EXHIBIT 3 – DILLINGHAM WATER AND SEWER MAP

The original 10-inch forcemain from the City Dock lift station to the lagoon ran alongside the Nushagak River; however, it was exposed as a result of beach erosion. In 2012, a new 12-inch HDPE forcemain was installed from the City Dock lift station to the lagoon using horizontal directional drilling (HDD). The new forcemain runs below a portion of the City in an arching, northeasterly alignment from the City Dock to the lagoon.

2.1.2 City of Dillingham Lagoon

The City's existing partially mixed, aerated wastewater treatment lagoon system was constructed in 1989 and includes two unlined cells, and associated equipment and site infrastructure. Each cell covers approximately 1.5 acres in area and has a total depth of approximately 18 feet including 3 feet of freeboard; the total storage volume is approximately 9.0 million gallons (4.5 million gallons per cell). The lagoon is permitted for 273,000 gallons per day of wastewater (AK Permit AKG573004). The lagoon has a single discharge point at the outlet of the Cell #2 overflow control structure. The existing system has not been required to disinfect prior to entering the discharge line and eventually discharging to the Nushagak River at the end of the outfall line.

The blower building is located at the northwest corner of the lagoon. Originally, an air manifold system was installed at the base of both lagoon cells to provide aeration. However, the lagoon has only ever operated with the first cell aerated. The aeration system in the base of the lagoon was damaged during past maintenance activities to remove sludge. The damage has been repaired; however, the aeration in Cell #1 consists of course bubbles that represent less efficient aeration and a more limited level of microbial breakdown and wastewater treatment than fine-bubble diffusers.

In 2013, baffles were installed to both cells of the lagoon to improve treatment. The baffle curtains are intended to lengthen the residence time of the wastewater in the lagoon, and provide additional time for treatment prior to discharge. However, the baffles have become misaligned, and appear to be creating short circuiting issues.

The current condition of the lagoon system has resulted in poor treatment performance. A report of wastewater effluent quality from the Environmental Protection Agency (EPA) Enforcement and Compliance History Online (ECHO) website shows the lagoon has struggled to meet permit limits. A summary of effluent exceedances for the past year (April 2019 – March 2020) is provided in the following table. The full ECHO Effluent Limit Exceedances report is located in Appendix D.

Table 2 Effluent Exceedance Summary (April 2019 – March 2020)

EXCEEDANCE DESCRIPTION	NUMBER OF EXCEEDANCES	DAYS WITH EXCEEDANCES
Biochemical Oxygen Demand (BOD 5-day), Weekly Average	18	126
Total Suspended Solids, Weekly Average	15	105
Fecal Coliform Bacteria, Daily Max	5	5

* Based on EPA ECHO online report, March 24, 2020.

To address these issues, the City of Dillingham has funded the completion of engineering plans for needed treatment upgrades. These improvements, discussed in Section 2.1.4, include new aeration and baffle systems, and a pretreatment pond which will provide more control over the septage and a safer pumper truck disposal area.

In 2015, the City constructed a septage disposal station at the existing lagoon to receive waste from local pumper trucks to reduce the amount of solids discharged directly into the treatment cells. Currently, however, the septage disposal station is not being used and pumper trucks dump directly into the southeast corner of the lagoon multiple times per day in summer and several times per month in winter, see Photograph 1.

PHOTOGRAPH 1 – PUMPER TRUCK DUMPING AT EXISTING LAGOON SE CORNER CELL #1 (7/12/19)

The lagoon accepts hauled wastewater from holding tanks (particularly associated with housing for fish processing facilities), as well as septage from homes in the Dillingham area. The fish processing facilities in Dillingham do not currently discharge fish processing waste to the City's lagoon.

In 2017, improvements were implemented at the lagoon including the installation of a new metering manhole adjacent to the existing inlet diversion box, improvements to Cell #2's overflow control structure/discharge point, improvements to the City Dock lift station, and a new section of the Snag Point Subdivision forcemain on the west side of the lagoon site. A site plan showing existing conditions at the lagoon is shown on Figure 1 – Existing Conditions Site Plan.

Wastewater characteristics for the City's existing lagoon are provided in Table 3.

Table 3 Dillingham Lagoon System and Wastewater Characteristics

DESCRIPTION	VALUE/UNIT	NOTES
Number of Cells	2	
Lagoon Area (both cells)	3 acres	1.5 acres each
Wastewater Depth	15 feet	Average, 18 feet total depth
Lagoon Volume	9,000,000 gallons	Total, including both cells
2019 Average Maximum Daily Flow Rate	150,000 gpd	Based on the average of maximum flow rates for 2016, 2017, and 2018
2019 Average Flow Rate	100 gpm	Based on system records for 2016, 2017 and 2018
2045 Estimated Daily Wastewater Flow	185,000 gpd	Based on population and per capita use
Maximum Permitted Flow	273,000 gpd	AK Permit AKG573004
Estimated Per Capita Flow	65 gpcpd	
2019 Detention Time	60 days	Based on max average flow
3-Yr Average Max BOD (Influent)	150 mg/L	Based on the average of maximum BOD measurements from 2016, 2017, and 2018
3-Yr Average Max BOD (Influent)	186 pounds/day	Based on the average of maximum BOD and flow measurements from 2016, 2017 and 2018
3-Yr Average Max TSS (Influent)	140 mg/L	Based on the average of maximum TSS results from 2016, 2017 and 2018
Estimated BOD Loading Rate	125 pounds BOD/acre day	Assuming one 1.5-acre aerated cell and a 1.5-acre settling cell
Estimated Average Wastewater Haul (Pumper Trucks)	7,500 gpd	Primarily in summer months

2.1.3 Effluent Outfall

The existing 12-inch ductile iron (DI) discharge line was installed in 1989 as part of the original lagoon project; it transfers effluent, by gravity, from lagoon Cell #2 to the Nushagak River. The discharge line is buried approximately 8 feet deep. The outfall line extends approximately 450 feet from the outfall manhole near the shoreline to its final discharge point as shown on Figure 1.

A 300-foot section of the outfall line was replaced in the summer of 2002 as that length of pipe had been exposed due to beach erosion and misalignment had resulted. The discharge line between the lagoon and outfall manhole, and the submerged section of the outfall line (the last 150 feet), consists of the original 12-inch DI pipe.

PHOTOGRAPH 2 – EFFLUENT LINE PROTECTION NORTH OF OUTFALL (7/11/19)

Similar to the original City Dock forcemain, erosion over time exposed a portion of the discharge line north of the outfall manhole. In 2012, the City reburied the exposed discharge line with approximately 6 feet of cover material and placed riprap at the surface to limit further erosion. They conducted emergency repairs in the summer of 2016, 2017, and 2018 after a series of storms exposed the lagoon discharge line. The City continues ongoing maintenance efforts to stabilize the shoreline.

2.1.4 Planned Treatment Lagoon Improvements

Since original lagoon construction, the City has completed several maintenance and improvement projects. Unfortunately, the maintenance activity to remove accumulated sludge by dredging damaged the aeration and baffle system. This has a serious impact on the ability of the lagoon to meet permit requirements.

A new floating aeration and baffle system has been designed to maintain treatment objectives, and to ensure the discharge meets safe water quality standards and permit requirements. The design also includes a new pumper truck dump station, pre-treatment pond, flow control structure, and gravity sewer line adjacent to the lagoon which connects to the existing diversion box installed as part of the original system. The pre-treatment pond was designed to accept year-round wastewater from residential and commercial septic tanks, wastewater holding tanks, graywater holding tanks, and portable toilets via the pumper trucks. These planned improvements are shown on Figures 2 and 6.

2.1.5 Kanakanak Hospital Lagoon

The Bristol Bay Health Corporation (BBHAC) has operated a two-cell lagoon serving the Kanakanak Hospital complex since 2000. The complex currently serves approximately 70 residents and 175 employees, with an estimated 2025 design population of 78 residents and 324 employees (DOWL, 2014).

The lagoon system consists of a facultative cell and a percolative cell located near a bluff along the Nushagak River. Following a 2004 U.S. Army Corps of Engineers Report, the hospital completed an engineering study to relocate the wastewater system (Kanakanak Hospital Wastewater Treatment System Feasibility Study, Dillingham, Alaska, September 2014, DOWL Engineers). The final design of a new percolative cell, located north of the existing cell, is currently being completed.

Wastewater characteristics for the Kanakanak Hospital's lagoon are provided in Table 4, as presented in the 2014 DOWL report.

Table 4 Kanakanak Hospital Lagoon System and Wastewater Characteristics

DESCRIPTION	VALUE/UNIT	NOTES
Number of Cells	2	
Lagoon Area (both cells)	2.6 acres	
Wastewater Depth	7 feet	
Freeboard	2 feet	
Max Permitted Flow Rate	21,000 gpd	
2014 Average Wastewater Flow Rate	13,808 gpd	Estimated Annual average
2014 Max Wastewater Flow Rate	31,758 gpd	Maximum daily estimated using 2.3 peaking factor
2032 Average Wastewater Flow Rate	17,856 gpd	Based on anticipated increase in service population
2032 Max Wastewater Flow Rate	41,069 gpd	Maximum daily estimated using 2.3 peaking factor
2045 Max Wastewater Flow Rate	50,000 gpd	Assumed
Average Influent BOD Estimate	250 mg/L	Assumed, no test results available

The hospital lagoon does not discharge to surface water and operates under a permit for the percolative discharge of 21,000 gallons per day (AK Permit 2006DB0052). This permit does not require monitoring. There is currently no data on the Hospital's wastewater characteristics.

3.0 REGULATORY CRITERIA

The State of Alaska Department of Environmental Conservation (ADEC) via the State of Alaska Wastewater Regulations (18 Alaska Administrative Code [AAC] 72) requires that any domestic wastewater treatment works meet minimum design/construction standards, operation standards, and treatment standards. These conditions are met by:

- Requiring ADEC approval of engineering plans prior to constructing or operating a wastewater treatment works (18 AAC 72.200);
- Requiring a certified wastewater operator (18 AAC 74); and by
- Requiring a discharge permit for any domestic wastewater discharged "into or onto land, surface water, or groundwater" (18 AAC 72.010).

3.1 MINIMUM CONSTRUCTION STANDARDS

The ADEC construction approval is contingent upon verifying design/construction standards that include:

- Sufficient subsurface information to evaluate soil types, percolative capacities, and water table depths including the following site constraints:
  - Maintain a minimum vertical separation distance to seasonally high groundwater of at least 4 feet.
  - Maintain a minimum vertical separation distance to an impermeable surface of at least 6 feet.
- Methods to maintain service and treatment during construction;
- The ability to accommodate organic and hydraulic loading, for current and future design flows;
- Infrastructure to ensure controlled, sanitary, operating conditions;
- The safe disposal of any treatment residuals;
- Compliance with specific treatment technology requirements and ADEC guidance documents; and
- The reasonable ability to meet discharge permit limits and water quality standards.

After receiving construction approval from ADEC, and construction of the wastewater treatment system, the owner must show the system was constructed substantially as approved, and can successfully meet operation and discharge standards, in order to obtain needed final operation approval from ADEC.

3.2 OPERATOR CERTIFICATION REQUIREMENTS

The ADEC Division of Water Operations Assistance Program oversees operator certification requirements for public water and wastewater systems in Alaska (18 AAC 74). Higher operator certification levels are required for more complex treatment systems, with points added for each treatment process. Operator certification requires passing exams, as well as meeting experience requirements.

The current lagoon treatment components result in a classification as a Level 1 Wastewater Treatment Facility. The sewer system is classified based on the number of service connections as a Level 1 Wastewater Collection System. The current Dillingham wastewater systems therefore require an operator with Level 1 Wastewater Treatment and Level 1 Wastewater Collection certifications.

The City's current operator, William Noonkesser, has a provisional Wastewater Collection certification only.

3.3 WASTEWATER DISCHARGE

The Environmental Protection Agency (EPA) Clean Water Act requires that wastewater discharge quality meet secondary treatment standards for conventional pollutants found in domestic wastewater, including:

- Five-day Biochemical Oxygen Demand (BOD_5)
- Total Suspended Solids (TSS)
- Potential Hydrogen (pH)
- Fecal Coliform
- Oil and Grease

Approximately 136 additional toxic pollutants have been identified by EPA as potentially critical to either human or aquatic life. Of these, the following are typically included in State of Alaska wastewater discharge permits:

- Dissolved Oxygen (DO)
- Total Residual Chlorine (TRC, for systems that chlorinate)
- Fecal Coliform (discharged to fresh or marine water)
- Total Ammonia as Nitrogen

The limits for these standards are defined in the State of Alaska Wastewater Regulations (18 AAC 72) and State of Alaska Water Quality Standards (18 AAC 70).

3.3.1 Surface/Subsurface Discharge

ADEC requires that all discharges from regulated wastewater systems have a discharge permit issued by ADEC. This includes surface, subsurface (percolation), and surface water discharges. For regulated wastewater systems that do not discharge to a surface water body, ADEC can elect to address the discharge during the engineering plan review, in lieu of issuing an additional discharge permit.

3.3.2 Surface Water Discharge (Fresh/Marine Water)

The federal Clean Water Act requires that any discharges to surface water meet water quality standards outlined in a discharge permit. ADEC has regulated these discharges through the Alaska Pollutant Discharge Elimination System (APDES) since 2008.

There are two categories of discharge permits in Alaska, "General Permits" and "Individual Permits." All permits (of either category) are effective for up to five years (as specified in statute). Individual Permits are custom written for a specific system and specific site circumstances. These take considerable time and effort to develop and implement.

Where possible, ADEC prefers to use General Permits. General Permits are written for a general use category, such as lagoons or wastewater treatment works (including package plant units). The discharge requirements listed in the General Permits are directly related to water quality standards and the assumed treatment ability for that general use technology (lagoons are not expected to be able to meet the same standards as public owned treatment works [POTW]). ADEC then authorizes individual systems to use one of these General Permits. These authorizations are good for the term of the General Permit (five years). They have historically included allowances for mixing zones in the receiving water bodies.

The City's lagoon system currently discharges to surface water, the Nushagak River. ADEC has implemented enforcement actions against the City of Dillingham due to permit violations including, but not limited to, MCL exceedances, sampling inconsistencies, and operator certification levels. The planned lagoon maintenance/upgrades should address these violations, under current lagoons operation parameters. Future changes in wastewater use or changes in the implementation of mixing zones in the APDES permits could prove challenging without adding additional treatment, as discussed in the sections on wastewater treatment alternatives.

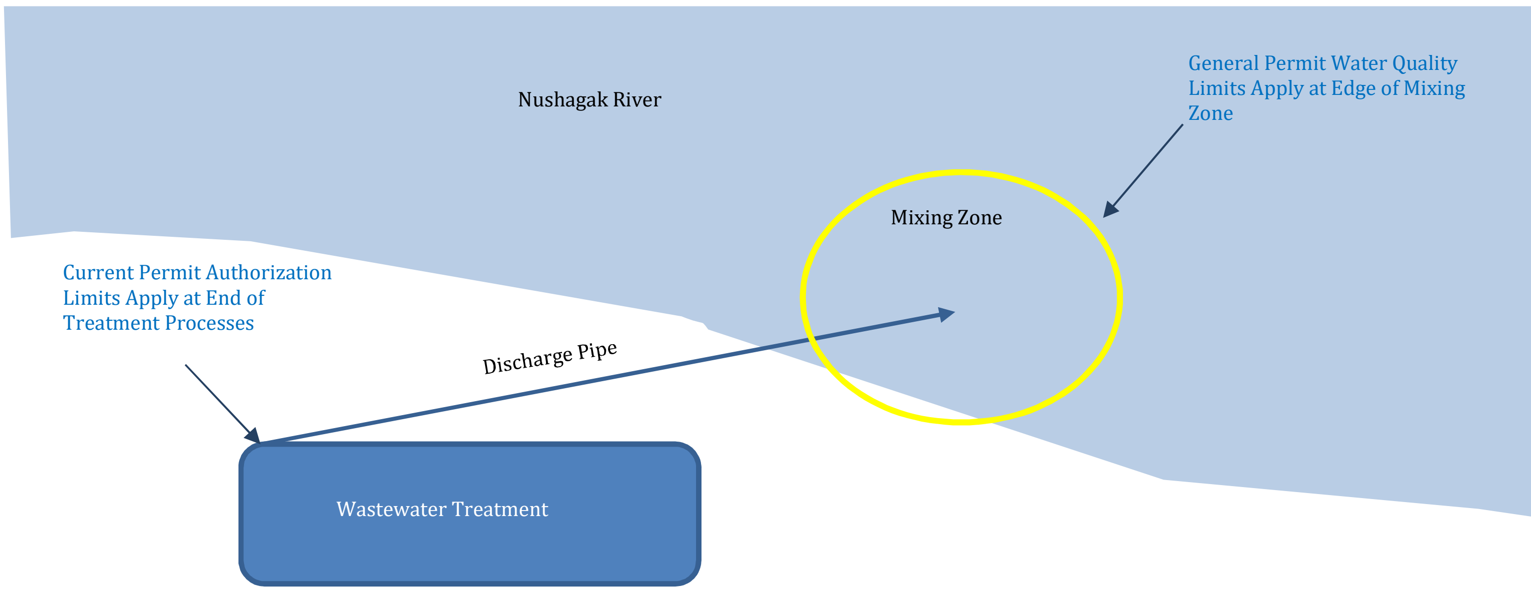
A summary of current discharge requirements is provided in Table 5, with a more complete table provided in Appendix D. Notable discharge limits are also presented in Table 5.

The permit limits included in the 2018 permit authorization for the Dillingham lagoon are more lenient than the limits listed in the General Permit because of the assumed mixing zone (shown on Exhibit 4). ADEC is currently revisiting legacy discharge authorizations such as the one that the Dillingham Lagoon is operating under. At this time, ADEC is honoring the existing mixing zone as long as there is not substantial change to the wastewater treatment system such as increased wastewater loading and/or a change in the overall treatment process. However, future authorizations under a General Permit may not include the legacy mixing zone, and the associated more generous discharge limits. Two notable limits that could see the most significant impact from this change are the fecal coliform limit and the ammonia limit, highlighted in Table 5. If future authorizations require a lower limit for coliform, then disinfection of the wastewater effluent could be necessary. This would add a requirement for disinfection monitoring (to ensure the disinfectant is adequately neutralized before discharge).

Table 5 Permit Authorization and General Permit Requirements

Parameter	2018 DLG Lagoon Authorization (AKG573004)	2018 Lagoon General Permit (AKG573000)	2018 POTW General Permit (AKG572000)	Unit	Notes
Flow	273,000	<1,000,000	<1,000,000	gpd	Max-Daily
pH	6 - 9	6.5 - 8.5	6.5 - 8.5		
Total Residual Chlorine (TRC)	N/A	0.011		mg/L	Avg-Monthly
	N/A	0.019		mg/L	Max-Daily
Dissolved Oxygen (DO)	2 (min)	7 - 17	7 - 17	mg/L	Daily Min - Max, Fresh Water
Biochemical Oxygen Demand (BOD)	30	30	30	mg/L	Avg-Monthly
	45	45	45	mg/L	Avg-Weekly
	60	60	60	mg/L	Max-Daily
% BOD Removal	65	65	85	%	
Total Suspended Solids (TSS)	45	45	30	mg/L	Avg-Monthly
	65	65	45	mg/L	Avg-Weekly
	-	-	60	mg/L	Max-Daily
% TSS Removal	65	65	85	%	
Fecal Coliform Bacterial (FC)	200	20	20	FC/100 mL	Avg-Monthly
	800	40	40	FC/100 mL	Max-Daily
Total Ammonia as Nitrogen	-	-	Report	mg/L	Max-Daily

EXHIBIT 4 – MIXING ZONES AND PERMIT LIMITS



4.0 WASTEWATER TREATMENT ALTERNATIVES

4.1 AERATED WASTEWATER TREATMENT LAGOON

General Design Considerations

Aerated, partial mix lagoons have been used successfully throughout Alaska for decades. These systems have the ability to meet current minimum discharge standards, within a relatively small footprint, with limited complexity and operational costs. Aerated lagoons include either floating aeration (in shallower systems), or submerged aeration (in deeper systems). Baffles can be added to maximize the efficiency of the lagoon by minimizing dead areas with limited flow, thereby preventing short circuiting.

The majority of the treatment in this system occurs in the organics that are suspended in the aerated wastewater. The settled solids and sludges will continue to breakdown through fermentation, but at a much slower rate because of the limited oxygen available at the bottoms of the lagoon, and the cold-water temperatures. Efficient aeration equipment minimizes sludge accumulation, but at some point, accumulated sludge may require removal. Submerged aerators are typically more efficient at distributing oxygen and therefore, require less energy and are typically more energy efficient.

The basic design components of aerated lagoons are:

Hydraulic Loading Criteria – sufficient detention time is essential to mitigate variations in system flow rates and influent wastewater quality, and to provide time for the microbial treatment of the wastes. Baffle systems help ensure that the entirety of the lagoon volume is used for treatment. These systems consisting of geofabric suspended from floats and guywires, and anchored at the walls and floor. Windows in the baffle’s walls are provided to direct and control the flow.

Organic Loading Criteria – higher strength wastewater requires more area and more oxygen to successfully treat the wastewater. Organic loading rates are typically expressed in terms of pounds of BOD per acre per day. The aeration components are critical in achieving organic treatment. These components serve two purposes:

- Mixing – the aeration provides some mixing of the suspended solids, but does not provide sufficient mixing to keep all the solids in suspension; and

- Oxidation- the aeration provides oxygen to the microbes in the suspension, that break down the suspended, organic wastes, resulting in needed reductions in BOD, TSS, and bacteria.

BOD reduction and the nitrification of ammonia both rely on dissolved oxygen. However, nitrification requires over 3 times the amount of oxygen than BOD removal. Systems with small foot prints and associated high ammonia loading may be able to meet BOD limits, but could struggle with ammonia limits because of insufficient oxygen. This problem is exacerbated in cold temperatures due to slower reaction times.

Operational Complexity and Maintenance Considerations

Operational complexity and operator certification are particularly important due to the enforcement actions issued by ADEC that referenced the inability of the City to meet required operator certification levels. It is difficult to train, hire, and retain certified operators throughout Alaska. This becomes more challenging as certification levels increase. Therefore, the impact of added wastewater treatment to the complexity and certification requirement of a wastewater system is an important consideration.

As discussed in Section 3.2, the current lagoon system is required to have an operator with Level 1 Wastewater Treatment certification with a facility score of approximately 20 points, with the Level 2 certification requirement beginning at a score of 30 points. Upgrading the existing lagoon, or constructing a new aerated lagoon, is not expected to substantially change the certification requirements. Adding a nitrification/polishing cell and disinfection would similarly not add sufficient points to require a Level 2 operator (see Operator Certification Estimates in Appendix D).

Operational considerations:

- Aeration System – Motors, blowers, and aeration heads should be regularly maintained.
- Baffle System – Baffle systems should be maintained to prevent damage by vegetation, and adjusted as needed to maintain alignment and prevent short circuiting.

- Sludge Management – Routine sludge depth monitoring should be conducted. New aeration equipment should increase sludge breakdown and minimize the amount of accumulated sludge. If needed, sludge should be removed to prevent an over-accumulation that could potentially interfere with treatment processes. Care should be taken to prevent any damage to aeration equipment and baffles.
- A potential aerated polishing cell would be filled with a media, making it less likely to attract water fowl.

It is anticipated that two (2) operators with Level 1 Wastewater Treatment and Level 1 Wastewater Collection certifications will be required to operate the aerated wastewater treatment lagoon alternatives.

Wastewater Discharge

Due to the relatively long detention times, aerated lagoons are not as impacted by daily variations in flow and loading as packaged plants. Although potential updates in Alaska discharge permits could decrease the authorized coliform bacteria discharge limits dramatically, an adequately sized, operated, and maintained lagoon system should be able to meet the stricter limits without relying on disinfection such as chlorination. If the City's volume or quality of wastewater changes substantially, upgrades may be necessary for wastewater disinfection and ammonia removal.

- If required, a disinfection system could be included at the site.
- If meeting ammonia limits becomes a concern, a third polishing cell could be added. This would also improve the treatment for BOD, TSS, and bacteria.

This Study considers two wastewater treatment lagoon alternatives – defend the existing lagoon in place and construct a new wastewater treatment lagoon in Dillingham. These two lagoon options are detailed in the following sections.

It is assumed that the existing lagoon system would continue to use the existing discharge line. The discharge line is currently experiencing erosion issues. Continued use will require continued protection of the line. The new lagoon would require a new discharge system. This systems placement should consider the ongoing erosion challenges experienced in the community.

4.1.1 Defend Existing Lagoon in Place

The City's lagoon has been in continuous operation for over 30 years. The treatment performance of the lagoon is impacted by aging components that have exceeded their useful life, and the backlog of much needed repairs. On multiple occasions ADEC initiated enforcement actions associated with the inability of the lagoon to consistently meet regulatory requirements and permit authorization limits. In 2019, engineering plans were developed that addressed the immediate enforcement issues without expanding the footprint of the existing system.

Although the planned improvements did not address erosion concerns or new anticipated regulated contaminants (such as ammonia), the design of the new aeration systems did assume a design flow equal to the maximum permit limit. This maximum permit flow is higher than the estimated maximum flow associated with 2045 population projections (Table 1). The new aeration components will maximize the treatment possible in the existing 1.5-acre cells, to address the current permit limits, as well as potentially meeting the more restrictive permit limits expected in the future. As ADEC phases in new regulatory requirements, any additional required processes could be phased in as needed on the available, adjacent land. However, expanding the footprint of the system, or building a new wastewater system, would potentially trigger more restrictive permit limits due to changes in mixing zone allowances.

A system schematic for the existing lagoon showing the planned treatment processes and potential expansion is provided in Figure 2. The following treatment design considerations would apply after the 2019 planned updates are completed and the system elects to defend the existing wastewater treatment lagoon in place, taking necessary steps to protect the system from erosion. These criteria are based on not making any changes to the footprint of the existing lagoon cells, with available adjacent space reserved for additional treatment if needed.

Design Criteria

The following design criteria reflects the existing footprint of the lagoon cells:

Table 6 Defend Existing Lagoon in Place Design Criteria

DESCRIPTION	VALUE/UNIT	NOTES
Max Permitted Flow	273,000 gpd	As per current permit limit, this is conservative based on pop. estimates
2019 Wastewater Flow	150,000 gpd	August 2019
2045 Wastewater Flow	185,000 gpd	Estimated, based on population projections
Influent BOD Concentration	150 mg/L	No change in wastewater quality is expected
Influent TSS	140 mg/L	No change in wastewater quality is expected
2019 Influent BOD	186 pounds/day	Based on current population flow records and BOD test results
2045 Influent BOD	233 pounds/day	Based on projected increase in population to 2045
2019 BOD Loading	125 pounds BOD/acre day	Existing system with one 1.5 acres aerated
2020 BOD Loading	75 pounds BOD/acre day	Planned aeration added, with 2.5 acres aerated and 0.5 acres for settling
2045 BOD Loading	93 pounds BOD / acre day	Assuming 2.5 acres aerated and 0.5 acre settling cell

The current lagoon organic loading, based on maximum flow rates and BOD influent testing, is approximately 125 pounds BOD/acre day. After construction of the planned aeration system improvements, the loading will decrease to approximately 75 pounds BOD/acre day. The planned improvements should be sufficient to provide needed reductions in BOD, TSS, and coliform bacteria under current use. However, the ability to meet the expanded wastewater needs of a growing population, or the addition of a high strength wastewater load to the system (such as fish processing wastes) could require a lagoon expansion, particularly if an ammonia limit is required by ADEC. A third cell could be constructed for final polishing, including nitrification and ammonia removal. The polishing cell would optimize ammonia removal by providing a substrate for the nitrifying bacteria to grow on, instead of being suspended in the wastewater. This cell would also provide additional BOD, TSS, and bacteria reduction.

Past engineering studies have indicated a potential need for chlorination (followed by dechlorination prior to discharge), to meet coliform bacteria permit limits. Although there have been exceedances, a prime contributor to this problem appears to be short circuiting around the baffles. If bacteria permit limits become more stringent, and chlorination is needed, an area is reserved for chlorine injection, along with an area nearer the outfall for dechlorination prior to discharge.

Continued use of the existing lagoon would mean continued use the existing sewer infrastructure, the blower building and blower systems, and the outfall line. All sludge residuals would be disposed of according to the permit requirements at the Dillingham Landfill.

Wastewater Treatment Sizing

This option would retain the two existing 1.5-acre cells and includes an area for additional wastewater treatment, if required by future flows and/or regulations. This configuration will fit within the area currently allocated for the wastewater treatment lagoon.

4.1.2 New Aerated Wastewater Treatment Lagoon

A new aerated wastewater treatment lagoon would function the same as the existing aerated lagoon. However, the construction of a new lagoon would allow for an increase in lagoon cell sizing. This would result in a decrease in loading and a better ability to provide a high-quality wastewater discharge. A system schematic for a new, aerated wastewater treatment lagoon showing the proposed treatment processes and potential expansion is provided in Figure 3.

Design Criteria

The following design criteria are assumed for a new aerated wastewater treatment lagoon:

Table 7 New Aerated Wastewater Treatment Lagoon Design Criteria

DESCRIPTION	VALUE/UNIT	NOTES
Max Permitted Flow	273,000 gpd	Assume current permit limit
2045 Dillingham Estimated Flow (Sites 1 and 2)	185,000 gpd	Based on increased City of Dillingham population
2045 Kanakanak Hospital Estimated Flow (Site 3 Only)	50,000 gpd	Based on 2032 estimate
2045 Total Estimated Flow (Site 3 Only)	235,000 gpd	Estimated total design flow (DLG and Hospital)
Influent BOD	150 mg/L	Assume no change in wastewater quality
Influent TSS	140 mg/L	Assume no change in wastewater quality
2045 Influent BOD	294 pounds/day	Based on Estimated Total Flow
2045 BOD Loading	107 pounds BOD/acre day	2.75-acre aerated cell
Estimated Aerated Cell	2.75 acres	Cell #1
Estimated Settling Cell	1.0 acres	Cell #2
Estimated Detention Time	67 days	
Estimated Active Depth	15 feet	Includes aeration and settling cells (3.75 acres total)
Minimum Separation to Groundwater	4 feet	ADEC
Minimum Separation to an Impermeable Surface	6 feet	ADEC
Maximum Baffle Window Velocity	30 gpm/sqft	

The new lagoon system would incorporate future City of Dillingham wastewater flows, and future flows from the Kanakanak Hospital (if ever needed). An enlarged footprint would also allow for more effective oxygenation, potentially eliminating the need for a third polishing cell.

Wastewater Treatment Sizing

A new lagoon system would require the development of a new site and a comparatively large amount of land to accommodate the new infrastructure. Site descriptions are provided in Section 5.

The aerated lagoon would consist of two cells, a larger aerated cell and smaller settling cell, as shown in Table 7. The sizing of the cell is based on the current maximum allowed permit limit for daily discharge rate (273,000 gpd) which is less than the estimated 2045 maximum flow rate based on population increases (185,000 gpd). Using the more conservative sizing allows for unexpected increases in service flow during the 25-year design life of the system. This could potentially include serving the wastewater needs of Kanakanak Hospital, with an estimated 2032 maximum daily design flow of 41,069 gpd. The new site should have space available for a potential polishing cell and chlorination system. If chlorination is needed, a sampling/dechlorination building would be needed near the outfall.

4.2 Packaged Wastewater Treatment Plants

General Design Considerations

Wastewater treatment plants have been used throughout Alaska to provide effective wastewater treatment in a relatively small, enclosed area (as compared to lagoons). Since the treatment can be located above ground, they can be used in areas where surface or subsurface conditions would preclude the use of a lagoon, or for temporary treatment during lagoon upgrades. The impacts to surrounding development are more limited, making packaged plants more acceptable to residential development.

The range of options in packaged wastewater treatment systems is broad, and includes highly technical options that will treat high strength wastewater to exceptional wastewater effluent standards, and less complex treatment systems that are easier to operate, but may not meet the same exceptional treatment limits. More complex treatment systems rely on