BCL ENGINEERING LTD.

FLYING DUST FIRST NATION

NEW WATER TREATMENT PLANT
PRE-DESIGN REPORT

ISC Project No. CT608

DRAFT

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1. INTRODUCTION

The Flying Dust First Nation is located adjacent to the City of Meadow Lake. The majority of the First Nation's land is north and east of Highway 55 and Highway 4. The First Nation also owns land south of Highway 55, east of Meadow Lake. The Provincial Highways (55 and 4) are paved. Roads within the community are all weather gravel roads.

There are two distinct settlements within the community, core subdivision developments on the north and south sides of the highway and a rural development elsewhere within the boundary. There are approximately 39 housing units located within the south core area east of the river, as well as community buildings such as the Band office administration, Band hall, store health clinic and school. There are 94 homes in the core developments north of the highway. The remaining 31 homes are located in the rural area scattered throughout the First Nation's lands. The total number of housing units within the community is 164. The existing layout of the community is shown on Drawing 1 (appended).

The purpose of this report is to evaluate treatment options for a new water treatment plant for the community. The report will also evaluate the most favorable location for a new water treatment plant, taking into consideration future development, as well as existing and proposed infrastructure, in order to recommend the most cost effective and beneficial location to meet the future needs of the Flying Dust First Nation.

2. EXISTING WATER AND SEWER FACILITIES

2.1 WATER SYSTEM

2.1.1 Water Supply

The source of water for the community is a treated water supply main, sourced from the SaskWater treatment plant located at the east end of the City of Meadow Lake. It is our understanding that the water treatment plant draws lake water from Meadow Lake, treats it, and distributes it to the community. Previous reports noted operational and treatment issues, and the plant was recently purchased by SaskWater. It is a desire of Flying Dust to own, operate, and control their own water treatment plant. The *Flying Dust First Nation Water Treatment Plant Feasibility Study* (Pinter and Associates Ltd., 2020) noted it was most economical to develop and treated a groundwater source.

2.1.2 Water Distribution System

The water distribution system in the community consists primarily of 200 mm and 150 mm water mains. There is small diameter distribution piping in the rural areas. The distribution system is pressurized by Meadow Lake's water treatment plant. The location of the existing water mains is shown on Drawing 2.

2.2 SANITARY SEWER

2.2.1 Sewage Collection and Pumping

Sewage collection and pumping within the core areas of the community are provided by conventional 200 mm diameter gravity sewer mains. Manholes are spaced at adequate distances (<120 m) to accommodate servicing. The location of the sewage collection and pumping infrastructure is shown on Drawing 3.

Sewage pumping station no. 1 is located north of the Meadow River and south of Highway 55. The pumping station is a wet well / dry well style of station and provides service to the core area, as well as the development around the school site. The wet well is a cast-in-place structure and has an operating volume of 936 L. The dry well houses two Flygt 3140 sewage pumps, the capacities of which are not known. Sewage pumping station no. 1 pumps sewage through 5,415 m of 150 mm dia. HDPE DR17 force main prior to discharging into the lagoon.

Sewage pumping station no. 2 is located east of the Meadow River and south of Highway 55. This pumping station is a wet well / dry well style of station and serves the housing development in this area. The wet well is a 1,800 mm dia. pre-cast manhole and has an operating volume of 1,781 L. The dry well is a 2,400 mm dia. pre-cast manhole and houses two 10 hp, drymount Flygt CT-3127HTpumps. The pumps have an estimated capacity of 6.3 L/s at 22 m TDH. Sewage pumping station no. 2 pumps sewage through 1,700 m of 100 mm dia. HDPE sewage force main, prior to discharging into the gravity sewer system that feeds sewage pumping station no. 1.

Sewage pumping station no. 3 is located in the core area, northwest of the school. The pumping station is a wet well / dry well style of station and provides service to the subdivision. The wet well is a 2.4 mm dia. pre-cast manhole and has an operating volume of 4,976 L. The dry well is a 2.4 mm dia. pre-cast barrel, housing two 2.4 hp, Flygt CT-3127HT sewage pumps, each capable of 6.3 L/s at 22 m TDH. Sewage pumping station no. 3 pumps to the force main from sewage pumping station no. 1, which discharges at the lagoon. There is a 35 kW genset in the building to provide power during an

outage.

2.2.2 Sewage Treatment

Sewage treatment is provided by a two cell sewage lagoon, which is located 2,800 m northeast of sewage pumping station no. 3. The lagoon was constructed in 2008 and the primary cell has a treatment area of 2.7 ha. The storage cell has a storage volume of 50,600 m^3. Drawings of record show that the lagoon is clay lined (600 mm) and has an outfall ditch constructed to direct flow to the Meadow River. The lagoon is located outside of the minimum recommended setback distance of 550 m for built-up areas. The location of the lagoon is shown on Drawing 3.

3. POPULATION STATISTICS

The current (2020) population of the Flying Dust First Nation was confirmed to be 591 people, based on population data provided by Indigenous Services Canada (ISC). Historical population statistics are shown in Table 3-1. Previous reports have used a historical growth rate of 2.69% per annum. This growth rate is slightly less than other Saskatchewan First Nations, which are typically in the order of 3% - 4% per annum. A growth rate of 2.69% will be used for the purposes of projecting future populations and related water consumptions in this report. As the water treatment plant upgrade is projected to receive funding for construction from ISC in the 2023/2024 fiscal year, the 2024 projected population of 676 will provide the baseline for the future populations used in design and planning. Therefore, the resulting 10 and 20 year population projections for the Flying Dust First Nation would be 881 and 1,148, respectively. The Band noted that there are currently 85 non-registered First Nation people living in Flying Dust. As such, the total current population is 676. The current housing density is approximately 4.02 people/house, based on a population of 676 people in 168 houses.

TABLE 3-1: HISTORICAL POPULATION

Year	Population
2020	591
2019	591
2018	588
2017	579
2016	577
2015	538
2014	536
2013	528
2012	574
2011	516
2010	496
2009	493
2008	488
2007	473
2006	467
2005	454
2004	433
2003	434
2002	419
2001	412
2000	394
1999	390

4. FUTURE DEMAND

The volume of water used by the Flying Dust First Nation is tracked and recorded in the Water Security Agency's data base – the *Saskatchewan Community Water Use Records*, 2018 – 2004. The 2020 Feasibility Study notes the community used water at a rate of 351 Lcd.

Table 4-1 shows the average day consumption for the community of Flying Dust for the next 20 years.

TABLE 4-1
WATER DEMAND REQUIREMENTS 2024 - 2044

	Existing	2019	2024	2029	2034	2039	2044
Population (2.69% growth)		676	772	882	1,007	1,149	1,312
Existing Water Demand:							
Lcd		351	351	351	351	351	351
L/d		237,276	270,972	309,582	353,457	403,299	460,512
L/s		2.75	3.14	3.58	4.09	4.67	5.33

As per Saskatchewan Region Operating Instructions, a peak day demand factor of 2.0 and a peak hour demand factor of 4.0 will be used.

5. HYDROGEOLOGICAL INVESTIGATION

In order to identify a suitable groundwater source for the community, Beckie Hydrogeologists Ltd. (BHL) was retained by the Project Management Team to complete a hydrogeological investigation. BHL initiated the investigation with a desktop study that included a review of all available historical reports, groundwater well databases, and all other hydrogeologic data. The result of the desktop study was that the Hatfield Valley Aquifer is available within the Flying Dust First Nation. The Hatfield Valley Aquifer is an extensive aquifer that extends from northwest Saskatchewan down through to the southeast part of the province.

Additional boreholes and piezometers were installed and completed to confirm aquifer limits. There were favourable outcomes with respect to location and potential aquifer production, which resulted in the construction of two new wells.

During the period of May 16th – May 29th, 2022, two production wells were drilled and developed. The wells were constructed with 250 mm diameter PVC casing, complete with stainless steel intake screens. Each well was pump tested at a rate of 30.27 L/s.

6. WATER QUALITY

Well data from the Hatfield Aquifer was analyzed for wells that are located and operated 9.0 km east of the community during the investigation of the new Flying Dust wells. The well water from this aquifer can vary depending on location, however based on recent testing of the new wells, the water quality does not vary significantly. As shown in Table 6-2 the raw water quality of the new wells is considered to be poor. The Band has indicated that their goal and objective for treated water quality is to meet or exceed the more stringent criteria of either the Canadian Drinking Water Quality Guidelines and / or the Saskatchewan Water Quality Guidelines. Some of the typical constituents that are considered when assessing a raw water of this nature include, but are not limited to, the following. Detailed quality results for the new wells and other reference wells are appended. A brief discussion is included for each constituent.

- total hardness;
- total dissolved solids (sum of ions);
- iron;
- manganese;
- turbidity;
- trihalomethanes and haloacetic acids;
- alkalinity;
- colour;
- micro organisms;
- ammonia;
- arsenic; and
- choramines.

The effects of each of the constituents in excess of the Canadian or Saskatchewan Drinking Water Standards are as follows (with the exception of *, write ups are from SRC Analytical – *Water Analysis Information Sheet*, and ** from Ministry of Environment – *Strategies for Dealing with Groundwater Treatment System Having High Natural Ammonia* March 2010 and *Ammonia in Source Water* January 2012).

It is important to note the distinction between standards and objectives concerning the constituents. Standards are legally enforceable requirements typically involving the safety of the drinking water, while objectives are non-mandatory recommendations that diminish the desirability of the water, but do not constitute a serious health hazard.

TABLE 6-2
Water Constituents

Parameter		Results	SK Guidelines	Canadian Objectives
Total Hardness	Water hardness is mainly caused by the presence of calcium and magnesium and is expressed as the equivalent quantity of calcium carbonate. Scale formation and excessive soap consumption are the main concerns with hardness. When heated, hard waters have a tendency to form scale deposits. Depending on the interaction of other factors, such as pH and alkalinity, hardness levels between 80 and 100 mg/L are considered to provide an acceptable balance between corrosion and incrustation. Water supplies with a hardness greater than 200 mg/L are considered poor, but tolerable; those in excess of 500 mg/L are unacceptable for most domestic purposes. Because water softening may introduce undesirably high quantities of sodium into drinking water, it is recommended that a separate unsoftened supply be used for drinking and cooking. Elevated levels of hardness can result in maintenance issues related to hard water, such as scaling, premature fixture failures, premature hot water heater failures, and increased salt consumption for softeners, etc.	Raw: 705 - 738 mg/L Treated: -	800 mg/L	200 mg/L
Sum of Ions	Sum of ions indicates the concentration of ions in the water (i.e. dissolved solids). Waters with high dissolved solids generally are of inferior palatability and also may leave a white film on dishes, etc. Levels that exceed both the Saskatchewan and Canadian objectives and the effects, such as taste and film deposits, would be readily noticeable to users.	Raw: 2,370 – 2,460 mg/L Treated: -	1,500 mg/L	500 mg/L
Iron	At levels above 0.3 mg/L, iron stains laundry and plumbing fixtures and causes undesirable taste. The precipitation of excessive iron causes a reddish brown colour in the water. It may also promote the growth of iron bacteria, leaving a slimy coating in piping. The presence of iron bacteria can also cause a "rotten egg" odour in the water and a sheen on the surface of the water.	Raw: 6.4 – 7.4 mg/L Treated: -	0.3 mg/L	0.3 mg/L

Manganese	Manganese can cause staining to plumbing and laundry and undesirable tastes in beverages. Also, it may lead to the accumulation of bacterial growth in the piping. Manganese is one of the constituents under review for lowering of the allowable concentration.	Raw: 0.10 mg/L Treated: -	0.05 mg/L	0.02 mg/L
Turbidity	Turbidity in waters is caused by suspended material such as algae, silts and organic matter. Turbidity is often considered to be the clarity of the water. Turbidity is considered to be very important for health and aesthetic reasons. High levels of turbidity or "cloudy" water is not aesthetically pleasing. In addition to this, turbidity levels are related to the effectiveness of disinfectants. Higher turbid waters occasionally mask the effects of disinfectants against viruses and pathogens.	Raw: - Treated: -		1 NTU
Colour	Colour is an aesthetic quality, however, is an indicator of other parameters such as the formation of disinfection byproducts like trihalomethanes (THM) and haloacetic acid (HAA). Colour is caused by substances in the water such as iron, manganese, algae and organic carbons.	Raw: - Treated: -		15 TCU
Micro Organisms	Micro organisms and pathogens such a giardia and cryptosporidium are linked to gastro intestinal illness such as diarrhea. No significant testing has been completed on the raw water, however, they are found to exist in most surface waters. Giardia and cryptosporidium are more predominant in surface waters with poor contributing watersheds such as those in agricultural areas. Cryptosporidium is resistant to conventional disinfectants such as chlorine and thus requires a multiple barrier approach for effective removal. The typical multi barrier approach includes filtration and disinfection. An additional barrier that is quickly gaining acceptance due to its ease of operation is the use of ultra-violet light disinfection.			
Trihalomethanes and Haloacetic Acid	The use of oxidants, such as chlorine, for disinfection, taste, odour and colour removal produces disinfection by-products (DBP). The most notable DBP at this time are THM and HAA. They are formed when chlorine reacts with organic substances in the water. It is			THM: 100 µg/L HAA: 80 µg/L

	critical that proper optimization of water treatment processes be adhered to in order to reduce / minimize the levels of THM / HAA precursors, such as organics, in filtered water prior to the addition of chlorineIt is expected that the maximum allowable concentration for total THM will be further lowered, keeping with trends set by the U.S. Environmental Protection Agency.			
Alkalinity	Alkalinity is a water's acid-neutralizing capacity and is primarily a function of carbonate, bicarbonate and hydroxide content. Excessive alkalinity levels may cause scale formation. The Saskatchewan aesthetic objective is set at a maximum of 500 mg/L.	Raw: 368 – 377 mg/L Treated: -	500 mg/L	-
Ammonia**	Naturally occurring ammonia that is present in most waters, results from biological degradation of nitrogenous organic matter which is very common in Saskatchewan groundwater. The concentration levels of natural ammonia in groundwater and surface water are generally below 0.2 mg/L. Fluctuating ammonia levels can affect the disinfection of the treated water. When in contact with chlorine, ammonia, will react rapidly to form chloramines. Breakpoint chlorination is one of the disinfection techniques for water containing high ammonia. Breakpoint chlorination is the addition of chlorine to the water or wastewater source until the chlorine demand has been satisfied (typically 8 - 10 times the ammonia level). Further dosage of chlorine passing the breakpoint will result in free chlorine residual. *EPB 431 – Ammonia in Source Water* – Ministry of Environment – January 2012, indicates that waters having ≥1.0 mg/L of ammonia nitrogen may not utilize breakpoint chlorination, as the maximum use level (MUL) for feeding of the chemical exceeds NSF 60 standard requirement.	Raw: 2.5 mg/L Fluctuating: -		
Arsenic*	Arsenic is an element found in higher concentrations in groundwater because of its presence in geological materials. Arsenic is a poison to humans at 0.01 mg/L or more and has been described as a carcinogen at concentrations of 0.0050 mg/L. The Saskatchewan and Canadian maximum	Raw: 0.014 – 0.016 mg/L Treated: -	0.01 mg/L	0.01 mg/L

	allowable concentration is set at 0.01 mg/L and is currently one of the constituents under review for lowering of the allowable concentration.			
Chloramines**	Chloramines (monochloramines) may be a byproduct found in treated drinking water supplies when chlorine and ammonia react with one another. When controlled, chloramines are often used in many jurisdictions as a secondary disinfectant. Chloramines are usually measured as 'combined' chlorine residual using chlorine residual determination procedures. The combined chlorine residual is calculated on the difference between the total and free residuals. Monochloromines are classified as being possibly carcinogenic to humans, so the Canadian Drinking Water Quality Guidelines have set the maximum allowable concentration for chloramines at 3.0 mg/L.		3.0 mg/L	3.0 mg/L
Sulphate	Sulphate occurs naturally in water and may be present in natural waters in concentrations ranging from a few to several thousand mg/L. Concentrations in excess of 500 mg/L, especially if the magnesium content is also high, may have a laxative effect, or cause gastrointestinal irritation. It may also result in a noticeable taste.	Raw: 300 - 320 mg/L Treated: -		500 mg/L
Sodium	Weathering of salt deposits and contact of water with igneous rock provides a natural source of sodium. Another potential source of sodium in water supplies is the water-softening process which replaces calcium and magnesium (hardness) with sodium. Persons on sodium restrictive diets should consult with physicians.	Raw: 534 - 566 mg/L Treated: -	300 mg/L	200 mg/L

It should be noted that federal and provincial regulators are currently reviewing the maximum allowable concentration limits and aesthetic objectives for arsenic, lead, manganese, and uranium. Based on past experience, these limits will become more stringent after review.

7. TREATMENT GOALS AND OBJECTIVES

Band members of the Project Management Team advised that their goals and objectives for treated water quality are to meet or exceed the criteria being more stringent of either the Canadian Drinking Water Quality Guidelines or Saskatchewan Water Quality Guidelines, including aesthetic objectives. The primary goal of the New Water Treatment Plant project is to select a treatment process suitable for the new Hatfield Aquifer groundwater source.

8. TREATMENT CONSIDERATIONS

Based on the Hatfield Aquifer being a challenging source water, limited treatment processes are appropriate technologies for the new water treatment plant. Based on our experience, it is recommended that a multi-process system be selected. For example, in order to address iron, manganese and ammonia, a process such as biological pre-filtration will be required. Once iron, manganese and ammonia are removed to acceptable levels, membrane treatment will be required to address chlorides, TDS, sulphate, and sodium.

A brief description of the technology, with comments on the advantages, disadvantages, and a summary of the current and expected requirements of the community's water supply, treatment, pumping, and storage infrastructure with each of the treatment processes, is provided below.

As a note, the April 28th, 2020 *Water Treatment Plant Feasibility Study* recommended biological membrane treatment, which is confirmed in this report.

8.1 BIOLOGICAL FILTRATION PRE-TREATMENT AND MEMBRANE FILTRATION

Biological filtration consists of culturing natural organisms in a controlled environment that thrive on specific constituents of the water. The bacteria are cultured in specific media, typically consisting of expanded clay, specialized sand, or anthracite. Iron, manganese, ammonia, and organics, when required, are the typical targets for biological filtration.

Biological filtration by itself will not remove other constituents of concern, such as chlorides, sulphate, TDS and sodium. Therefore, a membrane system would also be required to remove these constituents.

Biological filtration differs from other processes in that the requirements for peak factors are slightly different. Biological systems are intended to run more continuously for biological stability, rather than at peak demand. These systems perform better when operated at near average day peaks, thus requiring less supply and treatment capacity. This allows for longer filtration run times and lower backwash rates (< 5% of total water usage) than most processes.

Some advantages and disadvantages of biological filtration include:

TABLE 8-1: BIOLOGICAL / MEMBRANE FILTRATION PROCESS ADVANTAGES AND DISADVANTAGES

Advantages:	**Disadvantages:**
• minimal cleanings, longer filter run times, reducing backwash frequency; • ease of operation; • minimal chemical input; • effective iron, manganese, ammonia and organics removal; • lower backwash volumes for pre-treatment; • vendor may reduce membrane reject by using a combination of nano and reverse osmosis membranes; • minimal chlorine requirements as ammonia levels are found to be greatly reduced; • reduced metal deposits in reservoirs and distribution piping network; • condition of internal plumbing likely improved throughout the community; • continuous flow typically requires a reduction of raw water source flow requirement.	• requires higher operator involvement, including additional monitoring; • nitrate generation is a risk where high levels of ammonia are present; • may require additional treated storage as peak treatment rates are reduced – to be confirmed by water records analysis; • biological treatment alone does not meet the goals of the Band. However, the addition of membranes as a secondary treatment will greatly improve quality.

9. OPERATOR CERTIFICATION

In order to meet the treatment goals and objectives of the Band, an advance treatment system, such as the biological / membrane process described herein, will be required.

This option was evaluated to determine the required operator certification levels using an adapted table from *Water Security Agency's Water Treatment / Distribution Classification* (2010 ed.). Classifications are based on the cumulative point total for all categories - Class 1: 30 or fewer points; Class 2: 31 - 55 points; Class 3: 56 - 75 points; Class 4: 76 + points. It should be noted that the biological pre-treatment with membrane filtration would result in a Class 2 plant. The full classification table is appended.

10. PROPOSED DESIGN BASIS

The design is based on a number of documents, including the following:

- *ISC Water and Wastewater Policy and Level of Service Standards*;
- *ISC Design Guidelines for First Nation Waterworks*;
- *ISC Protocol for Centralized Drinking Water Systems in First Nation Communities*;
- *ISC Saskatchewan Region Operating Instructions*;
- *Water Security Agency Waterworks Design Standard EPB 501;*
- *Guidelines for Canadian Drinking Water Quality;*
- *Fire Underwriters Survey – Water Supply for Public Fire Protection*.

As referenced in the above noted documents, the guideline deemed to be most stringent was used. During the design basis discussion, references to the relevant sections of these documents will be provided. A preliminary layout of the proposed water distribution main, water treatment plant site and building floor plan are shown on Drawings 4, 5 and 6, respectively.

10.1 RAW WATER SUPPLY

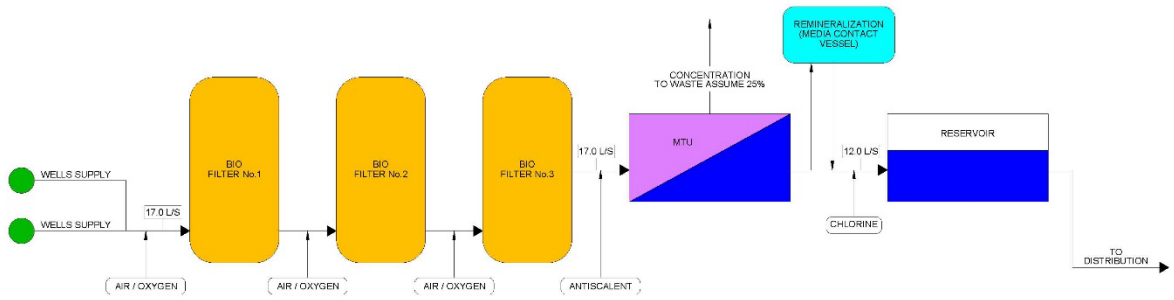
The report thus far has determined that the most suitable treatment process was biological pre-treatment / filtration, followed by membrane treatment. Two wells should be constructed (one duty and one backup) to meet the peak day demands. The wells would alternate to ensure the infrastructure remains operational. The well casing and screen equipment should be designed and constructed to accommodate the 20 year pumping equipment and / or the well capacity. The well completion, well pump, drop pipe etc. should be designed to meet the 10 year flow rates. A concentrated waste stream of 30% was used in the raw water supply calculations.

	10 Year	20 Year
Well Requirements (L/s)	11.7	15.2

The wells will share a common raw water main from the well site to the water treatment plant. The well line will be sized to meet the larger of the capacity of one of the wells or the projected 20 year flow rate of 14.2 L/s. The preliminary size of this line will be 200 mm diameter HDPE DR 11, which will have a velocity of 0.9 m/s. A flush out will be provided at the well head for maintenance purposes.

10.2 TREATMENT PROCESS

The treatment process will be designed to meet the proposed 10 year peak day demand. The sketch shown below summarizes the proposed treatment process which consists of two trains. The treatment trains shall be capable of meeting the projected 10 year flow rate of 8.2 L/s. In order to meet operating instructions referencing Water Security Agency guidelines, a total treatment capacity of approximately 16 L/s would be required. As per our earlier recommendations, a treatment capacity of 12 L/s is proposed.



BIOLOGICAL / MEMBRANE

It should be noted that the Water Security Agency's *Waterworks Design Standard* recommends that for redundancy in smaller plants, each treatment train should be capable of providing the plant capacity. This would result in two trains being installed. We are of the opinion that with biological filtration pre-treatment, one and a half trains can be provided, however appropriate bio-MTU bypasses should also be provided, along with future space for additional units for quicker implementation if needed.

10.3 WATER STORAGE

As per *Saskatchewan Region Operating Instructions* (Section 5.1.6.4.3, page 26), for systems requiring fire protection, the storage capacity will be the larger of:

a) Twice the average daily consumption. Total average day consumption = 353,457 L
Total Storage to Meet Requirements = 706,914 L

b) 136,380 L (30,000 imp gal). This will provide a fire stream of 1,891 L/min (416 imp gpm) for one hour, with a reserve of 22,730 L (5,000 imp gal) for domestic consumption.
Total Storage to Meet Requirements = 136,380 L

c) The volume created by constructing the reservoir as the foundation for the pump house / water treatment plant, providing this configuration is proven to be cost effective.
Total Storage to Meet Requirements = 945,000 L

Storage requirements based on *ISC Design Guidelines for First Nation Waterworks* was also considered. Fire protection was based on the *Fire Underwriters Survey*, recommending 33.3 L/s for one hour. In addition, a hose allowance was considered. Total recommended fire flow is 37.8 L/s for one hour.

Total Storage Required = A + B + C

Where:
A = Fire Protection Storage
B = Equalization Storage (25% MDD)
C – Emergency Storage (25% (A + B)

Total Storage to Meet Requirements = 136,080 + 176,728 + 56,111
= 368,919 L

The most suitable option is Option C. Previous design review comments acknowledged that the recommended reservoir size was greater than 2 x average day, however it matched the space required for the water treatment plant building.

10.4 DISTRIBUTION PUMPING

Two pumps are to be included in the project scope, each capable of meeting peak hour demand in the 10 year period. A spare pump, not installed, as per *Saskatchewan Region Operating Instructions*, will be included in the scope of the project. Pumps will be controlled by variable frequency drives, with a distribution pressure set point at the water treatment plant of 60 – 70 psi.

Minimum Peak Hour Demand = 16.36 L/s

Recommended Pump Duty Point = 16.36 L/s at 50 m TDH

10.5 STANDBY / FIRE PUMPS

- *ISC Design Guidelines for First Nation Waterworks* suggests that two pumping units be provided. One of the pumps would be supplied with backup power from a generator;
- *ISC Saskatchewan Region Operating Instructions* Section 5.3.4.5 with respect to municipal systems, recommends that fire flow plus peak hour flow be met with the largest pump out of service. Given that the distribution pumps, when operating together, are not capable of fire protection, two fire pumps will be provided. The proposed system is considered to be a municipal system;
- W*ater Security Agency Waterworks Design Standard EPB 501* recommends that systems providing fire protection consult the latest edition of the *Fire Underwriters Survey*. In it, it is recommended that the fire flow be provided with the two most important pumps out of service. In this case, three fire pumps would be required. We believe this to be too conservative and recommend two fire pumps.

The scope of the project will include two fire pumps, such that with the largest pump out of service, fire protection can still be provided. The provisions for fire protection with the largest pump out of service, would not be met with a single fire pump, as the distribution pumps, when pumping in parallel, would not be able to meet the criteria.

Recommended Fire Pump Duty Point = 37.8 L/s at 50 m TDH

Noting that the fire pump capacity requirement is nearly two times the distribution pump requirements, consideration should be given during the design phase to using multiple pumps to meet both fire and distribution requirements. This becomes typical, as communities and demand grow. For Flying Dust, the recommendation would result in four pumps in the order of 19 L/s each.

10.6 SUMMARY OF PUMPING EQUIPMENT

The following table provides a summary of proposed pumping equipment. If can be noted that this table has been added to the design drawings, following review comments received.

Pump Schedule

Application	Type	Capacity	
		L/s	m
Well No. 1	Submersible	17.1	TBD
Well No. 5	Submersible	17.1	TBD
Distribution (4)	Vertical Turbine	19	50
Standby (0)	Vertical Turbine	-	-
Truck Fill	Vertical Turbine	15.2	16
Sump Pump	Submersible	2.7	10

10.7 DISTRIBUTION PIPING

To maintain fire protection at the school site, a new distribution supply main will be required to tie-in to the core area distribution system. The proposed supply main will be 250 mm dia. HDPE DR11.

10.8 WASTEWATER DISPOSAL

It should be noted that the new sewage pumping station will collect / pump wastewater that will require disposal at the lagoon. The proposed wastewater upgrades will form part of the wastewater study that is ongoing.

11. PROJECT COSTS

Following are "Class C" cost estimates for the construction of the new water treatment plant. Costs are based on the discussed herein and represents the 10 year design period in accordance with ISC Operating Instructions. Estimated costs have been developed based on recently tendered projects. The following costs do not include allowances for soft costs.

TABLE 11-1: NEW WATER TREATMENT PLANT ESTIMATED CAPITAL COSTS	
General Requirements	
Bonds, Insurance and General Requirements	$300,000
Mobilization / Demobilization	100,000
Site Set Up	100,000
Subtotal	**$500,000**
Raw Water Supply	
Well Completions	200,000
200 mm dia. Raw Water Supply Main	800,000
Utility / Roadway Crossings	25,000
Power Supply	50,000
Subtotal	**$1,075,000**
Distribution Supply	
Distribution Mains (250 mm dia.)	750,000
Miscellaneous Valves, Hydrants, etc.	75,000
Utility / Roadway Crossings	150,000
Termination of Existing SaskWater Connection	25,000
Tie-in To Existing Water Main	25,000
Subtotal	**$1,025,000**
Building	
Site Work, Fencing, Crushed Rock, Landscaping and Imported Fill	275,000
Miscellaneous Metals	115,000
Masonry – Exterior Walls	175,000
Pre-finished Metal Roofing, Eaves, Downspouts, Soffits, Facia	100,000
Insulation	85,000
Carpentry – Interior Framing, Trusses	200,000
Doors / Frames / Windows	75,000
Interior Finishes – Millwork / Painting	175,000
Miscellaneous Specialties	125,000
Subtotal	**$1,325,000**

Concrete Works	
Excavation / Dewatering	150,000
Backfilling	100,000
Mud Slab	50,000
Base Slab	20,000
Walls	250,000
Top Slab	275,000
Subtotal	**$1,025,000**
Treatment Equipment	
Pre-Treatment	500,000
Secondary Pre-Treatment (MTU)	600,000
Subtotal	**$1,100,000**
Mechanical	
Piping, Bracing, Hangers, Supports, Bolts, Paintings, etc.	250,000
Valves, Actuators, Risers, Boxes, Rods	325,000
Fixtures	45,000
Pumps	275,000
Heating	75,000
Ventilation	100,000
Chemical Feeds	75,000
Reservoir Valves and Piping	45,000
Subtotal	**$1,190,000**
Electrical	
Lighting, Signage, Fixture Package	175,000
Level Sensors	75,000
Wiring / Cabling / Conduit	425,000
Generator	125,000
MCC	425,000
Subtotal	**$1,225,000**
Controls	
PLC and Programming	150,000
Subtotal	**$150,000**
Miscellaneous	
Utilities	75,000
Material Testing	25,000
Tools and Equipment	25,000
Subtotal	**$125,000**
Subtotal - Construction	**$8,740,000**
Contingency Allowance (15%)	1,311,000
Total Estimated Capital Cost	**$10,051,000**

12. RECOMMENDATIONS AND CONCLUSION

Based on the above, we recommend that the Project Management Team proceed with the design of the new water treatment plant to include a new stand-alone water treatment plant facility, incorporating into the design, a biological pre-treatment system and membrane filtration, and all related equipment. The upgrade will include the new treatment and pumping equipment, treated water storage, piping and control equipment. The treatment upgrades outlined herein will provide the Band with a water quality that meets all of their objectives and has the least impact on existing equipment capacities and long term operation and maintenance costs.

The new water treatment plant project described within this report should provide the Flying Dust First Nation with adequate water treatment capabilities to their meet current and future requirements.

We trust that this report fulfills your requirements for this project. Should you require additional information, please do not hesitate to contact our office.

Respectfully Submitted,

BCL ENGINEERING LTD.

L. F. Lukey, P.Eng.

Appendix A
Water Quality Summary

FLYING DUST FIRST NATION

153.00

Water Quality Summary

Aug-21

Constituents	Unit	SW1-03 Source Well SRC - 28955 Dec. 11/03 84.32	CM11-89 Piezometer SRC - 3218 April 11/89 77.18	CM16-89 Piezometer SRC - 4110 April 27/89 70.46	CM19-89 Piezometer SRC - 4111 April 29/89 73.14	Saskatchewan Drinking Water Quality Guidelines		Canadian Drinking Water Quality Guidelines	
METALS						MAC	AO	MAC	AO
Arsenic, As	mg/L	**0.027**	**0.028**	**0.02**	**0.02**	0.01		0.01	
Aluminum, Al	mg/L	<0.005	**0.26**	**2.3**	0.006				0.1
Antimony, Sb	mg/L							0.006	
Barium, Ba	mg/L	0.049	0.022	0.086	0.032	1		1.0	
Beryllium, Be	mg/L	<0.001	<0.001	<0.001	<0.001				
Benzene	mg/L					0.005		0.005	
Bismuth, Bi	mg/L								
Boron, B	mg/L	0.95	0.81	0.63	0.81	5		5	
Bromate	mg/L					0.01		0.01	
Bromide (Br)	mg/L								
Cadmium, Cd	mg/L	<0.001	<0.001	<0.001	<0.001	0.005		0.005	
Chromium, Cr	mg/L	<0.001	<0.001	0.005	0.003	0.05		0.05	
Cobalt, Co	mg/L	<0.001	<0.001	0.002	<0.001				
Copper, Cu	mg/L	<0.001	<0.001	0.007	<0.001		1		≤1.0
Iron, Fe	mg/L	**0.64**	**2.1**	**2.4**	**1.5**		0.3		≤0.3
Lead, Pb	mg/L	<0.002	**0.016**	<0.005	<0.005	0.01		0.005	
Lithium, Li	mg/L								
Manganese, Mn	mg/L	**0.052**	**0.037**	**0.073**	**0.078**		0.05	0.12	0.02
Mercury, Hg	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	0.001		0.001	
Nickel, Ni	mg/L	<0.001	<0.001	0.005	0.003				
Selenium, Se	mg/L	0.0005	<0.001	0.003	<0.001	0.01		0.05	
Silver, Ag	mg/L	<0.001	<0.001	<0.001	<0.001				
Tin, Sn	mg/L								
Titanium, Ti	mg/L	<0.001	0.008	0.077	<0.001				
Tungston, W	mg/L		<0.005	<0.005	<0.005				
Uranium, U	mg/L	0.0004	<0.0004	0.0011±0.0008	<0.0005	0.02		0.02	
Vanadium, V	mg/L	<0.001	<0.01	0.01	0.01				
Zinc, Zn	mg/L	0.043	0.011	0.017	0.004		5		≤5.0
Zirconium, Zr	mg/L	<0.001							
Other									
Cyanide, Total	mg/L	0.001	<0.001	<0.001	<0.001	0.2		0.2	
Routine Analysis									
Ammonia, N03	mg/L								
Bicarbonate, HCO3	mg/L	527	403	450	388				
Calcium, Ca	mg/L	35	52	48	67				
Carbonate, CO3	mg/L	<1		3					
Chloride, Cl	mg/L	248	284	**562**	**333**		250		≤250
Colour	TCU								≤15
Colour	ACU						15		
Fluoride, F	mg/L	0.17				1.5		1.5	
Hardness	mg/L	128	**211**	180	**269**		800		200
Hydroxide, OH	mg/L	<1							
Total Kjeldahl Nitrogen	mg/L								
Magnesium, Mg	mg/L	10	20	15	25		200		
Molybdenum, Mo	mg/L	0.015	0.01	0.012	0.011				
Nitrate	mg/L	0.13				45		45	
pH in Water	pH	7.82	8.22	8.35	7.84		7.0-10.5		7.0-10.5
Phosphate, P	mg/L								
Phosphorus, P04	mg/L	0.4	0.68	0.2	0.62				
Potassium, K	mg/L	5.7	6.3	7.9	6.9				
Silicon, Si	mg/L	6.9	2	2.1	2.2				
Sodium, Na	mg/L	**335**	**552**	**499**	**470**		300		≤200
Strontium, Sr	mg/L	0.29		1.4				7	
Sulphate, $S0_4$	mg/L	99	**705**	115	460		500		≤500
Total Alkalinity	mg/L	432	330	374	318		500		
Turbidity	NTU	**0.5**						≤0.3/≤1.0/≤0.1	
Total Organic Carbon	mg/L	6.2							
Total Organic Carbon, dis.	mg/L	5.8							
Validation									
Anion Sum	meq/L								
Sum of Major Ions	mg/L	1260	2020	1700	1700				
Cation Sum	meq/L								
Cation - Anion Balance	%								
Specific Conductivity	uS/cm	1760	2830	2610	2520				
Total Suspended Solids	mg/L	<1							
TDS	mg/L	**1030**					1500		≤500

* Estimated Water Quality Based on Test Hole 9.0 km East of Flying Dust

Key:
MAC - Max. Acceptable Concentration
IMAC - Interim Max. Acceptable Concentration
AO - Aesthetic Objective

SASKATCHEWAN RESEARCH COUNCIL

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www.src.sk.ca/analytical

SRC Group # 2022-5906

Jun 06, 2022

Beckie Hydrogeologists (1990) Ltd.
381 Park Street
Regina, SK S4N 5B2
Attn: Mike Famulak

Date Samples Received: May-30-2022 Client P.O.:

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Section 1 approved by Hamilton, Ashley
Results from Lab Section 2 approved by Britton, Stephanie

---

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
    * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
    * Environment Canada
    * US EPA
    * CANMET

* The results reported relate only to the test samples as provided by the client. Results apply to the sample as received, unless otherwise indicated.

* Data marked as "by Client" has been provided by the client and may affect the validity of results.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

* Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

This is a final report.

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SRC Group # 2022-5906

Jun 06, 2022

Beckie Hydrogeologists (1990) Ltd.

381 Park Street
Regina, SK S4N 5B2
Attn: Mike Famulak

Date Samples Received: May-30-2022 Client P.O.:

20401 05/27/2022 FLYING DUST PW1-2022 *WATER*
20402 05/26/2022 FLYING DUST PW2-2022 *WATER*

Analyte	Units	20401	20402
Lab Section 1			
Bicarbonate	mg/L	449	460
Carbonate	mg/L	<1	<1
Chloride	mg/L	940	1000
Hydroxide	mg/L	<1	<1
P. alkalinity	mg/L	<1	<1
pH	pH units	7.77	7.80
Specific conductivity	uS/cm	3990	4170
Sum of ions	mg/L	2480	2620
Total alkalinity	mg/L	368	377
Total hardness	mg/L	705	738
Ammonia as nitrogen	mg/L	2.5	2.5
Nitrate	mg/L	<0.4	<0.4
Organic carbon	mg/L	3.2	3.0
Organic carbon, dissolved	mg/L	2.5	2.5
Fluoride	mg/L	0.14	0.14
Total dissolved solids	mg/L	2370	2460
Total suspended solids	mg/L	<1	<1
Turbidity	NTU	0.5	0.4
Lab Section 2			
Calcium	mg/L	192	202
Magnesium	mg/L	55	57
Potassium	mg/L	10	11
Sodium	mg/L	534	566
Sulfate	mg/L	300	320
Aluminum	mg/L	0.0084	<0.0005
Antimony	mg/L	<0.0002	<0.0002
Arsenic	ug/L	16	14
Barium	mg/L	0.033	0.034
Beryllium	mg/L	<0.0001	<0.0001
Boron	mg/L	0.54	0.58
Cadmium	mg/L	<0.00001	<0.00001

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Beckie Hydrogeologists (1990) Ltd.

20401 05/27/2022 FLYING DUST PW1-2022 *WATER*
20402 05/26/2022 FLYING DUST PW2-2022 *WATER*

Analyte	Units	20401	20402
Lab Section 2			
Chromium	mg/L	<0.0005	<0.0005
Cobalt	mg/L	0.0001	0.0001
Copper	mg/L	<0.0002	<0.0002
Iron	mg/L	7.4	6.4
Lead	mg/L	<0.0001	<0.0001
Manganese	mg/L	0.10	0.11
Molybdenum	mg/L	0.0036	0.0042
Nickel	mg/L	<0.0001	0.0001
Selenium	mg/L	<0.0001	<0.0001
Silica, soluble	mg/L	15	15
Silicon, soluble	mg/L	6.9	6.8
Silver	mg/L	<0.00005	<0.00005
Strontium	mg/L	1.23	1.26
Thallium	mg/L	<0.0002	<0.0002
Tin	mg/L	<0.0001	<0.0001
Titanium	mg/L	<0.0002	<0.0002
Uranium	ug/L	<0.1	<0.1
Vanadium	mg/L	<0.0001	<0.0001
Zinc	mg/L	<0.0005	<0.0005

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

The temperature of the cooler was 16.7 °C upon receipt.

Turbidity and Total suspended solids analyzed on nitric acid preserved sample.
Time between sampling and receipt in lab exceeds the recommended 48 hours for Turbidity.

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Beckie Hydrogeologists (1990) Ltd.

Analyte Methods

Name	Units	Method
P. alkalinity	mg/L	Chm-211
Organic carbon, dissolved	mg/L	Chm-399
Organic carbon	mg/L	Chm-399
Chloride	mg/L	Chm-115
Carbonate	mg/L	Chm-211
Fluoride	mg/L	Chm-211
Bicarbonate	mg/L	Chm-211
Ammonia as nitrogen	mg/L	Chm-123
Nitrate	mg/L	Chm-124
Hydroxide	mg/L	Chm-211
pH	pH units	Chm-211
Total dissolved solids	mg/L	Chm-203
Total suspended solids	mg/L	Chm-206
Specific conductivity	uS/cm	Chm-211
Sum of ions	mg/L	Calculation
Total hardness	mg/L	Calculation
Total alkalinity	mg/L	Chm-211
Turbidity	NTU	Chm-316
Silver	mg/L	Chm-522
Aluminum	mg/L	Chm-522
Arsenic	ug/L	Chm-522
Boron	mg/L	Chm-522
Barium	mg/L	Chm-522
Beryllium	mg/L	Chm-522
Calcium	mg/L	Chm-508
Cadmium	mg/L	Chm-522
Cobalt	mg/L	Chm-522
Chromium	mg/L	Chm-522
Copper	mg/L	Chm-522
Iron	mg/L	Chm-522
Potassium	mg/L	Chm-508
Magnesium	mg/L	Chm-508
Manganese	mg/L	Chm-522
Molybdenum	mg/L	Chm-522
Sodium	mg/L	Chm-508
Nickel	mg/L	Chm-522
Lead	mg/L	Chm-522
Antimony	mg/L	Chm-522

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SRC Group # 2022-5906

Jun 06, 2022

Beckie Hydrogeologists (1990) Ltd.

Name	Units	Method
Selenium	mg/L	Chm-522
Silicon, soluble	mg/L	Chm-522
Silica, soluble	mg/L	Calculation
Tin	mg/L	Chm-522
Sulfate	mg/L	Chm-508
Strontium	mg/L	Chm-522
Titanium	mg/L	Chm-522
Thallium	mg/L	Chm-522
Uranium	ug/L	Chm-522
Vanadium	mg/L	Chm-522
Zinc	mg/L	Chm-522

Flying Dust First Nation
Water Treatment Plant / Distribution System Classification
Date: August 16, 2020
Reviewed by: RMA

Design Population: 1,007

Item	Points Possible	Biological / Reverse Osmosis Membrane - Deep Well
Size		
Design flow average day, or peak month's average day, whichever is larger (1 point per 0.5 MGD. Round up.) Design flow: Consider this to be the design capacity of the plant. Examples: 9.2 MGD = 19 points 4.7 MGD = 10 points (20 points maximum allowed)	1 - 20	1
Water Supply Sources (Rating based on public health significance)		
Seawater/saltwater	0	0
Groundwater	0	0
Groundwater under direct influence of surface water (GWI)	8	0
Surface water	10	0
Average Raw Water Quality Variation - Applies to all sources (surface and groundwater). Key is the effect on treatment process changes that would be necessary to achieve optimized performance. · Little or no variation - no treatment provided except disinfection (0 points) · Minor variation - e.g. "high quality" surface source appropriate for slow sand filtration (1 point) · Moderate variation in chemical feed, dosage changes made: monthly (2 points), weekly (3 points), or daily (4 points) · Variation significant enough to require pronounced and/or very frequent changes (5 points) · Severe variation - source subject to non-point discharges, agricultural/urban storm runoff, flooding (7 points) · Raw water quality subject to agricultural or municipal waste point source discharges (8 points) · Raw water quality subject to industrial waste pollution (10 points)	0 - 10	1
Raw water quality is subject to:		
· Taste and/or odor for which treatment process adjustments are routinely made [1]	2	0
· Color > 15 CU (not due to precipitated metals) [1]	3	0
· Iron or/and manganese > MCL: Fe (2 points), Mn (3 points) (3 points maximum allowed) [1]	2 - 3	3
· Algal growths for which treatment process adjustments are routinely made [1]	3	0
Chemical Treatment/Addition Processes		
Fluoridation	4	0
Disinfection/Oxidation (Note: Points are additive to a maximum of 15 points allowed for this category.) CHECK ALL THAT APPLY: · Chlorination: • Hypochlorites (5 points) • If generated on site (add 1 point) • Chlorine gas (8 points) • Chloramination (10 points) • Chlorine dioxide (10 points) · Ozonation (10 points) · UV Irradiation (2 points) · Iodine, Peroxide, or similar (5 points) · Potassium permanganate (4 points) (If used with greensand filtration do not give 4 points)	0 - 15	5
pH adjustment for process control (e.g. pH adjustment aids coagulation)	4	0
Stability or Corrosion Control (If the same chemical is used for both Corrosion Control and pH adjustment, count points only once)	4	4
Coagulation/Flocculation & Filter Aid		
Primary coagulant addition	6	0
Coagulant aid / Flocculant chemical addition (in addition to primary coagulant use)	2	0
Flocculation	2	0
Filter aid addition (Non-ionic/anionic polymers)	2	0
Clarification/Sedimentation		
Sedimentation (plain, tube, plate)	4	0
Contact adsorption	6	0
Other clarification processes (air flotation, ballasted clarification, etc.)	6	0
Upflow clarification ("sludge blanket clarifier") [2]	8	0
Filtration		
Granular media filtration (Surface water/GWI) <= 3 gpm/sq ft	10	0
Granular media filtration (Surface water/GWI) > 3 gpm/sq ft	20	0
Groundwater filtration	6	0
Membrane filtration · For compliance with a primary regulation (10 points) · For compliance with a secondary regulation (6 points)	6 - 10	10
Diatomaceous earth (pre-coat filtration)	10	0
Cartridge/bag	5	0
Pre-filtration (staged cartridges, pressure sand w/o coagulation, etc.): add one point per stage to maximum of 3 points	1 - 3	3
Slow sand	5	0
Other Treatment Processes		
Aeration	3	3
Air stripping (including diffused air, packed tower aeration)	5	0
Ion-exchange/softening	5	0
Greensand filtration	10	0
Lime-soda ash softening (includes: chemical addition, mixing/flocculation/ clarification/filtration - do not add points for these processes separately)	20	0
Granular activated carbon filter (do not assign points when included as a bed layer in another filter)	5	0
Powdered activated carbon	2	0
Blending sources with significantly different water quality · To achieve MCL compliance (4 points) · For aesthetic reasons (2 points)	2 - 4	0
Reservoir management employing chemical addition	2	0
Electrodialysis	15	0
Other: Certification authority may assign 2 to 15 additional points for processes not listed elsewhere in this document. (Specify) _____	2 - 15	0
Residuals Disposal		
· Discharge to surface, sewer, or equivalent (0 points) · On-site disposal, land application (1 point) · Discharge to lagoon/drying bed, with no recovery/recycling – e.g. downstream outfall (1 point) · Backwash recovery/recycling: discharge to basin or lagoon and then to source (2 points) · Backwash recovery/recycling: discharge to basin or lagoon and then to plant intake (3 points)	0 - 3	0
Facility Characteristics		
Instrumentation - Use of SCADA or similar instrumentation systems to provide data, with: · Monitoring/alarm only, no process operation - plant has no automated shutdown capability (0 points) · Limited process operation - e.g. remote shutdown capability (1 point) · Moderate process operation - alarms and shutdown, plus partial remote operation of plant (2 points) · Extensive or total process operation - alarms and shutdown, full remote operation of plant possible (4 points)	0 - 4	2
Clearwell size less than average day design flow	5	0
Laboratory control		
Bacteriological/biological [3]	0 – 5	0
Chemical/Physical [3]	1 – 10	3
Total Points		**35**

Water Plant Classification: 2

Water Distribution System Classification (Separate Option): 1

Water Plant Points -> Class: **Class - 1** = 30 or fewer **Class - 2** = 31 - 55 **Class - 3** = 56 - 75 **Class - 4** = 76 +

Water Distribution Population -> Class: **Class - 1** = 1,500 or fewer **Class - 2** = 1,501 - 15,000 **Class - 3** = 15,001 - 50,000 **Class - 4** = 50,000 +

Reference:
Table adapted from Saskatchewan Ministry of Environment Water Treatment/Distribution Classification (2010 ed.)
Now regulated by Water Security Agency - (306) 787-6504

Notes:

[1] **Raw water quality is subject to**:
- **Taste and/or odor** for which treatment process adjustments are routinely made (2 points): 1) T&O issue has been identified in a pre-design report, etc., 2) a process has been installed to address, and 3) operational control adjustments are made at least seasonally. Do not give points for T&O when there is no specific additional impact on operation. E.g. if a system is already pre-chlorinating for disinfection, give no points for T&O.
- **Color** > 15 CU (not due to precipitated metals) (3 points) ***with following exceptions***. Color will be considered elevated and points assigned when levels exceed 75 Color Units (CU) for conventional filtration, 40 CU for direct filtration, or 15 CU for all other technologies, except reverse osmosis (no points given for color for reverse osmosis).
- **Iron and/or manganese** > MCL: Fe (2 points), Mn (3 points) (3 points maximum allowed) ***with following exceptions***. Iron and manganese levels will be considered elevated and points assigned if they are greater than the MCL, except for applications of manganese greensand filters. For applications of manganese greensand filters, iron and manganese levels will be considered elevated when their combined level exceeds 1.0 mg/L (3 points allowed).
- **Algal growths** for which treatment process adjustments are routinely made (3 points): Raw water will be considered subject to algae growths when treatment processes are specifically adjusted due to the presence of high levels of algae on at least a weekly basis for at least two months each year.

[2] **Upflow clarification** ("sludge blanket clarifier") – 8 points **–** Also known as sludge blanket clarification. Includes such proprietary units as Super-Pulsator. These units include processes for flocculation and sedimentation. Important note: these are not the same as adsorption clarifiers.

[3] **Laboratory control**
The key concept is to credit laboratory analyses done on-site by plant personnel under the direction of the operator in direct responsible charge (points from 0 to 15).
Bacteriological/biological (0 min.- 5 max.)
0 - Lab work done outside the plant
3 - Membrane filter procedures
5 - Use of fermentation tubes or any dilution method; fecal coliform determination
Chemical/physical (0 min. - 10 max.)
0 - Lab work done outside the plant
3 - Push-button or visual methods for simple tests such as chlorine, iron, manganese, turbidity
5 - Additional procedures such as filtration, jar tests and alkalinity
7 - More advanced determinations such as numerous inorganics
10 - Highly sophisticated instrumentation such as atomic absorption, gas chromatography

Flying Dust First Nation
New Water Treatment Plant

Item	Quantity	Unit	Unit Price	Amount
1. General Requirements				
Bonds / Insurance / General Requirements	1	Lump Sum	$ 300,000.00	$ 300,000.00
Mobilization / Demobilization	1	Lump Sum	$ 100,000.00	$ 100,000.00
Site Setup	1	Lump Sum	$ 100,000.00	$ 100,000.00
Subtotal				**$ 500,000.00**
2. Raw Water Supply				
Hydrogeological Assessment	1	Lump Sum	$ 75,000.00	$ 75,000.00
Well Drilling	2	Each	$ 300,000.00	$ 600,000.00
Well Completions	2	Each	$ 100,000.00	$ 200,000.00
150 mm Diameter Raw Water Supply Main (assumed length)	300	Lin.M.	$ 180.00	$ 54,000.00
Miscellaneous valves, swab launches fencing	1	Lump Sum	$ 50,000.00	$ 50,000.00
Utility / Roadway Crossings	1	Lump Sum	$ 25,000.00	$ 25,000.00
Power Supply	1	Each	$ 50,000.00	$ 50,000.00
Subtotal				**$ 1,054,000.00**
3. Distribution Supply				
Distribution Mains - 250 mm Dia.	2500	Lin.M.	$ 300.00	$ 750,000.00
Miscellaneous valves, hydrants etc.	1	Lump Sum	$ 75,000.00	$ 75,000.00
Utility / Roadway Crossings	2	Lump Sum	$ 75,000.00	$ 150,000.00
Termination of existing Saskwater Connection	1	Lump Sum	$ 25,000.00	$ 25,000.00
Tie into existing water	1	Lump Sum	$ 25,000.00	$ 25,000.00
Subtotal				**$ 1,025,000.00**
4. Building				
Site work, fencing, crushed rock, landscaping, imported fill	1	Lump Sum	$ 275,000.00	$ 275,000.00
Miscellaneous Metals	1	Lump Sum	$ 115,000.00	$ 115,000.00
Masonary - Exterior Walls	1	Lump Sum	$ 175,000.00	$ 175,000.00
Pre-finished metal roofing, eaves, downspouts, soffit facia	1	Lump Sum	$ 100,000.00	$ 100,000.00
Insulation	1	Lump Sum	$ 85,000.00	$ 85,000.00
Carpentry - Interior Framing, trusses	1	Lump Sum	$ 200,000.00	$ 200,000.00
Doors / Frames / Windows	1	Lump Sum	$ 75,000.00	$ 75,000.00
Interior Finishes - Millwork / Painting	1	Lump Sum	$ 175,000.00	$ 175,000.00
Misc. Specialties	1	Lump Sum	$ 125,000.00	$ 125,000.00
Subtotal				**$ 1,325,000.00**
5. Concrete Works				
Excavation Incl. Dewatering	1	Lump Sum	$ 150,000.00	$ 150,000.00
Backfilling	1	Lump Sum	$ 100,000.00	$ 100,000.00
Mud slab	1	Lump Sum	$ 50,000.00	$ 50,000.00
Base slab	1	Lump Sum	$ 200,000.00	$ 200,000.00
Walls	1	Lump Sum	$ 250,000.00	$ 250,000.00
Top slab	1	Lump Sum	$ 275,000.00	$ 275,000.00
Subtotal				**$ 1,025,000.00**
6. Treatment Equipment				
Pretreatment	1	Lump Sum	$ 500,000.00	$ 500,000.00
Secondary Treatment (MTU)	1	Lump Sum	$ 600,000.00	$ 600,000.00
Subtotal				**$ 1,100,000.00**
7. Mechanical				
Piping, bracing, hangers, supports, bolts, painting etc.	1	Lump Sum	$ 250,000.00	$ 250,000.00
Valves, Actuators, risers, boxes, rods	1	Lump Sum	$ 325,000.00	$ 325,000.00
Fixtures - Toilet, Sink(s), Domestic Plumbing	1	Lump Sum	$ 45,000.00	$ 45,000.00
Pumps - Distribution, Transfer, Booster, Standby, Backwash	1	Lump Sum	$ 275,000.00	$ 275,000.00
Heating - Unit Heaters, Permits	1	Lump Sum	$ 75,000.00	$ 75,000.00
Ventilation - Exh. fans (bldg, chem room, W/R), Louvres, dampers, actuators, insulation	1	Lump Sum	$ 100,000.00	$ 100,000.00
Chemical Feeds - Potassium Permanganate, Chlorine, Antiscalent, Sodium Hydroxide	1	Lump Sum	$ 75,000.00	$ 75,000.00
Reservoir valves and piping	1	Lump Sum	$ 45,000.00	$ 45,000.00
Subtotal				**$ 1,190,000.00**
8. Electrical				
Lighting, signage, fixture package	1	Lump Sum	$ 175,000.00	$ 175,000.00
Level Sensors	1	Lump Sum	$ 75,000.00	$ 75,000.00
Wiring / Cabling / Conduit	1	Lump Sum	$ 425,000.00	$ 425,000.00
Generator	1	Lump Sum	$ 125,000.00	$ 125,000.00
MCC	1	Lump Sum	$ 425,000.00	$ 425,000.00
Subtotal				**$ 1,225,000.00**
9. Controls				
PLC and Programming	1	Lump Sum	$ 100,000.00	$ 100,000.00
Subtotal				**$ 100,000.00**
10. Miscellaneous				
Utilities - New Power, Gas, Telephone	1	Lump Sum	$ 75,000.00	$ 75,000.00
Material Testing	1	Lump Sum	$ 25,000.00	$ 25,000.00
Tools and Equipment	1	Lump Sum	$ 25,000.00	$ 25,000.00
Subtotal				**$ 125,000.00**
Estimated Construction Cost				**$ 8,569,000.00**

BECKIE HYDROGEOLOGISTS (1990) LTD.

CONSULTING PROFESSIONAL ENGINEERS AND GEOSCIENTISTS

phone: (306) 721-0846 email: bhl@sasktel.net

September 20, 2020

Flying Dust First Nation
c//o BCL Engineering Ltd.
200 - 302 Wellman Lane
Saskatoon, Sk, S7T 0J1

Attn: Mr. Lawrence Lukey, P. Eng. llukey@bcl-eng.ca

Dear Mr. Lukey:

Re: Flying Dust First Nation - Water Supply Well(s) Construction Project

With reference to the July 24, 2020 letter proposal prepared by Beckie Hydrogeologists Ltd. (BHL) and to the August 20, 2020 email approval to proceed from BCL Engineering Ltd. (on behalf of the Flying Dust PMT), BHL prepared a unit price tender document and invited three pre-qualified drilling contractors to submit tender (competitive) prices on the above noted Project.

The unit price tender document included personnel and equipment mobilization to Flying Dust, exploration test drilling, the installation of 50 mm diameter piezometer(s) and the construction and pump testing of 2 - 250 mm diameter type 304 stainless steel cased water supply wells into the Hatfield Valley Aquifer.

The proposed availability dates and the Total Tendered Prices received by BHL on September 18, 2020, based on the tendered unit prices submitted by the drilling contractors and on the **estimated** (by BHL) quantities of labour and materials that will be required for the drilling contractor to complete the work as specified, are tabulated below:

	McAllister Drilling Inc.	**Andrews and Sons Drilling Ltd.**	**Hayter Drilling Ltd.**
Total Tendered Price (GST and PST exempt)	$ 423,506.50	$ 424,369.20	$ 409,010.00
Proposed Availability Date (days following contract award) (refer to note d below)	30	90	50
Consent of Surety and Bid Bond Provided	yes	yes	yes

…2/

a) A tubulated summary of the tender submissions from the 3 drilling contractors is attached for review by BCL Engineering and the Flying Dust PMT.

b) The pre-tender cost estimate for the drilling contractor to complete this work was $275,000.00. This estimate was prepared by BHL (July 24, 2020 proposal) with the assumption that the two water supply wells would be constructed with 250 mm diameter **PVC plastic casing**. However, following subsequent review of the available hydrogeologic data, it was determined by BHL that the static water level in Hatfield Valley Aquifer at the potential well sites would be near surface, or potentially under flowing artesian conditions. Therefore, following discussions with BCL, BHL recommended that the wells be constructed with 250 mm diameter **stainless steel casing** and the tender documents were prepared accordingly; the casing substitution was the primary reason that the tendered costs are above the pre-tender estimate.

c) The final cost that will be invoiced by the selected drilling contractor will be based on their tendered unit prices and on the **actual** quantities of labour and material that they supply on the Project, as will be field verified by BHL. Therefore, the final contractor invoice may be marginally higher or lower than their Total Tendered Price.

d) The contractor's proposed availability date is subject to material availability (intake screens may require 3 to 4 weeks for delivery from the date of order) and to BHL's work schedule and availability at the time of contract award by the Flying Dust PMT.

e) The tendered prices were submitted by the drilling contractors with the understanding that the field portion of the work will not be completed during severe winter weather conditions.

Provided that their proposed availability date is acceptable, BHL recommends that the Flying Dust First Nation PMT award the water supply well(s) construction project to **Hayter Drilling Ltd.**, based on their submission of the lowest tender price of **$409,010.00**.

Please advise BHL of the PMT's decision on contractor selection so that we can proceed with contract award, with the preparation of the contract documents and with project scheduling.

Please contact the undersigned should have any questions or require any additional information related to this project.

Yours very truly,

PROFESSIONAL GEOSCIENTIST
M. S. FAMULAK
MEMBER 9716
2020 09 20
YR. MN. DAY
SASKATCHEWAN

Mike S. Famulak, P. Geo, P. Geol.
Principal Hydrogeologist
cellular (306) 536-1625
famulak@sasktel.net or mfamulak.bhl@sasktel.net

attach: 1

Flying Dust First Nation
September 18, 2020 Tender Analyses - Well Construction

Description of Work	Estimated Quantity	McAllister Drilling		Andrews and Sons		Hayter Drilling	
		Tendered Unit Price	Extension Price	Tendered Unit Price	Extension Price	Tendered Unit Price	Extension Price
1. Mobilization and demobilization	1.00	11,000.00	11,000.00	16,000.00	16,000.00	10,000.00	10,000.00
1b. Remobilization	1.00	3,600.00	3,600.00	7,000.00	7,000.00	3,000.00	3,000.00
2a. Drilling 159 mm test hole	784.00	41.00	32,144.00	46.00	36,064.00	40.00	31,360.00
2b. Electric logging test hole	784.00	6.00	4,704.00	3.30	2,587.20	5.00	3,920.00
3a. Bentonite drill mud	50.00	12.00	600.00	30.00	1,500.00	30.00	1,500.00
3b. 0.75 size filter sand	320.00	20.00	6,400.00	30.00	9,600.00	30.00	9,600.00
3c. Bentonite aggregate	100.00	15.00	1,500.00	30.00	3,000.00	30.00	3,000.00
3d. Type HS dry cement per 20 kg bag	380.00	20.00	7,600.00	20.00	7,600.00	30.00	11,400.00
3e. High solids bentonite grout	60.00	24.00	1,440.00	45.00	2,700.00	35.00	2,100.00
3f. Nuwell 220 mud dispersant	1.00	150.00	150.00	950.00	950.00	850.00	850.00
3g. Aqua Clear mud dispersant	4.00	120.00	480.00	125.00	500.00	250.00	1,000.00
3h. Barite weight material	125.00	24.00	3,000.00	50.00	6,250.00	45.00	5,625.00
4a. 50 mm PVC plastic casing	360.00	15.50	5,580.00	21.00	7,560.00	25.00	9,000.00
4b. Install 50 mm PVC casing	360.00	16.00	5,760.00	3.30	1,188.00	25.00	9,000.00
4c. 50 mm stainless steel screen	8.00	250.00	2,000.00	290.00	2,320.00	550.00	4,400.00
4d. Piezometer protector casing	4.00	400.00	1,600.00	275.00	1,100.00	750.00	3,000.00
5. Supply and installation of carbon steel surface casing	2.00	6,000.00	12,000.00	9,500.00	19,000.00	6,400.00	12,800.00
6. Drilling 381 mm diameter hole	170.00	102.00	17,340.00	300.00	51,000.00	370.00	62,900.00
7. 254 mm diameter type 304 SS casing	154.00	902.00	138,908.00	625.00	96,250.00	590.00	90,860.00
8. 256 mm type 304 SS intake screen	30.50	1,341.00	40,900.50	1,300.00	39,650.00	990.00	30,195.00
9a. Well development	80.00	450.00	36,000.00	450.00	36,000.00	400.00	32,000.00
9b. Piezometer Development	20.00	400.00	8,000.00	400.00	8,000.00	350.00	7,000.00
10a. Pump Testing	32.00	500.00	16,000.00	375.00	12,000.00	325.00	10,400.00
9b. Recovery Testing	10.00	400.00	4,000.00	325.00	3,250.00	300.00	3,000.00
11. Backfilling annulus	2.00	500.00	1,000.00	250.00	500.00	1,500.00	3,000.00
12. Disinfection and capping	2.00	500.00	1,000.00	250.00	500.00	1,000.00	2,000.00
13. Plumbness and alignment	2.00	500.00	1,000.00	750.00	1,500.00	500.00	1,000.00
14. Cementing time	20.00	450.00	9,000.00	400.00	8,000.00	400.00	8,000.00
15. Supply and maintenance of portable on-site toilet	1.00	500.00	500.00	500.00	500.00	500.00	500.00
16. Extra work	12.00	450.00	5,400.00	400.00	4,800.00	200.00	2,400.00
17 Standby time, men and equipment	16.00	400.00	6,400.00	250.00	4,000.00	200.00	3,200.00
18. Solinst monitoring equipment	1.00	8,500.00	8,500.00	8,500.00	8,500.00	8,500.00	8,500.00
19. Extra materials			10,000.00		10,000.00		10,000.00
208. Room and board	25.00	800.00	20,000.00	600.00	15,000.00	500.00	12,500.00
Sub Total			**423,506.50**		**424,369.20**		**409,010.00**
Plus 5% GST			exempt		exempt		exempt
Plus 6% Sask PST			exempt		exempt		exempt
Total Tendered Price			**423,506.50**		**424,369.20**		**409,010.00**
Bid Bond and Consent of Surety Provided			yes		yes		yes
Availability (days after award)			30		90		50

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BCL ENGINEERING LTD.

NUMBER C0312

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DISCIPLINE	SASK. REG. No.	SIGNATURE
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DRAWN:	G.K.M.
CHECKED:	R.M.A.
DESIGNED:	L.F.L.

FLYING DUST FIRST NATION

WATER TREATMENT PLANT UPGRADES
KEY PLAN

SCALE:	REV. No.	PROJECT No.	SHEET:
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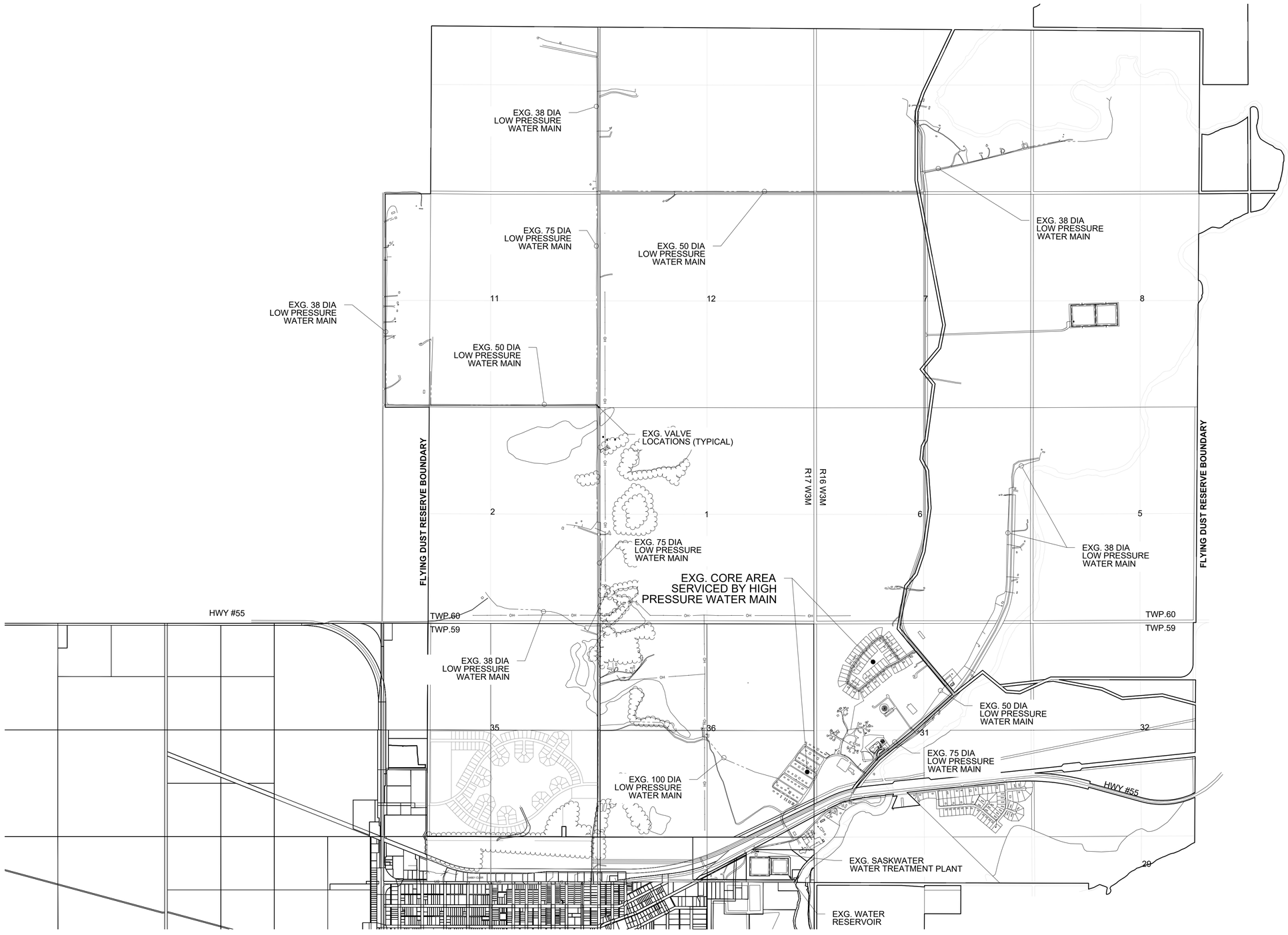

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WATER TREATMENT PLANT UPGRADES
EXG. WATER SYSTEM INFRASTRUCTURE

SCALE:	REV. No.	PROJECT No.	SHEET:
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LEGEND EXISITNG

- SANITARY SEWER
- SANITARY MANHOLE
- SEWAGE FORCE MAIN
- ROADWAY

NOTE: LOCATION OF EXISTING UTILITIES AND SERVICES ARE APPROXIMATE AND SHOWN FOR REFERENCE ONLY. CONTRACTOR RESPONSIBLE TO CONFIRM LOCATION OF ALL EXISTING UTILITIES AND SERVICES AND COORDINATED CROSSING, INSTALLATION, AND/OR RELOCATION REQUIRED TO COMPLETE WORK.

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WATER TREATMENT PLANT UPGRADES
EXG. SEWER SYSTEM INFRASTRUCTURE

SCALE:	REV. No.	PROJECT No.	SHEET:
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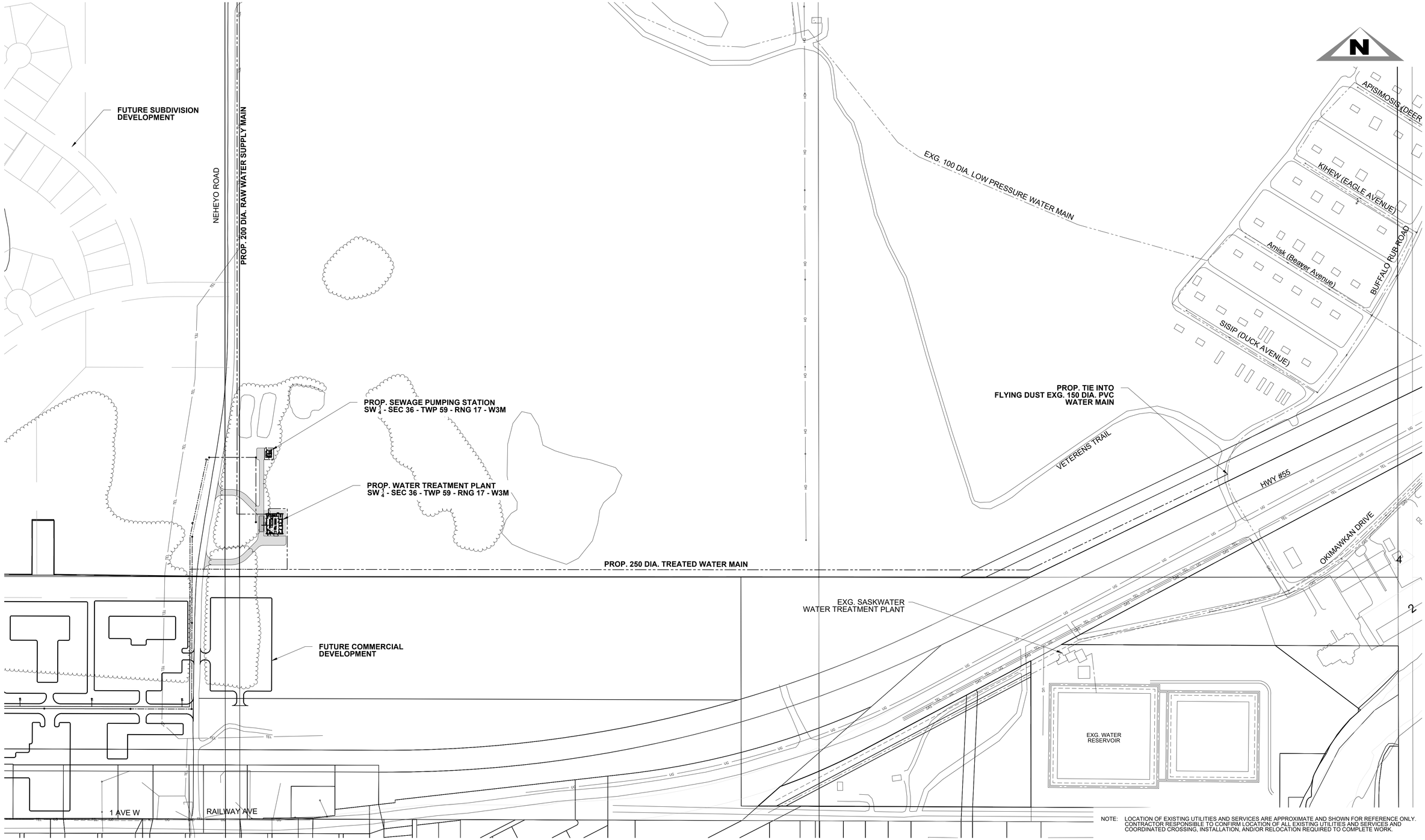

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FLYING DUST FIRST NATION

WATER TREATMENT PLANT UPGRADES
PROP. LOCATION PLAN

SCALE:	REV. No.	PROJECT No.	SHEET:
1:2500	A	CT608	04 OF 06

PROP. WATER TREATMENT PLANT (CONCEPTUAL LAYOUT)

PROP. 250 DIA. WATER MAIN SUPPLY MAIN

PROP. 250 DIA. WATER MAIN SUPPLY MAIN TO FLYING DUST

PROP. SEWAGE PUMPING STATION (CONCEPTUAL LAYOUT)

PROP. ACCESS ROADWAY

6.00

PROP. ACCESS ROADWAY

PROP. MH #14 (BY OTHERS)

PROP. 250 DIA PVC SDR35 SANITARY SEWER (BY OTHERS)

PROP. MH

PROP. TRUCK FILL PAD

PROP. ACCESS ROADWAY

PROP. 250 DIA. WATER MAIN SUPPLY MAIN TO FUTURE COMMERCIAL DEVELOPMENT

PROP. 200 DIA HDPE DR17 RAW WATER MAIN

PROP. 250 DIA PVC SDR35 SANITARY SEWER (BY OTHERS)

PROP. 200 DIA HDPE DR17 RAW WATER MAIN

EXG. TREE LINE TYPICAL

8.00

8.00

PROP. TIE-IN TO EXG. ROADWAY

PROP. TIE-IN TO EXG. ROADWAY

PROP. MH #13 (BY OTHERS)

PROP. 250 DIA PVC SDR35 SANITARY SEWER (BY OTHERS)

PROP. WATER MAIN (BY OTHERS)

LEGEND

	EXISTING	PROPOSED
SANITARY SEWER		
SANITARY MANHOLE	○	●
WATER MAIN		
HYDRANTS & VALVES		
GATE VALVE	△	▲
RAW WATER MAIN		
SEWAGE FORCE MAIN		
ROADWAY		

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EXISTING SLOUGH/TREE LINE SHOWN FOR ILLUSTRATIVE PURPOSES. ACTUAL TREE LINE TO BE CONFIRMED BY CONTRACTOR.

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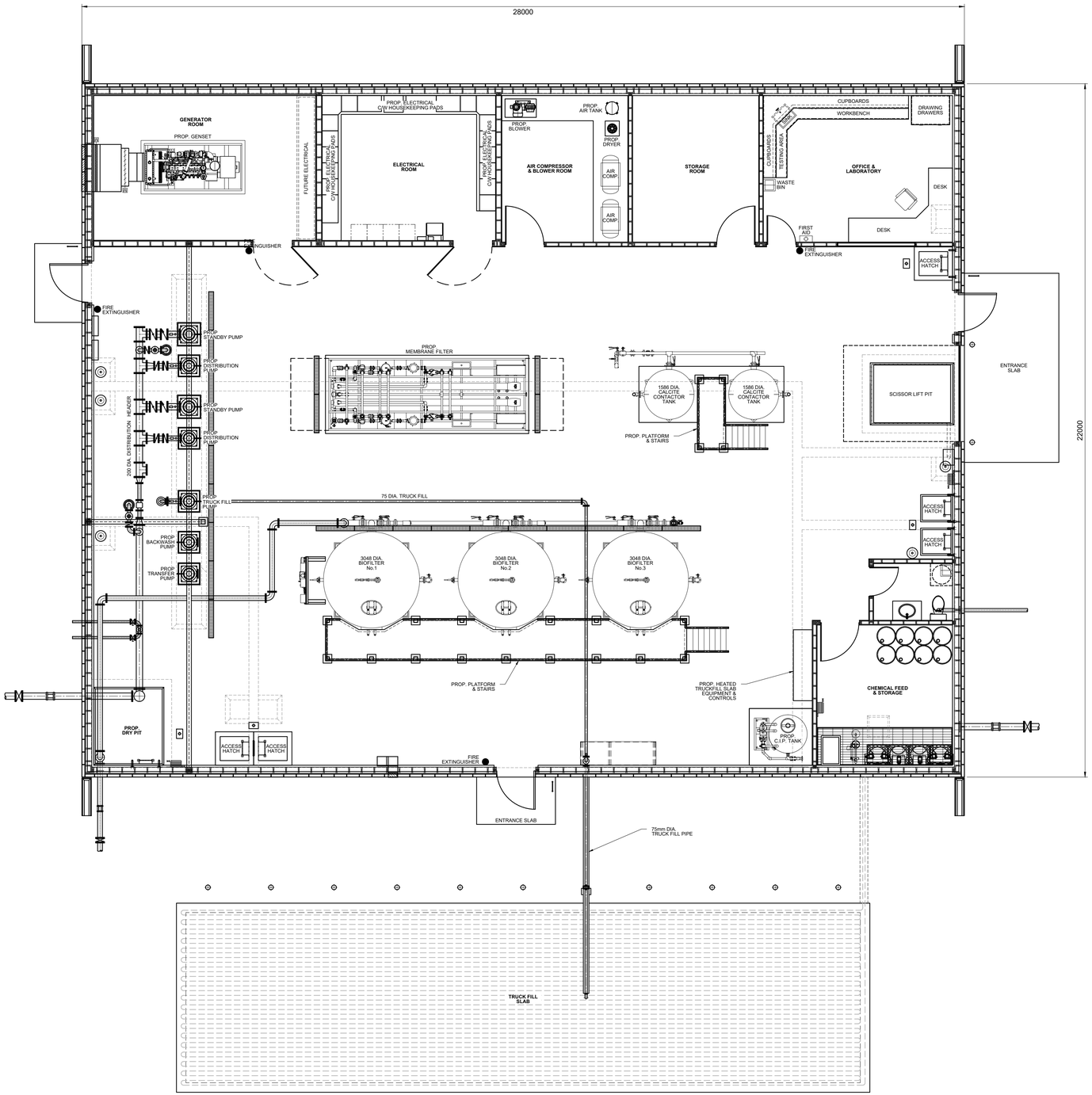
DESIGNED: L.F.L.

FLYING DUST FIRST NATION

WATER TREATMENT PLANT UPGRADES
PROP. SITE PLAN

SCALE: 1:300 | REV. No. A | PROJECT No. CT608 | SHEET: 05 OF 06



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CERTIFICATE OF AUTHORIZATION

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DESIGNED:	L.F.L.

FLYING DUST FIRST NATION

WATER TREATMENT PLANT UPGRADE
PROP. MECHANICAL FLOOR PLAN

SCALE:	REV. No.	PROJECT No.	SHEET:
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