531,421**	**$539,092**	**$546,994**	**$555,132**	
Target Ending Minimum Fund Bal./(Def.)	***($216,923)***	***($246,173)***	***($134,728)***	***($157,899)***	***($251,870)***	***($276,097)***	***($235,857)***	***($135,493)***	***($54,041)***	***$7,560***	***$48,342***	***$67,300***	

City of Palmer
Sewer Rate Study - Opt. A
Capital Improvement Plan
Exhibit 4

Inflation	**2.7%**

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	*Notes:*
WWTP - MBBR	$0	$0	$7,600,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	
WWTP - Secondary Clarifiers	0	0	6,162,000	0	0	0	0	0	0	0	0	0	
Unidentified Future CIP	25,000	50,000	0	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	
Total Capital Improvement Projects	$25,000	$50,000	$13,762,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	
Transfer to Cash Reserve	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Total Capital Improvement Projects	**$25,000**	**$50,000**	**$13,762,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	
Less: Outside Funding Sources													
Operating Fund - Sewer	$0	$0	$1,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	*Due to Rounding*
System Development Charges (SDCs)	0	0	0	0	0	0	0	0	0	0	0	0	
DCCED Grant	0	0	2,500,000	0	0	0	0	0	0	0	0	0	
ADEC Loan	0	0	1,678,000	0	0	0	0	0	0	0	0	0	30% *of Cost*
ADEC Grant	0	0	3,915,000	0	0	0	0	0	0	0	0	0	70% *of Cost*
USDA Loan	0	0	3,076,000	0	0	0	0	0	0	0	0	0	*55% of Cost*
USDA Grant	0	0	2,517,000	0	0	0	0	0	0	0	0	0	*45% of Cost*
Low Interest Loans	0	0	0	0	0	0	0	0	0	0	0	0	
State Legislative Grants	0	0	0	0	0	0	0	0	0	0	0	0	
Revenue Bonds	0	0	0	0	0	0	0	0	0	0	0	0	
Total Funding Sources	$0	$0	$13,687,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	
NET CIP FROM RATES	**$25,000**	**$50,000**	**$75,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	

City of Palmer
Sewer Rate Study - Opt. B
Summary of the Revenue Requirement
Exhibit 1

	Budget	Budget	Projected									
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Revenues:												
Rate Revenues	$979,910	$1,055,868	$1,066,427	$1,077,091	$1,087,862	$1,098,740	$1,109,728	$1,120,825	$1,132,033	$1,143,354	$1,154,787	$1,166,335
Miscellaneous Revenues	21,750	22,000	22,220	22,442	22,667	22,893	23,122	23,353	23,587	23,823	24,061	24,302
Total Source of Funds	**$1,001,660**	**$1,077,868**	**$1,088,647**	**$1,099,533**	**$1,110,528**	**$1,121,634**	**$1,132,850**	**$1,144,179**	**$1,155,620**	**$1,167,177**	**$1,178,848**	**$1,190,637**
Expenses												
Total Operations & Maintenance	**$878,273**	**$886,870**	**$913,476**	**$1,066,025**	**$1,140,973**	**$1,175,202**	**$1,210,458**	**$1,246,772**	**$1,284,175**	**$1,322,700**	**$1,362,381**	**$1,403,252**
Total Taxes	**$61,405**	**$65,992**	**$76,516**	**$90,570**	**$96,432**	**$102,198**	**$106,275**	**$110,515**	**$127,600**	**$128,876**	**$130,165**	**$131,467**
Rate Funded Capital	**$25,000**	**$50,000**	**$75,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**
Net Debt Service	**$102,537**	**$102,537**	**$102,537**	**$295,259**	**$295,259**	**$281,139**	**$281,139**	**$281,139**	**$547,283**	**$547,283**	**$547,283**	**$547,283**
Change in Working Capital +/-	**($65,555)**	**($27,531)**	**$107,742**	**($42,354)**	**($25,462)**	**$44,754**	**$73,370**	**$103,496**	**$67,613**	**$49,078**	**$29,588**	**$9,109**
Total Revenue Requirement	**$1,001,660**	**$1,077,868**	**$1,275,271**	**$1,509,501**	**$1,607,202**	**$1,703,293**	**$1,771,242**	**$1,841,923**	**$2,126,671**	**$2,147,938**	**$2,169,417**	**$2,191,112**
Bal./(Def.) of Funds Before Added Tax	**$0**	**$0**	**($186,625)**	**($409,968)**	**($496,674)**	**($581,659)**	**($638,392)**	**($697,744)**	**($971,051)**	**($980,761)**	**($990,569)**	**($1,000,475)**
Balance as a % of Rate Adj. Required	**0.0%**	**0.0%**	**17.5%**	**38.1%**	**45.7%**	**52.9%**	**57.5%**	**62.3%**	**85.8%**	**85.8%**	**85.8%**	**85.8%**
Proposed Rate Adjustment	**0.0%**	**0.0%**	**17.5%**	**17.5%**	**5.5%**	**5.0%**	**3.0%**	**3.0%**	**14.5%**	**0.0%**	**0.0%**	**0.0%**
Add'l Revenue with Rate Adj.	**$0**	**$0**	**$186,625**	**$409,968**	**$496,674**	**$581,659**	**$638,392**	**$697,744**	**$971,051**	**$980,761**	**$990,569**	**$1,000,475**
Bal./Def. After Rate Adjustment	**$0**	**$0**	**($0)**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Additional Rate Adjustment Required	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Debt Service Coverage Ratio (all debt)												
Before Rate Adjustment	0.60	1.22	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
After Needed Rate Adjustment	0.60	1.22	2.78	1.20	1.25	1.51	1.62	1.72	1.31	1.27	1.24	1.20
After Proposed Rate Adjustment	0.60	1.22	2.78	1.20	1.25	1.51	1.62	1.72	1.31	1.27	1.24	1.20
Average Residential Customer Bill	$21.80	(Current rates; Customer charge + 4,000 gal)										
Customer Bill on Proposed Adjustment	$21.80	$21.80	$25.62	$30.10	$31.75	$33.34	$34.34	$35.37	$40.50	$40.50	$40.50	$40.50
Bill Difference - Monthly	$0.00	$0.00	$3.82	$4.48	$1.66	$1.59	$1.00	$1.03	$5.13	$0.00	$0.00	$0.00
Cumulative Bill Difference	$0.00	$0.00	$3.82	$8.30	$9.95	$11.54	$12.54	$13.57	$18.70	$18.70	$18.70	$18.70
Ending Fund Balance	$234,445	$206,914	$314,656	$272,302	$246,840	$291,594	$364,964	$468,460	$536,073	$585,152	$614,740	$623,849
Target Ending Minimum Fund Bal./(Def.)	$451,368	$453,087	$458,408	$488,918	$503,908	$510,753	$517,805	$525,067	$532,548	$540,253	$548,189	$556,363

City of Palmer
Sewer Rate Study - Opt. B
Escalation Factors
Exhibit 2

	Budget	Budget	Projected										
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Revenues:													
Customer Growth	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
Miscellaneous Revenues	Budget	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
Expenses:													
Labor	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Benefits - Medical	Budget	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	
Benefits - Other	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Purchased Water	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Materials & Supplies	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Equipment	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Miscellaneous	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Other Utilities	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Electricity	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Insurance	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Interest:	0.5%	0.8%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
New Debt Service:													
ADEC Loan													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	
USDA Loan													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	
Revenue Bond													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	

City of Palmer
Sewer Rate Study - Opt. B
Revenue Requirement
Exhibit 3

	Budget 2015	Budget 2016	Projected 2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	*Notes*
Revenues													
Rate Revenues													
Residential	$0	$0	$498,776	$503,764	$508,801	$513,889	$519,028	$524,218	$529,461	$534,755	$540,103	$545,504	Customer Growth
Commercial	0	0	555,480	561,035	566,645	572,312	578,035	583,815	589,653	595,550	601,505	607,520	Customer Growth
Sewer Non Dependent	0	0	3,743	3,780	3,818	3,856	3,895	3,934	3,973	4,013	4,053	4,093	Customer Growth
Sewer Flat Rate	0	0	8,428	8,512	8,597	8,683	8,770	8,858	8,947	9,036	9,126	9,218	Customer Growth
Total Retail Rate Revenues	$979,910	$1,055,868	$1,066,427	$1,077,091	$1,087,862	$1,098,740	$1,109,728	$1,120,825	$1,132,033	$1,143,354	$1,154,787	$1,166,335	
Other Revenues													
Grants Admin Overhead	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	Flat
Service Fees	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Penalty	9,750	10,000	10,100	10,201	10,303	10,406	10,510	10,615	10,721	10,829	10,937	11,046	Miscellaneous Revenues
Connection Fee	12,000	12,000	12,120	12,241	12,364	12,487	12,612	12,738	12,866	12,994	13,124	13,255	Miscellaneous Revenues
Interest/Invest Earnings	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Miscellaneous Income	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Insurance Reimbursement	0	0	0	0	0	0	0	0	0	0	0	0	One Time Revenue
Total Other Revenues	$21,750	$22,000	$22,220	$22,442	$22,667	$22,893	$23,122	$23,353	$23,587	$23,823	$24,061	$24,302	
Total Revenues	**$1,001,660**	**$1,077,868**	**$1,088,647**	**$1,099,533**	**$1,110,528**	**$1,121,634**	**$1,132,850**	**$1,144,179**	**$1,155,620**	**$1,167,177**	**$1,178,848**	**$1,190,637**	
Expenses													
Operational Expenses													
Regular Salaries	$150,801	$152,994	$157,584	$162,311	$167,181	$172,196	$177,362	$182,683	$188,163	$193,808	$199,622	$205,611	Labor
Regular Benefits	115,528	124,838	128,583	132,441	136,414	140,506	144,721	149,063	153,535	158,141	162,885	167,772	Benefits - Other
Regular Overtime	3,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Labor
Personal Leave Expense	10,000	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Audit	5,497	7,296	7,515	7,740	7,973	8,212	8,458	8,712	8,973	9,242	9,520	9,805	Miscellaneous
Advertising	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Training	4,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Miscellaneous
Legal Fees	2,000	20,000	20,600	21,218	21,855	22,510	23,185	23,881	24,597	25,335	26,095	26,878	Miscellaneous
Engineering	5,000	7,000	7,210	7,426	7,649	7,879	8,115	8,358	8,609	8,867	9,133	9,407	Labor
Services	30,000	30,000	30,900	31,827	32,782	33,765	34,778	35,822	36,896	38,003	39,143	40,317	Miscellaneous
Contractual Services	15,000	40,000	41,200	42,436	43,709	45,020	46,371	47,762	49,195	50,671	52,191	53,757	Miscellaneous
Telephone	6,500	6,500	6,695	6,896	7,103	7,316	7,535	7,761	7,994	8,234	8,481	8,735	Miscellaneous
Power	175,000	175,000	180,250	185,658	191,227	196,964	202,873	208,959	215,228	221,685	228,335	235,185	Other Utilities
Heat	23,100	20,000	20,600	21,218	21,855	22,510	23,185	23,881	24,597	25,335	26,095	26,878	Other Utilities
Fuel	7,000	6,000	6,180	6,365	6,556	6,753	6,956	7,164	7,379	7,601	7,829	8,063	Materials & Supplies
Rental & Lease	4,000	4,000	4,120	4,244	4,371	4,502	4,637	4,776	4,919	5,067	5,219	5,376	Miscellaneous
Insurance	6,378	5,600	5,768	5,941	6,119	6,303	6,492	6,687	6,887	7,094	7,307	7,526	Insurance
Vehicle Insurance	3,901	3,801	3,915	4,032	4,153	4,278	4,406	4,539	4,675	4,815	4,959	5,108	Insurance
Office Supplies	1,600	1,600	1,648	1,697	1,748	1,801	1,855	1,910	1,968	2,027	2,088	2,150	Materials & Supplies
Operating Supplies	16,000	15,000	15,450	15,914	16,391	16,883	17,389	17,911	18,448	19,002	19,572	20,159	Materials & Supplies
Repair & Maintenance	25,000	27,000	27,810	28,644	29,504	30,389	31,300	32,239	33,207	34,203	35,229	36,286	Miscellaneous
Small Tools & Equipment	3,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Equipment
Chemicals	0	0	0	0	0	0	0	0	0	0	0	0	Materials & Supplies
Equipment	44,000	5,000	5,150	5,305	5,464	5,628	5,796	5,970	6,149	6,334	6,524	6,720	Equipment
Office Equipment	3,500	0	0	0	0	0	0	0	0	0	0	0	Equipment
Postage	4,000	4,000	4,120	4,244	4,371	4,502	4,637	4,776	4,919	5,067	5,219	5,376	Materials & Supplies
Interest	16,572	15,282	15,740	16,213	16,699	17,200	17,716	18,248	18,795	19,359	19,940	20,538	Miscellaneous
Alaska RR Permits	10,000	11,000	11,330	11,670	12,020	12,381	12,752	13,135	13,529	13,934	14,353	14,783	Miscellaneous
Safety Equipment	500	500	515	530	546	563	580	597	615	633	652	672	Miscellaneous
General Admin Exp	187,396	195,459	201,323	207,362	213,583	219,991	226,591	233,388	240,390	247,602	255,030	262,681	Miscellaneous
Computer Services	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Additional WWTP O&M Expenses	$0	$0	$0	$125,145	$171,866	$177,022	$182,332	$187,802	$193,436	$199,240	$205,217	$211,373	Materials & Supplies
Total Operations & Maintenance	**$878,273**	**$886,870**	**$913,476**	**$1,066,025**	**$1,140,973**	**$1,175,202**	**$1,210,458**	**$1,246,772**	**$1,284,175**	**$1,322,700**	**$1,362,381**	**$1,403,252**	

City of Palmer
Sewer Rate Study - Opt. B
Revenue Requirement
Exhibit 3

	Budget	Budget	Projected										
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Taxes													
Payment In Lieu of Taxes	$61,405	$65,992	$76,516	$90,570	$96,432	$102,198	$106,275	$110,515	$127,600	$128,876	$130,165	$131,467	*6% of Revenues*
Total Taxes	$61,405	$65,992	$76,516	$90,570	$96,432	$102,198	$106,275	$110,515	$127,600	$128,876	$130,165	$131,467	
Rate Funded Capital	$25,000	$50,000	$75,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	
Debt Service													
671011 - Sewer Repairs	$14,120	$14,120	$14,120	$14,120	$14,120	$0	$0	$0	$0	$0	$0	$0	Debt Schedule
671071 - SW Sanitary Sewer Extension	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	Debt Schedule
ADEC Loan	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 2% for 20 yrs.
USDA Loan	0	0	0	192,722	192,722	192,722	192,722	192,722	458,866	458,866	458,866	458,866	Calc'd @ 3.4% for 20 yrs.
New Revenue bonds	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 5% for 20 yrs.
New Low interest loans	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 2% for 20 yrs.
Total Debt Service	$102,537	$102,537	$102,537	$295,259	$295,259	$281,139	$281,139	$281,139	$547,283	$547,283	$547,283	$547,283	
Less: Debt Service Funding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Total Less Debt Service Funding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Net Debt Service	$102,537	$102,537	$102,537	$295,259	$295,259	$281,139	$281,139	$281,139	$547,283	$547,283	$547,283	$547,283	
Change in Working Capital +/-	($65,555)	($27,531)	$107,742	($42,354)	($25,462)	$44,754	$73,370	$103,496	$67,613	$49,078	$29,588	$9,109	
Total Revenue Requirement	**$1,001,660**	**$1,077,868**	**$1,275,271**	**$1,509,501**	**$1,607,202**	**$1,703,293**	**$1,771,242**	**$1,841,923**	**$2,126,671**	**$2,147,938**	**$2,169,417**	**$2,191,112**	
Bal./(Def.) of Funds Before Added Tax	**$0**	**$0**	**($186,625)**	**($409,968)**	**($496,674)**	**($581,659)**	**($638,392)**	**($697,744)**	**($971,051)**	**($980,761)**	**($990,569)**	**($1,000,475)**	
Balance as a % of Rate Adj. Required	**0.0%**	**0.0%**	**17.5%**	**38.1%**	**45.7%**	**52.9%**	**57.5%**	**62.3%**	**85.8%**	**85.8%**	**85.8%**	**85.8%**	
Proposed Rate Adjustment	**0.0%**	**0.0%**	**17.5%**	**17.5%**	**5.5%**	**5.0%**	**3.0%**	**3.0%**	**14.5%**	**0.0%**	**0.0%**	**0.0%**	
Add'l Revenue with Rate Adj.	**$0**	**$0**	**$186,625**	**$409,968**	**$496,674**	**$581,659**	**$638,392**	**$697,744**	**$971,051**	**$980,761**	**$990,569**	**$1,000,475**	
Bal./Def. After Rate Adjustment	**$0**	**$0**	**($0)**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	
Additional Rate Adjustment Required	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	

City of Palmer
Sewer Rate Study - Opt. B
Revenue Requirement
Exhibit 3

	Budget	Budget	Projected										
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Average Residential Customer Bill	**$21.80**	*(Current rates; Customer charge + 4,000 gal)*											
Customer Bill after Rate Adj. Req'd	$21.80	$21.80	$25.62	$30.10	$31.75	$33.34	$34.34	$35.37	$40.50	$40.50	$40.50	$40.50	
Bill Difference - Monthly	0.00	0.00	3.82	4.48	1.66	1.59	1.00	1.03	5.13	0.00	0.00	0.00	
Cumulative Bill Difference	0.00	0.00	3.82	8.30	9.95	11.54	12.54	13.57	18.70	18.70	18.70	18.70	
Customer Bill on Proposed Adjustment	$21.80	$21.80	$25.62	$30.10	$31.75	$33.34	$34.34	$35.37	$40.50	$40.50	$40.50	$40.50	
Bill Difference - Monthly	0.00	0.00	3.82	4.48	1.66	1.59	1.00	1.03	5.13	0.00	0.00	0.00	
Cumulative Bill Difference	0.00	0.00	3.82	8.30	9.95	11.54	12.54	13.57	18.70	18.70	18.70	18.70	
Debt Service Coverage Ratio (all debt)													
Before Rate Adjustment	0.60	1.22	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
After Needed Rate Adjustment	0.60	1.22	2.78	1.20	1.25	1.51	1.62	1.72	1.31	1.27	1.24	1.20	
After Proposed Rate Adjustment	0.60	1.22	2.78	1.20	1.25	1.51	1.62	1.72	1.31	1.27	1.24	1.20	
Cash Reserves													
Operating Fund													
Beginning Balance	$300,000	$234,445	$206,914	$314,656	$272,302	$246,840	$291,594	$364,964	$468,460	$536,073	$585,152	$614,740	
Plus: Additions	0	0	107,742	0	0	44,754	73,370	103,496	67,613	49,078	29,588	9,109	
Less: EPA Fees	0	0	0	0	0	0	0	0	0	0	0	0	
Less: Uses of Funds	(65,555)	(27,531)	0	(42,354)	(25,462)	0	0	0	0	0	0	0	
Ending Balance	$234,445	$206,914	$314,656	$272,302	$246,840	$291,594	$364,964	$468,460	$536,073	$585,152	$614,740	$623,849	
Target: 20% of O&M	$175,655	$177,374	$182,695	$213,205	$228,195	$235,040	$242,092	$249,354	$256,835	$264,540	$272,476	$280,650	
Target: 50% of Annual Depreciation	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	
Target Minimum Fund Balance	**$451,368**	**$453,087**	**$458,408**	**$488,918**	**$503,908**	**$510,753**	**$517,805**	**$525,067**	**$532,548**	**$540,253**	**$548,189**	**$556,363**	
Target Ending Minimum Fund Bal./(Def.)	***($216,923)***	***($246,173)***	***($143,752)***	***($216,616)***	***($257,068)***	***($219,159)***	***($152,840)***	***($56,607)***	***$3,525***	***$44,899***	***$66,551***	***$67,485***	

City of Palmer
Sewer Rate Study - Opt. B
Capital Improvement Plan
Exhibit 4

Inflation	**2.7%**

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	*Notes:*
WWTP - MBBR	$0	$0	7,600,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	
WWTP - Secondary Clarifiers	0	0	0	0	0	0	0	7,040,000	0	0	0	0	
Unidentified Future CIP	25,000	50,000	0	100,000	100,000	100,000	100,000	0	100,000	100,000	100,000	100,000	
Total Capital Improvement Projects	$25,000	$50,000	$7,600,000	$100,000	$100,000	$100,000	$100,000	$7,040,000	$100,000	$100,000	$100,000	$100,000	
Transfer to Cash Reserve	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Total Capital Improvement Projects	**$25,000**	**$50,000**	**$7,600,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$7,040,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	
Less: Outside Funding Sources													
Operating Fund - Sewer	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
System Development Charges (SDCs)	0	0	0	0	0	0	0	0	0	0	0	0	
DCCED Grant	0	0	2,500,000	0	0	0	0	0	0	0	0	0	
ADEC Loan	0	0	0	0	0	0	0	0	0	0	0	0	
ADEC Grant	0	0	0	0	0	0	0	0	0	0	0	0	
USDA Loan	0	0	2,764,000	0	0	0	0	3,817,000	0	0	0	0	*55% of Cost*
USDA Grant	0	0	2,261,000	0	0	0	0	3,123,000	0	0	0	0	*45% of Cost*
Low Interest Loans	0	0	0	0	0	0	0	0	0	0	0	0	
State Legislative Grants	0	0	0	0	0	0	0	0	0	0	0	0	
Revenue Bonds	0	0	0	0	0	0	0	0	0	0	0	0	
Total Funding Sources	$0	$0	$7,525,000	$0	$0	$0	$0	$6,940,000	$0	$0	$0	$0	
NET CIP FROM RATES	**$25,000**	**$50,000**	**$75,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	

City of Palmer
Sewer Rate Study - Opt. C
Summary of the Revenue Requirement
Exhibit 1

	Budget	Budget	Projected									
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Revenues:												
Rate Revenues	$979,910	$1,055,868	$1,066,427	$1,077,091	$1,087,862	$1,098,740	$1,109,728	$1,120,825	$1,132,033	$1,143,354	$1,154,787	$1,166,335
Miscellaneous Revenues	21,750	22,000	22,220	22,442	22,667	22,893	23,122	23,353	23,587	23,823	24,061	24,302
Total Source of Funds	**$1,001,660**	**$1,077,868**	**$1,088,647**	**$1,099,533**	**$1,110,528**	**$1,121,634**	**$1,132,850**	**$1,144,179**	**$1,155,620**	**$1,167,177**	**$1,178,848**	**$1,190,637**
Expenses												
Total Operations & Maintenance	**$878,273**	**$886,870**	**$913,476**	**$1,066,025**	**$1,140,973**	**$1,175,202**	**$1,210,458**	**$1,246,772**	**$1,284,175**	**$1,322,700**	**$1,362,381**	**$1,403,252**
Total Taxes	**$61,405**	**$65,992**	**$74,597**	**$86,072**	**$91,211**	**$96,661**	**$100,515**	**$104,524**	**$111,818**	**$112,936**	**$114,066**	**$115,206**
Rate Funded Capital	**$25,000**	**$50,000**	**$75,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**
Net Debt Service	**$102,537**	**$102,537**	**$102,537**	**$194,761**	**$194,761**	**$180,641**	**$180,641**	**$180,641**	**$307,970**	**$307,970**	**$307,970**	**$307,970**
Change in Working Capital +/-	**($65,555)**	**($27,531)**	**$77,669**	**($12,323)**	**($6,754)**	**$58,514**	**$83,635**	**$110,124**	**$59,672**	**$38,665**	**$16,678**	**($6,323)**
Total Revenue Requirement	**$1,001,660**	**$1,077,868**	**$1,243,279**	**$1,434,535**	**$1,520,191**	**$1,611,018**	**$1,675,249**	**$1,742,061**	**$1,863,635**	**$1,882,271**	**$1,901,094**	**$1,920,105**
Bal./(Def.) of Funds Before Added Tax	**$0**	**$0**	**($154,632)**	**($335,002)**	**($409,663)**	**($489,385)**	**($542,399)**	**($597,882)**	**($708,014)**	**($715,095)**	**($722,246)**	**($729,468)**
Balance as a % of Rate Adj. Required	**0.0%**	**0.0%**	**14.5%**	**31.1%**	**37.7%**	**44.5%**	**48.9%**	**53.3%**	**62.5%**	**62.5%**	**62.5%**	**62.5%**
Proposed Rate Adjustment	**0.0%**	**0.0%**	**14.5%**	**14.5%**	**5.0%**	**5.0%**	**3.0%**	**3.0%**	**6.0%**	**0.0%**	**0.0%**	**0.0%**
Add'l Revenue with Rate Adj.	**$0**	**$0**	**$154,632**	**$335,002**	**$409,663**	**$489,385**	**$542,399**	**$597,882**	**$708,014**	**$715,095**	**$722,246**	**$729,468**
Bal./Def. After Rate Adjustment	**$0**	**$0**	**($0)**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Additional Rate Adjustment Required	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Debt Service Coverage Ratio (all debt)												
Before Rate Adjustment	0.60	1.22	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
After Needed Rate Adjustment	0.60	1.22	2.49	1.45	1.48	1.88	2.02	2.16	1.52	1.45	1.38	1.30
After Proposed Rate Adjustment	0.60	1.22	2.49	1.45	1.48	1.88	2.02	2.16	1.52	1.45	1.38	1.30
Average Residential Customer Bill	$21.80	(Current rates; Customer charge + 4,000 gal)										
Customer Bill on Proposed Adjustment	$21.80	$21.80	$24.96	$28.58	$30.01	$31.51	$32.46	$33.43	$35.44	$35.44	$35.44	$35.44
Bill Difference - Monthly	$0.00	$0.00	$3.16	$3.62	$1.43	$1.50	$0.95	$0.97	$2.01	$0.00	$0.00	$0.00
Cumulative Bill Difference	$0.00	$0.00	$3.16	$6.78	$8.21	$9.71	$10.66	$11.63	$13.63	$13.63	$13.63	$13.63
Ending Fund Balance	$234,445	$206,914	$284,583	$272,259	$265,505	$324,019	$407,654	$517,778	$577,451	$616,116	$632,794	$626,470
Target Ending Minimum Fund Bal./(Def.)	$451,368	$453,087	$458,408	$488,918	$503,908	$510,753	$517,805	$525,067	$532,548	$540,253	$548,189	$556,363

City of Palmer
Sewer Rate Study - Opt. C
Escalation Factors
Exhibit 2

	Budget	Budget	Projected										
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Revenues:													
Customer Growth	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
Miscellaneous Revenues	Budget	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
Expenses:													
Labor	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Benefits - Medical	Budget	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	
Benefits - Other	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Purchased Water	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Materials & Supplies	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Equipment	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Miscellaneous	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Other Utilities	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Electricity	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Insurance	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Interest:	0.5%	0.8%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
New Debt Service:													
ADEC Loan													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	
USDA Loan													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	
Revenue Bond													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	

City of Palmer
Sewer Rate Study - Opt. C
Revenue Requirement
Exhibit 3

	Budget	Budget			Projected								
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Revenues													
Rate Revenues													
Residential	$0	$0	$498,776	$503,764	$508,801	$513,889	$519,028	$524,218	$529,461	$534,755	$540,103	$545,504	Customer Growth
Commercial	0	0	555,480	561,035	566,645	572,312	578,035	583,815	589,653	595,550	601,505	607,520	Customer Growth
Sewer Non Dependent	0	0	3,743	3,780	3,818	3,856	3,895	3,934	3,973	4,013	4,053	4,093	Customer Growth
Sewer Flat Rate	0	0	8,428	8,512	8,597	8,683	8,770	8,858	8,947	9,036	9,126	9,218	Customer Growth
Total Retail Rate Revenues	$979,910	$1,055,868	$1,066,427	$1,077,091	$1,087,862	$1,098,740	$1,109,728	$1,120,825	$1,132,033	$1,143,354	$1,154,787	$1,166,335	
Other Revenues													
Grants Admin Overhead	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	Flat
Service Fees	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Penalty	9,750	10,000	10,100	10,201	10,303	10,406	10,510	10,615	10,721	10,829	10,937	11,046	Miscellaneous Revenues
Connection Fee	12,000	12,000	12,120	12,241	12,364	12,487	12,612	12,738	12,866	12,994	13,124	13,255	Miscellaneous Revenues
Interest/Invest Earnings	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Miscellaneous Income	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Insurance Reimbursement	0	0	0	0	0	0	0	0	0	0	0	0	One Time Revenue
Total Other Revenues	$21,750	$22,000	$22,220	$22,442	$22,667	$22,893	$23,122	$23,353	$23,587	$23,823	$24,061	$24,302	
Total Revenues	**$1,001,660**	**$1,077,868**	**$1,088,647**	**$1,099,533**	**$1,110,528**	**$1,121,634**	**$1,132,850**	**$1,144,179**	**$1,155,620**	**$1,167,177**	**$1,178,848**	**$1,190,637**	
Expenses													
Operational Expenses													
Regular Salaries	$150,801	$152,994	$157,584	$162,311	$167,181	$172,196	$177,362	$182,683	$188,163	$193,808	$199,622	$205,611	Labor
Regular Benefits	115,528	124,838	128,583	132,441	136,414	140,506	144,721	149,063	153,535	158,141	162,885	167,772	Benefits - Other
Regular Overtime	3,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Labor
Personal Leave Expense	10,000	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Audit	5,497	7,296	7,515	7,740	7,973	8,212	8,458	8,712	8,973	9,242	9,520	9,805	Miscellaneous
Advertising	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Training	4,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Miscellaneous
Legal Fees	2,000	20,000	20,600	21,218	21,855	22,510	23,185	23,881	24,597	25,335	26,095	26,878	Miscellaneous
Engineering	5,000	7,000	7,210	7,426	7,649	7,879	8,115	8,358	8,609	8,867	9,133	9,407	Labor
Services	30,000	30,000	30,900	31,827	32,782	33,765	34,778	35,822	36,896	38,003	39,143	40,317	Miscellaneous
Contractual Services	15,000	40,000	41,200	42,436	43,709	45,020	46,371	47,762	49,195	50,671	52,191	53,757	Miscellaneous
Telephone	6,500	6,500	6,695	6,896	7,103	7,316	7,535	7,761	7,994	8,234	8,481	8,735	Miscellaneous
Power	175,000	175,000	180,250	185,658	191,227	196,964	202,873	208,959	215,228	221,685	228,335	235,185	Other Utilities
Heat	23,100	20,000	20,600	21,218	21,855	22,510	23,185	23,881	24,597	25,335	26,095	26,878	Other Utilities
Fuel	7,000	6,000	6,180	6,365	6,556	6,753	6,956	7,164	7,379	7,601	7,829	8,063	Materials & Supplies
Rental & Lease	4,000	4,000	4,120	4,244	4,371	4,502	4,637	4,776	4,919	5,067	5,219	5,376	Miscellaneous
Insurance	6,378	5,600	5,768	5,941	6,119	6,303	6,492	6,687	6,887	7,094	7,307	7,526	Insurance
Vehicle Insurance	3,901	3,801	3,915	4,032	4,153	4,278	4,406	4,539	4,675	4,815	4,959	5,108	Insurance
Office Supplies	1,600	1,600	1,648	1,697	1,748	1,801	1,855	1,910	1,968	2,027	2,088	2,150	Materials & Supplies
Operating Supplies	16,000	15,000	15,450	15,914	16,391	16,883	17,389	17,911	18,448	19,002	19,572	20,159	Materials & Supplies
Repair & Maintenance	25,000	27,000	27,810	28,644	29,504	30,389	31,300	32,239	33,207	34,203	35,229	36,286	Miscellaneous
Small Tools & Equipment	3,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Equipment
Chemicals	0	0	0	0	0	0	0	0	0	0	0	0	Materials & Supplies
Equipment	44,000	5,000	5,150	5,305	5,464	5,628	5,796	5,970	6,149	6,334	6,524	6,720	Equipment
Office Equipment	3,500	0	0	0	0	0	0	0	0	0	0	0	Equipment
Postage	4,000	4,000	4,120	4,244	4,371	4,502	4,637	4,776	4,919	5,067	5,219	5,376	Materials & Supplies
Interest	16,572	15,282	15,740	16,213	16,699	17,200	17,716	18,248	18,795	19,359	19,940	20,538	Miscellaneous
Alaska RR Permits	10,000	11,000	11,330	11,670	12,020	12,381	12,752	13,135	13,529	13,934	14,353	14,783	Miscellaneous
Safety Equipment	500	500	515	530	546	563	580	597	615	633	652	672	Miscellaneous
General Admin Exp	187,396	195,459	201,323	207,362	213,583	219,991	226,591	233,388	240,390	247,602	255,030	262,681	Miscellaneous
Computer Services	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Additional WWTP O&M Expenses	$0	$0	$0	$125,145	$171,866	$177,022	$182,332	$187,802	$193,436	$199,240	$205,217	$211,373	Materials & Supplies
Total Operations & Maintenance	**$878,273**	**$886,870**	**$913,476**	**$1,066,025**	**$1,140,973**	**$1,175,202**	**$1,210,458**	**$1,246,772**	**$1,284,175**	**$1,322,700**	**$1,362,381**	**$1,403,252**	

City of Palmer
Sewer Rate Study - Opt. C
Revenue Requirement
Exhibit 3

	Budget	Budget			Projected								
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Taxes													
Payment In Lieu of Taxes	$61,405	$65,992	$74,597	$86,072	$91,211	$96,661	$100,515	$104,524	$111,818	$112,936	$114,066	$115,206	*6% of Revenues*
Total Taxes	$61,405	$65,992	$74,597	$86,072	$91,211	$96,661	$100,515	$104,524	$111,818	$112,936	$114,066	$115,206	
Rate Funded Capital	$25,000	$50,000	$75,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	
Debt Service													
671011 - Sewer Repairs	$14,120	$14,120	$14,120	$14,120	$14,120	$0	$0	$0	$0	$0	$0	$0	Debt Schedule
671071 - SW Sanitary Sewer Extension	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	Debt Schedule
ADEC Loan	0	0	0	92,224	92,224	92,224	92,224	92,224	219,553	219,553	219,553	219,553	Calc'd @ 2% for 20 yrs.
USDA Loan	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 3.4% for 20 yrs.
New Revenue bonds	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 5% for 20 yrs.
New Low interest loans	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 2% for 20 yrs.
Total Debt Service	$102,537	$102,537	$102,537	$194,761	$194,761	$180,641	$180,641	$180,641	$307,970	$307,970	$307,970	$307,970	
Less: Debt Service Funding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Total Less Debt Service Funding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Net Debt Service	$102,537	$102,537	$102,537	$194,761	$194,761	$180,641	$180,641	$180,641	$307,970	$307,970	$307,970	$307,970	
Change in Working Capital +/-	($65,555)	($27,531)	$77,669	($12,323)	($6,754)	$58,514	$83,635	$110,124	$59,672	$38,665	$16,678	($6,323)	
Total Revenue Requirement	**$1,001,660**	**$1,077,868**	**$1,243,279**	**$1,434,535**	**$1,520,191**	**$1,611,018**	**$1,675,249**	**$1,742,061**	**$1,863,635**	**$1,882,271**	**$1,901,094**	**$1,920,105**	
Bal./(Def.) of Funds Before Added Tax	**$0**	**$0**	**($154,632)**	**($335,002)**	**($409,663)**	**($489,385)**	**($542,399)**	**($597,882)**	**($708,014)**	**($715,095)**	**($722,246)**	**($729,468)**	
Balance as a % of Rate Adj. Required	**0.0%**	**0.0%**	**14.5%**	**31.1%**	**37.7%**	**44.5%**	**48.9%**	**53.3%**	**62.5%**	**62.5%**	**62.5%**	**62.5%**	
Proposed Rate Adjustment	**0.0%**	**0.0%**	**14.5%**	**14.5%**	**5.0%**	**5.0%**	**3.0%**	**3.0%**	**6.0%**	**0.0%**	**0.0%**	**0.0%**	
Add'l Revenue with Rate Adj.	**$0**	**$0**	**$154,632**	**$335,002**	**$409,663**	**$489,385**	**$542,399**	**$597,882**	**$708,014**	**$715,095**	**$722,246**	**$729,468**	
Bal./Def. After Rate Adjustment	**$0**	**$0**	**($0)**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	
Additional Rate Adjustment Required	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	

City of Palmer
Sewer Rate Study - Opt. C
Revenue Requirement
Exhibit 3

	Budget	Budget	Projected										
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Average Residential Customer Bill	**$21.80**	*(Current rates; Customer charge + 4,000 gal)*											
Customer Bill after Rate Adj. Req'd	$21.80	$21.80	$24.96	$28.58	$30.01	$31.51	$32.46	$33.43	$35.44	$35.44	$35.44	$35.44	
Bill Difference - Monthly	0.00	0.00	3.16	3.62	1.43	1.50	0.95	0.97	2.01	0.00	0.00	0.00	
Cumulative Bill Difference	0.00	0.00	3.16	6.78	8.21	9.71	10.66	11.63	13.63	13.63	13.63	13.63	
Customer Bill on Proposed Adjustment	$21.80	$21.80	$24.96	$28.58	$30.01	$31.51	$32.46	$33.43	$35.44	$35.44	$35.44	$35.44	
Bill Difference - Monthly	0.00	0.00	3.16	3.62	1.43	1.50	0.95	0.97	2.01	0.00	0.00	0.00	
Cumulative Bill Difference	0.00	0.00	3.16	6.78	8.21	9.71	10.66	11.63	13.63	13.63	13.63	13.63	
Debt Service Coverage Ratio (all debt)													
Before Rate Adjustment	0.60	1.22	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
After Needed Rate Adjustment	0.60	1.22	2.49	1.45	1.48	1.88	2.02	2.16	1.52	1.45	1.38	1.30	
After Proposed Rate Adjustment	0.60	1.22	2.49	1.45	1.48	1.88	2.02	2.16	1.52	1.45	1.38	1.30	
Cash Reserves													
Operating Fund													
Beginning Balance	$300,000	$234,445	$206,914	$284,583	$272,259	$265,505	$324,019	$407,654	$517,778	$577,451	$616,116	$632,794	
Plus: Additions	0	0	77,669	0	0	58,514	83,635	110,124	59,672	38,665	16,678	0	
Less: EPA Fees	0	0	0	0	0	0	0	0	0	0	0	0	
Less: Uses of Funds	(65,555)	(27,531)	0	(12,323)	(6,754)	0	0	0	0	0	0	(6,323)	
Ending Balance	$234,445	$206,914	$284,583	$272,259	$265,505	$324,019	$407,654	$517,778	$577,451	$616,116	$632,794	$626,470	
Target: 20% of O&M	$175,655	$177,374	$182,695	$213,205	$228,195	$235,040	$242,092	$249,354	$256,835	$264,540	$272,476	$280,650	
Target: 50% of Annual Depreciation	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	
Target Minimum Fund Balance	**$451,368**	**$453,087**	**$458,408**	**$488,918**	**$503,908**	**$510,753**	**$517,805**	**$525,067**	**$532,548**	**$540,253**	**$548,189**	**$556,363**	
Target Ending Minimum Fund Bal./(Def.)	***($216,923)***	***($246,173)***	***($173,825)***	***($216,659)***	***($238,402)***	***($186,734)***	***($110,151)***	***($7,289)***	***$44,903***	***$75,863***	***$84,605***	***$70,107***	

City of Palmer
Sewer Rate Study - Opt. C
Capital Improvement Plan
Exhibit 4

Inflation	**2.7%**

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	*Notes:*
WWTP - MBBR	$0	$0	$7,600,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	
WWTP - Secondary Clarifiers	0	0	0	0	0	0	0	7,040,000	0	0	0	0	
Unidentified Future CIP	25,000	50,000	0	100,000	100,000	100,000	100,000	0	100,000	100,000	100,000	100,000	
Total Capital Improvement Projects	$25,000	$50,000	$7,600,000	$100,000	$100,000	$100,000	$100,000	$7,040,000	$100,000	$100,000	$100,000	$100,000	
Transfer to Cash Reserve	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Total Capital Improvement Projects	**$25,000**	**$50,000**	**$7,600,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$7,040,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	
Less: Outside Funding Sources													
Operating Fund - Sewer	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
System Development Charges (SDCs)	0	0	0	0	0	0	0	0	0	0	0	0	
DCCED Grant	0	0	2,500,000	0	0	0	0	0	0	0	0	0	
ADEC Loan	0	0	1,508,000	0	0	0	0	2,082,000	0	0	0	0	*30% of Cost*
ADEC Grant	0	0	3,517,000	0	0	0	0	4,858,000	0	0	0	0	*70% of Cost*
USDA Loan	0	0	0	0	0	0	0	0	0	0	0	0	
USDA Grant	0	0	0	0	0	0	0	0	0	0	0	0	
Low Interest Loans	0	0	0	0	0	0	0	0	0	0	0	0	
State Legislative Grants	0	0	0	0	0	0	0	0	0	0	0	0	
Revenue Bonds	0	0	0	0	0	0	0	0	0	0	0	0	
Total Funding Sources	$0	$0	$7,525,000	$0	$0	$0	$0	$6,940,000	$0	$0	$0	$0	
NET CIP FROM RATES	**$25,000**	**$50,000**	**$75,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	

City of Palmer
Sewer Rate Study - Opt. D
Summary of the Revenue Requirement
Exhibit 1

	Budget	Budget	Projected									
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Revenues:												
Rate Revenues	$979,910	$1,055,868	$1,066,427	$1,077,091	$1,087,862	$1,098,740	$1,109,728	$1,120,825	$1,132,033	$1,143,354	$1,154,787	$1,166,335
Miscellaneous Revenues	21,750	22,000	22,220	22,442	22,667	22,893	23,122	23,353	23,587	23,823	24,061	24,302
Total Source of Funds	**$1,001,660**	**$1,077,868**	**$1,088,647**	**$1,099,533**	**$1,110,528**	**$1,121,634**	**$1,132,850**	**$1,144,179**	**$1,155,620**	**$1,167,177**	**$1,178,848**	**$1,190,637**
Expenses												
Total Operations & Maintenance	**$878,273**	**$886,870**	**$913,476**	**$1,066,025**	**$1,140,973**	**$1,175,202**	**$1,210,458**	**$1,246,772**	**$1,284,175**	**$1,322,700**	**$1,362,381**	**$1,403,252**
Total Taxes	**$61,405**	**$65,992**	**$75,556**	**$88,307**	**$95,777**	**$103,887**	**$108,032**	**$112,343**	**$122,991**	**$124,221**	**$125,463**	**$126,718**
Rate Funded Capital	**$25,000**	**$50,000**	**$75,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**
Net Debt Service	**$102,537**	**$102,537**	**$102,537**	**$309,045**	**$309,045**	**$294,925**	**$294,925**	**$294,925**	**$465,623**	**$465,623**	**$465,623**	**$465,623**
Change in Working Capital +/-	**($65,555)**	**($27,531)**	**$92,705**	**($91,601)**	**($49,514)**	**$57,431**	**$87,114**	**$118,349**	**$77,063**	**$57,807**	**$37,587**	**$16,371**
Total Revenue Requirement	**$1,001,660**	**$1,077,868**	**$1,259,275**	**$1,471,776**	**$1,596,281**	**$1,731,445**	**$1,800,528**	**$1,872,389**	**$2,049,852**	**$2,070,351**	**$2,091,054**	**$2,111,965**
Bal./(Def.) of Funds Before Added Tax	**$0**	**$0**	**($170,628)**	**($372,243)**	**($485,752)**	**($609,811)**	**($667,678)**	**($728,210)**	**($894,232)**	**($903,174)**	**($912,206)**	**($921,328)**
Balance as a % of Rate Adj. Required	**0.0%**	**0.0%**	**16.0%**	**34.6%**	**44.7%**	**55.5%**	**60.2%**	**65.0%**	**79.0%**	**79.0%**	**79.0%**	**79.0%**
Proposed Rate Adjustment	**0.0%**	**0.0%**	**16.0%**	**16.0%**	**7.5%**	**7.5%**	**3.0%**	**3.0%**	**8.5%**	**0.0%**	**0.0%**	**0.0%**
Add'l Revenue with Rate Adj.	**$0**	**$0**	**$170,628**	**$372,243**	**$485,752**	**$609,811**	**$667,678**	**$728,210**	**$894,232**	**$903,174**	**$912,206**	**$921,328**
Bal./Def. After Rate Adjustment	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**($0)**	**$0**	**$0**	**$0**	**$0**
Additional Rate Adjustment Required	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Debt Service Coverage Ratio (all debt)												
Before Rate Adjustment	0.60	1.22	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
After Needed Rate Adjustment	0.60	1.22	2.64	1.03	1.16	1.53	1.63	1.74	1.38	1.34	1.30	1.25
After Proposed Rate Adjustment	0.60	1.22	2.64	1.03	1.16	1.53	1.63	1.74	1.38	1.34	1.30	1.25
Average Residential Customer Bill	$21.80	(Current rates; Customer charge + 4,000 gal)										
Customer Bill on Proposed Adjustment	$21.80	$21.80	$25.29	$29.33	$31.53	$33.90	$34.92	$35.96	$39.02	$39.02	$39.02	$39.02
Bill Difference - Monthly	$0.00	$0.00	$3.49	$4.05	$2.20	$2.37	$1.02	$1.05	$3.06	$0.00	$0.00	$0.00
Cumulative Bill Difference	$0.00	$0.00	$3.49	$7.53	$9.73	$12.10	$13.12	$14.16	$17.22	$17.22	$17.22	$17.22
Ending Fund Balance	$234,445	$206,914	$299,619	$208,018	$158,504	$215,935	$303,049	$421,398	$498,461	$556,267	$593,854	$610,225
Target Ending Minimum Fund Bal./(Def.)	$451,368	$453,087	$458,408	$488,918	$503,908	$510,753	$517,805	$525,067	$532,548	$540,253	$548,189	$556,363

City of Palmer
Sewer Rate Study - Opt. D
Escalation Factors
Exhibit 2

	Budget	Budget	Projected										
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	*Notes*
Revenues:													
Customer Growth	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
Miscellaneous Revenues	Budget	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
Expenses:													
Labor	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Benefits - Medical	Budget	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	
Benefits - Other	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Purchased Water	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Materials & Supplies	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Equipment	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Miscellaneous	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Other Utilities	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Electricity	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Insurance	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Interest:	0.5%	0.8%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
New Debt Service:													
ADEC Loan													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	
USDA Loan													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	
Revenue Bond													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	

City of Palmer
Sewer Rate Study - Opt. D
Revenue Requirement
Exhibit 3

	Budget	Budget	Projected										
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Revenues													
Rate Revenues													
Residential	$0	$0	$498,776	$503,764	$508,801	$513,889	$519,028	$524,218	$529,461	$534,755	$540,103	$545,504	Customer Growth
Commercial	0	0	555,480	561,035	566,645	572,312	578,035	583,815	589,653	595,550	601,505	607,520	Customer Growth
Sewer Non Dependent	0	0	3,743	3,780	3,818	3,856	3,895	3,934	3,973	4,013	4,053	4,093	Customer Growth
Sewer Flat Rate	0	0	8,428	8,512	8,597	8,683	8,770	8,858	8,947	9,036	9,126	9,218	Customer Growth
Total Retail Rate Revenues	$979,910	$1,055,868	$1,066,427	$1,077,091	$1,087,862	$1,098,740	$1,109,728	$1,120,825	$1,132,033	$1,143,354	$1,154,787	$1,166,335	
Other Revenues													
Grants Admin Overhead	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	Flat
Service Fees	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Penalty	9,750	10,000	10,100	10,201	10,303	10,406	10,510	10,615	10,721	10,829	10,937	11,046	Miscellaneous Revenues
Connection Fee	12,000	12,000	12,120	12,241	12,364	12,487	12,612	12,738	12,866	12,994	13,124	13,255	Miscellaneous Revenues
Interest/Invest Earnings	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Miscellaneous Income	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Insurance Reimbursement	0	0	0	0	0	0	0	0	0	0	0	0	One Time Revenue
Total Other Revenues	$21,750	$22,000	$22,220	$22,442	$22,667	$22,893	$23,122	$23,353	$23,587	$23,823	$24,061	$24,302	
Total Revenues	**$1,001,660**	**$1,077,868**	**$1,088,647**	**$1,099,533**	**$1,110,528**	**$1,121,634**	**$1,132,850**	**$1,144,179**	**$1,155,620**	**$1,167,177**	**$1,178,848**	**$1,190,637**	
Expenses													
Operational Expenses													
Regular Salaries	$150,801	$152,994	$157,584	$162,311	$167,181	$172,196	$177,362	$182,683	$188,163	$193,808	$199,622	$205,611	Labor
Regular Benefits	115,528	124,838	128,583	132,441	136,414	140,506	144,721	149,063	153,535	158,141	162,885	167,772	Benefits - Other
Regular Overtime	3,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Labor
Personal Leave Expense	10,000	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Audit	5,497	7,296	7,515	7,740	7,973	8,212	8,458	8,712	8,973	9,242	9,520	9,805	Miscellaneous
Advertising	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Training	4,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Miscellaneous
Legal Fees	2,000	20,000	20,600	21,218	21,855	22,510	23,185	23,881	24,597	25,335	26,095	26,878	Miscellaneous
Engineering	5,000	7,000	7,210	7,426	7,649	7,879	8,115	8,358	8,609	8,867	9,133	9,407	Labor
Services	30,000	30,000	30,900	31,827	32,782	33,765	34,778	35,822	36,896	38,003	39,143	40,317	Miscellaneous
Contractual Services	15,000	40,000	41,200	42,436	43,709	45,020	46,371	47,762	49,195	50,671	52,191	53,757	Miscellaneous
Telephone	6,500	6,500	6,695	6,896	7,103	7,316	7,535	7,761	7,994	8,234	8,481	8,735	Miscellaneous
Power	175,000	175,000	180,250	185,658	191,227	196,964	202,873	208,959	215,228	221,685	228,335	235,185	Other Utilities
Heat	23,100	20,000	20,600	21,218	21,855	22,510	23,185	23,881	24,597	25,335	26,095	26,878	Other Utilities
Fuel	7,000	6,000	6,180	6,365	6,556	6,753	6,956	7,164	7,379	7,601	7,829	8,063	Materials & Supplies
Rental & Lease	4,000	4,000	4,120	4,244	4,371	4,502	4,637	4,776	4,919	5,067	5,219	5,376	Miscellaneous
Insurance	6,378	5,600	5,768	5,941	6,119	6,303	6,492	6,687	6,887	7,094	7,307	7,526	Insurance
Vehicle Insurance	3,901	3,801	3,915	4,032	4,153	4,278	4,406	4,539	4,675	4,815	4,959	5,108	Insurance
Office Supplies	1,600	1,600	1,648	1,697	1,748	1,801	1,855	1,910	1,968	2,027	2,088	2,150	Materials & Supplies
Operating Supplies	16,000	15,000	15,450	15,914	16,391	16,883	17,389	17,911	18,448	19,002	19,572	20,159	Materials & Supplies
Repair & Maintenance	25,000	27,000	27,810	28,644	29,504	30,389	31,300	32,239	33,207	34,203	35,229	36,286	Miscellaneous
Small Tools & Equipment	3,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Equipment
Chemicals	0	0	0	0	0	0	0	0	0	0	0	0	Materials & Supplies
Equipment	44,000	5,000	5,150	5,305	5,464	5,628	5,796	5,970	6,149	6,334	6,524	6,720	Equipment
Office Equipment	3,500	0	0	0	0	0	0	0	0	0	0	0	Equipment
Postage	4,000	4,000	4,120	4,244	4,371	4,502	4,637	4,776	4,919	5,067	5,219	5,376	Materials & Supplies
Interest	16,572	15,282	15,740	16,213	16,699	17,200	17,716	18,248	18,795	19,359	19,940	20,538	Miscellaneous
Alaska RR Permits	10,000	11,000	11,330	11,670	12,020	12,381	12,752	13,135	13,529	13,934	14,353	14,783	Miscellaneous
Safety Equipment	500	500	515	530	546	563	580	597	615	633	652	672	Miscellaneous
General Admin Exp	187,396	195,459	201,323	207,362	213,583	219,991	226,591	233,388	240,390	247,602	255,030	262,681	Miscellaneous
Computer Services	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Additional WWTP O&M Expenses	$0	$0	$0	$125,145	$171,866	$177,022	$182,332	$187,802	$193,436	$199,240	$205,217	$211,373	Materials & Supplies
Total Operations & Maintenance	**$878,273**	**$886,870**	**$913,476**	**$1,066,025**	**$1,140,973**	**$1,175,202**	**$1,210,458**	**$1,246,772**	**$1,284,175**	**$1,322,700**	**$1,362,381**	**$1,403,252**	

City of Palmer
Sewer Rate Study - Opt. D
Revenue Requirement
Exhibit 3

	Budget	Budget	Projected										
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Taxes													
Payment In Lieu of Taxes	$61,405	$65,992	$75,556	$88,307	$95,777	$103,887	$108,032	$112,343	$122,991	$124,221	$125,463	$126,718	*6% of Revenues*
Total Taxes	$61,405	$65,992	$75,556	$88,307	$95,777	$103,887	$108,032	$112,343	$122,991	$124,221	$125,463	$126,718	
Rate Funded Capital	$25,000	$50,000	$75,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	
Debt Service													
671011 - Sewer Repairs	$14,120	$14,120	$14,120	$14,120	$14,120	$0	$0	$0	$0	$0	$0	$0	Debt Schedule
671071 - SW Sanitary Sewer Extension	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	Debt Schedule
ADEC Loan	0	0	0	75,284	75,284	75,284	75,284	75,284	162,799	162,799	162,799	162,799	Calc'd @ 2% for 20 yrs.
USDA Loan	0	0	0	131,224	131,224	131,224	131,224	131,224	214,407	214,407	214,407	214,407	Calc'd @ 3.4% for 20 yrs.
New Revenue bonds	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 5% for 20 yrs.
New Low interest loans	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 2% for 20 yrs.
Total Debt Service	$102,537	$102,537	$102,537	$309,045	$309,045	$294,925	$294,925	$294,925	$465,623	$465,623	$465,623	$465,623	
Less: Debt Service Funding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Total Less Debt Service Funding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Net Debt Service	$102,537	$102,537	$102,537	$309,045	$309,045	$294,925	$294,925	$294,925	$465,623	$465,623	$465,623	$465,623	
Change in Working Capital +/-	($65,555)	($27,531)	$92,705	($91,601)	($49,514)	$57,431	$87,114	$118,349	$77,063	$57,807	$37,587	$16,371	
Total Revenue Requirement	**$1,001,660**	**$1,077,868**	**$1,259,275**	**$1,471,776**	**$1,596,281**	**$1,731,445**	**$1,800,528**	**$1,872,389**	**$2,049,852**	**$2,070,351**	**$2,091,054**	**$2,111,965**	
Bal./(Def.) of Funds Before Added Tax	**$0**	**$0**	**($170,628)**	**($372,243)**	**($485,752)**	**($609,811)**	**($667,678)**	**($728,210)**	**($894,232)**	**($903,174)**	**($912,206)**	**($921,328)**	
Balance as a % of Rate Adj. Required	**0.0%**	**0.0%**	**16.0%**	**34.6%**	**44.7%**	**55.5%**	**60.2%**	**65.0%**	**79.0%**	**79.0%**	**79.0%**	**79.0%**	
Proposed Rate Adjustment	**0.0%**	**0.0%**	**16.0%**	**16.0%**	**7.5%**	**7.5%**	**3.0%**	**3.0%**	**8.5%**	**0.0%**	**0.0%**	**0.0%**	
Add'l Revenue with Rate Adj.	**$0**	**$0**	**$170,628**	**$372,243**	**$485,752**	**$609,811**	**$667,678**	**$728,210**	**$894,232**	**$903,174**	**$912,206**	**$921,328**	
Bal./Def. After Rate Adjustment	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**($0)**	**$0**	**$0**	**$0**	**$0**	
Additional Rate Adjustment Required	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	

City of Palmer
Sewer Rate Study - Opt. D
Revenue Requirement
Exhibit 3

	Budget	Budget	Projected										
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Average Residential Customer Bill	**$21.80**	*(Current rates; Customer charge + 4,000 gal)*											
Customer Bill after Rate Adj. Req'd	$21.80	$21.80	$25.29	$29.33	$31.53	$33.90	$34.92	$35.96	$39.02	$39.02	$39.02	$39.02	
Bill Difference - Monthly	0.00	0.00	3.49	4.05	2.20	2.37	1.02	1.05	3.06	0.00	0.00	0.00	
Cumulative Bill Difference	0.00	0.00	3.49	7.53	9.73	12.10	13.12	14.16	17.22	17.22	17.22	17.22	
Customer Bill on Proposed Adjustment	$21.80	$21.80	$25.29	$29.33	$31.53	$33.90	$34.92	$35.96	$39.02	$39.02	$39.02	$39.02	
Bill Difference - Monthly	0.00	0.00	3.49	4.05	2.20	2.37	1.02	1.05	3.06	0.00	0.00	0.00	
Cumulative Bill Difference	0.00	0.00	3.49	7.53	9.73	12.10	13.12	14.16	17.22	17.22	17.22	17.22	
Debt Service Coverage Ratio (all debt)													
Before Rate Adjustment	0.60	1.22	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
After Needed Rate Adjustment	0.60	1.22	2.64	1.03	1.16	1.53	1.63	1.74	1.38	1.34	1.30	1.25	
After Proposed Rate Adjustment	0.60	1.22	2.64	1.03	1.16	1.53	1.63	1.74	1.38	1.34	1.30	1.25	
Cash Reserves													
Operating Fund													
Beginning Balance	$300,000	$234,445	$206,914	$299,619	$208,018	$158,504	$215,935	$303,049	$421,398	$498,461	$556,267	$593,854	
Plus: Additions	0	0	92,705	0	0	57,431	87,114	118,349	77,063	57,807	37,587	16,371	
Less: EPA Fees	0	0	0	0	0	0	0	0	0	0	0	0	
Less: Uses of Funds	(65,555)	(27,531)	0	(91,601)	(49,514)	0	0	0	0	0	0	0	
Ending Balance	$234,445	$206,914	$299,619	$208,018	$158,504	$215,935	$303,049	$421,398	$498,461	$556,267	$593,854	$610,225	
Target: 20% of O&M	$175,655	$177,374	$182,695	$213,205	$228,195	$235,040	$242,092	$249,354	$256,835	$264,540	$272,476	$280,650	
Target: 50% of Annual Depreciation	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	
Target Minimum Fund Balance	**$451,368**	**$453,087**	**$458,408**	**$488,918**	**$503,908**	**$510,753**	**$517,805**	**$525,067**	**$532,548**	**$540,253**	**$548,189**	**$556,363**	
Target Ending Minimum Fund Bal./(Def.)	***($216,923)***	***($246,173)***	***($158,789)***	***($280,900)***	***($345,403)***	***($294,818)***	***($214,756)***	***($103,670)***	***($34,087)***	***$16,014***	***$45,665***	***$53,862***	

City of Palmer
Sewer Rate Study - Opt. D
Capital Improvement Plan
Exhibit 4

Inflation 2.7%

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	*Notes:*
WWTP - MBBR	$0	$0	$7,600,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	
WWTP - Secondary Clarifiers	0	0	0	0	0	0	0	7,040,000	0	0	0	0	
Unidentified Future CIP	25,000	50,000	0	100,000	100,000	100,000	100,000	0	100,000	100,000	100,000	100,000	
Total Capital Improvement Projects	$25,000	$50,000	$7,600,000	$100,000	$100,000	$100,000	$100,000	$7,040,000	$100,000	$100,000	$100,000	$100,000	
Transfer to Cash Reserve	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Total Capital Improvement Projects	**$25,000**	**$50,000**	**$7,600,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$7,040,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	
Less: Outside Funding Sources													
Operating Fund - Sewer	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
System Development Charges (SDCs)	0	0	0	0	0	0	0	0	0	0	0	0	
DCCED Grant	0	0	0	0	0	0	0	0	0	0	0	0	
ADEC Loan	0	0	1,231,000	0	0	0	0	1,431,000	0	0	0	0	*30% of Cost*
ADEC Grant	0	0	2,873,000	0	0	0	0	3,340,000	0	0	0	0	*70% of Cost*
USDA Loan	0	0	1,882,000	0	0	0	0	1,193,000	0	0	0	0	*55% of Cost*
USDA Grant	0	0	1,539,000	0	0	0	0	976,000	0	0	0	0	*45% of Cost*
Low Interest Loans	0	0	0	0	0	0	0	0	0	0	0	0	
State Legislative Grants	0	0	0	0	0	0	0	0	0	0	0	0	
Revenue Bonds	0	0	0	0	0	0	0	0	0	0	0	0	
Total Funding Sources	$0	$0	$7,525,000	$0	$0	$0	$0	$6,940,000	$0	$0	$0	$0	
NET CIP FROM RATES	**$25,000**	**$50,000**	**$75,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	

City of Palmer
Sewer Rate Study - Opt. E
Summary of the Revenue Requirement
Exhibit 1

	Budget	Budget	Projected									
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Revenues:												
Rate Revenues	$979,910	$1,055,868	$1,066,427	$1,077,091	$1,087,862	$1,098,740	$1,109,728	$1,120,825	$1,132,033	$1,143,354	$1,154,787	$1,166,335
Miscellaneous Revenues	21,750	22,000	22,220	22,442	22,667	22,893	23,122	23,353	23,587	23,823	24,061	24,302
Total Source of Funds	**$1,001,660**	**$1,077,868**	**$1,088,647**	**$1,099,533**	**$1,110,528**	**$1,121,634**	**$1,132,850**	**$1,144,179**	**$1,155,620**	**$1,167,177**	**$1,178,848**	**$1,190,637**
Expenses												
Total Operations & Maintenance	**$878,273**	**$886,870**	**$913,476**	**$1,066,025**	**$1,140,973**	**$1,175,202**	**$1,210,458**	**$1,246,772**	**$1,284,175**	**$1,322,700**	**$1,362,381**	**$1,403,252**
Total Taxes	**$61,405**	**$65,992**	**$112,028**	**$194,764**	**$339,318**	**$342,712**	**$346,139**	**$349,600**	**$353,096**	**$356,627**	**$360,193**	**$363,795**
Rate Funded Capital	**$25,000**	**$50,000**	**$75,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**
Net Debt Service	**$102,537**	**$102,537**	**$102,537**	**$102,537**	**$102,537**	**$186,268**	**$186,268**	**$186,268**	**$186,268**	**$186,268**	**$186,268**	**$186,268**
Change in Working Capital +/-	**($65,555)**	**($27,531)**	**$664,097**	**$1,782,741**	**$3,972,479**	**$3,907,679**	**$3,926,115**	**$3,944,029**	**$3,961,397**	**$3,978,190**	**$3,994,381**	**$4,009,940**
Total Revenue Requirement	**$1,001,660**	**$1,077,868**	**$1,867,138**	**$3,246,068**	**$5,655,307**	**$5,711,861**	**$5,768,979**	**$5,826,669**	**$5,884,936**	**$5,943,785**	**$6,003,223**	**$6,063,255**
Bal./(Def.) of Funds Before Added Tax	**$0**	**$0**	**($778,491)**	**($2,146,535)**	**($4,544,779)**	**($4,590,227)**	**($4,636,129)**	**($4,682,490)**	**($4,729,315)**	**($4,776,608)**	**($4,824,374)**	**($4,872,618)**
Balance as a % of Rate Adj. Required	**0.0%**	**0.0%**	**73.0%**	**199.3%**	**417.8%**	**417.8%**	**417.8%**	**417.8%**	**417.8%**	**417.8%**	**417.8%**	**417.8%**
Proposed Rate Adjustment	**0.0%**	**0.0%**	**73.0%**	**73.0%**	**73.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Add'l Revenue with Rate Adj.	**$0**	**$0**	**$778,491**	**$2,146,535**	**$4,544,779**	**$4,590,227**	**$4,636,129**	**$4,682,490**	**$4,729,315**	**$4,776,608**	**$4,824,374**	**$4,872,618**
Bal./Def. After Rate Adjustment	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Additional Rate Adjustment Required	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Debt Service Coverage Ratio (all debt)												
Before Rate Adjustment	0.60	1.22	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
After Needed Rate Adjustment	0.60	1.22	8.21	19.36	40.72	22.52	22.61	22.71	22.80	22.89	22.98	23.06
After Proposed Rate Adjustment	0.60	1.22	8.21	19.36	40.72	22.52	22.61	22.71	22.80	22.89	22.98	23.06
Average Residential Customer Bill	$21.80	(Current rates; Customer charge + 4,000 gal)										
Customer Bill on Proposed Adjustment	$21.80	$21.80	$37.72	$65.25	$112.88	$112.88	$112.88	$112.88	$112.88	$112.88	$112.88	$112.88
Bill Difference - Monthly	$0.00	$0.00	$15.91	$27.53	$47.63	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Cumulative Bill Difference	$0.00	$0.00	$15.91	$43.45	$91.08	$91.08	$91.08	$91.08	$91.08	$91.08	$91.08	$91.08
Ending Fund Balance	$234,445	$206,914	$871,011	$2,653,752	$310,231	$4,217,911	$8,144,026	$12,088,055	$8,919,452	$12,897,642	$16,892,023	$20,901,963
Target Ending Minimum Fund Bal./(Def.)	$451,368	$453,087	$458,408	$488,918	$503,908	$510,753	$517,805	$525,067	$532,548	$540,253	$548,189	$556,363

	Budget	Budget	Projected										
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	*Notes*
Revenues:													
Customer Growth	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
Miscellaneous Revenues	Budget	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
Expenses:													
Labor	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Benefits - Medical	Budget	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	
Benefits - Other	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Purchased Water	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Materials & Supplies	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Equipment	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Miscellaneous	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Other Utilities	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Electricity	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Insurance	Budget	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	
Interest:	0.5%	0.8%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	
New Debt Service:													
ADEC Loan													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	
USDA Loan													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	
Revenue Bond													
Term in Years	20	20	20	20	20	20	20	20	20	20	20	20	
Rate	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	

City of Palmer
Sewer Rate Study - Opt. E
Revenue Requirement
Exhibit 3

	Budget	Budget			Projected								
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Revenues													
Rate Revenues													
Residential	$0	$0	$498,776	$503,764	$508,801	$513,889	$519,028	$524,218	$529,461	$534,755	$540,103	$545,504	Customer Growth
Commercial	0	0	555,480	561,035	566,645	572,312	578,035	583,815	589,653	595,550	601,505	607,520	Customer Growth
Sewer Non Dependent	0	0	3,743	3,780	3,818	3,856	3,895	3,934	3,973	4,013	4,053	4,093	Customer Growth
Sewer Flat Rate	0	0	8,428	8,512	8,597	8,683	8,770	8,858	8,947	9,036	9,126	9,218	Customer Growth
Total Retail Rate Revenues	$979,910	$1,055,868	$1,066,427	$1,077,091	$1,087,862	$1,098,740	$1,109,728	$1,120,825	$1,132,033	$1,143,354	$1,154,787	$1,166,335	
Other Revenues													
Grants Admin Overhead	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	Flat
Service Fees	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Penalty	9,750	10,000	10,100	10,201	10,303	10,406	10,510	10,615	10,721	10,829	10,937	11,046	Miscellaneous Revenues
Connection Fee	12,000	12,000	12,120	12,241	12,364	12,487	12,612	12,738	12,866	12,994	13,124	13,255	Miscellaneous Revenues
Interest/Invest Earnings	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Miscellaneous Income	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous Revenues
Insurance Reimbursement	0	0	0	0	0	0	0	0	0	0	0	0	One Time Revenue
Total Other Revenues	$21,750	$22,000	$22,220	$22,442	$22,667	$22,893	$23,122	$23,353	$23,587	$23,823	$24,061	$24,302	
Total Revenues	**$1,001,660**	**$1,077,868**	**$1,088,647**	**$1,099,533**	**$1,110,528**	**$1,121,634**	**$1,132,850**	**$1,144,179**	**$1,155,620**	**$1,167,177**	**$1,178,848**	**$1,190,637**	
Expenses													
Operational Expenses													
Regular Salaries	$150,801	$152,994	$157,584	$162,311	$167,181	$172,196	$177,362	$182,683	$188,163	$193,808	$199,622	$205,611	Labor
Regular Benefits	115,528	124,838	128,583	132,441	136,414	140,506	144,721	149,063	153,535	158,141	162,885	167,772	Benefits - Other
Regular Overtime	3,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Labor
Personal Leave Expense	10,000	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Audit	5,497	7,296	7,515	7,740	7,973	8,212	8,458	8,712	8,973	9,242	9,520	9,805	Miscellaneous
Advertising	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Training	4,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Miscellaneous
Legal Fees	2,000	20,000	20,600	21,218	21,855	22,510	23,185	23,881	24,597	25,335	26,095	26,878	Miscellaneous
Engineering	5,000	7,000	7,210	7,426	7,649	7,879	8,115	8,358	8,609	8,867	9,133	9,407	Labor
Services	30,000	30,000	30,900	31,827	32,782	33,765	34,778	35,822	36,896	38,003	39,143	40,317	Miscellaneous
Contractual Services	15,000	40,000	41,200	42,436	43,709	45,020	46,371	47,762	49,195	50,671	52,191	53,757	Miscellaneous
Telephone	6,500	6,500	6,695	6,896	7,103	7,316	7,535	7,761	7,994	8,234	8,481	8,735	Miscellaneous
Power	175,000	175,000	180,250	185,658	191,227	196,964	202,873	208,959	215,228	221,685	228,335	235,185	Other Utilities
Heat	23,100	20,000	20,600	21,218	21,855	22,510	23,185	23,881	24,597	25,335	26,095	26,878	Other Utilities
Fuel	7,000	6,000	6,180	6,365	6,556	6,753	6,956	7,164	7,379	7,601	7,829	8,063	Materials & Supplies
Rental & Lease	4,000	4,000	4,120	4,244	4,371	4,502	4,637	4,776	4,919	5,067	5,219	5,376	Miscellaneous
Insurance	6,378	5,600	5,768	5,941	6,119	6,303	6,492	6,687	6,887	7,094	7,307	7,526	Insurance
Vehicle Insurance	3,901	3,801	3,915	4,032	4,153	4,278	4,406	4,539	4,675	4,815	4,959	5,108	Insurance
Office Supplies	1,600	1,600	1,648	1,697	1,748	1,801	1,855	1,910	1,968	2,027	2,088	2,150	Materials & Supplies
Operating Supplies	16,000	15,000	15,450	15,914	16,391	16,883	17,389	17,911	18,448	19,002	19,572	20,159	Materials & Supplies
Repair & Maintenance	25,000	27,000	27,810	28,644	29,504	30,389	31,300	32,239	33,207	34,203	35,229	36,286	Miscellaneous
Small Tools & Equipment	3,000	3,000	3,090	3,183	3,278	3,377	3,478	3,582	3,690	3,800	3,914	4,032	Equipment
Chemicals	0	0	0	0	0	0	0	0	0	0	0	0	Materials & Supplies
Equipment	44,000	5,000	5,150	5,305	5,464	5,628	5,796	5,970	6,149	6,334	6,524	6,720	Equipment
Office Equipment	3,500	0	0	0	0	0	0	0	0	0	0	0	Equipment
Postage	4,000	4,000	4,120	4,244	4,371	4,502	4,637	4,776	4,919	5,067	5,219	5,376	Materials & Supplies
Interest	16,572	15,282	15,740	16,213	16,699	17,200	17,716	18,248	18,795	19,359	19,940	20,538	Miscellaneous
Alaska RR Permits	10,000	11,000	11,330	11,670	12,020	12,381	12,752	13,135	13,529	13,934	14,353	14,783	Miscellaneous
Safety Equipment	500	500	515	530	546	563	580	597	615	633	652	672	Miscellaneous
General Admin Exp	187,396	195,459	201,323	207,362	213,583	219,991	226,591	233,388	240,390	247,602	255,030	262,681	Miscellaneous
Computer Services	0	0	0	0	0	0	0	0	0	0	0	0	Miscellaneous
Additional WWTP O&M Expenses	$0	$0	$0	$125,145	$171,866	$177,022	$182,332	$187,802	$193,436	$199,240	$205,217	$211,373	Materials & Supplies
Total Operations & Maintenance	**$878,273**	**$886,870**	**$913,476**	**$1,066,025**	**$1,140,973**	**$1,175,202**	**$1,210,458**	**$1,246,772**	**$1,284,175**	**$1,322,700**	**$1,362,381**	**$1,403,252**	

City of Palmer
Sewer Rate Study - Opt. E
Revenue Requirement
Exhibit 3

	Budget	Budget			Projected								
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Taxes													
Payment In Lieu of Taxes	$61,405	$65,992	$112,028	$194,764	$339,318	$342,712	$346,139	$349,600	$353,096	$356,627	$360,193	$363,795	*6% of Revenues*
Total Taxes	$61,405	$65,992	$112,028	$194,764	$339,318	$342,712	$346,139	$349,600	$353,096	$356,627	$360,193	$363,795	
Rate Funded Capital	$25,000	$50,000	$75,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	
Debt Service													
671011 - Sewer Repairs	$14,120	$14,120	$14,120	$14,120	$14,120	$0	$0	$0	$0	$0	$0	$0	Debt Schedule
671071 - SW Sanitary Sewer Extension	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	88,417	Debt Schedule
ADEC Loan	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 2% for 20 yrs.
USDA Loan	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 3.4% for 20 yrs.
New Revenue bonds	0	0	0	0	0	0	0	0	0	0	0	0	Calc'd @ 5% for 20 yrs.
New Low interest loans	0	0	0	0	0	97,851	97,851	97,851	97,851	97,851	97,851	97,851	Calc'd @ 2% for 20 yrs.
Total Debt Service	$102,537	$102,537	$102,537	$102,537	$102,537	$186,268	$186,268	$186,268	$186,268	$186,268	$186,268	$186,268	
Less: Debt Service Funding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Total Less Debt Service Funding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Net Debt Service	$102,537	$102,537	$102,537	$102,537	$102,537	$186,268	$186,268	$186,268	$186,268	$186,268	$186,268	$186,268	
Change in Working Capital +/-	($65,555)	($27,531)	$664,097	$1,782,741	$3,972,479	$3,907,679	$3,926,115	$3,944,029	$3,961,397	$3,978,190	$3,994,381	$4,009,940	
Total Revenue Requirement	**$1,001,660**	**$1,077,868**	**$1,867,138**	**$3,246,068**	**$5,655,307**	**$5,711,861**	**$5,768,979**	**$5,826,669**	**$5,884,936**	**$5,943,785**	**$6,003,223**	**$6,063,255**	
Bal./(Def.) of Funds Before Added Tax	**$0**	**$0**	**($778,491)**	**($2,146,535)**	**($4,544,779)**	**($4,590,227)**	**($4,636,129)**	**($4,682,490)**	**($4,729,315)**	**($4,776,608)**	**($4,824,374)**	**($4,872,618)**	
Balance as a % of Rate Adj. Required	**0.0%**	**0.0%**	**73.0%**	**199.3%**	**417.8%**	**417.8%**	**417.8%**	**417.8%**	**417.8%**	**417.8%**	**417.8%**	**417.8%**	
Proposed Rate Adjustment	**0.0%**	**0.0%**	**73.0%**	**73.0%**	**73.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	
Add'l Revenue with Rate Adj.	**$0**	**$0**	**$778,491**	**$2,146,535**	**$4,544,779**	**$4,590,227**	**$4,636,129**	**$4,682,490**	**$4,729,315**	**$4,776,608**	**$4,824,374**	**$4,872,618**	
Bal./Def. After Rate Adjustment	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	
Additional Rate Adjustment Required	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	

City of Palmer
Sewer Rate Study - Opt. E
Revenue Requirement
Exhibit 3

	Budget	Budget	Projected										
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	***Notes***
Average Residential Customer Bill	**$21.80**	*(Current rates; Customer charge + 4,000 gal)*											
Customer Bill after Rate Adj. Req'd	$21.80	$21.80	$37.72	$65.25	$112.88	$112.88	$112.88	$112.88	$112.88	$112.88	$112.88	$112.88	
Bill Difference - Monthly	0.00	0.00	15.91	27.53	47.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Cumulative Bill Difference	0.00	0.00	15.91	43.45	91.08	91.08	91.08	91.08	91.08	91.08	91.08	91.08	
Customer Bill on Proposed Adjustment	$21.80	$21.80	$37.72	$65.25	$112.88	$112.88	$112.88	$112.88	$112.88	$112.88	$112.88	$112.88	
Bill Difference - Monthly	0.00	0.00	15.91	27.53	47.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Cumulative Bill Difference	0.00	0.00	15.91	43.45	91.08	91.08	91.08	91.08	91.08	91.08	91.08	91.08	
Debt Service Coverage Ratio (all debt)													
Before Rate Adjustment	0.60	1.22	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
After Needed Rate Adjustment	0.60	1.22	8.21	19.36	40.72	22.52	22.61	22.71	22.80	22.89	22.98	23.06	
After Proposed Rate Adjustment	0.60	1.22	8.21	19.36	40.72	22.52	22.61	22.71	22.80	22.89	22.98	23.06	
Cash Reserves													
Operating Fund													
Beginning Balance	$300,000	$234,445	$206,914	$871,011	$2,653,752	$310,231	$4,217,911	$8,144,026	$12,088,055	$8,919,452	$12,897,642	$16,892,023	
Plus: Additions	0	0	664,097	1,782,741	3,972,479	3,907,679	3,926,115	3,944,029	3,961,397	3,978,190	3,994,381	4,009,940	
Less: EPA Fees	0	0	0	0	0	0	0	0	0	0	0	0	
Less: Uses of Funds	(65,555)	(27,531)	0	0	(6,316,000)	0	0	0	(7,130,000)	0	0	0	
Ending Balance	$234,445	$206,914	$871,011	$2,653,752	$310,231	$4,217,911	$8,144,026	$12,088,055	$8,919,452	$12,897,642	$16,892,023	$20,901,963	
Target: 20% of O&M	$175,655	$177,374	$182,695	$213,205	$228,195	$235,040	$242,092	$249,354	$256,835	$264,540	$272,476	$280,650	
Target: 50% of Annual Depreciation	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	275,713	
Target Minimum Fund Balance	**$451,368**	**$453,087**	**$458,408**	**$488,918**	**$503,908**	**$510,753**	**$517,805**	**$525,067**	**$532,548**	**$540,253**	**$548,189**	**$556,363**	
Target Ending Minimum Fund Bal./(Def.)	***($216,923)***	***($246,173)***	***$412,603***	***$2,164,834***	***($193,676)***	***$3,707,157***	***$7,626,221***	***$11,562,988***	***$8,386,904***	***$12,357,389***	***$16,343,834***	***$20,345,599***	

City of Palmer
Sewer Rate Study - Opt. E
Capital Improvement Plan
Exhibit 4

Inflation	**2.7%**

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	*Notes:*
WWTP - MBBR	$0	$0	$0	$0	$8,016,000	$0	$0	$0	$0	$0	$0	$0	
WWTP - Secondary Clarifiers	0	0	0	0	0	0	0	0	7,230,000	0	0	0	
Unidentified Future CIP	25,000	50,000	75,000	100,000	0	100,000	100,000	100,000	0	100,000	100,000	100,000	
Total Capital Improvement Projects	$25,000	$50,000	$75,000	$100,000	$8,016,000	$100,000	$100,000	$100,000	$7,230,000	$100,000	$100,000	$100,000	
Transfer to Cash Reserve	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Total Capital Improvement Projects	**$25,000**	**$50,000**	**$75,000**	**$100,000**	**$8,016,000**	**$100,000**	**$100,000**	**$100,000**	**$7,230,000**	**$100,000**	**$100,000**	**$100,000**	
Less: Outside Funding Sources													
Operating Fund - Sewer	$0	$0	$0	$0	$6,316,000	$0	$0	$0	$7,130,000	$0	$0	$0	
System Development Charges (SDCs)	0	0	0	0	0	0	0	0	0	0	0	0	
DCCED Grant	0	0	0	0	0	0	0	0	0	0	0	0	
ADEC Loan	0	0	0	0	0	0	0	0	0	0	0	0	
ADEC Grant	0	0	0	0	0	0	0	0	0	0	0	0	
USDA Loan	0	0	0	0	0	0	0	0	0	0	0	0	
USDA Grant	0	0	0	0	0	0	0	0	0	0	0	0	
Low Interest Loans	0	0	0	0	1,600,000	0	0	0	0	0	0	0	
State Legislative Grants	0	0	0	0	0	0	0	0	0	0	0	0	
Revenue Bonds	0	0	0	0	0	0	0	0	0	0	0	0	
Total Funding Sources	$0	$0	$0	$0	$7,916,000	$0	$0	$0	$7,130,000	$0	$0	$0	
NET CIP FROM RATES	**$25,000**	**$50,000**	**$75,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	

APPENDIX G: STAFFING ANALYSIS

NEIWPCC
New England Interstate Water Pollution Control Commission

THE NORTHEAST GUIDE FOR ESTIMATING STAFFING AT PUBLICLY AND PRIVATELY OWNED WASTEWATER TREATMENT PLANTS

Choose Staffing Shifts: One Shift

Enter Plant Design Flow: 0.5-1.0 mgd

Total Staffing Hours: 3619.00

Data Notes	# of Units	Process/Activity/Flow	Hours	Calculated	Subtotal
		Begin Chart 1 – Basic and Advanced Operations and Processes			
Data Notes	**# of Units**	**Process**	**Hours**	**Calculated**	**Subtotal**
	1	Preliminary Treatment	0.50	130.00	
# of units		Primary Clarification	0.50	0.00	
		Activated Sludge	4.00	0.00	
		Activated Sludge w/BNR	6.00	0.00	
Choose Range		Rotating Biological Contactor	2.25	0.00	
# of tanks		Sequencing Batch Reactor	1.00	0.00	
		Extended Aeration (w/o primary)	5.00	0.00	
		Extended Aeration w/BNR	7.00	0.00	
		Pure Oxygen Facility	*X*		
		Pure Oxygen Facility w/BNR	*X*		
		Trickling Filter	1.00	0.00	
		Oxidation Ditch (w/o primary)	5.00	0.00	
		Oxidation Ditch w/BNR	7.00	0.00	
	1	Aeration Lagoon	1.50	390.00	
	1	Stabilization Pond	1.00	260.00	
		Innovative Alternative Technologies	3.00	0.00	
	1	Nitrification	0.25	65.00	
		Denitrification	0.25	0.00	
		Phosphorus Removal (Biological)	0.25	0.00	
		Phosphorus Removal (Chemical/Physical)	0.50	0.00	
		Membrane Processes	0.25	0.00	
		Cloth Filtration	0.25	0.00	
		Granular Media Filters (Carbon, sand, anthracite, garnet)	1.00	0.00	
		Water Reuse	0.25	0.00	
		Plant Reuse Water	0.10	0.00	
		Chlorination	0.50	0.00	
		Dechlorination	0.50	0.00	
	1	Ultraviolet Disinfection	0.50	130.00	
# of units		Wet Odor Control	0.50	0.00	
# of units		Dry Odor Control	0.25	0.00	
		Septage Handling	0.50	0.00	
		End of Chart 1 – Basic and Advanced Operations and Processes SUBTOTAL:			**975.00**

** Secondary Clarification has been built into basic operations processes.*
** Activated Sludge process includes RAS and WAS pumping.*

Begin Chart 2 – Maintenance

Unit Descriptons	# of Units	Activity/Flow	Hours	Calculated	Subtotal
# of screens		Manually Cleaned Screens	0.25	0.00	
# of screens		Mechanically Cleaned Screens	0.25	0.00	
# of screens	1	Mechanically Cleaned Screens with grinders/washer/ compactors	0.50	130.00	
# of units	1	Comminutor/Macerator	0.25	65.00	
# of chambers		Aerated Grit Chambers	0.10	0.00	
# of units		Vortex Grit Removal	0.10	0.00	
# of units		Gravity Grit Removal	0.10	0.00	
# of tanks		Additional Process Tanks	0.10	0.00	
# of chemicals added for processes		Chemical Addition (varying dependent upon degree of treatment)	0.10	0.00	
# of clarifiers		Circular Clarifiers	0.25	0.00	
# of clarifiers		Chain and Flight Clarifiers	0.25	0.00	
# of clarifiers		*Traveling Bridge Clarifiers*	*X*		
# of clarifiers		Squircle Clarifiers	0.25	0.00	
X	1	Pumps	100.00	100.00	
# of trains		Rotating Biological Contactor	0.15	0.00	
# of TFs		Trickling Filters	0.15	0.00	
# of tanks		Sequencing Batch Reactor	0.15	0.00	
# of mixers		Mechanical Mixers	0.10	0.00	
# of blowers	4	Aeration Blowers	0.20	208.00	
# of cartridges		Membrane Bioreactor	0.10	0.00	
# of systems		Subsurface Disposal System	0.10	0.00	
X		Groundwater Discharge	0.10	0.00	
# of digesters		Aerobic Digestion	0.10	0.00	
# of digesters		Anaerobic Digestion	0.20	0.00	
# of basins		Gravity Thickening	0.10	0.00	
# of belts		Gravity Belt Thickening	0.15	0.00	
# of presses		Belt Filter Press	0.15	0.00	
# of units		Mechanical Dewatering (Plate Frame and Centrifuges)	0.15	0.00	
# of units		Dissolved Air Floatation	0.10	0.00	
X		Chlorination (gas)	0.10	0.00	
X		Chlorination (liq.)	0.20	0.00	
X		Dechlorination (gas)	0.10	0.00	
X		Dechlorination (liq.)	0.20	0.00	
# of racks	2	Ultraviolet	0.10	52.00	
# of units		Biofilter	0.50	0.00	
# of units		Activated Carbon	0.50	0.00	
# of units		*Wet Scrubbers*	*X*		
# of screens		Microscreens	0.10	0.00	
# of units		*Pure Oxygen*	*X*		
# of units		Final Sand Filters	0.20	0.00	
# of different types of probes	3	Probes/Instrumentation/Calibration	0.10	78.00	
End of Chart 2 – Maintenance SUBTOTAL:					**633.00**

Begin Chart 3 – Laboratory Operations

Frequency of test	# of times test is run for selected time frame	Tests	Hours	Calculated	Subtotal
		Acidity	0.75	0.00	
		Alkalinity, total	0.75	0.00	
52	1	Biochemical Oxygen Demand (BOD)	2.50	130.00	
		Chemical Oxygen Demand (COD)	2.50	0.00	
		Chloride	0.50	0.00	
		Chlorine, Total Residual	0.25	0.00	
52	1	Coliform, Total, Fecal, E.Coli	1.00	52.00	
52	1	Dissolved Oxygen (DO)	0.25	13.00	
52	5	Hydrogen Ion (pH)	0.25	65.00	
4	1	Metals	3.00	12.00	
4	1	Toxicity	2.00	8.00	
4	1	Ammonia	2.00	8.00	
		Total Nitrogen	2.00	0.00	
		Oil and Grease	3.00	0.00	
		Total and Dissolved Phosphorus	2.00	0.00	
52	1	Solids, Total, Dissolved, and Suspended	3.00	156.00	
		Specific Conductance	0.25	0.00	
		Sulfate	1.00	0.00	
		Surfactants	1.00	0.00	
4	1	Temperature	0.25	1.00	
		Total Organic Carbon (TOC)	0.25	0.00	
		Turbidity	0.25	0.00	
		Bacteriological Enterococci	1.00	0.00	
4	1	Lab QA/QC Program	1.00	4.00	
52	7	Process Control Testing	3.00	1092.00	
		Sampling for Contracted Lab Services	0.25	0.00	
		Sampling for Monitoring Groundwater wells	0.50	0.00	
		End of Chart 3 – Laboratory Operations SUBTOTAL:			**1541.00**

**Sampling time is built into testing time estimates.*

Begin Chart 4 – Biosolids/Sludge Handling

Unit Descriptons	# of Units	Process	Hours	Calculated	Subtotal
		Belt Filter Press	3.00	0.00	
		Plate & Frame Press	1.50	0.00	
		Gravity Thickening	0.25	0.00	
		Gravity Belt Thickening	0.25	0.00	
		Rotary Press	0.25	0.00	
		Dissolved Air Floatation	0.50	0.00	
		Alkaline Stabilization	0.25	0.00	
		Aerobic Digestion	0.50	0.00	
		Anaerobic Digestion	0.25	0.00	

		Centrifuges	1.00	0.00	
Choose Range		Composting	**2.00**	0.00	
		Incineration	*X*		
	1	Air Drying – Sand Beds	0.50	130.00	
	1	Land Application	0.50	130.00	
		Transported Off-Site for Disposal	1.00	0.00	
		Static Dewatering	1.00	0.00	
		End of Chart 4 – Biosolids/Sludge Handling SUBTOTAL:			**260.00**

Begin Chart 5 – Yardwork

Unit Descriptons	# of Units	Process	Hours	Calculated	Subtotal
		Janitorial/Custodial Staff	100	0.00	
	1	Snow removal	60	60.00	
	1	Mowing	100	100.00	
# of vechicles	**2**	Vehicle Maintenance	25	50.00	
		Facility Painting	60	0.00	
		Rust removal	60	0.00	
		End of Chart 5 – Yardwork SUBTOTAL:			**210.00**

Begin Chart 6 – Automation/SCADA

Automation/SCADA	Yes/No
Automated attendant or Interactive voice recognition (IVR) equipment	**No**
Automated Meter Reading (AMR), Touchpad meters or other automated metering technology	**No**
Automatic Call Director (ACD)	**No**
Billing system	**Yes**
Computerized Facilities Management (FM) System	**Yes**
Computerized preventative maintenance	**Yes**
Computerized recordkeeping	**Yes**
E-mail	**Yes**
Geographical Information System (GIS)	**No**
Integrated purchasing and inventory	**No**
Internet website	**No**
Laboratory Information Management System (LIMS)	**No**
Local Area Network (LAN)	**Yes**
Supervisory Control and Data Acquisition (SCADA)	**Yes**
Telemetry	**Yes**
Utility customer information system (CIS) package	**No**

End of Chart 6 – Automation/SCADA

Begin Chart 7 – Considerations for Additional Plant Staffing

Activities	Yes/No

Management responsibilities (i.e., human resources, budgeting, outreach, training, town/city meetings, scheduling, etc.) and responsibility for clerical duties (i.e., billing, reports, correspondence, phones, time sheets, mailings, etc.)	**Yes**
Plant staff responsible for collection system operation and maintenance, pump station inspections, and/or combined sewer overflows	**Yes**
Plant operators responsible for snow plowing, road/sidewalk repair, or other municipal project	**No**
Plant staff involved in generating additional energy	**No**
Plant receives an extra high septage and/or grease load (higher than designed organic and grease loadings) or plant takes in sludge from other treatment plants	**No**
Plant is producing a Class A Biosolid product	**No**
Plant operators responsible for operating generators and emergency power	**Yes**
Plant responsible for industrial pre-treatment program	**Yes**
Plant staff responsible for plant upgrades and large projects done both on-site and off-site (i.e., collection systems, manholes, etc.)	**No**
Plant operators responsible for machining parts on-site	**No**
Age of plant and equipment (over 15 years of age)	**Yes**
End of Chart 7 – Considerations for Additional Plant Staffing	

NEIWPCC
New England Interstate Water Pollution Control Commission

THE NORTHEAST GUIDE FOR ESTIMATING STAFFING AT PUBLICLY AND PRIVATELY OWNED WASTEWATER TREATMENT PLANTS (One Shift)	
Plant Name: City of Palmer WWTP - Existing Lagoon System	
Design Flow: 0.5-1.0 mgd	**Actual Flow: 0.6 mgd**
FINAL ESTIMATES	
Chart #	**Annual Hours**
Chart 1 – Basic and Advanced Operations and Processes	975.00
Chart 2 – Maintenance	633.00
Chart 3 – Laboratory Operations	1541.00
Chart 4 – Biosolids/Sludge Handling	260.00
Chart 5 – Yardwork	210.00
Estimated Operation and Maintenance Hours	3619.00
Estimated Operation and Maintenance Staff	2.41
Estimated Additional Staff from Chart 7	
TOTAL STAFFING ESTIMATE	**2.41**

Note: The Total Staff estimate from Charts 1-5 will not be the final amount of staff necessary to run the facility. Please review Chart 7 for additional staffing needs.

Chart 6 - Automation/SCADA

Billing system
Computerized Facilities Management (FM) System
Computerized preventative maintenance
Computerized recordkeeping
E-mail
Local Area Network (LAN)
Supervisory Control and Data Acquisition (SCADA)
Telemetry

Chart 7 - Considerations for Additional Plant Staffing

Management responsibilities (i.e., human resources, budgeting, outreach, training, town/city meetings, scheduling, etc.) and responsibility for clerical duties (i.e., billing, reports, correspondence, phones, time sheets, mailings, etc.)
Plant staff responsible for collection system operation and maintenance, pump station inspections, and/or combined sewer overflows
Plant operators responsible for operating generators and emergency power
Plant responsible for industrial pre-treatment program
Age of plant and equipment (over 15 years of age)

Note: The user should attach supporting information to justify additional staffing needs from Chart 7.

Final Comments:

New England Interstate Water Pollution Control Commission

THE NORTHEAST GUIDE FOR ESTIMATING STAFFING AT PUBLICLY AND PRIVATELY OWNED WASTEWATER TREATMENT PLANTS

Choose Staffing Shifts: One Shift

Enter Plant Design Flow: 0.5-1.0 mgd

Total Staffing Hours: 4035.00

Data Notes	# of Units	Process/Activity/Flow	Hours	Calculated	Subtotal
		Begin Chart 1 – Basic and Advanced Operations and Processes			
Data Notes	**# of Units**	**Process**	**Hours**	**Calculated**	**Subtotal**
	1	Preliminary Treatment	0.50	130.00	
# of units		Primary Clarification	0.50	0.00	
		Activated Sludge	4.00	0.00	
		Activated Sludge w/BNR	6.00	0.00	
Choose Range		Rotating Biological Contactor	**2.25**	0.00	
# of tanks		Sequencing Batch Reactor	1.00	0.00	
		Extended Aeration (w/o primary)	5.00	0.00	
		Extended Aeration w/BNR	7.00	0.00	
		Pure Oxygen Facility	*X*		
		Pure Oxygen Facility w/BNR	*X*		
		Trickling Filter	1.00	0.00	
		Oxidation Ditch (w/o primary)	5.00	0.00	
		Oxidation Ditch w/BNR	7.00	0.00	
		Aeration Lagoon	1.50	0.00	
		Stabilization Pond	1.00	0.00	
	1	Innovative Alternative Technologies	3.00	780.00	
	1	Nitrification	0.25	65.00	
		Denitrification	0.25	0.00	
		Phosphorus Removal (Biological)	0.25	0.00	
		Phosphorus Removal (Chemical/Physical)	0.50	0.00	
		Membrane Processes	0.25	0.00	
		Cloth Filtration	0.25	0.00	
		Granular Media Filters (Carbon, sand, anthracite, garnet)	1.00	0.00	
		Water Reuse	0.25	0.00	
		Plant Reuse Water	0.10	0.00	
		Chlorination	0.50	0.00	
		Dechlorination	0.50	0.00	
	1	Ultraviolet Disinfection	0.50	130.00	
# of units		Wet Odor Control	0.50	0.00	
# of units		Dry Odor Control	0.25	0.00	
		Septage Handling	0.50	0.00	
		End of Chart 1 – Basic and Advanced Operations and Processes SUBTOTAL:			**1105.00**

** Secondary Clarification has been built into basic operations processes.*
** Activated Sludge process includes RAS and WAS pumping.*

Begin Chart 2 – Maintenance

Unit Descriptons	# of Units	Activity/Flow	Hours	Calculated	Subtotal
# of screens		Manually Cleaned Screens	0.25	0.00	
# of screens		Mechanically Cleaned Screens	0.25	0.00	
# of screens	1	Mechanically Cleaned Screens with grinders/washer/ compactors	0.50	130.00	
# of units	1	Comminutor/Macerator	0.25	65.00	
# of chambers		Aerated Grit Chambers	0.10	0.00	
# of units		Vortex Grit Removal	0.10	0.00	
# of units		Gravity Grit Removal	0.10	0.00	
# of tanks		Additional Process Tanks	0.10	0.00	
# of chemicals added for processes	2	Chemical Addition (varying dependent upon degree of treatment)	0.10	52.00	
# of clarifiers	2	Circular Clarifiers	0.25	130.00	
# of clarifiers		Chain and Flight Clarifiers	0.25	0.00	
# of clarifiers		*Traveling Bridge Clarifiers*	*X*		
# of clarifiers		Squircle Clarifiers	0.25	0.00	
X	1	Pumps	100.00	100.00	
# of trains		Rotating Biological Contactor	0.15	0.00	
# of TFs		Trickling Filters	0.15	0.00	
# of tanks		Sequencing Batch Reactor	0.15	0.00	
# of mixers		Mechanical Mixers	0.10	0.00	
# of blowers	3	Aeration Blowers	0.20	156.00	
# of cartridges		Membrane Bioreactor	0.10	0.00	
# of systems		Subsurface Disposal System	0.10	0.00	
X		Groundwater Discharge	0.10	0.00	
# of digesters	1	Aerobic Digestion	0.10	26.00	
# of digesters		Anaerobic Digestion	0.20	0.00	
# of basins		Gravity Thickening	0.10	0.00	
# of belts		Gravity Belt Thickening	0.15	0.00	
# of presses		Belt Filter Press	0.15	0.00	
# of units		Mechanical Dewatering (Plate Frame and Centrifuges)	0.15	0.00	
# of units		Dissolved Air Floatation	0.10	0.00	
X		Chlorination (gas)	0.10	0.00	
X		Chlorination (liq.)	0.20	0.00	
X		Dechlorination (gas)	0.10	0.00	
X		Dechlorination (liq.)	0.20	0.00	
# of racks	2	Ultraviolet	0.10	52.00	
# of units		Biofilter	0.50	0.00	
# of units		Activated Carbon	0.50	0.00	
# of units		*Wet Scrubbers*	*X*		
# of screens		Microscreens	0.10	0.00	
# of units		*Pure Oxygen*	*X*		
# of units		Final Sand Filters	0.20	0.00	
# of different types of probes	3	Probes/Instrumentation/Calibration	0.10	78.00	

End of Chart 2 – Maintenance SUBTOTAL: **789.00**

Begin Chart 3 – Laboratory Operations

Frequency of test	# of times test is run for selected time frame	Tests	Hours	Calculated	Subtotal
		Acidity	0.75	0.00	
		Alkalinity, total	0.75	0.00	
52	1	Biochemical Oxygen Demand (BOD)	2.50	130.00	
		Chemical Oxygen Demand (COD)	2.50	0.00	
		Chloride	0.50	0.00	
		Chlorine, Total Residual	0.25	0.00	
52	1	Coliform, Total, Fecal, E.Coli	1.00	52.00	
52	1	Dissolved Oxygen (DO)	0.25	13.00	
52	5	Hydrogen Ion (pH)	0.25	65.00	
4	1	Metals	3.00	12.00	
4	1	Toxicity	2.00	8.00	
4	1	Ammonia	2.00	8.00	
		Total Nitrogen	2.00	0.00	
		Oil and Grease	3.00	0.00	
		Total and Dissolved Phosphorus	2.00	0.00	
52	1	Solids, Total, Dissolved, and Suspended	3.00	156.00	
		Specific Conductance	0.25	0.00	
		Sulfate	1.00	0.00	
		Surfactants	1.00	0.00	
4	1	Temperature	0.25	1.00	
		Total Organic Carbon (TOC)	0.25	0.00	
		Turbidity	0.25	0.00	
		Bacteriological Enterococci	1.00	0.00	
4	1	Lab QA/QC Program	1.00	4.00	
52	7	Process Control Testing	3.00	1092.00	
		Sampling for Contracted Lab Services	0.25	0.00	
		Sampling for Monitoring Groundwater wells	0.50	0.00	

End of Chart 3 – Laboratory Operations SUBTOTAL: 1541.00

**Sampling time is built into testing time estimates.*

Begin Chart 4 – Biosolids/Sludge Handling

Unit Descriptons	# of Units	Process	Hours	Calculated	Subtotal
		Belt Filter Press	3.00	0.00	
		Plate & Frame Press	1.50	0.00	
		Gravity Thickening	0.25	0.00	
		Gravity Belt Thickening	0.25	0.00	
		Rotary Press	0.25	0.00	
		Dissolved Air Floatation	0.50	0.00	
		Alkaline Stabilization	0.25	0.00	
	1	Aerobic Digestion	0.50	130.00	
		Anaerobic Digestion	0.25	0.00	

		Centrifuges	1.00	0.00	
Choose Range		Composting	**2.00**	0.00	
		Incineration	*X*		
	1	Air Drying – Sand Beds	0.50	130.00	
	1	Land Application	0.50	130.00	
		Transported Off-Site for Disposal	1.00	0.00	
		Static Dewatering	1.00	0.00	
		End of Chart 4 – Biosolids/Sludge Handling SUBTOTAL:			**390.00**

Begin Chart 5 – Yardwork

Unit Descriptons	# of Units	Process	Hours	Calculated	Subtotal
		Janitorial/Custodial Staff	100	0.00	
	1	Snow removal	60	60.00	
	1	Mowing	100	100.00	
# of vechicles	**2**	Vehicle Maintenance	25	50.00	
		Facility Painting	60	0.00	
		Rust removal	60	0.00	
		End of Chart 5 – Yardwork SUBTOTAL:			**210.00**

Begin Chart 6 – Automation/SCADA

Automation/SCADA	Yes/No
Automated attendant or Interactive voice recognition (IVR) equipment	**No**
Automated Meter Reading (AMR), Touchpad meters or other automated metering technology	**No**
Automatic Call Director (ACD)	**No**
Billing system	**Yes**
Computerized Facilities Management (FM) System	**Yes**
Computerized preventative maintenance	**Yes**
Computerized recordkeeping	**Yes**
E-mail	**Yes**
Geographical Information System (GIS)	**No**
Integrated purchasing and inventory	**No**
Internet website	**No**
Laboratory Information Management System (LIMS)	**No**
Local Area Network (LAN)	**Yes**
Supervisory Control and Data Acquisition (SCADA)	**Yes**
Telemetry	**Yes**
Utility customer information system (CIS) package	**No**

End of Chart 6 – Automation/SCADA

Begin Chart 7 – Considerations for Additional Plant Staffing

Activities	Yes/No

Management responsibilities (i.e., human resources, budgeting, outreach, training, town/city meetings, scheduling, etc.) and responsibility for clerical duties (i.e., billing, reports, correspondence, phones, time sheets, mailings, etc.)	**Yes**
Plant staff responsible for collection system operation and maintenance, pump station inspections, and/or combined sewer overflows	**Yes**
Plant operators responsible for snow plowing, road/sidewalk repair, or other municipal project	**No**
Plant staff involved in generating additional energy	**No**
Plant receives an extra high septage and/or grease load (higher than designed organic and grease loadings) or plant takes in sludge from other treatment plants	**No**
Plant is producing a Class A Biosolid product	**No**
Plant operators responsible for operating generators and emergency power	**Yes**
Plant responsible for industrial pre-treatment program	**Yes**
Plant staff responsible for plant upgrades and large projects done both on-site and off-site (i.e., collection systems, manholes, etc.)	**No**
Plant operators responsible for machining parts on-site	**No**
Age of plant and equipment (over 15 years of age)	**Yes**
End of Chart 7 – Considerations for Additional Plant Staffing	

THE NORTHEAST GUIDE FOR ESTIMATING STAFFING AT PUBLICLY AND PRIVATELY OWNED WASTEWATER TREATMENT PLANTS (One Shift)

Plant Name: City of Palmer WWTP - MBBR with Secondary Clarifiers	
Design Flow: 0.5-1.0 mgd	**Actual Flow: 0.65 mgd**

FINAL ESTIMATES

Chart #	**Annual Hours**
Chart 1 – Basic and Advanced Operations and Processes	1105.00
Chart 2 – Maintenance	789.00
Chart 3 – Laboratory Operations	1541.00
Chart 4 – Biosolids/Sludge Handling	390.00
Chart 5 – Yardwork	210.00
Estimated Operation and Maintenance Hours	4035.00
Estimated Operation and Maintenance Staff	2.69
Estimated Additional Staff from Chart 7	
TOTAL STAFFING ESTIMATE	**2.69**

Note: The Total Staff estimate from Charts 1-5 will not be the final amount of staff necessary to run the facility. Please review Chart 7 for additional staffing needs.

Chart 6 - Automation/SCADA

Billing system
Computerized Facilities Management (FM) System
Computerized preventative maintenance
Computerized recordkeeping
E-mail
Local Area Network (LAN)
Supervisory Control and Data Acquisition (SCADA)
Telemetry

Chart 7 - Considerations for Additional Plant Staffing

Management responsibilities (i.e., human resources, budgeting, outreach, training, town/city meetings, scheduling, etc.) and responsibility for clerical duties (i.e., billing, reports, correspondence, phones, time sheets, mailings, etc.)
Plant staff responsible for collection system operation and maintenance, pump station inspections, and/or combined sewer overflows
Plant operators responsible for operating generators and emergency power
Plant responsible for industrial pre-treatment program
Age of plant and equipment (over 15 years of age)

Note: The user should attach supporting information to justify additional staffing needs from Chart 7.

Final Comments:

APPENDIX H: PUBLIC MEETING INFORMATION

Meeting Minutes

Project:	City of Palmer Wastewater Treatment Facility Feasibility Study Recommendations
Subject:	Open House
Date:	Thursday, July 21, 2016
Location:	City of Palmer, Council Chambers
Attendees:	See attached sign-in sheet Attendees Column 2 (Tab to add more rows)

The following are some of the questions and concerns expressed at the meeting:

- We don't know that this system works in cold climates
- DEC may come back and reject or change their criteria after the fact—they've done it before
- Want a sewer plant for septage
- Public notice
  - Saw the notice in the paper, but the paper was wrong.
  - Information mailed on the 19th for a meeting on the 21st
  - Did not receive robo-call
  - Clerk did not know anything about the meeting when participant called to inquire
  - Who was in charge of the open house/lack of notice
- In 2010, the City received ARRA (?) money—thought this was taken care of then. Why are we not meeting the requirements? Ammonia was supposed to be fixed at that time.
- What did the Feds find that requires this new update?
  - Tom: the 2010 solution was to cover the pond and keep it warm. The insulated covers ended up just shifting the temperature season—cooler in the spring, but warmer longer in the fall
  - Ralph: they wanted a regional system and thought they didn't need an ammonia reactor. Now we're trying to play catch up.
- EPA is hitting us with fines. How much?
  - Nate: note established yet—still negotiating the consent decree (anticipated for November 2016)
- +What happens if you don't pay the fine?
- What are the penalties? This should never have happened in the first place.
- What is the lowest amount (EPA) is looking for?
  - Nate: not in the millions. We are in negotiation and will be able to share that information when the consent decree becomes public. The decree will be posted on the website and in the Council packet. We hope it gets resolved in a couple of months. It will come out of the City budget, not insurance. It will affect ratepayers.
- Is this supposed to fix the problem?
  - Yes. This is a compliance issue because permit requirements changed. The upgrades were not able to address the issue.
- How many public sewer systems are having problems meeting EPA requirements?
  - Not just in Palmer, have seen it elsewhere in Alaska
- Rate study in 2014 looked just at operations and maintenance costs/increases. Rates are half of Wasilla.

- How will you raise money for the fines
    - Nate: depends. The water/sewer fund has a reserve, and the City has loan authority and can bond based on voter approval for project loans and grants. Fines will come out of the City’s budget.
- How much did USDA pay for~~e~~? What was the City’s share of the loans?
- How will you disseminate information and make it understandable for folks?
- How do you expect people to vote on this without information—lack of transparency.
- Write a letter in simpler terms on where the money comes from.
- Want a septage disposal facility locally. These are essential projects that directly affect everyone.
- Why such as small system? Septage collection could raise funds for the City.

City of Palmer Wastewater Treatment Plant
Public Meeting
Thursday - July 21, 2016

Please Sign In.

Name (Please print)	E-mail	Street Address	ZIP Code
Helen Munoz	None	16105 E Helmauer	99645
EUGENE CARL HABERMAN			
Arlene Cohen		417 N. Alaska St.	
Jack Snodgrass		560 E. Arctic Palmer Ak	
Ralph Hulbert	rulbert@alaska.net		
LuAnn Maguire		12300 E Ivy Lane Palmer	
Ryan call → Robert Avezac 907-841-5689 (c)	RAvezac@Hotmail.com	825 N Blaine Cir Palmer Ak	99645
BRAD HANSON		325 E Dolphin Palmer	99645
TOM HEALY	trhealy@gci.net	211 GLORIA ST. PALMER	99645

City of Palmer
Wastewater Treatment Plant Facility Plan Update
Fact Sheet

We all rely on clean water—and having clean water relies on treating the wastewater discharged back into our waterways. It's a matter of public and environmental health.

The City of Palmer, through the Department of Public Works, is charged with collecting and treating wastewater in accordance with applicable state and federal laws. It's also responsible for maintaining treatment infrastructure.

The Palmer Wastewater Treatment Plant (WWTP) operates under an existing Alaska Pollution Discharge Elimination System (APDES) Permit (AK-002249-7). The permit was last renewed in 2007 and has been administratively extended since its expiration in 2011. The current APDES permit limits the peak daily flow capacity of the plant to 0.95 million gallons per day and limits the loading of total suspended solids, biochemical oxygen demand, ammonia nitrogen, and fecal coliforms to the Matanuska River outfall. The 2007 permit introduced the current ammonia effluent limits due to the presence of spawning salmon in the side channel where treated effluent discharges. The existing WWTP is not capable of meeting its current ammonia effluent limit for most of the year in its current configuration.

The primary purpose of the WWTP Upgrade Project is to bring the facility into compliance with the APDES permit requirements. The timing of the upgrades also allows the City to consider how to best meet future flow and treatment demands as our community grows.

How it works

The original system was designed and installed in the 1970s. The existing 3 lagoon facility provides screening, aerated lagoon treatment, and Ultra Violet disinfection. This process treats the wastewater for ammonia, dissolved organics, oxygen levels, nutrient levels, and other chemical qualities before releasing the treated water into the Matanuska River.

Multiple alternatives

The City considered multiple alternatives before deciding on a reasonable upgrade solution. Evaluation criteria included cost, public health benefits, community impacts, environmental sustainability, adaptability and phasing opportunities, and treatment effectiveness based on current and future population and treatment demands. The proposed solution had to avoid impacts to the surrounding area, as well as meet future anticipated regulatory requirements.

The proposed solution

The City is proposing a phased improvement program at its existing facility. The first phase will bring the WWTP into compliance by 2018. Phases 2 and 3 will expand the system to address Palmer's future population growth and wastewater flows by adding an additional treatment basin.

Phase 1, near-term modifications, include final design of the improved WWTP, a Moving Bed Biofilm Reactor (MBBR) treatment process, two secondary clarifiers (to remove solids from the effluent), and sludge pumping facilities.

Cost

Cost for Phase 1 is estimated between, $9.8 and $14.6 million. The City is currently pursuing funding, including grant-funding requests, for design and construction of the upgraded WWTP. The City administration has proposed to submit a bond proposition to the voters on the October 2016 ballot to support the project costs.

What if we do nothing?

The City must upgrade its WWTP to bring the facility into compliance. Without an upgrade, the City could face stiff fees and fines from state and federal regulators that would greatly increase the cost of operations. Without the new system, the City will not be able to meet permit requirements and will be limited in our ability to provide safe wastewater service to our community.

Next steps

The project will move forward into the Phase 1 design phase. Design will be complete by December 2016, and construction will occur in 2017 and 2018. Future public meetings will be held during the design process to solicit community comments.

In the meantime, please send your technical questions and comments to:

Ryan Moyers, HDR Project Manager * Ryan.Moyers@hdrinc.com * 907-644-2160

Meeting Minutes

Project:	City of Palmer Wastewater Treatment Facility Feasibility Study Recommendations
Subject:	Open House
Date:	Wednesday, August 24, 2016
Location:	Palmer Railroad Depot
Attendees:	See attached sign-in sheet Attendees Column 2 (Tab to add more rows)

The following are the questions and comments made by the public in the Q&A session following the presentation by Ryan Moyers, HDR:

- Clarify the served population versus city population in meeting materials
- Consider timing of the meeting, take commuters into consideration and host meetings later in the day
- Provide a longer lead time for meeting notification
- Start robo-calls earlier in the process, not two days before the meeting
- Schedule meetings around other meeting times to avoid overlap
- Where does the ammonia issue/rule come from?
- Why and how to national permits apply here?
- Is the issue of ammonia levels only because of fish reasons? We have higher concentrations of fish near the wastewater treatment plant now.
- Is the biofilm media going to stay in the tanks?
- What's in the media? Is it different than what's there now?
- Can [natural] gas be used to heat the water?
- Will the recommended alternative have to be heated
- Is the wastewater treated before it goes into the lagoon?
- What is the operating cost? Is it similar to what it is now?
- How much will my sewer bill go up? How does that compare to Anchorage?
- What happens if the bond doesn't pass?

Please Sign In.

City of Palmer Wastewater Treatment Plant
Public Meeting
Wednesday - August 24, 2016

Name (Please print)	E-mail	Street Address	ZIP Code
Linda Combs	lcombs@mtaonline.net	Not mailing 429 E Caribou, Palmer	
Jim + Jessie Patterson	jpatterson@gci.net	1321 S. Bonanza St, Palmer	
NEAL EUGENE CARL HARABZEZMDX			
Curt McClellan		405 W Pioneer PKwy Palmer	
Arlene Cohen		417 N AK ST	
Tom Healy	trhealy@gci.net	211 GLORIA ST. PALMER	
Jack Snodgr[illegible]		560 E Arctic Palmer	
Bill Mitchell		425 E. Sitka Dr.	
Sara Coleman		484 N. Chugach St.	
Alycia Anderson		424 E Gold Key ln	

Please Sign In.

City of Palmer Wastewater Treatment Plant
Public Meeting
Wednesday - August 24, 2016

Name (Please print)	E-mail	Street Address	ZIP Code
Steve Carrington	carrington@rocketmail.com	Hilltop Dr.	
Andy Coulson	andy.t.coulson@gmail.com	506 Cogar Loop	

City of Palmer

Wastewater Treatment Plant Facility Plan Update

Frequently Asked Questions

The City hosted a public meeting on the Wastewater Treatment Plant (WWTP) Facility Plan Update on July 21, 2016. The following are responses to some of the questions heard that evening.

Why is this update required?

The original system was designed and installed in the 1950s and updated several times over the years beginning in 1972. The existing WWTP is not capable of meeting its current ammonia effluent limit for most of the year in its current configuration, especially during the cooler months.

The City of Palmer first began exploring the possibility of a WWTP upgrade in 1999 to upgrade the facility to meet the then upcoming ammonia limits at the facility. Many of these early alternatives did not address permit requirements, had high operating or construction costs, or anticipated significant population growth within the system boundaries.

City of Palmer WWTP Terms

Effluent: treated waste discharged into the Matanuska River

Influent: sewage flowing into the treatment plant

Ammonia: compound of nitrogen and hydrogen; discharged in high levels, ammonia becomes a pollutant

The primary reason the update is required now is to meet regulatory requirements. State and federal permits place conditions on what and how much the WWTP discharges into the Matanuska River. The current permit was last renewed in 2007 and has been administratively extended since its expiration in 2011. The City of Palmer is working closely with the Alaska Department of Environmental Conservation (DEC), the Department of Justice, and the US Environmental Protection Agency (EPA) to outline the terms and requirements for the City to get into compliance.

The City of Palmer commissioned a new study in 2015 to identify a recommended alternative and preliminary design for an expandable WWTP system that could address future population growth and anticipated regulatory changes. As proposed, the near term recommended modifications will bring the WWTP into compliance by 2018.

WWTP Fast Facts

Service Area: City of Palmer and adjacent areas of the Matanuska-Susitna Borough

Service Area Population: 9,200
Projected Service Population (2035): 16,200

Average Daily Flow: 0.61 MGD

What if we do nothing?

As it stands today, the City of Palmer will be subject to fines for non-compliance. Without an upgrade, the City could face additional fees and fines from state and federal regulators that would greatly increase the cost of operations until such time as compliance requirements are met.

What are the recommended modifications?

The City is proposing a phased improvement program at its existing facility. Phase 1, near-term modifications, include the final design for the Moving Bed Biofilm Reactor (MBBR) treatment process, two secondary clarifiers (to remove solids from the effluent), and sludge pumping facilities. Phases 2 and 3 will expand the system to address wastewater flows and future population growth within the service area by adding an additional treatment basin.

This proposed system complies with current regulatory requirements, provides flexibility for future expansion or regulatory upgrades, and lowers operating costs.

How much will it cost?

Cost for Phase 1 is estimated between, $9.8 and $14.6 million. The City is currently pursuing funding, including grant-funding requests, for final design and construction of the upgraded WWTP. Additional funds are available from the City's water/sewer fund, and the City administration will submit a bond proposition on the October 2016 ballot to support the project costs, based on voter approval. The cost of regulatory fines will come out of the City's budget. Rate adjustments to support the upgrade are probable, but increases would likely be higher if no action is taken and stronger fines are assessed by the regulatory agencies until the WWTP is in compliance.

Will the proposed solution address the problem? Will the regulations change?

The recommended alternative provides for the required ammonia removal in cooler temperatures and requires less aeration than the current system.

While regulations are updated as needed, the City of Palmer has been working with the DEC and EPA to confirm the WWTP meets current and reasonably foreseeable future changes to regulatory requirements.

Why such a small system? Shouldn't it be bigger and include an option to receive septage?

Currently, the plant receives wastewater from residential and commercial sources. The Facility Plan Update's recommended alternative addresses two key future issues: regulatory compliance and future population growth. The alternative allows for phased development, and flexibility to expand as the served population grows or operating conditions are modified. This may include the ability to accept septage, based on documented future need.

Is there any impact to salmon from the effluent discharge?

The Matanuska River provides essential fish habitat for king, coho, pink, and chum salmon. The City of Palmer has been given end-of-pipe effluent limits for ammonia during anadromous fish spawning months. Current WWTP discharge is not always able to comply with regulatory levels for ammonia. While there is no indication that ammonia levels are currently affecting fish populations, high ammonia levels can result in algae blooms that reduce water oxygen levels and potentially could harm fish.

How do I find out more about the regulatory requirements?

The City of Palmer WWTP is regulated by state and federal agencies.

- Department of Environmental Conservation: http://dec.alaska.gov/water/wwdp/dmww/dmww.htm (Permit Number AK0022497)
- U.S. Environmental Protection Agency: https://www.epa.gov/cwa-404/clean-water-act-section-401-certification

What is the public process moving forward?

Future informational public meetings will be held during the design and construction process to solicit community comments.

Who do I contact if I have a comment on the master plan or facility design?
Please contact Ryan Moyers, HDR Project Manager, at Ryan.Moyers@hdrinc.com or 907-644-2160.

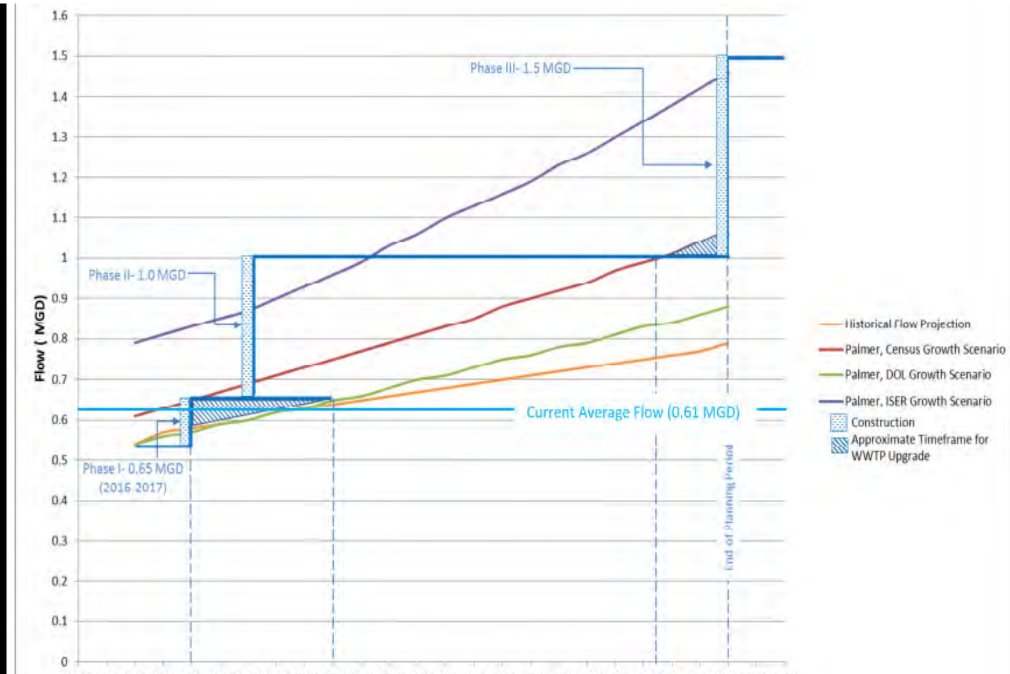
Welcome

Palmer Wastewater Treatment Plant Facility Plan Update

The purpose of this meeting is to provide information about the Facility Plan effort, the recommended upgrade alternative, and next steps.

Why do we need to update the wastewater treatment plant?

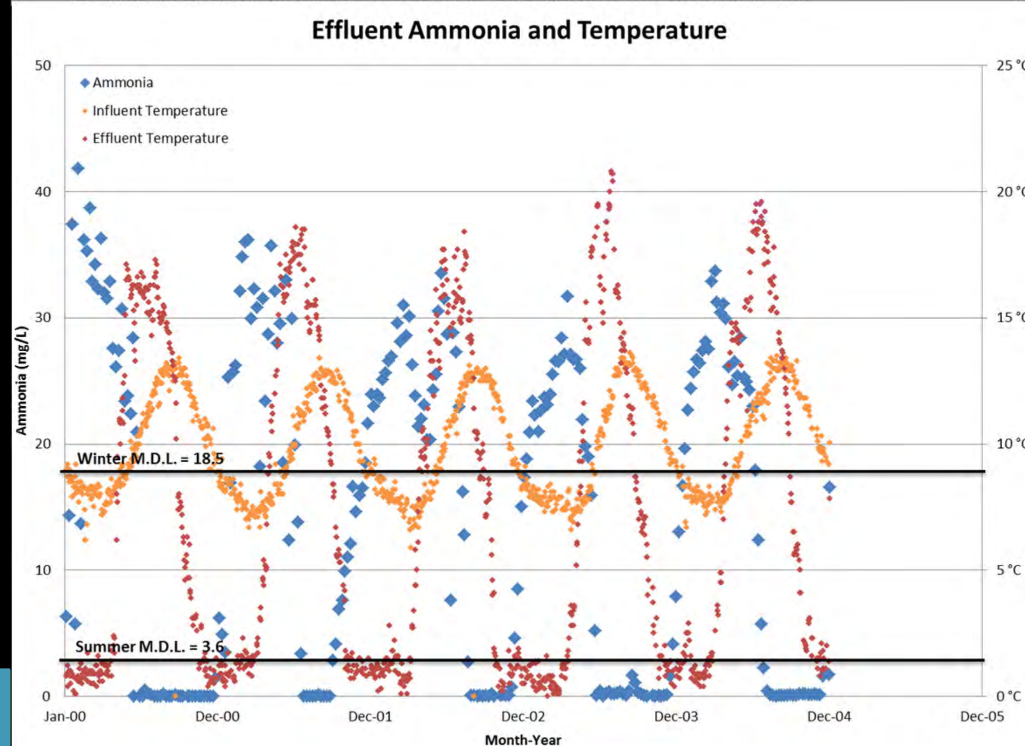
- **Compliance**
  - The current facility does not meet regulatory requirements, specifically ammonia effluent limits
  - Mandatory compliance required by 2018
- **Population Growth**
  - Palmer's served population is expected to grow from 9,200 today to 16,200 by 2035.



Previous Studies/Alternatives

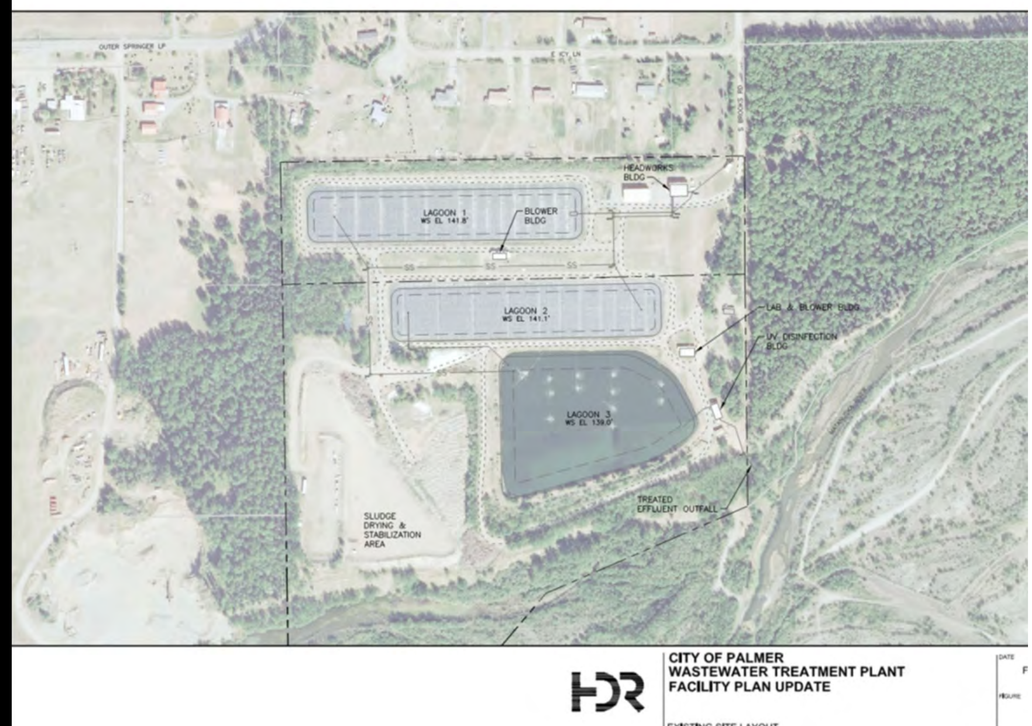
Initial studies began in 2000

- Looked at a variety of solutions, including subsurface discharge
- Limited phasing opportunities
- Did not address current/future permit requirements
- High cost



Plant History

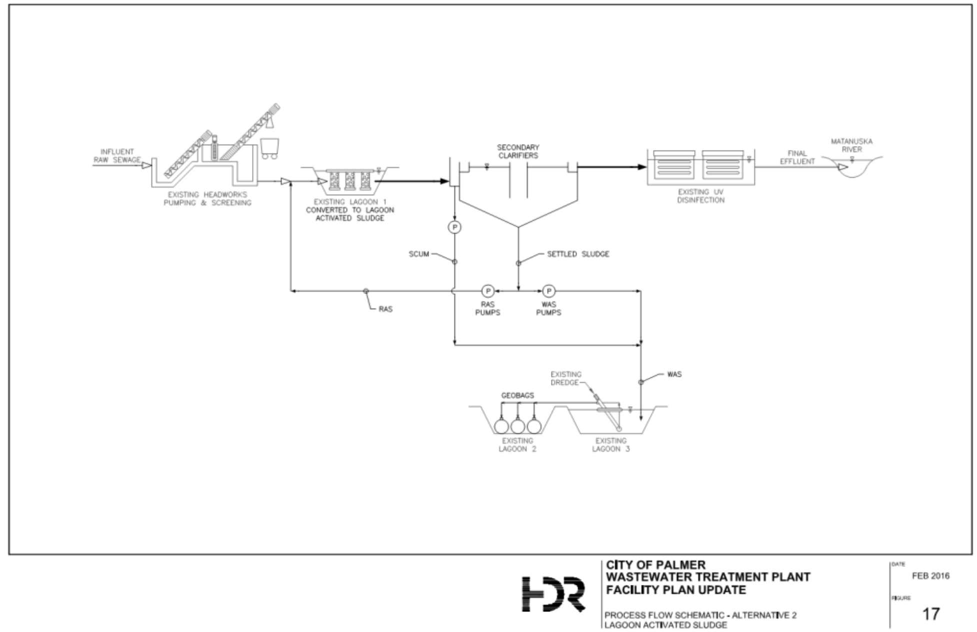
- Plant was originally constructed in 1950's
- 1972: New pond, concrete chlorine contact chamber, and lab
- 1988: New headworks building and manhole flow control structures
- 1998: New blower building; aeration system updated
- 2001: Baffle curtains installed in ponds
- 2002: New headworks building with new grinder and screen; UV treatment initiated
- 2010: 4 inch insulated panels and baffles installed on Lagoons 1 and 2
- 2010: Second UV treatment system installed; capacity expanded up to 2 MGD if needed
- 2012: New blowers installed – higher efficiency, probe controlled
- 2014: Second grinder installed



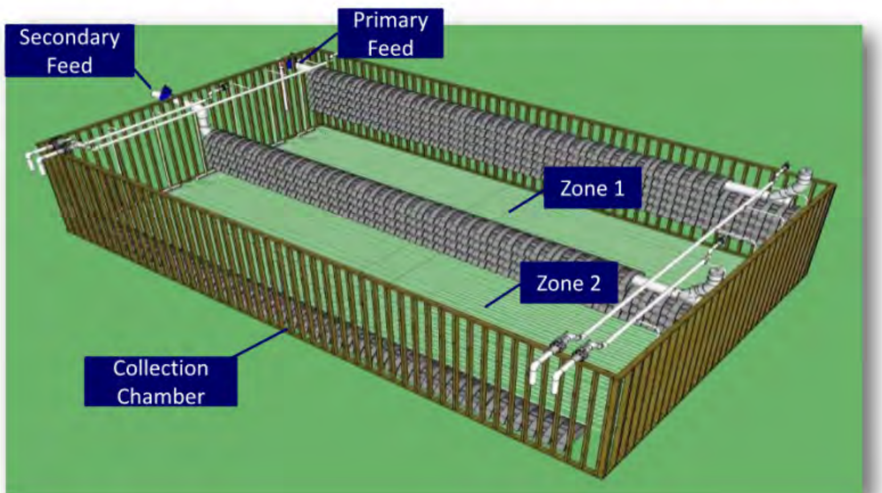
Alternatives Evaluation

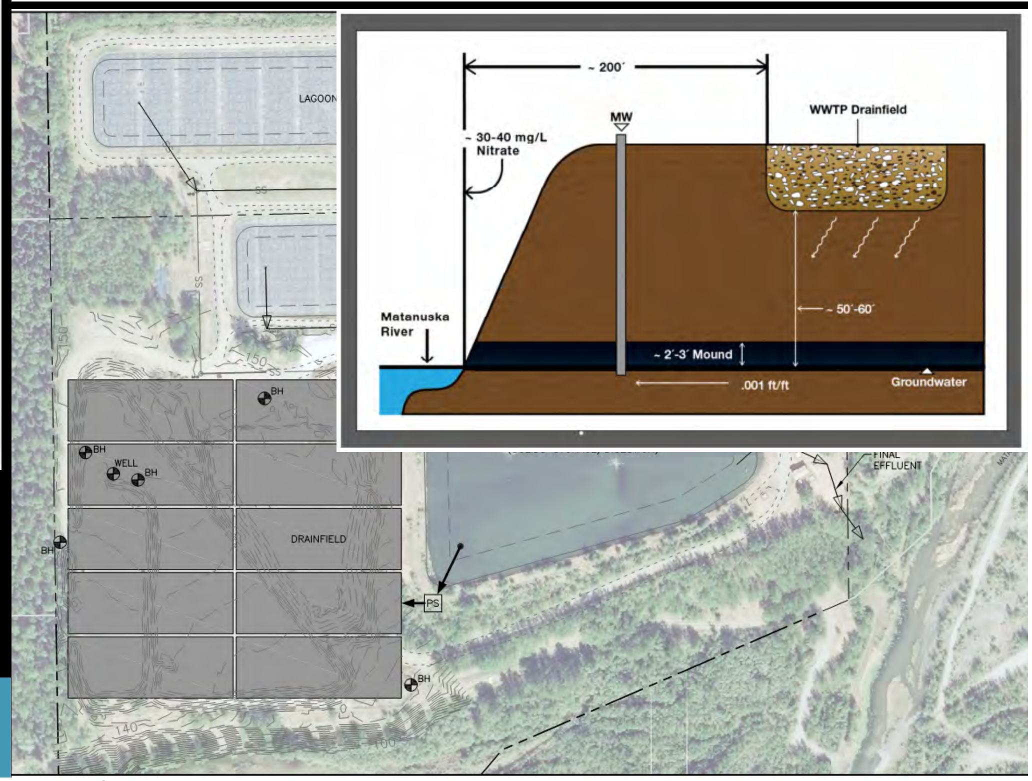
Facility Plan Alternatives

- Subsurface Disposal
- Lagoon Activated Sludge (LAS)
- SAGR Attached Growth Reactor
- Moving Bed Biofilm Reactor (MBBR)



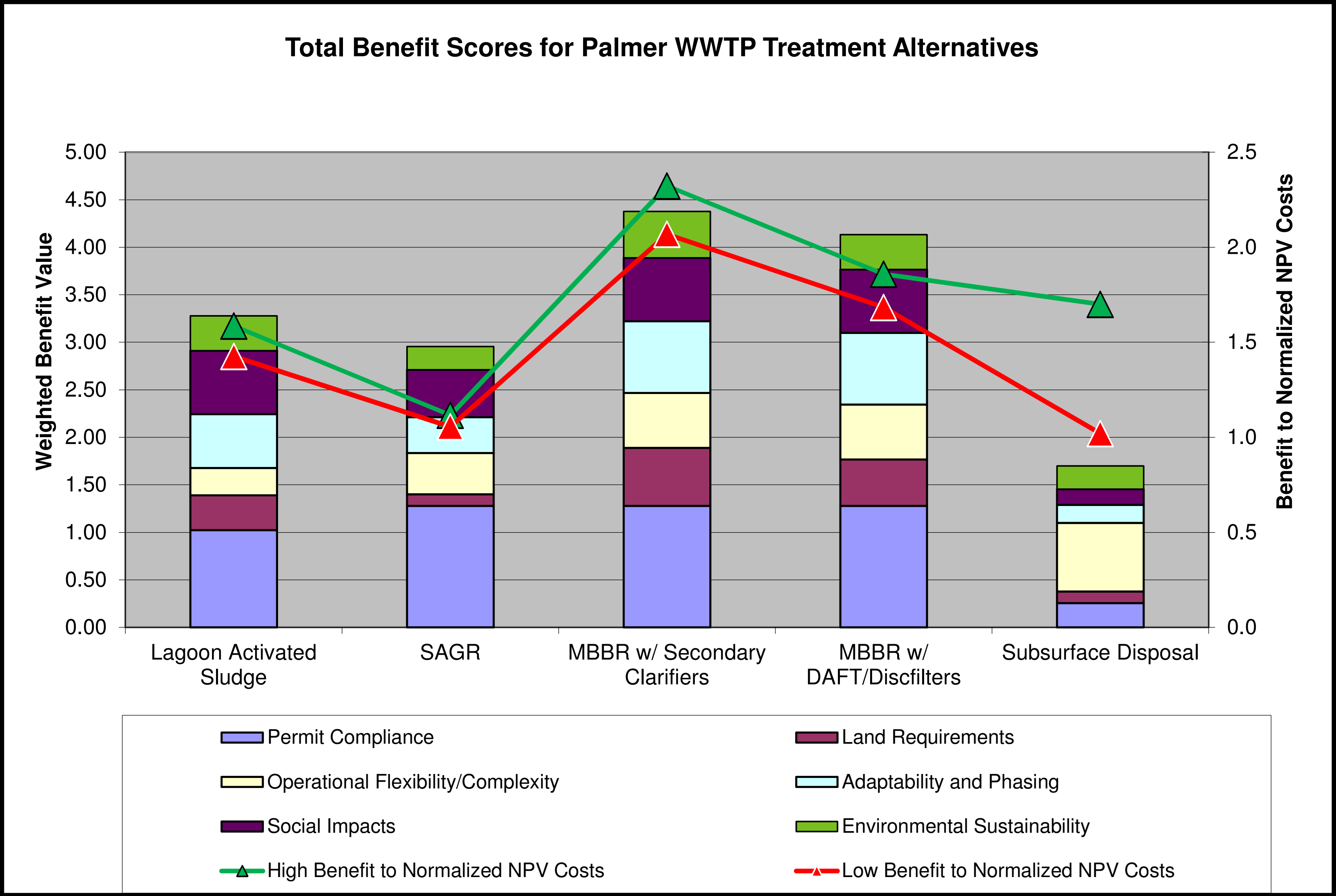
Submerged Attached Growth Reactor





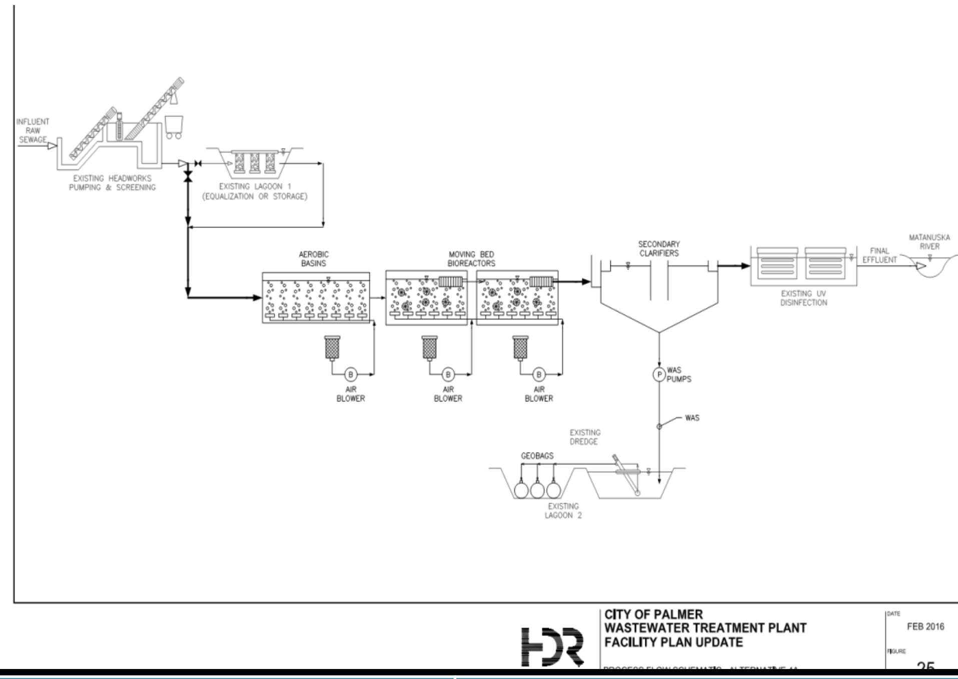
ALTERNATIVES EVALUATION

Palmer WWTP Decision Analysis



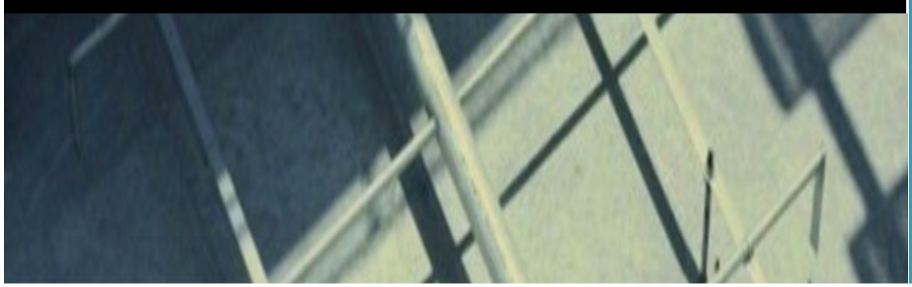
Recommended Alternative

Moving Bed Biofilm Reactor (MBBR)



Basic Elements:

- Aeration Diffusers
- Aeration Piping
- Retention Screens
- MBBR Media “Bug Condos”
- Design Coordination
- Secondary clarification (clarifier, DAF)



Advantages:	Disadvantages:
• Complies with current regulatory requirements and flexibility to meet future regulatory requirements. • Ability to phase upgrades , which minimizes initial capital costs. • Treats warmer influent wastewater by bypassing the lagoons. • Operational Cost Savings: ➢ Effluent pumping not required. ➢ Less aeration required (less power). • Smallest footprint (provides the ability for plant expansion) relative to other alternatives. • Operates year round and not subject to seasonal discharge.	• New, mechanical treatment plant replaces existing lagoon infrastructure. • Additional staff training will be necessary.

Slide 6

JKJ1	Need to rephrase this Jessen, Julie K., 7/20/2016

RECOMMENDED ALTERNATIVE

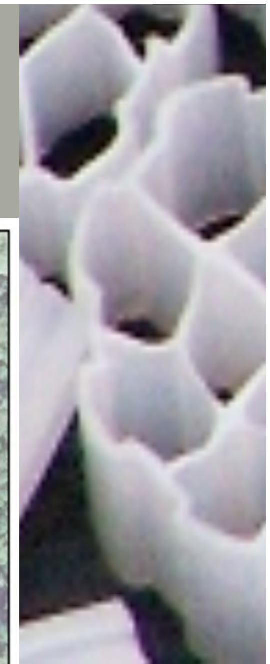
CITY OF PALMER
WASTEWATER TREATMENT PLANT
FACILITY PLAN UPDATE

CONCEPTUAL SITE LAYOUT - ALTERNATIVE 4A
MBBR WITH SECONDARY CLARIFIERS

DATE FEB 2016

FIGURE 26

Cold Weather (-21ºF) MBBR installation in Wisconsin



Next Steps

- Design of the facility plan recommended alternative is currently underway.
- Construction planned for 2017-2018.
- Future informational public meetings will be held during the design and construction process.

Questions?

HDR

Ryan Moyers, PE
Ryan.moyers@hdrinc.com
907-644-2160