City of Ferndale

Whatcom County, Washington

Wastewater Treatment Plant Operations and Maintenance Manual

Prepared by:

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Ferndale Wastewater Treatment Plant
Operations and Maintenance Manual

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CHAPTER 1
INTRODUCTION

1.1 PURPOSE AND INTENT

The purpose and intent of this document is to provide technical guidance to the operator to enhance operations during normal and emergency conditions. This manual will also include control strategies for various process issues the facility may encounter.

1.1.1 Purpose of Treatment Facilities

The City of Ferndale is responsible for the collection, treatment, and disposal of wastewater generated from its sewered service area. The City is entrusted with the protection of public health in the Ferndale area and of the quality of water in the Nooksack River. The purpose of the Ferndale Wastewater Treatment Facilities is: (1) to remove suspended and floatable material; (2) to treat biodegradable organics; and (3) to eliminate pathogenic organisms from the wastewater. The facility is designed to meet secondary effluent criteria specified in the National Pollution Discharge Elimination System (NPDES) waste discharge permit. The most recent NPDES waste discharge permit, which expired on July 31, 2019, is in effect until the new permit is issued by the Washington State Department of Ecology. Table 1-1 presents a summary of the permitted limitations. The entire NPDES Waste Discharge Permit WA-002245-4 included in Appendix G.

1.1.2 Background on Existing Facilities

The City of Ferndale Wastewater Treatment Plant (Ferndale WWTP) was originally constructed in 1969 with a design capacity of 0.5 MGD. It was expanded in 1984 and 1992 to accommodate a design flow of 1.72 MGD. The 1984 and 1992 expansion improvements were components of a twenty-year plan to meet the City of Ferndale's wastewater treatment and disposal needs through the year 2005. In 1989, effluent scum removal facilities were constructed as an improvement to the treatment plant. The WWTP was subsequently expanded during Phase I and Phase II Improvements during 1996 and 1998.

Prior to the most recent improvements in 2020, the WWTP consisted of a dual-power multicellular (DPMC) aerated lagoon system with a treatment capacity of approximately 3.23 MGD (peak month). The process included influent screw pumps, mechanical screens, a leachate pretreatment lagoon, the

multicellular lagoon, an effluent filter, chlorination disinfection, and dechlorination prior to the outfall into the Nooksack River. The leachate pretreatment lagoon, which is no longer used, was used to aerate leachate hauled from the Cedarville Landfill and other sources, and discharged the leachate into the wastewater stream for full treatment in the WWTP.

Plant upgrades, constructed in 2020, converted the facility into an extended aeration activated sludge system, and involved the addition of grit basins, additional mechanical screening, two parallel extended aeration basins modified from existing aerated lagoons, two secondary clarifiers, a return activated sludge (RAS) system, and a UV disinfection system in place of the chlorination disinfection.

1.1.3 General Facility Information

Plant Location:

City of Ferndale Wastewater Treatment Plant
5405 Ferndale Road,
Ferndale, WA 98248

Type of Treatment: Secondary (Extended Aeration Activated Sludge)

Discharge Location:

Nooksack River
Latitude: 48 50’ 06” N
Longitude: 122 35’ 51” W

Facility Contact: Mike Olinger, Chief Operator (360) 384-4607

1.1.4 Purpose and Organization of this Manual

This manual describes the operations and maintenance procedures for the City of Ferndale Wastewater Treatment Plant (WWTP). The purpose of the manual is: (1) to acquaint personnel responsible for operation of the treatment facility with the overall capabilities of the plant, (2) to outline responsibilities of the operations and maintenance personnel; (3) to instruct personnel on the purpose and intended operation of each treatment process; and (4) to provide personnel with the information required for the proper operation and maintenance of the treatment facility. Thus, this manual serves as a reference and guide for the safe, efficient and economic operation of the plant.

Table 1-1

Summary of NPDES Effluent Limitations

EFFLUENT LIMITATIONS: OUTFALL 001		
Parameter	Average Monthly [a]	Average Weekly [b]
Carbonaceous Biochemical Oxygen Demand [c], $CBOD_5$ (5-day)	25 mg/L, 85% removal of influent $CBOD_5$	40 mg/L
Total Suspended Solids, TSS	30 mg/L, 85% removal of influent TSS	45 mg/L
Fecal Coliform Bacteria [c]	28/100 mL	400/100 mL
pH	Daily minimum is equal to or greater than 6 and the daily maximum is less than or equal to 9.	
Parameter	Average Monthly	Maximum Daily [d]
Total Residual Chlorine	34 µg/L	76 µg/L
[a] Average monthly effluent limit means the highest allowable average of daily discharges over a calendar month. To calculate the discharge value to compare to the limit, you add the value of each daily discharge measured during a calendar month and divide this sum by the total number of daily discharges measured. See footnote c for fecal coliform calculations.		
[b] Average weekly discharge limitation means the highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week. See footnote c for fecal coliform calculations.		
[c] Ecology provides directions to calculate the monthly and the weekly geometric mean in publication No. 04-10-020, Information Manual for Treatment Plant Operators available at: http://www.ecy.wa.gov/pubs/0410020.pdf		
[d] Maximum daily effluent limit is the highest allowable daily discharge. The daily discharge is the average discharge of a pollutant measured during a calendar day. For pollutants with limits expressed in units of mass, calculate the daily discharge as the total mass of the pollutant discharged over the day. This does not apply to pH or temperature.		

The presentation of material in the manual is directed to personnel who are familiar with wastewater treatment and process theory. It should be emphasized that the manual cannot be substituted for experience, nor is it intended to cover all of the operational possibilities available. Limited information related to general theory and principals of biological treatment of wastewater has been included.

Reference publications that may provide additional pertinent information desired by personnel are provided in Appendix H. It is intended that this manual and related material provide the basis for an expanding plant library. Manufacturers' manuals for all equipment will also be made accessible as a part of the plant library.

The manual includes details on process control, operational strategies, troubleshooting guidance, and specific maintenance data for headworks, aeration basins, clarifiers, ultraviolent disinfection, pump stations, misc. piping/valving/hydraulic structure, and general plant facilities. This information is organized into twelve chapters, each providing summary description and instructions of specific processes, services, or functions.

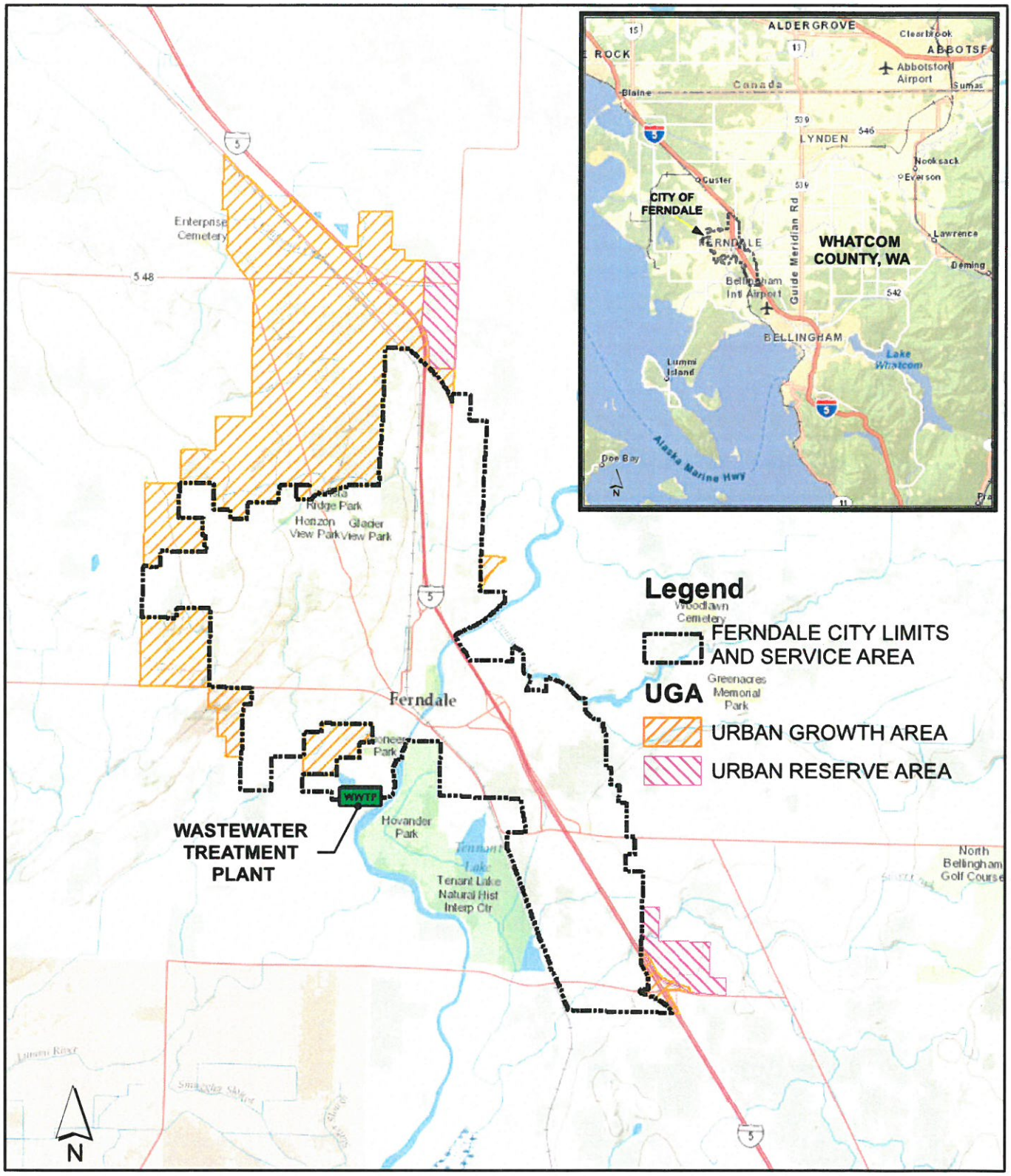
In addition, appendices are included at the end of the manual and include contact information for equipment suppliers and manufacturers, the NPDES permit and applicable safety rules, emergency plans, maintenance program, and SOPs for draining the various structures and basins. It is recommended that all personnel become familiar with the manual contents, format, and organization. Copies of this Operations and Maintenance Manual have been provided with complete sets of equipment operation, maintenance, and repair instructions prepared by the manufacturers. These manufacturer's manuals, along with submittal information and contract record drawings may be found on file with the City of Ferndale and the Wilson Engineering office in Bellingham, WA.

1.2 GENERAL DESCRIPTION OF FACILITIES

A general description of the treatment facility is contained in this section. Specific details into theory and operations are contained in the chapters which follow.

1.2.1 Collection System and Service Area

The collection system and service area for which the treatment facility serves is illustrated in Figure 1-1. It consists of 4,300 acres and projected 5,500 acres including future Urban Growth Areas. Currently the service area contains 340-inch miles of gravity lines and 46-inch miles of force mains per the 1996, City of Ferndale Comprehensive Wastewater Facilities Plan. The facility receives influent from sewer lines from the north and west, the stormwater decant facility, the water treatment plant (WTP), the East Plant Drain Pump Station, and the grit decant structure at the screw pump lift station on the north side of the facility. Stormwater collected onsite is directed to a 1-acre stormwater infiltration facility that is north of the facility. The base of this facility is roughly at Elevation 19 feet and ponding depth is currently planned at about 1.4 feet, with an emergency overflow spillway at Elevation 20.40 feet. Because the facility will be located in the floodplain, the berm height will allow flow-through of the projected 100-year flood event. The 100-year flood elevation in the vicinity of the facility is Elevation 23.5 feet.



1 inch = 1 miles

Wilson SURVEY/ENGINEERING WILSON ENGINEERING, LLC 805 DUPONT STREET BELLINGHAM, WA 98225 (360) 733-6100 FAX (360) 647-9061 www.wilsonengineering.com	CITY OF FERNDALE, WA WHATCOM COUNTY WASHINGTON FIGURE 1-1 VICINITY MAP AND SERVICE AREA	DATE JUNE 2012 SCALE 1:63,360 JOB NUMBER 2012-042	SHEET – OF –

1.2.2 Treatment Facilities

The Ferndale WWTP consists of the following basic components: influent pumping, headworks, aerated grit chambers, extended aeration basins, secondary clarifiers, UV disinfection, effluent pumping, and outfall to the Nooksack River. Figure 1-2 presents the plant layout and Figures 1-3 and 1-3A list abbreviations, symbols, equipment and piping identification used in other Figures throughout this manual.

1.2.2.1 Influent Pumping

The influent pump station (Pump Station No. 1) is located north of the treatment plant and receives unscreened wastewater from the Ferndale collection system. Its primary function is to lift the wastewater to the water level in the basin system. The influent pumping station contains three (3) screw pumps in the lift station located at the WWTP site.

1.2.2.2 Headworks and Preliminary Treatment

The goal of the headworks is to remove non-biological material from the wastewater to avoid strain on the equipment downstream. This contains one (1) coarse mechanical screen, two (2) aerated grit chambers, and two (2) fine mechanical screens. These steps serve to remove grit and debris that puts strain on pumps, pipes, and channels, and takes up space in sludge digestion tanks. The headworks also contain the aeration basin flow splitter where flow is split between the north and south aeration basins.

1.2.2.3 Aeration Basins

The aeration basin serves to promote biodegradation to reduce contaminates in the wastewater. Positive displacement blowers send air to a system of bubble diffusers that serve to aerate the entire basin. Dissolved oxygen (DO) probes help control the blowers to ensure the correct DO level is present before the wastewater flows to the clarifiers.

NO.	REVISIONS	BY	DATE

WETLAND BOUNDARY

WETLAND 50-FT BUFFER

~STORMWATER INFILTRATION BASIN~

EXISTING HEADWORKS

LAB/OPERATIONS BUILDING

~BIOSOLIDS DIGESTION BASIN~

GRIT CHAMBERS

NEW HEADWORKS

AERATION BASIN FLOW SPLITTER

~NORTH AERATION BASIN~

NORTH CLARIFIER

~SOUTH AERATION BASIN~

SOUTH CLARIFIER

FUTURE CLARIFIER

CITY OF FERNDALE SHORELINE JURISDICTION

EXISTING WATER TREATMENT PLANT

FERNDALE ROAD

SHOP/UV DISINFECTION BUILDING

BLOWER ROOM

SHEET C2.02
PLAN AREA 'A'

SHEET C2.03
PLAN AREA 'B'

SHEET C2.04
PLAN AREA 'C'

SHEET C2.06
PLAN AREA 'E'

SHEET C2.05
PLAN AREA 'D'

SHEET C2.07
PLAN AREA 'F'

N

100 0 100 200
SCALE HORIZONTAL SCALE FEET

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FIGURE 1-2
OVERALL SITE PLAN

SHEET	DATE	SCALE	JOB NUMBER
-	10-7-2022	AS SHOWN	2020-006

PAGE -

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W:\2020\2020-006 FERNDALE WWTP CONSTRUCTION\DWG - V2019\AS-BUILT DRAWINGS V2019\AB V2019_2020-006 C2.01 OVERALL SITE PLAN.DWG - 10/7/2022 3:24 PM Jeff Smith

GENERAL LEGEND & ABBREVIATIONS– SIZE & SCALE MAY VARY

NO.	REVISIONS	BY	DATE

EXISTING HATCH PATTERNS

DESCRIPTION
CONCRETE
BUILDING
EARTH
GRAVEL
SAND

PROPOSED HATCH PATTERNS

DESCRIPTION
CONCRETE
ASPHALT SURFACING
GRAVEL
SAND
QUARRY SPALLS
WETLAND HATCH

SURFACE FEATURES
EXISTING PLAN LINETYPES

DESCRIPTION
BRIDGE
BUILDING LINE
BUILDING COLUMN
BUILDING OVERHANG
BULKHEAD
CONCRETE EDGE
CREEK EDGE
CROWN OF ROAD
CURB
DITCH CENTERLINE
DECK
DOCK
EDGE OF SAWCUT
EDGE OF PAVEMENT
FENCE
GRAVEL
GUARDRAIL
JERSEY BARRIER
LAKE/POND WATER EDGE
LIP OF CURB
PLANTER
HANDRAIL
RETAINING WALL
ROAD STRIPING
ROCKERY
RIVERBANK/SHORELINE
THALWAG LINE
TOP OF BANK/SLOPE
TOE OF BANK/SLOPE
VEGETATION/SHRUB LINE
WETLAND/SWAMP PERIMETER
WETLAND BUFFER

SURFACE FEATURES
PROPOSED PLAN LINETYPES

DESCRIPTION
BRIDGE
BUILDING LINE
CONCRETE
CURB
DITCH CENTERLINE
EDGE OF BIKE LANE
EDGE OF PAVEMENT
FENCE
GATE
GRAVEL
GUARDRAIL
JERSEY BARRIER
LIP OF CURB
REBAR
RETAINING WALL
ROCKERY
ROAD STRIPING
HANDRAIL

UTILITIES
EXISTING PLAN LINETYPES

DESCRIPTION
CABLE TELEVISION (AERIAL)
CABLE TELEVISION (BURIED)
SURVEILLANCE CAMERA (BURIED
FIBER OPTIC LINE (AERIAL)
FIBER OPTIC LINE (BURIED)
TELEMETRY (BURIED)
TELEPHONE (AERIAL)
TELEPHONE (BURIED)
TRAFFIC SIGNAL CONDUIT LINE
POWER (AERIAL)
POWER (BURIED)
UTILITY (AERIAL)
UTILITY (BURIED)
POWER DUCT BANK (BURIED)
DRAIN FIELD
SANITARY SEWER
APPROXIMATE SANITARY SEWER
SANITARY SEWER (FORCE MAIN)
APPROXIMATE SANITARY SEWER (FORCE MAIN)
STORM DRAINAGE
APPROXIMATE STORM DRAINAGE
CULVERT (@ WIDTH)
CULVERT
RECLAIMED WATER
IRRIGATION
WATER
APPROXIMATE WATER
8" WATER
OVERFLOW
STEAM
GAS
OIL
AIR LINE
BURIED UTILITY APPROX. EXTENTS

PROPOSED PLAN UTILITY LINETYPES
WATER

DESCRIPTION
WATER (POTABLE WATER)
WATER (AIR GAP WATER)
WATER (REUSE WATER)
IRRIGATION
WATER SERVICE
FIRE DEPARTMENT CONNECTION
FIRE PROTECTION LINE

SANITARY SEWER

DESCRIPTION
SEWER
8" SEWER
FORCE MAIN
DRAIN FIELD
SEWER SERVICE

STORM DRAIN

DESCRIPTION
STORM DRAIN
STORM SERVICE
FOOTING DRAIN

MISC. UTILITIES

DESCRIPTION
GAS
POWER
TELEPHONE/COMMUNICATIONS

EROSION CONTROL

DESCRIPTION
EROSION TRIANGULAR SILT DIKE
EROSION CONTROL COMPOST BERM
EROSION CONTROL MINOR CONTOUR
EROSION CONTROL MAJOR CONTOUR
ORANGE BARRIER FENCE
SILT FENCE
STRAW WATTLE
EROSION CONTROL FLOWLINE
SB STRAW BALE
IP INLET PROTECTION
CD CHECK DAM

SURVEY
PLAN LINETYPES

DESCRIPTION
CENTERLINE (EXISTING)
CENTERLINE (CONSTRUCTION)
CENTERLINE (PROPOSED)
CONTOUR (EXISTING MINOR)
CONTOUR (EXISTING INDEX)
HYDRO CONTOUR (EXISTING INDEX)
CONTOUR (PROPOSED INDEX)
CONTOUR (PROPOSED MINOR)
DONATION LAND CLAIM (EXIST.)
EASEMENT (PROPOSED)
EASEMENT (EXISTING)
MEANDER LINE
ORDINARY HIGH WATER LINE
MEAN LOW LEVEL WATER LINE
OWNERSHIP LINE
PROPERTY LINE (RECORD OR ADJACENT)
PROPERTY LINE
QUARTER SECTION LINE
RANGE/TOWNSHIP LINE
RESERVATION/PARK/FOREST (EX)
RIGHT–OF–WAY ℄ (EXISTING)
RIGHT–OF–WAY (EXISTING)
RIGHT–OF–WAY (EXISTING USED)
RIGHT–OF–WAY (PROPOSED)
RIGHT–OF–WAY (EX. RECORD) (RECORD OR ADJACENT)
SECTION LINE
SETBACK LINE (EXISTING)
SIXTEENTH SECTION LINE
STATE/COUNTY/CORPORATE LIMIT
VACATED RIGHT–OF–WAY
EASEMENT (RECORD)
RIGHT–OF–WAY CENTER (RECORD)
DONATION LAND CLAIM (RECORD)
MEANDER LINE (RECORD)
PARK LINE (RECORD)
SECTION LINE (RECORD)
QUARTER SECTION LINE (RECORD)
SIXTEENTH SECTION LINE (RECORD)
STATE LINE (RECORD)
RANGE LINE (RECORD)

PROFILE LINETYPES

DESCRIPTION
PROFILE EX. GRND ℄
PROFILE FINISH GRND ℄
PROFILE GRID
PROFILE VERTICAL GRID
PROFILE EX. GROUND LEFT
PROFILE EXISTING GROUND RIGHT
FIBER OPTIC PROFILE (EXISTING)
GAS PROFILE (EXISTING)
POWER PROFILE (EXISTING)
RAILROAD PROFILE (EXISTING)
SANITARY PROFILE (EXISTING)
SANITARY PROFILE (PROPOSED)
STORM PROFILE (EXISTING)
TELEPHONE PROFILE (EXISTING)
STORM PROFILE (PROPOSED)
TV PROFILE (EXISTING)
UTILITY PROFILE (EXISTING)
WATER PROFILE (EXISTING)
WATER PROFILE (PROPOSED)

DEMOLITION

DESCRIPTION
SURFACE FEATURE OR UTILITY TO BE REMOVED
SAWCUT
CLEARING LIMIT
TREE OR BUSH TO BE REMOVED

GRADING

DESCRIPTION
GRADE BREAK
CATCHLINE
CUT LINE
FILL LINE
SLOPE ARROWS

MISC. SYMBOLS

EXISTING	PROPOSED	DESCRIPTION
		SOIL BORING
		MONITORING WELL
		TEST WELL
		TEST PIT
		EMBANKMENT
		MAIL BOX
		SIGN
		RIP RAP
		BOULDER
		SHRUB
		TREE (Conifer)*
		TREE (Deciduous)*
		STUMP–PLAN VIEW
		YARD LIGHT
		WELL
		PILE
		ROCKERY
		WHEEL STOP
		SPLASH BLOCK
		GAS METER
		GAS VALVE
		PAD MOUNTED TRANSFORMER
		POWER VAULT
		TRANSMISSION TOWER
		POWER METER
		GUY POLE
		UTILITY POLE
		UTILITY POLE ANCHOR
		TELE RISER
		CABLE RISER
		FIBER OPTIC RISER
		FIBER OPTIC MANHOLE
		TELEPHONE MANHOLE
		TELEPHONE VAULT
		STEAM MANHOLE
		POST
		PUMP

SANITARY SEWER SYMBOLS

EXISTING	PROPOSED	DESCRIPTION
		SAN. SEWER CLEAN OUT
		SAN. SEWER MANHOLE

STORM DRAIN SYMBOLS

EXISTING	PROPOSED	DESCRIPTION
		STORM DRAIN CB TYPE 1
		STORM DRAIN CB TYPE 2
		STORM DRAIN CB TYPE 2 W/CB LID
		STORM DRAIN WITH OVERFLOW GRATE
		STORM DRAIN CLEAN–OUT
DS	DS	STORM DOWNSPOUTS

WATER SYMBOLS

EXISTING	PROPOSED	DESCRIPTION
		ARV VALVE
		GLOBE VALVE, FL
		BALL CHECK VALVE, FL
		BLOW–OFF VALVE
		SWING CHECK VALVE, FL
		BUTTERFLY VALVE, FL
		HOSE BIB/SPIGOT
		DOUBLE LEAF CHECK VALVE
		PLUG VALVE
		BALL VALVE
		FLOAT VALVE
		PINCH VALVE
		PRESSURE & VACUUM RELIEF VALVE
		VACUUM RELIEF VALVE
		PRESSURE RELIEF VALVE
		PRESSURE REGULATING VALVE (SELF CONTAINED)
		BACK PRESSURE REGULATING VALVE (SELF CONTAINED)
		IN–LINE SPRING LOADED RELIEF VALVE
		CAP/PLUG
		GUARD POST
		THRUST BLOCK
		WATER METER
		FIRE DEPARTMENT CONNECTION
		WATER VALVE
		FIRE HYDRANT
		WATER MANHOLE
		POST INDICATOR VALVE
		11–1/4 BEND, MJ–FL
		22–1/2 BEND, MJ–FL
		45 BEND, MJ–FL
		90 BEND, MJ–FL
		FLXMJ ADAPTER
		COUPLER
		BLIND FLANGE
		GATE VALVE, FLxMJ
		GATE VALVE, MJ
		REDUCER, MJxFL
		REDUCER, MJ
		TEE, FL
		TEE, MJ
		TEE, MJxFL
		TEE, FLxMJ
		CROSS, FL
		CROSS, MJ

SURVEY SYMBOLS

BRASS SURFACE MONUMENT
CONCRETE MONUMENT
FOUND REBAR
SET REBAR
MONUMENT IN CASE
TRAVERSE POINT

PIPE CALL–OUT

36–SS
(A) (B)

PIPE CALL–OUTS: (A) REPRESENTS THE PIPE SIZE IN INCHES, (B) INDICATES THE UTILITY TYPE.

VALVE CALL–OUT

PV–XXX
(A) (B)

PIPE CALL–OUTS: (A) REPRESENTS THE VALVE TYPE, (B) INDICATES THE VALVE NUMBER.

SPOT ELEVATIONS

190.00 ① TBC ②

① = ELEVATION
② = DESCRIPTION– SEE DEFINED ABBREVIATIONS ABOVE

DIRECTIONAL ABBREVIATIONS

N	=NORTH
NE	=NORTHEAST
E	=EAST
SE	=SOUTHEAST
S	=SOUTH
SW	=SOUTHWEST
W	=WEST
NW	=NORTHWEST

SYMBOLS

°	=DEGREES
±	=PLUS/MINUS
ø	=DIAMETER
Δ	=DELTA
℄	=CENTERLINE
Ę	=FLOWLINE
Ƥ	=PROPERTY LINE

SECTION/DETAIL CALL–OUTS

B (A) / CX.XC (B)

SECTION CALL–OUTS: (A) REPRESENTS THE SECTION LABEL, (B) INDICATES THE SHEET ON WHICH THE SECTION APPEARS.

1 (A) / CX.XC (B)

DETAIL CALL–OUTS: (A) REPRESENTS THE DETAIL LABEL, (B) INDICATES THE SHEET ON WHICH THE DETAIL APPEARS.

B (A) / CX.XC (B)

SECTION SHEET LABELS: (A) REPRESENTS THE SECTION LABEL, (B) INDICATES THE SHEET ON WHICH THE SECTION IS CALLED OUT.

1 (A) / CX.XC (B)

DETAIL SHEET LABELS: (A) REPRESENTS THE DETAIL LABEL, (B) INDICATES THE SHEET(S) ON WHICH THE DETAIL IS CALLED OUT.

CX.XC (B)

(A) A

SECTION CALL–OUT: (A) REPRESENTS THE SECTION LABEL. SECTION LINEWORK APPEARS ON SAME SHEET AS CALL–OUT.

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FIGURE 1-3
LEGEND

DATE	SCALE	JOB NUMBER	SHEET	PAGE
10-7-2022	AS SHOWN	2020-006	1	1

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ABBREVIATIONS

AA	=ALL AROUND
AB	=AS-BUILT (RECORD)
ADF	=AVERAGE DAY FLOW
AL, ALN	=ALIGNMENT
ANC	=UTILITY POLE ANCHOR
APPROX	=APPROXIMATE
ARCH	=ARCHITECTURAL
AS	=ACTIVATED SLUDGE or ASPHALT SURFACE
ASD	=ACTIVATED SLUDGE DOSING
ASPH or AC	=ASPHALT CONCRETE PAVEMENT
ASS'Y	=ASSEMBLY
ASTM	=AMERICAN SOCIETY FOR TESTING & MATERIALS
BC	=BOTTOM OF CURB
BLDG	=BUILDING
BLKG	=BLOCKING
BMP	=BEST MANAGEMENT PRACTICE
B.N.	=BOUNDARY NAILING
BOT	=BOTTOM
BVCS	=BEGIN VERTICAL CURVE STATION
BVCE	=BEGIN VERTICAL CURVE ELEVATION
CB	=CATCH BASIN
CDF	=CONTROL DENSITY FILL
CK	=CHECK VALVE
C/L,	=CENTERLINE
CESCL	=CERTIFIED EROSION SEDIMENT CONTROL LEAD
CLR	=CLEAR
COL	=COLUMN
CMP	=CORRUGATED METAL PIPE
C.O. or CO	=CLEAN OUT
CONC, C	=CONCRETE
CRSI	=CONCRETE REINFORCING STEEL INSTITUTE
CPP	=CORRUGATED POLYETHYLENE PIPE
CSBC	=CRUSHED SURFACING BASE COURSE
CSTC	=CRUSHED SURFACING TOP COURSE
DBL	=DOUBLE
DCVA	=DOUBLE CHECK VALVE ASSEMBLY
DI	=DUCTILE IRON
DIP	=DUCTILE IRON PIPE
DIAM,	=DIAMETER
DO	=DISSOLVED OXYGEN
DR	=DIAMETER RATIO
DS	=DOWNSPOUT
DWG, DWGS	=DRAWING, DRAWINGS
EA	=EACH
EF	=EACH FACE
EFFL	=EFFLUENT
EG	=EXISTING GRADE
ELEV, EL	=ELEVATION
EOG	=EDGE OF GRAVEL
EOP, EP	=EDGE OF PAVEMENT, EXPLORATION PIT
EXIST, EX	=EXISTING
EVCS	=END VERTICAL CURVE STATION
EVCE	=END VERTICAL CURVE ELEVATION
FC	=FECAL COLIFORM
FDC	=FIRE DEPARTMENT CONNECTION
FDN	=FOUNDATION
FF	=FINISH FLOOR
FG	=FINISH GRADE
FL	=FLOWLINE OR FLANGE (CONNECTION)
	=FLOWLINE
FLC	=FLOWLINE OF CURB
FM	=FORCEMAIN
FNC	=FENCE
FRP	=FIBERGLASS REINFORCED PLASTIC
FTG	=FOOTING
GB	=GRADE BREAK
GMET	=GAS METER
GP	=GUY POLE
GPM	=GALLONS PER MINUTE
GRVL, G	=GRAVEL
GV	=GATE VALVE
H&V	=HORIZONTAL & VERTICAL
H:V	=HORIZONTAL:VERTICAL
HB	=HOSE BIB
HDG	=HOT-DIP GALVANIZED
HDPE	=HIGH DENSITY POLYETHYLENE
H, HOR, HORIZ	=HORIZONTAL
HRT	=HYDRAULIC RETENTION TIME
HSS	=HOLLOW STRUCTURAL SECTION
HWL	=HIGH WATER LEVEL
HYD	=HYDRANT
IBC	=INTERNATIONAL BUILDING CODE
ID	=INSIDE DIAMETER
IE	=INVERT ELEVATION
INF	=INFLUENT
INFO	=INFORMATION
INV, I.E.	=INVERT, INVERT ELEVATION
L	=ANGLE
LF	=LINEAR FEET
LUM	=LUMINAIRE
LT	=LEFT
LWL	=LOW WATER LEVEL
MANF	=MANUFACTURER
MAX	=MAXIMUM
MB	=MACHINE BOLT
MBR	=MEMBRANE BIO-REACTOR
MC	=MAINTENANCE CLEANING
MECH	=MECHANICAL
MFEM	=MEMBRANE FILTRATION EQUIPMENT MANUFACTURER
MFR	=MANUFACTURER
MGD	=MILLION GALLONS PER DAY
MH	=MANHOLE
MIN	=MINIMUM
MISC	=MISCELLANEOUS
MJ	=MECHANICAL JOINT
ML	=MIXED LIQUOR
MLSS	=MIXED LIQUOR SUSPENDED SOLIDS
MMWWF	=MAXIMUM MONTHLY WET WEATHER FLOW
MW	=MONITORING WELL
NPDES	=NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
NWL	=NORMAL WATER LEVEL
OC, O.C.	=ON CENTER
O.C.E.W	=ON CENTER EACH WAY
OD	=OUTSIDE DIAMETER
OHP	=OVERHEAD POWER
OHT	=OVERHEAD TELEPHONE
OSHA	=OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
PC	=POINT OF CURVATURE
PCC	=POINT OF CONTINUING CURVATURE
PE	=PLAIN END
PIV	=POST INDICATOR VALVE
PK	=PEAK
PL	=PLATE
P/L,	=PROPERTY LINE
PLC	=PROGRAMMABLE LOGIC CONTROLLER
PLTR	=PLANTER
POL	=POINT ON LINE
PREMANF	=PREMANUFACTURED
PROP	=PROPOSED
PS	=PUMP STATION
PSI	=POUNDS PER SQUARE INCH
PT	=POINT OF TANGENCY
PV	=PLUG VALVE
PVC	=POLYVINYL CHLORIDE
PVI	=POINT OF VERTICAL INTERSECTION
PW	=POTABLE WATER
R	=RADIUS
RAS	=RETURN ACTIVATED SLUDGE
RCP	=REINFORCED CONCRETE PIPE
REC	=RECORD
REINF	=REINFORCING
RET	=RETAINING
REQ'D	=REQUIRED
RI	=RAPID INFILTRATION
RPBA	=REDUCED PRESSURE BACKFLOW ASSEMBLY
RR	=RAILROAD
RT	=RIGHT
R/W or ROW	=RIGHT-OF-WAY
RW	=REUSE WATER
SCADA	=SUPERVISORY CONTROL AND DATA ACQUISITION
SCH	=SCHEDULE
SD	=STORM DRAIN
SDCB	=STORM DRAIN CATCH BASIN
SDCO	=STORM DRAIN CLEAN-OUT
SDMH	=STORM DRAIN MANHOLE
SDR	=STANDARD DIMENSION RATIO
SE	=SECONDARY EFFLUENT
SN	=SIGN
SOG	=SLAB ON GRADE
SOR	=SURFACE OVERFLOW RATE
SPD	=STANDARD PROCTOR DENSITY
SPK	=SPIKE
SS	=SANITARY SEWER
SSCO	=SANITARY SEWER CLEAN-OUT
SSMH	=SANITARY SEWER MANHOLE
SST	=STAINLESS STEEL
STA	=STATION
STEP	=SEPTIC TANK EFFLUENT PUMP
STR	=STRUCTURAL
SWD	=SIDE WATER DEPTH
T&B	=TOP & BOTTOM
TBC	=TOP BACK OF CURB
TBD	=TO BE DETERMINED
TBM	=TEMPORARY BENCH MARK
TC	=TOP OF CURB
THK	=THICK/THICKNESS
TOC	=TOP OF CONCRETE
TOW, T.O.W.	=TOP OF WALL
TYP	=TYPICAL
UNO	=UNLESS NOTED OTHERWISE
UP	=UTILITY POLE
VAC	=VACATED
VC	=VERTICAL CURVE
VEG	=VEGETATION
V, VERT	=VERTICAL
WAS	=WASTE ACTIVATED SLUDGE
WL	=WATERLINE
WM	=WATER METER
WS	=WATER SURFACE
WSDOT	=WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
WV	=WATER VALVE
WWTP	=WASTE WATER TREATMENT PLANT
YD	=YARD DRAIN

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FIGURE 1-3A
ABBREVIATIONS

DATE	SCALE	JOB NUMBER
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1.2.2.4 Secondary Clarifiers

Mixed liquor flows from the aeration basins to the mixed liquor pump station to the clarifier flow splitter. The flow splitter splits the flow between the two (2) clarifiers. As the mixed liquor travels through the flow splitter, activated polymer is injected to facilitate settling. As solids settle out in the clarifier, the settled sludge is gathered and removed. Return activated sludge reenters the aeration basins. Activated sludge enters the aerated grit chambers. Waste activated sludge enters the long-term digestion basin. Secondary effluent flows over the effluent weirs in the clarifiers, then flows the UV disinfection system.

1.2.2.5 UV Disinfection System

The UV disinfection system consist of a channel with five (5) UV banks. The UV lamps on the banks kill harmful bacteria as the water flows through the channel. The dose of UV light required to inactivate all bacteria is calculated based on the flow rate and the intensity. The light intensity is altered to ensure that sufficient bacteria has been deactivated before the water exits the disinfection system.

1.2.2.6 Effluent Pumping and Outfall

The effluent pump station contains five (5) pumps that provide the necessary head required to convey the plant effluent to its discharge point in the Nooksack River. Operation of the effluent pump station is necessary only during extreme conditions of peak wastewater flows or river flood stages, or a combination of both. Under normal conditions, the effluent flows by gravity through the 30-inch diameter outfall to the effluent chamber and then is discharged into the Nooksack River.

1.2.2.7 2W and 3W Water Systems

The 2W and 3W water systems are located at the UV/Maintenance building. 2W water is municipally supplied 1W water that has been sent through an air gap, and is used at the mechanical screen sprayers and various yard hydrants. 3W water is fully treated and UV-disinfected effluent from the wastewater treatment plant. It is distributed to the clarifier sprayers and to some of the yard and post hydrants around the site. Both 2W and 3W systems use sodium hypochlorite disinfection to ensure that a chlorine residual remains and ensures that the plant water remains safe.

1.2.2.8 Laboratory/Operations Building

The Laboratory/Operations building functions as the laboratory, control center, and office for the WWTP. The laboratory provides facilities required for NPDES monitoring and process control. A new laboratory/operations building was constructed in 2020. The building contains a new testing lab, general office, and employee support spaces.

1.2.2.9 UV/Maintenance Building

The UV/Maintenance building contains the UV disinfection system as well as the general maintenance shop for the plant.

1.2.2.10 Blower Building

During the 2020 treatment plant upgrade, the Chemical Building was converted into the new Blower Building. The structure of the building was not altered, but the old air scrubbing equipment was removed and six (6) blowers were installed during the 2020 treatment plant update. The Blower Building contains the blowers that supply air to the diffusers in the aeration basins and grit basins. It also contains the sodium hypochlorite solution that is used for the 2W and 3W plant water systems, and the activated polymer system that feeds into the Clarifier Flow Splitter, as well as various electrical equipment, including MCC-3, PLC-3, and the blower control panel. A 230kW backup generator, installed during the 2020 treatment plant upgrade, provides backup power to the Blower Building through ATS-4 and MCC-3, and is located just outside the south wall of the Blower Building.

1.2.2.11 Electrical/Generator Building

The electrical/generator building houses systems for the monitoring and control of the plant's equipment. A 1000 kW standby power generator, which provides emergency power for ATS-3 in the Water Treatment Plant (WTP), ATS-1 in the Main Electrical Building, and ATS-2 in the West Electrical Building, is also housed in this building. A 2,000-gallon diesel storage tank is located on the north side of the building and provides fuel to the generator.

1.3 PROCESS FLOW

The process design criteria are presented in Figure 1-4, the process flow diagram is presented in Figure 1-5, and the hydraulic profile through the treatment plant is presented in Figure 1-6.

Wastewater enters the headworks through the collection system via the influent main. It is then lifted by screw pumps and then enters a coarse mechanical filter. The wastewater then flows through the aerated grit chambers, where coarse bubble diffusers induce a spiral-patterned flow which allows grit and other heavier inorganic particles to settle out. Flow continues to the fine mechanical screens, which removes additional particles before the wastewater is sent to the aeration basins via the aeration basin flow splitter.

In the two aeration basins, microorganisms use oxygen, supplied by fine bubble diffusers, to remove potentially harmful chemicals from the wastewater. The mixed liquor then goes through the mixed liquor pump station and the clarifier flow splitter, where activated polymers are added to the mixed liquor to increase flocculation and subsequently settling. Once the biological material has settled out, the secondary effluent then flows into the UV disinfection system, where sufficient contact time is provided to achieve effective disinfection.

The treated effluent is conveyed from the UV disinfection system through a 30-inch diameter outfall pipe to its discharge point in the Nooksack River. Under high wastewater flows or river flood conditions, or both, the effluent pump station forces the effluent through the outfall into the Nooksack River.

PROCESS DESIGN DATA

NO.	REVISIONS	BY	DATE

START-UP DESIGN INFORMATION

FLOW:

ADF = 2.0 MGD
MMWF = 2.6 MGD
MAX. DAY = 7.0 MGD
PEAK HR = 9.4 MGD

AVERAGE DAILY LOADS:

CBOD = 210 mg/L
TSS = 216 mg/L
TKN = 50 mg/L

CLARIFIER INFORMATION:

NO. OF UNITS: 2
DIAMETER: 85FT
SWD: 15FT
RAS: 0.5Q TO 1.5Q

1 CLARIFIER ON-LINE

ADF SOR: 352 GAL / DAY / SF
MMWWF SOR: 458 GAL / DAY / SF
MAX DAY: 1234 GAL/ DAY / SF

2 CLARIFIERS ON-LINE

ADF SOR: 176 GAL / DAY / SF
MMWWF SOR: 229 GAL / DAY / SF
MAX DAY: 617 GAL / DAY / SF

AERATION BASIN INFORMATION:

NO. OF UNITS: 2
VOLUME OF EACH UNIT: 2.05 MG

1 BASIN ON-LINE

ADF HRT: 1.03 DAYS
MMWWF HRT: 0.79 DAYS
MAX DAY: 0.29 DAYS

2 BASINS ON-LINE

ADF HRT: 2.05 DAYS
MMWWF HRT: 1.58 DAYS
MAX DAY: 0.59 DAYS

UV DISINFECTION:

MONTHLY GEOMETRIC MEAN: 28 FC / 100mL
WEEKLY GEOMETRIC MEAN: 400 FC / 100mL
DOSE: 24 mJ/cm^2

LONG TERM BIOSOLIDS DIGESTION BASIN (LTBDB):

VOLUME= 10,000,000 GALLONS
WAS= 33,000 GALLONS PER DAY AT 0.7% SOLIDS
SUPERNATANT RETURN= 25,000 GALLONS PER DAY
DESIGN CAPACITY = 41 MONTHS WITH 2.8% SOLIDS
ACCUMULATION: 29 DRY TONS/MONTH (PRE-VS REDUCTION) = 17 DRY TONS/MONTH (POST-VS REDUCTION)

BUILD-OUT DESIGN INFORMATION

FLOW:

ADF = 3.2 MGD
MMWF = 4.1 MGD
MAX. DAY = 11.1 MGD
PEAK HR = 14.9 MGD

AVERAGE DAILY LOADS:

CBOD = 211 mg/L
TSS = 217 mg/L
TKN = 50 mg/L

CLARIFIER INFORMATION:

NO. OF UNITS: 2
DIAMETER: 85FT
SWD: 15FT
RAS: 0.5Q TO 1.5Q

1 CLARIFIER ON-LINE

ADF SOR: 564 GAL / DAY / SF
MMWWF SOR: 722 GAL / DAY / SF
MAX DAY: 1956 GAL/ DAY / SF

2 CLARIFIERS ON-LINE

ADF SOR: 282 GAL / DAY / SF
MMWWF SOR: 361 GAL / DAY / SF
MAX DAY: 978 GAL / DAY / SF

AERATION BASIN INFORMATION:

NO. OF UNITS: 2
VOLUME OF EACH UNIT: 2.05 MG

1 BASIN ON-LINE

ADF HRT: 0.64 DAYS
MMWWF HRT: 0.50 DAYS
MAX DAY: 0.18 DAYS

2 BASINS ON-LINE

ADF HRT: 1.28 DAYS
MMWWF HRT: 1.00 DAYS
MAX DAY: 0.37 DAYS

UV DISINFECTION:

MONTHLY GEOMETRIC MEAN: 28 FC / 100mL
WEEKLY GEOMETRIC MEAN: 400 FC / 100mL
DOSE: 24 mJ/cm^2

LONG TERM BIOSOLIDS DIGESTION BASIN (LTBDB):

VOLUME= 10,000,000 GALLONS
WAS= 49,000 GALLONS PER DAY AT 0.7% SOLIDS
SUPERNATANT RETURN= 27,000 GALLONS PER DAY
DESIGN CAPACITY = 27 MONTHS WITH 2.8% SOLIDS
ACCUMULATION: 43 DRY TONS/MONTH (PRE-VS REDUCTION) = 30 DRY TONS/MONTH (POST-VS REDUCTION)

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FIGURE 1-4
PROCESS DESIGN DATA

DATE	SCALE	JOB NUMBER
10-7-2022	AS SHOWN	2020-006

SHEET 1 PAGE 1

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NO.	REVISIONS	BY	DATE

INFLUENT 48" MAIN

6" SEWER FROM STORMWATER DECANT FACILITY

INFLUENT 24" SEWER

12" SEWER FROM WTP

LIFT STATION SUMP

3 SCREW PUMPS

BYPASS CHANNEL (TO REMAIN)

BAR SCREEN (TO REMAIN)

EXISTING SAMPLE LOCATION (TO REMAIN)

EXISTING MECHANICAL SCREEN (TO REMAIN)

13 ACRE CORN FIELD

BIOSOLIDS INJECTION

HAULED LEACHATE

36" SEWER

24" SEWER

12"/16"/24" SEWER FM

EAST PLANT DRAIN PUMP STATION

KEY:

- EXISTING PIPING TO BE REUSED
- WASTEWATER FLOW PATH
- EXISTING PROCESS PIPING TO BE ABANDONED
- PLANT WATER PIPING
- FM FLOW METER
- MOTORIZED PLUG VALVE
- STOP GATE
- WEIR GATE

FM

FM

SECONDARY EFFLUENT

NEW 5TH PUMP

EFFLUENT PUMP STATION (USED ONLY DURING HIGH RIVER LEVELS)

EFFLUENT CHAMBER RIM ELEVATION = 31.0 FEET

AERATED GRIT CHAMBERS

NORTH CLARIFIER

NORTH AERATION BASIN

CLARIFIER FLOW SPLITTER

UV DISINFECTION

30" EFFLUENT PIPELINE AND OUTFALL

EXISTING PRETREATMENT LAGOON (TO BE REPURPOSED)

BIOSOLIDS DIGESTION BASIN

TELESCOPING WEIR

EMERGENCY OVERFLOW

MANUAL BAR SCREEN

MECHANICAL SCREENS

AS

WAS

RAS

ML

FUTURE

MIXED LIQUOR PUMP STATION

FE

NOOKSACK RIVER

SOUTH CLARIFIER

SOUTH AERATION BASIN

PLANT WATER (3W) PUMP STATION

AERATION BASIN FLOW SPLITTER

TO WEST PLANT DRAIN PUMP STATION

100-YEAR FLOOD STAGE ELEV. = 22.7 feet

7Q10 LOW FLOW STAGE ELEV. = 5.0 feet

OUTFALL INVERT ELEV. = 4.0 feet

OUTFALL LOCATED AT RIVER MILE 4.9

EXISTING PIPING TO REMAIN AS INTERIM PROCESS PIPING DURING CONSTRUCTION

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FIGURE 1-5

PROCESS FLOW DIAGRAM

DATE	SCALE	JOB NUMBER
10-7-2022	AS SHOWN	2020-006

SHEET	PAGE
1	1

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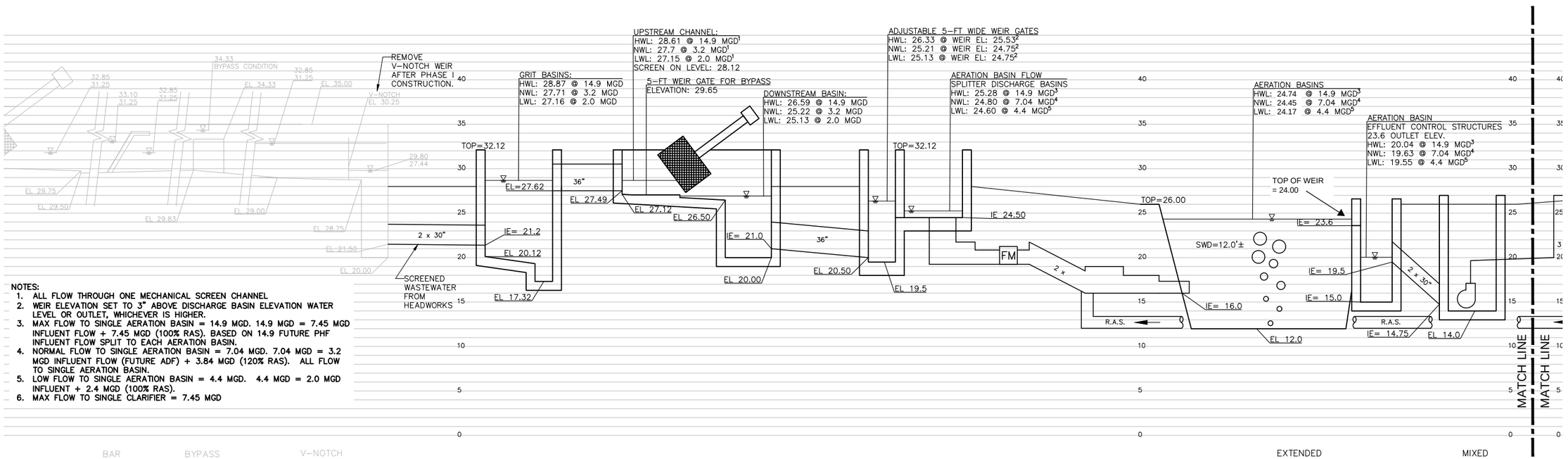

NOTES:
1. ALL FLOW THROUGH ONE MECHANICAL SCREEN CHANNEL
2. WEIR ELEVATION SET TO 3" ABOVE DISCHARGE BASIN ELEVATION WATER LEVEL OR OUTLET, WHICHEVER IS HIGHER.
3. MAX FLOW TO SINGLE AERATION BASIN = 14.9 MGD. 14.9 MGD = 7.45 MGD INFLUENT FLOW + 7.45 MGD (100% RAS). BASED ON 14.9 FUTURE PHF INFLUENT FLOW SPLIT TO EACH AERATION BASIN.
4. NORMAL FLOW TO SINGLE AERATION BASIN = 7.04 MGD. 7.04 MGD = 3.2 MGD INFLUENT FLOW (FUTURE ADF) + 3.84 MGD (120% RAS). ALL FLOW TO SINGLE AERATION BASIN.
5. LOW FLOW TO SINGLE AERATION BASIN = 4.4 MGD. 4.4 MGD = 2.0 MGD INFLUENT + 2.4 MGD (100% RAS).
6. MAX FLOW TO SINGLE CLARIFIER = 7.45 MGD

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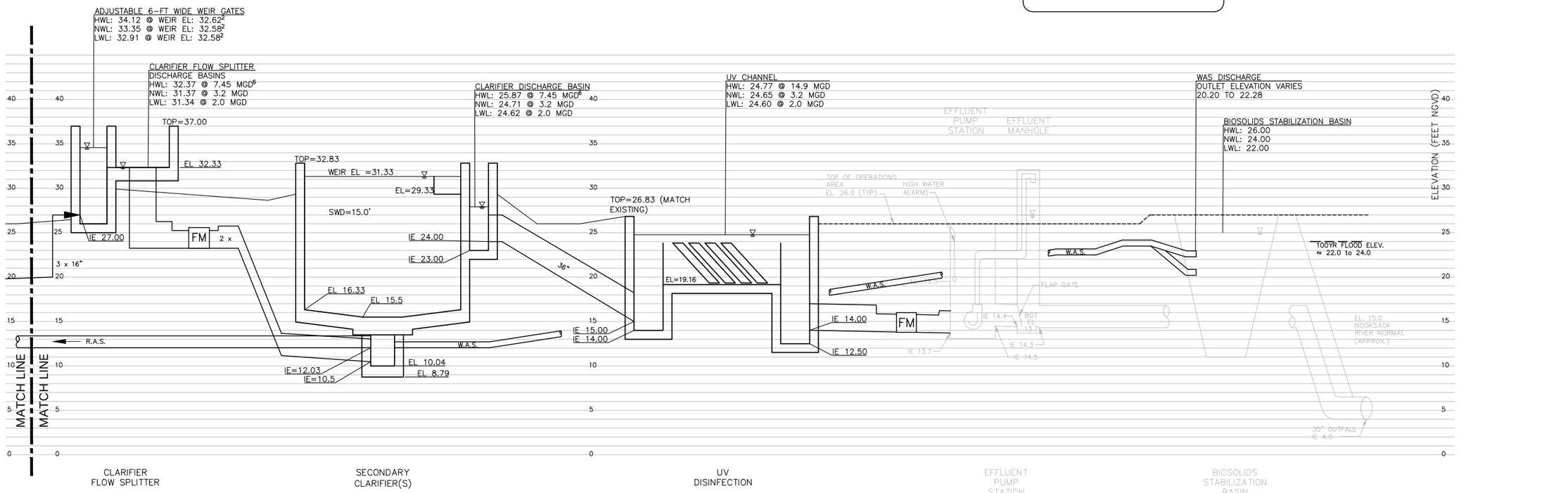

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FIGURE 1-6
HYDRAULIC PROFILE

SHEET	DATE	SCALE	JOB NUMBER
-	10-7-2022	AS SHOWN	2020-006

PAGE -

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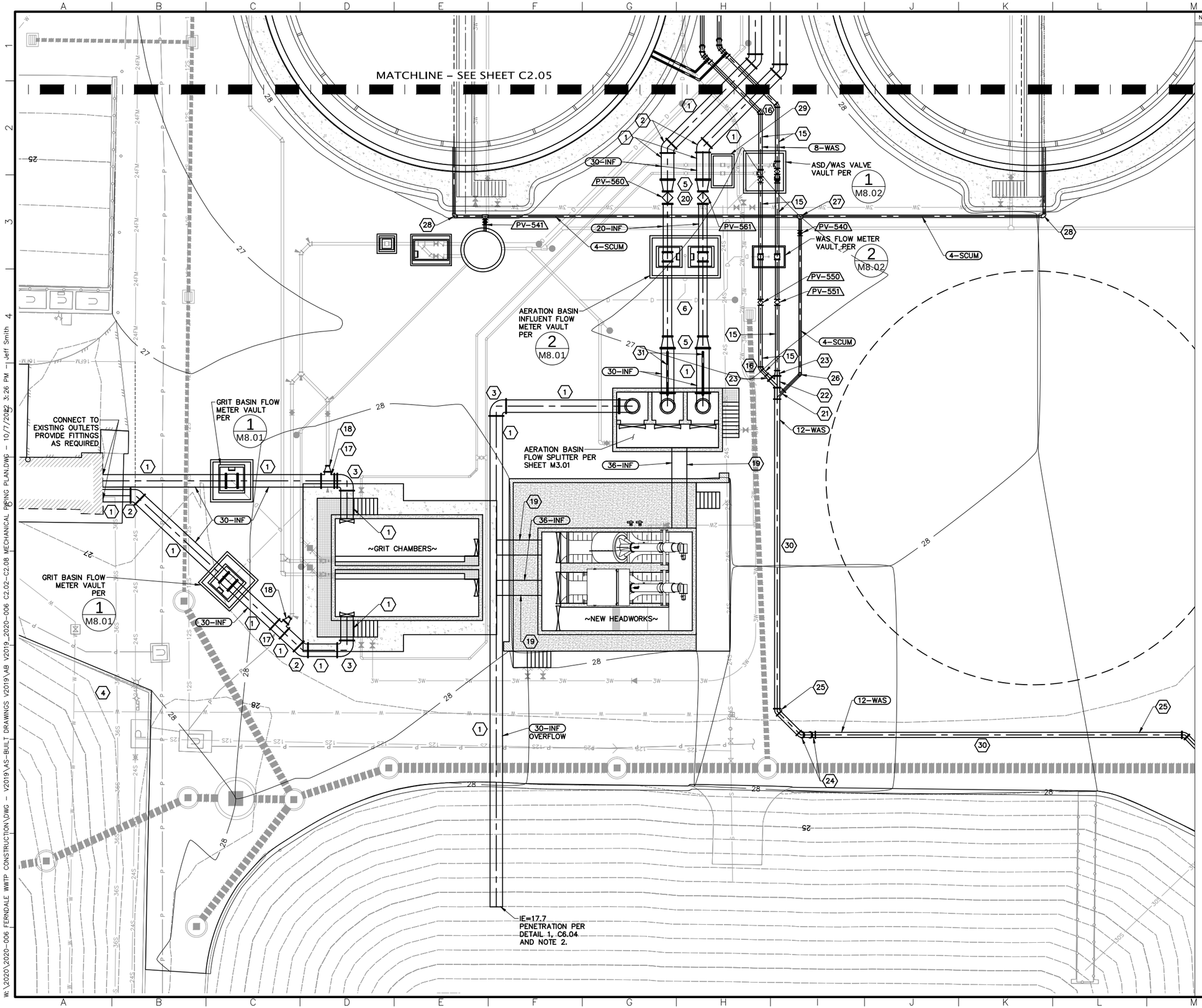
CHAPTER 2
INFLUENT AND PRIMARY TREATMENT

2.1 INTRODUCTION AND PURPOSE

This chapter contains a description of the influent pumping and preliminary treatment of the plant. Components include grit decant structures, influent screw pumps, mechanical screens, and aerated grit chambers. The original headworks structure contains an influent lift station which includes a wet well, three (3) parallel screw pumps, a coarse mechanical screen; and a standby bar screen. The new headworks shelter contains two fine mechanical screens and a bypass manual bar screen. Several slide and sluice gates are also contained within both the headworks and grit chambers to control the flow rate. Figure 2-1 shows a plan of the grit basins and headworks shelter that were constructed as part of the 2020 treatment plant improvements. Figure 2-2 presents the hydraulic profile of the original headworks, including the screw pump and mechanical coarse screen. The essential function of influent pumping and preliminary treatment is to deliver wastewater that has been filtered of inorganic debris to the aeration basins.



NO.	REVISIONS	BY	DATE

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10 0 10 20
SCALE HORIZONTAL SCALE FEET

KEYED NOTES

1. = 30" DI PIPE
2. = 30" DI 45° BEND
3. = 30" DI 90° BEND
4. = NOT USED
5. = 30" x 20" DI ECCENTRIC REDUCER
6. = 20" DI PIPE
15. = 8" DI PIPE
16. = 8" DI 45° BEND
17. = 30" x 16" DI TEE
18. = 16" x 6" DI ECCENTRIC REDUCER
19. = 36" DI PIPE
20. = 20" PLUG VALVE
21. = 12" x 6" DI WYE (TRANSITION TO PVC)
22. = 12" DI WYE
23. = 8" x 12" DI ECCENTRIC REDUCER
24. = 12" DI 45° VERTICAL BEND
25. = 12" DI 45° BEND
26. = 4" PVC 45° BEND
27. = 4" PVC TEE
28. = 4" PVC 90° BEND
29. = ACTIVATED SLUDGE DOSING (ASD) FLOW METER VAULT PER 3 M8.02
30. = 12" DI PIPE
31. = 4" AIR VENT

SHEET NOTES:

1) SEE SHEETS C0.01–C0.05 FOR EXISTING CONDITIONS.

2) CONTRACTOR SHALL TAKE CARE TO MINIMIZE DISTURBANCE TO THE EXISTING LINER WHEN TRENCHING. REPAIR TRENCHING WITH SINGLE PATCH AND BOOT PER DETAIL 1, C6.04. PATCH SHALL BE DOUBLE WELDED AND OVERLAP EXISTING LINER BY A MINIMUM OF 1–FOOT ON ALL SIDES. BACKFILL TRENCH UNDER LINER WITH CDF.

3) SEE M1.03 FOR INFLUENT PIPING CONNECTION TO EXISTING HEADWORKS.

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FIGURE 2-1
GRIT BASIN & HEADWORKS SHELTER PLAN

DATE	SCALE	JOB NUMBER	SHEET
10-7-2022	AS SHOWN	2020-006	-

PAGE -

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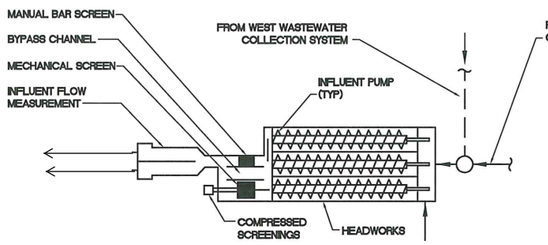
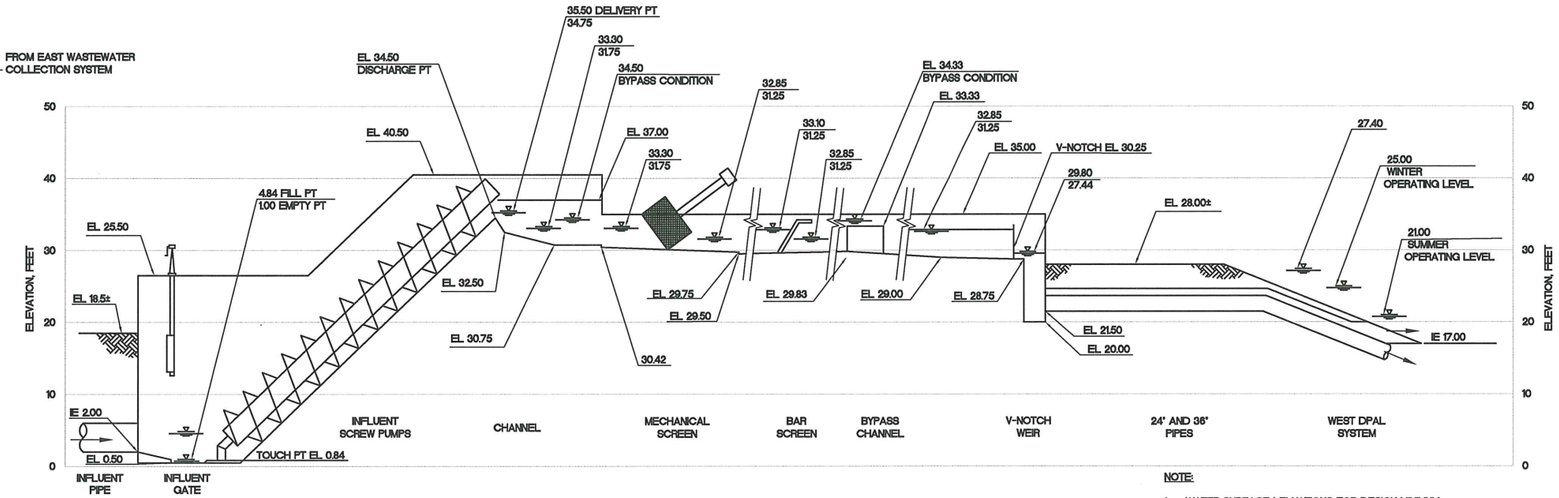


PROCESS FLOW SCHEMATIC



HYDRAULIC PROFILE

NOTE:

1. WATER SURFACE ELVATIONS FOR DESIGN MINIMUM AND MAXIMUM FLOWS IN THE STRUCTURES ARE INDICATED AS:
   MAXIMUM WS EL = 35 MGD MAX FLOW
   MINIMUM WS EL = 1 MGD MIN FLOW
2. FOR WASTEWATER FLOW RATES SEE THIS DRAWING.

WASTEWATER FLOW RATE AND HYDRAULIC CAPACITY

HYDRAULIC FEATURE	FLOW RATE, MGD
1) WASTEWATER FLOW RATE	
A. PHASE 1, 2	
• ANNUAL AVERAGE	2.1
• PEAK MONTH	3.2
• PEAK DAY	9.6
• PEAK HOUR, INFLUENT	12.8
• PEAK HOUR EFFLUENT	9.0
B. PHASE 3	
• ANNUAL AVERAGE	4.2
• PEAK MONTH	6.4
• PEAK DAY	19.2
• PEAK HOUR, INFLUENT	25.6
• PEAK HOUR EFFLUENT	16.2
2) COLLECTION / CONVEYANCE TO WWTP - HYDRAULIC CAPACITY	
A. DOWNTOWN / EASTSIDE INTECEPTOR	30
B. WESTSIDE INTECEPTOR	5

HYDRAULIC FEATURE	FLOW RATE, MGD
3) WWTP FACILITIES HYDRAULIC CAPACITY	
A. HEADWORKS	
• PHASE 1	N/A
• PHASE 2, 3	35
B. DPAL SYSTEM (LAGOONS AND YARD PIPING)	
• PHASE 1, 2 (WEST DPAL - ONLY)	
INFLUENT	28.0
EFFLUENT	12.6
• PHASE 1, 2 (WEST AND EAST DPAL - COMBINED)	
INFLUENT	35.0
EFFLUENT	16.2
C. CHLORINE CONTACT TANK	
• PHASE 1, 2 AND 3	16.2
D. EFFLUENT PUMP STATION	
• PHASE 1	4.2
• PHASE 2	12.6
• PHASE 3	16.2
E. EFFLUENT CHAMBER, PIPELINE AND OUTFALL	
• PHASE 1, 2 AND 3	16.2

DESIGN CRITERIA

HEADWORKS	ELEMENT / DESCRIPTION / CHARACTERISTIC
INFLUENT PUMPS	
NUMBER OF UNITS	THREE
CAPACITY, EACH	17.5 MGD
TYPE	OPEN SCREW
INCLINATION	38 DEGREES
LIFT	30.66 FEET
DIAMETER	80 INCH
MECHANICAL SCREEN	
NUMBER OF UNITS	ONE
TYPE	CYLINDRICAL, ROTATING, TILTED, DEWATERING
DESCRIPTION	SOLIDS COMPACTION, SOLIDS DISCHARGE TO DUMPSTER
CLEAR OPENING SCREEN WIDTH	3/8 INCH
NOMINAL DIAMETER	71 INCH
CAPACITY	18 MGD
REMOVAL	PIVOT OUT OF CHANNEL
WATER	REQUIRED FOR SPRAY WASH SYSTEM 35 GPM AT 60 PSI
HEATING AND INSULATION	AS REQUIRED (SEE SPECS)
BAR SCREEN	
NUMBER OF UNITS	ONE
CHANNEL WIDTH	3 FEET
TYPE	BAR
CAPACITY	20 MGD
CLEAR OPENING SCREEN WIDTH	1 INCH
CLEANING METHOD	MANUALLY RAKED TO WALKWAY PLATFORM W/ DRAINAGE TO HEADWORKS CHANNEL.
INFLUENT FLOW MEASUREMENT	
NUMBER OF UNITS	TWO
TYPE	V-NOTCH WEIR
SIZE, EACH	24 INCH, 90°
CONSTRUCTION MATERIAL	STEEL
SIDEWALL HEIGHT	3.5 FEET
CAPACITY, EACH	0.1 TO 9 MGD

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5-15-2013

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FIGURE 2-2
ORIGINAL HEADWORKS HYDRAULIC PROFILE

DATE	SCALE	JOB NUMBER
5/15/2013	AS SHOWN	2012-042

SHEET - OF -

2.2 DESCRIPTION OF SYSTEM COMPONENTS

Influent arrives into the lift station wet well in the headworks as raw wastewater. Three (3) parallel screw pumps lift the influent approximately 20 feet to the mechanical screen wet well. The mechanical screen removes debris from the wastewater using a coarse rotary screen. During extreme conditions of peak wastewater flows or river flood stages, overflow may travel through a bypass channel and/or a separate bar screen. Wastewater can also be diverted directly to the bar screen while routine maintenance is being performed on the mechanical screen. The flow rate is then measured as it is delivered to the aerated grit chambers. In the grit chambers, the wastewater is pre-seeded with biological material and mechanical motion is used to settle out additional particles. The water then enters an additional fine mechanical screen to filter out remaining sediment before entering the Aeration Basin Flow Splitter and entering secondary treatment.

2.2.1 Influent

Influent is collected in the collection area which is shown in Chapter 1, Figure 1-1. The influent from the collection area enters the main influent manhole through the 56-inch north collection pipe and the 30” west collection pipe. The main influent manhole also gathers influent from the 8-inch storm decant, and the 12-inch water treatment plant sewer. This 48-inch main influent then enters the influent flow gates. Influent also enters the influent flow gates from the 16-inch pipe leading from the East Plant Drain pump station and the 4-inch grit decant structure pipe.

The stormwater is directed to an area of approximately 1 acre that contains the shallow stormwater infiltration facility. This site is located to the north of the headworks equipment. The expected pond depth is approximately 1 foot. Low height berms are built 1.5 feet above the bottom of the expected ponding area. This stormwater infiltration area is in the floodplain of the area, so the low berm height allows flow-through of the projected 100-year flood.

2.2.2 Grit Decant Structures

2.2.2.1 Stormwater Grit Decant Structure

The grit decant structure removes waste consisting of dirt, rocks, and other debris that is collected in vacuum trucks while cleaning out storm water catch basins, oil water separators and storm water pipes. Since there is a liquid and solid portion to this waste, the liquid must be decanted from the solids before disposal of either waste. After separation the liquid portion is conveyed through a 4-inch process drain to the influent screw pump wet well. The solid portion may be disposed of in a lined landfill, provided that testing proves that the material is not a dangerous waste as defined by 173-303 WAC and passes the free liquids test (EPA test 9095), referred to as the paint test.

The grit decant structure consists of a 10% sloped slab approximately 20' X 40', one (1) slide gate and ten (10) 4-inch drain ports. A ¾-inch steel plate with openings for the drain ports is fastened to the back wall of the structure to protect the concrete wall from the metal bucket of the front loader during routine cleaning.

2.2.2.2 Wastewater Grit Decant Structure

The city has 17 sewage pump stations that it vacuums and cleans. The trucks collect waste which contains both a solids and liquid where they are discharged to the decanting structure. The liquid portion goes to the plant headworks and the solids are collected by a grate and disposed of with the solid waste from the headworks.

The grit decant structure consists of a 10% sloped slab approximately 20' X 40', one (1) slide gate and ten (10) 4-inch drain ports. A ¾-inch steel plate with openings for the drain ports is fastened to the back wall of the structure to protect the concrete wall from the metal bucket of the front loader during routine cleaning. A concrete bulkhead and trench drain was added to this structure during the 2020 WWTP upgrade to improve the efficiency of this decant structure.

2.2.3 Screw Pumps

The influent lift station consists of three (3) 80-inch diameter screw pumps with 14.9 MGD capacity or 12,153 gal/min. These pumps are all Siemens PE-21 Plus Type R6ZESD 150 hp, 460 V, 3 phase pumps with 30.66 feet of lift and an efficiency of 95.4. There is a 38-degree angle of inclination and a rotational speed of 28 rev/min. Wastewater reaches the pumps after passing through the influent flow gates. The screw pumps do not have any enclosed areas to clog and have self-adjusting pumping rates. These and other characteristics make these pumps ideally suited for lifting wastewater and other liquids carrying solids. Each screw pump is fitted with a positive pressure, automatic lubrication pump and 3/8-inch minimum diameter stainless steel grease line to ensure proper lubrication for the screw pumps. The automatic lubrication pump provides grease lubricant to the lower bearing assembly with provisions at the pump to manually charge the grease line.

These screw pumps were repainted, had their lower assemblies, gear boxes, lubricating systems, actuators, and motors replaced in 2020 as part of the plant-wide upgrade, but were originally installed in 1998. The old controls were replaced with a new NEMA 4X stainless steel panel and then was reconnected to the existing circuits in 2020. The level panel was also replaced in 2020 and reconnected to the existing level transmitters.

Three (3) sluice gates are located at the entrance of each screw pump bay. The purpose of the sluice gates is to allow the operator to isolate an individual screw pump for routine maintenance or repair without impacting the operation of the other pumps.

2.2.4 Coarse Mechanical Screen

One (1) cylindrical, rotating, tilted, dewatering mechanical screen is used for screenings separation, washing, transport, and compaction. This 3/8” coarse screen has a capacity of 18 MGD. The screen removes large pollutants from the waste stream to protect downstream equipment and operations from damage and to remove non-biodegradable particles, such as plastics. Screenings must be disposed of in a sanitary landfill. This coarse mechanical screen is a Model 71FS 3/8” Lakeside Raptor screen and has been in operation since it was upgraded in 2013.

The entire flow of wastewater goes through the open front end of the coarse mechanical screen, and screenings are retained in the screen basket and transported into a trough. The cleaning brush and spray bar are used to ensure that all screenings enter the trough. Water can flow through the trough, washing the screenings. At the bottom of the trough, a pump pulls the discharge through a pipeline to a screw conveyor. The screw conveyor transports the screening through a dewatering and compaction zone before depositing them in a dumpster. During this step, 2W plant water is also used to ensure the screenings are properly cleaned. This water used for the spray wash system has a flow rate of approximately 35 GPM at 60 psi. Two (2) slide gates are located just upstream and down stream of the mechanical screen for isolation of the screen during routine maintenance and repair, causing flow to enter the bypass channel instead. When the flow is diverted, the wastewater will flow through the bar screen which serves as a back-up form of coarse screening.

2.2.5 Influent Flow Measurement

In the 2020 plant upgrade the ultrasonic level meters within the Parshall flumes were removed along with the monitoring and recording equipment. Instead, a magnetic flow meter was installed on each of the two 30” ductile iron pipe between the coarse mechanical screens and aerated grit chambers. The flow meters are manufactured by Promag and are capable of measuring flows from 3.1 to 96.50 MGD. The flow is recorded and monitored via SCADA.

2.2.6 Aerated Grit Chambers

The goal of a grit chamber is to settle out the inorganic grit made of gravel and dirt, while not allowing the organic material to settle. Two (2) aerated grit chambers were installed in parallel in this treatment plant during the 2020 plant upgrade. The aeration for the grit chambers come from blowers that push air through coarse bubble diffusers in the aeration chambers, creating a spiral of water to flow through the tank and forcing the heavier sediments to settle out quickly. The lighter organic particles are suspended in the tank and continue through without settling. The velocity of air entering the chamber must be closely monitored and controlled. If the velocity is too high, grit will not settle and will be carried out with the lighter organic matter; if the velocity is too low, organic matter will settle with the grit.

The piping that feeds the grit chambers is configured to allow the influent to be dosed with a small amount of activated sludge from the secondary clarifiers. This sludge dosing can be used to control odor by pre-seeding the wastewater with biological material, but it is not necessary for treatment and can be turned off by closing valves PV-254 (East Grit Basin) and PV-255 (West Grit Basin).

Aerated Grit Basins Capacity (Target 3-minute minimum detention time):

Flow split to both Grit Basins:
Detention Time @ Max Month Flow (4.1 MGD) = 12.1 Minutes
Detention Time @ Max Day Flow (11.1 MGD) = 4.5 Minutes
Detention Time @ Peak Hour Flow (14.9 MGD) = 3.3 Minutes

Flow to only one Grit Basin:
Detention Time @ Ave Day Flow (4.1 MGD) = 6.0 Minutes
Detention Time @ Max Day Flow (11.1 MGD) = 2.2 Minutes
Detention Time @ Peak Hour Flow (14.9 MGD) = 1.7 Minutes

To calculate capacity when both basins are online use volume of 34,336 gallons.
To calculate capacity when only one basin is online use volume of 17,168 gallons.

Example calculation:

$$\left(\frac{34{,}336\ gallons}{4{,}100{,}000\ gpd}\right) * 1440\ minutes\, per\ day = 12.1\ minutes$$

2.2.7 Coarse Bubble Diffusers

There are ten (10) diffusers per grit chamber, for a total of 20 coarse bubble diffusers. These diffusers are mounted throughout the length of the channels to ensure proper airflow through the length of the channel. The minimum airflow for general operation is 5 scfm (standard cubic feet per minute), while the normal airflow is 10-20 scfm and the maximum is 40 scfm. If the diffusers are operated below the minimum provided airflow, uneven airflow distribution may occur so this must be avoided. This system can be used for intermittent operation as the large orifice opening allows solids to be expelled from the piping when the airflow to the grid is turned on.

2.2.8 Fine Mechanical Screens

Two (2) Huber Rotamat, Model RPPS PRO 2000/3, fine mechanical screens were installed in the 2020 plant upgrade. These screens function similarly to the coarse mechanical screen, but with a finer 3 mm (0.12”) screen size they trap smaller particles. If the fine mechanical screens require maintenance or repairs or if their capacity is exceeded, a third channel with a manual bar screen runs parallel to the channels of the fine mechanical screens. This third channel can be used for overflow capacity in combination with the two mechanical screens or as a bypassing measure if a mechanical screen cannot be used or requires maintenance. 2W water is used for the fine screens’ cleaning cycles, rather than 3W water due to the sensitive solenoid assembly. Wash water operation requires the 2W water pressure to be between 75 and 100 psi.

Contact information for the supplier and manufacturer of the fine screens can be found in Appendix A.

The mechanical screen structure was also constructed during the 2020 plant upgrade to provide protection to the fine screens. The structure is 36’-8” x 46’-8” and includes walls on the north and east sides to provide wind protection.

2.2.9 Slide Gate Actuators

Slide gates control the flow rates throughout the plant, including flow into and out of the grit chambers, and into fine mechanical screen channels and backup manual bar screen channel. All of the actuators throughout the plant are Auma. They have local displays on the actuator that displays the status and can be used to open or close them. The controls are usually in an automatic mode where the level adjusts to allow the desired flow rate. They also have power disconnect switches which can be used in emergencies and should be used when maintenance is required. The slide gates can be used to isolate the channels for each of the screens or each of the grit chambers if needed.

2.3 SYSTEM OPERATION

2.3.1 Grit Decant Structure

Wastewater from vacuum trucks is deposited into the sloped bed of the structure. Solids are allowed to settle from the wastewater. At the deep end of the structure the liquid portion of the waste is decanted by draining through the 4-inch drain ports. The slide gate, located on the same wall as the drain ports, can be opened to decant water in the event that the drain ports are not operational. The decanted liquid flows by gravity to the screw pump wet well through the 4-inch process drain or an 8-inch pipe depending which decant structure is used. The grit and other solids remaining in the structure should be removed and disposed of to help keep the structure from becoming clogged.

2.3.2 Screw Pumps

The screw pump is a positive displacement pump that uses an Archimedes screw to transport fluids along its axis. The wastewater enters from the sump and the capacity of the screw pump is governed by the submergence of the inlet height. Once the water reaches the fill point which is where the water covers the torque tube at the lower end the maximum pumping rate is obtained. As the water level falls below the fill level the pumping rate also falls and as it rises it must be monitored with an alarm or float to prevent any overflows in the sump. The pumped liquid moves up the screw cavities where it goes to the existing coarse mechanical screen.

2.3.2.1 Normal Screw Pump Operation

The influent lift station may be considered in normal operation when:

1. It is receiving electrical power from its primary utility source.
2. The wastewater flow is entering the wet well and all appropriate sluice gates are open.
3. The water levels in the wet well are being correctly sensed by the water level sensors.
4. The screw pumps are operating as prescribed for the selected operating condition except when performing routine tasks which require short-time operation on either the run or manual modes.
5. When the alarm functions are capable of responding as required.
6. There exists assurance that all emergency equipment will perform as required.

The pumps are operated from the electrical control panel that is located at the top of screw pump No. 2 above the bypass channel. Annunciator lights indicating the operational status of the pumps are located on the control panel. Starting alarm horn and beacon are located to the west of the control panel at the southwest corner of the screw pump channel structure.

During operation a minimum of operator attention is required. The screw pump capacity is regulated by the submergence of the inlet end of the pump and will match the incoming flow rate provided the water level in the wet well is at or below the pump "fill point." The fill point is that point which the water just begins to cover the top of the torque tube at the lower end. When the water level is at the fill point, the maximum pumping rate is obtained. As the incoming water rate decreases below the maximum pump rate, the water level at the inlet will drop thereby decreasing the inlet submergence which reduces the pumping rate accordingly.

Whenever the incoming flow rate exceeds the maximum pumping rate of the screw pump, the water level at the inlet will rise above the fill point. Through the use of level controls, alarms or visual observation, this increases in water level signals the need to put an additional pump(s) into operation to handle the higher flow.

2.3.2.2 Screw Pump Start-Up

Prior to initial start-up, thoroughly review the manufacturer's I&M Catalog information for preliminary checklist and step-by-step start-up procedures.

In OFF mode the screw pump will not run.
In HAND mode the screw pump will run.
In AUTO mode:
The pumps will be called to run according to the level in the influent wet well as signaled by the Miltronics level transmitter. As the well level rises, the pumps are called to run in the order lead, lag 1 and then lag 2. The lead pump should be alternated every two days.
When the screw pump is called to start, delay starting for fifteen (15) seconds and first manually energize the pump starting alarm light and sound the audible horn. The alarm condition will clear after the fifteen (15) second delay and requires no operator acknowledgement.

2.3.2.3 Screw Pump High Level Float All Start

If the influent chamber level reaches the high-level float, then all of the screw pumps are called to run and the high-level alarm will sound. The slide gates on either side of the bar screen (SG-016 and SG-017) will open to allow flow through the bar screen. The slide gate just upstream of parshall flume No. 1 (SG-018) also opens allowing flow through both Parshall flumes.

2.3.2.4 Screw Pump Shut-Down

Prior to shutting down a screw pump, verify that peak flows are not anticipated. Turn selected pumps control switch to the OFF mode.

2.3.2.5 Screw Pump Emergency Stop

An Emergency stop (ESTOP) button is located on the local control panel of the screw pumps. When the emergency stop circuit is de-energized by the ESTOP button, the screw pump power circuit is disconnected and the pumps stop immediately. This alarm condition sounds the audible horn and sets the emergency stop light of the alarm Annunciator. The pump(s) must be physically reset to OFF at the local control panel before they can be restarted.

2.3.2.6 Screw Pump Emergency Operation

During the normal course of operations, a single pump may be down for maintenance. Logic has been included within the PLC to call to run the next available pump in the AUTO mode.

2.3.3 Coarse Mechanical Screens

The coarse mechanical screen should be operated as is. No improvements or changes have been made to it as part of this project.

2.3.4 Influent Flow Measurement Operation

During normal operation both aerated grit chambers will be in use and flow will be directed to each chamber via the 30-inch ductile iron pipe where they pass their respective flow meters and influent flow is measured, recorded, and totalized.

2.3.5 Aerated Grit Chambers Operation

The aerated grit chambers each have five air drop pipes, each with two coarse bubble diffusers for a total of ten (10) diffusers per chamber. There is one manual valve to control the air flow into each basin. These valves are located on the outside of the center wall between both basins. The gate controllers are located locally at each gate. There are also emergency power cut offs to each of the gates, both influent and effluent.

Plant-specific treatment procedures should be used whenever starting up the blowers. All valves in the air supply system, blower shut-off, header, and throttling/isolation valves. Confirm uniform water levels in all of the basins that are served by a single basin. If there are differing water levels, basins with lower water levels may need to be throttled to assure proper airflow distribution between the basins. If all of the valves are not open, the blower unit may become over-pressured, releasing the pressure release valve, motor overload, or poor air distribution resulting in diffuser over pressuring and possible damage.

The blowers should be operated according to the operation instructions provided by the manufacturer and should be operated intermittently. They are designed with large orifices in mind to expel any solids and it is recommended to cycle the aerators once every 24 hours to clear any blockages and reduce the chances of plugging.

2.3.6 Slide Gate Actuator Controls

These gates actuators are AC controlled so they have screens. There are five (5) lights showing at the top of the screen panel. When the first light is lit (green), the gate is open. When the fifth light is lit (red), the gate is closed. When the third light is lit, an alarm is active. All of the lights at the top of the display are labelled with numbers. The percent open is displayed on the home screen of the display. The type of alarm is shown on the display and at the SCADA System so the cause of all alarms should be known.

The same switch between the control modes is on this display as on the other actuator controls.

The fault controls can be altered to change how they were displayed. This may be needed because there are 26 faults available and some of these trigger in combination. For instance, with the factory settings, the general alarm will trigger when the over torque alarm is triggered. This means that for every one alarm that occurs, two will be displayed which may confuse the operator. The settings can be changed to stop this if desired. Over torque alarms may not be of significant concern. Over torque alarms may be triggered when there is significant build-up and the gate is being raised for maintenance anyway. Sometimes the direction can be reversed to disengage the alarm. It is unlikely that there will be a significant amount of build up near the slide gates because they are just downstream of the grit chambers.

2.3.6.1 Slide Gate Actuator Display

When the gate is opening or closing, the green light will be on and the red light will be blinking. Due to the distance that this gate has to close, it will take a couple minutes for the gates to fully open or close. The shaft will move up while the gate opens and down while the gate closes. The height of this shaft will vary by several feet in height. When the gate is opening or closing, the sound of the motion will be audible. At any point, the operator can just press the STOP to stop the movement of the gate.

The percent open can be visible from the SCADA system if measuring the analog output. These gates are not designed to open partially so the SCADA system may not display the percent open but the local display will always show the percent.

The gate will be 100% open when it is up and the shaft is up.

2.3.6.2 Slide Gate Actuator Programming

When the programming mode, the control buttons can be used to scroll through the options. The programming control labels can be seen to the right of the buttons. Hold reset to access programming mode. To access the programs and to change the settings, the password is needed. The factory set password is: 0-0-0-0. If settings need to be changed, the actuator manufacturer's manual should be used to determine the code to access the desired setting. The menu and possible options that can be changed is extensive so it is

more efficient to type in the corresponding menu code instead of scrolling through all of them. The settings can change the cycle time and add a pulse. All of the settings were set as needed upon installation. The only settings that will likely need changing are the limit settings. The mechanical settings may need to be altered if it appears that there are leaks coming through when the gate is closed. The mechanical limits can also be changed to allow for short-cycling if it is determined that the gates do not need to open the entire way that is possible. The maximum height can be set to a shorter height if needed.

The slide gate actuators can be programmed by the user/operator with the AUMA CDT Windows application or the Assistant Application for Android phones. The settings that can be changed include but are not limited to defining intermediate points between the open and close points. Each individual point (up to 8) can be set with a value between 0 and 100 percent of the travel. When the gate reaches that point a signal can be sent. Additional control logic may be set see pages 46-55 within the actuator controls manual.

The AUMA supplier can be contacted should any issues arise. Contact info can be found in Appendix A.

2.3.6.3 Slide Gate Actuator Limits

Due to the height of the gate, the limits can be altered to “short stroke” the gate. The mechanical limits are set and then the electrical limits are set slightly inside the electrical limits so any errors in the electronics still cannot allow the gate to exceed the mechanical limits. The mechanical limits control the fully opened and fully closed height of the gate. This programming was all set up by the supplier before operation was started but can be easily altered.

2.3.6.4 Slide Gate Power Shutdown

These actuators also each have a breaker control. There is also a quick disconnect switch so that the power can immediately be locked out of the control panel. For other actuators, the breaker panel would have to be accessed to shut off the power if any work needed to be done. For these actuators, the switch can easily be flipped in case of emergency or if there is a need for maintenance. These switches are large and red and located near the gate actuators. The breaker panels are mostly much farther from the actuators than the quick disconnected switches. The switches can be padlocked in the OFF position to stop the gate from being activated accidentally if maintenance is occurring. Only the slide and weir gates have disconnect switches. The others only have the breaker panels.

2.3.7 Fine Mechanical Screens

The screens are controlled by a control panel located along the east wall of the mechanical screen structure. The fine screen consists of a perforated screen basket which the wastewater flows through on the open side. The solids collect on the screen surface and once the water level begins to rise, the solids are transported by drum rotation and collected in a trough via brush and spray nozzle. The screenings are then dewatered and compacted and transported via an augur to be disposed of. Additional detail on operations procedures can be found in Section 6 of the Huber Operating Instructions.

2.3.7.1 Fine Mechanical Screen Start-Up

Only qualified personnel should start up and run the machine. These operators should be familiar with the manufacturer's manual and follow all possible required procedures before starting machine.

Turn the HAND/OFF/AUTO (H-O-A) selector switch for the Rotamat fine screen to the AUTO position, and ensure all other control switches for the various pumps and valves are set to the automatic position. The fine screens will typically run in AUTO mode, where operation of the screen will be controlled automatically by the measured upstream liquid level. The two screens operate on a lead/lag system where the lead screen will operate at the LEAD water-level and the lag screen will turn on at the LAG water-level. The lead and lag screens will automatically alternate with each run.

2.3.7.2 Fine Mechanical Screen Shut Down

Turn the H-O-A selector switch for the Rotamat Fine Screen to the OFF position.

At the main Rotamat Fine Screen Control Panel, turn the main disconnect switch to the OFF position.

2.3.7.3 Fine Mechanical Screen Normal Cleaning Cycle

The cleaning cycles of the Rotamat screen are controlled in two different ways:

1. Ultrasonic Level Control – A rise in water level upstream of the Rotamat to a predetermined high-water level affects the controller and initiates the cleaning cycle.

2. Adjustable Override Timer – In the event that flow levels do not affect a cleaning cycle before the override timer times out, (an adjustable time) normally 60 minutes, a cleaning cycle will be automatically initiated.

If the water level has not gone down below the low set point of the ultrasonic controller after one cleaning cycle, another cleaning cycle as described above will begin immediately. If the water level has gone down below the set point, the drum will remain stationary until another cleaning cycle is called for by the differential level switch or override timer.

The press zone washing system will typically be automated. Water supply for this washing is initiated through a variable timer, typically every six (6) hours for a duration of 30 seconds, though the duration and frequency can be adjusted to ensure sufficient cleaning of the collection chamber.

2.3.7.4 Fine Mechanical Screen Manual Operation

It may be necessary to operate the fine screen manually during initial setup, troubleshooting, or maintenance. At the main Rotamat control panel, turn the main disconnect switch to the ON position, and turn the H-O-A selector switch for the screen to the HAND position.

Holding the screen rotation selector switch (FOR) in FORWARD position will cause the machine to rotate in the forward or counter-clockwise direction. When the switch is released rotation will stop.

Holding the screen rotation selector switch (FOR) in REVERSE position will cause the machine to rotate in the reverse or clockwise direction. When the switch is released rotation will stop. Note: Never reverse the screen by more than 90 degrees to prevent damage of the lower screw section.

Turn the H-O-A spray wash selector switch to the HAND position for hand operation of each spraying system.

2.4 HOISTS AND CRANES

Hoists and cranes are used throughout the plant to move and repair equipment. This equipment is described below. The maintenance for these cranes and lifts can be seen in Appendix C along with the maintenance instructions for the rest of the plant equipment.

2.4.1 Portable Davit Cranes

There are two (2) portable Davit cranes on site. They were provided with all of the needed accessories and hardware for lifting pumps and equipment as needed. The cranes are made of stainless steel and are designed for corrosive environments. These cranes are Thern Incorporated series 5124M3SS. There are also six (6) base pedestals and one (1) winch hand reel cable storage. The pedestal bases for the cranes, are stainless steel model 524SS. The stainless steel spur gear hand winch is model M4312PBSS-K. The cranes are used to lift and lower mechanical screens, plant drain pumps, equalization pumps, collection system pumps, and the equalization basin mixer. There are also base covers, cable spools, wire rope keepers, with adjustable boom length and adjustable boom height. The crane rotates 360-degrees and has a quick disconnect anchor for quickly attaching or removing the wire rope from the winch drum. There is a handle extension for ratchet style screw-jack and has a hook that reaches 20’ below floor level. The wire rope is stainless steel. All of the exposed metal is coated to minimize corrosion.

2.4.2 Hoists

There are three (3) 2-ton motorized trolley type hoist with the needed accessories and hardware to lift pumps and equipment and travel the full length of the I-beam. The trolley hoists are Budgit Lug Hoist with Motor Driven Trolley, Model BEH0208 as supplied by U.S. Crane & Hoist, Inc. There are both 2.6 FPM and 8 FPM lift speeds. The standard lift is 16 feet and there is a metal chain container, load limiting device, upper and lower limit switches, and a cable reel with a pivoting base. The hoist and the trolley are both ½ HP with 3 phase and 460 volts. There are three (3) tracks and three (3) brakes. All of the exposed metal is coated to minimize corrosion.

2.5 MAINTENANCE

2.5.1 Grit Decant Structure Maintenance

Structural integrity should be inspected at least twice a year. A good opportunity to examine the structure is after the structure has been drained, cleaned, and dried. Do not tolerate leaks. They only get worse and severe structural damage, including failure, may result. If a crack is serious, have it inspected by a structural concrete engineer for a recommended repair solution. Small, non-leaking cracks can be sealed with a non-shrinking, watertight grout. Grout, while helping the aesthetics, does not necessarily enhance structural integrity. When in doubt consult a specialist.

Inspect the grating, grating braces and handrails for structural stability. This inspection is necessary for operator safety.

Should any defect or inconsistency be spotted during routine maintenance activities, correct it as soon as possible. Structural damage or personal injury may result if prompt action is not taken.

2.5.2 Screw Pump Maintenance

All operators and maintenance personnel should become thoroughly familiar with the information contained in the manufacturer's screw pump manual provided in the instruction and maintenance catalog. It is recommended that a firm lubrication schedule be prepared in accordance with the I & M manual to ensure all points are given proper care.

With a total of three (3) pumps installed, the individual operation should be sequenced so that no pump remains idle or in a standby position for any long period of time. It is recommended that the operating sequence be alternated every two days to ensure that each pump is run a minimum of eight (8) hours per week.

A preventive maintenance schedule is to be implemented for all pumps and incorporated into the routine work schedule (see Appendix C).

2.5.3 Coarse Mechanical Screen Maintenance

The mechanical screen requires little lubrication and maintenance. Details and procedures for possible maintenance can be seen in the manufacturer's manual.

The Lenze gearbox comes filled with a synthetic lubricant and is totally sealed. No periodic oil changes are required. The manufacturer does recommend the lubricant be replaced with a similar synthetic oil should the gear box be overhauled for any reason. The gear motor lubricant should be replaced every 15,000 operation hours or 2-3 years.

The bottom bearing is self-lubricated and requires no additional grease.

2.5.4 Influent Flow Measurement Maintenance

The Parshall flume should be inspected to ensure that there is no cracks or deficiencies with the concrete. The flowmeters and their vaults shall be checked on a yearly basis to ensure that there are no major deficiencies within the concrete vaults. The flowmeters may need to have their seals replaced periodically and if the operators notice major discrepancies between flowmeters they can be recalibrated by the manufacturers.

2.5.5 Aerated Grit Chamber Maintenance

To avoid solids settling in the air piping and potentially plugging the system, the coarse bubble diffuser should be turned on at least once every 24 hours to clear solids from the piping and minimize the chances of plugging. The Aquarius Coarse Bubble Wide Band Aeration Systems have no mechanical/moving parts and typically operate at a low air pressure of less than 10.0 psig (pounds per square inch gauge) so maintenance required is limited. However, if an emergency required immediate shutdown, the valve that supplies the air to the system should be closed. A full maintenance schedule can be seen in Appendix C along with the schedule for all other systems in the treatment plant.

2.5.6 Slide/Sluice Gate Maintenance

A complete maintenance schedule can be seen in Appendix C along with the maintenance schedule for all of the other systems in the treatment plant.

2.5.6.1 Gate Maintenance

Other than periodic cleaning or painting, no maintenance is required on the gates themselves. However, gates may require occasional cycling to alleviate sticking. The manufacturer recommends cycling the gates at least once every 30 days.

2.5.6.2 Operating Stem Maintenance

To ensure proper operation and life of operating stems and lift nuts, it is very important that operating stems are cleaned and greased every six (6) months. To keep stem and lift nuts greased properly, see the manufacturers maintenance information in the I&M Catalog.

2.5.6.3 Manual Gate Operator Maintenance

All grease fittings on manual floor stands require lubrication at least four (4) times per year. See the manufacturer's I&M Catalog information for detailed maintenance instructions.

2.5.7 Slide Gate Actuator Maintenance

The grease should be changed approximately every five (5) years. The grease should be pumped until it comes out the top of the chamber onto the screw shaft. There should be grease on the stem which will be covered by the sleeve. The level of the grease should always be monitored as insufficient grease is one of the most common issues with the system.

2.5.8 Fine Mechanical Screen Maintenance

Similar to the coarse screen, the fine screen requires minor amounts of maintenance. Details and procedures can be found in Section 3: Operating Instructions, Chapter 8 of the manufacturer's O&M manual.

The fine screenings containers should be checked on a daily basis to ensure that there is no backing up of screenings into the discharge unit. On a weekly basis the screen, the basket, sensors, and bottom screws should be checked and cleaned for any stringy material and the housing interior shall be hosed down to ensure that no buildup of grease and other solids are stuck to the housing to prevent corrosion issues. Finally, on a monthly basis the strainer should be cleaned, along with the entire machine, and ensure that all roller bearings are functioning correctly with minimal play. The lubrication pump should be checked and refilled if needed as well.

Other than these tasks the unit should be inspected on a regular basis to ensure that press and device is functioning correctly.

2.5.8.1 Slurry Pump

The fine screen equipment includes a Boerger PL100 Rotary Lobe slurry pump. A complete maintenance schedule can be seen in Appendix C along with the maintenance schedule for all of the other systems in the treatment plant.

2.5.8.2 Grease Pump

The fine screen equipment includes a Graco Lube Master grease pump. This pump does not have a low-level switch to indicate when the grease level in the reservoir is low, so the level in the reservoir should be checked regularly. Guidance on refilling the grease reservoir can be found in Section 4: Components Information, of the manufacturer's O&M manual. A complete maintenance schedule can be seen in Appendix C along with the maintenance schedule for all of the other systems in the treatment plant.

2.6 TROUBLESHOOTING

2.6.1 Screw Pump Troubleshooting

Common symptoms, possible causes and their cures are listed below. A full list of troubleshooting advice can be seen in the manufacturer's manual and should be consulted whenever issues arise.

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
Equipment will not start.	Electrical.	Check switches, fuses and wiring.
	Grease pump not running or centrifugal switch in grease pump motor not connected or not functioning.	Check wiring and centrifugal switch.
	Level controls.	Check water level if up and pump should run. Check float and level probes.
Motor hums, screws will not run.	Drive belts too tight.	Adjust belts. Refer to V-belt instruction manual.
Motor labors, runs slow, etc.	Not wired correctly for plant voltage.	Correct wiring at motor.
	One fuse out.	Check fuses.
Screw starts slow.	Loose belts.	Adjust belts. Refer to V-belt instruction manual.
Grease does not show grease at orifice of visual line.	Grease lines not filled with grease.	Fill grease lines manually before initial startup.
	Inadequate running time to produce enough grease.	Allow grease pump 4 hours running time.
	Lower bearing seals not holding pressure.	Check seals. Replace if necessary.
	Visual flow line extended too far above bearing.	Refer to installation instruction drawing.
	Grease pump not functioning.	Check pumping element. Refer to separate instructions.
	Lines or fitting leaking.	Check lines, tighten fittings, etc.
Excessive grease leakage through seals of upper bearing.	Bad or worn seals.	Check seals and replace if necessary. Note: some leakage is normal especially after greasing.
Noisy reducer.	Low on oil.	Check oil and fill if necessary. If not low on oil, check with factory.

2.6.2 Coarse Bubble Diffusers

Common symptoms, possible causes and their cures are listed below. A full list of troubleshooting advice can be seen in the Aquarius Installation, Operation and Maintenance Manual and should be consulted whenever issues arise.

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
Poor or uneven air distribution	Diffuser airflow is below minimum recommended rate	Increase airflow above 5.0 scfm/diffuser
	Solids settling out around diffusers	Drain basin and remove settled solids
	Diffusers are not level	Adjust supports to level the aeration piping
	Plugged diffuser orifice	Remove diffuser and clean orifice
Large, localized boil	Mechanical failure	Drain tank and repair
Increased operating pressure	Diffusers are fouling	Clean diffusers
Increased air requirement	Diffusers are fouling	Clean diffusers
	Leak in aeration piping	Inspect and repair

2.6.3 Fine Mechanical Screen

Common symptoms, possible causes and their cures are listed below. Further details on troubleshooting or possible repairs can be seen in section 7 of the Huber Operating Instructions.

Symptom	Possible Cause	Repair
Screen does not run although the tripped lamp is off.	Mains isolator is in OFF position.	Switch mains isolator ON.
	Selector switch is in "0" or REVERSE position.	Turn selector switch to HAND or AUTO
	Control fuse has melted.	Replace fuse.
	PLC-CPU is set to STOP.	Switch to RUN.
	No signal from ultrasonic level transducer.	Check transducer.

Symptom	Possible Cause	Repair
Fault lamp is on or the fault is indicated in the text display	Motor overload has tripped.	- Switch off mains isolator - Check if something is jammed in the trough area (like a stone or piece of wood) or material is entangled in the discharge. - Switch on motor protection switch and operate reset key. - Switch on mains isolator.
	Current relay has tripped.	a) , b) , d) Ditto
	Phase breakdown	Check fuses and proceeding fuses in control panel.
	The screenings DS content is too high.	Dismount the discharge opening reducing plate or displace the discharge dia. reducing plate downwards.
Continuous operation in AUTO mode (screen) AUTO	Level control is permanently activating because: Level transducer is blocked.	Check for obstructions in transducer acoustic beam.
Continuous operation of pump.	Suction pipe is blocked in closed trough area.	- Check pipework connections and for obstructions inside the suction pipe. - Check bubbler level control system. - Clean and inspect the suction pipe connection to the closed trough for potential clogging.
Time-dependent control does not work.	Time has not been set in text display or on timer.	Set the time.
Solenoid valve does not close.	Servo boring is dirty inside.	Disassemble and clean the valve. Check dirt trap and insert a filter if required.

2.7 SAFETY

Because raw wastewater is present in the grit decant and the headworks system, personnel must exercise precautions in regard to personal hygiene and sanitation. All necessary precautions for ventilation and identification of dangerous gases in a confined space must be observed.

All warning and safety labels must be kept attached and legible. Because this equipment operates automatically, do not perform any service with power on. All electrical work should be done only by qualified personnel. Power from all sources should be disconnected and locked out when working on equipment. Do not manually operate equipment without knowing its result. Do not begin equipment operation that has just been installed or serviced without notifying personnel near equipment.

The manufacturer's safety precautions for operation and maintenance procedures provided in the various equipment manufacturers' O & M Manuals shall be adhered to in order to minimize risks to equipment and personnel. Almost any product improperly used or misapplied can become a health or safety hazard. Refer to Appendix E for additional safety precautions.

CHAPTER 3
AERATION BASINS

3.1 INTRODUCTION

This chapter contains a description of the flow from headworks through the aeration basins. This includes the aeration basin flow splitter, possible emergency overflow to Long-Term Digestion Basin, the North and South Aeration Basins, and the blower equipment in the Blower Building. Each aeration basin is equipped with fine bubble diffusers sized for both mixing and oxygen transfer requirements. Other system components include an outlet structure for each basin with a motorized weir gate, level sensor for each basin, dissolved oxygen sensor for each basin, and an HDPE liner system with leak detection manholes. Figure 3-1 presents the layout of the plant aeration basin systems.

3.1.1 General Description

The wastewater flows by gravity to the aeration basins after exiting the mechanical fine screen units. The wastewater initially enters the aeration basin flow splitter. This splits the flow into two (2) channels. One channel leads to the North Aeration Basin and one leads to the South Aeration Basin. There is also a third channel that leads to the Long-Term Digestion Basin. Operation staff can manually open the third channel and direct flow to the Long-Term Digestion Basin if there is a need to take other portions of the plant offline for maintenance/repairs. The third channel can also be used to reduce equalize high flows; however, operation staff will need to carefully monitor and manage storage volumes so that the Long-Term Digestion Basin does not overflow. The water directed to the first two channels in the aeration basin flow splitter will then enter the aeration basin where the aeration occurs. It is recommended that the flow is evenly split to the two aeration basins, and that both trains are configured with the same process control. The treatment plant uses a Parkson Biolac® System as an activated sludge process using extended retention of biological solids to create a stable, efficient, easily operated system. The Biolac system utilizes a longer sludge age than other aerobic systems; the sludge age in this system can range from 30 to 90 days. A basic system controls the aeration and the process. There are additional controls for denitrification and dissolved oxygen control. The Supervisory Control and Data Acquisition (SCADA) controls for the plant are used to remotely control the aeration basin system.

~NORTH AERATION BASIN~

~SOUTH AERATION BASIN~

~LAB/OPERATIONS BUILDING~

36-INF

30-ML

AIR

NO.	REVISIONS	BY	DATE

KEYED NOTES

1. = CLARIFIER FLOW SPLITTER (1 / M3.03)
2. = MIXED LIQUOR FLOW METER VAULT (1 / M5.01)
3. = AERATION BASIN EFFLUENT CONTROL STRUCTURE (2 / C6.05)
4. = MIXED LIQUOR PUMP STATION (1 / M5.01)
5. = LEAK DETECTION MANHOLE (3 / C6.06)
6. = LEAK DETECTION SUMP (2 / C6.06)

NOTE:

LIFE PRESERVER UNITS ARE TO BE PROVIDED AS FOLLOWS: LIFE PRESERVER UNITS ARE TO BE PROVIDED AT LOCATIONS AROUND THE PERIMETER OF BOTH AERATION BASINS. UNITS TO BE SPACED EVERY 100-FT ON CENTER (APPROX), AND SECURELY ATTACHED TO HANDRAIL. EIGHT LIFE PRESERVER UNITS PER BASIN, 16 TOTAL.LIFE PRESERVERS ARE TO BE 30" DIAMETER RING PRESERVERS, TYPE IV COMMERCIAL BOUY WITH VINYL COATING OVER MOLDED PVC SHELL. USA BLUEBOOK # ME-44925, OR EQUAL. EACH BOUY IS TO INCLUDE ALUMINUM BRACKETS, STAINLESS STEEL FASTENERS, AND 90-FT (MIN) OF HEAVING LINE. INSTALL 16 COMPLETE LIFE PRESERVER UNITS TOTAL, WITH FIBERGLASS LIFE RING CABINET AND HANDRAIL ATTACHMENTS AS NEEDED. CABINETS ARE TO BE NON-LOCKING "T-HANDLE" ENTRY, CHEYANNE MANUFACTURING INC. (800) 424-7575 OR EQUAL.

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DESIGNED BY	DRAWN BY	CHECKED BY
JGC/SJW	JGS	AWL

CITY OF FERNDALE, WASHINGTON

FERNDALE

FIGURE 3-1

AERATION BASINS - OVERALL PLAN

SHEET	DATE	SCALE	JOB NUMBER
-	10-7-2022	AS SHOWN	2020-006

PAGE -

PLOT SETTINGS: Adobe PDF1.pc3, ANSI full bleed B (17.00 x 11.00 Inches), Portrait, 1:2, WE APWA_UNSCREENED.ctb
W:\2020\2020-006 FERNDALE WWTP CONSTRUCTION\DWG - V2019\AS-BUILT DRAWINGS V2019\AB V2019_2020-006 C6.01 AERATION BASINS OVERALL PLAN.DWG - 10/7/2022 3:40 PM - Jeff Smith

3.1.2 General Structure

The aeration basins were reconfigured in the 2020 treatment plant upgrade. These current North and South aeration basins were adapted from the existing North and South Lagoons that existed before the 2020 upgrade. The basins have inside slopes of 1.5H:1V (horizontal to vertical). Each basin has a high-density polyethylene (HDPE) liner system to stop anything from inside the basin from leaching into this environment. There is ballast on top of the liner. The top of the basin is approximately 14 feet above the bottom of the basin with a water depth of approximately 12 feet.

There are six (6) positive displacement blowers in the blower room that pipe air to the aeration chains. There are 15 aeration chains in each basin, with nine (9) diffusers on each chain. The aeration chains cross the entire basin and have a valve with an actuator on the end that can open to allow air in or close to disable the aeration chain. These aeration chains aerate the entire basin and then the water flows out through the effluent weir gate and the DO probe sits in front of this gate, measuring the DO levels right before the effluent leaves the aeration basins.

3.2 OPERATION – BIOLAC EXTENDED AERATION TREATMENT PROCESS

Biological oxidation of matter and denitrification occurs in the aerated Biolac basin. Oxidation of organic matter by the microorganisms serves to reduce the oxygen depleting characteristics of the effluent upon receiving waters. The microbial demands represented by BOD and carbon content of the wastewater are to be met first, before allowing microbes removing nitrogen compounds to successfully compete for food. Denitrification is accomplished by creating oxic and anoxic zones in the aeration basin which removes total nitrogen to levels which are acceptable for rapid infiltration. The clarifier then separates the clear liquor from the suspended solids generated in the basin. Clarification is a critical link, as it is the final step in the removal of suspended solids and organic pollutants (as measured by the BOD test) from the wastewater. Basic operating theory, equipment control and maintenance are described below.

3.2.1 Process Description

While the complete secondary treatment system does not solely consist of the Biolac basin, the basic operating principles of activated sludge will be discussed in this section. In the activated sludge process, wastewater is fed continuously into an aerated tank, where the microorganisms degrade the solids by

oxidizing part of the soluble organic material for energy and synthesizing some of the soluble organic material into new bacterial cells. The activated sludge process is developed when these organisms floc together and are heavy enough to settle and be removed from the liquid. The physical system is really designed for the floc forming type which tend to settle easily in the clarifier. Microorganisms (activated sludge) are settled from the aerated mixed liquor in the clarifiers where a portion is returned to the aeration tank and the remaining portion is wasted. The reason for settling and recycling is to develop a concentrated biomass in the aeration basin. This concentrated biomass is used to oxidize organics and organic forms of nitrogen. Autotrophs, nitrifiers, reduce nitrates down to nitrogen. Whereas heterotrophs transform ammonia components into nitrates. Clear supernatant from the final clarifiers is the Plant effluent.

The Biolac basin process is a type of activated sludge system characterized by operation in the endogenous zone of cell metabolism. The term "endogenous" refers to a particular phase in the microbial growth pattern of the organisms that degrade the organic matter in the wastewater. This growth pattern can be compared to the life cycle of any living organism (i.e. birth, growth, maturity, death) and therefore any particular phase in the growth pattern is dependent on time or "age" of the microorganisms. Within a short period of time after the food or organic matter comes in contact with a healthy population of microorganisms, the microorganisms reproduce rapidly as long as there is an abundance of food available. This phase of growth is log growth phase. The rate of reproduction in this phase is only limited by the microorganisms; ability to consume and process the food.

As more microorganisms are produced in the system, their total food consumption causes an increasing shortage of food. This is characteristic of the declining growth phase. The rate of reproduction decreases until the number of microorganisms is stationary (rate of reproduction is equal to the rate of death.)

With time, the activity level slows down and because there is not enough food available, the growth rate also slows down. The process enters the endogenous zone and the microorganism population starts to decrease. Due to the lack of food, some of the microorganisms die. As death occurs the cells break apart and release some organic food matter to be used by the remaining population. Thus, even in the endogenous phase, growth still takes place.

By operation in the endogenous zone, the Biolac basin process is characterized by a low F/M ratio (food to microorganism ratio,) and a high sludge age or mean cell residence time, MCRT (the average time the mixed liquor stays in the system.) This highly competitive and self-destructive endogenous phase results in

a highly treated effluent with low, very stable sludge production. This process utilizes long detention times which allows the system to operate effectively even though flows and strengths may vary widely.

3.2.2 Wave Oxidation

The wave oxidation modification to the standard Biolac Process is used to provide denitrification. Wave oxidation consists of creating oxic (aerated) and anoxic (non-aerated) zones in the aeration basin by turning aeration chains on and off. A minimum of 3 adjacent chains are turned off for 20-30 minutes (typically) to create an anoxic zone. Adjacent oxic and anoxic zones are alternated every 20 – 30 minutes to create the proper environment for denitrification. A dissolved oxygen probe is provided for blower control. If oxygen levels drop below 0.5 mg/l then additional aeration is provided by turning on the VFD standby blower, and ramping-up blower power accordingly. The Biolac Manual provides a detailed description of the wave oxidation process and controls.

3.2.3 Aeration Basin

The aeration system consists of floating aeration chains which span the aeration basin and are fixed at both ends. Each aeration chain is formed by a floating HDPE pipe with 1" hanging hoses attached to the fine bubble diffusers. From the HDPE float assemblies, fine bubble diffusers are suspended above the basin floor. Air is introduced at one end of the aeration chain and then enters the wastewater through the diffusers. The air both oxygenates and mixes the basin contents. Because the aeration chains are flexible, the air released from the diffusers causes the aeration chains to oscillate back and forth in a regular pattern. The chains are installed so that the entire basin floor is covered by these patterns. The time for one complete oscillation is typically 2-3 minutes. The magnitude of the movement can be adjusted by adjusting the tension on the aeration chains using the restraining chains present on each end.

3.2.4 Process Design

The Biolac System is an extended aeration/activated sludge process which works in conjunction with the clarifiers for sludge separation and recycle. The criteria at design flow and design BOD loading is:

F/M Ratio	0.07
MLSS	3000 mg/l

Hydraulic Retention time	1.0 days
Solids Retention time	45-75 days
BOD effluent conc.	10 mg/L (Average Monthly)

Aeration Basin: The aeration requirements for the Biolac System are calculated below.

Actual Oxygen Requirements (AOR):

4.1 MGD * 211 mg/l BOD * 8.34 = 7215 lbs. BOD/day

1.5 lbs O_2/lb of BOD removed
24 hours retention time
97 % removal of BOD

(lbs. BOD removed/day) * (lbs. O_2/lb. BOD removed) = AOR for BOD removal
7215 lbs. BOD * 1.5 lbs O_2/lb. BOD = 10,823 lbs. O_2 (AOR for BOD removal)

4.1 MGD * 50 TKN mg/l * 8.34 = 1710 lbs. TKN/day

4.6 lbs O_2/lb. of TKN removed (standard)
97% TKN removal

(lbs. TKN removed/day) * (lbs. O_2/lb. TKN removed) = AOR for TKN removal
1710 lbs. TKN * 4.6 lbs O_2/lb. TKN = 7,866 lbs. O_2 (AOR for TKN removal)

Combined AOR = 18,689/24 hrs = 779 lbs. O_2/hr.

The required air is supplied by four 75 HP blowers (two blowers per basin). A third blower for each basin is provided for 100% backup with the largest unit out of service. Only one blower is necessary for individual basin mixing requirements.

Aeration Basin Design

Approx. Bottom Dimensions (ft.)	213 x 83
Walls	HDPE Lined Basin (Side Slope 1.5:1)
Side Water Depth (ft)	12

Basin Volume (MG)	2.05 each basin
Number of Basins	2

Aeration System Design

Diffuser Type	Fine Bubble
Blowers	6 - 75 HP Blowers
No. BioFuser 2004 Assemblies	135
No. BioFlex Headers	15

3.2.5 Process Control

The secondary treatment process at Ferndale is commonly referred to as an extended aeration activated sludge system. Characteristics of extended aeration activated sludge systems have been previously discussed.

As an operating process, a Biolac System Plant can adapt to and adsorb substantial changes in flow, loading or environment. However, adjustments must sometimes be made to respond to these changes in flow or loading if the efficiency is expected to remain at an acceptable level. This chapter presents process control strategies to enable operation under a wide range of conditions.

3.2.6 Process Control Variables

The operator basically has three methods of exerting control over the treatment system. These consist of:

1. increasing or decreasing the aeration
2. increasing or decreasing sludge wasting
3. increasing or decreasing sludge recycle

These control variables are interrelated and should only be adjusted when the operator has an overall process control strategy developed.

Two process control methods used commonly by Facility operators are the food/microorganism ratio (F/M), (food refers to the organic matter present in the influent) and the Mean Cell Residence Time (MCRT). The first one, F/M is the oldest method and therefore the most commonly used. The use of F/M is based on the idea that the amount of biodegradable organic matter fed to the process directly affects growth rate. Therefore it is desirable to keep a definite ratio between the incoming food and the microorganisms.
The MCRT method of control relates solids in the system to growth rate. It is expressed in time (days) which an average microorganism remains in the system.

Both of these controls are interrelated (changing one control changes the other) and both provide the operator with a means for maintaining the best effluent and sludge quality. Also, these controls indicate the solids level needed to stabilize the food and attain good sludge quality. No matter what operating strategy the operator uses, ultimate control of the system will be based on the solids level, which is controlled by wasting. To maintain a desired solids level it is necessary to waste the amount of net daily growth. Increasing the solids level can be accomplished by decreasing the waste rate and decreasing the solids level can in turn be accomplished by increasing the waste rate. Examples of solids level calculations applicable to the WWTP follow.

Thus, the best operating F/M or Ø (MCRT) must be experimentally determined based on actual results of treatment.

Perhaps the most important recommendation which can be given to an operator is to collect raw data from his various control tests, then plot these data on graphs. Graphing is the best means for converting raw numbers into a usable form which can then be easily and readily used to see developing patterns. This method also permits accumulation of a visual history on all kinds of operations. The operator can always trace back to see what results were obtained as response changes were made.

3.2.7 Solids Level Calculations

The determination of the optimum solids to be carried in the mixed liquor is based on two factors. These are concentration and quantity of the influent to the basin and the maximum amount of solids which can be maintained which will provide the best effluent quality. When considering the ratio of solids under aeration to the influent concentration, F/M, it is best to consider it on a pounds-basis. As an example, the pounds of BOD (or food for the microorganisms) in the influent are calculated by:

BOD mg/l x 8.34 x flow(MGD) = lbs/day of food

As an example, for the Ferndale WWTP, the BOD loading is calculated as follows:

211 mg/l x 8.34 x 4.1 MGD = 7,215 lbs BOD per day

To determine the amount of mixed liquor expressed in pounds, the volume of the aeration tank and the concentration of the solids are used in the following calculation:

MLSS mg/l x 8.34 x Vol. (million gallons) of aeration tank = total pounds of mixed liquor solids

The volume of the Biolac basin is, of course dependent on the depth of mixed liquor in the tank. For a given mixed liquor depth, the approximate volume in gallons for the Biolac basin can be calculated as follows:

D = Mixed Liquor Depth (ft) = 12 ft for the Ferndale WWTP

[[[92 + (D x 3)] x [144 + (D x 1.5)] ft^2 + 13,248 ft^2] / 2] x D ft x 7.481 gal/ft^3 = Biolac Basin volume in gallons = 2,050,000 gallons for each of the two Ferndale WWTP aeration basins

As an example of the use of F/M, assume the influent BOD (S_o) to be 211 mg/l, Ø = hydraulic detention time, and X = microorganism concentration in aeration basin, mg/l.

F/M = S_o/ Ø X (from Metcalf & Eddy, 3rd Ed., eq 8-48, page 532)

If the desired F/M is 0.07 and Ø = 1.0 (Ferndale WWTP Design Condition) then:

F/M = 211/1.0 X = 0.07

And the necessary concentration of volatile suspended solids in the aeration basin is:

X = 211 / ((1.0)(0.07)) = 3,014 mg/l

The above is an example of how aeration basin microorganism concentration (solids level) may be determined for a given influent BOD and a desired F/M. Values used for these calculations should be averaged over several weeks to arrive at figures to be used as process adjustments. Generally, it would be

found that higher amounts of sludge would be carried in the system during cold winter months, as compared to summer months; therefore an F/M of 0.06 to 0.07 might be selected for October through March and 0.07 to 0.8 during warmer weather. Details on the use of the F/M method for process control can be found later in this chapter under Sludge Wasting.

3.2.8 Sludge Wasting

An advantage of using the mean cell residence time ($Ø_c$) control method is that for a given mass of solids in the system the necessary solids wasted per day can be calculated for any $Ø_c$.

$$Ø_c = V_r X / Q_w X_r + Q_e X_e$$

V_r = volume of aeration basin
Q_w = wasteage rate
X = concentration of microorganisms (solids) in aeration basin
X_r = concentration of microorganisms (solids) in recycle
Q_e = effluent flow rate
X_e = effluent concentration of microorganisms (solids) in effluent

Solving for the wasteage rate with the following known values follows as an example:

V_r = 4,100,000 gallons
X = 3,000 mg/l
X_r = 7,000 mg/l
Q_e = 4,100,000 gallons per day
X_e = 10 mg /l
$Ø_c$ = mean cell residence time

$60 = (4{,}100{,}000)(3{,}000)/((Q_w)(7{,}000) + (4{,}100{,}000)(10))$; Q_w = 23,429 gallons per day

3.2.9 Operational Effects of Sludge Wasting/Return

It is important to emphasize that all of the variables affecting the process are interrelated, (i.e. a change in one variable produces change in others).

As an example: an increase in food produces a change in microbial growth which affects
MLSS concentration, air usage and settleability.

Similarly, changes made in sludge return and wasting will produce changes in or affect various process operations such as:

- air requirements and usage,
- sludge settleability,
- mean cell residence time (MCRT),
- concentration (MLSS and settled).

Therefore, it is necessary for the operator to realize the total impact on all process factors before changing control variables such as return or wasting sludge rates. Generally, change should be made in only one variable at a time, and then no more than ten percent of the total.

3.2.9.1 Return Sludge

An active bio-mass is required in the Biolac basin which should be maintained at a given level based on the optimum MCRT or F/M ratio. The active bio-mass or sludge is separated from the mixed liquor in the clarifiers and must be returned to the Biolac basin as rapidly as possible. Sludge return operations throughout the day are based on several considerations:

- The solids loading on the clarifiers. The Plant is limited by the maximum number of pounds it can carry in the system.
- The desired MLSS concentration or weight carried in the Biolac basin.
- Settleability of the solids entering the clarifier as measured by the SVI.
- The Influent flow (q).
- The concentration of solids in the return sludge.
- The concentration of solids in the effluent.

Since the solids level in the aeration basins will be influenced by the rate of Influent and rate and concentration of return sludge, several pieces of information will be necessary in finding the best return sludge rate. The sludge that settles to the bottom of the clarifiers is much more concentrated than the mixed liquor entering the final clarifiers, and the relationship of these concentrations and the return sludge and influent flows is given below.

The rate of return can be determined from the following formula:

$$Q_r = (Q_eX_e - Q_wX_r - QX) / X - X_r$$

Given:

Q = 4,100,000 gallons per day

X = 3,000 mg/l

X_r = 7,000 mg/l

Q_e = 4,100,000 gallons per day

X_e = 10 mg /l

Q_w = 23,429 gallons per day

Then:

Q_r = 3,105,751 gpd (or 3.1 MGD)

Typically, return sludge flow rate should be maintained between 0.5Q and 1.0Q. However, slightly greater return sludge flow rates are also acceptable.

3.2.9.2 Sludge Wasting

Ultimate control of the system, no matter what intermediate operating decisions are made, always will be based on solids wasting. There are three methods commonly used by operators to decide how much sludge to waste:

1. Control by maintenance of a constant MLSS.
2. Control by maintenance of a constant F/M ratio.
3. Control by maintenance of a constant MCRT.

1. Control by maintenance of a constant MLSS. With this method, the operator is maintaining a constant mass of organisms to use the incoming food supply. If the operator finds that an MLSS of 4,000 mg/l works effectively at the Plant, that level will be maintained. If the solids in the Biolac basin increase above 4,000 mg/l the operator will waste more until the MLSS level is again 4,000 mg/l. If the MLSS drops below 4,000 mg/l, the operator will waste less and allow the solids concentration to increase. Graphing can be very helpful with this method. MLSS values plotted against effluent quality parameters can help the operator to select the desired MLSS value. Wasting rates can also be plotted against resulting MLSS values to determine a relationship between wasting and MLSS. While this method is simple to understand and manage, problems can occur if large variations in loading are encountered. The problem occurs due to changes in the F/M ratio. For example, if the BOD of the incoming waste Increases by 50 percent over a substantial period of time, the increase in solids production from the higher BOD load would be wasted to maintain the constant MLSS. The result of this action, however, is that the F of the F/M ratio is 50 percent higher while the M remains at the previous level. The resulting increase in F/M could lead to process inefficiency or failure.

2. Control by maintenance of a constant F/M ratio. This method of control is based upon wasting to maintain a constant F/M ratio. The operator will try to increase or decrease the MLSS to match an increase or decrease in the BOD entering the Plant. The extended aeration ditch will operate best at a specific F/M ratio between 0.05 to 0.07. Plotting F/M values against effluent quality should aid in the selection of an F/M value. The solids level calculation examples should be referred to when increasing or decreasing the MLSS. This method tends to be the most difficult but is fairly successful if the Plant receives wastes with predictable variations.

3. Control by maintenance of a constant MCRT. The MCRT or sludge age can be expressed by the following equation:

MCRT = total solids under aeration/total solids wasted per day.

or

$$MCRT = \frac{XV}{Q_w X_r + (Q-Q_w)X_e}$$

or assuming X_e (effluent concentration) is very small at 75 lbs/day, use:

$$MCRT = \frac{XV}{Q_w X_r}$$

Where:

MCRT = mean cell residence time, days

X = MLSS, mg/l

V = volume of mixed liquor under aeration, gal

Q_w = flow rate of sludge being wasted, GPD

X_r = return sludge concentration, mg/l

The operator can set the MCRT that he feels will work well or has found to work well for this particular Plant. Therefore, to calculate the wasting rate, Q_w, the operator needs only to know the total liquid volume under aeration, the MLSS concentration and the return sludge concentration.

The MCRT for extended aeration plant will vary from 45 to 75 days. The operator can easily estimate what MCRT to use based on past solids wasting practices which yielded good effluent and sludge quality.

The wasting of sludge must be based on a reliable base of sludge inventory. Since operation of the WWTP requires intermittent wasting, it is wise to time the wasting periods such as to always have enough sludge in the Biolac basin during periods of increased loading such as known industrial contributions or diurnal changes. The following are some general guidelines for wasting:

1. Compute and set the wasting rate and time so as to maintain sufficient solids in the system.
2. Don't over waste or there will be an insufficient amount of M in the aeration basins when the load hits the Plant in the morning or during other known load increases.
3. Monitor the sludge blanket in the clarifier. If the depth of sludge is unusually high then the start of wasting or increasing the rate of wasting may be necessary.
4. To increase the amount of solids under aeration (decrease F/M ratio), decrease or stop wasting and increase the return. To decrease the amount of solids under aeration (increase F/M ratio) increase wasting and decrease the return.
5. Normally wasting practices will be changed at those times when the process is becoming upset.

3.2.10 Operating Problems

Severe problems can often be avoided by observing and controlling a process problem before it gets out of hand. The operator should inspect all processes daily for abnormalities.

3.2.11 Biolac Basin Appearance

The operator should look at general appearance of the Biolac basin contents to determine if there are any unusual colors or foams.

3.2.11.1 Mixed Liquor Color

A dark blackish color may indicate an anaerobic condition caused by poor aeration or an improper discharge of sludge to the Biolac basin. Other unusual colors may indicate the presence of an industrial waste. These situations may require increased aeration (See Section 3.3), a check of the entering flow streams, and possible separation of industrial waste components for pretreatment.

Industrial waste is not to be accepted at this plant. The City should also be reluctant to accept any septage. Septage is highly corrosive and may have high levels of grit. If septage is to be accepted, use only sources that are well known and uncontaminated. Pump septage into the grit basin, so that material may be screened. Assuming that septage has 8000 mg/L of BOD, the City should not exceed the total plant design load of 750,000 gallons/day at 300 mg/L. This means that a load of 1000 gallons of septage is equal to 26,667

gallons of normal wastewater, and the plant will only be able to handle 723,333 gallons of City wastewater, during that day.

3.2.11.2 Fresh Crisp White Foam

A modest accumulation of fresh crisp white foam is usually a good sign of a well operated system that is producing good effluent. The operator should try to maintain the system (i.e., keep operating variables constant) until the -physical characteristics of the system change or other control tests dictate a change.

3.2.11.3 Excessive Billowing White Foam

Thick billows of white sudsy foam may indicate that the MCRT is too low (young sludge age) and requires an increase by reducing the sludge wasting rate. It can also indicate the presence of a non-biodegradable surface active material, for example, from an industrial cleaning compound, or another industrial waste of some kind.

The sludge wasting rates should be gradually decreased until observations and lab tests reveal improving trends. The operator may choose to plot all the process characteristics such as sludge volume index, mixed liquor concentrations, and MCRT. The operator can then use previously discussed control methods to maintain an effective MCRT. It is not wise for the operator to make drastic changes in sludge wasting rates, because the system will respond better to gradual changes in the wasting rates. Wasting rates should be changed by no more than 10 percent at any one time.

3.2.12 Thick Scummy Dark Tan Foam

A dense and somewhat greasy and scummy layer of deep tan to brown foam covering the Biolac Basin surface may indicate an old sludge or one that is over oxidized. To eliminate this situation the MCRT can be reduced by increasing the sludge wasting rate. Again the wasting rate requires an increase at a modest rate.

Foam of any color or characteristic should never be allowed to cover the entire water surface in the Biolac basin. Foam can be broken up by the use of a water hose.

3.2.13 Clarifier Appearance

Careful observation of the surface of the clarifier and the effluent can give the operator the best clues to required process changes.

If the effluent is clear and attractive, the operator normally will continue present control policies. If the effluent is turbid, contains noticeable solids, or is deteriorating steadily, the operator will review the control and response trend lines and adjust the operating variables. Without adjustment, the deteriorating condition of the effluent often will be followed closely by more serious problems that are reflected by the clarifier surface.

3.2.13.1 Sludge Bulking

Sludge bulking is probably the most commonly stated reason for a poorly operated activated sludge plant. Bulking sludge, sludge in which the solids will not separate, is normally attributed to the presence of filamentous and/or nonfilamentous microorganisms. The nonfilamentous or "zoogleal" bulking is quite rare and is associated with large amounts of entrapped water in the sludge floc. This type of bulking usually can be eliminated by reducing the F/M ratio.

Filamentous bulking is associated with large numbers of hairlike bacteria or fungi in the sludge floc. These organisms are easy to recognize under a microscope, although identification of the type of filament may require the assistance of an experienced microbiologist. Such service may be desirable because the benefits associated with knowing the filament type are often worth the initial expense. Even if the type of filament is not determined the operator can proceed to correct the problem on a short-term basis by chemical treatment such as chlorination. Wastewater characteristics that can affect sludge bulking include fluctuations in flow and strength, pH, temperature, staleness, nutrient content, dissolved oxygen, and toxicants.

Other causes of bulking sludge can be microbial problems such as nutrient deficient influent, deflocculation, septic sludge, rising sludge, floating sludge or pinpoint floc. These problems will be discussed separately later.

An organized approach to finding a chemical treatment for bulking is a necessity. The following approach is recommended:

1. Identify bulking as distinct from such factors as poor operation, deflocculated sludge, foam-forming sludge, rising sludge, and septic sludge. Influent and effluent quality parameters should be compared with those when the system was working satisfactory (i.e., check D.O. in basin). Characteristics of bulking are (a) sludge settles and leaves a clear supernatant but SVI is high (greater than 150 ml/g), (b) low solids concentration in return sludge, and (c) high sludge blanket in final settling tank.
2. Determine if the bulking is filamentous or nonfilamentous by microscopic examination of mixed liquor and return sludge. The use of a microscopic predominance chart is recommended. If nonfilamentous bulking, chlorinate return sludge at 5 to 10 mg/l; if filamentous bulking, go to Step 3.
3. Determine if filamentous organisms are bacteria or fungi. If fungal organisms are causing the bulking, look for an industrial waste problem. If bacterial filamentous organisms are responsible for the bulking, identify the organisms, if possible, and go to Step 4.
4. Look for the source of the massive concentrations of filamentous bacteria in wastewater or process return flows. If the source of filamentous bacteria is found, disinfectant should be used to eliminate it. If filamentous bacteria are growing in activated sludge, then go to Step 5.
5. Choose as basic approach one of the following: (a) killing sludge and starting over, (b) using disinfectant on return sludge, or (c) using flocculent or weighing agent to decrease SVI.
6. Establish objectives, minimum time, and control procedures for the corrective treatment chosen.
7. Carry out the corrective treatment and collect data for evaluation.
8. Evaluate Steps 5 through 7. If successful, continue as needed. If unsuccessful, go back to Step 5 and try again.

Other methods that may help reduce or eliminate bulking on a longer term basis are: increasing the sludge age; adding nutrients such as nitrogen and phosphorus; increasing the return sludge rate; and, increasing the air applied. Carrying a greater than normal amount of activated sludge solids when adequate aeration capacity exists in a system subject to periodic upsets of this kind will help cushion the effect. In most cases, when excess solids are carried, bulking to the extent of solids carry over will not occur.

Many factors have been blamed for the development of bulking sludge. They include shock loadings, ineffective aeration, nutrient imbalance, too low sludge age, and improper operation. Once severe bulking is present, it is difficult to eliminate. With daily microscopic examination of the MLSS, however, impending filamentous bulking can be recognized and cured before the situation gets out of control.

3.2.13.2 Clumping, Ashing and Rising Sludge

At times, large masses of sludge, possibly 0.3 m (1 ft) in diameter will rise to the final surface, burst, and spread over the surface. This has been termed "clumping". Smaller sludge particles, usually deep brown to gray in color, may rise and spread over the settling tank surface. Some operators call this "ashing." If aeration is sufficient to produce nitrates in the aeration tanks, problems may result in the settling tanks. If the sludge inventory is too high or if the DO level in the clarifier influent is not high enough, denitrification may result. The oxygen associated with the nitrate is removed, and the remaining nitrogen gas rises to the surface, carrying solids with it. Anaerobic conditions eventually may develop that result in the beginning phases of digestion and gas production. This also may cause rising sludge.

When floating sludge appears in quantity on the clarifier surface, the following may be tried as a remedy:

- Increase the rate of return activated sludge from the clarifier(s). This reduces the average depth of sludge on the tank floor and increases movement of sludge toward the sludge withdrawal lines.

3.2.13.3 Sludge Solids Washout

Solids may be washing over the effluent weirs even though classic bulking is not occurring. This can be shown by settling tests which will indicate a good settling sludge. In these instances, the sludge blanket may be several feet below the settling tank surface except near the weirs. Washout may be occurring in these instances because of unequal mixed liquor flow into or by unequal return sludge removal from the clarifier. In this case, flow into and out of the clarifier will require balancing. Maintaining the sludge blanket as low as possible will help. Solids washout also can be caused by nonlevel weirs, or hydraulic overloading.

3.2.13.4 Deflocculation

Deflocculation is just what the name implies - the sludge breaks up into very small particles that settle poorly and the effluent becomes very turbid. The effluent turbidity is caused by individual microbial cells

and other microscopic particles that give the effluent a high SS concentration and a high BOD. Deflocculation may occur because of toxic wastes, acid wastes, anaerobic conditions in the aeration tank, overloading of the aeration tank, inadequate nitrogen or phosphorus supply, and excess shear caused by hydraulic turbulence. The phenomenon of deflocculated sludge is quite different from that of bulking sludge, but the initial symptoms of rising SVI and turbid effluent are the same. However, deflocculation is normally a temporary condition that will correct itself in several days. Chemical treatment in this case would be of no help. Interpretation of deflocculation versus bulking characteristics by using the SVI depends on the time increment: for deflocculation the SVI will stop rising after several days, while for a bulking sludge the SVI will continue rising. A microscope can be used to interpret deflocculation versus bulking characteristics. Bulking sludge will exhibit filamentous organisms which can be identified through the use of a microscopic predominance chart.

3.2.13.5 Pin Floc

At other times, very small, compact pin floc, usually less than 0.76 mm (0.03 in) in diameter may be observed suspended throughout moderately turbid clarifier contents. This is a strong indication that the sludge age may be too high, (sludge age may be reduced by increasing the sludge wasting rate) the sludge may be overoxidized, or the turbulence in the Biolac basin is too great, resulting in floc shear instead of floc formation. This will be confirmed by a settleability test if rapidly settling discrete sludge particles appear granular rather than flocculent and accumulate rather than compact while forming a sludge blanket.

The pin floc might be reduced by lowering the sludge age or reducing the turbulence in the Biolac basin.

3.3 MAINTENANCE – BIOLAC EXTENDED AERATION TREATMENT PROCESS

Maintenance of the Biolac System will mostly consist of equipment cleaning and lubrication. All exposed parts of the basins should be washed frequently and scraped occasionally to prevent the accumulation of odor-causing deposits, such as scum, solids, algae, and fungi. Slime growths on concrete walls should be removed by scrubbing with a course bristled brush and/or high-pressure water nozzles as often as needed to prevent foul odors and appearances. Remove any debris or floating material from the clarifier's surface with a simple hand skimmer. Occasionally, the Biolac system will need to be dewatered for sludge and grit removal and other maintenance operations. The clarifier should be drained and inspected on an annual basis. Regularly remove grease and scum from the surface of the clarifiers. The overflow weir must be maintained

level and kept clean to achieve equal flow and even velocities throughout the tank. Check the drive motor, bearings, and gears, and lubricate in accordance with the manufacturer's instructions. Be sure cover plates are in place when they are not in use. Cleanliness is essential in the operation of the clarifiers.

3.3.1 Troubleshooting

Problem	***Solution***
Unusual turbulence	1. Close the aeration chain butterfly valve. 2. If turbulence continues, check the diffuser sheath for tears or damage. Clean off any obstructing material and replace the diffuser if damaged.
Clogged diffuser sheaths	1. Flex diffuser by shutting off 2 or 3 aeration chains at the same time. 2. Open the 3/4" ball valves which are located next to the aeration chain's butterfly valve. 3. Close ball valve and open butterfly valve.
Septic conditions are present causing odors	1. Sludge needs to be wasted from the clarifiers. 2. Add chlorine to the clarifiers. Use small doses (about 2 mg/l) to prevent disruption of the activated sludge process. 3. Be sure the clarifier walls and all other parts exposed to wastewater are regularly hosed down to prevent odors.
The supernatant zone above the settled sludge is not clear	1. Sludge removal is insufficient. Increase sludge withdrawal rate from the clarifier.
Sludge bulking (accumulation and overflow with the effluent)	1. Increase sludge withdrawal time.
Plugging of sludge lines	1. Loosen compacted material manually or by jetting. 2. Backflush clogged pipelines. 3. Pump sludge more frequently.

3.3.2 Safety

Domestic sewage contains bacteria, some of which may cause illness; therefore, precautions should be taken when working around the treatment Plant.

1. WASH EQUIPMENT that has been in contact with sewage, with a mild chlorine solution.
2. CLEAN UP ANY SPILLED SEWAGE IMMEDIATELY.
3. GOOD HOUSEKEEPING is essential.
4. GOOD PERSONAL HYGIENE is important (keep open wounds covered).
5. DO NOT EAT, DRINK, OR SMOKE IN THIS AREA.
6. All personnel, when working in and around the basin and lagoons MUST WEAR LIFE JACKETS.
7. All electrical equipment should have local disconnects so that service personnel may shut down the equipment at the site of operation.
8. When entering a drained tank, use a harness and safety line to prevent falling.
9. Use lockouts and signs to discourage accidentally re-energizing equipment while repairs are ongoing.

3.3.3 Geomembrane HDPE Liner Maintenance

Minimal geomembrane maintenance needs to be completed on the liner. The material is fragile and can be punctured easily so minimizing contact should be the top priority. Monthly visual inspections should be done to ensure there was no damage to the visible portion of the liner. If sludge builds up, then the liner can be gently cleaned.

There are no repair procedures that can be completed by the owner or the contractor. If repairs are needed, the manufacturer should be contacted so that an experienced technician qualified to work with the material in question can repair the damage. Any punctures or leaks in the lining can be detrimental to the environment, so operators must report any potential damage to the liner immediately.

3.3.4 Electrical Safety

Work done on any machinery or electrical equipment should only be performed by qualified personnel. Power should be disconnected and locked out when working on the electrical equipment.

3.4 POSITIVE DISPLACEMENT BLOWERS – BLOWER BUILDING

The blower room of the blower building contains six 75 HP blowers, each: Aerzen Model # GM050L-00 1850 ICFM, 1692 SCFM @ 6.27 PSIG. The blower system provides aeration for the two Biolac aeration basins. Additionally, the Building contains the Motor Control Center (MCC), the Main Control Panel (MCP), service breakers, and transfer switches.

3.4.1 Blower Operation and Maintenance

The blowers are automatically controlled to provide air, as needed, to meet the dissolved oxygen set point for each aeration basin. Blowers are sized so that one blower will supply sufficient energy to completely mix an Aeration Basin. Two blowers will supply sufficient aeration to maintain the dissolved oxygen level at approximately 2.0 mg/l when the Plant is loaded to the design capacity. The third blower for each basin is provided as a backup blower in the event of mechanical problems. The blowers should be alternated weekly to promote even wear. Detailed startup procedures are presented in the manufacturer's O&M manual.
The manufacturer's operation and maintenance manual contains detailed blower maintenance instructions. Please follow manufacturer’s information.

The manufacturer's O&M manual has a detailed guide for mechanical problems. Refer to these documents in the event of operational problems.

In general, to perform maintenance work, switch off the machine and activate the EMERGENCY STOP and switch off the main circuit breaker and secure it against restarting. Ensure that there is no live electricity, open the maintenance elements, and open the guard cover. All required maintenance can be viewed in Parkson’s equipment O&M Manual along with the directions for the various maintenance inspection and replacements. A full list of the maintenance required for all parts of the treatment plant can be seen in Appendix C - Maintenance. After maintenance is complete, make sure responsible on-site personnel are

aware of conditions and the commissioning plan. Check all loosened screw connections for tightness, mount all protective hardware and covers, remove all tools, materials and other equipment from the workspace, remove operating substances, operating materials, processing material and similar materials and dispose of them appropriately. Ensure that there are no persons in the hazard area and release the main circuit breaker and activate it. Release the EMERGENCY STOP function and inform the responsible on-site person about the result of the work carried out.

3.4.2 General Blower Description

Atmospheric air is collected and compressed by the six (6) blowers in the Blower Building. The Blower Building is located between the Lab/Operations Building and the UV/Maintenance building to the east of the north aeration basin. These blowers are connected to the ends of the aeration chains in both basins. The blower has an acoustic hood and protective covers. These cannot be removed during operation and should only be removed for maintenance and troubleshooting. The intake side of the blower serves to bring air into the blower and contains a silencer and filter which serves to reduce noise emissions and ensure clean intake gas. The machine stage of the blower system serves to compress the air that has entered the system. The oil system contains all components necessary for providing lube oil to the machine stage. The drive system serves to allow a high revolution speed for the rotational motion of the machine stage. The discharge side is where the discharging air is conveyed out. The discharge side also has a silencer to reduce noise and all surfaces are hot and under pressure during operation. The belt drive derives tension automatically from the weight of the motor. The drive motor is powered by connecting its power lines to the terminal box.

3.4.3 Initial Blower Start Up

Initial start-up instructions can be seen in the manufacturer's O&M Manual. Before starting the equipment, the operator should wear proper PPE, be familiar with the manufacturer's manual, and inspect the equipment to make sure that it has been properly installed and is ready for startup. Follow the manufacturer's directions. Perform the checks that are outlined in the manufacturer's O&M Manual to ensure that all equipment is functioning properly.

3.4.4 Emergency Blower Shutdown

If a hazard is identified during operation, the equipment should be turned off as quickly as possible and the electrical power should be disconnected and locked out. Immediately activate the EMERGENCY STOP and inform the responsible staff. Switch off the main circuit breaker and secure it against restarting. Once the equipment is fully shut-down, qualified personnel can work on making repairs and fixing the issue.

3.4.5 Blower Start-up and Shutdown

When the drive motor is started, all of the protective measures built-in to the machine should be observed. The drive motor must be started and stopped by AERtronic. AERtronic already has a built-in potential-free contact. The start-up procedure may depend on the mode that the equipment is operating in. The shutdown procedures also vary slightly based on the mode of operation. In all modes though, the machine will not shut off immediately.

Before startup, ensure that all connections are clean and there is no dirt accumulation. Ensure that all ventilation is unobstructed and natural vibrations and associated sound emissions are properly prevented (e.g., insulation). Check the oil level in the acoustic hood and the machine stage and ensure that the acoustic hood is closed and locked. In the case of an emergency, all of the moving components must be stopped as soon as possible and the electric power supply must be shut off and locked out. The EMERGENCY STOP should be engaged immediately, then the responsible staff should be notified. Next, the main circuit breaker should be turned off and secured and all qualified personnel should be assigned to fix the fault.

3.4.6 Blower AERtronic System

The complete AERtronic instruction manual can be consulted for complete directions on the blower operation. The drive motor can be started up to 160 kW with six (6) starts per hour and from 200 kW with 3 cold starts or 2 warm starts per hour. The AERtronic system is integrated as a control device and as a display and monitoring device. The AERtronic is fitted with a color graphics display with a touch-screen interface. All prompts are clearly displayed and the operator is prompted through the navigation. The terminal box contains the sensors and the terminals for connecting electrical and electronic components with the external power supply. The distribution cabinet is locked to restrict access to the high voltage parts

that could be dangerous to the touch. The terminal box contains the discharge pressure gauge which displays the discharge pressure of the compressed gas.

3.4.7 Blower Hinged Motor

The hinged motor should not rest on the guide bushing when in operating position, but should be entirely supported by the belt drive. The hinged motor should also have sufficient space to place the guide bushing after the belt has stretched. The motor specifications can be seen in the manufacturer's O&M Manual.

3.4.8 Blower Operation Modes

There are four operation modes for the blower: On-site Operation Mode, Remote Control Mode, Automatic Operation Mode, and Load Operation Mode.

3.4.8.1 On-site Operation Mode

On-site operation is when the operation of the machine happens on site. To start the equipment in on-site mode, manually activate the starter switch on the machine. To shut down the machine, manually activate the cut-out switch on the machine. In this mode, the blower can be switched off by activating the cut-out switch on the machine and the machine switches off and shuts down without stopping immediately.

3.4.8.2 Remote Control Mode

Remote control is when the machine is operated by the control station. To start in remote operation mode, activate the starter switch in the remote station. To turn off the system, activate the cut-out switch in the remote station. To shut down the blowers in this mode, activate the cut-out switch in the remote station. The machine will shut down but not stop immediately.

3.4.8.3 Automatic Operation Mode

Automatic operation is when the machine is operated by sensors or a system switch. In automatic operation mode, the sensors and system switch execute the starting command and the system starts automatically. In automatic mode, sensors and a system switch shut down the system. The shutdown of the blowers in this mode, occur automatically as they are carried out by sensors or a system switch. This shutdown does not immediately stop the system.

3.4.8.4 Load Operation Mode

Load operation is when the machine processes the operating data that it has been given. The equipment is not started while it is in load operation mode.

If the blower is in nitrogen operation mode and must be shut down, the operator should turn off the system as he otherwise would. If the shutdown is expected to be long, then the gas lines should be disconnected to avoid a possible gas leak during down time. Additional details on start-up, shut-down, and decommission and recommission can be seen in manufacturer's manual.

3.4.9 Blower Control Elements

There is a safety valve that is used for the conveyance of air. This safety valve is set at the factory and if the set value is exceeded, the valve opens and releases excess conveyed material into the atmosphere. The safety valve is not a regular control component and should not be relied on regularly. The current working pressure can be displayed via a pressure gauge or the control system screen. The acoustic hood is ventilated by a fan. The safety valve cannot be used at a temperature above 200°C.

There is a non-return flap that prevent the compressed air from reentering the machine once the compressor has been switched off. This stops the machine from "running in reverse". The acoustic hood reduces the noise and serves as a safety device to isolate the potentially dangerous equipment. The hood must be closed during the operation. To prevent accidental or unauthorized opening, a key is used to lock the hood. This key must be accessible for authorized personnel and authorized personnel only. The acoustic hood should be heated when the ambient temperature is less than -10°C to prevent damage by heating up the housing and preheating the lube oil and air that will be conveyed. The blower system can effectively operate in a

temperature range from -10 to 40°C and the mounting of the acoustic hood heating must occur at temperatures less than -10°C. The acceptable relative humidity is 0 to 80% and the atmosphere should be chemical-free. The maximum continuous operating period is 24 hours. Lubrication and grease specifications and requirements can be seen in the manufacturer's manual.

3.4.10 Blower Equipment Safety

The blowers hazard zone, within the acoustic hood should be avoided while the operations are occurring. The acoustic hood can be lifted to perform maintenance. When this occurs, several measures must be taken to ensure that the machinery does not perform an unregulated restart which could result in serious injury. Before entering the "hazard zone" for maintenance work, disconnect the electrical power supply, activate the EMERGENCY STOP function, operate the main circuit breaker, attach the padlock to the main circuit breaker, check and ensure that the machine is completely connected from the power source, and display a sign on the machine that prohibits a machine start. Before restarting after maintenance, ensure that safety devices are installed and functioning correctly and that there are no potential hazards to the safety of any persons.

Lubricants and greases contain poisonous substances and must be disposed of by a certified waste management company. AERtronic batteries contain poisonous heavy metals and they need to be deposited at local collection points or disposed of by specialist companies. Electrical and electronic components may contain poisonous material. These components must be collected separately and deposited locally or collected by specialist companies. Anti-corrosion agents may contain poisonous substances that cannot be released into the environment. This must be accomplished by a certified waste management operator.

All personnel should be wearing protective equipment including protective work clothing, gloves, and safety shoes. AERtronic fault messages are recorded and displayed in the event of issues within the system. Directions on action that should be taken in the event of certain faults can be seen in Chapter 9 of the blower manufacturer's operating instructions, which can be found in Section 10 of the Biolac Treatment System Installation, Operation, and Maintenance Manual.

Coupling guards should be in place over all of the drive shafts on the blower or any other mechanical equipment before starting up.

3.4.11 Blower – General Safety Information Discussion

1. Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
2. DO NOT REACH into any opening in the blower while it is operating, or while subject to accidental starting. Cover external moving parts with adequate guards.
3. DISCONNECT POWER before doing any work and use all safety and protective devises. Lockout and tag power disconnection to minimize accidents.
4. If blower is operated with piping disconnected, place a strong coarse screen over the inlet and avoid standing in the discharge air stream.
5. Stay clear of open inlet piping of pressure blowers, open discharge blast from vacuum blowers, blast from pressure relief valves and the suction area of vacuum relief valves.
6. Avoid extended exposure to unsafe noise levels.
7. Casing pressure MUST NOT EXCEED 25 PSI (172 kPa) gauge. Do not pressurize vented cavities from an external source, nor restrict the vents.
8. DO NOT USE air blowers on explosive or hazardous gases.

3.5 AERATION ACCESS BOATS

3.5.1 Introduction

The aeration access boats are used to access and maintain the aeration diffusers. The boats can be maneuvered to be positioned over the floating aerators and are equipped with a lift to lift and hold the aeration header while operators remove and replace diffuser assemblies.

3.5.2 Aeration Boat Description

The primary aeration access boat is a 12-foot long pontoon style boat which can be maneuvered into either basin and aligned above the diffuser assembly that needs to be replaced. The aerator can be lifted so that it can be either fixed in place or removed and replaced with a new diffuser assembly.

There is also a secondary aeration access boat which consists of two 12’ long flat bottom boats connected together. The secondary aeration access boat is also designed for use in the Long-Term Digestion Basin. Uses include sampling and sludge depth measurements.

3.5.3 Aeration Boat Diffuser Lifting Setup Description

The boat has a trolley, hoist, and lifting strap. All of the hardware is made of type 304 stainless steel. This lifting system can be used to lift a submerged diffuser and perform necessary repairs on it before setting it back in the water.

3.5.4 Aeration Access Boat Operation

The boat should be positioned so that one hull (or pontoon) is on each side of the aeration chain. The boat should then be maneuvered so the frame is directly above the equipment that needs repair. The hook will then be lowered by pressing the buttons on the A-frame of the barge. The hook should be positioned under the air lateral, and then lifted to the working level. Once work is complete, the diffuser should be lowered back down, manually unhooked, and then the hook should be returned to a safe position. If the trolling motor is in use, the battery should be attached at all times. When the barge is not in use, the battery should be disconnected from the motor and reconnected to the solar panel to recharge the battery. The maximum load capacity is 750 pounds. All Operators should always be wearing a life jacket when on or near the aeration basin.

CHAPTER 4
MIXED LIQUOR PUMP STATION

4.1 INTRODUCTION AND PURPOSE

Mixed liquor flows into the Mixed Liquor Pump Station from 30-inch influent pipes from the North and South Aeration Basins. Flow is pumped to the Clarifier Flow Splitter through three (3) 16" force mains. There is a flow meter on each pipe to measure the flow through the pump station. The pump station is made up of six (6) pumps and six (6) corresponding motors contained in a wet vault. The pumps lead into the valve vault and then into the flow meter vault where the flow is measured before entering the Clarifier Flow Splitter.

4.2 MIXED LIQUOR PUMP STATION DESCRIPTION

Mixed liquor feeds from the aeration basins to the Mixed Liquor Pump Station. The Mixed Liquor Pump Station has a wet well that contains the pumps and a valve vault that contains the check valves for the pumps. This pump station is located to the east of the aeration basins. The flow meters on the pipes that flow into the Mixed Liquor Pump Station can be accessed to the west of the valve well. The pump station pumps the water from the aeration basins to the Clarifier Flow Splitter.

4.2.1 Mixed Liquor Pump Station Materials

The pumps are automatically connected to the discharge connection without personnel having to enter the wet well. The seal is accomplished with a metal-to-metal connection that does not need an O-ring or a profile gasket. All exposed nuts and bolts are 316 stainless steel construction and all metal surfaces that contact liquid and are not stainless steel or brass are protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump. All of this reduces corrosion and wear on the exterior of the pump. The pump can operate at full capacity when completely submerged, partially submerged, or totally non-submerged.

The outside of the pump is made of chromoly steel which is very resistant to rust. This pump is also painted to assist in corrosion resistance; however, if the paint is damaged, the pump should still be rust-free and requires no maintenance. The impeller is made of hard-iron so it is unlikely to be damaged.

4.2.2 Concrete Vaults

All equipment from the pumps, valves, and flowmeters are located within poured/precast concrete vaults. These vaults require minimal maintenance and the interior is coated with a protective epoxy/urethane coating. Access to all equipment is provided by Halliday hatches with fall protection.

4.2.3 Valves and Flowmeters

As part of the station to monitor and control flow from each set of pumps a pressure gage, flowmeter, plug valve, and a check valve were installed into separate vaults. The purpose of the valves is to direct flow and prevent and backflow from entering the pumps. The flowmeters are used to monitor flow to ensure that there are no major leaks within the plant process.

4.3 MIXED LIQUOR PUMPS

There are six (6) Flygt brand solids-handling pumps equipped with N-technology. Each pump has a mating cast iron 12-inch discharge connection and is capable of delivering 2,400 gallons per minute (GPM) at 17 feet TDH. The minimum shut off head is 52 feet. These pumps are guaranteed to operate clog free for twelve (12) months, as part of the Clog Free Operations Guarantee. These pumps are also guaranteed to use at least 25% less energy for pumping than a competitor's non-clog solids handling pump. Each pump has a built-in lubrication chamber to adequately seal the shaft system. The lubricant chamber is designed to prevent overfilling, and allows for future expansion, should it be necessary. A separate seal leakage chamber is built-in so that any leakage that may occur past the upper secondary mechanical seal will be captured prior to entry in the motor stator housing.

The pump is set up with the impeller and inlet on the bottom of the pump. The discharge is on the side with the large discharge hook attached at the end of the discharge. The pump motor is encased in a cooling jacket above the inlet. Four (4) removable bolts attach the pump section and the motor section. At the boundary between the motor casing and the impeller casing is a cartridge that contains two (2) seals. This joint provides access to the dry area between the two (2) seals. If there is liquid in this area, it should be identified and the source should be found. There are two (2) seals in this area. The bottom seal stops the water from entering the motor area. The top seal stops the cooling fluid from the pump area. The area in between the two (2) seals is a dry chamber that should be free from all fluids. There is an access port to this region so that the operator can easily ensure that there is no fluid in the dry chamber. This access port is located near

the bottom of the motor casing, near the joint between the motor and pump sections. Two (2) drain/fill ports are located near the top of the motor casing. These ports look similar to the access port for the dry chamber. There is a manual lifting handle on the top of the pump. The lifting chain is also attached at the top of the motor casing. The lifting action is an 18-inch section of chain with the end attached to the 40 feet of spectra guide line. The pump is made so that the inlet is on the bottom and the discharge is on the side. The motor sits above this portion in a casing that contains the coolant for the motor.

4.3.1 Mixed Liquor Pump Motors

Each of the pumps will have one corresponding motor, for a total of six (6) identical pump motors. These motors are 35 HP submersible electric motors that are induction types with squirrel-cage rotor, shell type design and are housed in an air-filled watertight chamber. They are connected for operation on 460 volts, 3 phase, 60 hertz, 7 wire service with 50 feet of shielded submersible power cable. All of this equipment is appropriate for operation in submerged conditions. The power cable is sized according to NEC and ICEA standards and has P-MSHA Approval. The motor is designed to continuously pump media at a maximum temperature of 104°F. The motor can withstand at least 15 evenly spaced starts per hour. The motor includes thermal switches that are used with supplemental motor overload protection to avoid equipment damage. The switches and additional measures are also attached to the control panel. The motor service factor (combined effect of voltage, frequency, and specific gravity) is a minimum of 1.15. The motor has a voltage tolerance of plus or minus 10%.

4.4 MIXED LIQUOR PUMP IMPELLER

The pumps are chopper style/N-style. This impeller is made to remain clog free by cutting through any solids that make their way into the pump inlet.

4.4.1 Mixed Liquor Pump Impeller Gap

The impeller gap between the impeller and the contact ring should be 8-10 thousandths of an inch, similar to the thickness of a piece of paper. This gap has large impacts on the operation and efficiency of the pump so it must be monitored carefully. There would be approximately a 5% drop in flow if the gap was doubled in any of these low head pumps. The gap needs to be small because this helps the impeller cut through debris instead of becoming tangled in it or sucking it into the intake. If the gap is too large, the water will

try to work back out through the impeller gap between the volute and impeller in the inlet instead of into the discharge outlet. The higher head and pressure that the pump is working with, the higher the efficiency loss from a small change in the impeller gap.

4.4.2 Mixed Liquor Impeller Adjustment

To adjust the impeller or to check the gap, lift the pump out of the well, and lay it on its side. The impeller bolt should be loosened and removed using an Allen wrench to adjust the impeller. If an Allen wrench cannot loosen it, it may be necessary to jam a piece of wood or similar material into the pump outlet to stop the impeller from spinning so that it can be loosened. The pump has a tapered shaft with a brass split ring on the end of the shaft. The open hub is placed over the shaft. This set up is what takes the torque and attaches the impeller to the rest of the pump. The impeller bolt locks this set up in place. Once the impeller bolt is removed, the impeller will still be attached and can spin. To fully remove the impeller, work the set screw back and forth until it is released. This screw is reverse threaded. The impeller can be hit with wood to fully loosen if it remains stuck. Once the set-up is released, the set screw should be turned hand tight clockwise to bring the set screw lower, which will shrink the impeller gap. The rotation should be checked to ensure the impeller gap is even all the way around the inlet opening and is correct. Once the impeller gap is correct, the impeller bolt can be replaced and the pump lowered back into the wet well.

4.4.3 Mixed Liquor Impeller Troubleshooting

The impeller is moving quickly when the pump is operating. If the impeller hits the contact ring it may become dangerously sharp and could become dangerous to operators. Operators should not be near the impeller of the pump before the breaker lock out has locked out the power.

If the impeller gets stuck or tangled, the motor casing section should be removed. This can be done by simply removing four (4) bolts and separating the pieces. This will come with the impeller and will make whatever object is stuck much easier to remove. There is an O-ring at this joint to help seal, but this O-ring is not vital and does not require frequent inspection.

4.5 MIXED LIQUOR PUMP LIFTING SYSTEM

The lifting system is provided with the pumps by the manufacturer. This system should be the only one that is used for lifting the pumps. If the system malfunctions, the pumps can be lifted manually by the operator, although this should be avoided whenever possible.

4.5.1 Mixed Liquor Pump Lifting Equipment

Each pump was installed with 40 feet of lifting chain assembly, fabricated by the pump manufacturer. This lifting chain assembly is made up of Spectra cord and 18-inches of stainless-steel chain. This is part of the Flygt Grip Eye Lifting System. The working load of this system is 50% more than the unit weight of each pump. The Flygt Grip Eye lifting system can easily lift a pump for repairs and no other lifting systems should be used with these pumps.

To operate the lifting system, a Grip-Eye was also supplied. This Grip-Eye should be attached by the small eye at the end of the hoist cable. To lower the pump, the operator should thread the guide rope and attached lifting chain through the Grip-Eye. A link in the chain should be caught in the bottom of the grip eye when the guide rope is slack and the chain should slide through the grip when the lifting rope is taut. The pump should then be lifted with the hoist and a loosened guide rope (so the lifting chain is locked in). As it is being lifted, the operator should be careful to ensure that all lifting chain and shackles remain straight. The operator should hold the hoist controls in one hand and the guide rope in the other. The hand with the guide rope should also rest on the chain that is attached to the pump. The guide rope should remain slack as the pump is lowered so that the Grip-Eye remains secured on the lifting chain.

The end of the discharge hook has a T-shaped section of metal that fits between the guide rails, called the guide bars. The guide rails are set up vertically over the discharge connection. The T-shaped part of the discharge hook should be fitted in between the guide rails as it is lowered. The rails serve to guide the pump so that it can be seated properly. As the pump is lowered, the intake section of the pump will touch the surface of the water in the wet well first. When this happens, the operator should shake the hoisting chain that is attached to the pump. This will dislodge the air in the pump before it is attached to the discharge. As the pump is lowered the weight of it causes the discharge hook to attach to the discharge opening and seal it. The seal between the pump and discharge ping has no rubber parts and is not meant to be a perfect water tight seal.

When the pump has reached the seat, the chain on the lifting hoist will become measurably slack. If the well is full, it may not be possible to see the pump when it is seated, but the operator should be able to feel the chain on the crane/hoist lose tension with the hand that is resting on this portion. Once the pump is seated, the operator should jerk the lifting cable sharply toward the discharge outlet. There should be no movement or shifting if the pump is properly seated. If there is shifting, the pump should be raised and then lowered again to ensure that it is properly seated. The operator should pull the slack out of the guide rope to free the lifting chain from the grip eye. The operator should feel the links of the chain slipping around the Grip-Eye. Once the lifting chain is free, the hoist should be raised up and the guide rope unthreaded and tied to the top of the vault. The rope should have enough slack that the chain can lay flat against the pump. If the chain cannot lie flat, it may get caught up in anything floating in the wet well. This could cover the chain which would stop the Grip-Eye from functioning and therefore disable the lifting system. If this occurs the operator would have to enter the wet well to clear the lifting chain or manually attach the hoist/crane to the pump.

4.5.2 Mixed Liquor Pump Guide Rails

There are two (2) guide rails positioned over the outlet of the wet vault. These guide rails guide the discharge hook down as it is lowered and lifted. However, the guide rails are not meant to hold the weight of the entire pump (approximately 7,500 pounds per pump) at any time. Care must be taken when lifting or lowering the pumps to ensure that it is always being pulled straight up and down, parallel to the rails so that they are not supporting any significant weight. This can be especially challenging when the pump has been operating in a wet well with significant water. The pump will likely be cemented to the outlet to some degree. In this situation, extra care must be taken to ensure that the pump is being lifted up straight.

4.5.3 Mixed Liquor Pump Discharge Hook and Outlet Connection

The pump has a discharge hook at the edge of the discharge outlet. This hook has a T-shaped region on the outermost edge that is farthest from the body of the pump. This T-shaped region must be fed between the two guide rails as the pump is lowered back into the wet well. This serves as a guide to ensure that the pump is reseated properly. The discharge hook also serves to seal the discharge region of the pump to the discharge outlet from the wet well. As the pump is reseated, the weight of the pump causes the hook to attach to the outlet and seal it. There is no rubber seal, just the metal-to-metal attachment between the discharge and the outlet. This seal is not perfectly water tight, but should not have significant leaks. If there

is any kind of large or “fire hose” leak when the pump is running, the pump should quickly be turned off and reseated. If the large leak continues, the high pressure that the water is under will cause a channel to be made in the metal which will alter the shape of the vault outlet and discharge of the pump. This will cause a good seal to be impossible and will cause larger and larger leaks as time goes on and will become more and more difficult to fix.

4.5.4 Mixed Liquor Pump Lifting/Lowering Operation

As the tension is being put on the lifting chain, the operator should make sure that the hoisting chain, lifting cable, and any shackles are straight and untangled.

The power cord is the most sensitive spot in the pump and should be paid special attention to during operation, maintenance, and repairs. Lifting and lowering can be especially risky for the power cord as it may get caught, especially if the wet well is full and cannot be seen clearly during removal. If any nicks or visible damage is seen on the insulation of the power cord, it should be immediately addressed.

4.5.4.1 Lowering Pumps

To lift and lower the pumps, the Flygt Grip-Eye Lifting System is used. The Grip-Eye should be attached to the crane/hoist. Before lowering, the guide rope should be passed through the hole in the Grip-Eye and then a link of the 18-inch lifting chain should be hooked into the Grip-Eye. The operator should hold the hoist/crane controls in one hand and the guide rope in the other. The guide rope should be held loosely so that the chain remains hooked by the grip eye. The pump should be raised and aligned over the entrance to the wet well. The discharge hook T-shape should be aligned between the guide rails and then lowered. As the pump is lowered, the operator should keep the guide rope relatively loose and with the same hand should lightly hold the lifting cable to get a sense of the tension in it. When the bottom of the pump reaches the surface of the water, the operator should shake the lifting cable. This will remove the air bubbles from the pump.

When the pump is seated, the weight should be supported by the outlet/discharge connection and the lifting cable should go slack. The operator should be able to feel the tension ease in the lifting cable to signal that the pump is seated, if the connection is not visible (because of a full wet well). Once seated, the operator should sharply push the lifting cable towards the rail. If the pump is properly seated, there should be no

shifting when the lifting cable is moved. Once the operator confirms proper seating, the guide rope should be held tightly to unhook the lifting chain from the Grip-Eye. The guide rope should be held tightly as the hoist is raised until the operator feels the grip eye pass all of the chain links. Once the Grip-Eye is passing only over the guide line, the line can be held loosely. When the lifting cable and grip eye is completely out of the wet well, the guide rope can be passed through the Grip-Eye so that it is disconnected from the hoist/crane. The rope should be looped over the hook on the side of the top of the guide rails and then tied around the top as well so it is attached with two fasteners. There should be enough slack in the guide line that the chain can lay flat against the pump but no extra. If the chain does not lay flat, the chain will catch the solid waste in the wet well and become covered in waste. The Grip-Eye will then not be able to lock into the chain and the lifting system will not work as intended.

If there is too much slack in the guide line, the guide line may be sucked into the pump and stop it from operating effectively. The operator should take great care not to drop the guide rope into the wet well at any point. If it is dropped, the line should float at the surface briefly. While it is floating, the operator should try and retrieve it using a hook of some kind. If the line sinks into the wet well, the pump farthest from the one with the lost guide line should be used to pump the level of the wet well down so that the guide rope is visible. The farthest pump should be the one that is activated to minimize the possibility of the guide line being sucked into a pump. The dropped guide line should then be retrieved using a hook or pole of some kind. If using a hook is not possible, the operator may need to enter the wet well to retrieve it. If the line is sucked into another pump, that pump will likely have to be lifted to remove the guide rope so this should be avoided as much as it can be.

4.5.4.2 Lifting Pumps

To raise a pump, the guide rope should be retrieved and then passed through the grip eye. The hoist/crane should be lowered as the operator holds the guide rope taut. The operator will be able to feel when the Grip-Eye reaches the stainless-steel chain. The operator should then loosen the guide line (not drop, just release tension) so that the Grip-Eye can lock onto the lifting chain. Once locked, the pump should be lifted straight out of the well, taking care not to put tension on the guide rails. Once the pump is out it should be guided by hand and gently set down. The operator should then pull the guide rope tight to unlock the Grip-Eye from the chain and the hoist/crane should be removed. The guide rope can be set next to the pump neatly while the pump is not in the wet well.

4.6 MIXED LIQUOR PUMP MOTOR COOLING SYSTEM

The pumps are installed with an integral motor cooling jacket that encircles the motor stator housing, allowing the dissipation of motor heat. An impeller that is driven by the pump shaft provides the necessary circulation of the cooling liquid through the jacket. The cooling system has one (1) fill port and one (1) drain port integrated into the cooling jacket. The cooling system allows the pump to operate continuously in liquid or ambient temperatures of up to 104°F (40°C). Any operational restrictions that occur under this threshold temperature are not acceptable and the manufacturer should be contacted to solve this issue. No additional fans, blowers, or auxiliary cooling system should be added to the system.

The cooling jacket surrounds the motor. There is a mini plastic impeller in this jacket area that drives the circulation of the coolant. This fluid is driven down along the motor and dissipates the gathered heat into the water that is being pumped before running up along the outside edge of the cooling jacket where it recirculates. No fluid is expected to leave the motor casing so there should be no need to replace coolant unless there is a malfunction.

4.6.1 Replacing Mixed Liquor Motor Coolant

Towards the top of the motor casing are the drain/fill holes, located near the top of the motor casing on opposite sides. To drain the glycol coolant, open both holes and lay the pump on its side. This lets the glycol drain out of one side while air enters the area through the other side. To fill the chamber, set the pump upright and open both drain/fill holes. Put a funnel in one hole and fill with the glycol coolant solution until it overflows. This will likely be about 7 gallons of liquid. As the glycol is added in one hole, the displaced air will escape the other hole. The coolant level should be level with the fill hole and therefore easy to check. Coolant is not used up and should not exit the chamber so there is no scheduled glycol replacement unless it is required.

4.7 MIXED LIQUOR PUMP STATION CONTROLS

The Mixed Liquor Pump Station has two (2) level transmitters that are used to monitor the water level in the wet well. There are also six (6) high level floats that will sound alarms if the water level in the wet well gets too high. There is also a check valve limit switch for each pipe.

The Mixed Liquor Pump Station consists of a valve vault and a wet vault. The wet vault contains six (6) pumps that pump the mixed liquor to the clarifier flow splitter. The Pump Station contains two (2) Programmable Logic Controllers (PLCs) that control when the pumps are active. The first PLC controls Pumps 1, 3, and 5, while the second controls Pumps 2, 4, and 6. If one PLC fails the other one is used as back up. The bottom of the wet well is at an elevation of 14 feet and the top is 27 feet. At an elevation of 16 feet, the LOW Alarm will be triggered and the redundant All Pumps OFF control will be activated via a transducer. At an elevation of 20.5 feet, the HIGH Alarm #1 is triggered. At an elevation of 21 feet, HIGH Alarm #2 is activated and the redundant All Pumps ON signal is activated. At this point all six (6) pumps should be working at their full capacity. At an elevation of 21.5 feet, HIGH Alarm #3 is activated and the first float control activates the Redundant Pump 1 ON control. At every 6-inch interval, up to 24 feet, an additional float control activates another Redundant Pump ON to ensure that all pumps are working at their full capacity at these high-water levels.

There are two (2) inlet pipes into the mixed liquor pump stations and six (6) outlet pipes, one for each pipe. These wye back into 3 pipes after each passes a check valve with a limit switch and plug valve in a precast concrete valve vault. The limit switch can be used to individually control the flow to each pump. Pumps 1, 3, and 5 are wired to one control panel to the east of the wet well. Pumps 2, 4, and 6 are wired to the second control panel, slightly to the south of the first panel. If one (1) control panel has any issues, the second will be functional and can be used separately from the first.

4.7.1 Mixed Liquor Pump Station Control Logic

The control logic for the pumps is as follows. The lead pump will turn on and drop to 45 Hz with a capacity of 2,200 GPM at 18 feet, then speeds up to the maximum of 60 Hz with a capacity of 4,250 GPM as the water level increases to an elevation of 18.75 feet. If the water level increases past the single pump capacity, the lead pump will continue and a second pump will turn on and drop to 45 Hz. As the water continues rising, the second pump will speed up to 60 Hz (maximum capacity). If the water continues rising, the same control logic will continue until all six (6) pumps are working at full capacity, if necessary. The lead pump will alternate upon every start-up to keep the hours of operation relatively equal between all of the pumps. The maximum operating run-time for each pump is 24 hours. After this time has been reached, the pumps that are running should be alternated to avoid excessive wear. In addition the lead pump should be alternated for each start to reduce wear on a single pump.

4.7.2 Mixed Liquor Pump MiniCAS and Alarms

Each pump motor stator incorporates three (3) thermal switches. There is a stator phase winding and the thermal switches are connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor will stop and activate an alarm. A float switch will be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection. The thermal switches and float switch will be connected to a MiniCAS control and status monitoring unit. The MiniCAS is designed to be mounted in the pump control panel. The MiniCAS monitors conditions and triggers alarms for high temperature, seal leakage, and shorted sensors. The MiniCAS works by sending 12 V DC power supplies to the sensor using protected, noise-filtered electronic circuitry. When conditions are in the correct range of values, the Temperature Alarm Relay is activated and normal pump operation can occur. The alarms can be monitored remotely using the plant-wide SCADA system.

The controls for the pumps include a MiniCAS relay for each of the pumps. These relays translate the resistance from the alarm circuit to determine what alarms may be triggered. The alarm circuit is made up of a circuit of two wires that are included in the power cable. These will then be displayed on the MiniCAS display in the control panel and also on the plant SCADA system. There is a float leakage sensor that will indicate if there is a leak in the pump. This will likely not immediately shut down the pump because the pump can endure some degree of leaking before the pump is damaged. These alarms should still be addressed as soon as possible to avoid the risk of damage. There is an Overtemp sensor that will likely be triggered if the pump is clogged or if the cooling system malfunctions. This will shut off the pump immediately. If the pump did not shut down, it would continue heating up and eventually melt and likely cause an explosion in the wet well. The pumps are rated as explosion-proof because they do automatically shut down.

The MiniCAS relay has a manual and automatic alarm reset. The manual reset should be used for the relay. This will mean that after an alarm and pump shut down, the operator will have to disable the alarm and reset the system themselves before the pump will restart. If the relay was set to automatic and there was an Overtemp alarm, the pump would cool down once it was shut down. After it passed the threshold temperature, the pump would restart automatically, only to overheat again as the issue has not yet been fixed. This might end up causing more damage so the MiniCAS should not be set to automatic reset mode.

4.7.3 Mixed Liquor Pump Station Backup Power

The mixed liquor pump station control panels are connected to the Main Control Center 3 in the Blower Building. If a power outage occurs the automatic transfer switch will transfer power from the 230kW generator to the mixed liquor pump station and it will continue operation.

4.8 MAINTENANCE

4.8.1 Mixed Liquor Pump Inspection

The most important preventative maintenance is to track the amperage that each pump is drawing. Each pump has their own drive and is expected to draw about 42 amps, but the actual draw should be noted upon commissioning. If any significant alterations are observed, the pump should be powered down and checked for possible malfunctions or early warning signs of such.

Every pump should be lifted and inspected based on 2,000 hours of run time or once per year. This can be done by operators, but is also provided by Flygt as a service that can be purchased. During this inspection, each pump should be removed from the wet well and run. There should be very minimal noise after start-up and little vibrations. If there is significant noise or vibration, further investigation should be done to determine the source and repairs should be made. A visual inspection should also be performed to ensure that the impeller gap is correct and all cables and pump exterior are in good condition. The coolant should then be checked by opening the drain/fill holes and observing. The liquid should appear clear and smell like sugar water. If it is not, the reason for this should be identified and the coolant replaced. The rotation direction should also be checked. It should be clockwise. If the impeller is turning the wrong direction (counterclockwise) but would have an estimated 40% drop in flow. The inspection should also check the dry chamber, through the hole near the joint between the motor and the pump, between the upper and lower seals to ensure that it is dry. If it is not, the problem allowing this to happen should be identified and repaired as soon as possible.

At the boundary between the motor casing and the impeller casing is a cartridge that contains two (2) seals. This joint provides access to the dry area between the two seals. If there is liquid in this area, it should be identified and the source should be found. If there is glycol solution in the dry area, then the top seal is leaking and the coolant is escaping. If there is mixed liquor in this area, the bottom seal likely failed. These seals should be fixed as soon as possible upon finding the failure.

Additional maintenance tasks and intervals can be found in Section 2 of the manufacturer's Operation and Maintenance Manual, Volume 1 of 3 of the Submersible Pumps O&M. Other tasks can be found in Appendix C.

As part of inspection all valves should be exercised to confirm that they are working correctly and the interior of all vaults should be visually inspected in order to confirm no spalling or corrosion is occurring from hydrogen sulfide.

4.8.2 Mixed Liquor Pump Replacement Parts

Each component of the pump is individually balanced during manufacturing. Any components, including the impeller, can therefore be replaced individually. If a part requires repairs, it can be replaced with the correct Flygt-made part without the need to replace any other parts.

CHAPTER 5
SECONDARY CLARIFICATION AND SLUDGE SYSTEM

5.1 INTRODUCTION AND PURPOSE

The secondary clarification system settles out and removes solids and biological contaminants. The mixed liquor flows out of the aeration basins and into the Mixed Liquor Pump Station and then to the Clarifier Flow Splitter, where a chemical feed system can be used to add either polymer or sodium hypochlorite to the mixed liquor. The polymer assists with the settling as the mixed liquor enters the two (2) parallel secondary clarifiers where solids settle out and are removed as sludge. These clarifiers serve to allow the biological material to settle out of the mixed liquor. The settled material flows back to different parts of the treatment facility, where it is reintroduced into the treatment process as return activated sludge (RAS), or disposed of as waste activated sludge (WAS). Once the solids have settled out, the effluent overflows the effluent weirs to the UV disinfection system for final disinfection.

5.2 PROCESS DESCRIPTION

5.2.1 Clarifier Flow Splitter

The Clarifier Flow Splitter splits the flow of mixed liquor into two (2) streams which then flow into the North and South (secondary) clarifiers. There is equipment that would allow an additional split into a third stream that can flow into a third future clarifier. This third clarifier has not yet been constructed. If the demand increases in future years, the third clarifier can be built and used for additional treatment capacity.

5.2.2 Polymer Feed System

This system includes dual flow meters, a peristaltic metering pump system, as well as piping, tubing, valves, and an injection apparatus, along with other components. The polymers are added and then activated as they are mixed into the process water which then flows into the mixed liquor just before it passes the clarifier flow splitter. The activated polymers attract suspended polymers forming larger solids that can more efficiently be settled when in the clarifiers.

The equipment for this system was replaced in the 2020 plant upgrade. The main Polymer Feed System is located in the Blower Building, near the positive displacement blowers. The Blower Building is located in between the Laboratory/Operations Building and the UV/Maintenance Building. The system in the Blower Building connects to the Clarifier Flow Splitter where the polymer is combined with the mixed liquor.

5.2.3 North and South Clarifiers

The mixed liquor with added polymer flows to each of the two (2) 85-foot diameter clarifiers. This is where the organic remnants in the mixed liquor settle out with the help of any polymers that may have been added. The equipment in the clarifier ensures that the settled solids are conveyed properly while maintaining the condition of the clarifier and ensuring that there is sufficient removal of suspended solids and organic pollutants from the effluent that flows over the effluent weirs of the clarifiers.

5.2.4 Sludge Flow

The sludge that is separated from the effluent flows back into different areas of the treatment plant. The return activated sludge re-enters the North and South Aeration Basins where it helps to treat the waste and continues flowing through the plant, eventually returning to the clarifiers. The return activated sludge (RAS) is returned to avoid loss of microorganisms from the aeration tank, in order to maintain the adequate level of micro-organisms for treatment. The waste activated sludge (WAS) enters the Long-Term Digestion Basin, and is effectively removed from the treatment system. This portion of the activated sludge is approximately equal to the microbial growth/yield and is removed to avoid overpopulation of microbes in the treatment system. Activated sludge may also be sent to the aerated grit chambers to assist in odor reduction.

5.3 POLYMER FEED SYSTEM

5.3.1 Polymer Feed System Theory of Operation

Long-chained organic molecules (polymers) are coagulant aids that bring about the removal of particles through absorption, charge neutralization, and bridging between particles. Polyelectrolytes are water-soluble synthetic polymers that have many ionizable groups and are classified as anionic (negatively charged compounds), cationic (positively charged compounds), and nonionic (neutral compounds).

Because each commercial polyelectrolyte has specific properties, the type and dosage must be determined experimentally. Due to the complexity of wastewater treatment, anionic or nonionic polymers often prove best suited.

Effective coagulation involves two (2) distinct phases of operation: mixing and flocculation. Mixing rapidly disperses the dissolved coagulant throughout the water being treated, usually by violent agitation. Flocculation involves agitation of the water at lower velocities for a much longer period, during which very small particles grow and agglomerate into well-defined flocs of sufficient size to settle readily.

5.3.2 Polymer Feed System Equipment Description

The polymer feed system utilizes one (1) Mixmate Polymer Feed System Model #M072-424-A234 and 2W plant water. The system has an injection module and a static mixer. The injection module supplies adequate energy to atomize the polymer and provide an initial mix to the solution or, when called for, a primary emulsion break. The system is designed to minimize the possibility of fouling. The second stage of mixing is provided by two (2) 14-stage in-line static mixers that have been specially prepared to blend and activate the polymer. The system can hydrate emulsion polymer from 1.0% to .2%, with no limit on the volumes that are needed. The system hydrates emulsion polymers and conveys them into the water system directly and continuously. The Mixmate polymer feed system has enough polymer efficiency that no aging is required for the flow exiting the polymer feed system. This uses the kinetic work available in the pressurized city (2W) water that is used. The hydration is nearly immediate. The system is made of PVC and the static mixer is made of transparent material so that the mixing can be seen. The brass globe valve in the system allows extensive water control. The equipment can quickly be disassembled if cleaning is needed.

The unit functions to meter the polymer dosage, regulate the mixing water, provide uniform dilution and activation of the polymer, and feed the solution to its discharge point in the mixing vault. Dilution water controlled by the solenoid valve and polymer from the metering pump enter the mixing chamber of the unit, where dilution and activation occur. The prepared solution is then ready for use. The polymer dosage is adjusted at the pump face or at the pump controller. Opening or closing the water control valve controls the primary dilution water at the mixing chamber of the unit. Post-dilution water is controlled by the globe valve.

Before operation, the metering pump must be primed according to the manufacturer's instructions. After the unit is activated, the output must be adjusted. The output is determined by setting pump stroke length

and stroke frequency together with setting the dilution water flow. The operator will determine which output setting is best for filter operation based on experience with the system. However, DO NOT EXCEED POLYMER CONCENTRATIONS OF 1% IN THE UNIT. The pump must not be operated unless water flow is established. Polymer alone (without water) or excessive polymer concentration can plug the discharge plumbing. The operator must become familiar with the manufacturer's manual before operating the Polyblend unit. The polymer feed system pumps the polymer solution to the flow splitter. The alum and polymer treated wastewater is then conveyed into the effluent filter.

5.4 SECONDARY CLARIFIERS

The system contains two (2) identical secondary clarifiers has an 85-foot inner diameter with the side water depth of 15 feet, manufactured by Ovivo USA, LLC. There are six (6) sludge suction pipes per clarifier, and a 9-inch tall, 2-inch 90-degree V-Notch FRP Weir around the perimeter of each clarifier. The sludge collector is Model SS-3.5-P which is also a product of Ovivo USA, LLC. Most of the equipment used in the clarifiers are stainless steel and all parts have high corrosion resistance, meaning little maintenance is required for these parts. The connections that are bolted connections designed to resist all static, live, and erection loads. The maximum allowable combined stress in any member at this loading shall not exceed 20,000 PSI. The concrete clarifier basins are supported by augercast pile foundations.

5.4.1 Secondary Clarifier Structure

The clarifiers are large circular concrete basins. The bottoms of the basins are sloped 2% downwards towards the center of the basin. In the center of each clarifier, the center pier column attaches to the lowest point in the basin. This central column contains the scum collection pumps, the gear assembly, and other necessary components. This column is a circular stainless-steel center pier with a concentric sludge return pipe. The top of the center pier has a stable surface that the main gear is mounted on. This pier supports the access truss bridge, drive service platform, and the entire weight of the rotating mechanism. There is an access walkway/bridge that attaches to the center pier column and the edge of the clarifier basin along with stairs up to the top of the basin walls and a walkway around the border of the basin. The operator can access any of the central equipment via the access walkway.

The main gear housing is fitted with one (1) oil fill port and one (1) oil level indicating site glass. One (1) drain shall be provided to assure the complete removal of spent oil and condensate from the housing. The

main housing shall also be fitted with a minimum of eight (8) mounting/leveling bolts, one (1) inch in diameter.

The influent enters the clarifier from the 30-inch diameter influent pipe to the center pier and is directed toward the surface while the velocity is reduced. This diffuses the influent and directs the scum to the surface, all inside the octagonal flocculation baffle. This baffle ends 20 inches from the surface of the water.

The center column supported hydraulic differential type sludge collector mechanisms with separate scum removal mechanisms. The equipment was constructed such that all rotating elements of the mechanism shall be supported above the water surface.

There is a surface spray assembly spanning from the peripheral scum baffle to the outside of the feed well. This spray assembly uses 3W water to direct any scum that forms on the surface of the clarifier into the scum ports in the return sludge trough, and into the scum collection trough for removal via the scum pump.

There are two (2) collector rake arm frames in each clarifier, each equipped with stainless steel squeegees. The squeegees and blades that are specially designed to direct sludge along the floor of the clarifier to the nearest suction pipe, where it is removed from the clarifier. Each rotating rake arm scrapes the floor of the clarifier once each revolution, so the clarifier is scraped two (2) times per full revolution of the rake arm. The rake arm rotates at approximately 7-10 ft/min.

The center drive assembly is mounted to the center pier. This consists of a cast iron turntable base with an internal forged steel spur gear designed such that the gear, bearing balls, and raceways can be removed for service or replaced without removing the access bridge, gear housing, or disconnecting the drive cage. All repairs or replacement of drive components can be performed without dewatering the collector basin or disrupting the flow through the basin with the aid of only a 1-ton capacity portable hoist. The gear drive assembly rotates the rake arm.

The inner PVC spray system serves to suppress foam. It sprays water around the center column, below the gear drive. If it is operated automatically, then the operation will coincide with the scum pump operating cycle. This system can be operated manually or automatically. The water used in this spray system is 3W plant water, piped from the 3W Pump Station.

The drive cage frame is a center rotating drive cage frame and integral sight well assembly that provides an attachment structure for the sludge collector arms, return activated sludge (RAS), scum trough, and influent

well. The drive cage shall be completely supported and stabilized by the main gear bearing. No below water supports, bearings, or bumpers are present. The clarifier influent flows through the feed well. This well is supported by channels attached to the drive cage. The well rotates with the drive cage frame.

5.4.2 Activated Sludge Collection

The sludge collector has rake arms and a hydraulic differential sludge removal system to allow for a high-rate sludge return and concurrent skimming of the clarifier surface between the influent well and scum baffle. This system contains suction pipes, which are vertical and attached to the bottom of the sludge collection manifold troughs. The collection manifold is an open trough that allows for visual inspection and easy sampling of the return sludge flows. The collection troughs also allow for full surface skimming from the skimming weirs and the liquid surface.

5.4.3 Scum Collection

The scum discharge equipment is located in the center pier column, accessible from the center access platform. The surface spray assembly uses 3W water to direct scum that forms on the surface into the scum collection trough. Scum flows into the scum collection box around the center pier column, where it is pumped through the 2-inch diameter discharge hose and subsequent 3-inch diameter schedule 40 hot-dip galvanized carbon steel piping at a rate of 80-100 gallons per minute (GPM). The 3-inch scum piping parallels the 3W spray system piping, and is mounted to the access bridge, which leads from the edge of the clarifier to the access platform.

Scum is typically pumped to the Long-Term Digestion Basin, but opening plug valve PV-541 and closing PV-540 will redirect the scum into the West Plant Drain Pump Station, where it will ultimately be pumped to the front end of the grit chambers and incorporated with the plant influent.

The scum pump is a WEMCO/Hidrostal A2Q submersible pump, and is mounted in the scum collection box of the center pier column. See Section 4 of the Hidrostal A2Q Installation, Operation, and Maintenance Manual within the Clarifier Equipment manual for repair and maintenance instructions.

5.4.4 Clarifier Scupper

The basin has inboard concrete troughs that direct the effluent to the clarifier scupper and then out of the structure. The treated water overflows into the effluent trough, which is concrete coated with a protective epoxy/urethane coating, along the edge of the clarifier basins. The trough may develop algal growth that should be removed regularly using a brush or water hose to avoid elevated concentrations of suspended solids in the final effluent.

The effluent trough leads to the clarifier scupper, which is 5'x5'x5' concrete box that is attached to the side of the clarifier basin and then leads to the secondary effluent piping. This piping leads to the UV disinfection system for final treatment before exiting the plant. The secondary effluent leaves from the northeast edge of each clarifier.

5.4.5 Clarifier Motor

The motor is a DR motor with SEW-Eurodrive model with BM(G) brakes. The motor can function with ambient temperatures up to 104°F (40°C). The motor can be up to full-load and rotate with 300 rotations per minute (RPM) without additional cooling. The motor comes equipped with a torque indication scale and alarm and shutdown sensors with hermetically sealed contacts.

The system contains a small sized Snuggler Gearmotor attached to the main gearbox. This Snuggler is held in place by springs that allow it to rotate. This Snuggler serves to measure the torque that is being applied and will automatically shut down and trigger the alarms if the factory-set Alarm and Shutdown torques are reached. Besides the sensor output, there are no other electronic devices that are a part of the mechanism, allowing for minimal maintenance. The Snuggler motor requirements will likely never exceed ½ HP. The sensors are triggered by magnet proximity so the internal contacts are changed by a magnetic field and they can operate with voltage. The Snuggler works by building torque required to move proportionally to the output torque. This builds up energy in the springs and the Snuggler rotates, pressuring the spring. The amount of rotation is proportional to the torque. The pointer then points to an indicating scale on a plate attached to the torque arm.

5.4.6 Clarifier Operation

There is a local control panel at the end of each walkway for spray and clarifier controls. The local panels are also connected via fiber patch cables to the main operation building. The process can be monitored and controlled via the SCADA computer.

Monitoring the clarifiers for changes in the settled sludge or in the effluent being drawn off the surface will provide important information to help guide operation of the entire treatment process. Chapter 3 – Aeration Basins includes detailed information about conditions that may be observed in the clarifiers and methods for dealing with these conditions.

5.5 VALVE ACTUATORS

There are 8-inch and 12-inch plug valves that are involved in the activated sludge piping. These are located in the vaults between the two (2) clarifiers. Each of these valves is controlled by an actuator. These actuators are similar to the aeration basin actuators. They can be controlled by the plant SCADA System and the local controls. Some of these plug valve actuators are modulated so they can be opened and closed partially, while others are only Open/Close valves. There are Overtemp., power loss, and over-torque alarms that will show on the SCADA System when triggered and help indicate why an alarm was triggered.

5.5.1 Plug Valve Actuator Controls

All of the activated sludge plug valve actuators between the clarifiers are controlled by one (1) breaker panel. If the power needs to be shut off for any reason, the breaker should be used to lock out the power and avoid accidental restart.

The local actuator controls are on the side of the actuators in the vaults. These controls include: Open, Close, and Stop buttons.

5.5.2 Plug Valve Actuator Display

There is a display that shows the state of the valve. If the green light is on then the valve is closed. If the red light is lit then the valve is open. If both lights are lit, then the valve is partially open and/or in the process of opening/closing.

An additional display can be used if the main display fails. The panel with an additional dial can be used to ensure that the operator can see and control the state of the valve manually.

5.5.3 Plug Valve Actuator Alarms

The plug valve motors can be active for 15 minutes out of an hour. Running the motors for longer than this may leave the motor overheated. If they are overheated, the motor will automatically shut off and can be re-activated once the motor cools down. The operator should be careful when approaching an actuator that was recently overheated because it will likely be hot enough to burn the operator.

5.5.4 Plug Valve Actuator Operation

These actuators should be left ON at all times, even when the sludge system is not in use. The protections and heat control that is within the actuators will help stop moisture from entering the system. Even if moisture enters the conduit, there is a seal so water still shouldn't damage the electronics. However, if there is water entering the conduit, the leaks should be repaired immediately to avoid damage. The water will also likely cause short circuits in the electronics so these need to be repaired before the equipment can be restarted.

The actuator motor can be active for 15 minutes every hour. It is not expected that the motors will be active for anywhere close to this time period. If it is active for longer than this the motor may overheat and will not be able to be reactivated until it cools down again.

5.5.5 Plug Valve Actuator Manual Override

The plug valves actuators have manual overrides. These manual overrides are similar to the ones in the aeration basin butterfly valves. There is a wheel and a button in the center that must first be pressed to clutch the valve. The wheel can then be turned to open or close the gate. In these cases, there is a 2-inch

drive that may require a drill to clutch the wheel and manually override it. Once clutched and the valve in the desired location, nothing needs to be done to de-clutch the system. The override will be automatically de-clutched when a command is sent to the actuator. If the system is in automatic mode and a command is sent, the valve will return to the programmed state once the manual override is no longer in use.

5.5.6 Plug Valve Actuator Maintenance

The plug valves themselves are billed as maintenance free. No routine maintenance is needed for these parts.

Plug valves and the actuators are reparable and have repair kits for bearings, plugs, and other portions of the set up. There is no maintenance required on the plug valves unless the packing appears to be leaking. The plug valves and actuators are explosion proof. Once they are activated and set up and activated, foam is injected into the couplers. This stops any possible sparks from exiting the valve casings.

If there are gears, there may be issues with the gears. There are no gears in the aeration basin valve actuators but other actuators have to move farther and are larger and thus have gears.

5.6 MAINTENANCE

The complete required maintenance can be seen in the manufacturer's manual. The maintenance schedule for the entire plant can be seen in Appendix C.

5.6.1 Oil

All of the grease oil that needs to be used for the system should be Mobil gear 600 (629 and 630) series or equal quality grease. The specific maintenance instructions can also be seen in section 6 of the manufacturer's manual. Lubrication should be used as specified by the General Contractor and this contractor must certify that the collector drive system has the proper amount of recommended lubricant.

5.6.2 Flowmeter Cleaning

To clean the flowmeter, disassemble and use a bottle brush and appropriate mild soap solution. Cleaning agents that will damage float, tube, or O-rings should not be used. Before the meter is reassembled, inspect all parts for damage. O-rings should be replaced during meter maintenance and cleaning. Meters should be regularly cleaned with a mild soap solution. This will be an effective cleaner of rust stains. The meters should be cleaned with a mild soap solution. Hard water deposits can be removed with 5% acetic acid solution (vinegar).

5.7 SAFETY

Because wastewater is present in the effluent filter system, personnel must exercise precautions in regard to personal hygiene and sanitation. All necessary precautions for ventilation and identification of dangerous gases in a confined space must be observed.

All warnings and safety labels must stay attached and legible at all times. Because this equipment operates automatically, do not perform any service with the power on. All electrical work should be done only by qualified personnel. Power from all sources should be disconnected and locked out when working on equipment. Do not manually operate equipment or perform any repairs without knowing the results of this work. Do not begin equipment operation that has just been installed or serviced without notifying personnel near equipment. Do not enter the filter basin while the disk is moving. Do not intermix synthetic lubricants and mineral lubricants together.

The manufacturer's O&M catalog for the clarifier system contains safety precautions for operation and maintenance. Refer to Chapter 4 and Appendix E for pump station safety precautions.

CHAPTER 6
ULTRAVIOLET DISINFECTION (UV) EQUIPMENT

6.1 INTRODUCTION

This chapter describes the Ultraviolet (UV) disinfection system. UV treatment is a consistent and effective method of wastewater disinfection. The secondary effluent is sent from the clarifiers to the UV disinfection system. In the UV channel, secondary effluent is exposed to ultraviolet light which inactivates bacteria, and in turn, protects public health. This process is the final step in the treatment process before discharge into the effluent pump station and outfall into the Nooksack River.

6.2 THEORY OF OPERATION

6.2.1 Theory of Ultraviolet (UV) Disinfection

Ultraviolet light kills bacteria and viruses by destroying their genetic material. The UV light alters DNA so that the organisms cannot reproduce and multiply. They live until the end of their normal life cycle but are unable to reproduce so the overall bacteria level is reduced over time. The performance of UV systems to disinfect water is expressed in terms of reduction of bacteria counts to a certain allowable level, which depends on the requirements of the specific application.

6.2.2 UV Dosage Theory

The size and number of UV modules required in a particular application is determined by the flow rate, water/wastewater quality, and disinfection requirements. The dose of UV light available to kill bacteria is measured in milliwatt-seconds/cm^2, which is dependent on the light intensity and the duration of exposure, or retention time. The UV intensity depends on the power that the UV lamps give off. The hydraulic retention time depends on the time spent flowing through the channel which changes based on the flow rate. Any factor that affects light intensity of retention time will affect performance. Poor performance may result in ineffective disinfection so this must closely be monitored. Ineffective disinfection is a violation of the discharge permit and may result in public health issues.

6.3 DESCRIPTION OF FACILITIES

6.3.1 General UV Disinfection Equipment

The system contains one (1) open-channel UV system that uses high-output amalgam UV lamps in an inclined, staggered array for municipal wastewater disinfection. There are four (4) duty UV banks and one (1) standby bank, each holding an array of UV lamps. There are three (3) bank support frames that can each hold two (2) UV banks. There is a spot for a sixth UV bank to be added to the last frame in the future, and space for a fourth support frame to be added to the channel, which would hold a seventh UV bank. These banks may be added in the future if the flow increases.

The banks are labeled on the controls as A-F and elsewhere as 1-6. Bank A is the farthest upstream UV Bank and corresponds with Bank #1, and Bank B is Bank #2, etc. Bank #6 and #7 and Banks F and G are the future banks that has not yet been added. The bank numbering can be seen in the UV layout drawing in the Layout Drawings section of the Trojan UV Owner's Manual, in the Layout Drawings section. Each UV bank consists of twenty (20) UV lamps, organized into 2 rows of 10. The lamps in each row are numbered 1-10, where Lamp #1 is on the south side and Lamp #10 is on the north side. The lamps in each bank are organized in two (2) rows of ten (10) lamps. The row that is upstream in the channel are labelled A and the downstream row is B. An ultraviolet intensity (UVI) sensor measures the output UV of lamp B2 on each bank.

The lamps are controlled by lamp drivers that each control two (2) lamps, for a total of ten (10) drivers per bank and fifty (50) overall. The lamp drivers control the intensity of the lamps and ensures that the lamps needed for proper disinfection are active. The controls automatically ensure that the required dose is given to the water by activating and inactivating banks as needed. It is expected that there will never need to be more than four (4) banks operating at 98% capacity. The fifth bank is present as a standby in case of malfunction and shouldn't need to be operated during standard procedures. The motorized overflow weir maintains correct water depth over the complete range of flow rates to be treated. The channel includes a drain line, which can drain the channel to the East Plant Drain Pump Station to facilitate channel cleaning.

The system includes two (2) hydraulic system centers (HSC), which can be operated remotely using SCADA, or can be operated locally from the HSC control panel. The HSCs provide lift and wipe functions for the UV banks for maintaining, replacing, and cleaning the UV bulbs.

6.3.2 UV Treatment/Maintenance Building

The UV Treatment and Maintenance Shop was built in 2020 as part of the treatment plant upgrade. The building is 57 feet by 60 feet, and is divided into the south UV side and the north maintenance side with a dividing center wall. It was built over the chlorine contact basin that was used for disinfection before the implementation of the UV system in the 2020 plant upgrade. This chlorine contact basin is below-grade and was backfilled to the existing grade. The UV/Maintenance Building was built over the top of the chlorine contact basin, using the exterior walls and footing of the basin as the footing for the new building. The UV channel was essentially constructed inside the former chlorine contact basin, with the top of the channel flush with the finish grade of the UV/Maintenance Building. Large metal grates cover the UV channel to block the UV light from escaping the channel, and to allow operators to walk over the channel. The UV equipment will be lifted above the floor level for maintenance or repairs. The controls, electrical panels, and disinfection monitoring equipment are along the walls around the UV side of the building.

6.3.3 UV Equipment Location

The UV channel is located in the south UV side of the UV/Maintenance building. Secondary effluent enters from the east side of the building and the disinfected final effluent exits to the west. The UV Signa System has two (2) Hydraulic System Centers (HSC), two (2) Power Distribution Centers (PDC), and one (1) System Control Center (SCC). All of the controls are inside the same room of the UV/Maintenance building as the UV channel. The HSC controls the hydraulics that control the lifting, lowering, and wiping of the lamps and sensors. The two HSCs are located on the east side of the UV/maintenance building, just east of the UV channel. The PDC contains the lamp drivers that control the intensity of UV light that is being released. These are along the center wall of the building, just north of the UV channel. The SCC contains the main controls for the system and has the Human Machine Interface (HMI) screen on the outside of the panel. This allows the operator to access the controls and change settings as needed. This is located along the south wall of the building, near MCC5. The display for the flow is on the north wall, closer to the effluent side. The display for the UV transmittance (UVT) is near the influent into the channel and is just on the north side of the channel. The display for the weir gate height is also just to the north side of the channel, near the effluent gate.

6.3.4 UV Lamp Description

Each UV bank holds 20 high-intensity, low-pressure, amalgam, TrojanUV Solo Lamps with minimal input wattage of 1,000 Watts. Lamps are operated by a lamp driver that will allow the lamps to dim from 100% to 30% of nominal power. The lamps have a UVC lamp efficiency of 42% after the 100-hour burn in period, with an End-of-Lamp-Life factor of 0.86 and an average sleeve fouling factor of 0.94. The UV lights are enclosed in a protective quartz sleeve to prevent damage and to facilitate cleaning. The sleeve has an automatic cleaning procedure that will stop the solids from collecting on the outside of the UV lamps and sleeves.

6.3.2 UV Lamp Driver Description

The lamp driver serves to vary the intensity of the bulbs from 30-100% of the available intensity. The power cords plug into each bulb and then are led to the PDC. The PDC varies the bank activation and the intensity to match the necessary dosage. To ensure that the driver settings are correct, check that the setup of any replacement drivers are identical to the one that was just replaced. The operator must also ensure that all of the wires are reattached the same as they were in the old one. The operator can photograph the set up to recreate it perfectly if needed.

6.3.3 Ultraviolet Intensity (UVI) Sensor Description

The system uses one duty ultraviolet intensity (UVI) sensor on each UV bank to measure the UV intensity that is being output to the system. This UVI sensor measures the intensity of lamp B2 on each bank. These sensors are used to calculate the necessary UV dose and to adjust the lamp intensity accordingly. If the intensity measured is lower than expected, the sleeves likely need to be cleaned. There is an automatic cleaning system, called the ActiClean Cleaning System, for the lamps and for the intensity sensor. A reference UVI sensor, that is the same model as the duty UVI sensors, is also present. It is used to compare intensity results over time and ensure the continued good-quality results from the duty sensor. The instructions for calibrating the sensors can be seen in the Reference Sensor Procedure section, in the Product Information section of the Trojan UV Owner's Manual. The UVI Sensor Check Interval setting can be adjusted to control the time between the automated checks with the reference sensor.

6.3.4 Water Level Sensor Description

A low water level sensor is in each channel between the furthest downstream UV bank and the level controller. If the water level does not reach the bottom of the level sensor, then the lamps will deenergize until the required water level is reached. The water level measured causes the weir gate to lower or raise to correct for the alterations. The details of the control algorithm for the weir gate can be seen in the Controls Philosophy section of the Trojan UV Owner's Manual.

There is a water level sensor in the channel and a reference sensor that is slightly longer than the main sensor. Ensure that there are no strings of algae attached to the bottom of the level control sensor. This will alter the reading and could pose a risk to the operator if the water level gets too low, and exposes active lamps. The sensor should be checked every day to ensure that the algae has not begun to grow to avoid risk of exposure.

If the operator enters the area and it smells like ozone, the lamps have exited the water. Ozone has been described as smelling like a burning wire or chlorine or a clean smell. In this case, all operators should don full UV safety gear and face shields. The lamps should then be disabled through the controls. Once disabled, the channel covers can be removed to check the status and determine the cause of the issue.

6.4 AUTOMATED CLEANING PROCESS

If the quartz sleeves have build-up or scaling on them, the UV intensity probe will likely display a lower reading than what is expected. If the probe is reading lower numbers, the operator should verify that the lamp age is less than 15,000 hours, the wiper seals are worn, the UV intensity probe has been verified via calibration, and UV transmittance has not dropped below the site's normal operating conditions by checking recorded readings. If all of these things are true, the operator should initiate a wiping sequence, this can be done from the wiper control screen. This should help remove the buildup on the outside of the quartz sleeve.

The wiper cannister assemblies for the lamp sleeves are all identical except for the ones that work on Lamp B2. The wiper cannister contains two (2) seals, two (2) O-rings, one (1) scraper, and one (1) squirrel cage. The wiper cannister for the UVI Sensor Probe is approximately 1.5 inches around and has screw attachments to keep it in place.

If the flow rate through the channel is low, suspended solids will be more prone to settle onto the lamp casings, therefore requiring more frequent cleaning. The automatic cleaning interval can be set by the operator. It is recommended that the frequency starts at 4 hours and then extends as needed. It is possible that if suspended solids are relatively low and the flow rate is high then the cleaning may only need to happen every 24 hours. The UVI sensor is cleaned along with the lamp sleeves. There is an additional (smaller) wiper casing just for the sensor that runs along with the B2 wiping.

The hydraulic cylinders are used for lifting the banks and for moving the wipers for cleaning. There are no required checks of this hydraulic equipment because the wiping equipment is used daily and the lifting equipment is used at least every two (2) months to refill the ActiClean chambers. The hydraulic cylinders are powered by magnets that move back and forth on the wiping carriage travelers.

A full wiping sequence works by running until it reaches the dead head and then remains for 5-10 seconds and then retracts to the dead head before stopping.

The wiping process is controlled by pressures and not necessarily timing. The pressure when wiping can be anywhere from 200 to 300 PSI and when lifting the bank can be from 300 to 400 PSI. The high-pressure alarm is set to 580 PSI so any pressure below this is acceptable. The pressure needed to move the wiper seals will likely vary, so the hydraulic system just builds up pressure until the wiper canisters begin moving. If the seals are dry, it will likely take a higher pressure to move it. If there are more seals moving, there will likely be more pressure to move the parts. It is recommended that the owners do not change the pressure settings.

6.5 UV TRANSMISSION SENSOR

The UVT analyzer is located near the inlet of the UV channel. The UVT analyzer displays the percent UV transmittance. It will also display when the wiper blades for the probe need changing, which is every 50,000 counts. The sensor checks every 90 seconds for a new %UVT measurement.

To replace the wiper blade in the UVT sensor, the operator should use the menu. The operator should enter the Sensor Setup, Dust and Maintain, and then Maintain Outputs, and then Set Place Profile. The probe can be lifted out of the channel and then the blade will stick out so it can be replaced. The new wiper should be stuck in properly so that it is not too far back because otherwise it wouldn’t hit the window and it wouldn’t get cleaned off. As the probe is being replaced, the operator must take care not to catch the probe in

anything. The extra power cord should be hung neatly over the bracket that holds the probe. The probe can be recalibrated but the steps must be followed very closely to ensure the safety and accuracy of the probe.

6.6 EFFLUENT WEIR GATE

The dead band for the weir gate covers 1 inch above the set value and half an inch below the set point. The weir height adjusts every six (6) seconds while it is in the dead band, and every three (3) seconds when not in the dead band. If the level in the channel is within the dead band, the weir height will not adjust. This dead band is essentially the margin for error.

The low-level controls are next to the weir gate near the exit of the channel. When the sensor is not touched by the top of the water, the relay drops and signals the gate to raise to hold more water into the channel. The maximum height of the weir gate is 69 inches. There is no high-level control, but a message is sent and displayed when the weir height is 69 inches. The current weir height is shown on the screen of the control panel.

The calibration probe is longer than the primary level sensor probe. The shutoff must be wired to the shorter probe. If it is wired the other way around, the UV banks would shut down at a lower level than they should, causing issues with system performance and possibly danger to the operator.
The controls for the weir display multi-ranger have a remote-control clicker. This should be stored just on top of the control box for this display.

The level sensor is set to about 1.5” above the top lamp arc. A low water alarm is triggered when water is no longer touching the sensor. Once this alarm is active, the system will shut off in 1-5 minutes. The exact timing of this shut down can be altered through the controls. This should happen very rarely, if ever. If it is happening often, the provider should be contacted to fine tune the weir gate settings. This fine tuning cannot be done on the fly, so a technician will need to be contacted. The effluent weir gate is used to ensure that the proper water level is maintained in the UV channel. When there is high flow into the channel, the weir gate lowers significantly so that a lot of water can flow out. When there is low flow into the channel, the weir gate raises significantly so that little water exits the channel. When the UV channel needs to be bypassed for any reason, the weir gates will automatically close as the flow decreases. Once closed, the channel can be drained, where the water will flow to the East Plant Drain Pump Station and the channel will empty. An SOP for draining the UV channel is included in Appendix I.

6.7 UV SYSTEM CONTROLS

The System Control Center (SCC) provides the necessary controls and monitoring displays for the entire system and can be accessed through the attached touch-screen or through the plant's remote SCADA system. The SCC coordinates measurements, calculations, and adjustments to ensure the UV dose is adequate for disinfection. The Hydraulic Systems Center (HSC) contains the valves, pump, and other equipment to power and control the ActiClean Cleaning system for the lamps and UVI sensors. The HSC can be controlled locally, by the SCC, or remotely through the plant SCADA system. The Power Distribution Center (PDC) holds the lamp drivers that power and adjust the UV lamps. The PDC can also be controlled through the SCC, and thus remotely via the plant's SCADA system.

6.7.1 Hydraulic System Center (HSC)

There are two (2) hydraulic system centers (HSCs). One of them controls Banks A-D and the second controls Bank E. There are eight (8) control buttons on the HSC. The first switch can be put in the Wipe or Lift mode, depending on what the operator is trying to accomplish. The second switch can be turned to Up, Off, or Down. When it is being lifted (UP) or lowered (DOWN), the operator must hold this button over to its position and should continue holding it until the bank stops. This ensures that the bank is all the way in or all the way out. The third switch controls which bank is being accessed. This switch can be turned to: 1, 2, 3, or 4. These correspond to Banks A, B, C, and D. On the second HSC, the 1 corresponds to Bank E. The next switch controls the wiper modes, the switch can be turned to RET, EXT, or SEQ (retract, extend, sequence). This will put the wiper all the way up, all the way down, or run the whole wiper sequence. The next switches, control each bank individually. The choices are OFF, REM, or LOC (Off, Remote, or Local). To control the banks with the HSC, the selected bank must be in Local control mode. The other banks should then be in Remote mode so that it can be controlled by the system. If the system is in Lift mode, it won't be able to wipe, so it should be left in wipe mode and shift to lift mode only when it is required.

The HSC has a pump to build up the pressure to run the hydraulic system. When the HSC is brought online or when it is rebooted, the pump direction should be checked to make sure that it is rotating in the right direction. If the pump is capable of building up pressure, the pump is moving in the right direction. Only one pump needs to be checked, as all of the pumps will be rotating in the same direction. The wiring of the HSC works so that turning off one HSC will still allow the second HSC to continue working. If there is a break at the HSC, the next HSC may also go off line. There are four (4) hydraulic hoses per bank. Two (2)

of these are for lifting with one responsible for lifting the bank and one responsible for the lowering of the bank. Two (2) of these are for wiping, as one works to extend the wiper and one to retract it.

The HSC needs oil to remain lubricated. The same oil should be used to run the system. This oil can be purchased from any manufacturer that sells the same type. If the owners want to change the type of oil, there is a complex set of steps to complete this so it should be well thought out before it is executed. The oil is also not known to be safe for fish or other animals so it should never enter the channel or any other water in the treatment plant.

Each wiping group has two (2) solenoids that blink when they are active, under main HSC controls. The pressure reading is also visible under the main HSC display. The HSC oil level should be checked to make sure it is between the two (2) tick marks. It should only be checked when it is not running. There is a breaker to control the HSC controls. The wiping system runs by building up the pressure until it reaches the dead head and then waiting 5-10 seconds and then going the other way. If the wiper reaches a dead head before 60 or after 300 PSI, it will trigger a wiper jam alarm that will need to be cleared before trying again. If this fault is activated, the bank should be lifted so the source of the fault can be found and fixed so the fault can then be clear.

The oil that is needed for the hydraulics system is Mobil DTE Excel 15.

6.7.2 Power Distribution Center (PDC)

When the door to the PDC is opened, the lights inside the door can be observed. When the lights are blinking, the corresponding bank is turning on. The green and yellow solid lights on the door should be lit when they are operating properly. If a red light is blinking, there is likely a fan out. Each driver controls two (2) lamps and each bank has two (2) PDC compartments so there are five (5) drivers in each cabinet. There is also a screen at the bottom of each cabinet so that if an object is dropped, it won't fall all the way down and interfere with lower equipment. To remove a driver, unplug both cords, unscrew the top and bottom and make sure that the driver isn't stuck on any wires, and pull out. When replacing the driver, align the top first and begin pushing this side in first as it sticks into the cabinet farther. Then push the rest of the driver in and screw it back in, reattaching the wires in the same order they were removed in. The wires should be double checked to ensure that they are all the way attached. Before any of the drivers are touched, wait 20 minutes to ensure all of the charge is discharged. There is a breaker in the bottom of the cabinet can control the level sensor transmission so this should be checked to make sure that it is in the proper position.

The PDC for each bank contains twelve (12) fans to improve ventilation. Each bank also has its own disconnect switch on the outside of the PDC cabinet. This disconnect can be twisted so that the handle is parallel to the ground. The red knob in the back of the handle can be pushed out from the back of the handle, and the disconnect can be locked out.

The air conditioning in the PDC offsets the heat created by the lamp drivers. This A/C system is not adjustable, as it kicks in only to keep the lamp drivers from overheating. If the A/C is not functioning effectively, the system can run with the door open for a short time to facilitate cooling. Because of the significant amount of electronics, the door should remain closed whenever possible to avoid additional damage. There are 12 fans at the bottom of the PDC controller to help dissipate heat. This also helps reduce the condensation within the system. The filter must also be changed on occasion. This stops foreign particles from being drawn into the system. There is a fault if a fan goes out. If the A/C goes out, and the set point is exceeded, the issues with the A/C must be found as soon as possible.

For each bank's lamp driver control, there are two (2) fan racks with six (6) fans each and internal fans between compartments to finish the A/C model. The thermostat for the high temperature warning is a minor alarm that triggers at 50°C and the High Temp Shutdown alarm is a critical alarm that is triggered at 55°C. There are two (2) temperature sensors in the system. These stop the system from running if the system is overheated. The first alarm is a warning that is triggered at 113°F and indicates that there may be a problem. The second alarm is triggered at 133°F and this is a fault that shuts off the system and the system can only be reactivated once it cools down. If the warning is triggered, the operator should immediately try to determine why to avoid shut down of the equipment. It may work to open the door of the HSC. It is possible that the A/C system has gone out. In this case, the operation can temporarily be run with the door open to lower the temperature. The A/C system should be repaired as soon as possible.

The PDC selector switch can be switched to Off, Remote, and On. In the remote setting, the state of the bank will be controlled as needed to maintain the required dose. In On, the bank will just stay on and in off, the bank will just stay off.

The specifics of the program and operation can be stored on an SD card. This should be reloaded before an expected power loss. If power is lost to the PDC, it is likely that the program will need to be reloaded with the SD card. If the PDC does not power back on when the power is restored, the PDC should be replaced as soon as possible. There is a spare PDC that should be used in the case of failure.

6.7.3 System Control Center (SCC)

On the HMI, whenever something is in manual mode, it will appear yellow. When it is in Remote/Auto mode it will appear in yellow. Anything yellow will likely trigger the alarm so it is expected that most equipment will remain in remote mode.

If the PDC air filter requires cleaning, it can be removed and then sprayed in reverse to rinse off the buildup on the filter.

The SCC has a small backup power unit so that it will not immediately knock out in the event of a power outage. It can keep running for 10-15 minutes on backup power alone. The SCC contains the HMI which has simple graphics for easy use. The PDC controls the system with a touch screen HMI. The PDC turns the equipment on or off and varies the power basin on the operational variables. Major alarms include an individual wiper failure alarm, an individual driver failure alarm, an individual lamp failure alarm, a low/high flow alarm, a low water level alarm, and a panel over-temp alarm.

6.8 UV SYSTEM OPERATION

6.8.1 Start-Up/Shutdown Operation

Only qualified operators should operate the system. These operators should read and understand the Trojan UV Owner's Manual before attempting to use the UV disinfection equipment. If any part of the operating procedure is unclear, the operator should stop and call the service provider. A detailed description of the startup for the UV system can be seen in Section 5.1 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual. Section 5.2 shows how to shut down the system. If any kind of long term shut down or storage needs to occur, a description of the shutdown procedures can be seen in Section 5.3 and the restarting procedures in 5.4. Once active, the system should not require significant operator intervention as the system is almost entirely automated.

6.8.2 UV Dose Determination

The UV dose depends on the intensity of UV light and the contact time of the water. This dose is calculated by the system. A flow meter measures the flow, and a UVI sensor on each UV bank measures the UV intensity at each bank. The system uses these values along with the ultraviolet transmission (UVT),

operating power levels of the banks, and the lamp age to calculate dose. The dose is essentially calculated as the influent flow rate times the UV intensity.

The current dose flow can be seen on the home screen of the SCC. If the required dose cannot be met with the current UV settings, the system will automatically adjust to reach the necessary intensity. The system's ActiClean cleaning system cleans the quartz sleeves around the lamps and the intensity sensors automatically to ensure that the dose remains sufficient for disinfection. The operator must carry out the recommended maintenance inspections to ensure the system is not damaged, and take note of any alarms that are activated by the system. The operator does not need to do any calculations or change any controls manually unless the system fails. There are manual overrides for the controls, if necessary. All alarms and controls are shown through the screen on the SCC and through the plant SCADA system. The details of this display and the available manual overrides are further explained in Section 8.3 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual.

UV is efficient at disinfection as it reduces organics and chemicals. UV light has no effect on water quality parameters such as suspended solids.

While the UV system is operating, a minimum of one bank is always on. It is possible that only one will be needed, depending on flow.

6.8.3 System Design Parameters

Operators should be careful that the level of suspended solids is not too high in the UV channel. This can pose a risk as large or overly numerous particles may pose a challenge to UV disinfection. If a large particle is between the UV lamps and another particle, there will be particle shading and the hidden particle will not be exposed to enough UV light to inactivate bacteria. If there is a very large particle, then the center of the particle may become a region of limited damage as the UV light will not be able to penetrate to the middle of the particle.

The weir gate at the effluent end of the channel controls the water level, and the lamp drivers control the amount of UV light being emitted. This means that these two are varied together to maintain the required level of disinfection. The system should be able to adjust at any area within the design criteria without issue. At the maximum flow, this would have all four (4) duty banks running at 98%. The fifth bank provides

redundancy and should not be needed for treatment for any levels within design criteria unless one of the other banks fails.

The wavelength of light used is 254 nm, which works to destroy the DNA of the pathogens, thereby eradicating them over time. The HMI is mostly used to manage controls and monitor the settings. This HMI can also be seen remotely with the plant SCADA system. The plant is designed to have less than 15 mg/L of suspended solids. The weekly geometric mean of 400 fecal coliforms and 29 as a monthly average. The required dose that is set for the UV is 24 mJ/cm2. This dose should not be lowered, but can be raised if the operator deems it necessary.

6.8.4 Required System Adjustments

The lamp drivers should have no more than four (4) On/Off cycles per day. If there are too many cycles happening, the operator may need to adjust the Off delay. It will need to be greater than the distance between peaks. This should be seen in the trends screen. This will ensure that a bank will not shut down due to a short dip in flow. If there is a small change in flow, the bank will shut down and then have to start up again when the flow increases. By changing the OFF-delay time, the lamps will just stay on the whole time. As there is no known byproduct from UV disinfection, there is no issue with a dose that is higher than necessary. The only drawback from this is the added draw on plant power that is needed to power the additional lamps.

6.8.5 UV Bank Local Control Behavior

When in local mode, the banks that are on run at 100% power as they are no longer run by the remote system that calculated the intensity needed for the dose. If the system is not being run in the remote mode, an alarm will be triggered. As there is little disadvantage to extra disinfection, when the system is not being automatically controlled, the panels go to 100% to ensure sufficient disinfection.

If any of the gates are not in remote mode for operation, then all of the lamps are turned to 100% intensity and remain on until the fault is resolved.

6.8.6 UV Bank Activation Behavior

If there is an issue with one of the banks, it will ramp up to 100% of its capacity while the next bank in the priority chain activates. This will also trigger an alarm that will be seen on the HMI or on the plant SCADA system. Once the next bank is activated, the malfunctioning bank is shut down. The banks take ten (10) minutes to come online. When they are activated, they warm up at 30% capacity for 8.5 minutes, and then at 100% capacity for the next 1.5 minutes. It then drops to the level that is necessary to maintain the proper dose. While the bank is coming online, the UV bank that is being activated will not be included in the dose calculations. The UV from a newly activated bank will not be counted in the dose calculation until it is deemed fully online, after 10 minutes.

6.8.7 UV Bank Priority Controls

The lamps are warrantied to 15,000 hours. They are replaced for free if they fail in 9,000 hours or less. If they fail between 9,000-15,000 hours, the replacements will be pro-rated. If they operate for the full 15,000 hours, then the plant is responsible for their replacements. The operating hours for the banks are all tracked by the controls and can be seen on the HMI.

The hierarchy of the order of importance of the banks can be altered in the settings when logged in as "OP1". This can set up an order to prioritize bank activation and then also specify the time before rotating the priority. This is the automatic mode for this operation. The priority can also be put in manual mode so the operator can just change the priority as desired, though it is important that the operator remember to make any needed changes while in manual control. There is no required rotation of the priority, though if the operator keeps all of the lamp operating hours equal, it is likely that many of the lamps would need to be replaced around the same time which could be challenging depending on the number of spare lamps available. However, it is important that the bank priority setting is such that none of the banks sit idle for an extended time.

6.9 UV MONITORING DISPLAY

Most monitoring of the system is done automatically. The System Control Center (SCC) monitors and controls all UV function. It adjusts UV levels to maintain the required level of disinfection while minimizing power use. Operation of the SCC is done through the touch-screen Human Machine Interface (HMI) or remotely through the plant SCADA system. The daily operation will include monitoring the

system, carrying out necessary checks and maintenance, and occasionally manually initiating and controlling the processes. The default login for the HMI requires no password. If login information is required, see Section 8.3.1.3 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual.

6.9.1 UV System Display Screens

6.9.1.1 Home Screen

The HMI home screen will show a bar graph of the UVT, flow, and dose, along with the manual overrides for each. The displayed value shows the calculated value for dose, and the measured values for flow and UVT. The real time values for all three values will be displayed to the right of each graph. The alarm setpoints for UVT and Flow are indicated by the indicator arrows. The indicator arrow on the dose graph shows the Reduction Equivalent Dose (RED) target. The bar graphs will be green with no icon if the values are within the design parameters. If the values are not within design parameters, an icon indicating an alarm will appear and/or the graph will change colors. In this case, consult Section 8.3.2 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual, and address the issue as required. Manual override instructions are described in Section 8.3.2.1, should they be needed.

6.9.1.2 UV Channel Overview Screen

The UV channel overview screen can be reached from the home screen, using the button marked CHANNEL. This screen displays the current measured flow and RED (Reduction Equivalent Dose), displays flow direction, shows low water level alarms, and can be used to enter maintenance mode (with the MAINTENANCE button).

6.9.1.3 UV Bank Overview Screen

The UV Bank Overview Screen can be reached by pressing the button for the desired bank from the channel overview screen. From here, the status of each individual lamp on the bank is displayed. A labelled and color-coded circle will represent each lamp. If the circle is black, the lamp is off and healthy. If the circle is green, the lamp is on and healthy. All possible colors and their corresponding conditions are shown in Section 8.3.4.2 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual. The lamp driver status is displayed as a color-coded border around a set of two (2) lamps (because one

driver controls two lamps). No border color indicates a healthy driver, yellow indicates a minor alarm, and red indicates a major alarm. A visual representation of what this looks like can be seen in section 8.3.4.2 of the manufacturer's manual. By clicking on the visual representation of the driver on the screen, the details of the driver can be seen, including a readout of the hours that each individual lamp has been in operation. The bank details can also be viewed from the UV Bank Overview Screen, using the BANK DETAILS button. This will show the number of times the UV bank has turned ON (as BANK CYCLES), the UV intensity used in the dose calculation (as UVI FILTERED), the UV intensity measured by the sensor (UV ACTUAL), and the calculated UV dose (RED). The full details of the UV Bank Overview Screen can be seen in Section 8.3.4 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual.

6.9.1.4 Wiper Overview Screen

The Wiper Overview Screen can be reached through the WIPER button at the bottom of the screen. This will show a button for each wiper in the channel. Green arrows will appear if the wiper is moving, a yellow or red icon means that there is an alarm active. No icon means that the wiper is stationary and healthy. The details of the Wiper Overview screen can be seen in Section 8.3.5 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual.

6.9.1.5 Trending Screen

The TRENDS button will take the operator to the Trending Screen Overview which will display the flow, dose, and UVT value, as well as a plot of the recently measured values. The details of this screen can be seen in Section 8.3.6 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual.

6.9.1.6 Alarm Screen Overview

The Alarm Screen Overview can be reached through the "Alarm" button at each screen. This screen shows either a list of the active alarms (ACTIVE ALARMS button), or past alarms with a date/time stamp (INACTIVE ALARMS). Alarms will be displayed in a color-coded list. Red indicates critical/major alarms, yellow indicates minor alarms, and blue indicates the selected alarm. The details of this screen can be seen in Section 8.7 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual.

6.9.1.7 Screen

The settings screen can only be accessed if the user is logged in at OP1 level or higher (see section 8.3.1.3 of manufacturer's manual for log-in details). From this screen, the settings for the wipers, flow, UVT, intensity, dose, time delay, channel, water level, and outlet gate can all be altered. The details for all of these settings are in Section 8.8 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual.

6.9.1.8 Information Screen

The Information Screen (accessed through the INFO button at the bottom of the screen) shows the information for the controller, firmware, memory usage, status, mode, scan time, and product number. It can be used to set the date and time and displays the diagnostics for the runtimes from the HMI which will help with troubleshooting. The details of this screen can be seen in Section 8.9 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual.

6.9.2 Log-in Security

Without any Log-in, some of the controls can be seen. It is likely that any operator will want to log in as "OP". To do this, click the Login button in the upper right of the HMI screen. Enter "OP" as the username and then "11111" as the password. This will work for the basic monitoring procedures that are required. To access the settings, lamp requirements and to reset the bulb settings, the operator will need to log in as "OP1". The password for OP1 is known by the plant supervisor and should only be known by essential personnel to avoid accidental changes.

The HMI has different log in levels to ensure settings aren't changed accidentally or by unqualified personnel. Most operators will likely log in as "OP". The username is "op" and the password is, "11111". This allows basic observation but the settings cannot be accessed through this log in. To access diagnostics and system settings, an operator must log in as "OP1". The password for this log in is only known by a few in the plant to avoid accidental changes in settings. If there are unknown faults or unexpected behavior, the diagnostics screen is very useful to determine exactly where the fault happens. When the diagnostics screen is entered, the operator must also press "Get Data" and the system will run the diagnostics. There is a diagnostics screen for the lamp driver and the drivers in question must be on for this to be effective because otherwise they don't receive power. If everything is working as it should, all of the diagnostic categories

should appear next to a green checkmark. Anything not green, should have triggered some level of alarm or warning.

6.10 WATER SAMPLING AND TESTING

Samples are taken to ensure that the UV disinfection is functioning as it should be and that the water is properly disinfected. The percent UV Transmittance (%UVT), Total Suspended Solids (TSS), and Particle Size Distribution (PSD) are monitored to characterize the effluent and ensure that the desired characteristics are meant. The presence of indicator organisms, such as coliforms, indicate the possible presence of pathogens in the wastewater.

These indicator organisms are monitored to track the level of the disinfection. Pre-disinfected samples are collected for the analysis of the effluent, including %UVT, TSS, PSD, and influent bacteria counts. Samples for a collimated beam test are taken before disinfection to determine microbial response to varying UV dose. Disinfected samples are collected by an automated sampler after UV to determine the efficacy of the equipment. UV dose is changed by flow rate and lamp intensity so testing procedures must specify the testing conditions. The Trojan Technologies detailed testing plan must be obeyed to ensure that the equipment was accurately tested.

For microbial testing, grab samples that are taken at specific times and locations should be taken. Microbiological sample bottles must be heat-sterilized using an autoclave. The sample bottles may also contain preservatives, including sodium thiosulphate or EDTA. Sodium thiosulphate is a chlorine-neutralizing chemical that absorbs UV light and can significantly lower %UVT in samples. EDTA is used to neutralize the toxic effects of metals. It also absorbs UV light and can lead to inaccurate %UVT readings. Reducing agents such as sodium thiosulphate and EDTA should not be used. The sample bottles must be clearly labeled with permanent waterproof marker. Sample numbers, sample date, sample time, location, and relative flow rate should be recorded for each sample. Safety grating should be replaced as soon as possible to avoid risk of falling into the channel.

6.10.1 Percent UV Transmittance (%UVT) Testing

The UV transmittance test measures the ability of a solution to transmit UV light through a 1 cm distance. This demonstrates the amount of UV energy that is not absorbed by chemicals or solids on wastewater. The UV transmittance is measured with a wavelength of 254 nm as a percentage relative to deionized water

standardized at 100% Transmittance. To test %UVT, a grab sample should be taken in a sterilized sample bottle without preservatives. If there is a delay between sampling and shipping of the sample, the sample should be refrigerated. If there are large swings in the process flow rates, the two samples should be taken to represent disinfection at low and high flow conditions.

The percent of UV transmittance (%UVT) is measured by a probe in the channel. This is measured by calculating what percent of the UV light is absorbed through 1 cm of water. The UV transmittance is the difference between 100% and the % absorbed. If the water absorbs 20% of the light, then the UV transmittance is 80%. As the turbidity increases, the transmittance decreases. The system is around an effluent with 39% UVT but the measured %UVT may vary depending on influent characteristics, flow rate, and condition of treatment operations. If the %UVT gets to below 24%, an alarm is triggered on the SCC.

6.10.2 Total Suspended Solids (TSS)

The suspended solids present in wastewater effluent is composed of bacteria-laden particles. The concentration of TSS and the size of the particles are factors that help determine the UV dose required. The UV system is set up to operate with the expected TSS conditions. Any increase in TSS levels may reduce the UV system's ability to disinfect so the TSS level should be carefully tested. To sample and test for TSS, a clean 0.5-quart sample without preservative agents should be used to obtain a grab sample of final effluent prior to the UV disinfection system, near the midpoint of the channel and refrigerate if there is a delay between sampling and sending. The sample bottles should be placed within two (2) sealed garbage bags then packed in a sturdy cooler without ices. The cooler must be taped and sealed to prevent leakage. If there are large swings in flow rates, two (2) samples should be taken to represent low and high flow conditions.

6.10.3 Particle Size Distribution (PSD)

The PSD test is used to determine the averages size and percentage of each size of particle in a sample. The PSD for wastewater samples depends on the upstream treatment process and type of effluent. Primary solids generally have smaller particles with a mean size range of 13 to 25 microns. Secondary effluents have particles that average between 20 to 35 microns or larger. Solids with a high percentage of large particles can pose a challenge to UV disinfection. PSD data combined with TSS data and process information is used to help establish the potential for disinfection. To take a PSD Sample, a 0.5-quart sample bottle without preservative agents, should be used to obtain a grab sample of effluent prior to the UV disinfection system near the midpoint of the channel. Ensure sample is taken well below the effluent surface. 0.5 mL (2-3 drops)

of bleach to the effluent sample to prevent any changes to particle size during shipping. If there is a delay between the sampling and shipping, the samples should be refrigerated. Samples should be placed in two (2) sealed garbage bags and packed in a sturdy cooler (without ice). The cooler must be taped and sealed to prevent leakage. If the plant experiences large changes in process flow rates, two samples should be forwarded to Trojan to reflect Low and High flow conditions.

6.10.4 Collimated Beam Test

The collimated beam test uses a bench scale UV apparatus to irradiate wastewater samples with varying UV doses. Accurate measurements of exposure time and UV intensity provide a calculated UV dose. The indicator bacteria (i.e., fecal or total coliform) are enumerated before and after irradiation. The survivors are plotted against the UV dose to produce a dose-response curve. This test has been completed before the equipment was installed. It can be repeated post installation to help in determining the underlying effluent quality issues, not detected by other wastewater sampling tests. The transit time and temperature are important factors that affect sample quality. The samples should be delivered on ice to the Trojan laboratory within 24 hours of sampling for the collimated beam test.

6.10.5 Sample for Post-Disinfection Microbial Analysis

These samples are done regularly to assess conformity to disinfection standards. The microbial grab samples should be taken from the midpoint of a UV channel, immediately downstream of the UV system. If any uncertainty exists while sampling, the sample should be discarded and retaken with a new, sterile bottle. The samples should be taken in three (3) one-quart sterile microbiological sample bottle. The capped plastic bottle should be under water well below the surface scum and foam near a midpoint of the channel just downstream of the UV system. The cap should then be removed and then filled to approximately 1 inch from the top to allow airspace for proper mixing. Transit time and temperature are extremely important factors affect sample quality. Because of this, the samples must be delivered on ice to the laboratory and be tested within 1 to 6 hours of sampling. If this is not possible, samples should be refrigerated at 39.2°F (4°C) and cultured within 24 hours. If the samples are being shipped, they must be placed within 2 sealed garbage bags then placed on ice/ice pack within a sturdy cooler. The cooler lid must be taped and sealed to prevent leakage. If there are large variation in flow conditions, then two (2) samples should be used to represent the low and high flow condition.

6.11 LIFTING AND LOWERING UV BANKS

6.11.1 Lifting UV Banks

The wiping cylinders are at the front of the UV bank. The lifting cylinder is slightly off center (by design). This may cause the bank to shift slightly to the side as it lifts or lowers. The operator must simply pay attention and if the bank gets stuck, shift it slightly until it can't fit anymore.

6.11.2 Locking Plates

Once the UV banks are lifted, the locking plates should be attached. This ensures that if any of the lifting mechanisms break, the bank cannot fall unexpectedly, which could cause serious injury. The locking plates are bright yellow and should have the arrow pointing toward the higher side of the bank. The two (2) holes in the plates hook over the bolts in the sides of the UV banks. The top hole should be attached first, and then the bottom hole.

6.11.3 Lowering Plates

When lowering the banks of the UV lights, the operator should ensure that the cable management are out of the way. When lifting the banks, the cables should not be in the way of the banks, but operators should double check as they left the banks.

6.11.4 Bank in Place Signal

The Bank in Place sensor ensures that the bank is properly seated and inside the UV channel. The UV bank will not activate if the bank is not fully engaged and activating the bank sensor. This will also activate a fault that has to be reset before it can run again. If the operator attempts to reset the fault and it doesn't work, the bank is likely still be out of place. This means that the operator must work to put the bank back in place before resetting. To do this, hold the Down control on the switch selector on the HSC to ensure it is all the way down. It is also possible that the bank may shift slightly to the side as it is lowered and will need to be pushed sideways to allow it to seat properly.

6.11.5 Equipment Failure Measures

If the HSC fails there is no way to lift the banks without it unless other equipment is added. It is also possible that the equipment could just be disabled and then manually lifted. This is not ideal, should not be attempted except as a last resort, and should be done with multiple operators if attempted. It is rare that either HSC will fail and even more unlikely that they will both fail at once. If one does fail, it would be fairly possible to disconnect the controls from the broken HSC and reconnect it to the other one. The filter should be changed every year and the oil should be changed every two (2) years.

6.12 MAINTENANCE

The UV channel can be set to MAINTENANCE mode. This will cause all gates in the UV channel to close and all UV banks in the channel to turn off. All alarms will be disabled except the maintenance mode alarm. Once maintenance is done, the DISABLE button can be pressed and the channel will resume its operations. Individual UV Banks can also be disabled and lifted from the channel for maintenance, while the other banks continue their usual operation. The recommended maintenance schedule for different parts of the process can be seen in section 9.2 of the manufacturer's manual. The hydraulic hose, air filter, lamp driver, wiper seals, O-rings, and bushings, lamp sleeves, and lamps all need to be regularly cleaned and checked for damage. Other parts of the system need monthly, semi-annual, annual, or every 2-year checks for damage. A summary of all necessary maintenance for the treatment plant, including the UV disinfection equipment, can be seen in Appendix C. Before maintenance is carried out, the operator should read and understand the owner's manual for the equipment. The operator should know every step in the procedure that they are carrying out to avoid making missteps.

Before any work is being done, the power must be locked out. This will stop the power from entering the lamp drivers. Because of the capacitors in the lamp drivers, even when the power is off, there may be a stored charge that could sock the operator. The operator should wait 15-20 minutes before removing or touching any of the lamp drivers to ensure they have time to dissipate their charge in time.

The main maintenance tasks are the removal of UV intensity sensors and cleaning, the removal and replacement of UV lamp drivers, inspect and clean the water level device, inspect and clean the low water rods, and compare flow reading on HMI to flow meter reading. Remove and replace the oil filter. Monitor the hydraulic oil level and how to add hydraulic fluid and inspect wiper seals and remove and replacement of wiper seals. The operator must keep records of the maintenance that is carried out. This information will

be needed if technical support is needed and to uphold the warranty. The recommended record documents are in the manufacturer's manual for the equipment.

6.12.1 Lamp/Sensor Replacement

Lamps should be replaced when the operation time reaches 15,000 hours, or the lamp fails. Each lamp is designed to withstand up to four (4) ON/OFF cycles a day without compromising lamp lifespan. Any lamp that fails in under 9,000 hours will be replaced by the supplier under full warranty. If a lamp fails between 9,000 and 15,000 hours, the plant owner will be credited by the supplier with an amount proportional to the lamp's unused lamp life. Individual lamp operation hours can be viewed from the *UV Bank Overview* screen (see section 6.5.3, above). The system monitors the operation hours of each lamp and ensures that the active lamps are rotated to keep the operation hours of each lamp as equal as possible. Lamp operation hours can be manually overridden; however, this should be avoided so that records are accurate. To ensure that lamps are replaced at the proper time, it is best to replace all lamps in a scheduled operation and to keep a record of the replacement date and elapsed time of the lamps. It is imperative that lamp modules be unplugged before being removed from the unit. It is advisable to maintain in stock at all times of a number of lamps equivalent to 5% of the total in the system. Specific instructions on lamp replacement can be seen in section 9.3.2 of the manufacturer's manual.

6.12.2 Automated Cleaning

To ensure maximum performance, it is essential that the quartz sleeves containing the UV lamps on the UV module be kept clean. If a coating is allowed to build up on the quartz sleeves around the UV lamps, the amount of UV light transmitted to the water will be reduced which could lead to insufficient disinfection. The automatic cleaning interval for the UV modules depends on the effluent quality, and is calculated and carried out by the system. The Hydraulic Systems Center (HSC) contains the ActiClean Cleaning System with the materials to clean the UV lamp quartz sleeves and the intensity sensors. The HSC can be accessed remotely through the SCC, through the SCADA system, or locally. The ActiClean system works without operator input and without disrupting the disinfection process. ActiClean uses a cleaning solution that is contained around the quartz lamp sleeves as well as mechanical wiping. Cleaning the lamps ensures that the water is exposed to sufficient UV for disinfection and cleaning the intensity sensors ensures that the intensity can be measured correctly to calculate the UV dose that is required. Section 9.7 of the manufacturer's manual details how to ensure that the ActiClean system is filled and working.

The automatic cleaning ActiClean Gel must be replaced every two (2) months. To do this, attach the drain attachment to the hole near the front of the bank. The pump attachment should then be attached near the middle of the bank. The pump attachment should be attached to the opening of an ActiClean bottle. The operator should then pump liquid until liquid starts draining out of the drain tube. An old (empty) ActiClean bottle or other old bottle should be held by the opening of the drain pipe so that the old ActiClean gel has somewhere to go. As soon as the old gel begins draining, the operator can stop pumping the new gel in. It is estimated that it will take 40-60 pumps of ActiClean Gel.

The ActiClean fill and waste ports can be reversed, as long as one is used as the fill and one is the drain.

6.12.3 Manual Cleaning

If the automated cleaning process is not sufficient, lamp sleeves can also be cleaned manually. The need for manual cleaning will be apparent from the lamp status display as seen in Section 8.3.4.2 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual. Lamp sleeves must be removed, cleaned with a mildly acidic Trojan Technologies approved cleaning solution, rinsed with water, and reassembled. The specifics of this procedure and of replacing lamp sleeves can be seen in section 9.4 of the manufacturer's manual. The UVI sensor can also be cleaned manually. This should be done when there is a low UVI alarm is activated or a low UV dose alarm is not resolved after the sleeve is cleaned with the automatic wiper. The UV bank must first be shut down, then the sensor housing is removed, washed with a mildly acidic solution, rinsed, and reinstalled. This procedure is further detailed in section 9.5 of the manufacturer's manual along with the process for cleaning and replacing the intensity sensor, sensor housing sleeve, sensor wiper, floor bushing, O-rings, and fittings. Details for the cleaning and replacement for the UV bank can be seen in Section 9.6 of the Product Operations and Maintenance Manual. The lamp sleeve wiper maintenance instructions can be seen in Section 9.7. Section 9.8 explains the necessary upkeep and maintenance for the HSC. This includes: inspection, depressurizing, changing the filter, draining and filling the reservoir, and replacing the hose. Section 9.9 explains maintenance and possible replacements for the hydraulic cylinders. Section 9.10 explains the maintenance for the Power Distribution Center (PDC).

6.12.4 Replacement Parts

The quartz sleeves only require replacing if broken. When removing the sleeves, the operators should take great care not to hit the sleeves against anything. The sleeves are long and once the bottom of the sleeve exits the wiper apparatus, the operator needs to make sure that the sleeve is removed straight as the bottom

will no longer be controlled by the seals of the sleeve. The lamp drivers should last years, but will eventually need replacements.

Replacing additional parts are all listed in the manufacturer's manual. These repairs and replacements include instructions for wiper seals, floor seals, lamp drivers. There are also other maintenance instructions for other required tasks, including filling or replacing oil, draining the hydraulic filter, greasing the hydraulic cylinder and cleaning the low water level sensor. The flow reading from the UV system should be compared to the flow meter mounted to the wall. If they do not match, the manufacturer should be contacted immediately to fix this.

The spare parts as per the specification are, four (4) quartz sleeve assemblies, eight (8) UV lamps, two (2) operator kits, and 10 wiper seals. On site at the treatment plant should be, the UV Layout Drawings, Controls Philosophy, Electrical drawings, and the manufacturer's O&M manual. The control's philosophy should be confirmed to be the absolute newest version as there were several versions created throughout construction.

6.12.5 Lamp Sleeve Replacement

To remove lamps and casings, the bank should be lifted out of the channel. The wiper sleeves should be retracted to approximately the middle of the sleeves. The locking plates should then be attached to ensure that the bank does not accidentally begin moving. The controls should then be switched to Off and then the disconnect for the relevant banks should be flipped. To remove the sleeves, the small pin needs to be pushed in and then twisted counterclockwise slightly before being pulled out. To do this, two (2) removal tools were provided with the system. These red caps can be used to help release the top of the sleeve. The gold part at the bottom is used to push the pin in and then the red tool can be twisted slightly to remove. This tool will likely not work to remove all of the sleeves because the power cord needs to fit through the end of the tool. The power cord for some of the lamps is not long enough to fit into the tool straight so it will need to be removed by hand. Once the cord is removed, the dust cover should immediately be closed and latched to keep out contaminates.

The sleeve should then be pulled out slowly, keeping it straight as it is pulled. Because the sleeve has to be pulled through the wiper seals, the operator will need to pull hard to remove the sleeve, particularly if the sleeve is dry. If the sleeve is dry, the operator can pour water over the sleeve and the seal cannister. This should help the sleeve slide out. While the sleeve is being pulled and before it exits the seal, the lamp should

remain approximately straight in its casing. The sleeve will pivot based on where the wiping cannister is so it should be moved to maximize the ease of removal. Once the sleeve has been removed from the seal, the casing will have more freedom of movement and the operator will have to take extra care to pull the sleeve straight. Another operator can also hold the edge of the sleeve as it is being removed to help the sleeve slide out smoothly.

6.12.6 Lamp Replacement

These lamps should also not be touched by bare hands. When they are removed from the banks, they are likely removed inside of the casing. The outside of the casing can be touched with bare hands. The operator should then put on clean gloves when removing the lamp itself. The outside of the sleeve gets cleaned automatically, but the lamp does not so any fingerprints that would be there will stay.

The profile on the lamp driver connection is a “D” shape and the flat part of the “D” always faces the pin. To remove the lamp from the sleeve, twist the top slightly and pull. Before the lamp exits the case fully, the operator should don clean and dry gloves. The lamp itself should be handled with cate. It has four (4) wires with two (2) filaments. Some flexing is fine in the wires as the lamp is removed from the sleeve. To put the bulb in, ensure that the lamp is not caught on anything as it is inserted. Align the top profile so the D faces the pin and push one side in. Then push the other side in. Next turn to lock the lamp in place. It should be fairly obvious if the lamp is seated properly. If just the lamp needs replacing, the lamp can be removed and replaced without removing the entire casing.

6.12.7 Wiper Cannister Removal

If the wiper canister needs to be removed, use one of the two (2) provided silver wrench-like tools to remove. The cannister should be gripped with the tool at the bottom and then twisted to remove. All of the parts need to be in the deals or they can’t compress enough and the seal leaks. The seals have tabs to help lock into the cannister. The wiping cannister for the probe is screwed in so the entire cannister needs to be removed to fix it.

6.12.8 Troubleshooting

There are three alarm levels included in the system, all with various levels of importance. A complete list of the critical alarms can be seen in Section 10.2.1 of the Product Operations and Maintenance Manual

within the Trojan UV Owner's Manual. These alarms require immediate attention as the conditions mean that at least part of the system will or is shut down. Once the alarms are resolved, a reset of the system may be required. Section 10.2.2 lists the major alarms. These alarms also require immediate attention, as damage may occur or insufficient disinfection if the indicated issues are not resolved. Section 10.2.3 lists minor alarms. Minor alarms mean that the system is still operating effectively, but requires maintenance. Sections 10.2-10.7 explains common issues, their possible causes, and their likely solutions for different sections of the system. Section 11 of the Product Operations and Maintenance Manual gives the specifications for many of the common parts that may need replacement. The above sections should be referred to if an alarm is activated.

If issues arise, the local representative for UV Signa systems should be contacted. The number for this person should be on a business card near the HMI. The project number is: 810138. This number will likely be needed for any technical support.

6.13 SAFETY

The UV disinfection system contains potentially risky chemical and electrical components. Only a qualified operator should operate the equipment. All operators should read and be familiar with the manufacturer's manual before operating any equipment. Section 2 of the Product Operations and Maintenance Manual within the Trojan UV Owner's Manual contains important details on potential risks from the equipment. Operators should pay special attention to this section in the manufacturer's manual.

6.13.1 UV Exposure Safety

Each lamp in the UV module is a powerful source of ultraviolet light. UV light will cause damage to unprotected skin and eyes, but it is safe when the proper precautions are taken. The best protection is to prevent exposure to UV light. The UV modules pose no health threat when submerged. If it becomes necessary to work with an open source of UV light, gloves, protective clothing and UV face shield should be worn. Ordinary eye glasses are not adequate protection. Neither are safety glasses with plastic lenses or goggles that do not cover the entire face. No part of the body should be exposed to UV light. Exposure to a burning UV lamp can damage eyes and skin.

It is important not to look at the UV light when it is turned on. The amount of light that is emitted by the lamps are enough to permanently damage the eyes with irreparable scarring. Any exposed skin may also be

damaged. Excessive UV light is known to contribute to cancer. Also, with too much exposure to UV light, the operator may develop light sensitivity which can result in chronic itching. When the banks are on, but submerged, the operator should wear the provided face shields and cover all skin if they are working close to the lamps or if they are expected to be looking at the lamps. If the lamps are above water, they should not be activated. The dose of UV light would be very high for any operators looking at the exposed and active light. If the grating is on, then operators should not need any protective equipment unless they are looking directly at the lamps through a hole in the grating.

The equipment came with two (2) face shields. Additional face shields can be bought from any source if needed. These face shields block the operators' face and eyes from dangerous levels of UV light. Sunglasses, or other non-approved eye protection should not be worn as they may not provide sufficient protection.

6.13.2 Chemical Exposure Safety

Each UV lamp contains small amounts of mercury and may contain phthalates. Careful disposal of used or broken lamps is necessary to avoid risk. The used lamps should be placed in the UV lamp shipping container that they were received in or a similar container to store them before disposal. Boxes of used lamps should be labeled and stored carefully to avoid breakage. Local UV lamp recyclers may have specific storage requirements. The local UV lamp recycler should be consulted to ensure all necessary requirements are met and all potential risks are avoided. The used UV lamps should be removed from the site as soon as possible to avoid risk to the users.

6.13.3 Lifting Safety

The grating above the channel is heavy and may be difficult to remove. If the operator has difficulty removing the panels, they should get assistance from another operator to avoid straining themselves. The panels should always be closed when possible. Unless there is a specific reason to remove a cover, the panels should be laid down. This helps reduce the risk of someone accidentally falling into the channel and reduces the risk of eye damage from UV exposure.

CHAPTER 7
EFFLUENT PUMP STATION AND OUTFALL

7.1 INTRODUCTION

This chapter contains a description of the effluent pump station and outfall. The facilities include five (5) submersible wastewater pumps installed in a wet well, an effluent chamber, effluent pipeline, and outfall to the Nooksack River. One (1) of the pumps was installed in 2020, while four (4) of the pumps were installed in a previous renovation in the 1990s.

7.2 PURPOSE

Under normal flow conditions, treated effluent is discharged out of the UV treatment channel, flows by gravity through the wet well, and then into the effluent chamber, where it enters the effluent pipeline. The effluent is then discharged through the outfall into the Nooksack River.

The effluent pump station is intended for operation only during extreme conditions of peak flows, river flood stages, or a combination of both. The pump station ensures that the Ferndale WWTP will continue to operate during 100-year flood conditions, without overflowing the UV Channel and upstream equipment, as required by the Washington State Department of Ecology regulations.

7.2.1 Equipment Description

The effluent pump station consists of a wet well and an effluent chamber. The wet well contains five (5) submersible non-clog wastewater pumps, each equipped with a 25 hp electric motor. The ultrasonic transducer located on the north wall of the wet well controls the pumps, depending upon the water level in the wet well. The pump station is also equipped with a high-water level sensor alarm and a low water sensor. A jib crane is provided above the wet well to lift the pumps out of the wet well for maintenance or repair.

The effluent chamber collects the flow from the wet well and directs it into the 30-inch diameter effluent pipeline. The chamber is partially above grade to allow a higher water elevation relative to the wet well. This higher elevation provides enough head to force effluent through the pipeline and outfall when the pumps lift the effluent into the chamber. Figure 7-1 presents the effluent pump station configuration.

The 30-inch diameter effluent pipeline begins in the effluent chamber and runs in a southwesterly direction under the center of the east lane of the Ferndale Road. It terminates at the outfall in a bend of the Nooksack River along Ferndale Road at river mile 4.9.

7.3 PUMP STATION EQUIPMENT

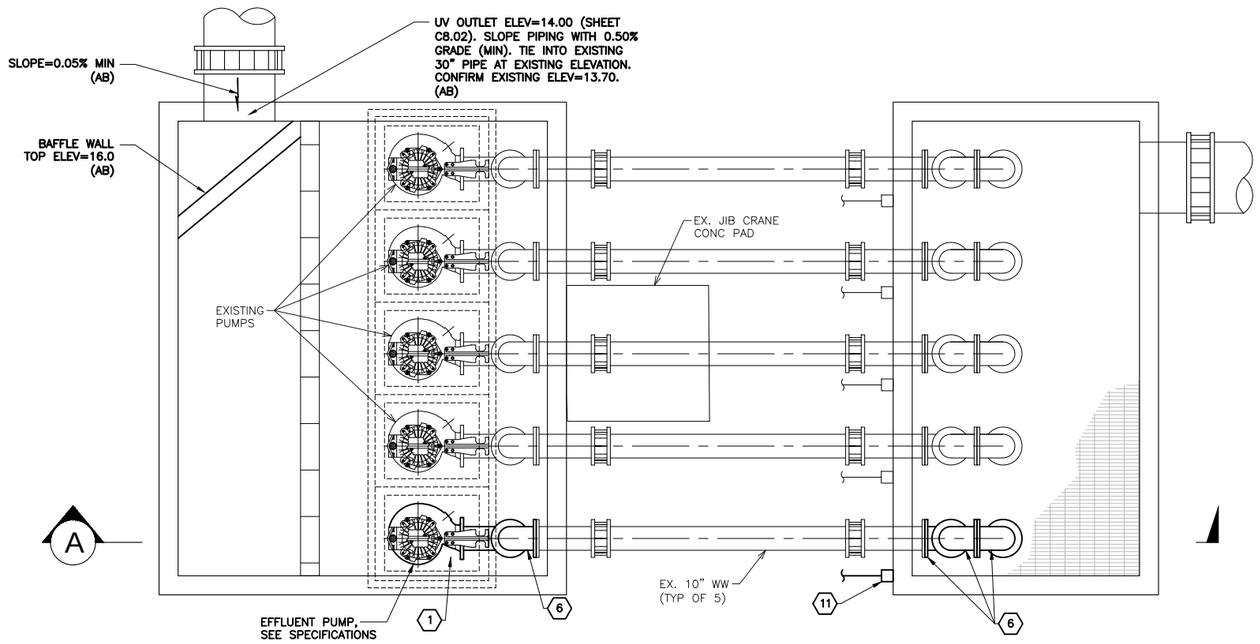
One (1) new submersible wastewater pump was installed and commissioned in 2020. This pump was added to the four (4) existing pumps that are already in the wet well to increase the capacity of the pump station. Two (2) of these existing pumps were commissioned in July of 1997 and the other two were commissioned in February of 1999. All four (4) of the old pumps are the same kind of pump, made by the same manufacturer as the new pump that was installed in 2020. The old pumps are Flygt 3170.090 submersible pumps. The new pump is a Flygt 3171.095 submersible pump. The specifications are largely the same between these pumps. Each pump has attached sensors, motors, and cooling mechanisms installed with the pump.

7.3.1 New Pump Equipment

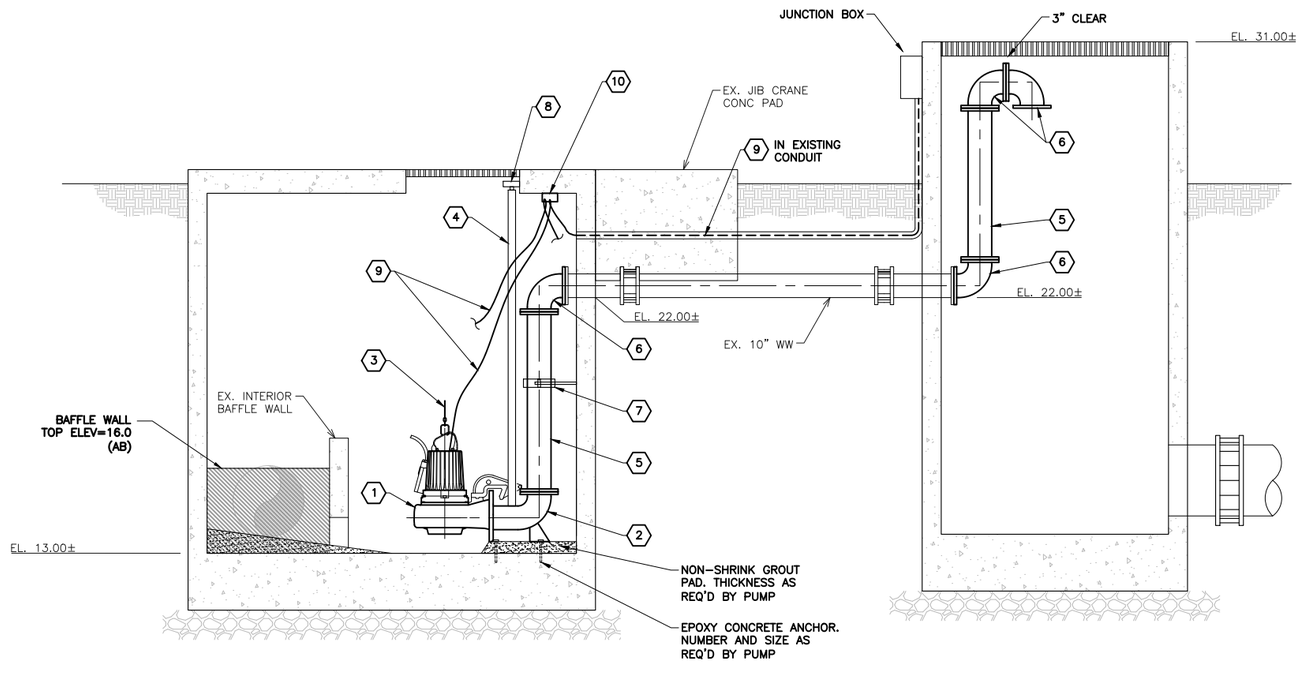
7.3.1.1 New Effluent Pump

The effluent pump that was added in 2020 is a submersible non-clog wastewater pump. The discharge connection is 10” and is capable of delivering 2900 GPM at 20 feet TDH. The shut off is 41 feet (minimum). Each pump is with 20 feet of lifting chain assembly, consisting of Spectra cord and 18-inch stainless steel chain for use with the Flygt Grip Eye lifting system. The working load of the lifting system is 50% greater than the pump unit weight. The pump will be equipped with a leakage chamber. This chamber will have a float type switch that will signal if the chamber should reach 50% capacity in case of leakage.

NO.	REVISIONS	BY	DATE



EFFLUENT PUMP STATION PLAN



A EFFLUENT PUMP STATION SECTION A-A

KEYED NOTES

1. = SUBMERSIBLE PUMP w/ ACCESSORIES, SEE SPECS (TYP)
2. = 10" DISCHARGE ELBOW
3. = STAINLESS STEEL LIFTING CABLE
4. = GUIDE BARS – 3"ø SST PIPE (2 PER PUMP)
5. = 10" DI SPOOL, FL
6. = 10" DI FL x FL 90° ELBOW
7. = ~~PIPE SUPPORT~~ NOT USED (AB)
8. = UPPER GUIDE BAR BRACKET AND SAFETY CHAIN HOOK
9. = PUMP MOTOR CORD, SEE ELECTRICAL PLANS AND SPECS
10. = CABLE HOLDER, SECURE WITH CONCRETE ANCHORS
11. = TERMINAL BLOCK, SEE ELECTRICAL PLANS AND SPECS

811 Call 811 two business days before you dig

RECORD DRAWINGS

WILSON ENGINEERING
WWW.WILSONENGINEERING.COM

SCOTT JAMES WILSON, 48879, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER — 10-07-22

JOSEPH GERHART, 50888, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER — 10-07-22

DESIGNED BY	DRAWN BY	CHECKED BY
JGC/SJW	RDN	AWL

CITY OF FERNDALE, WASHINGTON
FERNDALE

FIGURE 7-1
EFFLUENT PUMP STATION CONFIGURATION

DATE	SCALE	JOB NUMBER
10-7-2022	AS SHOWN	2020-006

SHEET 1 PAGE 1

PLOT SETTINGS: Adobe PDF1.pc3, ANSI full bleed B (17.00 x 11.00 Inches), Portrait, 1:2, WE APWA_UNSCREENED.ctb
W:\2020\2020-006 FERNDALE WWTP CONSTRUCTION\DWG - V2019\AS-BUILT DRAWINGS V2019\AB V2019_2020-006 M7.01-M7.04 WEST PLANT DRAIN PS.DWG 10/7/2022 5:51 PM - Jeff Smith

7.3.1.2 New Effluent Pump Motor

Each pump is equipped with a 25 HP submersible electric motor and is connected for operation to 460 volts, 3 phase, 60 hertz, 7 wire service with 50 feet of submersible cable. The motor is a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The motor is designed to perform at least 30 evenly spaced starts per hour without compromising performance. The motor service factor (combined effect of voltage, frequency and specific gravity) is 1.15. The motor will have a voltage tolerance of +/- 10%. The motor and cable are capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater. The motor is explosion-proof rated.

7.3.1.3 New Effluent Pump MiniCAS

The miniCAS system provides motor over temperature and seal leakage protection. The unit supplies 12 VDC to the sensor and measures the current through the sensor using protected, noise-filtered electronic circuitry. When sensor current is in the normal range, the Temperature Alarm Relay is activated to allow the normal pump operation. In high temperature condition, the pump thermal contacts open and the current becomes zero, preventing operation and the Overtemp indication is turned on. This indication will be reset based on the Alarm Reset Mode Select Switch which can be set to auto or manual mode. If there is seal leakage, the sensor decreases its internal resistance. The sensor's internal current is reduced, the reduced current is sensed, leakage indicator is turned on and the Leakage Alarm Relay is activated. The shorted sensor condition will be indicated by the leakage alarm relay and alternately flashing the leakage and Overtemp LED together with the Power LED. The fault will automatically be reset within 30 seconds if the fault is repaired.

7.3.1.4 New Effluent Pump Impeller

The impeller will be of Hard-Iron (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back-swept, non-clog design. The impeller vane leading edges will be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on a replaceable insert ring. The impeller has vanes capable of handling solids, fibrous materials, heavy sludge, and other matter found in wastewater. The impeller to volute clearance will be readily adjustable by the means of a single trim screw. The impellers will be locked to the shaft, held by an impeller bolt and will be coated with

alkyd resin primer. This set up has a manufacturer guarantee of no clogging for at-least twelve (12) months after beginning operation.

7.3.1.5 New Effluent Pump Alarms

The pump motor stator will incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor will stop and activate an alarm. A float switch will be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection. The thermal switches and float switch will be connected to a MiniCAS control and status monitoring unit. The Mini CAS unit will be designed to be mounted in the pump control panel. The alarms can also be monitored through the plant-wide SCADA system.

7.3.1.6 New Effluent Pump Cooling System

The pump is installed with a stainless-steel motor cooling jacket that encircles the stator housing, allowing dissipation of motor heat. An impeller that is driven by the pump shaft provides the necessary circulation of the cooling liquid through the jackets. The cooling system has one (1) fill port and one (1) drain port integrated into the cooling jacket. The cooling system lets the pump operate continuously in liquid or ambient temperatures up to 104°F (40°C). Any operational restrictions that occur under this threshold temperature are not acceptable and the manufacturer should be contacted to solve this issue.

7.3.1.7 New Effluent Pump Materials

The pump will be automatically connected to the discharge connection without personnel having to enter the wet well. The seal will be accomplished with metal-to-metal connection that does not need an O-ring or a profile gasket. All exposed nuts and bolts are 316 stainless steel construction and all metal surfaces that contact liquid and are not stainless steel or brass are protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump. All of this reduces corrosion and wear on the exterior of the pump to a minimum. The pump can operate at full capacity when completely submerged, partially submerged or totally non-submerged.

7.3.2 Old Pump Station Equipment

7.3.2.1 Old Effluent Pumps

The discharge connection is 6” in the old pumps. The old pumps are equipped with impeller 602 which is cast iron. The maximum operating depth is 65 feet. The pumps were not installed with a patented Flygt lifting system, like the new pump. Because of this, a jib crane has been in place to lift the four (4) old pumps.

7.3.2.2 Old Effluent Pump Motors

The four (4) old pumps are also equipped with 25 HP submersible electric motors and is connected for operation at 460 volts, 3 phase, and 60 hz. All of these specifications are the same as the new pump. The old pumps have 40 feet of submersible cable, instead of 50 feet like the new pump. The old motors are squirrel-cage 3-phase induction motor like the new pump. This motor can be run either continuously or intermittently with a maximum of 15 evenly spaced starts per hour. The motor will have a voltage tolerance of +/- 10%.

7.3.2.3 Old Effluent Pump Cooling System

The maximum liquid temperature for operation is 104°F (40°C) which is the same as the new pump. The stator of the pump is cooled by circulating a portion of the pumped liquid in the space between the stator casing and the cooling jacket.

7.4 OPERATION

Under normal operating conditions, effluent flows by gravity through the pump station wet well, and into the effluent chamber, where it enters the effluent pipeline and outfall. During extreme conditions of peak wastewater flows or river flood stages, the flow backs up into the effluent chamber and pump station wet well. When the water level reaches elevation 10’, the ultrasonic level transducer activates the lead pump. The pump lifts the effluent from the wet well into the raised effluent chamber. The effluent is discharged into the effluent chamber through a 10-inch diameter pipe elbow located near the top of the structure, providing the necessary head to force the effluent through the pipeline and outfall into the river. When the w

ater level is lowered back to the normal operating level, the pumps are deactivated and gravity flow of the effluent is resumed.

The pumps are controlled by means of a Hand-Off-Automatic (HOA) switch on the local control panel located near the pump station. Motor operation and alarms conditions are monitored by annunciators in the Main Electrical Building. The following alarm conditions are monitored:

- High water level.
- Low water level.
- Power failure.
- Pump failure.
- Overtemp
- Seal Fail

A motor moisture alarm is also provided for each pump.

7.4.1 Start-Up Procedures

1. Check maintenance records. Verify that all preventive maintenance has been performed.
2. Check wet well. Remove any floating materials.
3. Check the oil level in the oil casing.
4. Check level control and alarm systems. Close canal gate in wet well to allow water level to raise high enough to run pumps. Observe pumping cycle with the pumps in the “HAND” mode to be sure all level controls and alarm systems are working correctly.
5. Check the rotation direction of the pump. The impeller should rotate clockwise, as viewed from above. When started, the pump will jerk in the direction opposite of impeller rotation. Watch Out! The starting jerk can be powerful.
6. Check pumps. Listen for unusual noises or vibration. Keep pump and shaft free of grease.
7. Set pump controls for normal operation. Set switch on the control panel to “AUTO” for each pump.

The pumps will have a starting jerk upon start-up. This will jerk in the opposite direction to the direction in which the impeller rotates. This can be a powerful jerk so operators take extra care and maintain a safe distance while starting up the machinery.

7.4.2 Shut Down Procedures

1. Check water level in wet well. Level should be well below the highest float switch.
2. Shut down pumps. Shutoff one at a time if operating. Turn control switch to “OFF” position.
3. Open canal gate to allow for gravity flow.

7.5 PUMP PROTECTION MEASURES

The new pumps have an FLS that senses the presence of water in the stator housing of the miniCAS attached to the leakage sensor. The FLS sensor is a miniature float switch for detection of water in the stator housing. The miniCAS is attached to the alarm functionality so an alarm will sound if the FLS is activated. There is also an overheat alarm that will be activated if the system overheats.

7.6 MAINTENANCE

7.6.1 Pump Maintenance

A preventative maintenance schedule is to be implemented for all pumps and incorporated into the routine work schedule (see Appendix C). Pump maintenance is listed specifically in Appendix C. This maintenance is similar for both models of effluent pumps that are used in this effluent pumping station. The manufacturer’s manuals for both pump varieties should be consulted for additional details on maintenance and inspections. Troubleshooting advice for the newer pumps can be seen in the “Troubleshooting” section of the Flygt 3171 Installation, Operation, and Maintenance Manual.
This advice includes what to do if:

- the pump does not start;
- the pump does not stop when a level sensor is used;
- the pump starts-stops-starts in rapid sequence;
- the pump runs but the motor protection trips; or,
- the pump delivers too little or no water.

7.6.2 Effluent Pipeline Maintenance

The “pigging” method is the recommended method for cleaning the effluent pipeline. “Pigs” are bullet-shaped, plastic-coated, polyurethane objects that are forced through the pipe by the flow and pressure

developed behind it. As a pig moves through a pipe, it scours build-up from the sides of the pipe. The standard pig for a 30-inch diameter pipe is 48 to 50 inches long. The pig should be launched from the effluent chamber and retrieved from the river. The pressure differential required for the procedure is developed in the pipeline with backup of flow into the raised effluent chamber.

7.6.3 Effluent Outfall Maintenance

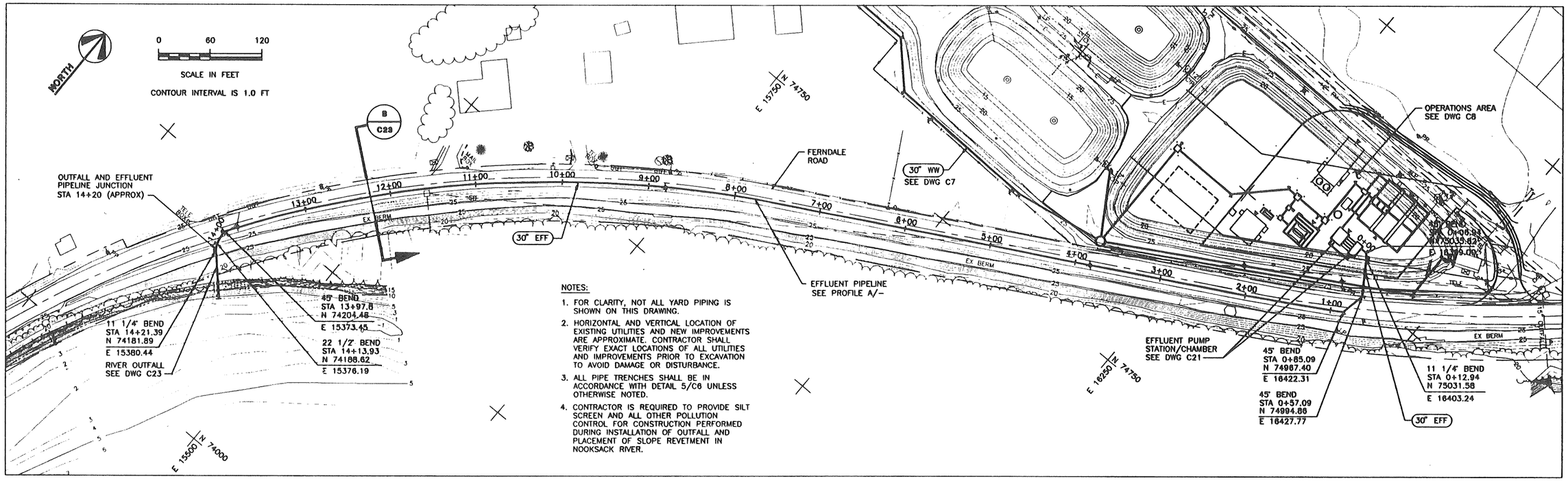
The outfall discharge location into the Nooksack River, shown on Figure 7-2, should be inspected after high flow/flood events. The outfall should also be inspected annually for condition of the rip-rap pad and dike to determine if repairs are necessary.

7.7 SAFETY

In any area where wastewater is present, it is important to maintain good personal hygiene. Avoid smoking, eating, or drinking in the pump station area. Because the pumps are used in wastewater, it is necessary to prevent exposure to the wastewater when performing pump maintenance or repair. When working on a pump, observe the following:

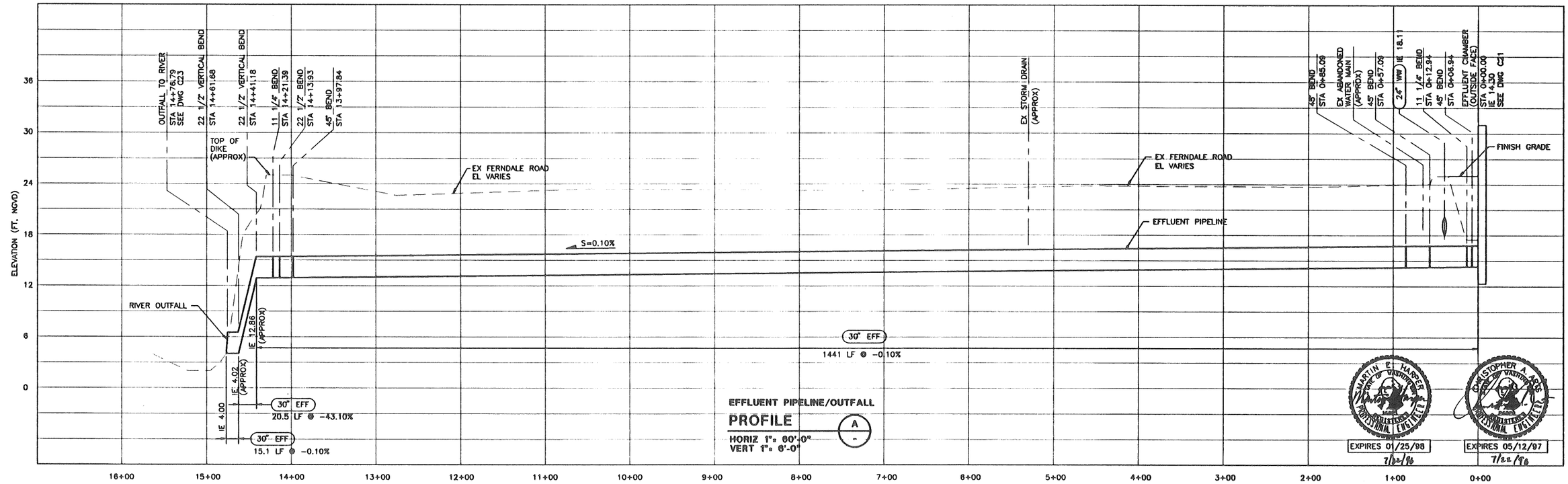
- Rinse the pump thoroughly with clean water before starting work.
- Always wear goggles and rubber gloves.
- Rinse the components in clean water after disassembly.
- When removing the oil casing screw and the inspection screw, hold a rag over the screws to prevent splattering of wastewater into eyes or onto skin.

Safety precautions for operating the jib crane are contained in the Gorbel I&M Catalog. When completing inspections or repairs on the pumps, all personnel should read and be familiar with the manufacturer approved procedures. Inspecting the liquid in the stator casing requires removing the inspection screw which temporarily renders the pump non-explosion proof. Level sensors contain mercury and thus special care must be taken when in close proximity to these sensors or when disposing of them.



NOTES:

1. FOR CLARITY, NOT ALL YARD PIPING IS SHOWN ON THIS DRAWING.
2. HORIZONTAL AND VERTICAL LOCATION OF EXISTING UTILITIES AND NEW IMPROVEMENTS ARE APPROXIMATE. CONTRACTOR SHALL VERIFY EXACT LOCATIONS OF ALL UTILITIES AND IMPROVEMENTS PRIOR TO EXCAVATION TO AVOID DAMAGE OR DISTURBANCE.
3. ALL PIPE TRENCHES SHALL BE IN ACCORDANCE WITH DETAIL 5/C6 UNLESS OTHERWISE NOTED.
4. CONTRACTOR IS REQUIRED TO PROVIDE SILT SCREEN AND ALL OTHER POLLUTION CONTROL FOR CONSTRUCTION PERFORMED DURING INSTALLATION OF OUTFALL AND PLACEMENT OF SLOPE REVETMENT IN NOOKSACK RIVER.



EFFLUENT PIPELINE/OUTFALL
PROFILE (A)
HORIZ 1"= 60'-0"
VERT 1"= 6'-0"

EXPIRES 01/25/98 7/22/96

EXPIRES 05/12/97 7/22/96

XREFS: WWTPBASE.dwg
TIME: 10:14am PLOT SCALE: 1=1
C:\0 PLS\ WWTP-25.dwg
PLOT DATE: 07/19/96

No.	Revision	By	Date
1	ISSUED FOR CONSTRUCTION W/ALL ADDENDA	CAA	07/22/96

vasey engineering
1479 4th street, nanaimo, bc v9s 3s3, 753-753-3382 fax 753/753-7881
1218 4th avenue, suite 1109, seattle, washington 98101, 206/682-6894 fax 206/682-6491

Designed	JK/MJ
Drawn	PS
Checked	Date 7/22/96
Approved	Date 7/22/96
Scale	AS NOTED
Date	08/14/96

One Inch At Full Scale — If Not One Inch Scale Accordingly

FIGURE 7-2

FERNDALE WWTP
OUTFALL DISCHARGE

Drawing C22
Sheet 28 of 93

CHAPTER 8
SAMPLING AND LABORATORY TESTING

8.1 PURPOSE AND INTENT

The treatment facility testing program provides the basis for process control and provides a record of how the biological treatment processes are functioning. Laboratory data keep the personnel informed of plant efficiencies and help in predicting problems that may be developing in the system. In order to meet the State of Washington Water Quality Standards for discharge to the Nooksack River as required in the NPDES Permit, laboratory tests must be conducted and the results recorded and reported to the State of Washington Department of Ecology. The results of the laboratory tests are compared with regulatory standards for specific laboratory parameters. For these reasons, it is essential that the laboratory testing program produce complete and accurate results.

8.2 OPERATIONS AND LABORATORY STRUCTURE

The Operations and Lab Building was built in the 2020 plant upgrade. The building is approximately 36-feet by 65-feet and is in the eastern section of the treatment plant site. It is located between the aeration basins and the Blower Building. The building is made of concrete masonry unit blocks. The foundation consists of grade-beam style footings with structural mat foundation.

8.3 SAMPLING PROCEDURES

The value of results from laboratory testing of the wastewater is dependent upon the sample being truly representative of the condition of the wastewater at the sampling point. The operator is responsible for ensuring that all personnel who might participate in the sampling program be personally instructed in the sampling techniques that is utilized at the Ferndale Plant.

Supplemental information regarding proper methods of sampling can be found in the WPCF OM-1, Wastewater Sampling for Process and Quality, and other references listed herein.

8.3.1 Wastewater Sampling

General guidelines for wastewater sampling include:

1. Samples should be taken at locations where the wastewater is as completely mixed as possible.
2. Particles greater than 1/4-inch diameter should be excluded when sampling or blended well.
3. Any floating materials, growth, etc., which may be present at a sampling location should not be included in the sample.
4. Samples kept on site for more than one hour should be immersed in ice water or placed in a refrigerator to retard bacterial action. Every effort should be made to run tests on the samples immediately after sampling. However, when samples must be stored to await testing, they should be refrigerated as soon as possible.
5. Proper sampling equipment should be used and safety precautions should be exercised during all sampling.
6. Consideration should be given to the relationship between the plants' daily flow variation and detention time through the units so that influent samples relate to the same waste.

8.3.2 Sludge Sampling

8.3.2.1 Clarifiers: Sludge Sampling

Activated sludge samples can be taken directly from the sludge collection troughs. Flow in the trough will generally be well-mixed, but regardless, the sludge should be visually observed to avoid sampling from an area that does not appear well-mixed.

The depth (i.e., thickness) of the sludge blanket should be monitored frequently in both clarifiers using a Sludge Judge or similar measuring device, in order to maintain stable operation. The blanket depth should be in the range of 1-3 feet. If the sludge blanket depth is too high, the clarifier may require additional sludge wasting or an increased sludge wasting rate.

8.3.2.2 Long-Term Digestion Basin: Sludge Sampling

Before each dredging event, digested sludge from the Long-Term Digestion Basin should be sampled, and the digested sludge depth should be measured. Results from these measurements and sampling are used to calculate the solids land application rate.

The depth (i.e., thickness) of the sludge blanket can be determined in the Long-Term Digestion Basin at sampling locations determined by using a grid pattern throughout the basin, and the average sludge blanket depth can be calculated. A Sludge Judge can be used to determine sludge blanket depth. The device should be slowly lowered through the sludge layer, down to the floor of the basin. The sludge depth can be measured from the core sample.

Alternatively, a graduated pole and a 2'x2' acrylic plate can be used to measure the sludge blanket depth by locating the basin bottom and the top of the sludge blanket. Guidance on how to measure the sludge blanket depth at each location using this method is as follows:

1. Bring the boat to the first location and maintain the position of the boat.
2. Lower the graduated pole until it is firmly planted on the bottom liner material.
3. Record the water level elevation above the lagoon bottom at that location to the nearest 0.05 ft or 0.01 ft mark (Depth A).
4. Lower the 2-ft x 2-ft acrylic plate until it rests lightly on the sludge blanket at the same location. The plate should be attached to a graduated ten-foot rigid stem, with a combined weight of approximately 10 lbs.
5. Record the water level elevation above the sludge blanket to the nearest 0.05-ft or 0.01-ft mark (Depth B).
6. Sludge thickness (in feet) at each sampling location = Depth A - Depth B

8.4 SAMPLING LOCATIONS AND FREQUENCIES

8.4.1 NPDES Permit Monitoring Schedule and Testing

The recommended sampling schedules and location of each sampling point are presented in Table 8-1, and have been developed to provide data for process control and NPDES permit monitoring. These requirements will change with issuance of a new discharge permit after July 2019. Automatic samplers are provided in two locations: the coarse screen at the headworks, and after the UV channel.

Table 8-1

NPDES Permit Monitoring Schedule and Testing

Category	Parameter	Units	Sample Point	Minimum Sampling Frequency	Sample Type
Wastewater Influent [a]	Flow	MGD	Grit Basin Flow Meter Vaults	Continuous [a]	Metered / Recorded
Wastewater Influent [a]	$CBOD_5$	mg/L	Headworks	2/week	24-hr comp. [b]
Wastewater Influent [a]	$CBOD_5$	lbs/day	Headworks	2/week	Calculated [g]
Wastewater Influent [a]	TSS	mg/l	Headworks	2/week	24-hr comp. [b]
Wastewater Influent [a]	TSS	lbs/day	Headworks	2/week	Calculated [g]
Wastewater Effluent	Flow	MGD	UV Effluent Flow Meter Vault	Continuous [a]	Metered / Recorded
Wastewater Effluent	$CBOD_5$	mg/L	Final Effluent	2/week	24-hr comp. [b]
Wastewater Effluent	$CBOD_5$	lbs/day	Final Effluent	2/week	Calculated [g]
Wastewater Effluent	$CBOD_5$	% removal [c]	Final Effluent	1/month	Calculated [c]
Wastewater Effluent	TSS	mg/L	Final Effluent	2/week	24-hr comp. [b]
Wastewater Effluent	TSS	lbs/day	Final Effluent	2/week	Calculated [g]
Wastewater Effluent	TSS	% removal [c]	Final Effluent	1/month	Calculated [c]
Wastewater Effluent	Fecal Coliform [e]	Count	Final Effluent	2/week	Grab [f]
Wastewater Effluent	Total Residual Chlorine	µg/L	Final Effluent	Daily	Grab [f]
Wastewater Effluent	pH [d]	Standard Units	Final Effluent	Daily	Grab
Wastewater Effluent	Temperature [h]	Degrees Centigrade	Final Effluent	Daily	Meter / Recorded

Category	Parameter	Units	Sample Point	Minimum Sampling Frequency	Sample Type
WET Testing	Acute Toxicity Testing	Fathead minnow 96-hour static-renewal test / Daphnid 48-hour static test	Final Effluent	January 2018 and June 2018	24-hr comp. [b]
WET Testing	Chronic Toxicity Testing	Fathead minnow survival and growth / Water flea survival and reproduction	Final Effluent	January 2018 and June 2018	24-hr comp. [b]

[a] Continuous means uninterrupted except for brief lengths of time for calibration, power failure, or unanticipated equipment repair or maintenance.

[b] 24-hour composite means a series of individual samples collected over a 24-hour period into a single container, and analyzed as one sample.

[c] % removal = (influent conc. [mg/L] – effluent conc. [mg/L]) / [influent conc. [mg/L]] x 100
Calculate the percent (%) removal of CBOD5 and TSS using the above equation.

[d] Report the daily minimum and maximum pH.

[e] Report a numerical value for fecal coliforms following the procedures in Ecology's Information Manual for Wastewater Treatment Plant Operators, Publication Number 04-10-020 available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html . Do not report a result as too numerous to count (TNTC).

[f] Grab means an individual sample collected over a fifteen (15) minute, or less, period.

[g] Calculated means figured concurrently with the respective sample, using the following formula:

Concentration (in mg/L) X Flow (in MGD) X Conversion Factor (8.34) = lbs/day

[h] Temperature grab sampling must occur when the effluent is at or near its daily maximum temperature, which usually occurs in the late afternoon.

8.4.2 Digested Sludge Testing

Samples of digested sludge from the Long-Term Digestion Basin are to be tested for the parameters as shown in Table 8-2 below.

Table 8-2

Digested Sludge Sampling Plan

Parameter	Method	Sample Type	Number of Samples
Fecal Coliform	9221 E, 9222 D	Grab	7
Total Solids	SW-846	Composite	1
Total Volatile Solids	SW-846	Composite	1
Total Kjeldahl Nitrogen	4500 Norg C	Composite	1
Ammonia	4500 NH3 F	Composite	1
Nitrate	300.0	Composite	1
Total Phosphorus	4500 P C/E	Composite	1
Metals (As, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Se, and Zn)	SW-846	Composite	1
Cyanide	SW-846	Composite	1
Phenols	SW-846	Composite	1
Volatile Organic Compounds	EPA 8140/8160	Composite	1
Base/Neutral & Acids	EPA 8170	Composite	1
Pesticides/PCBs	EPA 8080	Composite	1

8.5 TYPES OF SAMPLES

8.5.1 Wastewater Samples

The operator will be required to take two types of samples and composite samples. A grab sample is a single withdrawal at one point in time. A composite sample is a mixture of samples of equal volume or amounts that are in exact proportion to the volume of flow. This type of sample is taken at selected time intervals throughout one day (24 hours) to minimize the effect of variability. Grab samples are normally taken for use in tests for DO, Settleable Solids, Fecal Coliform, and pH. Suspended Solids and BOD tests require a composite sample.

8.5.2 Digested Sludge Samples

Digested sludge requires grab samples to test levels of fecal coliform, and composite samples to test the other parameters listed in Table 8-2, above. The composite sample should be comprised of subsamples from at least five (5) representatively distributed locations in the Long-Term Digestion Basin. Each of the subsamples can be collected in a bucket to create one composite sample. The composite sample should be mixed thoroughly using a stainless steel ladle. The sample can be distributed into sample jars, continuing to stir the composite frequently. Collect 7 individual grab samples for fecal coliform testing.

8.6 LABORATORY TESTING

This section contains descriptions of each laboratory test and explains its application to the wastewater treatment facilities. The laboratory/office building houses the laboratory equipment and chemicals necessary to perform these tests. Detailed laboratory procedures may be found in the references listed in this chapter.

8.6.1 Temperature Testing

The temperature of the wastewater in the basins directly affects the treatment efficiency. As temperature decreases the amount of BOD removal will also be decreased. Temperature is reported in terms of degrees Centigrade (°C) or degrees Fahrenheit (°F).

8.6.2 pH Testing

The term pH is used to express the intensity of the acid or alkaline conditions of a solution. The pH scale is usually represented as ranging from 0-14, with a pH of 7 representing absolute neutrality. Acid conditions increase as pH values decrease, and alkaline conditions increase as the pH values increase.

Independently, the pH test is not an indicator of need for specific corrective action within the plant, but is used as a corroborator with the tests for solids and oxygen. A pH of 7 is the condition under which organisms function best. A pH of significantly less than seven (7) may suggest anaerobic decomposition or a septic condition.

8.6.3 Dissolved Oxygen (DO) Testing

Dissolved oxygen represents the amount of oxygen in solution in a liquid. The solubility of oxygen in fresh waters ranges from 14.6 mg/L at 0°C to about 7 mg/L at 35°C. The solubility of oxygen decreases as temperatures increase. In wastewater testing, dissolved oxygen measurements are used to monitor aerobic conditions in receiving streams and to control the aerobic treatment process in the aeration basin.

8.6.4 Chemical Oxygen Demand (COD) Testing

The COD test is based on the fact that practically all organic compounds can be oxidized by the action of strong oxidizing agents under acid conditions. In the test, all organic matter is converted to carbon dioxide and water regardless of the biological assimilability of the substances. As a result, COD values can be much greater than $CBOD_5$ values if large amounts of biologically resistant organic matter are present. The test is widely used in the operation of treatment facilities because of the speed with which results can be obtained. In fact, it may be possible to establish a relationship between COD and $CBOD_5$ concentrations. COD test results are in terms of milligrams of oxygen per liter of sample (mg/L).

8.6.5 Carbonaceous Biochemical Oxygen Demand (CBOD) Testing

The CBOD test is used to determine the oxygen required to biologically stabilize the organic matter that is present in the wastewater. It is the principal test to determine the strength of the wastewater. It is widely used to evaluate the efficiency of many treatment processes. CBOD test results are usually reported in mg/L of oxygen consumed at the end of a five-day test period incubated at a test temperature of 20°C. These results are referred to as the 5-day CBOD ($CBOD_5$) and should not be confused with the ultimate CBOD of the sample.

8.6.6 Total Suspended Solids (TSS) Testing

The undissolved substances in wastewater are referred to as suspended solids or suspended matter. It is a major parameter in evaluating wastewater strength and in determining the efficiency of treatment processes. It is also used to estimate effects of pollution on receiving streams. Suspended solids test results are reported in terms of mg/L.

8.6.7 Fecal Coliform Testing

The Coliform group of bacteria is considered a reliable indicator of the adequacy of treatment for bacterial pathogens. Tests for Coliform bacteria are made on the treatment plant effluent and give an indication of its sanitary quality. The test shows the presence of that portion of the Coliform group found in the intestines of warm-blooded animals. Effluent fecal Coliform counts are used to assess the effectiveness of the plant UV disinfection system. Test results are reported in number of Coliforms per 100 mL of sample.

8.6.8 Volatile Suspended Solids Testing

This is the combustible fraction of the suspended solids and is indicative of the organics fraction. Laboratory analysis of the volatile suspended solids in the mixed liquor is a good indicator of the number of microorganisms that are present.

8.6.9 Chlorine Residual Testing

Chlorine residual is the chlorine remaining in wastewater at the end of a specified contact period. This parameter is used to determine if desired chlorination objectives are being met. Test results are reported in terms of mg/L. In this plant, disinfection is achieved using ultraviolet light, so the effluent should have minimal to no chlorine residual. It is noted that small amounts of chlorine are used for the 2W and 3W water services, as needed to maintain detectable chlorine concentration in the pipes, and trace concentrations may be detected from this source; however, dechlorination is not planned or anticipated as a future need for the WWTP process.

8.7 LABORATORY REFERENCES FOR TEST PROCEDURES

- Standard Methods for the Examination of Water and Wastewater, 18th Edition.
- EPA Publication, Methods for Chemicals Analysis of Water and Wastewater, (GPD Stock No. 5501-0067), 1983.
- WPCF Publication MOO18PA, Simplified Laboratory Procedures for Wastewater Examination, 1985.
- Chemistry for Environmental Engineering, Sawyer and McCarty, McGraw-Hill, 3rd Ed., 1978.
- EPA Publication, Handbook for Analytical Quality Control in Water and Wastewater Laboratories, Technology Transfer, 1979.

- WPCF Manual for Practice No. OM-1, Wastewater Sampling for Process and Quality.
- WPCF Manual of Practice No. SM-1, Laboratory Management, 1981.

8.8 REFRIGERATED SAMPLERS

8.8.1 Refrigerated Sampler Introduction

There are two (2) sample sites equipped with refrigerated samplers in the treatment plant. One sample site is in the headworks and the sample is taken after the screw pumps lift the influent water. This is known as the influent sampler. This sampler was replaced in 2020, but is located in the old sample shed and connected to the existing power and controls. The second sampler is located at the end of the UV disinfection system. A sample is taken after the disinfection to ensure that the effluent does not exceed permitted contaminant levels once treated. This sampler is known as the effluent sampler. Both samplers are Teledyne Isco 58 Outdoor Refrigerated Samplers. They are equipped with a control panel, refrigeration unit, distributer arm, two pump tubes, instruction manual, and pocket guide.

8.8.2 Refrigerator Description

The shell of the Teledyne Isco 58 Outdoor Refrigerated Sampler is made of rotationally molded UV-resistant polyethylene with thermal insulation. This allows the unit to be exceptionally resistant to corrosion and weathering. The copper refrigeration lines, condenser coil and evaporator plate are power-coated and additional heat-treated polyester is applied for additional corrosion resistance. All of this allows the unit to be durable and require minimal maintenance.

Minimal operator oversight is required to operate the sampler, as the sampling and intervals are automated. The operator can program the sampler to collect sequential or composite samples at user-definable intervals and volumes, and can even set a delay on the first sample based on the real-time clock if desired. On startup, the temperatures within the sampler will drop to 2.5°C below the set temperature and will remain there for 24 hours before resuming normal operation. The top section housing the control panel, pump, distributor electronics, and power supply box shall be NEMA rated at 4X, 6, and IP 67. The required power is 120 VAC and 60 Hz.

8.8.3 Refrigerated Sampler Operating Procedures

The samples are taken automatically by the samplers. The frequency of these samples can be set as a time trigger that will take samples at certain uniform time intervals. It can also be triggered by flow volume which is measured by an external flow measurement device and can be used for flow pacing or constant volume variable time. Once the sample is taken, the pump delivers the liquid using a pump revolution counter and on-contacting liquid detector. These samples are then preserved in the sampler's refrigerator until an operator retrieves them and delivers the samples to the lab for analysis. For security, a padlock is present on the door of the refrigerator so that only authorized personnel can access the samples and to stop any potential tampering.

Because the sampler operation is fully automated, no user intervention is required. If there is a need to check on a program while it is running, the sampler display can be viewed. This always reports the current state or operation and the refrigerator temperature. This display will count down to the next sample event. This countdown may alternate with various other messages. If the sampler is disabled by an external device, the display will show PROGRAM DISABLED. If the sampler is currently taking a sample, the display will say TAKING SAMPLE (number), where the number is the sample number. If the sampler has an error condition that has been triggered, the display will show ERRORS HAVE OCCURRED. If the sampler is programmed for time-switched bottles, the display will show NEXT BOTTLE AT: HH:MM:SS DD-MON-YY. If any part of the current sampler program controls the operation, the display will show the current time and date.

The program can be paused or stopped manually. When a program is paused, the display will show a 5-minute timer and if no more buttons are pressed, then the program will resume after the timer runs down. While the program is paused, the operator can view the sampling log, collect a grab sample, halt the program, and resume the program.

After the sampling program has ended, the operator will be able to choose the post sampling activity. The operator can view the log, retrieve the refrigerator temperature log, and remove the sample bottles. The sampler records events during the running program and summarizes them in a log. This log is held in the sampler memory until the next program is started. The log contains the following information:

The log shows the average, minimum, and maximum temperature, but if more temperature data is required, the temperature log can be retrieved. The temperature log shows the temperature data, taken at each minute interval. This report requires a connection to a personal computer to download the temperature data.

8.8.3.1 Sampling Reports

To retrieve the report of the sampler's program settings, type SETTINGS<CR>. The sampler records the sample and bottle number at the time of each sample collection. These records can be obtained by typing RESUTLS<CR>. To get the information from both the settings and results, type REPORT<CR>. To get the same information from the previous run, type PREVIOUS REPORT<CR>. For a report with the Results information from the Previous run, type PREVIOUS RESULTS<CR>. For a report with the settings information from the previous run, type PREVIOUS SETTINGS<CR>.

8.8.3.2 Removing Sample Bottles

After the program has run, the sample containers should be removed. This can be done by releasing the door latch and swinging the door open. The bottles can then be removed from the rack or locating base. Push the distributor arm out of the way if needed. If the 24-bottle rack is being used, the rack can be slid out to reach the bottles in the back. The back two guide pins hold the rack and prevent it from tipping forward. If the rack is being slid out, the rack should not be pulled past these guide pins unless the rack is being securely held. The removed bottles should be capped and labeled according to the protocol established by your laboratory.

8.8.3.3 Grab Samples

Grab samples can be taken on demand and collected in a separate container. These grab samples can be taken while the sampler is running a program, paused, or at the Main Menu screen by pressing the GRAB SAMPLE button. The operator can then choose to USE DEFINED SAMPLE or to ENTER SAMPLE VOLUME. The defined sample is the sample that is being taken as per the program. The enter sample volume will allow the user to enter a different sample size. When the sampler is ready to take a new sample, the lower pump tube must be pulled from the bulkhead fitting. Hold the end of the tube over a container and press the enter button.

8.8.3.4 Calibrating Sample Volumes

The sampler can deliver sample volumes repeatable to +/- 5 mL or +/- 5% of the average volume in a set. For accurate sample volumes, the sampler uses the suction line length to generate pump tables. The pump tables along with the liquid detector are used to determine the suction head height and measure the liquid volume. By calculating the suction head, the delivered volumes are not affected by varying liquid levels. The sampler should be calibrated to ensure that the volume measurements are accurate. To calibrate the sampler, the suction line must first be cut and its length entered in the sampler configuration. A graduated cylinder is also needed to measure the delivered sample volume. Press the CALIBRATE VOLUME option and press enter. Pull the lower pump tube from the bulkhead fitting and hold it over the graduated cylinder. Measure the volume that was poured into the graduated cylinder and enter it into the VOLUME DELIVERED screen. If there is a large difference between the expected volume and the entered volume, the sampler will ask you to confirm the entered volume. If the volume is correct, continue and return the pump tube to the bulkhead fitting. If the volume is small, repeat the calibration to ensure that the calibration is averaged and not unduly influenced by normal random variations.

The sampler pump can also be operated manually from the main menu. To operate the pump:

1) Press the “1” number button to prepare the pump for reverse operation (line purge).
   Or press the “3” number button to prepare the pump for forward operation (sample).
2) Press the Enter button to start the pump in the selected direction.
3) Press the Stop button to stop the pump and return to the Main Menu.

8.8.3.5 Sampler Cooling System

The refrigerator uses a condensing coil with forced-air cooling that allows the unit to function without issue in ambient temperatures from -20 to 120°F (-29 to 49°C). The refrigerant that is used has an ozone depletion potential of zero. The built-in heaters shall prevent collected samples from freezing if the ambient air temperature drops below freezing. The current temperature will be displayed and a record of past temperature readings will be stored to ensure that the required operating temperature range is never violated. On startup, the temperatures within the sampler will drop to 2.5°C below the set temperature and will remain there for 24 hours, before resuming normal operation. If a temperature of 221°F or higher is reached, then the temperature safety cutout will disengage the compressor. Any error conditions detected by the diagnostic routines will be displayed to the user. The top section housing the control panel, pump,

distributor electronics, and power supply box shall be NEMA rated at 4X, 6, and IP 67. The required power is 120 VAC and 60 Hz.

8.8.3.6 Refrigerated Sampler Oversight

Minimal operator oversight is required to operate the sampler, as the sampling and intervals are automated. The operator must create a sampling program that specifies the sample frequency among other details. This program will then be carried out automatically. The operator must collect the samples from the refrigerator after the sampling program is completed and should monitor the system for any errors that occur.

8.8.3.7 Refrigerated Sampler Outputs

FLOW PACING, ANALOG INPUT
The sampler shall have a standard 4-20mA flow proportional input compatible with most flow meters without additional interfacing. Samples shall be equal in volume and shall be taken at variable times proportional to flow.

FLOW-WEIGHTED VOLUMES, DC PULSE
The sampler shall accept a 5 to 15 VDC flow proportional pulse or isolated dry contact closure from an external flow meter. The pulse or contact closure shall be at least 25 ms in duration. Samples shall be taken at equal time intervals, and variable sample volumes shall be proportional to cumulative flow.

FLOW-WEIGHTED VOLUMES, ANALOG INPUT
The sampler shall have a standard 4-20 mA flow proportional input compatible with most flow meters without additional interfacing. Samples shall be taken at equal time intervals, and variable sample volumes shall be proportional to cumulative flow.

8.8.4 Refrigerated Sampling Programming

A sampling program can be created from the Main Menu Screen, by selecting PROGRAM. The sampler can store up to four (4) sampling programs. There are two (2) pacing method options for sampling programs, flow pacing and time pacing.

If there is only one sample container, use the Composite Samples screen to type the number of composite samples to take and combine in one sample container.

8.8.4.1 Sample Log

After the sampling program has ended, the operator will be able to choose the post sampling activity. The operator can view the log, retrieve the refrigerator temperature log, and remove the sample bottles. The sampler records events during the running program and summarizes them in a log. This log is held in the sampler memory until the next program is started. The log contains the following information:

- The log reports the number of successful samples out of the total number programmed.
- To view data for each sample event, select YES
- If the program is run continuously, enter the number of hours of data (between 0 and 999) to be displayed. 0 will display all of the data.
- If samples were not collected, the log reports the number of missed samples and error messages. If there were multiple errors, then this screen will be repeated for each one.
- The log reports the time and date the program was started
- If the program was allowed to finish, the log reports the time and date the program was completed.
- If the program was allowed to finish, the log reports the time and date the program was completed.
- If the program was halted before the program is paused, the log displays the number of samples that remain.
- If power was lost during the program, the log reports the time of the most recent power failure even and the time that power was restored.
- The log reports the average refrigerator temperature and the most recent time of the minimum and maximum recorded temperatures.
- The log reports the time and date of the last sample calibration or the last define sample.
- The log reports the last time the program was modified.
- The last time the clock was set
- The unique ID for the sampler control panel. This identifier is assigned at the factory.
- The log reports the hardware and software revision of the control panel.
- If the sampler displays a language other than English, the translation revision is displayed.
- If the pump tubing count is exceeded the log will display a warning.

The log shows the average, minimum, and maximum temperature, but if more temperature data is required, the temperature log can be retrieved. The temperature log shows the temperature data, taken at each minute interval. This report requires a connection to a personal computer to download the temperature data.

8.8.4.2 Pacing Options

Flow Pacing

Flow paced sampling uses an electronic signal from a flow measurement device to indicate that the desired volume has passed through the flow channel. Samples should be equal in volume and are taken at variable times proportional to flow. This kind of sampling can also be called Constant Volume Variable Time (CVVT) sampling. When the flow pacing option was chosen, the sampler will prompt the operator to enter the number of pulses to count before collecting a sample. The operator can select the number of flow pulses as the flow interval for each sample collection, from 1 to 9,999 pulses. The volume that each flow pulse represents is determined by the flow measurement device and can be either user defined or fixed. If the Isco 4250 Flow Meter is used, a flow pulse is sent every 100 gallons. If a sample was required every 10,000 gallons, you would enter 100 flow pulses.

10,000 gallons ÷100 gallons per pulse=100 pulses

Time Pacing

The sampler uses an internal real-time clock to provide time and date information to ensure sample times are always recorded. Uniform time-paced samples are collected at regular time intervals that can be set from 1 minute to 99 hours 59 minutes. When the time pacing option is chosen, the operator will be prompted to enter the desired time interval between samples.

8.8.4.3 Multiple Bottle Sampling

If multiple bottles are used, there are different options on how to switch between bottles.

Bottles per Sample Event

The sampler places a sample volume in one bottle or sets of bottles at each sample event. The operator can choose how many bottles to repeat the sample volume at each sample event. If the number 1 was chosen, 1 sample container would be filled with each sample. If the number 3 was chosen, 3 sample containers will be filled at each sample time.

Switch on Time or Number of Samples

The sampler will switch bottles at regular time intervals or switch after a specified number of samples. If Switch on Time was chosen, use the number buttons to enter the desired time interval for bottle or bottle set switches. If you are switching by time intervals, use the First Switch Time to specify the first switch time.

Samples per Bottle

The sampler will place a sample volume from one or more samples events in a bottle. If one was chosen, there would be one sample per bottle. If three was chosen, there would be three samples per bottle so samples 1-3 would all be in bottle 1.

Run Continuously

The samples program can continue or stop at the end of the program. If it continues, then when it reaches the last bottle in the sequence, it will return to the first. This assumes that the bottles will be replaced before it loops back to there. If the program is not running continuously, then it will report PROGRAM DONE, when the last container in the program is filled.

Sample Volume

The operator can enter the desired volume for each sample. The default is 200 mL. The operator can also use a manually defined sample volume based on pump counts.

If there is only one sample container, use the Composite Samples screen to type the number of composite samples to take and combine in one sample container.

8.8.4.4 Additional Sample Controls

Suction head

This screen is only visible if the liquid detector is off. Suction head height is the vertical distance from the liquid surface to the pump inlet. The sampler will automatically calculate the suction head height, which results in more accurate and repeatable sample volumes.

Pause and Resume

This allows a program to halt in the middle and continue later. This must be enabled before the sampler is programmed. It is also usually used on continuous mode. There can be up to nine (9) pause & resume pairs.

Other options include: No Delay to Start Time, Auto Re-Run, First Sample At, Start Flow Count at, select days, first valid day, and maximum run time. The directions for all of these and the rest of the programming options, refer to section 3 in the manufacturer's manual. Examples of different programs can also be seen in this section of the manufacturer's manual. A program has been changed and saved when the 'Program Completed' message is shown.

8.8.4.5 Sample Distribution Modes

The sampler program has 3 types of sample distributions, that can be chosen from.

- Samples per bottle mode: A minimum of 15 samples will be deposited in each sample container.
- In the bottles per sample mode: all sample bottles shall be capable of being filled with just one initiation.
- Multiple bottle compositing: shall allow the user to simultaneously create a pair of bottles containing multiple samples. The sampler switches bottles after a period of time has elapsed.

8.8.5 Refrigerated Sampler Controls

The controller will be housed in a pocket of the sampler's molded frame. An 18-position keypad is used for all program entries and manual control of the sampler. The controller can be used to automatically switch input power to a connected Isco power supply in the event of a loss of AC power. A user-initiated diagnostic routine shall determine the operational status of the sampler. Any error conditions detected by the diagnostic routines will be displayed to the user. The operator can program the sampler to collect sequential or composite samples at user-definable intervals and volumes, and can even set a delay on the first sample based on the real-time clock if desired.

8.8.5.1 Refrigerated Sampler Alarms

The sampler has four (4) digital alarm outputs capable of direct wiring to a Programmer Logic Controller (PLC) or data logger (5Volt, 100 mA). The output alarms include: Program Started, Program Completed, Pump Error, Distributor Jammed, 3-way Valve Control, Taking Sample, pumping forward, Powered up, Bottle full, and Delay before sample. The sample outputs an even mark of 12 VDC for the duration of the sample fill, from the flow meter connector. The sampler shall store a one-minute temperature data report retrievable by an IBM compatible computer using a program such as Hyper Terminal. The program shall include failsafe loading with site ID codes to prevent field errors due to multiple files.

8.8.5.2 Operating Processes

The samples are taken automatically by the samplers. The frequency of these samples can be set as a time trigger that will take samples at certain uniform time intervals. It can also be triggered by flow volume which is measured by an external flow measurement device and can be used for flow pacing or constant volume variable time. Once the sample is taken, the pump delivers the liquid using a pump revolution counter and on-contacting liquid detector. These samples are then preserved in the sampler's refrigerator until an operator retrieves them and delivers the samples to the lab for analysis. For security, a padlock is present on the door of the refrigerator so that only authorized personnel can access the samples and to stop any potential tampering.

8.8.5.3 Operator Controls

Because the sampler operation is fully automated, no user intervention is required. If there is a need to check on a program while it is running, the sampler display can be viewed. This always reports the current state or operation and the refrigerator temperature. This display will count down to the next sample event. This countdown may alternate with various other messages. If the sampler is disabled by an external device, the display will show PROGRAM DISABLED. If the sampler is currently taking a sample, the display will say TAKING SAMPLE (number), where the number is the sample number. If the sampler has an error condition that has been triggered, the display will show ERRORS HAVE OCCURRED. If the sampler is programmed for time-switched bottles, the display will show NEXT BOTTLE AT: HH:MM:SS DD-MON-YY. If any part of the current sampler program controls the operation, the display will show the current time and date.

The program can be paused or stopped manually. When a program is paused, the display will show a 5-minute timer and if no more buttons are pressed, then the program will resume after the timer runs down. While the program is paused, the operator can view the sampling log, collect a grab samples, halt the program, and resume the program.

8.9 SAFETY

When entering a manhole, operators should be aware of the most common hazards, including a possible adverse atmosphere. This may include flammable or poisonous gases or the atmosphere must be deficient in oxygen. This may require forced ventilation. Before any operator enters the manhole, tests should be

done to ensure the atmosphere is safe. To test for hydrogen sulfide, and oxygen deficiency, gas will be put at least ¾ of the way down the shaft as dangerous gases may be denser than air and sink to the bottom. If the atmosphere appears adverse, forced ventilation should be engaged and then the shaft retested a few minutes later to once again test its safety. If no testing equipment is available, the forced blowers should be turned on and ventilate the area.

There also may be deteriorated rungs on the ladder. The steps may be corroded and not strong enough to support a person. It may be difficult to inspect because of poor lighting. No one should ever enter the manhole without proper safety equipment including a harness and hard hat. Two persons should be stationed at the surface to lift the worker out if needed. The two people at the surface should also guard the area and ensure that there are no vehicles or people near the opening. When two people enter the manhole, the first should reach the bottom and step off of the ladder before the second enters.

If there is traffic in the area of the manhole, traffic cones, markers, warning signs, and barricades should be placed around the area. A vehicle or heavy piece of equipment should also be placed between the working area and the entrance. Flashing warning signals should be used to alert drivers and pedestrians. Orange safety vests should be worn by personnel stationed at the surface. Objects near the manhole opening may fall and injure a worker in the manhole. All loose items should be removed from around the manhole opening before working on the equipment. Sharp edges near a manhole cause cuts, stains, and bruises. Only properly designed hooks should be used to remove manhole covers. Pick axes, screwdrivers, or small pry bars should not be used as they may result in injury. Further directions on the proper removal of manhole covers can be seen in Appendix B of the Isco 5800 Refrigerated sampler manual.

Advance planning should be done before executing repairs. This should include test equipment such as: tools, ventilating equipment, protective clothing, traffic warning devices, ladders, safety harness, and adequate number of personnel. Planning should also serve to minimize the time spent in the manhole. Personnel entering the manhole should be wearing a hard hat, boots, rubberized/waterproof gloves, and a safety harness with a stout rope attached. Personnel should also be wearing coveralls or another removable outer garment that can be readily removed when the work is completed. Personnel should avoid touching themselves above the collar until their hands have been cleaned.

Oxygen concentration is rarely if ever low enough to kill a worker in a sewer. Many sewers also check for explosive gasses which could definitely proof dangerous if present in high concentrations. However, hydrogen sulfide (H_2S) likely kills more people in a sewer. Even small amounts of H_2S in wastewater in a

poorly ventilated but turbulent environment can result in deadly levels of H_2S in the air in a sewer. To test for H_2S, the bellows-and-ampoule type of tester is satisfactory. Hang the ampoule in the air to be tested, with a suction tube to the bulb or bellows. Use lead acetate paper to indicate the levels of H_2S. If the paper turns black, do not enter. However, the paper turns black at a concentration that is one tenth the deadly dose.

The explosive-meter tests as well as the sense of smell should be used to sense hydrocarbon vapors. These will also be sensed long before they could cause asphyxiation but should be carefully monitored as they pose a risk for explosion. Chlorine gas may also cause asphyxiation so it should be carefully monitored and strange smells should not be ignored.

Care should be taken when sampling sludge, as H_2S may be released by the stirring of sludge. When collecting samples in the Long-Term Digestion Basin, the following safety precautions should be taken:

- At a minimum, two people should be present to provide assistance during sampling
- Wear life jackets and have an onshore observer with a cell phone
- Wear personal protective equipment (gloves, waterproof clothing, respirator, goggles)
- Decontaminate with a thorough wash and with an antibacterial agent when leaving the work area
- A current Hepatitis B vaccination is recommended.

CHAPTER 9
2W AND 3W PLANT WATER SYSTEMS

9.1 PLANT WATER PURPOSE

The plant water system is used to supply all of the functions in the treatment plant that require additional water, beyond what is being treated. The treatment plant contains 1W, 2W, and 3W water distribution systems to supply these necessary functions. 1W water is municipally supplied potable water which is used in the Lab/Operations Building and UV/Maintenance Building. 2W water is this municipally supplied 1W water that has been air gapped to ensure no cross-contamination. This 2W water is used for the spray wash water at the mechanical screens, various yard hydrants, and other tasks that are required for on-site operators. 3W water is the fully treated effluent plant water that exits the UV disinfection channel after it has been fully disinfected. This processed water is used in the clarifier sprayers to reduce foam and visible scum, and to supply some of the yard and post hydrants around the site.

9.2 GENERAL DESCRIPTION OF PLANT WATER PROCESS ELEMENTS

9.2.1 Plant Water Equipment Specifications

There are eight (8) pumps in total used for plant water distribution. Four (4) of these pumps are for the 3W distribution system and four (4) of these are for the 2W distribution system. The pump control system coordinates the pumps to ensure that a constant pressure is maintained in the system by turning pumps on and off and varying the operation speed. The target operating pressure is expected to be set to between 60 and 90 PSI for both the 2W and 3W systems and can be set and controlled through the plant SCADA system. If the pressure exceeds approximately 110 psi, then the pressure release valve (located in the pump station wet well) releases excess pressure to avoid potentially dangerous conditions within the system.

9.2.2 Location of Plant Water Equipment

The plant water pump stations are located to the west of the UV/Maintenance building. The 2W pumps are to the north of the 3W pumps. There is a separate wet well for the 2W and the 3W pumps built below grade. There are two (2) access manholes for each pumps station with each access manhole providing access to two (2) of the pumps. A third access point exists for each pump station wet wells, should they be needed.

The control panel for the pumps is mounted on the outside of the west side of the UV/Maintenance Building, centered between the 2W and 3W Pump Stations.

9.2.3 1W Potable Water System Description

The potable water for the treatment plant is provided by the municipal water distribution system. A 4-inch 1W line supplies potable water to the Lab/Operations Building and UV/Maintenance Building.

There is a separate 12-inch 1W water main supplying water from the municipal water distribution system to the facility's fire hydrants and the to the air gap for the 2W plant water system. There are fire hydrants east of the influent screw pumps, north of the North Aeration Basin, north of the Lab/Operations Building, southwest of the Blower Building, and northeast of the UV/Maintenance Building. The supply to the air gap for the 2W plant water system is a 4-inch HDPE line that tees off the 12-inch water main to the north of the UV/Maintenance Building.

9.2.4 2W Process Water System Description

The 2W water is pulled from the municipal supply through a 4-inch force main as 1W potable water. The water is then air gapped so the potable water does not become cross-contaminated with non-potable plant water.

There is also a sodium hypochlorite system to add additional disinfection as the water exits the 2W Pump Station wet well. This sodium hypochlorite system is separate, but identical to the 3W sodium hypochlorite system. There is a set of hydropneumatic tanks to help ensure the proper pressure is kept within the 2W system.

The 2W wet well has a bottom elevation of 10 feet, while the top has an elevation of 23 feet, with three access manholes extending up to the finish grade at elevation 25.6 feet. The motorized valve PV-601 opens to feed the air gap system when the water level in the 2W wet well reaches 18.5 feet. The valve closes when the water level reaches 21 feet. The High-Level Alarm and the Redundant Valve Close signal is triggered at a water level of 23.5 feet. The Low-Level Alarm and the Pumps OFF float switch is triggered if the water level falls below 15.5 feet.

9.2.5 3W Plant Water System Description

When the water level in the 3W Pump Station is below the water level in the effluent sump of the UV channel, treated effluent flows by gravity to the pump station from the downstream side of the UV disinfection channel. Effluent that does not flow to the 3W pump station continues through the system to the effluent pump station and subsequently to the Nooksack River outfall.

A sodium hypochlorite system, identical to the 2W sodium hypochlorite system, adds sodium hypochlorite to the 3W line as it exits the pump station to ensure proper disinfection. The water then flows through the sediment filter and then is distributed to the necessary purposes in the plant. The sediment filter can be isolated for maintenance. A set of hydropneumatic tanks ensure the proper constant pressure is maintained within the 3W system.

The 3W wet well floor is at an elevation of 6 feet and the top is at an elevation of 23 feet, with three access manholes extending up to the finish grade elevation of 25.6 feet. The High-Level Alarm is triggered when the water level reaches a level of 23.5 feet. The Low-Level Alarm is triggered when the water level reaches 11 feet. The Pumps OFF Float Switch is also set of at a water-level of 11 feet to ensure that all pumps are turned off when the water level is too low.

9.3 PUMP STATIONS

9.3.1 Pump Station Equipment Description

Each of the eight (8) plant water pumps are sized for a standard 4” diameter well. They are ITT Gould’s submersible pump model #65GS50 with stainless steel components. The motor for each pump is a Centripro 3-phase, 460 Volt, 5 horsepower, model #M50434. The design flow range is 20 to 80 gallons per minute (GPM), but should be able to handle 0 to 150 GPM. The pumps include variable frequency drives (VFDs), allowing the pumps to operate at different levels to handle different capacities of water. The pump control strategy is to maintain a constant pressure for both the 2W and 3W water treatment. The pressure is input by the user and is anticipated to be between 60 and 90 psi. The pumps will turn on, adjust speed, and turn off as needed to maintain the constant pressure. The pumps that are in use will alternate after each ON/OFF cycle to ensure that the operating hours for each pump remain approximately equal to ensure equal wear on all equipment.

9.3.2 Plant Water Pump Station Float Tree Assembly Description

9.3.2.1 2W Float Tree

The elevation of the bottom of the 2W wet well is at 10.0 feet. At an elevation of 15.5 feet the Low Water Level Alarm and Pumps OFF signal is triggered to ensure that the water level in the wet well does not get too low. At an elevation of 18.5 feet, the Valve OPEN for the air gap plug valve is triggered. At an elevation of 21 feet, the Valve CLOSE for the air gap plug valve is triggered. At an elevation of 23.5 feet the Valve CLOSE signal for the air gap plug valve and the High-Water Level Alarm is triggered. All of these are triggered by float level sensors that are attached to the float tree assembly, with four (4) different float level sensors.

9.3.2.2 3W Float Tree

The elevation of the bottom of the 3W wet well is 6.0 feet. At a level of 11.0 feet, the Pumps OFF signal is triggered along with the Low Water Level Alarm to ensure that the water level does not get too low. At an elevation of 23.5 feet, the High-Water Level Alarm is triggered. These are all triggered by the 3W Float Level Assembly which has two (2) floats for level sensing.

9.3.3 Pump Controls

All of the float level sensors are wired to the Programmable Logic Controller (PLC) digital inputs and the float triggers a change in the alarm circuits which triggers the signals so they can be displayed. The alarms also signal a display in the SCADA system so that they can be monitored along with the other equipment. There is also an Over Temp. and Seal Fail Sensor in the pump housing for each pump which ensure any malfunctions are communicated to the operator.

The goal of each distribution system is to ensure a constant pressure and sufficient pumping rate in the distribution system. This can be accomplished automatically by keeping the pumps on the AUTO setting where the pump motor speed is automatically changed to maintain the desired flow rate. There is also a HAND mode for the operation of the pumps. This allows the operator to adjust the speed of the motors operating the pumps by hand. When the pump controls are in the HAND Mode, the VFD speed potentiometer can be adjusted so that the pump motors will work at the desired speed. The operator should only need to operate in HAND mode on the rare occasion that the automated system fails, otherwise the

system should remain in AUTO mode to maintain the required target metrics. The controls can also be in the OFF position, where the pump will not run, should any repairs be needed.

9.4 PLANT WATER SODIUM HYPOCHLORITE SYSTEM

9.4.1 Sodium Hypochlorite Description

There are two (2) separate, but identical, sodium hypochlorite systems located in the Blower Building of the treatment plant, one for the 2W plant water and one for the 3W. These systems both utilize a SVP4 peristaltic metering pump for the sodium hypochlorite feed, as well as sodium hypochlorite drums. These pumps have both automatic and manually adjusted output controls. The drum scales for both plant water systems include a single digital indicator of the type Solo G2, 2 channel, 4-20mA output. The weight and percent full will be displayed through the SCADA system. An alarm will be activated that will notify the operator when the drum is almost empty. The target concentration for residual chlorine is .5 mg/L. This target concentration is reached by using a sodium hypochlorite solution that is 6-15% sodium hypochlorite.

9.4.2 Sodium Hypochlorite Purpose

The 2W and 3W plant water systems have sodium hypochlorite disinfection systems that add sodium hypochlorite to the corresponding pump station wet well. The 2W water has been disinfected through the municipal water treatment system and the 3W water has been disinfected through the UV disinfection system in the wastewater plant. However, this sodium hypochlorite system is present to add residual chlorine to the water to ensure that there is no re-growth in the distribution system. This chlorine residual is especially important for the 3W system as the sediment filter screen can become a place where algae and fine organic particles will build up if there are no preventative measures taken. This build-up can force the filter to foul and require backwash more often which is resource intensive. The residual chlorine stops this from happening.

The 2W system may maintain a chlorine residual without the sodium hypochlorite system, as a result of the municipal water treatment. In this case, the owner of the plant has the option to run the system without dosing the water with sodium hypochlorite. The system can also be used to deliver a higher dose to super chlorinate the lines if needed.

9.4.3 Sodium Hypochlorite Peristaltic Metering Pump

Both the 2W and 3W plant water distribution systems use a Stenner SVP4H1A3S peristaltic metering pump for sodium hypochlorite distribution. These two pumps work to dose liquid sodium hypochlorite solution to the plant water based on a 4 to 20 mA signal from the respective flow meters on the 2W and 3W lines located in the UV/Maintenance Building. The metering pump flow rate adjusts relative to the 2W or 3W flow rate. Each peristaltic pump has a 0 GPD to 5 GPD capacity. The power is 1/30 HP, 120 VAC, and 60 Hz and the tubing size is 3.8" OD.

9.4.3.1 Peristaltic Metering Pump Operation

The pump flow rate is adjusted based on the Flow Meter Flow Rate using the 4-20 mA signal. The solution concentration of the sodium hypochlorite solution is 12%. If the flow meter value is 0 gpm then the peristaltic pump flow rate is 0.0 gpd (OFF). If the flow meter measures 50 gpm then the peristaltic flow rate is 1.0 gpd (20% speed). The capacity of the pump continues to increase as the measured flow rate increases. At a flow meter measurement of 250 GPM, the peristaltic pump flow rate is 5.0 gpd (100% speed). The operator can adjust the pump speed up or down across the board if desired (for stronger or weaker solutions).

9.5 HYDROPNEUMATIC TANKS

9.5.1 Hydropneumatic Tank Description

Hydropneumatic tanks are used in both the 2W and 3W systems to maintain the pressure in the distribution systems. There are two (2) tanks for each system, each with a volume of 119 gallons. All of these are located inside the UV/Maintenance Building along the south wall, near the southeast corner. The 3W tanks are to the east of the 2W tanks. All of these tanks are Well-X-Trol diaphragm tanks made by Worthington Industries Inc. – Amtrol Inc. Each of these tanks has two (2) air/water tight sections, separated by a diaphragm. The air is above a diaphragm and the water is below. These tanks are used to maintain the pressure in the water.

9.5.2 Presetting Tank Pressure

To preset the tanks, they should be pressurized to a few pounds per square inch (PSI) under the target system pressure, by adding air above the diaphragm through the top of the tank. While this is being done, the discharge valve should be opened and the influent valve (feeding from the pump station) should be closed. This will allow the water to exit the tank as the air side is pressurized, so that both sides of the tank are not being pressurized. While this is happening, the closed valve will stop the water from the pump station to flow in. Each tank must be pressurized separately before beginning operation.

9.6 2W AIR GAP SYSTEM

The air gap for the 2W system is used as an added measure to ensure that the potable 1W water does not become contaminated with any of the treatment water or the other plant water. The pressure differences throughout the plumbing may result in suction that unintentionally pulls 3W water into the 2W system. The air gap prevents 3W water from contaminating the potable 1W water. The air gap system utilizes a 55-gallon Air Gap Drum. This HDPE black drum is food-grade so that it can safely store water. The barrel is set up so that the opening in the top of the tank accepts water with minimal splashing while still maintaining the required air gap opening of 8 inches, or two times the pipe diameter. The air gap tank has a 4” motorized valve for the air gap tank to let water into the 2W system when needed.

9.7 3W SEDIMENT REMOVAL FILTER

9.7.1 Sediment Removal Filter Description

The sediment removal filter is used to remove any remaining sediment in the 3W water before it is distributed throughout the plant. The water enters the unit through the inlet pipe and reaches the sediment filter coarse screen, passing through from the outside to the inside of the filter. The coarse screen is designed to protect the cleaning mechanism from large particles. This coarse screen is not expected to accumulate significant debris. This coarse screen is not automatically cleaned, so if accumulation is observed, the coarse screen must be manually cleaned by the operator. After the coarse screen, the water passes through the sediment filter fine screen from the inside to the outside. The accumulation of sediment on the fine screen eventually causes head loss, requiring a cleaning cycle for the filter screen. This accumulation is called the “filtration cake” and is cleaned off automatically.

9.7.2 Sediment Removal Filter Specifications

The sediment removal filter is an SAF-1500 filter with a 1,500 square centimeter filter area and a maximum flow rate of 350 GPM. The filter housing is made of epoxy-coated steel and is 10 inches in diameter. The screens are weave-wire, 316 stainless steel with a 300-micron screen element. This screen element is self-cleaning to limit the need for operator intervention. The automatic cleaning operates by backwashing and is completed through suction that forces the screen to backwash. The controller is the AML3 single filter controller with a 460/3/60 power supply. The controller has a NEMA 4X enclosure and the ability to log backwash and alarm events.

There are four (4) layers in the fine screen. The outer layer is referred to Layer #1 and Layer #2 is the inner layer of the screen. Layers #2 and #3 are in between #1 and #4. There is one (1) spare filter on site should the first filter malfunctions and a replacement be necessary.

9.7.3 Sediment Removal Filter Structure

The sediment removal filter is located in the UV/Maintenance Building in the Northeast corner, near the 2W and 3W hydropneumatic tanks. The control panel for the filter is located on the north wall of the building, near the filter itself.

The water outlet is on the left side of the filter set up, closer to the drive unit. The water inlet is on the side closer to the exhaust valve. The water enters the filter system, passes through the screen within the filter and then exits. The filter has a motor that feeds into the drive unit gear box that controls the drive shaft that operates the backwashing. The motor spins the gears in the drive unit which allows effective backwashing. The motor spins at about 1,200 rotations per minute (RPM) but it has a gearbox so the nozzles aren't spinning very quickly. The main filter housing contains the filters and seals that allow the filters and the backwashing equipment.

The limit switches serve to control the movement of the drive shaft. The drive shaft is used to provide the lateral movement that controls the scanners as they travel over the screen for backwashing. The plate at the end of the drive shaft is always by the inside limit switch when it is not in the midst of backwashing. During backwashing the shaft is moved to the outside limit switch. Once backwashing is complete, the shaft moves slowly back to the inside limit switch. Backwashing is not occurring as the shaft returns to the "home position" by the inside limit switch.

The 3-way valve can be used to test the differential pressure (DP) switch. When this valve is opened, the pressure changes to trigger the differential pressure backwashing. Whenever this is done, the valve should be closed once the check is completed so that the backwashing doesn't just continue.

9.7.4 Operation Modes

The filter unit can operate in one of four modes, as explained below:

9.7.4.1 Filtering Mode

This is the normal function condition. Self-cleaning is not occurring when this mode is active. The filter is in this mode when the power light on the control board is lit.

9.7.4.2 Flushing Mode

This mode is active when the flushing and auto-cleaning process is in progress. The motor and exhaust valves are operating as indicated by the program in this mode. This mode is typically activated automatically, without the need for operator intervention.

9.7.4.3 Continuous Flushing Mode

This mode is activated when the operator moves the switch near the timer on the control board to the "CONT." position. This causes the self-cleaning/flushing process to continue until the mode is changed, or the fault time is triggered.

9.7.4.4 Malfunction Mode

Malfunction mode is triggered when there is a continuous signal from the pressure differential switch for a duration of more than the pre-set time, indicating that the cleaning process was unsuccessful. This mode is also triggered when the motor protector was activated, either manually or automatically due to overload. A malfunction of the limit switches may also trigger this operation mode. When "Malfunction Mode" is active, the self-cleaning process is stopped, the malfunction light on the control board is turned on, and an external output of 24V AC is activated.

9.7.5 Self-Cleaning

9.7.5.1 Self-Cleaning Process Description

The self-cleaning process can be triggered manually or automatically. To start self-cleaning manually, the operator can press the “TEST” push button at the control board. As a form of automatic triggering, a signal from the Pressure Differential Switch (PDS) goes to the control board and the self-cleaning operation begins. The PDS sends an electric signal when the pressure differential across the fine screen reaches a pre-set value (approximately 7 PSI) that cannot be altered by the operator. This signal triggers the self-cleaning. “TIMER” in the control board can also trigger the self-cleaning automatically. This timer can be used to set up time intervals which will trigger self-cleaning when the interval is reached. This operates independently from the head loss condition. A signal from the continual flushing switch triggers the self-cleaning process by allowing operation in the continuous flushing mode so that the filter is constantly flushing itself regardless of flow rate or water quality.

The backwashing of the filter is similar to the vacuum cleaner in a house. When backwashing is triggered, the solenoid valve is opened and it creates suction which cleans the sediment from the screen and then sends the dirt out of the exhaust. When the solenoid valve is opened, the motor kicks on and the suction scanners turn on and scan the entire screen, ensuring the entire thing is backwashed.

9.7.5.2 Triggering Self-Cleaning

During the flushing process, the filter uses 6.6 gallons per cycle and the flushing cycle time is 15 to 20 seconds with a minimum flow of 26 GPM (at 30 PSI). The cleaning is done by the suction scanner which rotates in a spiral movement while it removes the filtration cake from the fine screen. The removed sediment is then expelled through the exhaust valve. The scanner rotation is operated by a 2-way drive unit that is attached to the scanner by a threaded shaft which provides the linear movement. The exhaust valve is activated for the duration of a cleaning cycle by a 3-way solenoid. During the self-cleaning process, filtered water continues to flow downstream so the filter is still in operation, even during cleaning.

The backwashing can be triggered in one of three ways. The first way is differential pressure. This pressure difference is 7 PSI. This setting cannot be changed by the operator. The pressure differential switch is on the side of the filter. The pressure differential display doesn’t have any numerical displays but the

backwashing cycle is triggered when the needle is pointed about at the border between the green and red portion of the display.

The backwashing can also be triggered by the timer. The timer can be set by the operator. It was initially set to a time of 2 hours but can be adjusted by the operator should the need arise. The backwashing can also be triggered with the green button on the display on the control panel. Whenever the backwashing is triggered, the timer is reset to the set interval time. The timer therefore represents the maximum time between backwashing cycles if nothing else triggers it first. Even though the filter may not be in continuous use, the filter must continue being backwashed. Any biological remnants will stay on the screen and grow. It must be backwashed to ensure that the growth does not clog the filter.

9.7.5.3 Expected Self-Cleaning Backwashing

When the backwashing is triggered, the operator can hear a click as the solenoid valve. After three (3) seconds, the backwashing begins and the drive shaft can be seen to move. This occurs in the drive shaft housing and could be seen if the drive shaft housing cover is open. This lasts about 15 seconds and then shuts off. After the backwashing, the solenoid closes, again causing an audible click. Once backwashing is complete, the drive shaft slowly moves back the other way as it returns to its original position. It is not backwashing during this time. The whole process is around 20 seconds.

9.7.5.4 Testing Self-Cleaning

There is no need for a scheduled inspection of the self-cleaning equipment, but if there is a suspected self-cleaning issue the self-cleaning process can be tested. To do this, close the low-pressure ¼” valve to the pressure differential switch for a period of 5 seconds. This will initiate the self-cleaning cycle. While the cycle is active, ensure that the exhaust valve opens, that the scanner moves forwards, and when it reaches the limit switch – verify that the exhaust valve closes.

9.7.6 Sediment Removal Filter Controls

The control panel has a Human Machine Interface (HMI) on the outside of the panel that allows the operator to control the equipment without actually opening the control panel. There is a clear plastic cover over the controls so that the display can be seen while it is protected. The control panel can also be fully opened so that the electronics can be accessed. The HMI display is made to be easily managed by any operator. When

the display is switched on, it may take several seconds for the display to begin working. Once the display is switched on, the average flush interval and number of flushes is displayed, along with the navigation buttons. It also shows the time to the next flush. This is based off of the timer that is set by the operator. This display counts down in minutes and if nothing else triggers a backwashing, this will be the maximum time until the next backwashing cycle. The display box has a Flush push button, a fault reset, and the HMI screen.

The intake is on the right and the outlet is on the left.

The original filters made by the manufacturer were installed vertically instead of horizontally. This means that some controls are labelled “up” and “down”. Because this filter is horizontal, the “up” direction corresponds to the outside level sensor and the “down” direction corresponds with the inside limit switch.

9.7.7 Sediment Filter Display

One of the options from the home screen is the *Flush Settings*. This has the Meter Fault Delay, the Flush Valve Delay, the Dwell Time, the DP Delay, the Flush Interval Timer and the DP Fault Time. The Fault Time indicates the time that is set so that if a backwashing event continues for this length of time.

The second option is the *Data Collection* option on the home screen. This displays the Fault Counter, the DP Fault Counter, and the Average Flush Interval (between cycles). There is a reset button that can be pressed or held by the operator. This will reset all of these data measurements. This will allow experienced operators to be able to determine if and how the behavior is changing of the sediment filter.

There is also a *Technical Support* screen. This screen mostly has the phone number for the manufacturer that can help with any technical support.

The *Test Output* screen is mostly used for the technicians from the manufacturer. This serves to test the control outputs and ensure that the displays are functioning as they should. These tests don’t affect the actual filter, they just test the electronics and displays. There are a few test buttons on this screen but will likely only be used by technicians.

9.7.8 Destructing Sediment Filter

9.7.8.1 Removing Lid

Before dismantling any part of the sediment filter, the control filter valve should be opened to ensure that all built up pressure is removed from the sediment filter system. There is always some water in the filter so when the lid is removed, the operator should stand to the side so the water that flows out doesn't hit them. The lid is on the side of the filter, opposite the side with the motor and can be removed by removing the four (4) bolts on the side. When putting the lid back on the filter, the nuts should be tightened on the bolts so that the filter does not leak. If a leak starts when the pump is turned on, the nuts should be tightened further. However, there is no exact torque that is required when tightening the lid. There is a hydraulic seal in the lid that allows the lid to remain water tight. This seal is why there doesn't need to be a certain tightness maintained in the lid of the sediment filter.

9.7.8.2 Removing Backwash Chamber

The backwash chamber can be taken out once the lid is removed. The bottom of this chamber has another hydraulic seal that is used to help maintain the pressure within the casing. It is important that the seal remains intact because this is how the pressure is maintained to create the suction that is used for backwashing. It is important that the seal is facing the correct direction with the tabs facing the operator. When the backwash chamber is reinstalled, the operator must ensure that the seal is not caught on the motor casing as this could cause damage to the seal.

9.7.8.3 Removing Prescreening Screen

Next, the prescreening screen can be removed and maintenance carried out if needed. There is no required maintenance for this screen. It should not have excessive build-up as this screen is just meant to filter out the large pieces of debris.

9.7.8.4 Removing Filter Screen

Next, the fine mechanical screen is inside the filter casing. To remove it, the operator must reach in to the chamber and grasp the screen before pulling hard. The first removal will likely be the most difficult to remove the screen. If the operator cannot pull the filter screen out, the operator can tie a rope to the filter

and then use this rope to help remove the filter screen. A visible name plate is on the screen which indicates the mesh structure. The name plate should indicate that the filter screen is 300-micron as expected. There is a seal on both sides of the screen that helps maintain the needed separation between the chambers. If the filter is not performing, then the filter should be removed, observed, and then cleaned if needed. This removal and inspection should be completed once a year. If once a year appears to be too rarely, it should be checked more often, starting with twice a year.

9.7.9 Reconstruction Filter Screen

9.7.9.1 Reinserting Screen

When the screen is replaced, the slot in the edge of the screen must go over the pin inside of the casing. This pin is located at about 9 o'clock in the casing. This should be done by putting the screen in with the slot close to the 9 o'clock position and then turned slightly until the pin pops into the slot. The operator should be able to feel it when the filter pops into the correct position. For operators without significant experience, the seal can be removed while the screen is replaced. This allows the operator to see the pin and ensure that it pops into place. If the filter screen does not fit in properly, when the rest of the equipment is replaced, the lid will not be able to seal. If the lid is pushed too hard while the screen is out of place, it will break the seating of the screen and the operator will have to remove the equipment and replace this section of the screen. If the seal was removed, it must be replaced before anything is resealed. To do this, one spot of the seal must be pushed into the slot and then you should go around the rest of the seal is fully in place.

9.7.9.2 Reinserting Coarse Screen

The pre-screen should be replaced after the filter screen is in place. There are two (2) small legs in the prescreen filter. These are used only for the operator to properly place the filter. It is important not to damage the coating of the inside of the casing. If the casing is damaged, then corrosion will follow and the casing will need replacement. If the casing is damaged, the coating should immediately be repaired. To avoid damage, the legs should not be scraped along the bottom of the casing. The legs have a plastic casing along the bottom but these will likely take damage after a few years so the operator should take care. The legs should be placed downwards when the prescreening is in place. The operator should feel when the prescreen fits into place. Either end of the prescreen filter can enter the casing first (reversible).

9.7.9.3 Replacing Backwash Chamber

When replacing the backwash chamber, the seal should first be checked to ensure that it is in place. The operator should place the sealed end at the opening of the casing and then use their fingers to push around the edge of the seal and make sure that no part of the seal is caught. Once the whole seal has entered the casing straight without any parts being caught up, the operator should push it all the way in with both hands. It should be pushed in as far as it goes.

9.7.9.4 Filter Lid

Next, the lid should be closed. This lid shouldn't be pushed too hard as if the equipment is out of place, this might harm the components that are out of place. If the lid will not fit, remove the other components and shift them to ensure they are properly installed and then try again to replace the lid. The washers and nuts should be put on the bolts and tightened so that there is no leakage. If there is leakage, the bolts should be further tightened. There is a device that holds the bolts in place, so you shouldn't have to hold the head of the bolt. The bolts should be tightened across, so the diagonally opposite bolts should be tightened.

9.7.10 Sediment Filter Trolley and Hoist Assembly

There is one (1) permanent manually operated trolley and hoist for the sediment filter. It can be used for the removal and replacement of the sediment filter, moving all required accessories, and hardware for lifting the sediment filter equipment on and off of the proposed piping connections. This include an Aluminum I-Beam, 5 x 3.7, 5" tall, approx. 3.7 lb/ft. The trolley is a CM Series 633 Wide Range Trolley, ½ ton rating. The trolley and its accessories are 304 stainless steel, and designed for corrosive environments. This is provided by Washington Crane and Hoist and they should be contacted if there are any issues with the equipment. The hoist is a manually operated chain hose with a half-ton rating, and 8 ft. of lift and the maximum distance between hooks when retracted of 12 7/8". The hoist materials and accessories are made of 304 stainless steel and designed for corrosive environments. This equipment is also provided by Washington Crane and Hoist. The lifting strap itself is a synthetic fiber strap that is a minimum of 3 inches wide with closed eyehooks on each end which are sized for hoist hooks.

9.8 SAFETY PRECAUTIONS

9.8.1 Eyewash Stations

Four (4) emergency eye wash stations are installed in the area in case of accidental eye contact with chemicals. These eye wash stations are Fendall Eyesaline Wall-Mount Eye Wash Station. These systems are not plumbed, but have a 32 oz. saline bottle. This station should be used to sooth eyes until a primary eyewash station can be reached. The stations are bright green so that they are easily visible in low light or with blurred vision. Each saline bottle has a tamper proof lid with a clear expiration date so that they are easy to inspect. Before operating any equipment all safety information from the manufacturer should be read and understood. Any uses of the eye wash stations or other injury should be reported and a record of each incident should be kept.

9.8.2 Spill Safety

The drum scales used for the containment of the Sodium Hypochlorite being used are the SpillSafe LX Drum Scales. These scales monitor chemical usage and remaining inventory while also providing total containment in case of a leak or spill. This combination system means that the manufacturer's scale does not need to be combined with an additional secondary containment system. The steel platform holds the spill containment units which are made of polyethylene. There are also four (4) IP67 rated shear beam load cells located outside the spill containment vessel provide the highest accuracy weight measurement possible. The load cells are under the platform and are further protected by removable polyethylene splash guards. This system means that the first 11 gallons of a leak/spill is contained below the drum in the polyethylene basin. A roll out bladder can also be deployed for larger spills which can hold up to 66 gallons. The whole system complies with EPA regulation 40 CFR 264.175.

9.8.3 Specialized Valve

Both systems include a D-025 Combination Air Valve combines an air & vacuum component and an air release component in a single body. The combination air valve discharges air (gases) during the filling or charging of the system, admits air into the system during drainage and at water column separation and releases accumulated air (gases) from the system while it is operating under pressure. The valve's unique design enables the separation of the liquid from the sealing mechanism and assures optimum working conditions.

9.8.4 Pump Safety

The pumps in use in the 2W and 3W System Water plants each have a corresponding 4", 5 HP, 3-phase motor. Each motor/pump has a 2-minute minimum run cycle. Excessive or repeated starts and stops creates heat that may damage the equipment prematurely. There should not be more than 300 starts per 24-hour period. The minimum effective flow speed is 0.25 ft/sec, otherwise a flow sleeve is needed to maintain proper and effective lubrication.

The area where the tank, pressure switch, and pressure relief valve are installed should have ambient temperatures that are never lower than 34°F (1°C). The pump works without any performance deficits up to 86°F. A pressure relief valve is present to ensure that dangerous pressures are not reached. The details for troubleshooting these pumps can be seen in the Troubleshooting section of the 3W and 2W Submersible Pumps IOM manual within the 3W and 2W Equipment O&M Manual.

9.8.5 Pump Station Alarms

The 3W water system contains two (2) float alarms. These floats are the HIGH Alarm Float which alerts users to when the water level in the pump station is too high. The other floating alarm is the LOW Alarm/Pumps OFF Float. This indicates that the level in the pump station wet well is low enough that the pumps should stop operating until the internal water level rises again.

The 2W water system has four (4) floating alarms. The High Alarm float alerts the users to when the water level in the pump station wet well rises too high and acts as a redundant valve close for the automated valve at the air gap. The 2W valve CLOSE float, positioned below the High Alarm float, should close the automated valve when activated. The 2W valve OPEN float does the opposite of the valve close float to send water from the air gap to the 2W pump station. The LOW Alarm and Pumps OFF float functions just as in the 3W system and turns off the pumps so that the internal water level can rise.

9.8.6 Pump Lifting Safety

When using lifting equipment for maintenance or repairs, the operator must ensure that the lifted part is chained securely to avoid unexpected falling. Safety helmets should be worn at all times while using lifting equipment. The flooring in the filtration area is sloped to help drainage but must also be kept clean and clear of debris to avoid the accumulation of any liquids. All operating instructions and safety stickers should

be read and understood before operating the filter. All stated safety rules must be followed at all times during filter operation. When maintaining or repairing the filter, an operator must wear a safety helmet, goggles, gloves, and any other personal safety equipment that is locally required. The filter enters a flushing mode automatically and without advance warning. This means that no operator input is needed to maintain effective filtration and care should be taken when the filter is active in case of a sudden change in operation mode.

9.8.7 Sediment Removal Filter Safety

Before any operation of the filter, the operator and anyone working nearby must read and understand all safety precautions to reduce the risk of injury or unpredicted behavior. The filter enters the flushing mode automatically so operator should be aware of this when working in proximity to the filter. To conduct repairs or maintenance, the power should be shut off and locked out of the filter components. The filter should only be used for what it is designed to do and any changes to the set up must be explained in advance. All safety measures that were provided with the equipment must be observed at all times. The safety sticker on the filter must be visible at all times and no operations that contradict these instructions should ever be executed.

9.8.8 Pressure Release Valves

The pump station pressure release valves are set to 110 PSI. The air diaphragm tanks have a pressure release valve mounted on the tank tee that is set to release at 120 psi. The tanks also have a pressure relief valve mounted on the discharge piping and set to 110 psi. This goes for both the 2W and 3W distribution systems. The multiple pressure release valves ensure that excessive pressures are not exceeded.

9.9 WATER DISTRIBUTION MAINTENANCE

9.9.1 Pump Maintenance

There is no maintenance required for the pumps. The operator should just ensure that the pumps are operated with an adequate water level. The automated alarm system should ensure that adequate water levels are maintained so operators must just ensure that the alarm system is functioning effectively. However, should repairs be needed, the pumps can easily be removed by hand. The connection between the pump and the discharge assembly can be removed (after the pipe is decommissioned and the power is locked out). The

metal lifting cable can then be lifted by the operator, thereby removing the pump from the wet well where repairs can then be made.

9.9.2 Hydropneumatic Tank Maintenance

No regular maintenance is required for the tanks or hydropneumatic system. If any part of the tank system fails for any reason, it is likely that the entire tank will need replacement.

To check for diaphragm failure, the operator should press on the top of the Schrader Valve, located at the top of each diaphragm tank. If the diaphragm is intact, air alone should exit the tanks. If the diaphragm has failed, then water will exit the valve with the water. If this happens, then the tank must be replaced. Even when the diaphragm has failed, the operator will likely not notice any short cycling of the system. Because the VFDs allow changing speed in the pump motors, there will be little cause for short cycling. This means that only the valve can be used to monitor the functionality of the diaphragms within the tank. If the system is not functioning as expected, this should be the first thing the operator inspects.

The pressure gauge displays a pressure from 0 to 150 PSI, that indicates the system pressure. The target operation pressure will likely be from 55 to 75 PSI. The pressure transducer is next to the pressure gauge to maintain the pressure. Both the pressure gauge and pressure transducer are right in front of the diaphragm tanks, along the flow pipes. There is a pressure relief valve that releases pressure when it exceeds approximately 120 PSI. This is around the same pressure that releases the pressure relief valves in the pump station wet wells for added safety. This ensures that dangerously high pressures are avoided in the plant water systems.

9.9.3 Sediment Removal Filter Maintenance

All maintenance and filter service must be done by technicians that are authorized by the filter manufacturer, Amiad Water Systems. Before any maintenance is carried out, the power, compressed air, and water supplies should be shut off and locked out of the filter. Any residual water pressure must be released by opening the Pressure Release/Drainage Valve. The filter should also be emptied using the drainage valve, although some water will always remain so the operator should always be wary of the water that will be released when the filter casing is opened. Warning signs should be placed around the work area when the maintenance or non-regular operation is occurring. The filter safety stickers should be inspected and replaced if damaged. Care should be taken to ensure that splashing is minimized. All necessary safety

gear should be worn during maintenance per local guidelines, including a safety helmet, gloves, and goggles.

9.9.3.1 Manual Filter Cleaning

The filter screens serve to collect the organic material that remains in the water. Organic material building up on the screen is dangerous as it will continue to grow if possible. This material is sticky so some of the organics will likely stick to the screen. Most of the organics should be removed from the filter screen with the automatic screen cleaning process, but eventually the small amount that sticks will accumulate, which is why the screen must be removed and hand washed on occasion. If the behavior of the filter changes, the filter should be taken apart to manually clean the parts of it. Before removing any parts of the filter assembly, close the inlet valve and then operate a flushing cycle to reduce pressure.

To complete a manual cleaning, use a pressure washer to slowly and methodically spray off the screen. Once the wash is done, a flashlight should be placed inside the screen facing out. The light should shine through with a clear white color. If the screen is still dirty, the light will appear brown or green. If the light appears brown or green, the screen should be washed again.

The coarse screen may also need to be cleaned by being removed and then sprayed off. This coarse screen is not automatically cleaned and should only catch the largest chunks in the influent so it should not require significant cleaning.

The control filter is at a 45-degree angle, pointing downwards that carries the water that feeds the solenoid valve needs to be cleaned periodically. This screen is not automatically cleaned so it must be done manually. The inspection interval depends on the quality of the influent flow. This inspection period should initially be once a week. If it is clean after the first several checks, the interval can be changed to monthly or longer if the filter is still clean on inspection. It is unlikely that the inspection will ever be more than a month. If there is an anticipated change in effluent characteristics, the control filter should be checked more often.

9.9.3.2 Motor Housing Cover

The drive shaft housing cover is not entirely necessary and can be left off if needed. It is important to ensure that the drive shaft is properly lubricated and surrounding O-rings and seals are properly maintained. This maintenance may be easier when the drive shaft is uncovered as it is more easily visible. Because the filter

is located inside the building, the cover can be left off if desired. The motor housing cover can be easily removed or replaced at any time, using the bolt, washer, and wingnut. The external O-ring should be greased and the O-ring seat should be cleaned to prolong the effective life of the equipment. The operator should also ensure that the sealing bolt is tightened and there are no leaks.

9.9.3.3 Self-Cleaning Equipment

The backwashing/self-cleaning system is made up of the suction scanner shaft attached to the suction scanner nozzle which is inside the housing. The backwash nozzles don't need cleaning usually. Each nozzle has a plastic cap over the scanner. This helps keep the nozzle clean; however, eventually the plastic caps need replacing. The replacements will likely be needed every 5 years. The O-ring in the shaft will likely wear out the most.

The scanner is out on the shaft side after removing the pin. This scanner is only needed to check every few years as it should last a long time. This area also has an O-ring. This is the most likely way for the filter to fail so the operators should ensure that this O-ring doesn't begin to fail. To access this O-ring, you have to move the limit switch down the shaft so there is room to remove the O-ring. This can be done by removing the motor and gear and turn the shaft by hand so the limit switch plate is out of the way. The shaft can also be moved by using the motor contacts so that the shaft is moved out of the way. You can also trigger the backwashing cycle so that the O-ring can be accessed when the shaft moves.

9.9.3.4 Out-of-Service and Filter Bypassing

If the filter is out of service for more than a week, the sediment filter must be completely drained. If it is not, the bacteria in the water will grow and foul the screen so it becomes ineffective. There is a bypass pathway for the filter. This allows water to bypass and not pass through the filter. In this bypass flow there is also a strain to ensure large debris cannot pass through the piping and reach the destination of the 3W water.

9.9.3.5 Recommissioning Post-Maintenance

After maintenance or if needed, the "Start-Up and First Operation" procedures (see page 12 of the 3W sediment removal filter Instruction and Operation Manual) that are provided by Amiad Water Systems can be carried out to ensure that the filter is functioning as expected. This includes starting the motor and

ensuring that the suction scanner shaft turns clockwise and moves towards the filter housing, stopping at limit switch “A”. The procedures also include running a “dry” flushing cycle by pressing on the “TEST” button and ensuring that all of the required steps are carried out as expected. The flush cycle should then be repeated and observed with an open inlet valve and a closed outlet view. This ensures that the filter is operating at a low flow rate. Next, the ¼ inch valve should be closed for five (5) seconds to ensure that the filter will start the flushing process. The filter should then be operated at the designed hydraulic conditions with the timer set for 6-8 hours. The bolts should all be checked and retightened after the first week that the system is operating after restarting/maintenance.

9.9.3.6 Miscellaneous Maintenance

All of the electrical connections should be checked at least once a year to ensure that all of the connections are tightened and are not corroded. The valves are fairly robust but solenoids eventually fail and require replacement. This is not expected to happen for at least five (5) years. The diaphragm eventually fails but is easily replaced. Whenever any of the seals are taken apart or adjusted, silicon grease must be used to lubricate the seals to help avoid damage. This works to extend the life of the rubber seals. If there are brass metal shavings in the drive shaft housing, they likely come from the drive bushing and indicate that proper lubrication is likely not completed and should be checked. If there is liquid dripping into the drive shaft housing, it likely comes from a failed O-ring. If this O-ring is not replaced, there will eventually be a stream of water. If this happens then eventually the whole brass plate will need to be replaced.

There is a warehouse in California and North Carolina with replacement parts made by the manufacturer. All of the parts are fairly standard and should be easily replaceable. These should all be quickly replaced when ordered form the manufacturer.

CHAPTER 10
PLANT DRAIN PUMP STATIONS

10.1 INTRODUCTION AND PURPOSE

The drain pump stations serve to ensure that the flow of water used in treatment is recycled and returns back to the beginning of the treatment process.

10.2 WEST PLANT DRAIN PUMP STATION DESCRIPTION

The West Plant Drain Pump Station consists of two (2) pumps, motors, and a monitoring system. This station was added as part of the 2020 plant upgrade. It is located immediately to the west of the North Clarifier. The wet well accepts flow from the various structures on the west side of the facility, including drain lines from the Grit Basins, North and South Clarifiers, Aeration Basin and Clarifier Flow Splitters, and various vaults, as well as the supernatant line from the Long-Term Digestion Basin. Flow is pumped back to the Grit Basins, tying into the two 30" influent lines feeding the Grit Basins.

10.3 EAST PLANT DRAIN PUMP STATION DESCRIPTION

The East Plant Drain Pump Station is located in between the UV/Maintenance Building and the Blower Building. The East Drain Pump Station was known as the Return Pump Station before the 2020 plant upgrade, where the existing equipment remained and the station was renamed. Wastewater from the Lab Building and the UV/Maintenance building, including backwash from the 3W sediment filter, as well as drain lines from various vaults, flow to the East Plant Drain Pump Station. This pump station sends wastewater to the influent flow gates just upstream of the influent screw pumps.

10.3.1 West Plant Drain Pump Station Materials

The pumps are automatically connected to the discharge connection without personnel having to enter the wet well. The seal is accomplished with a metal-to-metal connection that does not need an O-ring or a profile gasket. All exposed nuts and bolts are 316 stainless steel construction and all metal surfaces that contact liquid and are not stainless steel or brass are protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump. All of this

reduces corrosion and wear on the exterior of the pump. The pump can operate at full capacity when completely submerged, partially submerged, or totally non-submerged.

The outside of the pump is made of chromoly steel which is very resistant to rust. This pump is also painted to assist in corrosion resistance; however, if the paint is damaged, the pump should still be rust-free and requires no maintenance. The impeller is made of hard-iron so it is unlikely to be damaged.

10.3.2 Materials

All exposed nuts and bolts are 316 stainless steel. All of the exposed metal that is not stainless steel will be given a spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish to prevent corrosion. Because of this, little maintenance is required on the pumps. All seals are made through metal-to-metal contact. If a watertight seal exists, a fitted Nitrile or Viton rubber O-ring is fitted and compressed to maintain a proper seal. No other sealing compounds, grease, or elliptical O-rings are needed to maintain the seal, cutting down on maintenance. The pumps are attached to the discharge connection by a machined metal to metal watertight contact that does not require an operator to enter the wet well for operation or maintenance.

10.3.3 Motor

The motor is capable of 30 evenly spaced start/stop cycles per hour and is designed for continuous duty handling. The motor is a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, water type chamber. The junction chamber with the terminal board is hermetically sealed from the motor. The motor will have a voltage tolerance of plus or minus 10%. The motor and cable are able to operate while submerged to a depth of up to 65 feet or more. The motor is also FM-explosion-proof rated.

10.3.4 Cooling System

The pump motors are cooled by the environment and the water they are pumping so no other cooling measures are needed to maintain the temperature.

10.3.5 Concrete Vaults

All equipment from the pumps, valves, and flowmeters are located within poured/precast concrete vaults. These vaults require minimal maintenance and the interior is coated with a protective epoxy/urethane coating. Access to all equipment is provided by Halliday hatches with fall protection.

10.3.6 Valves and Flowmeters

As part of the station to monitor and control flow from each set of pumps a pressure gage, flowmeter, plug valve, and a check valve were installed into separate vaults. The purpose of the valves is to direct flow and prevent and backflow from entering the pumps. The flowmeters are used to monitor flow to ensure that there are no major leaks within the plant process.

10.4 PLANT DRAIN PS PUMPS

The drain station contains two (2) submersible non-clog wastewater pumps. Each pump is a 10 HP submersible electric motor connected on 460 Volt, 3 phase, 60 Hertz, wire devices with 50 feet of submersible shielded cable that can be submerged to use for pump application. The power cable is sized based on NEC and ICEA standards and is P-MSHA approved. Each pump is capable of delivering 590 GPM at 34 feet TDH. The minimum shut off head is 59 feet plus or minus one (1) foot. The pump drive type is single speed and the rated speed is 1,720 RPM. The Pump Station Starter Panel and Control Panel is located to the east of the pump station wet well.

10.5 LIFTING SYSTEM

The drain system exists in a wet-well. No operator should need to enter the wet-well. Each pump is fitted with 40 feet of lifting chain assembly, made of Spectra cord and 18” stainless steel chain. This lifting chain assembly is part of the Flygt Grip Eye lifting system which has a lifting capacity of 1.5 times each pump’s unit weight.

10.5.1 Lifting Procedure

The drain station contains two (2) submersible non-clog wastewater pumps. Each pump is a 10 HP submersible electric motor connected on 460 Volt, 3 phase, 60 Hertz, wire devices with 50 feet of

submersible shielded cable that can be submerged to use for pump application. The power cable is sized based on NEC and ICEA standards and is P-MSHA approved. Each pump is capable of delivering 590 GPM at 34 FT. TDH. The minimum shut off head is 59 feet plus or minus one (1) foot. The pump drive type is single speed and the rated speed is 1,720 RPM. The Pump Station Starter Panel and Control Panel is located to the East of the pump station wet well.

To lift the pumps for repair or maintenance. First connect the small eye of the Grip-Eye to the end of the hoist cable. Slip the rope end of the guide rope through the large eye of the Grip-Eye. Lower the Grip-Eye until it is positioned over the pump lifting chain while keeping the guide rope taut. Release the guide rope tension and allow the lifting chain to take a position to become engaged in the Grip-Eye. Gradually take up tension on the joist cable and the Grip-Eye will make a positive grip on the pump lifting chain. Continue hoisting until the pump is clear of the station. All lifting must be done with the patented Flygt Pump Lift materials to ensure the equipment remains undamaged.

10.6 IMPELLER

The impeller is self-cleaning and semi-open. The adaptive N-impeller that is present in the pumps uses the guide pin and relief groove to guide debris to the perimeter of the inlet. The relief groove and the swept back impeller edges push the debris through the volute. If the torque is not sufficient to push the debris through, then the impellor is pushed upward, allowing the debris to be more carefully moved through the relief groove. Hydraulic pressure then returns the impellor to its previous position. The dampening effect of the axially moving impeller also reduces stress on the shaft and bearings as well as reducing wear on the impeller edges. There is a guaranteed 25% energy saving over traditional pumps. There is significantly less clogging with this pump model than most other models, significantly increasing the time between needed maintenance.

10.6.1 Impeller Troubleshooting

The impeller is moving quickly when the pump is operating. If the impeller hits the contact ring it may become dangerously sharp and could become dangerous to operators. Operators should not be near the impeller of the pump before the breaker lock out has locked out the power.

If the impeller gets stuck or tangled, the motor casing section should be removed. This can be done by simply removing four (4) bolts and separating the pieces. This will come with the impeller and will make

whatever object is stuck much easier to remove. There is an O-ring at this joint to help seal, but this O-ring is not vital and does not require frequent inspection.

10.7 MINICAS

The MiniCAS contains the temperature and leakage alarm signals. When the MiniCAS sensors measure normal conditions, the Temperature Alarm Relay is activated and normal pumping operation occurs. If a high temperature condition is measured, an alarm is activated and pumping automatically stops. When the condition has cleared, the system will reset. This reset is based on the Alarm Reset Mode Select Switch conditions, which can be AUTO or MANUAL. In Auto mode, the reset occurs without operator intervention; in manual mode, the Overtemp Reset Push-button must be pushed to clear the alarm.

It is highly recommended that the fault reset is always in Manual mode so that any faults must be acknowledged by the operator, ensuring that they are not missed. If a seal leakage condition is sensed, a leakage indicator is activated. If the wires of the sensor are shorted, the leakage alarm is activated, and the leakage and Overtemp. alarms are alternately flashed with the power LED. When the short is removed, the fault will automatically reset. A cleared fault indication appears if a fault occurred and has been fixed. This indication can be removed by pressing the Overtemp. reset push-button. Any fault indications should be recorded and immediately addressed before continuing.

10.8 PLANT DRAIN PUMP STATION FLOAT TREE ASSEMBLY

The West Plant Drain Pump Station has a level transmitter to measure and transmit the level of water in the Plant Station wet well. The West Plant Drain Station has a high float sensor for both of the drain station pumps. All three (3) of these sensors hang from the top of the wet well toward the bottom and are located along the center line of the pump station wet well. The water from the pumps flow to the valve vault where the outlets join into one and then enter the pump station flow meter.

There is a High-Water Level Alarm that also serves as the signal for Pump 1 to be turned ON. There is a second High Water Level Alarm that also serves as the signal for Pump 2 to be turned ON. The lag pump ON level transducer setpoint. There is also a lead pump ON level transducer setpoint. There is a Pump OFF Level Transducer Setpoint. There is a Pump(s) OFF Low Water Level Alarm,

The pumps in the plant drain pump stations are triggered automatically when the corresponding high float is triggered as part of the secondary wet well level control. All of the pumps will start and then run for a set time when the water level reaches their corresponding high float.

10.9 MAINTENANCE

10.9.1 Pump Station Inspection

Every pump should be lifted and inspected based on 2,000 hours of run time or one year. This can be done by operators, but is also provided by Flygt as a service that can be purchased. During this inspection, each pump should be removed from the wet well and run. There should be very minimal noise after start-up and little vibrations. If there is significant noise or vibration, further investigation should be done to determine the source and repairs should be made. A visual inspection should also be performed to ensure that the impeller gap is correct and all cables and pump exterior are in good condition.

Additional maintenance tasks and intervals can be found in the vendor manual in section 2, and attached in Appendix C.

As part of inspection all valves should be exercised to confirm that they are working correctly and the interior of all vaults should be visually inspected in order to confirm no spalling or corrosion is occurring from hydrogen sulfide.

10.9.2 Replacement Parts

Each component of the pump is individually balanced during manufacturing. Any components, including the impeller, can therefore be replaced individually. If a part requires repairs, it can be replaced with the correct Flygt-made part without the need to replace any other parts.

CHAPTER 11
LONG TERM DIGESTION BASIN

11.1 LONG TERM DIGESTION BASIN DESCRIPTION

Waste Activated Sludge (WAS) from the North and South Clarifiers is configured to drain periodically to the Long-Term Digestion Basin. WAS is drained via 8" motorized valves, which are configured to open and close as needed to maintain the operator's desired wastage rate. In addition, the overflow from the aeration basin flow splitter structure is also designed to discharge to the Long-Term Digestion Basin (LTDB) if plant operation staff determines that they need to take plant off-line and temporarily store screened influent flow. Reasons for taking plant off-line may include equipment maintenance and/or treatment equipment malfunction. The LTDB contains six (6) floating aerators that are configured to ensure that proper aeration and partial mixing occurs in the basin. The basin was converted from the existing West Lagoon as part of the 2020 Ferndale Plant Upgrade.

11.2 GENERAL STRUCTURE

The basin has six 7.5 horsepower aerators that serve to ensure the basin is properly aerated. The motor control center for the aerators is located in the West Electrical Building. The total storage capacity of the LTDB is 10,000,000 gallons. The water is drained out of the basin through a telescoping valve located on the southeast corner of the basin. The telescoping valve is configured to operate anywhere from EL = 20.5 (low water set point) to EL = 26.0 (high water set point). Bottom of basin EL = 11.0 (approx.) and is protected with a 4-inch layer of control density fill. Please note that the lowest point of the basin overflow weir is EL = 27.03. In addition, the surrounding dike is configured with a top EL = 28.0 (approx.). Operation staff is to adjust basin outlet set point (telescoping valve set point) as desired.

11.3 SAFETY

The basin has no control fencing around the perimeter. All operators must take great care not to fall into the basin. If someone does fall into the basin, there are six (6) life preservers distributed around the basin which can be used for rescue if needed.

The LTDB will need to be accessed via boat for sampling sludge and measuring the sludge blanket depth Information about sludge sampling can be found in Chapter 8 of this O&M Manual. A plan should be

prepared detailing how to place the boat in the basin, how to safely get in and out of the boat, and how remove the boat from the basin. The quarry spalls around the perimeter of the basin are large and can easily shift underfoot, so there is an elevated risk of injury when walking down to the water surface of the basin.

When collecting samples in the Long-Term Digestion Basin, the following additional safety precautions should be taken:

- At a minimum, two people should be present to provide assistance during sampling
- Wear life jackets and have an onshore observer with a cell phone
- Wear personal protective equipment (gloves, waterproof clothing, respirator, goggles)
- Decontaminate with a thorough wash and with an antibacterial agent when leaving the work area
- A current Hepatitis B vaccination is recommended.

11.4 DIKE MAINTENANCE

The dikes must be periodically checked for the following conditions:

1. Dike erosion is primarily storm, wave action, or the result of the neglect of proper monitoring and maintenance.
2. Burrowing animals can potentially penetrate the liner and cause the LTDB to leak. Evidence of burrowing animals will require measures taken to ensure that the integrity of the liner is not threatened.

Caution must be taken by the operator during times when it is found necessary to drain or pump into a lagoon. The operator should avoid concentrating temporary discharges directly onto the upper slope of the LTDB. This could cause erosion. In addition, the basin should not be drained during times of high ground water and is best performed during drier periods in the summer. Draining the lagoon during times of high groundwater, may make the lagoon sides become unstable and slump into the lagoon causing possible damage to the liner.

CHAPTER 12
ELECTRICAL POWER AND CONTROL SYSTEM

12.1 INTRODUCTION

This chapter provides an overview of the electrical power and control system components of the City of Ferndale's Waste Water Treatment Plant (WWTP). This includes the existing equipment from the original facility construction, as well as the recent Waste Water Treatment Plant Upgrade project.

The major electrical system components include the electric service equipment, standby generators, power distribution, Motor Control Centers and motor controllers, PLC based control system, instrumentation, SCADA system, and telemetry equipment.

12.2 POWER SYSTEM DESCRIPTION

12.2.1 Electric Service

The Puget Sound Electric (PSE) electric service provides power for both the City of Ferndale's Waste Water Treatment Plant (WWTP) and the Water Filtration Plant (WFP). The electrical service is a 200 amp, 3 phase, 12,470Y/7200V service which enters the site at the utility pole near Ferndale Road and routes underground to a PSE pad mount primary metering cabinet, meter #Z016414923.

The 12.47 kV primary service conductors extend from the PSE metering cabinet in conduit to a 12.47 kV fusible disconnect switch near the North wall of the WFP. This primary switch has two fusible output sections. One feeds the Water Filtration Plant Transformer #1. The other feeds a junction vault at the existing lab which extends to Transformer #4 at the West Electrical Building, and a new 12.47 kV switch near the Blower Building. This new switch has two fusible output sections. One feeds the existing Transformer #2 at the Main Electrical Building, and the other feeds the new Transformer #5 at the Blower Building.

Note: Transformer #3 was previously located near the Middle Electrical Building and was demolished and removed during the recent project construction. The Middle Electrical Building was converted to a storage building, with lighting and heat powered from MCC#3 in the West Electrical Building.

The underground 12.47 kV primary cable is a combination of direct buried armored cable and individual conductors installed in PVC conduit.

Refer to Record Drawing E10.01 for the electrical system one-line diagram which shows the detailed electrical system diagrams with electrical equipment and raceway ratings.

The new Transformer #5 at the Blower Building is a 1000 kVA 12.47kV to 480Y/277V three phase pad mount transformer, manufactured by Eaton.

The new medium voltage switch near the Blower Building is a 200 amp 14.4 kV nominal S&C pad mounted switch, model PMH-7, manufactured by S&C Electric Company.

Refer to the manufacturer Operation and Maintenance manuals provided by the Contractor for equipment ratings, testing and certification reports, product information, spare parts and preventative maintenance instructions for the new transformer and medium voltage switch.

The equipment was provided by:
North Coast Electric
2424 8th Ave S, Seattle, WA 98134
Tel: (206)436-4444

12.2.2 Standby Diesel Generators

12.2.2.1 Existing Standby Diesel Generator

The existing standby diesel generator is rated at 1000 kW, 288 kVA, 60 Hz and 1504 amperes at 480V AC, 3-phase, and is located inside the Electrical Building. This generator serves the emergency side of the Automatic Transfer Switch (ATS) ATS #3 in the Water Filter Plant, ATS #1 in the Main Electrical Building, and ATS #2 in the West Electrical Building.

Previous to the plant expansion, this generator served both the WWTP and the WFP. With the expansion of the plant and addition of the new aeration basins and mixed liquor pump station, the generator was no longer large enough to serve both the WWTP and WFP. A new additional standby diesel generator was installed to serve the Blower building and equipment, including new Automatic Transfer Switch ATS #4.

12.2.2.2 New Standby Diesel Generator

The new generator at the Blower Building is a Cummins model DSHAD rated at 230 kW, 288 kVA, 60 Hz and 346 amperes at 480V AC, 3-phase. The generator controller is a Cummins PowerCommand 2100 series. The diesel engine generator is located on the south side of the Blower Building, installed on top of a 526 gallon sub-base diesel fuel tank.

The new generator powers the Blower Building thru ATS #4 and feeds Motor Control Center MCC #3. The MCC#3 powers six (6) 75 HP Blowers with Variable Frequency Drives (VFD's) for the aeration basins, powers the Parkson Treatment panel, the grit chambers, and the Mixed Liquor Pump Station (MLPS).

The Parkson Treatment panel provides automatic control to shed load in case of Utility power failure. While on generator power, the PLC controller only allows automatic operation of two 75 HP blowers, one for each aeration basin.

Refer to Record Drawing E10.01 for the electrical system one-line diagram which shows additional information for the standby generators and electrical system.

Refer to the manufacturer Operation and Maintenance manuals provided by the Contractor for equipment ratings, testing and certification reports, product information, spare parts and preventative maintenance instructions for the new Cummins standby diesel generator.

The equipment was provided by:
Cummins Power Generation
1030 SW 34th St, Suite A
Renton, WA 98057
Tel: (425)277-5346

12.2.3 Automatic Transfer Switches

All of the existing Automatic Transfer switches were replaced as part of the Waste Water Treatment Plant Upgrades project. This includes ATS#1 in the Main Electrical Building, ATS #2 in the West Electrical Building, and ATS#3 in the Water Filtration Plant. The emergency feed for these three ATS's are powered from the existing diesel generator.

A new ATS #4 was installed for the new service to the Blower Building. The emergency feed for this ATS is powered from the new standby diesel generator.

Refer to Record Drawing E10.01 for the electrical system one-line diagram which shows the detailed electrical system diagrams including the new Automatic Transfer Switches.

The Automatic Transfer Switches are manufactured by ASCO, 7000 series, with delayed transition, surge arrestors, power monitors, and Reduced Energy Let Thru (RELT) arc flash provisions on selected models. See ASCO bill of materials for detailed model numbers and equipment options.

Refer to the manufacturer Operation and Maintenance manuals provided by the Contractor for equipment ratings, testing and certification reports, product information, spare parts and preventative maintenance instructions for the new ASCO Automatic Transfer Switches.

The equipment was provided by:
ASCO Power Generation
160 Park Avenue
Florham Park, NJ 07932
Tel: (800)800-ASCO
thru
North Coast Electric
2424 8th Ave S, Seattle, WA 98134
Tel: (206)436-4444

12.2.4 Electrical Panels and Motor Control Centers (MCC)

There are a total of four electrical services throughout the WWTP and WFP facility. A description of each is listed below:

12.2.4.1 Water Filtration Plant

The electrical service to the WFP includes the pad mount, 1500 kVA 12.47kV-480Y/277V Transformer #1 which feeds the 2000 amp main of ATS#3 and is bussed to the 2000-amp switchboard. The emergency feed to ATS#3 is a 1000-amp feed from the Generator Switchboard in the Main Electrical Building.

The WFP switchboard powers all of the equipment in the Water Filtration Plant building, including the lighting panels, power distribution panels, and Motor Control Centers.

See drawing E10.02 for the Water Filtration Plant system electrical one line diagram and drawing E11.01 for electrical panel schedules.

12.2.4.2 Main Electrical Building

The electrical service to the Main Electrical Building includes the pad mount, 1000 kVA 12.47kV-480Y/277V Transformer #2 which feeds the 1600 amp main of ATS#1 and is bussed to the 1600-amp Main Switchboard. The emergency feed to ATS#1 is an 800-amp feed from the Generator Switchboard in the Main Electrical Building.

The Main Switchboard powers the existing MCC#1 and MCC#4, which are the original Cutler Hammer MCC's. These power the Effluent pump station, building lights and heaters for the Main Electrical Building and the existing lab building.

A new 800-amp 480V power feed was installed in the Main Switchboard to power MCC#5 located in the new UV Maintenance Building. MCC#5 includes 8 VFD's for the 2W and 3W plant water motor controls, power for the UV treatment systems, and UV building general power and lighting.

Additionally, a new 125-amp feeder and 75 kVA 480-208Y/120V transformer was installed to provide power to the new Lab/Operations Building, panel OLP1.

There are two Allen Bradley Power monitors installed in the Main Switchboard; one for the utility service and one for the generator. Allen Bradley power monitors are also installed at the WFP switchgear and in each of the new Allen Bradley MCCs. This power data is monitored by the control system via Ethernet connection.

See drawing E10.03 and E10.04 for the Main Electrical Building electrical one line diagram, and drawing E11.02 and E11.03 for electrical panel schedules.

12.2.4.3 West Electrical Building

The electrical service to the West Electrical Building includes the pad mount, 750 kVA12.47kV-480Y/277V Transformer #4 which feeds the 1000 amp main of ATS#2 and is bussed to the 1000-amp MCC#2. The emergency feed to ATS#2 is an 800-amp feed from the Generator Switchboard in the Main Electrical room.

The West Electrical Building MCC#2 switchboard powers the six remaining floating aerators, all Headworks power including the screw and grease pumps, motorized gates, site lighting, and building power for both the West and Middle Electrical Buildings. There is also a 200-amp 480V three phase power feed from the MCC to panel MDP4 which provides power to the new Aerated Grit Chamber, Mechanical Screens, West Plant Drain pump station and the North and South Clarifiers.

See drawing E10.05 for the West Electrical Building electrical one line diagram, and drawing E11.05 and E11.06 for electrical panel schedules.

12.2.4.4 Blower Building

The electrical service to the Blower Building includes the new pad mount, 1000 kVA12.47kV-480Y/277V Transformer #5 which feeds the 1200 amp main of ATS#4 and is bussed to the 1200-amp MCC#3. The emergency feed to ATS#4 is a 500-amp feed from the new 230 kW generator.

The Blower Building MCC#3 powers the six 75 HP blower and Variable Frequency Drives, Mixed Liquor Pump Station, Biolac Treatment Panel for aeration and valve power, and building power for the Blower Building heating and miscellaneous loads.

See drawing E10.06 for the Blower Building electrical one line diagram, and drawing E11.07 for electrical panel schedules.
The electrical panels were provided by:
North Coast Electric
2424 8th Ave S, Seattle, WA 98134
Tel: (206)436-4444

The Motor Control Centers were provided by:
Rockwell Automation via Technical Systems Inc. (TSI)
Rockwell Automation Project No.6504773120
TSI Project No. 7881
Technical Systems Inc. (TSI)
2303 196th Street SW
Lynnwood, WA 98036
Tel: (425)775-5696

12.3 CONTROL SYSTEM DESCRIPTION

12.3.1 Background

The original WWTP control system installed in the 1994 Phase 1 Improvements project included Programmable Logic Controllers (PLC's) from Siemens based on the Simatic 505/545 series of controllers. Illuminated alarm annunciators were installed on the control panel doors, and Idec Micro O/I operator interface keypad displays were installed for operator input.

In recent year projects, the existing PLC systems have all been upgraded and migrated from the Siemens PLC controllers to the current Allen Bradley ControlLogix and CompactLogix series PLC controllers. The Idec operator interfaces have been removed, and a few of the annunciators remain but are no longer used for operations. The original copper communications cabling has all been upgraded to fiber optic cabling.

The SCADA computer system has also been modernized and is used for alarm monitoring and control of the WWTP systems.

12.3.2 Control System Overview

The PLC based control system for the City of Ferndale WWTP consists of multiple distributed PLC panels throughout the plant and communicate with each other via Ethernet over fiber optic cabling. These Allen Bradley PLCs provide the automatic control features for all of the WWTP equipment based on the programmed logic in the controllers, and communicate with the central SCADA system for monitoring, control, and data logging. A software alarm dialer is installed on the SCADA computer to notify operators of alarm conditions and events which require operator attention.

The 2020 WWTP Upgrade project include the construction of a new Lab/Operations building including a new climate-controlled data room with multiple racks of IT and communications equipment. The communications hub for the facility was moved from the Water Filtration Plant to the new data room in the Lab/Operations building. All of the WWTP fiber optic cabling routes to the racks in the data room and serves as the new communications hub for the WWTP control system. The SCADA computers were upgraded to blade style servers and are installed in the data room racks.

The Master Telemetry Unit (MTU) control panel and antenna assembly was relocated to the new data room in the Lab/Operations building. This panel communicates with the City's sewer lift stations and to the SCADA system for lift station alarm and status monitoring.

12.3.3 Control System Components

The major WWTP control system equipment is described in this section. For a detailed control system overview, refer to drawings E9.03 and E9.04. For specific PLC control panel Bill of Materials and wiring diagrams, refer to the TSI Operation and Maintenance Manuals, project No.7881.

Lab/Operations Building
Location: Lab/Operations Building data room.
Hardware: Rack mount SCADA servers located in data room.
Equipment: Serves as the communications hub for all WWTP fiber optic cabling to control system network. SCADA workstations located in operators offices, large screen views in lab building. UPS system installed in data room for server equipment power backup. MTU panel located in data room for communications to sewer lift stations.

Main Control Panel (MCP)
Location: Old Lab Building
PLC Hardware: Allen Bradley CompactLogix model L33ER PLC with I/O.
Equipment: Lab building monitoring, intrusion, hardware backup autodialer.

Remote Control Panel 1 (RCP-1)
Location: Main Electrical Building
PLC Hardware: Allen Bradley ControlLogix PLC with I/O.
Equipment: Main electrical building and generator status, intrusion, power monitors.

Remote Control Panel 2 (RCP-2)

Location: West Electrical Building

PLC Hardware: Allen Bradley CompactLogix model L33ER PLC with I/O.

Equipment: Motors and controllers located in MCC#2 including Headworks screw pump Soft Starters, grease pumps, gates, six lagoon aerators, power monitor, instrumentation.

Local Control Panel - Effluent/Return Pump Stations (LCP-600/700)

Location: Effluent Pump Station

PLC Hardware: Allen Bradley CompactLogix model L33ER PLC with I/O.

Equipment: Effluent pumps, return pumps, instrumentation.

Local Control Panel- Water Filter Plant (LCP-WFP)

Location: Water Filtration Plant

PLC Hardware: Allen Bradley CompactLogix model L33ER PLC with I/O.

Equipment: Water Filtration Plant building, pumps and equipment, instrumentation.

Remote Control Panel (RCP-3A)

Location: Mixed Liquor Pump Station

PLC Hardware: Allen Bradley CompactLogix model L33ER PLC with I/O.

Equipment: Mixed Liquor Pump Station VFD's for P-401/403/405, instrumentation.

Remote Control Panel (RCP-3B)

Location: Mixed Liquor Pump Station

PLC Hardware: Allen Bradley CompactLogix model L33ER PLC with I/O.

Equipment: Mixed Liquor Pump Station VFD's for P-402/404/406, instrumentation.

Blower Building PLC Controller (PLC-3)

Location: Blower Building

PLC Hardware: Allen Bradley CompactLogix model L33ER PLC with I/O.

Equipment: Blower Building monitoring, generator and ATS, power monitors, intrusion, smoke, chemical treatment systems, instrumentation.

Treatment System PLC Controller (BL-CP by Parkson Biolac)

Location: Blower Building

PLC Hardware: Allen Bradley CompactLogix model L33ER PLC with I/O.

Equipment: Six 75 HP Blower VFD's located in MCC#3, aeration basin valves, Biolac equipment, instrumentation.

Clarifier and Mechanical Screens area PLC Controller (PLC-4)

Location: Outdoor panel by Clarifiers

PLC Hardware: Allen Bradley CompactLogix model L33ER PLC with I/O.

Equipment: Valve actuators, gates, clarifier panels, West Plant Drain PS, flow meter panels FMP-1/2/3/4, mechanical screen control panels, instrumentation.

UV Building PLC Controller (PLC-5)

Location: UV Building

PLC Hardware: Allen Bradley CompactLogix model L33ER PLC with I/O.

Equipment: Equipment located in MCC#5 including four 2W pump VFD's, four 3W pump VFD's, UV and aux system monitoring, building intrusion and smoke alarms, flow meters, power monitor, instrumentation.

12.3.4 SCADA system

The Supervisory Control And Data Acquisition (SCADA) system consists of Rockwell Automation FactoryTalk View SE software, installed on rack-mount computers in the Lab/Operations data room server racks. A local SCADA workstation is located in the operator's office. A large HD TV screen is in the main lab room to display the WWTP system overview.

Custom SCADA displays have been programmed by the System integrator to show the WWTP system overview and process data, and detailed screens for each area and equipment at the WWTP. Consult the System Integrator manuals for detailed descriptions of the SCADA screens and operation.

The system operator can adjust process control set points, alarm set points, and control select equipment from the SCADA screens. Password protection is installed to prevent unauthorized access.

The SCADA system collects and saves the historical process data in the servers, which can be viewed in graphical trend format to monitor both current and historical data. This data can also be used to create custom reports for local agency reporting requirements.

Alarm monitoring software by WIN-911 is installed on the SCADA computer to monitor for WWTP process alarms. These alarms and setpoints are user-customized in the SCADA system. When an alarm becomes active, the operator is notified via text messaging or phone call based on the priority and on-call list programmed in the software. The operator will then acknowledge the alarm and take the appropriate action to clear the alarm condition.

12.3.5 Programming of PLC and SCADA system

The City of Ferndale currently contracts a local System Integrator, Technical Systems Incorporated (TSI), to program and maintain the entire control system, including the PLC's and SCADA system.

The TSI programmer(s) work directly with the City operators for PLC programming requirements to adjust the automatic operation of the WWTP based on the City's needs and requests.

The SCADA control system is also programmed and maintained by the same TSI programmers.

Detailed control descriptions and operational requirements for the PLC and SCADA system should be provided by the PLC and SCADA system programmers.

Contact information:
TSI Project No. 7881
Technical Systems Inc. (TSI)
2303 196th Street SW
Lynnwood, WA 98036
Tel: (425)775-5696

APPENDIX A

MAJOR EQUIPMENT VENDOR AND MANUFACTURER CONTACT LIST

SUPPLIER EMERGENCY CONTACT LIST

FERNDALE WWTP

Specifications	DESCRIPTION	Sub/Supplier	PHONE NUMBER	Email	Contact	Manufacturer	Address and Phone
	DIVISION 8 DOORS AND WINDOWS						
08 33 23	Overhead Coiling Door	Overhead Door Company	360-734-5960	tony@ohdbellingham.com	Tony McClellan	Overhead Door Corporation	Lewisville, TX 469-549-7100
	DIVISION 10 SPECIALTIES						
10 43 13	Defibrillator Cabinets & Devices	AED First Response	425-785-8835	aedsupport@philips.com	Brooks Simpson Brookss@aedfirstresponse.com	Philips Medical Systems	Bothell, WA 800-263-3341x1
	DIVISION 11 EQUIPMENT						
11 30 00	Thermo Scientific Refrigerator	Laboratory Design Thermo Scientific - Gig Harbor, WA	888-274-0106 800-438-4851	brian@laboratorydesign.net; mkt@thermofisher.com	Brian Johnston	Thermo Fisher Scientific LLC	Marietta, OH 866-984-3766
11 30 00	Flaskscrubber Glassware Washer	Laboratory Design	888-274-0106	brian@laboratorydesign.net; labconco@labconco.com	Brian Johnston	Labconco	800-522-7658
11 50 00	Polymer Feed Equipment	Harrington Plastics	909-597-8641	d.swanson@hipco.com	Derek Swanson	LMI - Accudyne AR Valve- Plast-o-matic KOFLO Mixer	508-263-9800 973-256-3000 847-516-3700
	DIVISION 12 FURNISHINGS						
12 20 00	Window Treatments	Amazing Window Treatments	360-927-5153	Jim@amazingwindowtreatments.com	Jim Anderson	A&I Manufacturing Co. of Monroe	Monroe, WA 360-805-8200
	DIVISION 22						
22 10 00	Plumbing Piping and Pumps	Spectrum Plumbing & Heating	360-739-9207	info@spectrumpandh.com	Ben Fuller	Mixing Valve/Circ Pump System: Leonard Expansion Tank: Amtrol Circulation Pump: Taco	Leonard: Cranston, RI 800-222-1208 Amtrol: Warwick RI 401-884-6300 Taco: Cranston RI 409-942-8000
22 19 29	Submersible Sewerage Pumps	Whitney Equipment	503-310-9893 Jason 425-486-9499 Dana	jmorse@WECI.com , dwehrman@weci.com	Jason Morse-Field Service , Dana Wehrman - Parts	Xylem / Flygt	Charlotte, NC 704-409-9765
22 20 00	MLQ Pump Station Pumps	Whitney Equipment	503-310-9893 Jason 425-486-9499 Dana	jmorse@WECI.com , dwehrman@weci.com	Jason Morse-Field Service , Dana Wehrman - Parts	Xylem / Flygt	Charlotte, NC 704-409-9765
22 33 00	Domestic Water Heaters	Spectrum Plumbing & Heating	360-739-9207	info@spectrumpandh.com	Ben Fuller	AO Smith	Ashland City TN 877-552-0010
22 40 00	Plumbing Fixtures	Spectrum Plumbing & Heating	360-739-9207	info@spectrumpandh.com	Ben Fuller	Water Heaters: AO Smith Shower/Eye Wash: Amtrol	AO Smith: Ashland City TN 877-552-0010 Amtrol:Warwick RI 401-884-6300
	DIVISION 23 - HVAC						
23 30 00	HVAC Air Distribution	Barron Heating	360-676-1131	paulc@barronheating.com	Paul Cecka	Daikin	Minneapolis, MN 800-432-1342 763-553-5330
23 34 00	HVAC Fans	Barron Heating	360-676-1131	paulc@barronheating.com	Paul Cecka	Greencheck Corporation	Schofield, WI 715-359-6171
23 80 00	Decentralized HVAC Equipment	Barron Heating	360-676-1131	paulc@barronheating.com	Paul Cecka	Daikin	Minneapolis, MN 800-432-1342 763-553-5330
	DIVISION 26 ELECTRICAL						
26 05 00	General Electrical	JH Kelly	R. 360-575-3116, C. 360-957-8260	rfleming@jhkelly.com; cmeyer@jhkelly.com	Ryder Fleming, Chris Meyer	JH Kelly	R. 360-575-3116, C. 360-957-8260
26 24 19	MCC	JH Kelly	425-320-7632 Mitch 360-957-8260 Chris	mitchs@tsicontrols.com cmeyer@jhkelly.com	Mitch Stewart - TSI , Chris Meyer - JH Kelly	Rockwell Automation	Milwaukee, WI 888-382-1583
26 29 23	VFD	JH Kelly	425-320-7632 Mitch 360-957-8260 Chris	mitchs@tsicontrols.com cmeyer@jhkelly.com	Mitch Stewart - TSI , Chris Meyer - JH Kelly	Mitch Stewart - TSI , Chris Meyer - JH Kelly	425-320-7632 Mitch 360-957-8260 Chris
26 32 13	Generator	JH Kelly	425-238-1267 April 206-376-7950 Eugene	april.loomis@cummins.com eugene.laporte@cummins.com	April Loomis Eugene LaPorte	Cummins	Renton, WA 425-277-5346
26 36 00	ATS	JH Kelly	425-320-7632 Mitch 360-957-8260 Chris	mitchs@tsicontrols.com cmeyer@jhkelly.com	Mitch Stewart - TSI , Chris Meyer - JH Kelly	Mitch Stewart - TSI , Chris Meyer - JH Kelly	425-320-7632 Mitch 360-957-8260 Chris
26 80 00	Instrumentation & Control	JH Kelly	425-320-7632 Mitch 360-957-8260 Chris	mitchs@tsicontrols.com cmeyer@jhkelly.com	Mitch Stewart - TSI , Chris Meyer - JH Kelly	Mitch Stewart - TSI , Chris Meyer - JH Kelly	425-320-7632 Mitch 360-957-8260 Chris
	HMI, SCADA, Network & PLC Programming	Technical Systems, Inc	425-320-7632 Mitch 360-957-8260 Chris	mitchs@tsicontrols.com cmeyer@jhkelly.com	Mitch Stewart - TSI , Chris Meyer - JH Kelly	Mitch Stewart - TSI , Chris Meyer - JH Kelly	425-320-7632 Mitch 360-957-8260 Chris
			M. 425-320-7632, T. 206-402-1412	mitchs@tsicontrols.com; timh@tsicontrols.com	Mitch Stewart, Tim Hecox	Mitch Stewart - TSI , Chris Meyer - JH Kelly	425-320-7632 Mitch 360-957-8260 Chris
	DIVISION 27 TELECOMMUNICATIONS						
27 136 23	Telecommunications Cabling	Technical Systems, Inc	M. 425-320-7632, T. 206-402-1412	mitchs@tsicontrols.com; timh@tsicontrols.com	Mitch Stewart, Tim Hecox	Mitch Stewart - TSI , Chris Meyer - JH Kelly	425-320-7632 Mitch 360-957-8260 Chris
	DIVISION31						
31 00 00	Paving	Granite Construction	360-752-4317	Lance.Chanmbers@gcinc.com	Lance Chambers	Granite Construction	360-752-4317
	DIVISION 33						
33 44 63	Stormwater Pretreatment Manhole	Contech Engineered Solutions	206-730-8090	scostello@conteches.com	Steven Costello	Contech Engineered Solutions	206-730-8090
33 51 00	Geomembrane & Geosynthetic Liner	Northwest Linings & Geotextile	800-729-6954	russj@northwestlinings.com	Russell Jackson	Colloid Environmental Tech. Agru America	Hoffman Estates, IL 847-851-1500 Georgetown, GA 843-546-0600
33 51 00	Leak Detection Manhole	Goble Sampson / Plastifab	330-770-6418	jsimon@goblesampson.com	John Simon	Plastifab	Vancouver, WA 503-692-5460
	DIVISION 40						
40 05 57	Actuators for Gates & Valves	Whitney Equipment	503-310-9893 Jason 425-486-9499 Dana	jmorse@WECI.com , dwehrman@weci.com	Jason Morse-Field Service , Dana Wehrman - Parts	Whipps, Inc. - Gates Auma - Actuators	Athol, MA 978-249-7924 Canonsburg, PA 724-743-2862
40 05 59	Slide and Weir Gates	Whitney Equipment	503-310-9893 Jason 425-486-9499 Dana	jmorse@WECI.com , dwehrman@weci.com	Jason Morse-Field Service , Dana Wehrman - Parts	Whipps, Inc.	Athol, MA 978-249-7924

40 05 71	Telescoping Valve	C&B Piping	206-799-5526	sgables@cbpiping.com , rmiller@cbpiping.com	Stephen Gables, Ryan Miller	Trumbull Industries	Youngstown, OH 330-799-3333
	DIVISION 41						
41 22 00	Hoists and Cranes	Washington Crane & Hoist	800-304-6661	tschmidt@washingtoncrane.com	Ted Schmidt	Budgit - Hoist Thern - Crane	Forest Park, IL 800-322-9144 Winona, MN 507-954-2996
	DIVISION 43						
43 22 10	3W & 2W Plant Water System Equipment	Amiad Water Systems / JBI Water	775-385-3472 Kathleen 206-617-5525 Brett	kathleen.kelleher@amiad.com Brettkreier@jbiwater.com	Kathleen Kelleher Brett Kreier	Amiad Water Systems / JBI Water	775-385-3472 Kathleen 206-617-5525 Brett
43 23 59	Screw Pump Equipment	Lakeside Equipment	630-837-5640 x 245 Jim 360-849-3568 Jim Cell 630-837-5640 x 236 Parts	js@olakeside-equipment.com te@lakeside-equipment.com	Jim Snyder - Service Manager Toni Erwin - Parts Manager	Lakeside Equipment	630-837-5640 x 245 Jim 360-849-3568 Jim Cell 630-837-5640 x 236 Parts
	DIVISION 45						
45 05 50	Valves	KGS	425-451-0667	gregg@kgsnorthwest.com	Gregg Carroll	Milliken - Valves Auma - Actuators	Bethlehem, PA 610-861-8803 Canonsburg, PA 724-743-2862
45 05 50	Valves	C&B Piping	206-799-5526	sgables@cbpiping.com , rmiller@cbpiping.com	Stephen Gables, Ryan Miller	VSI	Alpharetta, GA 770-740-0800
	DIVISION 46						
46 10 00	Wastewater Samplers	Whitney Equipment	503-310-9893 Jason 425-486-9499 Dana	jmorse@WECI.com , dwehrman@weci.com	Jason Morse-Field Service , Dana Wehrman - Parts	Teledyne Instruments	Lincoln, NE 402-465-3094
46 21 33	Rotary Drum Screen	Huber Technology	704-990-2430 Simon 980-579-0536 Simon Cell	simon.randle@hhusa.net	Simon Randle	Huber Technologies	Denver, NC 704-949-1010
46 43 00	Clarifier Equipment	Ovivo	512-497-5152 LoRay 512-834-6009 Bala	loray.cox@ovivowater.com bala.balachandran@ovivowater.com	LoRay Cos - Field Tech. Bala Balachandran	Ovivo Water	Round Rock, TX n 855-341-0627
46 43 00	Weirs / Baffles	Edgeng	405-888-6327	aa@edgeng.com	Ann Amerasekera	Edg Engineering	White Plains, NY 405-888-6327
46 51 21	Coarse Bubble Diffusers	Aquarius Technologies, Inc.	262-284-0112 Kevin 414-807-3443 Kevin Cell 262-268-1500 Jerry 425-691-7101 - Kristin	klapean@aquariustechnologies.com jtruszynski@aquariustechnoligies.com Krintin@tec-nw.com	Kevin LaPean - Engineer Jerry Truszynski Kristin Faulkner	Aquarius Technologies Inc.	Saukville, WI 262-268-1500
46 53 00	Biological Treatment System	Parkson Corporation	954-917-1866 Jorge 954-253-2122 Jorge Cell 954-974-6610 - Kevin 503-223-6197 - Bill	Jfernandez@parkson.com kbunting@parkson.com , Bill@whreilly.com	Jorge Fernandez - PM Kevin Bunting , Bill Reilly	Aerzen - Blowers Aventis Systems - UPS Parkson - Diffusers	Coatesville, PA 610-380-0244 Marietta, GA 678-324-5230 Ft. Lauderdale, FL 954-974-6610
46 53 50	Aeration Access Boats	Camano Marine	360-629-4507	bruce@camanomarine.net	Bruce Hawthorne	G3 Boats - Yamaha Corp.	Newnan, GA 866-894-1626
46 66 00	UV Disinfection Equipment	Trojan Technologies	866-388-0488 24/7 Assistance 519-619-7352 Jake Cell 519-457-3400 , 503-223-6197	jboyd@trojantechnologies.com jfournier@trojanuv.com , bill@whreilly.com	Jake Boyd - Local Field service Specialist Jordan Fournier , Bill Reilly	Trojan Technologies	London, Ontario, Canada 519-457-3400

APPENDIX B

PERSONNEL

APPENDIX B

PERSONNEL

B-1 PURPOSE AND INTENT

To ensure that the treatment facility is operated efficiently and economically, it is necessary to employ qualified personnel. The purpose of this section of the O&M manual is to describe the requirements for personnel who operate and maintain the treatment plant.

B-2 PERSONNEL REQUIREMENTS

It is recommended that a minimum of four full time persons be staffed to efficiently operate and maintain the City of Ferndale WWTP under normal conditions. Based on the State of Washington Wastewater Treatment Facility Classification (WAC 173.230.330), one of the persons employed to maintain the facility must have certification as a Class II operator.

B-3 PERSONNEL QUALIFICATIONS FOR TREATMENT PLANT OPERATOR

The treatment plant operators are required to perform the operation, regulation, maintenance, and process functions in the treatment plant. The job also requires the performance of additional related work. As an example, the treatment plant operators perform, record, and analyze routine laboratory tests and modify plant operations in accordance with the test results. The operators also control the flow of sewage and its components to ensure operational process efficiency; perform all types of maintenance; maintain the records necessary for effective maintenance of the process machinery and equipment.

Effective operation of the treatment plant requires that the operators possess knowledge of plant operation process, equipment, and control. Ability to operate all processing equipment and to utilize laboratory tests in making necessary process modifications, as well as developing and maintaining orderly records, is also necessary.

The operators of the City of Ferndale WWTP must have education and experience sufficient for carrying out the procedures described in this manual and in the references provided. Operator certification is

required. The plant is a very large investment, and, as such, needs to be run as efficiently as possible by a knowledgeable operator.

B-4 CERTIFICATION

State of Washington requirements are based upon the sizing of the treatment facilities and the unit processes employed. A Class II operation license is sufficient for the operation of the City of Ferndale WWTP (Design Flow: 4.1 MGD [max month], Treatment Type: Extended Aeration).

WAC 173-230-330 Classification of wastewater treatment plants. (1) The director shall classify all wastewater treatment plants according to the criteria in Table 4.

(2) If Table 4 indicates multiple classifications, the department will classify the wastewater treatment plant at the higher classification.

(3) The operator in responsible charge of the wastewater treatment plant must be certified at a level equal to or higher than the plant classification.

(4) When the plant is operated on more than one daily shift, the lead operator of each shift must be certified no lower than one level below the plant classification.

Table 4
Treatment Plant Classification Criteria

Treatment Plant Classification Criteria		
Treatment Type	**Design Flow MGD**	**Classification**
Primary	≤ 1	I
	> 1 ≤ 10	II
	> 10 ≤ 20	III
	> 20	IV
Lagoon (Nonaerated)	All	I
Lagoon (Aerated)	≤ 1	I
	> 1	II
Biofiltration	≤ 1	II
	> 1 ≤ 10	III
	> 10	IV
Extended aeration	≤ 5	II
	> 5	III
Activated sludge	≤ 1	II
	> 1 ≤ 10	III
	> 10	IV
SBR	≤ 1	II
	> 1 ≤ 10	III
	> 10	IV
Wetland treatment	≤ 1	I
	> 1 ≤ 5	II
	> 5	III
Tertiary	≤ 5	III
	> 5	IV
MBR	≤ 1	II
	> 1 ≤ 10	III
	> 10	IV

(5) Plants may be classified differently than indicated in Table 4 if:

(a) They have characteristics that make operation more or less complex or difficult than other similar plants with the same flow range.

(b) The conditions of flow or the use of the receiving waters require an unusually high degree of plant operational control.

(c) They use an approved method of wastewater treatment that is not included in this section.

[Statutory Authority: Chapter 70.95B RCW. WSR 19-15-025 (Order 18-02), § 173-230-330, filed 7/10/19, effective 8/10/19.]

APPENDIX C

ROUTINE TASK AND MAINTENANCE PROGRAM

APPENDIX C

ROUTINE TASK AND MAINTENANCE PROGRAM

C-1 PURPOSE AND INTENT

The operator has certain duties that need to be performed on a regular basis. The tasks outlined in this chapter constitute the minimum recommended list, from which a detailed checklist of routine operational duties can be developed by experience. All equipment manufacturer's maintenance requirements, as given in their operation and maintenance manuals, must be incorporated into the working schedule.

A well-operated treatment facility depends to a great extent on a good preventive maintenance program. The City of Ferndale WWTP must operate twenty-four hours a day, every day of the year. Preventative maintenance is most important to long life of the equipment and is necessary in order to qualify for warranty protection. To maintain continued operation of the plant when maintenance is performed, some duplication of plant equipment and functions has been provided for operation flexibility.

C-2 MAINTENANCE RECORDS

Records of service, maintenance, and repair must be maintained in order to develop historical data vital for planning purposes. Standardization of records and procedures will reduce confusion in the use of these records. Good records will also permit the determination of major or recurring problem areas where improved maintenance or other appropriate action may be required.

Maintenance records shall be kept for each individual unit. All maintenance performed on each unit must be recorded when it is performed.

Card File System

It is recommended that a maintenance card file system be used. This system may be computerized if desired. Each item of equipment should have a set of two cards filed alphabetically in a card file. These Equipment Cards should be provided to summarize pertinent information from the equipment submittals and manufacturer's manuals. One card contains information about the manufacturer, model, capacity, bearings, drive, seals, etc. The other card summarizes the electrical information. Each card also contains lubrication

information and the type and frequency of work to be done on the equipment. The backs of the cards should be used to record the dates that any work is performed, the type of work done, and the initials of the person performing the tasks. Repair work as well as routine maintenance should be included on the card. The purpose of the card system is to provide a complete record of all maintenance work performed on every piece of equipment in the plant. Figures C-1 through C-3 show the sample cards. The format and information presented in the figures may also be used on the plant computer system. A record of parts used and parts in stock should also be in file with the equipment records.

C-3 LUBRICATION

Regular lubrication for all bearings and gears is one of the most important items in preventing equipment failures and as such requires special mention. Manufacturer's I&M catalogs contain lubrication schedules for each piece of equipment requiring lubrication. There are three important considerations when lubricating machinery:

1. Do not let bearings or gears run dry. Know all the points to be lubricated - follow the schedule or, if operating conditions dictate, change frequency as necessary.
2. Do not over-lubricate. Too much lubricant causes anti-friction bearings to overheat and may damage grease seals. In motors, over-lubrication may damage windings, which may result in motor failure.
3. Use the manufacturers recommended lubricant. The type and grade of lubricant is affected by the composition of metal in bearings and gears, the use of equipment, and operating conditions such as ambient temperature.

SAMPLE EQUIPMENT CARD

CITY OF FERNDALE WWTP

EQUIPMENT CARD NO. 1

ITEM _____

EQUIPMENT

LOCATION	IMPELLER NO. SIZE
DATE INSTALLED	WEAR RING
MANUFACTURER	MOTOR SHEAVE
ADDRESS	DRIVE SHEAVE
	BELT
PHONE	DRIVE
VENDOR	COUPLING
ADDRESS	IN BEARING
	PACKING
PHONE	SEAL
MODEL	SHAFT
MODEL NO	CLEARANCES
SIZE	
SERIAL NO	WORK TO BE DONE FREQUENCY
RATED CAPACITY	
RATED PRESSURE	
RATED RPM	
LUBRICATION POINT LUBRICANT QUANTITY	
COMMENTS:	

FIGURE C-1

SAMPLE ELECTRICAL EQUIPMENT CARD

CITY OF FERNDALE WWTP EQUIPMENT CARD NO. 2 ITEM _____	
EQUIPMENT	
MOTOR MAN.	SHAFT SIZE
MODEL	KEY SIZE
SERIAL NO.	IN BEARING
HORSEPOWER	OUT BEARING
SERVICE FACTOR	STARTER SIZE
RPM	CIRCUIT BREAKER
VOLTAGE	HEATER
HERTZ	COIL NO
RATED AMPERAGE	ROTATION
INITIAL AMPERAGE	
PHASE	WORK TO BE DONE FREQUENCY
FRAME	
ENCLOSURE	
INSULATION	
AMBIENT TEMP ° C	
TEMP RISE ° C	
LUBRICATION POINT LUBRICANT QUANTITY	
COMMENTS:	

FIGURE C-2

BACK OF EQUIPMENT CARD

DATE	WORK DONE	SIGNED	DATE	WORK DONE	SIGNED	DATE	WORK DONE	SIGNED

FIGURE C-3

C-4 EQUIPMENT MAINTENANCE

A summary of required maintenance is seen below. A table summarizing necessary maintenance and recommended frequency for all equipment is included at the end of this appendix.

Pumps

Pumps are probably the most important pieces of equipment in the treatment facility. An understanding of individual pump capacities and construction is important. During normal operational evaluation it is possible to estimate wastewater flow based on the pumping time alone. These estimated flow rates may also be used to test the pump efficiency and, when compared to the manufacturer's pump capacity curve, to check the capacity of the pump. If the observed pump capacities do not match the curve, then repair of the pump may be required. Detailed information including nameplate data, maintenance and specific pump capacity curves are included in the manufacturer's catalogs.

Daily inspection of the influent, effluent, drain, and return pump stations should be performed. Each pump should be checked for correct operation. Special attention should be given to any unusual noise or vibration from the pumps or motors. All control equipment should be kept clean and in good working order. At periodic intervals (refer to manufacturer's operation instructions) the pumps should be serviced. A careful inspection of the pump and motor should be conducted to identify wear or any damaged parts. Replacement of parts or troubleshooting should be performed according to the manufacturer's operation and maintenance manual.

From time to time, it is advisable to check current electrical consumption by means of an ammeter. A constant current reading indicates normal operation. Occasional current fluctuations indicate the presence of solids in the pump fluid as they pass the pump.

A general overhaul of a pump is usually required in the case of defective bearings or motor. Overhaul should be performed at a manufacturer's authorized service shop.

Care of the pumping equipment cannot be over-emphasized. A breakdown of equipment may mean general degradation of the treatment process and ultimate decline in quality of treated effluent. Therefore, it is advisable that the operator become thoroughly familiar with the manufacturer's operation and maintenance manuals.

Electrical Equipment

The treatment plant cannot operate continuously without a planned maintenance program to keep all electrical units functioning efficiently. It is known that 90 percent of motor failures are due to four causes: dirt, moisture, friction, and vibration. A routine cleaning program eliminates dirt. Anti-moisture precautions are effective in combating moisture. Proper oil and grease tend to eliminate friction. Regular daily observations should check for tightness and to see that moving parts are free, contact pressure firm, and shunts unfrayed. Controls should also be checked to see that they are operating at rated voltage and amperage. Most important of all is to see that all electrical controls are kept dry.

Major Process Equipment

All mechanical equipment must be kept in perfect working order. Moving parts should be regularly lubricated, and pipes should be maintained open and free from obstructions and accumulations of any sort. All gates and valves should be exercised every 3 months. A complete cleaning of each unit should be done at regularly scheduled intervals, if it can be taken out of service without seriously affecting treatment. Structures such as inlet/outlet structures, influent channels, wet wells, and the contact tank should be dewatered on an annual basis for inspection and protective coatings applied as necessary. For metals and concrete in contact with wastewater, coal tar epoxies are to be utilized.

Spare Parts

Refer to the manufacturer's I&M catalogs for listing of spare parts available for each piece of equipment.

Tools

Good maintenance depends upon the availability of proper tools to do the job. An important consideration in caring for a good stock of tools is to have regular places of storage for them. Tool boards with specialized or frequently used tools should be located with appropriate equipment where required. Specialty tools and delicate instruments should be stored in the maintenance room within the office/lab building.

Painting

The aesthetic quality and structural integrity of the treatment facility are enhanced by painted surfaces. Paint provides a protective coating against weathering and corrosion by wastewater. A painted surface is more easily cleaned.

Oxygen dissolved in wastewater combines with iron to form iron oxide (rust). Hydrogen sulfide gas emitted from the wastewater surface combines with moisture in the atmosphere to form sulfuric acid that will attack unprotected surfaces. Metal surfaces must be painted to prevent these types of corrosion.

Paint on all structures and equipment should be evaluated annually to determine if refinishing is required. Repainting should be done with an industrial grade of paint that is sufficiently durable to withstand the corrosive environment at the plant. All surfaces should be thoroughly cleaned and all loose dried paint and rust removed before repainting.

Instrument Calibration

It is necessary that the flow meters and laboratory equipment be serviced and recalibrated on a regular basis to ensure that they give accurate readings. Coating of the transducers by wastewater could cause attenuation of the flow meters' signal and produce inaccurate flow data. The transducers in the flow meters should be removed and inspected semi-annually. Recalibration should also be performed at this time. The laboratory balance requires service at least annually.

C-5 MAINTENANCE SCHEDULE OUTLINE

It is the responsibility of the plant operator to incorporate a regular preventive maintenance program into the routine work schedule based on the guidelines presented in this appendix and the information provided in the manufacturer's I & M manuals for each piece of equipment in the plant.

The tasks outlined in this section serve as a minimum recommended list of maintenance tasks from which a detailed checklist of routine operation can be developed by experience. All equipment manufacturer's I & M manuals, must be incorporated into the working schedule.

Daily Routine Work Schedule

The following daily checks should be made in the morning when the operator arrives for work, and again in the late afternoon at the end of the working day. Record all equipment running time meters and the flow meter readings at the beginning of each day. In addition, note and report any unusual conditions that should be investigated.

Lab/Office Building:

1. Check the SCADA to determine if all equipment is operating normally.
2. Record information such as weather observations, aerator running times, influent flow, RAS flow, WAS flow, and effluent flow.
3. Test and record process parameters such as sludge settleability (SV30), DO concentration, MLSS concentration, and sludge blanket thickness.
4. Maintain clean, safe and orderly working environment.

Effluent, Mixed Liquor, and Drain Pump Stations:

1. Observe for any unusual noise or vibration from the pumps and motors.
2. Inspect wet well interiors for any fat, oil, and grease buildup

Screw Pumps:

1. Check alarm lights on screw pump control panel.
2. Check screw pump base and influent chamber for materials that could potentially damage pumps. Remove as necessary.
3. Visually inspect wiring and float level sensors for proper operation.
4. Check to see that the lower bearing grease system is operating at each screw pump and that the grease reservoir is filled above the minimum level.

Aerated Grit Chambers:

1. Visually inspect the air release patter on the water surface of the aeration basin, which should be a uniform, consistent roll pattern. Large boiling in an isolated area is an indication that a mechanical failure has occurred. See Troubleshooting section for corrective action required.
2. Air should be sent through the coarse bubble diffusers at least once every 24 hours to clear solids from the piping and minimize the chances of plugging.

Mechanical Screen (Fine and Coarse):

1. Check alarm lights on mechanical screen control panel.
2. Check screenings container and replace or empty it if necessary to avoid back-up of screenings into the discharge unit.

Aeration Basins and Equipment:

1. Check and record the discharge pressure of the blowers noting any change in pressure. Inspect the intake filter daily for any obstructions, clean as required.
2. Check the electrical controls for possible malfunctioning, such as timers, run lights, etc.
3. Check and clean bar screens as often as required

UV System:

1. Check the alarm status screen for new faults and record new alarms.
2. Check the Alarm History screen to get an overview of past faults
3. Check the Overview screen(s) on the user interface to make sure that all the UV banks are in REMOTE AUTO.
4. Check the Wiper Control screen(s) on the HMI to make sure that all the wiper groups are in REMOTE AUTO.

General Plant:

1. Close and lock all gates and exterior doors when leaving plant for the night.
2. Maintain clean, orderly appearance of buildings and grounds.
3. Neatly store unused tools, parts and equipment.

Weekly Work Schedule

Process Control:

1. Perform weekly sampling as outlined in Chapter 8, Sampling and Laboratory Testing.
2. Review daily record sheets and transfer data to monthly NPDES reports as required.
3. Note any trends in process conditions and adjust operating parameters as needed.

Slide Gate and Actuators

1. Visually inspect gates for misalignment, damage, or corrosive attack. Visually inspect threads for any grit or debris. If any is found they should be cleaned and lubricated.

Aeration Basins and Equipment:

1. Check all instrumentation for accuracy and re-calibrate according to the manufacturer's instructions.
2. Alternate weekly the operating blowers with the installed spare.
3. Blower Maintenance
    a. Replace the lubricant oil after 500 operations hours. See “changing oil” in Chapter 8 of the Aerzen Operating Instructions .
    b. Check the differential pressure.
    c. Check the intake filter for contamination. (display unit, max. permissible -45 mbar)
    a. Check the oil level. See “Checking the oil level” in Chapter 8 of the Aerzen Operating Instructions.
    b. Check the belt guard for total stability and for damage and contamination. See “Checking the belt guard” in Chapter 8 of the Aerzen Operating Instructions.
    d. Remove any dirt from the outer belt guard.

Polymer Feed Unit:

1. Clean auxiliary water and/or polymer strainers weekly.

Decant Facilities:

1. Remove any obstructions or debris from the spillway channel.

Screw Pumps:

1. Check drive belts for proper tension and sleeve alignment.
2. Wash any accumulation of material from pump deflector plate and surrounding supports.
3. Check oil level in gear reducer and the gear reducer on the grease pump.

Mechanical Screen (Fine and Coarse):

1. Clean and inspect level sensors.
2. Open the wash water valve for press zone washing and wash until clear water runs off through the transparent hose into the channel. This flushing may be required several times per week (only if press zone washing is manual and not included in automatic controls)
3. Hose down possible deposits or stringy material on the screen basket. This cleaning may be required several times per week.
4. Check the screenings discharge for ropes wrapping around the auger, remove screenings wraps.
5. Check the bolted bottom screw flight for stringy material. To avoid stringy material buildup, run the machine in reverse until stringy material is broken up. Observe the limitation of reverse run as detailed in Chapter 6.2.5 of the Huber Operating Instructions within the Fine Screen O&M Manual.

2W and 3W Water System Equipment:

1. Sediment Filter
    a. Check that the filter operates properly, following a general inspection.
    b. Clean the 3/4" filter (close the 3/4" valve and operate a flushing cycle in order to release pressure and then open the bowl).
    c. Check that there is grease on the drive shaft, and drive bushing. Add grease if necessary.
    d. Take care of any leakage from the scanner shaft. If necessary, replace the sealing nut internal O-Ring (Part No. 7.7 as listed on pages 17-18 in the Amiad Sediment Filter Instruction and Operation Manual).

Long-Term Digestion Basin Aerators:

1. Check that mooring lines are secure.

Monthly Work Schedule

Screw Pumps:

1. Grease the upper bearing.

Mechanical Screen (Fine and Coarse):

1. Clean the water strainer, if any, in front of the solenoid valve. Repeated cleaning may be necessary if the water is very dirty.
2. Hose down the complete machine including the inside of the screen basket cover and tank (if any), with a high pressure cleaning device if possible. This prevents sedimentation and chloride accumulation that may lead to corrosion issues.
3. Refill the tank of the lubrication pump (on size 2000 and bigger units), if required (see 8.2.2 of the Huber Operating Instructions within the Fine Screen O&M Manual).
4. Check the operation condition of the basket roller bearings and check bearing play.

Aeration Basins and Equipment:

1. Check that the aeration chains are moving correctly. Make sure that all of the mechanical connections are securely fastened assuring a leak proof system.
2. Normal care of the BioFuser Diffuser consists of "flexing" the unit approximately every two (2) to four (4) weeks. If there is a noticeable increase in air pressure at the blower, the Diffusers may need to be flexed more often.
    a. This "flexing" action is accomplished by adjusting the air flowing through the Diffuser. First the airflow is turned completely off at the control valve located at the berm. Then open the purge valve located on the adapter (hose connection) until all the air escapes from the air lateral. This allows the Diffuser Sheath material to relax and collapse onto the Diffuser Tube Frame. Next close the purge valve, then slowly open the control valve increasing the airflow until it exceeds the normal operating airflow rate but does not exceed the maximum SCFM/per Diffuser tube. (See System Design Parameters in this manual). This could be accomplished by either turning ON an additional blower or by having several chains OFF in order to increase the airflow per chain. This airflow is maintained for 2 to 3 minutes to dislodge any foreign materials on the diffuser surface. In some cases, this procedure may have to be repeated.

    b. The airflow is then returned to the normal rate required to provide the desired dissolved oxygen concentration.

Clarifier and Equipment:

1. Inspect structure and walkways for any damage.
2. Inspect bearings and other moving parts. Clean moving parts of the original lubricants and relubricate.

UV System:

1. Inspect the water level sensor(s) rods for debris, algae or damage. Clean the sensor rods as necessary.
2. Inspect the Hydraulic System Center.

2W and 3W Water System Equipment:

1. Eye Wash
    a. Run and test eyewash and emergency shower.

Weir and Slide Gates:

1. Cycle to alleviate sticking.

Decant Structures:

1. Keep drains free and clear. Rod and ream internal drains to keep them functioning.

Quarterly Maintenance

Aeration Basins and Equipment:

1. Clean and inspect the DO sensor for damage
2. Calibrate the sensor as needed.

Slide/Weir Gate and Actuators

1. All operators shall be used every 3 months to ensure that the crank or handwheel turn easily.
2. Lubricate all grease fittings on manual floor stands.

Plug Valves:

1. Inspect according to manufacturer's instructions.

Semi-Annual Maintenance

Headworks:

1. Close and open each valve to ensure proper operation. Check for leakage.
2. Provide maintenance as specified in the manufacturer's manual.

Screw Pump:

1. Change the oil in the main drive gear reducer. See the gear reducer manufacturer booklet.
2. Change grease pump gear reducer oil. See manufacturer booklet.
3. Inspect and touch-up any rust spots on any part of the pump.

Hydrogen Sulfide Gas Sensor:

1. Recalibrate sensor according to manufacturer's instructions. See Instrumentation & Controls Operation and Maintenance Information, Volume 1, Field Equipment Item A-010A-C – Sierra Monitor 5100-05 Gas Detector Manual.

Aeration Basins and Equipment:

1. Blower Motors
    a. Check and clean the inlet and exhaust air openings on the acoustic hood. And check that the acoustic hood fan is operating correctly. See "Checking the inlet and exhaust air openings on the acoustic hood" on page 163 of the blower Operating Instructions.
    b. Check that the safety valve is operating correctly and clean it. See "Checking the AERZEN safety valve" on page 160 of the blower Operating Instructions.
    c. Check the condition of the belts. If necessary, replace them. See page 156-158 of the blower Operating Instructions.
    d. Inspect the sheaves for unusual wear and tear or obvious damage. Inspect for alignment and stability. Replace if needed. See page 155 of the blower Operating Instructions.
    e. Replace the lube oil at a discharge temperature of over 140 C. See page 134 of the blower Operating Instructions for further details.

Clarifier and Equipment:

1. Inspect structure and walkways for any damage.
2. Inspect bearings and other moving parts. Clean moving parts of the original lubricants and relubricate.
3. Visually inspect scum pump and insulation check via megger.
4. Check the stator housings of the scum pump.
5. Check the oil level and quality of the scum pump.

UV System:

1. Clean the UV channel around the UV system. Perform semi-annually for poor water quality conditions. Lift the UV Banks (Section 8.1.2 of the TrojanUV Operation and Maintenance User Manual within the UV Owner's Manual).
2. From the grating level, use a garden hose or pressure washer to clean the UV Channel.
3. Fill Wiping System (Section 9.7.2 of the TrojanUV Operation and Maintenance User Manual within the UV Owner's Manual).

2W and 3W Water System Equipment:

2. D-025 Air Release valve
    a. Open the pressure relief vale and release the internal pressure inside the body.
    b. Remove the two parts of the clamp and pull out the top portion and wash out the mechanism and inside of the valve.
    c. Reassemble the parts and pay attention to the placement of the O-rings.
3. Well X-Trol Bladder Tanks
    a. Visually inspect for faults. Have a licensed professional check system if issues are found.
4. Chemical Feed System
    a. Visually inspect tanks and tubing to ensure no leakage is occurring.
    b. Inspect metering pumps and ensure they are functioning correctly.

Flow Meters:

1. Remove transducers and clean if necessary.
2. Check calibration of flow meter.

Electrical Systems:

1. Test each alarm condition to determine if all systems are operational. Replace light bulbs and take remedial action as necessary.
2. Inspect motor control center. Badly worn or pitted contacts should be replaced.

Slide/Weir Gate and Actuators

1. Clean and grease operating stems.

Yearly Maintenance

Aerated Grit Chambers:

1. Drain the tank.
    a. Follow SOP for draining the appropriate grit chamber, see Appendix I of the Wastewater Treatment Plant Operations and Maintenance Manual.
    b. Note: To drain a grit chamber, all of the influent flow must be diverted to the remaining grit chamber. A single grit chamber can hydraulically handle the design Peak Hour Flow, but the grit chamber may see a reduced efficiency of grit removal at flows above 8.2 MGD. It is not advised to drain a grit chamber during periods of high flow.
2. Remove excess settled solids from the tank.
3. Clean diffusers and piping system with a pressure washer. If required, a bristle brush or plastic scraper can be used to remove material not removed with the use of a power washer.
4. Check hardware connections and retighten if required.
5. Confirm that the diffusers are tight and orientated with the "V" facing down.
6. Confirm that PVC plugs are installed in the blank connector locations.
7. Confirm that diffusers are level and adjust as necessary.
8. Confirm all field assembled pipe joints are tight and prevent excessive movement / rotation of the pipe system.
9. Confirm all submerged flanged joints are leak free and that hardware is tight.
10. Once all maintenance has been completed, confirm that no operational conditions require consideration that may have been added since the original design that may cause damage to the aeration system. (i.e.: Addition of mechanical mixers, influent gates, baffle walls and openings that could cause excessive liquid velocity, etc.)
11. Review the Startup Procedure to return the aeration system into service.

Slide/Weir Gate and Actuators

1. All grease fittings (if applicable) should be lubricated with a small amount of heavy duty grease which will not harden in cold weather nor become liquid in warm weather. See Lubrication Chart.

Aeration Basins and Equipment:

1. An annual visual inspection of the BioFuser assemblies is recommended. If rags, strings and other foreign materials are present, steps should be taken to locate the source and control it. The BioFuser assemblies should be hosed off to remove these or any other materials accumulating on the Diffusers affecting their performance. The general condition of the flexible sheath should also be noted at the time of this inspection.
2. All parts of the plant should be inspected very closely once a year. Inspect a representative number of diffusers.
3. All joints and clamps should also be checked for positioning and leakage.
4. All piping and channels should be cleaned of any obstructions
5. Blower Motors
    a. Replace intake filter. See "Replacing the Intake Filter" in Chapter 8 of the Aerzen Operating Instructions.
    b. Replace lube oil. See "Changing Oil" in Chapter 8 of the Aerzen Operating Instructions.
    c. For a gas-tight shaft seal, change the grease. See Replacing the grease on gas-tight drive shafts" in Chapter 8 of the Aerzen Operating Instructions.
    d. Check the control system for correct operation

Effluent, Mixed Liquor, and Drain Pump Stations:

1. Check amp draw either via amp meters in the control panel or by using a hand held current clamp device. Cross check against amp draw during start-up. Check meggar readings
2. Check miniCAS relay to ensure green light is on and there is no leak or thermal indication.
3. Perform a draw down of the wet well to see if pumps are operating and there is no "blow- by" on the discharge elbows.
4. Make a visual inspection of pump cables and lifting device.
5. Make a physical inspection of the pump exterior, impeller, power cable and lifting chain and or guide cable.
6. Check for oil or water in the leak chamber (see Care and Maintenance manual for procedure).
7. Examine gap between impeller and volute. If the gap is more than ¼-inch, adjust impeller, or schedule impeller to be adjusted (see Care and Maintenance manual).
8. Ensure impeller is not loose (make sure power to pump is shut off before checking impeller - this is where shutting all pumps off is a good idea).
9. Run pump briefly to check for bearing noise.
10. Check rotation of each pump (see Care and Maintenance manual for procedure).

11. Check electrical condition of insulation on power cable and on all phases of the motor using an Ohms meter. Measure resistance between stator windings in Ohms.
12. Check for any loose or faulty electrical connections within the pump control panel.
13. Check voltage supply between all phases of the electrical control panel in volts A/C.
14. Check voltage balance between all phases on the load side of the pump control with each pump on (volts A/C).
15. Reinstall Flygt pumps on their elbows and run to ensure pumps are properly seated on their respective discharge connection.
16. Check operation of valves in the station.

UV System:

1. Replace the hydraulic fluid filter element (Section 9.8.3 of Trojan UV O&M Manual).
2. Add grease to the wiping cylinder(s) (Section 9.9.1 of Trojan UV O&M Manual).

2W and 3W Water System Equipment:

1. 2W and 3W Pumps
    a. Check amp draw either via amp meters in the control panel or by using a hand held current clamp device. Cross check against amp draw during start-up. Check meggar readings.
    b. Make a visual inspection of pump cables and lifting device.
    c. Make a physical inspection of the pump exterior, impeller, power cable and lifting chain and or guide cable.
    d. Check electrical condition of insulation on power cable and on all phases of the motor using an Ohms meter. Measure resistance between stator windings in Ohms.
    e. Check for any loose or faulty electrical connections within the pump control panel.
    f. Check voltage supply between all phases of the electrical control panel in volts A/C.
    g. Check voltage balance between all phases on the load side of the pump control with each pump on (volts A/C).
    h. Check operation of valves in the station.

Headworks:

1. Check functions of level sensors, starter, and monitoring equipment.
2. Check pipes and peripheral equipment
3. Inspect equipment voltage, drain and meggar readings.

C-6 SUMMARY

The foregoing information is not a comprehensive list of everything the operator should be observing, but will serve as an initial guide to setting up a routine work plan. It is recommended that the operator formulate their own abbreviated list from the material in this chapter and print it on a checklist sheet which will allow him to keep a record of items performed. This will be of particular value for new personnel not familiar with the plant.

Table C-1
Ferndale Recommended Maintenance Schedule

Source	*System*	*Component*	*Task*	***Frequency***								
				Daily	*Weekly*	*Monthly*	*Every 3 Months*	*Every 6 Months*	*Annually*	*Every 2 Years*	*On Removal*	*As Necessary*
OM Manual-Vasey Engineering Chapter 2	Screw Pumps	Screw Pumps	Observe operation and look for any unusual accumulations and check for unusual noises or abnormal operating temperatures of reducers, bearings, and motors.	✓								
			Check to see that lower bearing grease system is operating at each screw pump and that grease reservoir is filled above the minimum level.	✓								
			Check drive belts for proper tension and sheave alignment.		✓							
			Wash any accumulation of material from the pump, deflector plate and surrounding supports.		✓							
			Grease upper bearing.		✓							
			Check oil level in main drive gear reducer and the gear reducer on the grease pump. See the gear reducer manufacturer's booklet in U.S. Filter service manual.		✓		✓					
			Grease the drive motor.					✓				
			Inspect for any rust spots on any part of the pump and touch up paint if needed.					✓				
2016/2016-145 Ferndale WWTP/Background Info/Existing O&M Data/Phase II Improvements/separate pages		Motor	Rotate motor shaft.	✓								
		Motorized Grease Lubricator	Fill with appropriate grease if needed.	✓								
			Run 30 min/day when screw pump not in operation.	✓								
		General Pump	Keep area clean.	✓								
		Anchors, Nuts, & Bolts	Tighten to correct torque, based on torque value chart in this manual at all anchors and equipment connections.		✓							
		General Pump	Replace worn components as required.		✓							
			Check lubrication level as required or oil change.		✓							
			Restore alignment if needed.		✓							
		Gear Boxes	Rotate low speed shaft 3x.			✓						
		General Pump	Check if screw pump rubbing in trough, reference trouble shooting guide if so.				✓					
			Check all guards for looseness and tighten bolts and anchors.				✓					
			Check all running gears for vibration, noise & lubricant leakage and correct per recommendation in vendor literature.				✓					
			Check all components for lubricant leakage and correct with recommendation in vendor literature.				✓					
			Check equipment grout pads for cracking and loose sand and repair grout and verify correct alignment of components.				✓					

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
		Dodge Couplings	Inspect entire unit dodge couplings. Paint, grease, and correct misalignment if necessary.						✓			
		Lower Bearing	Open lower bearing cover and check waste grease and if grease has bronze color, replace bronze bushing.						✓			
		Upper Bearing	Inspect upper bearing and repack with new grease.						✓			
		Motors	Inspect motors and follow Manufacturer's instructions.						✓			
		Gearboxes	Inspect gearboxes and follow manufacturer's instructions.						✓			
O&M No. 011 Screw Pumps			Grease upper bearing.			✓						
			Change the oil in the main drive gear reducer. See the gear reducer manufacturer's booklet in U.S. Filter Service Manual.					✓				
			Change the grease pump gear reducer oil (see manufacturer's booklet).					✓				
			Inspect and/or touch up any rust spots on any part of the pump.									✓
		Gearboxes	Feed oil at purchasing.									✓
			Change oil (after 500 hours or 6 months for first time, after 2500 hours or 6 months for second time, every 2500 hours or 6 months if case oil is 158°F or higher for 3rd time or after, otherwise 5000 hours or one year).					✓				✓
			Check if: current below rated current shown, abnormal sound from reducer, excessive vibration, high surface temperature, oil level reach top line of oil gauge at rest, different oil level in operation, oil or grease leak from gear section, loose foundation bolts, chain, and V-belt loose.	✓								
		Motor	Check that the motor is clean (free of dirt/oil/grease/water etc. inside and out). Ensure that motor ventilation is not blocked.				3 months or 500 hours of operation (whichever first).					
			Perform dielectric with stand test periodically to ensure tht the integrity of the winding insulation has been maintained, record readings, immediately investigate any significant decrease in insulation resistance.				3 months or 500 hours of operation (whichever first).					
			Check that all electrical connectors are tight.				3 months or 500 hours of operation (whichever first).					
			Check motor lubricant level and replace if needed.			Every 2 mo.	Every 2 mo.					
		V-Belt Drive	Inspect visually by removing belt guard and watch the drive while it is running under load.									Inspect when noisy V-belt drive.

Source	System	Component	Task	Frequency								
				Daily	*Weekly*	*Monthly*	*Every 3 Months*	*Every 6 Months*	*Annually*	*Every 2 Years*	*On Removal*	*As Necessary*
			Keep belts clean with a dry cloth. Occasionally remove any build-up of foreign material or with methyl chloroform or soap and water if belts splattered with grease and/or oil.									✓
			Check belt guards for damage and loose/missing mounting bolts.									✓
			Ensure bearings are not hot when turned off.									✓
			Ensure proper belt tension.									✓
O&M No. 002 Coarse Bubble Diffuser	Grit Aeration Chambers	Coarse Bubble Diffuser	Visually inspect air release pattern on the water surface of the aeration basin (should be a uniform, consistent roll pattern). Large boiling in an isolated area is an indication that a mechanical failure has occurred.	✓								
			Drain the tank by: **(1)** Place the blower system in manual mode. **(2)** Stop the flow to tank. **(3)** Adjust air flow to 5 scfm per diffuser. **(4)** Drain liquid from tank. **NOTE:** Monitor the distribution of air to all tanks. As the liquid level is reduced in the tank being drained, adjustments to the air control valve will be required to maintain distribution of process air to the tanks remaining in service. **(5)** Turn the air completely off to the tank being drained when the liquid level is approximately 2 feet above the diffusers and piping system.						✓			
			Remove excess settled solids from the tank.						✓			
			Clean diffusers and piping system with a pressure washer. If required, a bristle brush or plastic scraper can be used to remove material not removed with the use of a power washer.						✓			
			Check hardware connections and retighten if required.						✓			
			Confirm that the diffusers are tight and orientated with the “V” facing down.						✓			
			Confirm that PVC plugs are installed in the blank connector locations.						✓			
			Confirm that diffusers are level and adjust as necessary.						✓			

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Confirm all field assembled pipe joints are tight and prevent excessive movement/rotation of the pipe system.						✓			
			Confirm all submerged flanged joints are leak free						✓			
			Confirm that no operational conditions require consideration that may have been added since the original design that may cause damage to the aeration system (i.e.: Addition of mechanical mixers, influent gates, baffle walls and openings that could cause excessive liquid velocity, etc.).						✓			
			Add Never-Seez thread compound lubricant to diffuser threads per manufacturer's instructions.									At installation.
O&M No. 025 Mechanical Screens	Fine Mechanical Screen (ROTAMAT Perforated Plate Screen RPPS PRO)		Check screenings container and replace or empty if necessary to avoid back up of screenings into discharge unit.	✓								
			Clean and inspect level sensors.		✓							
			Open the wash water valve for press zone washing and wash until clear water runs through the transparent hose into the channel.		✓							May be required more often.
			Hose down possible deposits or stringy material on the screen basket. This cleaning may be required several times per week.		✓							May be required more often.
			Check the screenings discharge for ropes wrapping around the auger. Remove screenings wraps.		✓							
			Check the bolted bottom screw flight for stringy material. To avoid stringy material buildup, run the machine in reverse until stringy material is broken up. Observe the limitation of reverse run (90 degrees).		✓							
			Clean the water strainer, if any, in front of the solenoid valve.			✓						Repeat cleaning more often if very dirty water.

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Hose down the complete machine including the inside of the screen basket cover and tank (if any), with a high pressure cleaning device if possible. This prevents corrosion-related issues.			✓						
			Refill the tank of the lubrication pump (on size 2000 and bigger units), if required (see 8.2.2).			✓						
8.4 of manufacturer's manual (p86/344) in O&M No. 027			Check the operation condition of the basket roller bearings and check bearing play.			✓						
		Bottom Bearing Bush of Screw?	Replace bottom bearing bush of screw. The machine must be lifted out of channel/tank for bearing change.									8000 operation hours at the latest.
8.5 of manufacturers manual (p87/344) in O&M No. 027		Drive Shaft	Replace/change drive shaft.									8000 operation hours at the latest.
		Basket	Check shaft-bearing (journal bearing) for play using a lever.									4500 operating hours or 3 yr.
		Basket Roller Bearing	Check for bearing play.									4500 operating hours or 3 yr.
		Screw Shaft in rising Pipe Section	Check bearing shell for wear.									4500 operating hours or 3 yr.
8.2.2 of manufacturers manual (p83/344) in O&M No. 027		Basket	Replace/change the screw and drum support.									8000 operation hours at the latest.
		Gear Motor	Replace lubricant.									15000 operating hours or 3 yr.
O&M No. 017 Geo-Membrane HDPE Liner	Aeration Basin	HDPE Geothermal liner	Conduct visual inspections if possible.									✓
			Remove items that could puncture the liner/floating cover.									✓
			Only clean sludge off of liner if absolutely necessary. Be extremely careful of punctures!									✓
from Vasey engineering O&M, chapter 4		Dam Embankment	Cut grass at least twice annually or more frequently to allow for visual surveillance of the embankment surfaces. Grass should not exceed 8 inches. Trees larger than 6" should not be removed without advice from a professional engineer.					✓				
			Confirm placement of rip-rap on slopes are sufficient to prevent erosion on exterior and interior slopes. Add additional if needed.						✓			
			Repair animal burrows by compacting fill into the excavated holes.			✓						
			If extensive burrowing, seek advice. Eliminate the burrowing animals to alleviate the problem for the long term.			✓						

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Regrade eroded crest roadway as needed.						✓			
			Maintain design elevation of unimproved crest surfaces by leveling and grading the crest to design specification, filling ruts and minor depressions.						✓			
		Concrete Features	Patch spalled areas with a bonding agent, strengthen areas by applying coatings or by adding reinforcements, repairing minor cracks with an adhesive or epoxy injection, and keep concrete joints and surfaces free of vegetation.						✓			
		Spillway Channel	Remove any obstructions or debris from the spillway channel.		✓							
O&M No. 013 Basin Boats		Aeration Access Boat	Check battery for signs of corrosion. Clean terminal posts with baking soda and water solution and wire brush. Before cleaning, remove vent caps and seal vent wells with corks to preven solution from entering battery.									✓
			Check the fluid levels in the battery cells, If needed, fill with distilled water. Do not overfill.									✓
			If circuit continuously overloads, boat should immediately be inspected by dealer.									✓
			Use mild detergent and warm water solution to wash the hull. Wax if painted surface.									✓
			Check the steering system by ensuring hardware at helm and engine end is tightened.									✓
			Use high quality waterproof marine grease to fully coat the steering bar and then turn wheel back and forth to work the grease in.									✓
O&M No. 001 Biological Treatment	Biolac Aeration System	Electrical Equipment	Check control equipment for tightness, firm contact pressures, and free moving									✓
			Check that controls are operating at rated voltage.									✓
			Check that the tripping element in each starter is free to offer protection to the motor (if contact points					✓				
			Clean start contacts if visibly dirty.									✓
			Clean cabinet with a blower or vacuum type cleaner.									✓
		Lubrication	Ensure all parts have adequate grease and oil, using the highest quality of grease/oil. Do not over lubricate motor bearings.						✓			
		Plant Structures	Regularly lubricate moving parts.									✓
			Keep pipes and air lines open and without obstruction.									✓

Source	System	Component	Task	Frequency								
				Daily	*Weekly*	*Monthly*	*Every 3 Months*	*Every 6 Months*	*Annually*	*Every 2 Years*	*On Removal*	*As Necessary*
			If unit can be bypassed without interfering with treatment, regularly execute thorough cleaning.									✓
			Dewater and inspect: channels, tanks, wet wells and apply protective coeating if needed.						✓			
			Examine Aqua Guard, Roto-guard, and other screening devices should, replace damaged teeth.									✓
		Aeration Blowers	Check and record disharge pressure of blowers, and take note of changes.	✓								
			Check intake filter for any obstructions and clean when needed.	✓								
			Alternate the operating blowers with the installed spare.	✓								
		Electrical Controls	Check controls for possible malfunctioning (timers, run lights etc).	✓								
		Bar Screens	Check and clean when needed.	✓								
		Instrumentation	Check for accuracy and recallibrate (according to manufacturer instructions).	✓								
		Wastewater Flow Measurement	Inspect and check functionality.	✓								
		Aeration Chains and Air Headers	Ensure that aeration chains are moving correctly.			✓						
			Make sure mechanical connections are securely fastened (to ensure leak-proof).			✓						
			At Flex BioFuser Diffuser, if noticeable pressure increase at blower, flex more often. See flexing directions on page 23 of manufacturer's manual.			Every 2-4 weeks.						If noticeable pressure increase, flex more often.
		Blowers and Motor/Reducers	Perform visual inspection of BioFuser assemblies. If rags, strings, or other materials are present, find and control source.						May need to be more often, depending on conditions.			
			Hose off BioFuser assemblies.						✓			
			Take note of flexible sheath condition.						✓			
			Inspect all parts of plant very closely, including a representative number of diffusers.						✓			
			Check all joints for positioning and leakage.						✓			
			Clean all piping and channels of any obstructions.						✓			
O&M No. 001 Biological Treatment	Blowers		Replace the lube oil and grease.									After 5000 hours of operation.
			Check differential pressure.		✓							
			Check intake filter for contamination (max. perceptible is -45 mbar). Replace if needed.		✓							
			Check oil level.		✓							

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Check belt guard for total stability and damage and contamination, remove dirt from outer belt guard if necessary, contact customer service if too damaged or unstable.		✓							
		Drive Motor	Relubricate drive motor.									Read and follow signage on drive motor.
		Acoustic Hood	Check and clean exhaust air opernings on acoustic hood.					Or 4000 operation hours.				
			Check that acoustic hood fan is operation correctly.					Or 4000 operation hours.				
		Safety Valve	Check safety valve is operating correctly and clean it.					Or 4000 operation hours.				
		Belts	Check and replace belts if necessary.					Or 4000 operation hours.				
		Sheaves	Check sheaves for unusual wear and tear or obvious damage. Also for alignment and stability.					Or 4000 operation hours.				
		Lube Oil	Replace lube oil at discharge temperature of over 140°C.					Or 4000 operation hours.				
			Replace the sheaves if necessary.					Or 4000 operation hours.				
			Replace Delta Lube 06 (only if there is a pressure difference of over 800 mbar).						Or 8000 operation hours.			
			Change grease (for gas tight shaft seal).						Or 8000 operation hours.			
			Replace lube oil (used when discharge temperature of over 140°C).						Or 8000 operation hours.			
			Replace intake filter.						Or 8000 operation hours.			
			Check the control system for correct operation.						Or 8000 operation hours.			
			Replace the belts.							Or every 16,000 hours of operation.		
			Check sheeve alignment, and correct if necessary.							Or every 16,000 hours of operation.		
			Check non-return flap for wear and tightness, and replace if necessary.							Or every 16,000 hours of operation.		
			Check flexible pipe connections on discharge and intake sides for tightness, and replace if necessary.							Or every 16,000 hours of operation.		
			Replace Delta Lube 06.							Or every 16,000 hours of operation.		
			Check and replace hose lines (if needed).									Recommended every 20000 op. hr/ 3 yr.
			Replace hose lines.									Recommended every 6 years.
			Perform main inspection/maintenance.									Recommended every 20000 op. hr/ 3 yr.

Source	System	Component	Task	Frequency								
				Daily	*Weekly*	*Monthly*	*Every 3 Months*	*Every 6 Months*	*Annually*	*Every 2 Years*	*On Removal*	*As Necessary*
			Inspect, and change replacement and expendable parts.									Recommended every 20000 op. hr/ 3 yr.
			Check entire machine.									Recommended every 20000 op. hr/ 3 yr.
		Induction Motor	Visually inspect motor and coupling for abnormal noises, vibrations, excessive heating, wear signs, misalignment or damaged parts are noticed and replace as needed.									✓
			Measure insulation resistance (as per Item 5.4).									✓
			Clean the motor enclosure by removing oils spills and dust accumulation from motor frame surface to ensure better heat transfer to surrounding ambient air.									✓
			Check cooling fan condition and clean air inlet & outlet openings to ensure free air flow over the motor.									✓
			Investigate actual condition of seals and replace them, if required.									✓
			Drain condensed water from inside motor. Rreposition drain plugs and ensure drain hole is at lowest point.									✓
			Check connections to power supply cables, ensuring correct clearance distance.									✓
			Check if tightening torque of bolted connections and mounting bolts meet tightening torque specified.									✓
			Check status of cable passages, cable gland seals and seals inside terminal box and replace them.									✓
			Check bearing operating conditions. Checking for presence of abnormal noise, vibration or other abnormal operating conditions, like motor temperature rise. Check oil									✓
			Record and file all changes performed in the motor.									After any actions are taken.
O&M No. 030 Polymer Feed System	Clarifier Flow Splitter/Polymer Feed System	Polymer Feed: Flow Meter	Clean with bottle brush and appropriate mild soap.									✓
			Inspect for damage while disassembled for cleaning (^).									✓
			If hard water deposits, remove with 5% acetic acid solution.									✓
		Polymer Feed: Static Mixers	Remove mixers for cleaning.									✓
O&M No. 024: Clarifier Equipment	Clarifier	Lubrication/ Grease	Check oil level/quality and change if needed.							Or every 10,000 hr (or 20,000 hr/4 yr if using synthetic oil).		

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Clean and regrease grease packed bearings. There should be filled with grease of less thant 1/3 of he bearing's free volume. Output bearings and bearings with replaceable grease shields should be filled to 2/3 of their free volume.							Or every 10,000 hr (or 20,000 hr/4 yr if using synthetic oil).		
		Gear Motors/Reducers	Check oil levels and oil quality.									✓
			Check coupling alignments, chain or belt attachments, and mounting bolt torque periodically.									✓
			Keep drive relatively free of dust and dirt.									✓
		Submersible Solids Pump	Raise pump until totally visible and clean of debris with water hose. Check motor and cable for damage, missing components, or excessive corrosion. Check overload relay, contractors, fuses and time relays. Check correct function and condition of level control.			First interval is 1 mo. or 500 hr.		Routine interval is 6 mo. or 3000 hr.				
			Check insulation resistance of motor windings and cables with high-voltage ohm-meter ("megger") by attaching to the motor starter, from each winding lead to other two winding leads and to ground lead.			First interval is 1 mo. or 500 hr.		Routine interval is 6 mo or 3000 hr.				
			Stator housing check by removing plug and draining out liquid. Consult chart in section 4.4 of manufacturer's model for possible repairs based on liquid that is drained.			First interval is 1 mo. or 500 hr.		Routine interval is 6 mo. or 3000 hr.				
			Check oil level by removing plug. If oil is below plug level, top up and recheck in 200-500 hr. If significantly low, replace lower mechanical seal and then refill.			First interval is 1 mo. or 500 hr.		Routine interval is 6 mo. or 3000 hr.				
			Check oil quality by draining a small amount into a glass jar. If oil is clear, return oil and continue. If some water, separate and reuse oil. If significant water in oil, repair/replace mechanical seal and oil.			First interval is 1 month or 500 hr.		Routine interval is 6 mo. or 3000 hr.				
			Change oil if severely contaminated oil.									When significant water in oil.
			Check gap between impeller and suction cover. The gap should be .2-.3 mm as measured by a long feeler gauge. To adjust, consult section 5.1 of manufacturer's manual.									When severe loss in pump performance.
		Cast Iron Screwed End Y Strainers	Execute self cleaning by opening the plug or valve connected to the blowoff outlet.									✓

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Cryogenic valves are degreased & cleaned to keep them free of moisture.									✓
O&M No. 007 UV System	UV Disinfection System	UV Channel	Clean the UV channel around the UV system. Lift the UV Banks.					✓				
		Water Level Sensor	Inspect for debris, algae, or damage. Clean sensor rod as necessary.			✓						
		Hydraulic System Center (HSC)	Inspect Hydraulic System Center (HSC).			✓						
			Drain the hydraulic fluid reservoir. During the first 2 mo. of operation, air works its way out of the system. Fill when level is less than full.							✓		
			Replace hydraulic fluid filter element.						After 50 hours initially. Annually thereafter.			
			Replace hydraulic hose.									✓
		Power Distribution Center	Flush air filters with warm running water (clean side up). If accumulated dirt is oily, wash in detergent bath after flushing.									✓
			Replace lamp driver.									✓
		Lamp Sleeve Wiper	Add grease to wiping cylinders.						✓			
			Fill wiping system.					✓				
			Flush Wiping System for seasonal winterization.									If winterizing.
			Replace the Wiper Seals, O-rings, and Bushings.					Inspect.		Replace.		
			Inspect all the wiper components that can be seen. Remove any debris and clean components as necessary.					✓			✓	
		UV Bank	Inspect the UV Bank seal when the UV Bank is lifted into the service position. Ensure the seal is clean from debris. Inspect for cracks and ensure it is not damaged or worn.								When UV bank is lifted.	
			Clean UV Bank.									✓
			Inspect Floor Support Seals. Replace if damaged or worn.								✓	
		UV Lamp	Replace lamp. Reset lamp hours.									At 15,000 hours or if lamp has failed.
		Lamp Sleeve	Replace lamp sleeve if damaged.									✓
			Clean lamp sleeves manually.									✓
		Lamp Plug	Inspect the lamp plug O-rings. Ensure the O-ring is not rolled or twisted and fits in the groove. Replace O-ring that is damaged or								✓	
			Check sockets for corrosion (observed as a white discoloration or patina on the surface of the pin). Manually clean using contact cleaner. Ensure any debris is removed. It is recommended to apply a corrosion preventative compound.								✓	
		UVI Sensor	Clean the UVI sensor housing sleeve with a mild acidic solution.									✓

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Replace the UVI Sensor Wiper O-rings and seals.							✓		
			Inspect UVI Sensor Wiper O-rings and Fittings. Replace if damaged, worn or brittle (Section 9.5.6).					✓			✓	
			Inspect UVI Sensor Floor Bushing for damage or wear. Replace if required.								✓	
		SCC	Check Alarm Status Screen for new faults and record new alarms.	✓								
			Check the Alarm History screen to get an overview of past faults.	✓								
		ActiClean Cleaning System	Check the Overview screen(s) on the user interface to make sure that all the UV banks are in REMOTE AUTO.	✓								
			Check the Wiper Control screen(s) on the HMI to make sure that all the wiper groups are in REMOTE AUTO.	✓								
		Weir Gate Stem	Ensure stem guides are aligned on the channel so uniform clearance between the stem and stem guide halves.									Prior to operating
			Inspect the threaded portion of the stem to ensure clean, free of foreign matter, and well lubricated. Clean with stainless steel brush and apply grease when needed.					3 mo. if high exposure to dust/particles				
		Weir Gate	Open gate and visually inspect seals. Contact factory for replacements if needed.									"With scheduled maintenance".
			Ensure handwheel/crank turns easily. If not, fix alignment.									"With scheduled maintenance".
			Lubricate all grease fittings.									"With scheduled maintenance".
			Ensure that end of thread of operating stem cannot enter floor stand nut using gear limit switch.									"With scheduled maintenance".
			Ensure that maintenance required light is off. If it is on, refer to <Corrective action>.									"With scheduled maintenance".
			Change grease, 4-6 yr for modulating duty, 6-8 yr for frequent operation, 10-12 yr if infrequent operation.									As indicated.
			Replace seals when changing grease.									"With scheduled maintenance".
		Sensors	Visual inspection.		✓							
			Check calibration.		Comparative measurements.							
			Perform inspection.					(as per counter)				
			Change seal.						(as per counter)			
			Change wiper profile.									As indicated by counter.
		Transducer	Shut down level measurement system and perform thorough inspection, especially on the transducer.									If performance changes observed.
O&M Manual from 2000	OLD Effluent Pump Station/Outf	Pump Station	Inspect visible parts on pump, pump casing, and impeller for wear.						✓			

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
Ferndale Upgrade	all		Check oil level and condition. Change as necessary.						✓			
			Check cables for wear and tightness.						✓			
			Inspect pump voltage draw and meggar readings.						✓			
			Check function of level sensors, starter and monitoring equipment.						✓			
			Check pipes, valves, peripheral equipment.						✓			
		Effluent Pipeline	use pigging method to clean pipeline.									✓
		Jib Crane	Check boom level.				✓					
			Check electrification system.				✓					
			Tighten all hardware.				✓					
			Perform general inspection.					✓				
2016-0145/Background Info/Existing O&M data/phase 2 improvements/volume 2		Discharge Location (in Nooksack)	Inspect condition of rip-rap pad and dike and repair if needed.						✓			After flood/high flow events.
		Old Effluent Pumps	Inspect visible parts on pump, pump casing, and impeller for wear. Replace or fixed if damaged. Make sure all screw, bolts, and nuts are tight. Check condition of carrying handle/lifting eyes, chains, and wire ropes. Ensure guide bars are vertical.						✓			
			Check oil level and condition. Change as necessary. Lubricant is Mobil Whiterex 309 or equal.						✓			
			Check cables for wear and tightness.						✓			
			Inspect pump voltage draw and gather meggar readings.						✓			
			Check function of level sensors, starter and monitoring equipment.						✓			
			Check rotation direction of pump. If impeller not rotating clockwise as viewed from above transpose two phase leads. Rotation in the wrong direction reduces pump capacity and overloads motor.									When reconnecting.
			Check pipes, valves, peripheral equipment, and repair faults and notify supervisor of faults/defects.						✓			
			Check pump casing and impeller. Replace worn parts. If the clearance between the impeller skirt and pump casing exceeds 2 mm, replace the wear ring.						✓			
			Check that oil reaches up to the oil hole and add oil as needed. WARNING: if the seal leaks, the casing may be under pressure so a rag should be held over the casing screws to prevent splatter.						✓			

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Check the condition of the oil by inserting a tube/hose into the oil hole and covering the top to take up a little oil from the bottom. If the oil is emulsified or contains separated water, chenge the oil.		Recheck one week after replacing.				✓			
			Inspect the liquid in the stator casing. This can only be done by an authorized service shop or Flygt personnel because removing the inspection screw renders the pump non-explosion proof.						✓			
			Inspect the cooling system and rinse and clean if the flow through the system is restricted.						✓			
			Inspect the cable entry and ensure that the cable clamps are tight.						✓			
			Inspect cables and replace if outer jacket is damaged. Ensure that there are no sharp bends or pinched cables.						✓			
			Check the function of the level sensors. Clean, adjust, or replace as needed. The level sensors contain a mercury switch so damaged sensors should be disposed of properly.						✓			
			Inspect the starter equipment. If it is faulty, contact and electrician.						✓			
			Check monitoring equipment, signals, and tripping equipment. Check that relays, lamps, fuses, and connections are intact.									"Often".
Vasey Engineering Report, Gorbel I&M Catalog			Check insulation resistance in stator with insulation tester. With a 1000V DC megger the insulation between the phases and any phase and earth/ground should be > 1MΩ.						✓			
		Jib Crane	Check level of boom.					✓				
			Check electrification system.					✓				
			Tighten all hardware.				✓					
O&M No. 026 Submersible Sewerage Pumps	Sewage Pumps (New Effluent/Mixed Liquor/West Plant Drain)		Remove pump from wet well using lifting advice to perform inspection. Inspect pump exterior, impeller power cable and lifting chain and or guide device.				Initial inspection.		Or every 2,000 hr.			
			Check for oil and water in leak chamber.						Or every 2,000 hr.			
			Ensure gap between impeller and volute is less then 1/4". Adjust impeller or schedule impeller to be adjusted if needed.						Or every 2,000 hr.			
			Ensure impeller is not loose.						Or every 2,000 hr.			
			Briefly run pump to check for bearing noise.						Or every 2,000 hr.			
			Check rotation of each pump using Care and Maintenance manual procedures.									✓

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Check electrical condition of insulation on power cable and on all phases of the motor using an Ohms meter. Measure resistance between stator windings in Ohms.						Or every 2,000 hr.			
			Check for loose/faulty electrical connections within pump control panel.						Or every 2,000 hr.			
			Check voltage supply between all phases of electrical control panel in volts A/C.						Or every 2,000 hr.			
			Check voltage balance between all phases on load side of pump control with each pump on (volts A/C.						Or every 2,000 hr.			
			Reinstall Flygt pumps on elbows and run to insure pumps are properly seated on their respective discharge connection.									✓
			Check operation of pipes, valves, and peripheral equipment in station.						Or every 2,000 hr.			
			Check lubricant/coolant level and condition and change as necessary. Mineral Oil Consistant Oil should be used.						Or every 2,000 hr.			
			Check cables for wear and tightness.						Or every 2,000 hr.			
			Check function of level sensors, starter and monitoring equipment.						Or every 2,000 hr.			
			Check rotation direction of pump.									When reconnecting.
			Check cooling system.						Or every 2,000 hr.			
			During maintenance, clean all parts (esp. O-ring grooves). Change all O-rings, gaskets and seal washers. Lubricate all springs, screws, O-rings with grease. Upon reassembly, ensure index markings are in line.									✓
			When drive unit is reassembled, utilize insulation-testing and reassembled pump must always be test-run before normal operation.									✓
			Check amp draw and cross-check against start-up current.				Initial inspection.		Or every 2000 hr.			
			Check miniCAS relay to ensure green light is on and there is no leak or thermal indication.				Initial inspection.		Or every 2000 hr.			
			Perform draw down of the wet well to see if pumps are operating and that there is no "blow-by" on discharge elbows.				Initial inspection.		Or every 2000 hr.			
			Examine gap between impeller and volute. IF gap over 1/4", adjust.						Or every 2000 hr.			
O&M No. 023 3W2W Equipment	2W Plant Water System	Combination Air Valve for Wastewater	Open pressure relief valve and make sure that internal pressure inside the SAV body is released.									"Periodically"
			Open and remove the 2 parts of the clamp and pull out the top part, wash and clean the mechanism and the inside of the valve.									"Periodically"

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			When system is not under pressure, attach pressure hose to quick release nozzle flushing out the valve to the main line.									"Periodically"
			A licensed professional should check the complete system including the Well-X-						✓			
			Perform "try lever test" at or near maximum operating pressure by holding test level open for at least 5 seconds to flush valve seat free of sediment and debris, then release lever and permit the valve to snap shut.				✓					
			Pressure test.						Prior to heating season.			
		Conbraco Safety Valve	Execute "try level test".					If steam service.	If air/gas service.			
			Visually inspect.				Every 2 mo. if steam pressure.	If air/gas service.				
			Pressure test.						If steam operation.	Every 3 years if air/gas operation.		
		Peristaltic Metering Pump	Replace tubing when damaged/worn.									✓
O&M No. 012 3W Sediment Removal Filter	3W Plant Water System	Sediment Removal Filter	Check for proper filter operation.		✓							
			Clean the 3/4" filter by closing the 3/4" valve and operating a flushing cycle in order to release pressure and then open the bowl.		✓							
			Check that there is grease on the drive shaft, and drive bushing. Add grease if necessary. Drive shaft must be lubricated with heavy-duty, water resistant grease that will not oxidize. This should be Shell, Darina EP-2, or similar).		✓							
			Take care of any leakage from the scanner shaft. If necessary, replace the sealing nut internal O-Ring.		✓							
O&M No. 022 3W Sediment Filter Trolley & Hoist Assembly		Sediment Filter Trolley	Regularly inspect: wear or damage from overloading, motion along runway.									"At regular intervals".
			Apply lithium based NLGI Grade 2 grease to grease fittings to drive shaft support block and handwheel guard.									"At regular intervals".
		Sediment Filter Lift	Land load and move hoist to least distracting place, lock in place, before inspecting.									"At regular intervals".
O&M No. 020 Refrigerated Sampler	Refrigerated Sampler		Replace pump tubing.				✓					When indicated.
			Clean refrigerator.					✓				
			Clean interior of refrigerator.					✓				
			Clean sample container.									After each use.
			Inspect pump housing and rollers.									Before each use.

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Clean or replace the wetted parts (bottles, suction line, strainer, pump tube, and discharge tube). Clean with soapy water and a brush, then rinse. Glass bottles and 1-L polypropolene bottles autoclaved. Strainers should be cleaned with cleaning solution pumped through and then water to rinse.									Before each use.
			Inspect pump, ensuring no excessive wear in pump tube (replace if there is), debris build-up on pump roller/guide surfaces/pump band, debris inside pump housing.									Before each use.
			Clean sampler with warm water and brush and then rinse. Use detergent that is compatible with low-density polyethylent, polystyrene, PVC, ABS, polycarbonate and NORYL. No strong solvents or acids.									✓
			Run sampler diagnostics (from CONFIGURE on Main Menu screen).									✓
			Verify temperature readings displayed by the control panel.									✓
			Verify that pump tube is in good condition.									Before starting a program.
			Place the empty bottles in the rack or locating base.									Before starting a program.
			Inspect the pump. Service as necessary. Service is indicated if there is faulty liquid detection, inaccurate sample volumes, the sampler will not pump any liquid, and pump jams.									Before running pump.
			Inspect the pump housing and rollers.									Before running pump.
			Clean or replace the wetted parts (bottles, suction line, strainer, pump tube, and discharge tube).									Before running pump.
			Clean the sampler as necessary, removing all debris.									Before running pump.
			Follow Isco pump guidelines, minimize line rinses and sampling retries in sampling program, use shortest possible suction line.									✓
			Run diagnostic tests to ensure everyhting is in working order.									✓
O&M No. 021	Hoist and Cranes	Cranes	Clean the crane by wiping all equipment. Leave a light film of oil on all surfaces to protect against rust/corrosion, wipe off excessive oil, remove unnecessary objects from surrounding area.					✓				If dirty.
			Check wire rope, end connections and end fittings for corrosion, kinking, bending, crushing, birdcaging or other signs of damage.									"Frequently"
			Check the number, distribution, and type of visible broken wires.									"Frequently"

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Check the wire rope for reduction of rope diameter from loss of core support, or wear of outside wires.									"Frequently"
			Take extra care when inspecting: saddles, sheaves, repetitive pickup points, crossover points and end connections.									"Frequently"
			Visually inspect entire crane and all other equipment in operation. Check for cracks, dents, bending, rust, wear, corrosion, and other damage.									"Frequently"
			Make sure wire rope is installed correctly and anchored securely.									"Frequently"
			Make sure entire crane is properly lubricated. This includes: all pins, base pin, mast bearing, ratchet jack, winch, and wire rope.									"Frequently"
			Make sure all fasteners are tight and securely.									Ffrequently"
			Test crane performance by operating the crane with a load not exceeding the load rating.									"Frequently"
			Listen for unusual noises and look for signs of damage as you operate the crane.									"Frequently"
			Make sure the wire rope winds evenly and tightly onto the drum.									"Frequently"
			Make sure load moves smoothly.									"Frequently"
			Make sure winch responds to control device.									"Frequently"
			Make sure boom rotates freely when handle is pushed and remains stationary when released.									"Frequently"
			Check the winch break, ensure no coasting or creep. If there is, brake is likely worn and should be replaced.									"Frequently"
			Fill out entire inspection checklist, seen in table 2 of owner's manual for Thern Commander Series Portable Davit Cranes.									"Frequently"
			Visually inspect entire crane and all other equipment in operation. Check for cracks, dents, bending, rust, wear, corrosion, and other damage.									"Periodically"
			Check the finish for wear, flaking, or other damage.									"Periodically"
			Check all fasteners for stripped threads, wear, bending, and other damage.									"Periodically"
			Make sure the entire crane is properly lubricated.									"Periodically"
			Check the ratched jack from the crane assembly. Test the travel limits of the ratchet jack to ensure it doesn’t completely unthread.									"Periodically"

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Make sure all labels and plates are readable, firmly attached, free of damage and clean. Replacements are available from the factory.									"Periodically"
			Check the entire length of wire rope for bent wires, crushed areas, broken/cut wires, corrosion, and other damage. Carefully inspect									"Periodically"
			Note the location and concentration of broken wire. Replace if more than 6 broken in one lay, or 3 in one strand.									"Periodically"
			Ensure load hook/other device is securely attached to the wire rope, not frayed, corroded, broken, or otherwise damaged.									"Periodically"
			Measure throat opening, thickness, and twist of the hook. Replace if any sign of damage.									"Periodically"
			Check anchor holes in drum and surrounding area for signs of wear or distortion.									"Periodically"
			Measure the diameter of wire rope, especially where wear is noticeable. Replace if diameter is below minimum diameter anywhere.									"Periodically"
			Remove the winch and inspect it.									"Periodically"
			Disassemble the crane and inspect each component for damage.									"Periodically"
			Remove the crane basket and check fasteners for stripped threads, wear, bending, and other damage, then reassemble.									"Periodically"
			Test performance by operating with load equal to load rating.									"Periodically"
			Listen for unudual noises and look for signs of damage as you operate the crane.									"Periodically"
			Make sure the wire rope winds evenly and tightly onto drum.									"Periodically"
			Make sure the load moves slowly.									"Periodically"
			Make sure the winch responds to control device (rotate and turn off).									"Periodically"
			Make sure boom rotates freely.									"Periodically"
			Check the brake (raise then lower and replace if any creep).									"Periodically"
		Hoist	Operate hoist under load and observe operation of chain over sprocket in both directions of chain travel. If chain does not travel smoothly, clean and lubricate.			✓						
			Clean chain and inspect for gouges, nicks, weld spatter, corrosion or distorted links. Determine chain wear by measuring the length of unworn chain and comparing to worn length.			✓						

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Check connection of chain to anchor inside hoist frame on double-reeved, 2-ton hoist and replace if signs of damage, twisting, or elongation.			✓						
			Ensure hook is free to swivel and pivot and hook is not opened beyond the given diameter. Lubricate these points if necessary.			✓						
			Inspect suspension lug and replace if damaged or cracked.			✓						
			Check that upper lock plate securing hook is in place and screwa holsing it are tight and lubricate hook shank.			✓						
			Inspect threaded upper suspension bushing. Verify keeper is in place against flat of suspension bushing and securing screw and lock washer are in place and tight.			✓						
			Inspect motor, frame and electrical compartment cover, including checking tightened bolts, visible damage.			✓						
			Inspect motor, frame, and electrical compartment cover: check for visible damage, tighten bolts.			✓						
			Check hoist frame for signs of visible damage. If frame shows evidence of fracture, the hoist should be disassembled and inspected further.			✓						
			Check oil and ensure level reaches bottom of tapped hole.			✓						
			Inspect electrical controls by removing electrical compartment cover from hoist. Care should be taken when removing parts as some covers may contain counterweights.					Or 500-750 hours of operation.				
			Check siring/terminals, tighten screws, check control circuit transformer, check limit switch to ensure screws tight and wires are secure. Check contactor solenoid coils and replace if needed and check control cable wire strain reliever to see that it is in good condition and securely attached to gearcase cover. Replace a rubber strain reliever grommets if damaged.					✓				
			Change gear case oil.					✓				

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Relubricate load chain.					✓				
			Lubricate upper hook and lower block.					✓				
			Remove from overhead suspension.									Every 5000 hours of operation or 5 years.
			Disassemble hoist into subassemblies.									✓
			Motor shaft oil seal, sprocket shaft bearing, seal and all gaskets should be applied.									✓
			Inspect load brake and overload clutch.									✓
			Friction disks could be discarded and replaced if damaged.									✓
			Check load brake friction surfaces on flange, ratchet assembly and gear clutch cone and replace if badly scorn or worn.									✓
			Check condition of pawl and ratchet assembly, brake cam and gear clutch cone and pinion teeth and clean and replace if needed.									✓
			Inspect sprocket and intermediate gears and pockets on chain sprocket and replace if needed.									✓
			Check braking surfaces for wear and scoring, spring studs, and guides, and coil shock mounts for deterioration and damage.									✓
			Check air gap adjustment.									✓
N/A	Stand-by Generator		Replace Air Filter when line indicates.									Approx. 10 yr.
			Replace filters (fuel, oil, coolant).						Or 250 hr.			
			Ensure coolant is at the required level.									✓
			Exercise generator to ensure functionality.		✓							
O&M No. 029 Valves	Valves	Bonded Seat Butterfly Valves	Cycle valve to ensure operation and no interference in line.						✓			
			Close and check for leakage. If leakage, check actuator stops to verify closed. If leak continues remove valve and inspect seat. If seat damaged, return valve to factory.						✓			
			Check flange connection for leakeage and tighten bolts if necessary.						✓			
			Check top trunnion for shaft leakage. If leakage, replace valve packing.						✓			

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			If repair made, cycle valve through one complete operating cycle and check for leakage once line pressure restored.									✓
		Ballcentric Plug Valve	Cycle from full open to full close.						✓			
			Replace seals (stem and "U" Cup). Ensure valve is depressurized and disassemble before making any repairs.									✓
		Henry Pratt MDT Actuators	No scheduled maintenance. If grease replacement is required, pack gear box with L-W 2000 NGLI #2.									✓
		Electronic Control Unit AC 1.02	Inspect cable entries, cable glands, blanking plugs, etc. or correct tightness and sealing. Consider torques as indicated by manufacturer.				Initially 6 mo.		Annually after initial inspection.			
			Check screws between actuator and gearbox/valve for tightness. If needed, fasten screws while applying recommended tightening torque.				Initially 6 mo.		Annually after initial inspection.			
			If rarely operated, perform test run.				Initially 6 mo.		Annually after initial inspection.			
			Check actuator for efficacy.									✓
			If water ingress, dry device and check function. Locate and repair leaks.									✓
			Change grease and seals.									4-6 yr. if modulating duty, 6-8 yr. if frequently op, 10-12 yr. if rarely op.
		Electronic Control Unit ACExC 1.02	Perform same maintenance as for AC 1.02.									✓
			Check actuator visually and ensure no outside damage or chages visible.									✓
			Ensure electric connection cables are without damage and wired correctly.									✓
			Touch up paint as needed to avoid corrosion.									✓
			Ensure Ex connections are fastened correctly.									✓
			Repair any discoloration of terminals and wires (as this indicates increased temperature).									✓
			Remove excess water from Ex housings immediately. Water may come from damaged seals (requiring replacement), or extreme temperature change (no repairs needed).									✓
			Ensure no dirt or corrosion in flame path gaps of flameproof enclosures.									✓

Source	System	Component	Task	Frequency								
				Daily	*Weekly*	*Monthly*	*Every 3 Months*	*Every 6 Months*	*Annually*	*Every 2 Years*	*On Removal*	*As Necessary*
			Maintain and clean flameproof joints. Never do any mechanical work (i.e. grinding) on flameproof joints.									✓
			Check seals on all housing covers.									✓
		Gearboxes (GS 50.3-GS250.3)	If subject to strong vibration: Check screws between actuator and gearbox/valve for rightness and fastenwith tightening torque as required. Not needed of sealed and secured with thread sealing material.					Initially.	Annual after initial inspection.			
			If frequent operation, change grease and seals.									Every 4-6 years.
			If potentially explosive atmosphere: Ensure ambient temperature, type of duty, and running times are all obeyed.					✓				✓
			If potentially explosive atmosphere: inspect for dust/dirt deposits and clean if needed.									"Regularly".
		Bray Resilient Seated Butterfly Valves	If component needs replacement, remove valve from line by placing disc in near closed position, then supporting valve and removing flange bolts.									✓
O&M No. 031 Valves		Trumbull Telescoping Valve	Ensure rack is kept greased with heavy-duty machine grease at all times.									✓
			If slippage of slip tube, re-engage lock pin and tighten the seal assembly bolts (in 3 ft/lbs increments) until seal assembly no longer slips. If still slippage, replace split seal.									✓
			Inspect both split seals for damage (rips/punctures). Replace if damaged.									✓
			Make seal assembly adjustments if necessary per instructions in "Final Valve Seal Adjustments" section in Manufacturer's manual.									✓
		Swing Check Valves	Inspect seating surfaces and bearing surfaces (hinge pins, hinges, and packing glands) and ensure no obvious flaws.									✓
			Replace parts that are subject to corrosion.									✓
			Lubricate and repack hinge pin stuffing boxes for outside lever valves.									✓

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Replace resilient discs any time there is excessive leakage.									✓
		Flap Valve Installation	Inspect to ensure flap disk remains free to swing open and bronze seats have not been damaged.									"Periodically" .
O&M No. 003 Telescoping Valve	Telescoping Valve		Ensure the travel stem should be kept greased with heavy duty machine grease at all times.									✓
			Inspect seals. If leaking, tighten assembly by 3 ft/lbs. If leaking again, inspect both seals for abnormalities and replace if needed.									✓
O&M No. 027 Slide gates, Weir Gates, Actuators	Gates	Fabricated Sluice Gates, Slide Gate and Weir Gate: MANUAL operated gates	Exercise gates every month during routine inspection and maintenance.			✓						
			Ensure all gate seals, including invert seal, and both sides of the slide. Thoroughly clean off all foreign matter.									"Before operation."
			Check hoist, stem guide, and gate attaching bolts for proper tightness.									"Before operation."
			Apply tension to stem and check any stem guides for proper alignment. There must be a uniform clearance between operating stem and all stem guides.									"Before operation."
			Visually inspect threaded portion of the stem. It must be clean and free of foreign matter, including dirt or sand, and lubricated with suitable industrial grease. If a wire brush is used to clean the stem, using a tainless steel type. Do NOT use carbon steel brush.									"Before operation."
			Adjust stem stop collar to within 1/16" of the top of the hois operating nut and lock in place.									"Before operation."
			Ensure connection between stem cover and stem cover adapter are sealed with silicone.									"Before operation."
		Gates	Inspect for signs of misalignment, damage or corrosive attack.					✓				✓
			If water level rises to threaded portion of stem, threads become coated with grit or debris. Threaded portion of stem should be cleaned and re-greased.									✓
			Exercise ocasionally to keep the guides clean and free of debris.				✓					
		Manual Operators	Lubricate all grease fittings with small amount of heavy duty grease which will not harden in cold weather nor become liquid in warm water. ***If present ***						✓			
		Electric and Hydraulic Operators	Ensure all stop collars are in the proper position and set into place.									✓

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Ensure connection between stem cover and stem cover adapter are sealed with silicone.									✓
		Modulating Electric Operators	Ensure threaded portion of the stem is cleaned and greased.									✓
			The operating nuts should be removed and inspected for wear after first 6					Initially after 6 mo.	After initial, annually.			
			Replace brinze operating nut as soon as noticeable wear is evident.									✓
		Operating Stems	Clean and grease. If grease becomes dirty, decrease inspection interval and clean more often.									✓
		Stop Gates	Guides and stop plates should be visually inspected at regular intervals for signs of damage or corrosive attack. Pay special attention to water line.									✓
		Stem	Ensure stem guides are aligned on the channel so uniform clearance between									✓
			Inspect the threaded portion of the stem to ensure clean, free of foreign matter, and well lubricated. Clean with dedicated (to avoid cross contamination) stainless steel brush. Lubricate with appropriate industrial grease. Do not use carbon steel brush.				If exposed to severe dust or heavy particles.	After initial inspection.				On initial start up.
		Seals	Open gate and visually inspect seals. Contact factory for replacements if needed.									✓
		Manual Operators	Ensure approximately 1/16" clearance between bottom of stop collar and top of operating nut. Adjust set screw if needed.									✓
			Ensure crank or handwheel turns easily. Check stem guide and stem alignment if needed.									✓
			Lubricate all grease fittings with small amount of Mobil Grease Special or equal (will not harden in cold weather or become liquid in warm weather).									✓
		Electric Operators	Ensure "open" switch/opening cycle does not allow end of thread of operating stem to enter the floor stand nut.									✓
		Electronic Control Unit	Track all operating faults and maintenance alarms and follow manufacturer instructions.									✓
			Change grease.									4-6 yr. if modulating data. 6-8 yr. if open-close/frequent operation. 10-12 yr. if open-close/infrequent operation.
			Replace seals when changing grease.									See above.
O&M No. 005	Sectional Doors	Track	Track surface should be free of all oil or grease.			✓						

Source	*System*	*Component*	*Task*	***Frequency***								
				Daily	*Weekly*	*Monthly*	*Every 3 Months*	*Every 6 Months*	*Annually*	*Every 2 Years*	*On Removal*	*As Necessary*
Sectional Doors			Check tightness of track bolts to anfles and fasteners attaching angle to jambs or snugness.			✓						
			Check for track damage.			✓						
		Door Surface and Hardware	Top fixture with door in the down position, adjust roller assembly holder so that the wheel is tight against the track surface on door side, lightly oil and wipe off excess oil.					✓				✓
			Oil the hinge points on all center hinges.					✓				✓
			Check all door hardware fasteners for tightness and freedom from corrosive activity.					✓				✓
			Inspect bottom seal for damage and replace if necessary.					✓				✓
		Counterbalance	Check set screw for tightness.					✓				✓
		Cable	Examine for frayed or broken strands. All cables should be tight when the door is closed.					✓				✓
		Torsion Spring	Lightly oil across the top of coils.					✓				✓
		Shaft Bearing	Oil each bearing located on the counterbalance shaft.					✓				✓
		Set Screws	Visually inspect all set screws for corrosion or slippage.					✓				✓
		Collars	Check tightness of set screws.					✓				✓
O&M No. 004 Rolling Steel Doors	Rolling Doors		Check manual operation of door.					Or 5000 cycles.				
			Check photocell/sensing edge operation.				✓					
			Clutch adjustment.						Or 10000 cycles.			
			Check for lose or missing heardwire.						Or 10000 cycles.			
			Check limit position.									Every 36 months or 30000 cycles.
			Gear train wear.									Every 36 months or 30000 cycles.
			Oil all moving parts except the clutch mechanism on fire doors and wool pile in guides on rolling grilles or counter doors. The guides should be lubricated with a paste wax or silicone spray.				✓					
			If electrically operated, check the operator gear reducer of oil leakage. If it is necessary to add oil, use Mobile Synthetic Oil.				✓					
			Check tension of roller chain between the operator and door sprocket.				✓					
			Oil the interior roller chains on operators without gear reducer.					✓				
			Oil all exposed roller chains, and on electric operators, dry lube the limit switch shaft threads.					✓				
			All bearings provided with grease fittings should be lubricated. If possible, find bearings located in drive bracket and tension end of counterbalance.					✓				

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Fire doors should be drop tested. Use drop test instructions located in the tension headplate cover.					✓				
			On crank operated doors and grilles, the crank assemblies are sealed with grease and should not require lubrication.					✓				
O&M No. 010 Stormwater Pretreatment Manhole	Pretreatment Manhole		Visually inspect and ensure no blockages present.					✓				✓
			Measure level of accumulated pollutants with marked dipstick.					✓				✓
			Clean out captured sediment using vacuum truck.									When sediment at 75% in sump or appreciable level of hydrocarbons /trash.
O&M No. 015 Fire Hydrants	Fire Hydrants		Physical examination noting condition of operating nut, nozzle caps and drains, and general appearance.					Fall and Spring.				After every operation in extremely cold weather.
			Use aquaphone and listen for leakage through the main valve.					Fall and Spring.				After every operation in extremely cold weather.
			Check for leakage at seals by loosening one hose cap one half turn. Check ease of operation while fully opening hydrant. When all the air has escaped through the hose cap and the hydrant is full, re-tighten the hose cap and check for leakage at joints, packing or seals, and outlet caps.					Fall and Spring.				After every operation in extremely cold weather.
			Close hydrant and remove one nozzle cap. Observe drainage.					Fall and Spring.				After every operation in extremely cold weather.
			Open hydrant completely, flush hydrant and observe flow. Care must be taken that the water coming from hydrant will not cause any damage to surrounding area.					Fall and Spring.				After every operation in extremely cold weather.
			Close hydrant slowly to ensure tight closure.					Fall and Spring.				After every operation in extremely cold weather.
			Clean and lubricate all nozzle threads. Replace caps, tighten with spanner wrench, then back off slightly so that the caps will not be excessively tight, but have sufficient frictional resistance to prevent removal by hand.					Fall and Spring.				After every operation in extremely cold weather.
			Lubricate stem threads through the Alemite fitting centered in the operating nut (one or two pumps with a grease gun).					Fall and Spring.				After every operation in extremely cold weather.

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Clean the exterior of the hydrant and repaint, if necessary.					Fall and Spring.				After every operation in extremely cold weather.
			Be sure any auxiliary valves are in the wide open position.					Fall and Spring.				After every operation in extremely cold weather.
			Keep complete records on inspection and location of all hydrants in the system.					Fall and Spring.				After every operation in extremely cold weather.
O&M No. 009 Fire Extinguisher	Fire Extinguisher	Metal Cabinets	Ensure that outer surface of cabinet and hinge area are kept clean.									✓
			If latches, locks or hinges need to be lubricated, use a "3 in q" type light oil, removing excess with cloth.									✓
		Extinguisher	Check for damage.			✓						
			Check the discharge outlet, ensure that it's not blocked.			✓						
			Ensure seal is not broken.			✓						
			Ensure fully charged.			✓						
			Ensure operating instructions are clearly visible.			✓						
			Get professional annual inspection to determine need for hydrotesting.						✓			
			Empty and subject to thorough examinationof mechanical parts, extinguishing agent, and expelling means.									Every 6 yr.
			Conduct hydrotesting.									✓
			Recharge (professionally).									After every discharge and after emptying.
O&M No. 006 Defibrillator Cabinet	Defibrillator	AED	Replace battery or pads when audible alarm sounds.									✓
			Check Ready Light. If battery is completely dead, light may not be lit and battery should immediately be changed.									✓
			Run battery insertion test (BIT) by inserting a battery into the HIS AED.									✓
		Exterior Grade Cabinets	Replace 9-Volt battery (used to power alarms).						✓			
			Ensure that outer surface of cabinet and hinge area are kept clean.									✓
			If latches, locks or hinges need to be lubricated, use a "3 in q" type light oil. Remove excess with cloth.									✓
O&M No. 032 Fume Hood	Fume Hood		Document inspection for each fume hood.						✓			
			Verify instruments including fume hood face velocity and determine usage by						✓			

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			Physically examine liner conditions and cleanliness, baffle and sash operation and conditiion, counter balance cables, light operation and condition, and service fixture function.						✓			
			Low air flow detectors should be inspected at least annually (if present). If filters are present, the inspection frequency should be increased.						✓			
			Velocity and pressure-sensing detectors should be tested at each inspection.						✓			
			Low-flow or no-glow alarms of the visible (lights) or audible (horns or bells) type should be tested for correct operation at each inspection.						✓			
			Signal transmission for alarms designed to activate signals at multiple locations must be tested at each location.						✓			
			Replace all frayed fan belts.									✓
			Where double pulleys and belts are employed, inspection frequency may be semi-annually.					✓				
O&M No. 028	Wall Protection	Cornerguards	For basic cleaning (including fingerprints) clean with warm water and mild soap or organic solvent (Acetone alcohol or methylated spirits). Sponge rinse with clean water and wipe dry following polish lines.									✓
			For difficult stains and grease, use organic solvent, mild cleaning, or specialty stainless steel cleaners. Use sponge, rag, or soft fiber brush to clean, rinse well with sponge and clean water and wipe dry, following polish lines.									✓
		Wall Paneling	Use mild cleaner applied with sponge, soft bristle brush or towel. Avoid cleaner or stin remover considered abrasive or containing chlorinated hydrocrbons or aromatic hydrocarbons. Apply soap in scrubbing or circular motion. Rinse thoroughly with cold water.						✓			✓
			If stubborn stains or graffiti, use Misty Vandalism Mark Remover or Censor Vandalism Mark Remover.									✓

Source	*System*	*Component*	*Task*	***Frequency***								
				Daily	*Weekly*	*Monthly*	*Every 3 Months*	*Every 6 Months*	*Annually*	*Every 2 Years*	*On Removal*	*As Necessary*
O&M No. 014 Lab Casework	Work Surfaces	Surfaces	Perform visual inspection of all joints, surfaces and sinks in lab.			✓	✓					
		Glassware Washer	Wipe the outer edges on the inside door panel to remove particles and residue that occur during loading.									✓
			Use a sponge with non-abrasive stainless steel cleaner to gently wipe the washer tank and door to remive surface discoloration caused by exposure to halogenated compounds or steel parts.									✓
			Check the airgap for build-up.									If washer drain poorly.
			Check and clean the filter screen of the water fill valve screen.									If low water fill occurs.
			Clean sump filter screen if debris accumulates. Remove to clean and take care not to let any debris into the opened sump.									✓
			Disassemble and thoroughly clean all surfaces.									✓
			To remove film or spots from the washer interior. Choose the Glass Program, Steam OFF, Pure Rinse OFF, and set drying time to zero. After first fill, add one cup of bleach into bottom of tank. After second fill, add two cups of 4-8% acetic acid (or white vinagar) to bottom of tank.									✓
		Epoxy Resin Worksurfaces	Promptly remove all spills.									✓
			Clean and polish regularly using Crystal Simple Green with a paper towel, clean rag or a white Light Duty Sotchbrite Pad.									✓
			Finishing oil can be used when cleaning and polishing. Too much oil will cloud the surface									✓
			Never sand seams or scrathces or use wax on epoxy resin worksurfaces or sinks.									✓
			If there is marring (line, smooth to the touch). Remove with acetone or mild cleaning products and "elbow grease".									✓
			If a scratch is made, it can be covered using permanent marker if desired.									✓
			Immediately extinguish all flames on work surface.									✓
			Place trivet under all hot containers and components.									✓
			Protect the feet of lab apparatus with rubber, felt, or a protective pad.									✓

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
		Epoxy Resin Sink	Inspect sink surfaces, joints in sink area including the outlet joint and the sink rim joint above and below the work surface. Cracked or pitted joints should be filled with two-part Smooth-On epoxy grout to prevent leaking and damage to the supporting casework.									✓
O&M No. 033 Lab Casework	Lab Casework		Remove removable back panels, to immediately clean up spills.									✓
O&M No. 016 Metal Lockers	Lockers		Open and shut the locker, note any problems with latch, door frame, hinge, or lock bar.						✓			
			Check for missing/broken parts (i.e. loose hooks or bent coat rod).						✓			
			Inspect locker for dents, sharp edges, or rivets popped out.						✓			
			Grease lock bar located just inside the door.				✓					
			Grease the door hinges (WD40).				✓					
			Dust/clean inside and out with mild detergent. Rinse with warm water and dry thoroughly immediately.						✓			
O&M No. 016 Metal Lockers	Wooden Bench		Use furniture wax to restore luster.									✓
			Immediately dry any water on bench.									✓
			Refinish.									Old finish will likely last years/decades.
			Wipe down top with warm, soapy water or household cleaners (excluding ammonia-based products) and immediately dry.									✓
			Use bleach or fingernail polish remover to remove stains.									✓
O&M No. 008 Toilet Accessories	Toilet Accessories	TB-21 Stainless Steel	Wiper or polish with grain direction of satin finishes.									✓
			Remove cleaning or soap residue from stainless surface with water and wipe dry with clean cloth.									✓
			If dirt, smudges, or fingerprints, apply mild cleaning solution or stainless steel cleaner and then wipe with sponge, cloth, or soft brush. Rinse and dry.									✓
			If there is grafitti apply Bobrick Graffiti Remover, part #891099 or equivalent and rub spots with cloth or sponge. Rinse and dry.									✓

Source	System	Component	Task	Frequency								
				Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Annually	Every 2 Years	On Removal	As Necessary
			If there is mineral deposits or scale from hard water, use a bathroom cleaner containing phosphoric acid or acetic acids. Apply liberally and allow to stand for a few minutes. Scrub with coarse toweling or soft bristle brush in direction of grain. Rinse and dry.									✓
			If there is "rust" discoloration, use an appropriate cleaner plus 3M Scotch Brite pad #7447 or equivalent. Clean the surface and then rub stained area lightly with 3M Scotch Brite pad. Clean with stainless steel polish. Rinse and dry and only rub with the grain of direction of the satin finish. Do not use on bright polish stainless steel.									✓
		Mirror Care	Clean mirror with lint/grit-free cloth and a warm water. Wring all water from cloth before wiping. Dry immediately after wiping. Do not spray cleaner directly on mirror.									✓
			Do not clean with products containing ammonia, vinegar, acid or alkali cleaners. Also never use abrasive cleaners on the mirror surface.									✓
			After cleaning, make sure edges and joints are dry so no liquid or cleaner comes into contact with edges and backing.									✓
			Use #0000 oil-free steel wool, not solvents, to remove surface marks or stubborn dirt. Solvents can damage edges and backing.									✓

APPENDIX D

RECORDS AND REPORTS

APPENDIX D

RECORDS AND REPORTS

D-1 PURPOSE AND INTENT

Maintaining a complete and accurate set of records is very important to the treatment plant's continuing operational efficiency. Records provide to the operator an indication of trends in the treatment process that may assist in predicting future operating performance. The purpose of maintaining records is summarized below:

1. Evaluating plant operation. Review of operating records can indicate plant efficiency and help pinpoint past or future problems. This information may be used as a guide in upgrading or modification of treatment units and equipment.

2. Determining maintenance frequency of operating units. These records are also necessary qualifications for warranties issued by manufacturers.

3. Supporting budget for personnel, treatment units, or equipment to assist the City of Ferndale officials in arriving at annual budget estimates.

4. Protection against damage suits against the City.

5. For use in reports required by the State Department of Ecology for water pollution protection and public health safety.

6. For public and administrative officials.

D-2 RECORDS

Process Operation/Performance Records

It is recommended that the operator keep a daily log of all laboratory tests conducted, all operational action taken, and any required data. Entries in the log should be made twice daily, preferably in the early morning and late afternoon, when the operator conducts his routine inspection. Data should be recorded on worksheets located in the laboratory/office building.

Daily Operating Log

It is good practice to maintain a daily operating log. Entries should be clearly and concisely made as they often describe important situations with potential legal ramifications. The log should be bound to prevent the destruction or alteration of the records. Information recorded in the daily log should include, but not be limited to:

1. Date and time of entry.

2. Performance Data.
    - Facility influent and effluent flows.
    - Equipment running time.
    - Dissolved oxygen levels aeration basins
    - Temperature and pH of wastewater aeration basins and digestion basin.
    - Effluent data from the autosampler at the UV Treatment
    - Chlorine dosage for 3W water treatment system

3. Atmospheric conditions.
    - Air temperature.
    - Rainfall.
    - Cloud cover.
    - Severe weather conditions.

4. Changes in routine duties.

5. Changes in operating mode, including actions taken to control or correct processes.

6. Incidents requiring bypass procedures.

7. Accidents involving personnel.

8. Complaints.

9. Plant Visitors.

10. Major pump or equipment failure.

Entries should be dated and signed.

Maintenance Records

A discussion of maintenance records is found in Appendix C.

Safety Records

Every accident, injury, or illness occurring on the job must be immediately reported and recorded. A form must be filled out and kept on record for five years for surveillance by the Department of Labor and Industries.

Physical Plant Records

The following records were provided when the treatment facility was upgraded and describe in detail the entire plant. These records are:

1. Design Drawings: A full set of as-built engineering drawings showing structural, architectural, mechanical, and electrical features of the plant.

2. Installation-Operations-Maintenance (I&M) Catalogs: These describe the capacity, size, and functions of the various pieces of equipment which were placed within the plant. The compilation of literature from the manufacturers includes shop drawings of the original installation. They provide useful data on parts, capabilities, and dimensions.

3. This Operations and Maintenance Manual: This manual provides under one cover all of the essential material regarding the administration, management, operation, and maintenance of the plant. It covers design data, flow diagrams, and discussions of emergency plans and procedures, as well as operation strategy. The appendix of the manual includes several supporting documents relating to the operation of this plant.

The above records are located at the City of Ferndale City Hall, and at the Wilson Engineering office in Bellingham, WA.

D-3 REPORTS

Reports differ from records in that they are always submitted to someone as evidence of operation. Records, on the other hand, remain at the plant and should be retained for at least three years as evidence or back-up data for the information contained in a report.

NPDES Report

A monthly operation report must be filed with the Washington State Department of Ecology (WDOE) and submitted to the above department's office in Bellevue. Special instructions for using and filling in the required data are included in the instructions by the WDOE. The NPDES monthly report should be sent to the following location:

Department of Ecology
Northwest Regional Office
3190 160th Ave. NE
Bellevue, WA 98008-5452

Annual Report

It is suggested that an annual report be prepared and submitted at the end of each fiscal year to the Ferndale City Council summarizing the past year's operations and making recommendations for the coming year. In general, the report should contain the following:

1. Title Page
2. Letter of Transmittal
3. Table of Contents
4. Description of plant operation highlighting events that occurred in each month
5. Maintenance Information
6. Summary of plant operation efficiency parameters
7. Recommendations for the coming year

Useful graphs could also be included to illustrate in summary form the important plant operations data including, quantities of flow received, $CBOD_5$ and suspended solids removed. A brief summary could also be included on the safety and accident program, including results.

APPENDIX E

SAFETY RULES AND REGULATIONS

APPENDIX E

SAFETY RULES AND REGULATIONS

E-1 PURPOSE AND INTENT

The City of Ferndale Wastewater Treatment Plant contains potential hazards that are present in any industrial plant, as well as special hazards related specifically to the wastewater treatment process. Occupational hazards associated with the operation of mechanical and electrical equipment exist in any industrial setting. Hazards that are unique to wastewater treatment facilities are associated with the characteristics of wastewater. It should be kept in mind at all times that raw sewage is highly infectious and that old sewage generates noxious, explosive, and oxygen-replacing gases.

Consequently, the telephone numbers of several local physicians, the nearest hospital, police and fire departments, ambulance services and rescue squad should be posted at the phone in the Chemical and Laboratory/Office Buildings.

SAFETY IS ONE OF THE TREATMENT PLANT EMPLOYEES' MOST IMPORTANT RESPONSIBILITIES!!!

The operator should take necessary steps to protect themselves and others from known and unknown dangers at the plant site. This section discusses some of the common hazards encountered by plant personnel. Personnel are alerted that information contained herein is not comprehensive.

E-2 SAFETY REGULATIONS

Two State of Washington publications which contain guidelines for safe working conditions and health standards should be on file in the plant office. Each employee should be acquainted with their general contents. They are entitled:

1. General Safety Standards, WAC 296, Chapter 25.

2. Occupational Health Standards, WAC 296, Chapter 62.

E-3 GENERAL PLANT SAFETY

1. PREVENT FALLING! KEEP ALL AREAS CLEAR AND CLEAN. Pick up all loose objects, tools, trash, ladders, hose, etc. Clean up all oil or grease spill immediately. This is especially important when working around the lagoons. A fall into a lagoon would prove most unpleasant and even disastrous.

2. PREVENT BODY INFECTIONS AND DISEASE. Wash hands. Wear gloves when working on or near sewage equipment or collecting samples. Keep food and drink in office areas.

3. DO NOT RUN TO ANSWER THE TELEPHONE.

4. NEVER WORK ON EQUIPMENT WITHOUT locking it out at push buttons or circuit breaker. Tag main circuit breaker.

5. KNOW WHERE SAFETY EQUIPMENT IS AND USE IT.

6. KNOW ALL LOCATIONS OF ALL FIRE EXTINGUISHERS AND HOW TO USE THEM.

7. DON'T DO IT ALONE! It takes two people to work in a manhole or vault. Use safety harness.

8. ALL INJURIES, EVEN SCRATCHES AND SKIN ABRASIONS, MUST BE REPORTED AND FIRST AID GIVEN. An entry MUST be made in the daily log giving time and nature of accident or injury.

9. BE CONTINUALLY ALERT TO SAFETY CONDITIONS AROUND THE PLANT! If something is out of place or not working, fix it.

10. HAZARDOUS AREA. Certain hazardous areas require special attention. Safety rules and precautions for these areas must be followed.

11. It is everyone's responsibility to report immediately any safety hazard or unsafe condition!

E-4 MANUAL HANDLING OF MATERIAL

Everyone should know the proper way to lift objects by hand. The correct procedure is: (1) get a good footing with feet about shoulder width apart; (2) bend at the knees to grasp the weight, keeping the back straight; (3) get a firm hold; and (4) keeping the back as straight and upright as possible, lift slowly by straightening the legs.

Whenever it is desirable to change directions, the whole body should be turned, including the feet, rather than just twisting the back. No one should ever lift a load that is too heavy or too large to lift comfortably.

When transporting objects, whether by a wheelbarrow, hand rack, or cart, care should be exercised. Equipment should be properly maintained and not overloaded. Clearances should be carefully judged, and horseplay should be prohibited.

E-5 STRUCTURAL HAZARDS

Scaffolds, ladders, stairways, walkways, aisles and handrails can be structural hazards. All scaffolds should be maintained in a safe condition. Unstable objects such as barrels, blocks, boxes, or loose brick should not be used to support scaffolds or planks. Any scaffold damaged or weakened from any cause should be immediately repaired and not used until the repairs have been completed. Scaffolds should not be loaded in excess of the working load for which they are designed.

Tools, materials and debris should not be allowed to accumulate in quantities to cause a hazard.

An individual ascending or descending a ladder should face it. Only one person should be on a ladder at one time. The top of a stepladder should never be used as a platform on which to stand. Straight ladders should be placed so that the distance of the base of the ladder from the wall is one foot for every four feet of the ladder. Everyone should make a habit of carefully inspecting any ladder before using it.

Stairways should always be kept clear of tools, supplies, and other materials. Also, grease, water, and other slippery substances should be kept off stairs. Running on stairs and not using handrails should be discouraged.

Aisles and walkways should be kept clear of obstructions. Handrails should be of adequate strength and firmly mounted.

E-6 HAND TOOLS

Basic rules for personnel hand-tool usage are as follows:

1. Always select the appropriate tool for the job, never a makeshift.

2. Check the condition of a tool at frequent intervals, and repair or replace if tool is found to be faulty.

3. Avoid using tools on moving machinery; stop the machine before making adjustments.

4. Check clearance at the work place to make sure there is sufficient space to recover it if the tool should slip.

5. Have good support underfoot so that there is no hazard of slipping, stumbling, or falling.

6. Protect hands by wearing gloves in confined places, except when using hammers. Rings should not be worn.

7. Carry sharp or pointed tools in covers, or be sure they are pointed away from the body in case of a fall. Wear eye protection when using impact tools on hard, brittle material or in any other situation where debris or foreign matter could cause injury to the eye.

8. After using tools, wipe them clean and put them away, thus keeping the work place orderly.

9. Do not lay tools on top of stepladders or on other places from which they could fall on someone below.

10. Learn and use the right way to work all hand tools.

11. Use tools made of non-sparking material where fire is a hazard.

E-7 CONFINED SPACE ENTRY

If the necessity of entering a manhole, pump station wet well, or other confined space ever arises, observe the following basic rules for your protection:

1. PROVIDE ADEQUATE VENTILATION: Underground structures should never be entered until one is assured that the air is safe. Oxygen and gas detectors should be used to check for harmful gases and for sufficient oxygen. If the manhole contains insufficient or depressed oxygen levels and/or dangerous gases, then the structure should be ventilated until the condition is corrected. If a blower is used, the discharge end of the hose should be placed near the bottom of the structure. This forces the old air up and out.

2. PROVIDE ADEQUATE ILLUMINATION: The use of electric explosion-proof lantern is suggested.

3. NEVER ENTER ALONE: Open flow in the wet well produces currents capable of pulling a person into the pump's suction. Always have someone to help in the event of trouble. The buddy system should always be used when working in manholes to allow one person to be stationed at the top of the manhole. This person can save steps by raising and lowering needed tools, and can also operate rescue equipment if something should happen to the other person.

4. USE A SAFETY HARNESS equipped with safety line.

5. BE CAREFUL ABOUT FOOTING.

6. USE BUCKET AND ROPE to lower tools and equipment.

7. GOOD HOUSEKEEPING is essential in valve chambers.

8. NEVER SMOKE OR STRIKE MATCHES in the vicinity of any enclosure where explosive gasses could accumulate.

9. ELECTRICAL EQUIPMENT is contained in the pump stations. Any time equipment or wiring is to be worked on, turn off power and lock out. Post sign until an all-clear inspection is made.

10. PUMPS AND PUMP MOTORS WILL BE ROTATING: Caution should be taken to keep all guards in place until power is locked off any time work is being performed.

11. HIGH PRESSURES WILL BE PRESENT in the pump and pipe lines. Care must be taken to isolate equipment and release pressures before dismantling any connections.

Care should be exercised in removing manhole covers. The use of mechanical assists will minimize the chance of any possible foot or back injuries if properly used.

E-8 SAMPLING SAFETY

Caution must be exercised when sampling to avoid infection or injury. Please observe the following rules.

1. RUBBER GLOVES must be worn when handling samples.

2. WASH HANDS WITH SOAP before eating or smoking.

3. LOCK OUT AND TAG mechanical equipment that could present a hazard to an operator taking a sample.

E-9 ELECTRICAL SAFETY

1. LOCK OUT AND TAG main switch of electrical equipment before working on it.

2. DO NOT REMOVE TAG without first checking with person who initiated the tag.

3. NOTIFY PLANT FOREMAN in the event a motor circuit breaker trips out.

4. DO NOT OPEN MOTOR CONTROL PANELS unless you are trained and authorized to perform the work.

5. REPORT AND LOG any unusual motor noise, vibrations, etc.

E-10 FIRE PROTECTION

All personnel should know what to do in case of a fire. If fires are dealt with quickly, they are less likely to cause damage. In order to deal with a fire promptly, the proper type of fire extinguisher must be used.

TYPES OF FIRE CLASSIFICATIONS

Class	Material
A	Wood, Paper, Cloth
B	Gas, Oil, Grease, Paint
C	Electrical
D	Combustible Metals

Fires are classified into four classes. Class A fires are fires of ordinary combustible material, such as wood, clothing, or paper. Class B fires are of flammable liquids, greases, paints, or similar material. Class C fires are in or near electrical equipment. Class D fires are for combustible metals such as magnesium. Class D fires are rarely encountered and will not be covered here.

Water may be used only on Class A fires. Never direct a stream of water on a Class B or C fire. Most extinguishers are effective to some degree on Class A fires. Class B fires are fought with extinguishers issuing foam, carbon dioxide (CO_2), or dry chemical. Use only CO_2 and dry-chemical extinguishers on Class C fires. If possible, turn off power to electrical fires.

Fire extinguishers should be conspicuously located with signs or lights nearby to assist in their location. All personnel should know the type of fire for which extinguishers are meant and their proper use. All fire

equipment should be inspected on a regular basis, such as quarterly or semi-annually. All extinguishers should be refilled promptly after their use.

All exits should be marked. Flammable storage areas should be segregated based on chemical compatibility and marked with signs and smoking should not be permitted. All personnel should know the phone number of the local fire station, which should be posted conspicuously to ensure prompt response by the local department.

E-11 UV EQUIPMENT SAFETY

The UV disinfection equipment includes a hydraulic circuit that is used during the automated wiping and lifting of the UV banks. Hydraulic circuit must be depressurized before servicing. Be sure to protect hands, face, and body before disconnecting the hydraulic lines.

Always use UV protective gear, including gloves, clothing, and face shield when working around the UV light.

Additional safety information regarding the UV disinfection equipment can be found in the UV manufacturer's user manual.

E-12 CHLORINE SAFETY

Safety information for chlorine handling may be found in The Chlorine Manual.

E-13 FIRST AID MEASURES FOR CHLORINE EXPOSURE

Be sure you know the location of breathing apparatus, first aid kits, and other safety equipment at all times.

Immediately remove clothing contaminated with liquid chlorine. Carry victim from gas area into a warm room. It is essential to keep the victim warm and quiet. Place patient on his back with his head higher than the rest of his body. If breathing has stopped immediately start artificial respiration (CPR).

Call a doctor and fire department IMMEDIATELY.

Eyes

If even small quantities of chlorine have entered the eyes, hold the eyelids apart and flush with lukewarm water. Continue flushing for about fifteen minutes. Do not attempt to give any medication except under specific instruction from a physician.

Skin

Get patient under a shower immediately, clothes and all. Remove clothing while the shower is running. Wash the skin with large quantities of soap and water. Do not attempt to neutralize chlorine with chemicals. Do not apply salves or ointments except as directed by a physician.

Inhalation

If the patient is breathing, place him in a comfortable position; keep him warm and at rest until a physician arrives.

If breathing seems to have stopped, begin artificial respiration immediately. Mouth-to-mouth resuscitation or any of the approved methods may be used. Oxygen should be administered if equipment and trained personnel are available.

Automatic artificial respiration is considered preferable to manual but only when administered by an experienced operator. Rest is recommended after severe chlorine exposure.

Throat Irritation

Drinking milk will relieve the discomforts of throat irritation from chlorine exposure. Chewing gum or drinking spirits of peppermint also will help reduce throat irritation. Follow emergency rules given by your physician. In the absence of such rules, the first aid steps above are suggested.

APPENDIX F

EMERGENCY PLANS AND PROCEDURES

APPENDIX F

EMERGENCY PLANS AND PROCEDURES

F-1 PURPOSE AND INTENT

The operator must be prepared to act in the event of an emergency situation which might cause harm to people, damage to the wastewater collection system or create a health hazard in the receiving waters or in the City of Ferndale. Emergency planning is essential to insure continued effective operation of the plant during such emergencies. However, should such damage occur or a health hazard be created, the operator must immediately report it to the Washington State Department of Ecology, to which department the operator must also report all bypassing of wastewater into the receiving waters regardless of what might have caused the bypassing.

F-2 EMERGENCY RESPONSE PLAN

An emergency response plan is necessary to ensure continued operation of the plant under any emergency condition. The plan may be based upon the following response procedures:

1. Analyze all emergencies to determine the proper course of action.
2. Implement protection measures where applicable.
3. Dispatch pretrained crew where applicable.
4. Check spare parts inventory before ordering parts.
5. Take the unit processes out of operation only as a last resort.
6. Keep the down-time to a minimum.
7. Critique the response plan.

It is recommended that a unit process priority list be made. In an emergency situation, this list will serve as a guide for quick response to the situation. The following is a sample priority list for emergency conditions. Items are listed in order of priority.

1. Restore power supply.
2. Maintain wastewater pumping.
3. Check UV system for proper operation.
4. Check screw pump station/Headworks.
5. Check the aeration basin and clarifiers.
6. Check effluent pump station, mixed liquor pump station, and splitters
7. Check inlet/outlet structures.
8. Check the 2W and 3W system.

F-3 EMERGENCY OPERATION PROCEDURES

Power Failure

In the event of a general power failure, an emergency generator located in the Electrical/Generator Building and a secondary emergency generator located at the Blower Building will automatically started to provide power to the entire treatment plant. Operation of the generator under emergency power conditions should be according to the manufacturer's operation and maintenance manual. Close supervision of generator fuel levels and power production is required to maintain reliable treatment plant operation. Upon resumption of normal power, the automatic transfer switch will transfer the load back to the normal source. After transfer to the normal electrical supply, all motors will start automatically if their automatic mode is calling them to start.

Flooding

The plant is built above the 100-year flood elevation and if any additional flooding occurs, sandbags may be used to prevent any overtopping or to protect the equipment buildings. In the event of heavy rainfall the effluent pump station check valve will close and the pumps will operate to continue discharging effluent to the Nooksack River.

Earthquakes

Fire is the worst danger after an earthquake. Be sure to shut down all gas lines as soon as possible. Assess the structural damage that may have occurred to any unit process. Bypass any damaged unit process until the damage is repaired.

Fires

In case of fire, the first action to take is to get all personnel away from the fire and to a safe place. Then call the Fire Department. All buildings on the site each contain a fire extinguisher. Water spigots are provided at various locations around the plant (See Figures A-1 and A-2).

Influent Lift Station/Headworks Pump Failure

Failure of all pumps simultaneously in the influent lift station or Headworks will necessitate use of a portable pump. Immediate arrangements should be made for the emergency repair of the pumps.

Explosions

After an explosion, the first action to take is to shut off the source of the explosion and ignition sources to prevent further explosions. Provide care for any injured persons and then leave the area. Call the Fire Department. Keep people a safe distance from the site of the explosion.

Freezing

During freezing conditions, it is important to break up ice around the inlet/outlet structures and weirs of the clarifier and aeration chains.

Cold weather operation of mechanical aeration equipment in the Long-Term Digestion Basin requires frequent observation of air and water conditions to prevent damage to the aerators. The following operation schedule is recommended for winter operation of the aerators.

1. Water temperature below 38°F and air temperature below 32°F. Use programmed operation. A program of 5 to 15 minutes of ON operation each hour is recommended.

2. Water temperature below 38°F and air temperature above 32°F. Full operation okay.

3. Water temperature between 45°F and 38°F and air temperature below 32°F. Operation full time with anti-ice device or programmed operation.

4. Water temperature above 45°F. Air temperature below 32°F. Full operation is okay.

CAUTION:

If ice has formed around the propeller or motor shaft, care should be exercised when restarting in order not to burn the motor out. In no instance should ice accumulation on the aeration unit be allowed to reach such proportions that the operation of the unit is impaired.

Rupture of Aeration Basin Liners

The new aeration basins contain two layers of HDPE liners, plus a bottom layer of geosynthetic clay liner. The liners have been tested and warranted against leakage for an extended period of time. They must be protected from puncture or tearing. If rupture of the liners does occur, it should be reported and the lagoon should be drained to prevent groundwater contamination. Contact the manufacturer's representative to determine the appropriate repair procedure.

Leakage from the lagoon should be evident by monitoring the leak detection manholes for the North and South Aeration Basins. An increase of the water level in the leak detection manhole is indicative of a liner leak. Leakage may also be evident in the daily records. Comparison of the pump influent flow with the effluent flows should provide an indication of leakage. Contamination of the ground water represents a violation of the discharge permit. Immediately report any sources of potential leakage.

F-4 EMERGENCY NOTIFICATION SCHEDULE

Table F-1

Emergency Schedule

RESPONSIBLE PLANT PERSONNEL	PHONE NUMBERS
Operator:	
Mike Olinger, Chief Water/Wastewater Plant Operator	(360) 384-4006
Fax:	(360) 384-4607
Public Works Director:	
Mr. Kevin Renz	(360) 685-2376
Fire Department:	911
Law Enforcement:	911
Medical:	911
Utilities:	
Power – Puget Sound Energy	1-800-321-4123
Telephone:	
Repair Service - Comcast	1-877-824-2288
NPDES Permit (Non-Compliance):	
Department of Ecology	206-594-0000
Whatcom County Health Department	(360) 778-6000

F-5 PREVENTION OF EMERGENCY CONDITIONS

The operator is responsible for preventing conditions that may result in emergency situations arising from poor maintenance, negligent operation, and accidents. Carefully following the preventive maintenance program should eliminate equipment breakdown caused by poor maintenance practices.

APPENDIX G

NPDES PERMIT

Issuance Date: July 15 , 2014
Effective Date: August 1, 2014
Expiration Date: July 31, 2019

National Pollutant Discharge Elimination System
Waste Discharge Permit No. WA0022454

State of Washington
DEPARTMENT OF ECOLOGY
Bellingham Field Office
1440 10th Street, Suite 102
Bellingham, WA 98225-7028

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1342 et seq.

City of Ferndale
2905 Main Street
Ferndale, Washington 98248

is authorized to discharge in accordance with the Special and General Conditions that follow.

Plant Location:	Receiving Water:
5405 Ferndale Road Ferndale, WA	Nooksack River
Treatment Type: Dual Powered Aerated Lagoons	

Douglas R. Allen
Manager
Bellingham Field Office
Washington State Department of Ecology

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Appendix A 32

Summary of Permit Report Submittals

Refer to the Special and General Conditions of this permit for additional submittal requirements.

Permit Section	Submittal	Frequency	First Submittal Date
S3.A	Discharge Monitoring Report	Monthly	September 15, 2014
S3.E	Reporting Permit Violations	As necessary	
S3.E.a	Reporting Permit Violations – Immediate Reporting	As necessary	
S3.E.b	Reporting Permit Violations – 24-Hour Reporting	As necessary	
S3.E.c	Reporting Permit Violations – Report within Five Days	As necessary	
S3.E.e	Reporting Permit Violations – All Other Reporting	Monthly as necessary	
S3.F	Other Reporting	As necessary	
S4.B	Plans for Maintaining Adequate Capacity	As necessary	
S4.D	Notification of New or Altered Sources	As necessary	
S4.E	Infiltration and Inflow Evaluation	1/permit cycle	July 30, 2018
S5.F	Bypass Notification	As necessary	
S5.G	Operations and Maintenance Manual Update or Review Confirmation Letter	Annually	September 1, 2014
S6.E	List of Industrial Users	2/permit cycle	January 1, 2016 and January 1, 2018
S8	Application for Permit Renewal	1/permit cycle	July 30, 2018
S9	Outfall Evaluation	1/permit cycle	July 30, 2018
S10	Acute Toxicity Effluent Test Results - Submit with Permit Renewal Application	Once in July/Once in January	July 30, 2018
S11	Chronic Toxicity Effluent Test Results with Permit Renewal Application	Once in July/Once in January	July 30, 2018
G1	Notice of Change in Authorization	As necessary	
G4	Reporting Planned Changes	As necessary	
G5	Engineering Report for Construction or Modification Activities	As necessary	
G7	Notice of Permit Transfer	As necessary	
G10	Duty to Provide Information	As necessary	
G13	Payment of Fees	As assessed	
G20	Compliance Schedules	As necessary	
G21	Contract Submittal	As necessary	

Special Conditions

S1. Discharge limits

S1.A. Effluent limits

All discharges and activities authorized by this permit must comply with the terms and conditions of this permit. The discharge of any of the following pollutants more frequently than, or at a level in excess of, that identified and authorized by this permit violates the terms and conditions of this permit.

Beginning on the effective date of this permit, the Permittee may discharge municipal wastewater to the Nooksack River at the permitted location subject to compliance with the following limits:

Effluent Limits: Outfall 001 **Latitude: 48.8347 Longitude: -122.5981**		
Parameter	**Average Monthly [a]**	**Average Weekly [b]**
Carbonaceous Biochemical Oxygen Demand (5-day) ($CBOD_5$)	25 milligrams/liter (mg/L) **673** pounds/day (lbs/day) 85% removal of influent $CBOD_5$	40 mg/L **1077** lbs/day
Total Suspended Solids (TSS)	30 mg/L **808** lbs/day 85% removal of influent TSS	45 mg/L **1212** lbs/day
Parameter	**Minimum**	**Maximum**
pH	6.0 standard units	9.0 standard units
Parameter	**Monthly Geometric mean**	**Weekly Geometric mean**
Fecal Coliform Bacteria [c]	28 /100 mL	400 /100 mL
Parameter	**Average Monthly**	**Maximum Daily [d]**
Total Residual Chlorine	34 µg/L	76 µg/L

[a]	Average monthly effluent limit means the highest allowable average of daily discharges over a calendar month. To calculate the discharge value to compare to the limit, you add the value of each daily discharge measured during a calendar month and divide this sum by the total number of daily discharges measured. See footnote c for fecal coliform calculations.
[b]	Average weekly discharge limitation means the highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week. See footnote c for fecal coliform calculations.
[c]	Ecology provides directions to calculate the monthly and the weekly geometric mean in publication No. 04-10-020, *Information Manual for Treatment Plant Operators* available at: http://www.ecy.wa.gov/pubs/0410020.pdf
[d]	Maximum daily effluent limit is the highest allowable daily discharge. The daily discharge is the average discharge of a pollutant measured during a calendar day. For pollutants with limits expressed in units of mass, calculate the daily discharge as the total mass of the pollutant discharged over the day. This does not apply to pH or temperature.

S1.B. Mixing zone authorization

Mixing zone for Outfall 001

The paragraph below defines the maximum boundaries of the mixing zones.

Chronic mixing zone

The width of the chronic mixing zone is limited to a distance of 22 feet[1] (6.7 meters). The length of the chronic mixing zone extends 302 feet (92 meters) downstream of the outfall. The mixing zone extends from the discharge port to the top of the water surface. The concentration of pollutants at the edge of the chronic zone must meet chronic aquatic life criteria and human health criteria.

Acute mixing zone

The width of the acute mixing zone is limited to a distance of 10 feet (3 meters) in any horizontal direction from the outfall. The length of the acute mixing zone extends 30 feet (9 meters) downstream of the outfall. The mixing zone extends from the discharge port to the top of the water surface. The concentration of pollutants at the edge of the acute zone must meet acute aquatic life criteria.

Available Dilution (dilution factor)	
Acute Aquatic Life Criteria	4
Chronic Aquatic Life Criteria	29
Human Health Criteria - Carcinogen	29
Human Health Criteria – Non-carcinogen	29

S2. Monitoring requirements

S2.A. Monitoring schedule

The Permittee must monitor in accordance with the following schedule and the requirements specified in Appendix A.

Parameter	Units & Speciation	Minimum Sampling Frequency	Sample Type
(1) Wastewater influent			
Wastewater Influent means the raw sewage flow from the collection system into the treatment facility. Sample the wastewater entering the headworks of the treatment plant excluding any side-stream returns from inside the plant.			
Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)	mg/L	2/week	24-hour composite [b]
$CBOD_5$	lbs/day	2/week	Calculated [g]
Total Suspended Solids (TSS)	mg/L	2/week	24-hour composite [b]
Total Suspended Solids (TSS)	lbs/day	2/week	Calculated [g]
Flow	MGD	Continuous [a]	Metered/recorded

[1] Widths of acute and chronic mixing taken from page 18 of 1997 Dilution Analysis-Berryman & Henigar/Vasey Engineering.

Parameter	Units & Speciation	Minimum Sampling Frequency	Sample Type
(2) Final wastewater effluent			
Final Wastewater Effluent means wastewater exiting the last treatment process or operation. Typically, this is after or at the exit from the chlorine contact chamber or other disinfection process. The Permittee may take effluent samples for the $CBOD_5$ analysis before or after the disinfection process. If taken after, the Permittee must dechlorinate and reseed the sample.			
Flow	MGD	Continuous [a]	Metered/recorded
$CBOD_5$	mg/L	2/week	24-hr composite [b]
$CBOD_5$	lbs/day	2/week	Calculated [g]
$CBOD_5$	% removal [c]	1/month	Calculated [c]
TSS	mg/L	2/week	24-hr composite [b]
TSS	lbs/day	2/week	Calculated [g]
TSS	% removal [c]	1/month	Calculated [c]
Chlorine (Total Residual)	µg/L	Daily	Grab [f]
Fecal Coliform [e]	# /100 ml SM 9222 D	2/week	Grab [f]
pH [d]	Standard Units	Daily	Grab
Temperature [h]	Degrees centigrade (°C)	Daily	Metered/recorded
(3) Whole effluent toxicity testing – final wastewater effluent			
Acute Toxicity Testing	Fathead minnow 96-hour static-renewal test/ Daphnid 48-hour static test	January 2018 and June 2018	24-hr composite [b]
Chronic Toxicity Testing	Fathead minnow survival and growth/ Water flea survival and reproduction	January 2018 and June 2018	24-hr composite [b]
(4) Permit renewal application requirements – final wastewater effluent			
The Permittee must record and report the wastewater treatment plant flow discharged on the day it collects the sample for priority pollutant testing with the discharge monitoring report.			
Temperature	Degrees Celsius	Monthly [i]	Grab
Total Ammonia	mg/L as N	Monthly [i]	24-hr composite [b]
Total Phosphorus	mg/L as P	Monthly [i]	24-hr composite [b]
Soluble Reactive Phosphorus	mg/L as P	Monthly [i]	24-hr composite [b]
Nitrate plus Nitrite Nitrogen	mg/L as N	Monthly [i]	24-hr composite [b]
Total Kjeldahl Nitrogen (TKN)	mg/L as N	Monthly [i]	24-hr composite [b]
Oil and Grease	mg/L	3/yr [i]	Grab
Total Dissolved Solids	mg/L	3/yr [i]	24-hr composite
Total Hardness	mg/L	3/yr [i]	24-hr composite
Cyanide	micrograms/liter (µg/L)	3/yr [i]	Grab
Total Phenolic Compounds	µg/L	3/yr [i]	Grab
Priority Pollutants (PP) – Total Metals	µg/L; nanograms(ng/L) for mercury	3/yr [i]	24-hr composite [b] Grab for mercury
PP – Volatile organic compounds	µg/L	3/yr [i]	Grab
PP – Acid-extractable compounds	µg/L	3/yr [i]	24-hr composite [b]
PP – Base-neutral compounds	µg/L	3/yr [i]	24-hr composite [b]

[a]	Continuous means uninterrupted except for brief lengths of time for calibration, power failure, or unanticipated equipment repair or maintenance.
[b]	24-hour composite means a series of individual samples collected over a 24-hour period into a single container, and analyzed as one sample.

Parameter	Units & Speciation	Minimum Sampling Frequency	Sample Type
c	% removal = $\frac{\text{Influent concentration (mg/L)} - \text{Effluent concentration (mg/L)}}{\text{Influent concentration (mg/L)}} \times 100$ Calculate the percent (%) removal of $CBOD_5$ and TSS using the above equation.		
d	Report the daily minimum and maximum pH.		
e	Report a numerical value for fecal coliforms following the procedures in Ecology's *Information Manual for Wastewater Treatment Plant Operators*, Publication Number 04-10-020 available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html . Do not report a result as too numerous to count (TNTC).		
f	Grab means an individual sample collected over a fifteen (15) minute, or less, period.		
g	Calculated means figured concurrently with the respective sample, using the following formula: Concentration (in mg/L) X Flow (in MGD) X Conversion Factor (8.34) = lbs/day		
h	Temperature grab sampling must occur when the effluent is at or near its daily maximum temperature, which usually occurs in the late afternoon.		
i	Sampling to occur the year before the permit application is due. Results to be included in the next permit application.		

S2.B. Sampling and analytical procedures

Samples and measurements taken to meet the requirements of this permit must represent the volume and nature of the monitored parameters. The Permittee must conduct representative sampling of any unusual discharge or discharge condition, including bypasses, upsets, and maintenance-related conditions that may affect effluent quality.

Sampling and analytical methods used to meet the monitoring requirements specified in this permit must conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136 (or as applicable in 40 CFR subchapters N [Parts 400–471] or O [Parts 501-503]) unless otherwise specified in this permit . Ecology may only specify alternative methods for parameters without permit limits and for those parameters without an EPA approved test method in 40 CFR Part 136.

S2.C. Flow measurement, and continuous monitoring devices

The Permittee must:

1. Select and use appropriate flow measurement, and continuous monitoring devices and methods consistent with accepted scientific practices.
2. Install, calibrate, and maintain these devices to ensure the accuracy of the measurements is consistent with the accepted industry standard and the manufacturer's recommendation for that type of device.
3. Calibration as specified in this document is not required if the Permittee uses recording devices certified by the manufacturer.
4. Use field measurement devices as directed by the manufacturer and do not use reagents beyond their expiration dates.
5. Calibrate flow-monitoring devices at a minimum frequency of at least one calibration per year.
6. Maintain calibration records for at least three years.

S2.D. Laboratory accreditation

The Permittee must ensure that all monitoring data required by Ecology for permit specified parameters is prepared by a laboratory registered or accredited under the provisions of chapter 173-50 WAC, *Accreditation of Environmental Laboratories*. Flow, temperature, settleable solids, conductivity, pH, and internal process control parameters are exempt from this requirement. The Permittee must obtain accreditation for conductivity and pH if it must receive accreditation or registration for other parameters.

S2.E. Request for reduction in monitoring

The Permittee may request a reduction of the sampling frequency after twelve (12) months of monitoring. Ecology will review each request and at its discretion grant the request when it reissues the permit or by a permit modification.

The Permittee must:

1. Provide a written request.
2. Clearly state the parameters for which it is requesting reduced monitoring.
3. Clearly state the justification for the reduction.

S3. Reporting and recording requirements

The Permittee must monitor and report in accordance with the following conditions. Falsification of information submitted to Ecology is a violation of the terms and conditions of this permit.

S3.A. Reporting

The first monitoring period begins on the effective date of the permit. The Permittee must:

1. Summarize, report, and submit monitoring data obtained during each monitoring period on the electronic Discharge Monitoring Report (DMR) form provided by Ecology within WAWebDMR. Include data for each of the parameters tabulated in Special Condition S2 and as required by the form. Report a value for each day sampling occurred (unless specifically exempted in the permit) and for the summary values (when applicable) included on the electronic form.

   To find out more information and to sign up for WAWebDMR go to: http://www.ecy.wa.gov/programs/wq/permits/paris/webdmr.html .

   If unable to submit electronically (for example, if you do not have an internet connection), the Permittee must contact Ecology to request a waiver and obtain instructions on how to obtain a paper copy DMR.

   Enter the "no discharge" reporting code for an entire DMR, for a specific monitoring point, or for a specific parameter as appropriate, if the Permittee did not discharge wastewater or a specific pollutant during a given monitoring period.

2. Report single analytical values below detection as "less than the detection level (DL)" by entering < followed by the numeric value of the detection level (e.g. < 2.0) on the DMR. If the method used did not meet the minimum DL and quantitation level (QL) identified in the permit, report the actual QL and DL in the comments or in the location provided.
3. Report the test method used for analysis in the comments if the laboratory used an alternative method not specified in the permit and as allowed in S2.
4. Calculate average values (unless otherwise specified in the permit) using:
   a. The reported numeric value for all parameters measured between the agency-required detection value and the agency-required quantitation value.
   b. One-half the detection value (for values reported below detection) if the lab detected the parameter in another sample for the reporting period.
   c. Zero (for values reported below detection) if the lab did not detect the parameter in another sample for the reporting period.
5. Report single-sample grouped parameters (for example priority pollutants, PAHs, pulp and paper chlorophenolics, TTOs) on the WAWebDMR form and include: sample date, concentration detected, detection limit (DL) (as necessary), and laboratory quantitation level (QL) (as necessary). The Permittee must also submit an electronic PDF copy of the laboratory report using WAWebDMR.

   If the Permittee has obtained a waiver from electronic reporting or if submitting prior to the compliance date, the Permittee must submit a paper copy of the laboratory report providing the following information: date sampled, sample location, date of analysis, parameter name, CAS number, analytical method/number, detection limit (DL), laboratory quantitation level (QL), reporting units, and concentration detected.

   The contract laboratory reports must also include information on the chain of custody, QA/QC results, and documentation of accreditation for the parameter.
6. Ensure that DMRs are electronically submitted no later than the dates specified below, unless otherwise specified in this permit.

   Submit DMRs for parameters with the monitoring frequencies specified in S2 (monthly, quarterly, annual, etc.) at the reporting schedule identified below.

   The Permittee must:

   a. Submit **monthly** DMRs by the 15th day of the following month.
   b. Submit permit renewal application monitoring data in a report by July 30, 2018.
7. Submit reports to Ecology online using Ecology's electronic WAWebDMR submittal forms (electronic DMRs) as required above. Send paper reports to Ecology at:

   Water Quality Permit Coordinator
   Department of Ecology
   Bellingham Field Office
   1440 10th Street, Suite 102
   Bellingham, WA 98225-7028

S3.B. Records retention

The Permittee must retain records of all monitoring information for a minimum of three (3) years. Such information must include all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit. The Permittee must extend this period of retention during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology.

S3.C. Recording of results

For each measurement or sample taken, the Permittee must record the following information:

1. The date, exact place, method, and time of sampling or measurement.
2. The individual who performed the sampling or measurement.
3. The dates the analyses were performed.
4. The individual who performed the analyses.
5. The analytical techniques or methods used.
6. The results of all analyses.

S3.D. Additional monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by Special Condition S2 of this permit, then the Permittee must include the results of such monitoring in the calculation and reporting of the data submitted in the Permittee's DMR unless otherwise specified by Special Condition S2.

S3.E. Reporting permit violations

The Permittee must take the following actions when it violates or is unable to comply with any permit condition:

1. Immediately take action to stop, contain, and cleanup unauthorized discharges or otherwise stop the noncompliance and correct the problem.
2. If applicable, immediately repeat sampling and analysis. Submit the results of any repeat sampling to Ecology within thirty (30) days of sampling.

a. Immediate reporting

The Permittee must **immediately** report to Ecology and the Department of Health, Shellfish Program, and the Local Health Jurisdiction (at the numbers listed below), all:

- Failures of the disinfection system.
- Collection system overflows.
- Plant bypasses discharging to marine surface waters.
- Any other failures of the sewage system (pipe breaks, etc.)

Northwest Regional Office	425-649-7000
Department of Health, Shellfish Program	360-236-3330 (business hours) 360-789-8962 (after business hours)
Whatcom County Health Department	360-715-2588

b. Twenty-four-hour reporting

The Permittee must report the following occurrences of noncompliance by telephone, to Ecology at the telephone numbers listed above, within 24 hours from the time the Permittee becomes aware of any of the following circumstances:

1. Any noncompliance that may endanger health or the environment, unless previously reported under immediate reporting requirements.
2. Any unanticipated bypass that causes an exceedence of an effluent limit in the permit (See Part S5.F, "Bypass Procedures").
3. Any upset that causes an exceedence of an effluent limit in the permit (See G.15, "Upset").
4. Any violation of a maximum daily or instantaneous maximum discharge limit for any of the pollutants in Section S1.A of this permit.
5. Any overflow prior to the treatment works, whether or not such overflow endangers health or the environment or exceeds any effluent limit in the permit.

c. Report within five days

The Permittee must also submit a written report within five days of the time that the Permittee becomes aware of any reportable event under subparts a or b, above. The report must contain:

1. A description of the noncompliance and its cause.
2. The period of noncompliance, including exact dates and times.
3. The estimated time the Permittee expects the noncompliance to continue if not yet corrected.
4. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.
5. If the noncompliance involves an overflow prior to the treatment works, an estimate of the quantity (in gallons) of untreated overflow.

d. Waiver of written reports

Ecology may waive the written report required in subpart c, above, on a case-by-case basis upon request if the Permittee has submitted a timely oral report.

e. All other permit violation reporting

The Permittee must report all permit violations, which do not require immediate or within 24 hours reporting, when it submits monitoring reports for S3.A ("Reporting"). The reports must contain the information listed in subpart c, above. Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply.

f. Report submittal

The Permittee must submit reports to the address listed in S3.A.

S3.F. Other reporting

a. Spills of oil or hazardous materials

The Permittee must report a spill of oil or hazardous materials in accordance with the requirements of RCW 90.56.280 and chapter 173-303-145. You can obtain further instructions at the following website: http://www.ecy.wa.gov/programs/spills/other/reportaspill.htm .

b. Failure to submit relevant or correct facts

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to Ecology, it must submit such facts or information promptly.

S3.G. Maintaining a copy of this permit

The Permittee must keep a copy of this permit at the facility and make it available upon request to Ecology inspectors.

S4. Facility loading

S4.A. Design criteria

The flows or waste loads for the permitted facility must not exceed the following design criteria:

Maximum Month Design Flow (MMDF)	3.23 MGD
$CBOD_5$ Influent Loading for Maximum Month	4490 lb/day
TSS Influent Loading for Maximum Month	5388 lb/day

S4.B. Plans for maintaining adequate capacity

a. Conditions triggering plan submittal

The Permittee must submit a plan and a schedule for continuing to maintain capacity to Ecology when:

1. The actual flow or waste load reaches 85 percent of any one of the design criteria in S4.A for three consecutive months.

2. The projected plant flow or loading would reach design capacity within five years.

b. Plan and schedule content

The plan and schedule must identify the actions necessary to maintain adequate capacity for the expected population growth and to meet the limits and requirements of the permit. The Permittee must consider the following topics and actions in its plan.

1. Analysis of the present design and proposed process modifications.
2. Reduction or elimination of excessive infiltration and inflow of uncontaminated ground and surface water into the sewer system.
3. Limits on future sewer extensions or connections or additional waste loads.
4. Modification or expansion of facilities.
5. Reduction of industrial or commercial flows or waste loads.

Engineering documents associated with the plan must meet the requirements of WAC 173-240-060, "Engineering Report," and be approved by Ecology prior to any construction.

S4.C. Duty to mitigate

The Permittee must take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

S4.D. Notification of new or altered sources

1. The Permittee must submit written notice to Ecology whenever any new discharge or a substantial change in volume or character of an existing discharge into the wastewater treatment plant is proposed which:
   a. Would interfere with the operation of, or exceed the design capacity of, any portion of the wastewater treatment plant.
   b. Is not part of an approved general sewer plan or approved plans and specifications.
   c. Is subject to pretreatment standards under 40 CFR Part 403 and Section 307(b) of the Clean Water Act.
2. This notice must include an evaluation of the wastewater treatment plant's ability to adequately transport and treat the added flow and/or waste load, the quality and volume of effluent to be discharged to the treatment plant, and the anticipated impact on the Permittee's effluent [40 CFR 122.42(b)].

S4.E. Infiltration and inflow evaluation

1. The Permittee must conduct an infiltration and inflow evaluation. Refer to the U.S. EPA publication, I/I Analysis and Project Certification, available as Publication No. 97-03 at:
   http://www.ecy.wa.gov/programs/wq/permits/guidance.html

2. The Permittee may use monitoring records to assess measurable infiltration and inflow.
3. The Permittee must prepare a report summarizing any measurable infiltration and inflow. If infiltration and inflow have increased by more than 15 percent from that found in the previous report based on equivalent rainfall, the report must contain a plan and a schedule to locate the sources of infiltration and inflow and to correct the problem.
4. The Permittee must submit a report summarizing the results of the evaluation and any recommendations for corrective actions by July 30, 2018.

S5. Operation and maintenance

The Permittee must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances), which are installed to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes keeping a daily operation logbook (paper or electronic), adequate laboratory controls, and appropriate quality assurance procedures. This provision of the permit requires the Permittee to operate backup or auxiliary facilities or similar systems only when the operation is necessary to achieve compliance with the conditions of this permit.

S5.A. Certified operator

This permitted facility must be operated by an operator certified by the state of Washington for at least a **Class II** plant. This operator must be in responsible charge of the day-to-day operation of the wastewater treatment plant. An operator certified for at least a **Class I** plant must be in charge during all regularly scheduled shifts.

S5.B. Operation and maintenance program

The Permittee must:

1. Institute an adequate operation and maintenance program for the entire sewage system.
2. Keep maintenance records on all major electrical and mechanical components of the treatment plant, as well as the sewage system and pumping stations. Such records must clearly specify the frequency and type of maintenance recommended by the manufacturer and must show the frequency and type of maintenance performed.
3. Make maintenance records available for inspection at all times.

S5.C. Short-term reduction

The Permittee must schedule any facility maintenance, which might require interruption of wastewater treatment and degrade effluent quality, during non-critical water quality periods and carry this maintenance out in a manner approved by Ecology.

If a Permittee contemplates a reduction in the level of treatment that would cause a violation of permit discharge limits on a short-term basis for any reason, and such reduction cannot be avoided, the Permittee must:

1. Give written notification to Ecology, if possible, thirty (30) days prior to such activities.
2. Detail the reasons for, length of time of, and the potential effects of the reduced level of treatment.

This notification does not relieve the Permittee of its obligations under this permit.

S5.D. Electrical power failure

The Permittee must ensure that adequate safeguards prevent the discharge of untreated wastes or wastes not treated in accordance with the requirements of this permit during electrical power failure at the treatment plant and/or sewage lift stations. Adequate safeguards include, but are not limited to, alternate power sources, standby generator(s), or retention of inadequately treated wastes.

The Permittee must maintain Reliability Class I (EPA 430/9-74-001) at the wastewater treatment plant. Reliability Class I requires a backup power source sufficient to operate all vital components and critical lighting and ventilation during peak wastewater flow conditions.

S5.E. Prevent connection of inflow

The Permittee must strictly enforce its sewer ordinances and not allow the connection of inflow (roof drains, foundation drains, etc.) to the sanitary sewer system.

S5.F. Bypass procedures

This permit prohibits a bypass, which is the intentional diversion of waste streams from any portion of a treatment facility. Ecology may take enforcement action against a Permittee for a bypass unless one of the following circumstances (1, 2, or 3) applies.

1. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

   This permit authorizes a bypass if it allows for essential maintenance and does not have the potential to cause violations of limits or other conditions of this permit, or adversely impact public health as determined by Ecology prior to the bypass. The Permittee must submit prior notice, if possible, at least ten (10) days before the date of the bypass.

2. Bypass which is unavoidable, unanticipated, and results in noncompliance of this permit.

   This permit authorizes such a bypass only if:

   a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause

them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.

b. No feasible alternatives to the bypass exist, such as:
   - The use of auxiliary treatment facilities.
   - Retention of untreated wastes.
   - Maintenance during normal periods of equipment downtime, but not if the Permittee should have installed adequate backup equipment in the exercise of reasonable engineering judgment to prevent a bypass.
   - Transport of untreated wastes to another treatment facility or preventative maintenance), or transport of untreated wastes to another treatment facility.

c. Ecology is properly notified of the bypass as required in Special Condition S3.E of this permit.

3. If bypass is anticipated and has the potential to result in noncompliance of this permit.

   a. The Permittee must notify Ecology at least thirty (30) days before the planned date of bypass. The notice must contain:
      - A description of the bypass and its cause.
      - An analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing.
      - A cost-effectiveness analysis of alternatives including comparative resource damage assessment.
      - The minimum and maximum duration of bypass under each alternative.
      - A recommendation as to the preferred alternative for conducting the bypass.
      - The projected date of bypass initiation.
      - A statement of compliance with SEPA.
      - A request for modification of water quality standards as provided for in WAC 173-201A-410, if an exceedence of any water quality standard is anticipated.
      - Details of the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

   b. For probable construction bypasses, the Permittee must notify Ecology of the need to bypass as early in the planning process as possible. The Permittee must consider the analysis required above during preparation of the engineering report or facilities plan and plans and specifications and must include these to the extent practical. In cases where the Permittee determines the probable need to bypass early, the Permittee must continue to analyze conditions up to and including the construction period in an effort to minimize or eliminate the bypass.

c. Ecology will consider the following prior to issuing an administrative order for this type of bypass:

- If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.
- If feasible alternatives to bypass exist, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.
- If the Permittee planned and scheduled the bypass to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, Ecology will approve or deny the request. Ecology will give the public an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Ecology will approve a request to bypass by issuing an administrative order under RCW 90.48.120.

S5.G. Operations and maintenance (O&M) manual

a. O&M manual submittal and requirements

The Permittee must:

1. Review the O&M manual at least annually and confirm this review by letter to Ecology by September 1 of each year.
2. Submit to Ecology for review substantial changes or updates to the O&M Manual whenever it incorporates them into the manual. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
3. Keep the approved O&M manual at the permitted facility.
4. Follow the instructions and procedures of this manual.

b. O&M manual components

In addition to the requirements of WAC 173-240-080 (1) through (5), the O&M manual must include:

1. Emergency procedures for cleanup in the event of wastewater system upset or failure.
2. A review of system components which if failed could pollute surface water or could impact human health. Provide a procedure for a routine schedule of checking the function of these components.
3. Wastewater system maintenance procedures that contribute to the generation of process wastewater.
4. Reporting protocols for submitting reports to Ecology to comply with the reporting requirements in the discharge permit.

5. Any directions to maintenance staff when cleaning or maintaining other equipment or performing other tasks which are necessary to protect the operation of the wastewater system (for example, defining maximum allowable discharge rate for draining a tank, blocking all floor drains before beginning the overhaul of a stationary engine).
6. The treatment plant process control monitoring schedule.
7. Minimum staffing adequate to operate and maintain the treatment processes and carry out compliance monitoring required by the permit.
8. Specify other items on case-by-case basis such as O&M for collection systems pump stations, lagoon liners, etc.

S6. Pretreatment

S6.A. General requirements

The Permittee must work with Ecology to ensure that all commercial and industrial users of the publicly owned treatment works (POTW) comply with the pretreatment regulations in 40 CFR Part 403 and any additional regulations that the Environmental Protection Agency (U.S. EPA) may promulgate under Section 307(b) (pretreatment) and 308 (reporting) of the Federal Clean Water Act.

S6.B. Duty to enforce discharge prohibitions

1. Under federal regulations (40 CFR 403.5(a) and (b)), the Permittee must not authorize or knowingly allow the discharge of any pollutants into its POTW which may be reasonably expected to cause pass through or interference, or which otherwise violate general or specific discharge prohibitions contained in 40 CFR Part 403.5 or WAC-173-216-060.
2. The Permittee must not authorize or knowingly allow the introduction of any of the following into their treatment works:
    a. Pollutants which create a fire or explosion hazard in the POTW (including, but not limited to waste streams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21).
    b. Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, or greater than 11.0 standard units, unless the works are specifically designed to accommodate such discharges.
    c. Solid or viscous pollutants in amounts that could cause obstruction to the flow in sewers or otherwise interfere with the operation of the POTW.
    d. Any pollutant, including oxygen-demanding pollutants, (BOD_5, etc.) released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the POTW.
    e. Petroleum oil, non-biodegradable cutting oil, or products of mineral origin in amounts that will cause interference or pass through.

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

g. Heat in amounts that will inhibit biological activity in the POTW resulting in interference but in no case heat in such quantities such that the temperature at the POTW headworks exceeds 40 degrees Centigrade (104 degrees Fahrenheit) unless Ecology, upon request of the Permittee, approves, in writing, alternate temperature limits.

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

i. Wastewaters prohibited to be discharged to the POTW by the Dangerous Waste Regulations (chapter 173-303 WAC), unless authorized under the Domestic Sewage Exclusion (WAC 173-303-071).

3. The Permittee must also not allow the following discharges to the POTW unless approved in writing by Ecology:

   a. Noncontact cooling water in significant volumes.

   b. Stormwater and other direct inflow sources.

   c. Wastewaters significantly affecting system hydraulic loading, which do not require treatment, or would not be afforded a significant degree of treatment by the system.

4. The Permittee must notify Ecology if any industrial user violates the prohibitions listed in this section (S6.B), and initiate enforcement action to promptly curtail any such discharge.

S6.C. Wastewater discharge permit required

The Permittee must

1. Establish a process for authorizing non-domestic wastewater discharges that ensures all SIUs in all tributary areas meet the applicable state waste discharge permit (SWDP) requirements in accordance with chapter 90.48 RCW and chapter 173-216 WAC.

2. Immediately notify Ecology of any proposed discharge of wastewater from a source, which may be a significant industrial user (SIU) [see fact sheet definitions or refer to 40 CFR 403.3(t)(i)(ii)].

3. Require all SIUs to obtain a SWDP from Ecology prior to accepting their non-domestic wastewater, or require proof that Ecology has determined they do not require a permit.

4. Require the documentation as described in S6.C.3 at the earliest practicable date as a condition of continuing to accept non-domestic wastewater discharges from a previously undiscovered, currently discharging and unpermitted SIU.

5. Require sources of non-domestic wastewater, which do not qualify as SIUs but merit a degree of oversight, to apply for a SWDP and provide it a copy of the application and any Ecology responses.
6. Keep all records documenting that its users have met the requirements of S6.C.

S6.D. Identification and reporting of existing, new, and proposed industrial users

1. The Permittee must take continuous, routine measures to identify all existing, new, and proposed SIUs and potential significant industrial users (PSIUs) discharging or proposing to discharge to the Permittee's sewer system (see *Appendix C* of the fact sheet for definitions).
2. Within 30 days of becoming aware of an unpermitted existing, new, or proposed industrial user who may be a significant industrial user (SIU), the Permittee must notify such user by registered mail that, if classified as an SIU, they must apply to Ecology and obtain a State Waste Discharge Permit. The Permittee must send a copy of this notification letter to Ecology within this same 30-day period.
3. The Permittee must also notify all Potential SIUs (PSIUs), as they are identified, that if their classification should change to an SIU, they must apply to Ecology for a State Waste Discharge Permit within 30 days of such change.

S6.E. Industrial user survey

The Permittee must complete two industrial user surveys listing all SIUs and potential significant industrial users (PSIUs) discharging to the POTW. The Permittee must submit the surveys to Ecology by January 1, 2016 and January 1, 2018. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF). The Permittee must update the survey list and provide a copy by January 1, 2016, and January 1, 2018.

At a minimum, the Permittee must develop the list of SIUs and PSIUs by means of a telephone book search, a water utility billing records search, and a physical reconnaissance of the service area. Information on PSIUs must include, at a minimum, the business name, telephone number, address, description of the industrial process(s), and the known wastewater volumes and characteristics.

S7. Solid wastes

S7.A. Solid waste handling

The Permittee must handle and dispose of all solid waste material in such a manner as to prevent its entry into state ground or surface water.

S7.B. Leachate

The Permittee must not allow leachate from its solid waste material to enter state waters without providing all known, available, and reasonable methods of treatment, nor allow such leachate to cause violations of the State Surface Water Quality Standards, Chapter 173-201A WAC, or the State Ground Water Quality Standards, Chapter 173-200 WAC. The Permittee must apply for a permit or permit modification as may be required for such discharges to state ground or surface waters.

S8. Application for permit renewal or modification for facility changes

The Permittee must submit an application for renewal of this permit by July 30, 2018. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF). The Permittee must also submit a new application or supplement at least one hundred eighty (180) days prior to commencement of discharges, resulting from the activities listed below, which may result in permit violations. These activities include any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility.

S9. Outfall evaluation

The Permittee must inspect, once during the permit cycle, the submerged portion of the outfall line and diffuser to document its integrity and continued function. If conditions allow for a photographic verification, the Permittee must include such verification in the report. By July 30, 2018, the Permittee must submit the inspection report to Ecology.

The inspector must, at a minimum:

- Assess the physical condition of the outfall pipe, and associated couplings.
- Determine the extent of sediment accumulation in the vicinity of the outfall.
- Ensure the outfall pipe is free of obstructions and is allowing uniform flow.
- Confirm physical location (latitude/longitude) and depth (at MLLW) of the opening of the outfall.
- Assess physical condition of anchors used to secure the submarine line.

S10. Acute toxicity

S10.A. Testing when there is no permit limit for acute toxicity

The Permittee must:

1. Conduct acute toxicity testing on final effluent once in the last winter, by January 15, 2018, and once in the last summer, by June 15, 2018 prior to submission of the application for permit renewal.
2. Submit the results to Ecology by July 30, 2018 (with the permit renewal application).
3. Conduct acute toxicity testing on a series of at least five concentrations of effluent, including 100% effluent and a control.
4. Use each of the following species and protocols for each acute toxicity test:

Acute Toxicity Tests	Species	Method
Fathead minnow 96-hour static-renewal test	*Pimephales promelas*	EPA-821-R-02-012
Daphnid 48-hour static test	*Ceriodaphnia dubia, Daphnia pulex,* or *Daphnia magna*	EPA-821-R-02-012

5. The Permittee must collect effluent samples for whole effluent toxicity testing just prior to the chlorination step in the treatment process.

6. The Permittee must collect 24-hour composite effluent samples for toxicity testing. The Permittee must cool the samples to 0 - 6 degrees Celsius during collection and send them to the lab immediately upon completion. The lab must begin the toxicity testing as soon as possible but no later than 36 hours after sampling was completed.
7. The laboratory must conduct water quality measurements on all samples and test solutions for toxicity testing, as specified in the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*.
8. All toxicity tests must meet quality assurance criteria and test conditions specified in the most recent versions of the EPA methods listed in Subsection C and the Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If Ecology determines any test results to be invalid or anomalous, the Permittee must repeat the testing with freshly collected effluent.
9. The laboratory must use control water and dilution water meeting the requirements of the EPA methods listed in Section A or pristine natural water of sufficient quality for good control performance.
10. The Permittee must chemically dechlorinate final effluent samples for whole effluent toxicity testing with sodium thiosulfate just prior to test initiation. Do not add more sodium thiosulfate than is necessary to neutralize the chlorine. Provide in the test report the calculations to determine the amount of sodium thiosulfate necessary to just neutralize the chlorine in the sample.

S11. Chronic toxicity

S11.A. Testing when there is no permit limit for chronic toxicity

The Permittee must:

1. Conduct chronic toxicity testing on final effluent once in the last winter, by January 15, 2018, and once in the last summer, by June 15, 2018, prior to submission of the application for permit renewal.
2. Submit the results to Ecology July 30, 2018 (with the permit renewal application).
3. Conduct chronic toxicity testing on a series of at least five concentrations of effluent and a control. This series of dilutions must include the acute critical effluent concentration (ACEC). The ACEC equals 25% effluent. The series of dilutions should also contain the CCEC of 3.4% effluent.
4. Compare the ACEC to the control using hypothesis testing at the 0.05 level of significance as described in Appendix H, EPA/600/4-89/001.
5. Perform chronic toxicity tests with all of the following species and the most recent version of the following protocols:

Freshwater Chronic Test	Species	Method
Fathead minnow survival and growth	*Pimephales promelas*	EPA-821-R-02-013
Water flea survival and reproduction	*Ceriodaphnia dubia*	EPA-821-R-02-013

6. The Permittee must collect effluent samples for whole effluent toxicity testing just prior to the chlorination step in the treatment process.
7. The Permittee must submit all reports for toxicity testing in accordance with the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. Reports must contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data in electronic format for entry into Ecology's database, then the Permittee must send the data to Ecology along with the test report, bench sheets, and reference toxicant results.
8. The Permittee must collect 24-hour composite effluent samples for toxicity testing. The Permittee must cool the samples to 0 - 6 degrees Celsius during collection and send them to the lab immediately upon completion. The lab must begin the toxicity testing as soon as possible but no later than 36 hours after sampling was completed.
9. The laboratory must conduct water quality measurements on all samples and test solutions for toxicity testing, as specified in the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*.
10. All toxicity tests must meet quality assurance criteria and test conditions specified in the most recent versions of the EPA methods listed in Section C and the Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If Ecology determines any test results to be invalid or anomalous, the Permittee must repeat the testing with freshly collected effluent.
11. The laboratory must use control water and dilution water meeting the requirements of the EPA methods listed in Subsection C or pristine natural water of sufficient quality for good control performance.

General Conditions

G1. Signatory requirements

1. All applications, reports, or information submitted to Ecology must be signed and certified.

   a. In the case of corporations, by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

      - A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation, or
      - The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.
      - In the case of a partnership, by a general partner.
      - In the case of sole proprietorship, by the proprietor.
      - In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official.

   Applications for permits for domestic wastewater facilities that are either owned or operated by, or under contract to, a public entity shall be submitted by the public entity.

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

   a. The authorization is made in writing by a person described above and submitted to Ecology.

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

3. Changes to authorization. If an authorization under paragraph G1.2, above, is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph G1.2, above, must be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative.

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

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

G2. Right of inspection and entry

The Permittee must allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law:

1. To enter upon the premises where a discharge is located or where any records must be kept under the terms and conditions of this permit.
2. To have access to and copy, at reasonable times and at reasonable cost, any records required to be kept under the terms and conditions of this permit.
3. To inspect, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.
4. To sample or monitor, at reasonable times, any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

G3. Permit actions

This permit may be modified, revoked and reissued, or terminated either at the request of any interested person (including the Permittee) or upon Ecology's initiative. However, the permit may only be modified, revoked and reissued, or terminated for the reasons specified in 40 CFR 122.62, 40 CFR 122.64 or WAC 173-220-150 according to the procedures of 40 CFR 124.5.

1. The following are causes for terminating this permit during its term, or for denying a permit renewal application:
   a. Violation of any permit term or condition.
   b. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.
   c. A material change in quantity or type of waste disposal.
   d. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations and can only be regulated to acceptable levels by permit modification or termination.

e. A change in any condition that requires either a temporary or permanent reduction, or elimination of any discharge or sludge use or disposal practice controlled by the permit.

f. Nonpayment of fees assessed pursuant to RCW 90.48.465.

g. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

2. The following are causes for modification but not revocation and reissuance except when the Permittee requests or agrees:

a. A material change in the condition of the waters of the state.

b. New information not available at the time of permit issuance that would have justified the application of different permit conditions.

c. Material and substantial alterations or additions to the permitted facility or activities which occurred after this permit issuance.

d. Promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision.

e. The Permittee has requested a modification based on other rationale meeting the criteria of 40 CFR Part 122.62.

f. Ecology has determined that good cause exists for modification of a compliance schedule, and the modification will not violate statutory deadlines.

g. Incorporation of an approved local pretreatment program into a municipality's permit.

3. The following are causes for modification or alternatively revocation and reissuance:

a. When cause exists for termination for reasons listed in 1.a through 1.g of this section, and Ecology determines that modification or revocation and reissuance is appropriate.

b. When Ecology has received notification of a proposed transfer of the permit. A permit may also be modified to reflect a transfer after the effective date of an automatic transfer (General Condition G7) but will not be revoked and reissued after the effective date of the transfer except upon the request of the new Permittee.

G4. Reporting planned changes

The Permittee must, as soon as possible, but no later than one hundred eighty (180) days prior to the proposed changes, give notice to Ecology of planned physical alterations or additions to the permitted facility, production increases, or process modification which will result in:

1. The permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b)

2. A significant change in the nature or an increase in quantity of pollutants discharged.

3. A significant change in the Permittee's sludge use or disposal practices. Following such notice, and the submittal of a new application or supplement to the existing application, along with required engineering plans and reports, this permit may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation.

G5. Plan review required

Prior to constructing or modifying any wastewater control facilities, an engineering report and detailed plans and specifications must be submitted to Ecology for approval in accordance with chapter 173-240 WAC. Engineering reports, plans, and specifications must be submitted at least one hundred eighty (180) days prior to the planned start of construction unless a shorter time is approved by Ecology. Facilities must be constructed and operated in accordance with the approved plans.

G6. Compliance with other laws and statutes

Nothing in this permit excuses the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G7. Transfer of this permit

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the Permittee must notify the succeeding owner or controller of the existence of this permit by letter, a copy of which must be forwarded to Ecology.

1. Transfers by Modification

   Except as provided in paragraph (2) below, this permit may be transferred by the Permittee to a new owner or operator only if this permit has been modified or revoked and reissued under 40 CFR 122.62(b)(2), or a minor modification made under 40 CFR 122.63(d), to identify the new Permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

2. Automatic Transfers

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

   a. The Permittee notifies Ecology at least thirty (30) days in advance of the proposed transfer date.

   b. The notice includes a written agreement between the existing and new Permittees containing a specific date transfer of permit responsibility, coverage, and liability between them.

   c. Ecology does not notify the existing Permittee and the proposed new Permittee of its intent to modify or revoke and reissue this permit. A modification under this subparagraph may also be minor modification under 40 CFR 122.63. If this notice is not received, the transfer is effective on the date specified in the written agreement.

G8. Reduced production for compliance

The Permittee, in order to maintain compliance with its permit, must control production and/or all discharges upon reduction, loss, failure, or bypass of the treatment facility until the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

G9. Removed substances

Collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters must not be resuspended or reintroduced to the final effluent stream for discharge to state waters.

G10. Duty to provide information

The Permittee must submit to Ecology, within a reasonable time, all information which Ecology may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee must also submit to Ecology upon request, copies of records required to be kept by this permit.

G11. Other requirements of 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G12. Additional monitoring

Ecology may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G13. Payment of fees

The Permittee must submit payment of fees associated with this permit as assessed by Ecology.

G14. Penalties for violating permit conditions

Any person who is found guilty of willfully violating the terms and conditions of this permit is deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to ten thousand dollars ($10,000) and costs of prosecution, or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit may incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars ($10,000) for every such violation. Each and every such violation is a separate and distinct offense, and in case of a continuing violation, every day's continuance is deemed to be a separate and distinct violation.

G15. Upset

Definition – "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limits because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limits if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

1. An upset occurred and that the Permittee can identify the cause(s) of the upset.
2. The permitted facility was being properly operated at the time of the upset.
3. The Permittee submitted notice of the upset as required in Special Condition S3.E.
4. The Permittee complied with any remedial measures required under S3.E of this permit.

In any enforcement action the Permittee seeking to establish the occurrence of an upset has the burden of proof.

G16. Property rights

This permit does not convey any property rights of any sort, or any exclusive privilege.

G17. Duty to comply

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G18. Toxic pollutants

The Permittee must comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G19. Penalties for tampering

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two (2) years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this condition, punishment shall be a fine of not more than $20,000 per day of violation, or by imprisonment of not more than four (4) years, or by both.

G20. Compliance schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit must be submitted no later than fourteen (14) days following each schedule date.

G21. Service agreement review

The Permittee must submit to Ecology any proposed service agreements and proposed revisions or updates to existing agreements for the operation of any wastewater treatment facility covered by this permit. The review is to ensure consistency with chapters 90.46 and 90.48 RCW as required by RCW 70.150.040(9). In the event that Ecology does not comment within a thirty-day (30) period, the Permittee may assume consistency and proceed with the service agreement or the revised/updated service agreement.

Appendix A

LIST OF POLLUTANTS WITH ANALYTICAL METHODS, DETECTION LIMITS AND QUANTITATION LEVELS

The Permittee must use the specified analytical methods, detection limits (DLs) and quantitation levels (QLs) in the following table for permit and application required monitoring unless:

- Another permit condition specifies other methods, detection levels, or quantitation levels.
- The method used produces measurable results in the sample and EPA has listed it as an EPA-approved method in 40 CFR Part 136.

If the Permittee uses an alternative method, not specified in the permit and as allowed above, it must report the test method, DL, and QL on the discharge monitoring report or in the required report.

If the Permittee is unable to obtain the required DL and QL in its effluent due to matrix effects, the Permittee must submit a matrix-specific detection limit (MDL) and a quantitation limit (QL) to Ecology with appropriate laboratory documentation.

When the permit requires the Permittee to measure the base neutral compounds in the list of priority pollutants, it must measure all of the base neutral pollutants listed in the table below. The list includes EPA required base neutral priority pollutants and several additional polynuclear aromatic hydrocarbons (PAHs). The Water Quality Program added several PAHs to the list of base neutrals below from Ecology's Persistent Bioaccumulative Toxics (PBT) List. It only added those PBT parameters of interest to Appendix A that did not increase the overall cost of analysis unreasonably.

Ecology added this appendix to the permit in order to reduce the number of analytical "non-detects" in permit-required monitoring and to measure effluent concentrations near or below criteria values where possible at a reasonable cost.

CONVENTIONAL PARAMETERS

Pollutant & CAS No. ***(if available)***	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL) [2]** ***µg/L unless specified***
Biochemical Oxygen Demand	SM5210-B		2 mg/L
Soluble Biochemical Oxygen Demand	SM5210-B [3]		2 mg/L
Chemical Oxygen Demand	SM5220-D		10 mg/L
Total Organic Carbon	SM5310-B/C/D		1 mg/L
Total Suspended Solids	SM2540-D		5 mg/L
Total Ammonia (as N)	SM4500-NH3-B and C/D/E/G/H		20
Flow	Calibrated device		
Dissolved oxygen	SM4500-OC/OG		0.2 mg/L
Temperature (max. 7-day avg.)	Analog recorder or Use micro-recording devices known as thermistors		0.2º C
pH	SM4500-H^+ B	N/A	N/A

NONCONVENTIONAL PARAMETERS

Pollutant & CAS No. (if available)	Recommended Analytical Protocol	Detection (DL)[1] µg/L unless specified	Quantitation Level (QL)[2] µg/L unless specified
Total Alkalinity	SM2320-B		5 mg/L as CaCO3
Chlorine, Total Residual	SM4500 Cl G		50.0
Color	SM2120 B/C/E		10 color units
Fecal Coliform	SM 9221E,9222	N/A	Specified in method - sample aliquot dependent
Fluoride (16984-48-8)	SM4500-F E	25	100
Nitrate + Nitrite Nitrogen (as N)	SM4500-NO3- E/F/H		100
Nitrogen, Total Kjeldahl (as N)	SM4500-N_{org}B/C and SM4500NH_3-B/C/D/EF/G/H		300
Soluble Reactive Phosphorus (as P)	SM4500- PE/PF	3	10
Phosphorus, Total (as P)	SM 4500 PB followed by SM4500-PE/PF	3	10
Oil and Grease (HEM) (Hexane Extractable Material)	1664 A or B	1,400	5,000
Salinity	SM2520-B		3 practical salinity units or scale (PSU or PSS)
Settleable Solids	SM2540 -F		500 (or 0.1 mL/L)
Sulfate (as mg/L SO_4)	SM4110-B		0.2 mg/L
Sulfide (as mg/L S)	SM4500-S^2F/D/E/G		0.2 mg/L
Sulfite (as mg/L SO_3)	SM4500-SO3B		2 mg/L
Total Coliform	SM 9221B, 9222B, 9223B	N/A	Specified in method - sample aliquot dependent
Total dissolved solids	SM2540 C		20 mg/L
Total Hardness	SM2340B		200 as CaCO3
Aluminum, Total (7429-90-5)	200.8	2.0	10
Barium Total (7440-39-3)	200.8	0.5	2.0
BTEX (benzene +toluene + ethylbenzene + m,o,p xylenes)	EPA SW 846 8021/8260	1	2
Boron Total (7440-42-8)	200.8	2.0	10.0
Cobalt, Total (7440-48-4)	200.8	0.05	0.25
Iron, Total (7439-89-6)	200.7	12.5	50
Magnesium, Total (7439-95-4)	200.7	10	50
Molybdenum, Total (7439-98-7)	200.8	0.1	0.5
Manganese, Total (7439-96-5)	200.8	0.1	0.5
NWTPH Dx [4]	Ecology NWTPH Dx	250	250
NWTPH Gx [5]	Ecology NWTPH Gx	250	250
Tin, Total (7440-31-5)	200.8	0.3	1.5
Titanium, Total (7440-32-6)	200.8	0.5	2.5

PRIORITY POLLUTANTS

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
METALS, CYANIDE & TOTAL PHENOLS			
Antimony, Total (7440-36-0)	200.8	0.3	1.0
Arsenic, Total (7440-38-2)	200.8	0.1	0.5
Beryllium, Total (7440-41-7)	200.8	0.1	0.5
Cadmium, Total (7440-43-9)	200.8	0.05	0.25
Chromium (hex) dissolved (18540-29-9)	SM3500-Cr EC	0.3	1.2
Chromium, Total (7440-47-3)	200.8	0.2	1.0
Copper, Total (7440-50-8)	200.8	0.4	2.0
Lead, Total (7439-92-1)	200.8	0.1	0.5
Mercury, Total (7439-97-6)	1631E	0.0002	0.0005
Nickel, Total (7440-02-0)	200.8	0.1	0.5
Selenium, Total (7782-49-2)	200.8	1.0	1.0
Silver, Total (7440-22-4)	200.8	0.04	0.2
Thallium, Total (7440-28-0)	200.8	0.09	0.36
Zinc, Total (7440-66-6)	200.8	0.5	2.5
Cyanide, Total (57-12-5)	335.4	5	10
Cyanide, Weak Acid Dissociable	SM4500-CN I	5	10
Cyanide, Free Amenable to Chlorination (Available Cyanide)	SM4500-CN G	5	10
Phenols, Total	EPA 420.1		50

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
ACID COMPOUNDS			
2-Chlorophenol (95-57-8)	625	1.0	2.0
2,4-Dichlorophenol (120-83-2)	625	0.5	1.0
2,4-Dimethylphenol (105-67-9)	625	0.5	1.0
4,6-dinitro-o-cresol (534-52-1) (2-methyl-4,6,-dinitrophenol)	625/1625B	1.0	2.0
2,4 dinitrophenol (51-28-5)	625	1.0	2.0
2-Nitrophenol (88-75-5)	625	0.5	1.0
4-nitrophenol (100-02-7)	625	0.5	1.0
Parachlorometa cresol (59-50-7) (4-chloro-3-methylphenol)	625	1.0	2.0
Pentachlorophenol (87-86-5)	625	0.5	1.0
Phenol (108-95-2)	625	2.0	4.0
2,4,6-Trichlorophenol (88-06-2)	625	2.0	4.0

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. ***(if available)***	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL)[2]** ***µg/L unless specified***
VOLATILE COMPOUNDS			
Acrolein (107-02-8)	624	5	10
Acrylonitrile (107-13-1)	624	1.0	2.0
Benzene (71-43-2)	624	1.0	2.0
Bromoform (75-25-2)	624	1.0	2.0
Carbon tetrachloride (56-23-5)	624/601 or SM6230B	1.0	2.0
Chlorobenzene (108-90-7)	624	1.0	2.0
Chloroethane (75-00-3)	624/601	1.0	2.0
2-Chloroethylvinyl Ether (110-75-8)	624	1.0	2.0
Chloroform (67-66-3)	624 or SM6210B	1.0	2.0
Dibromochloromethane (124-48-1)	624	1.0	2.0
1,2-Dichlorobenzene (95-50-1)	624	1.9	7.6
1,3-Dichlorobenzene (541-73-1)	624	1.9	7.6
1,4-Dichlorobenzene (106-46-7)	624	4.4	17.6
Dichlorobromomethane (75-27-4)	624	1.0	2.0
1,1-Dichloroethane (75-34-3)	624	1.0	2.0
1,2-Dichloroethane (107-06-2)	624	1.0	2.0
1,1-Dichloroethylene (75-35-4)	624	1.0	2.0
1,2-Dichloropropane (78-87-5)	624	1.0	2.0
1,3-dichloropropene (mixed isomers) (1,2-dichloropropylene) (542-75-6) [6]	624	1.0	2.0
Ethylbenzene (100-41-4)	624	1.0	2.0
Methyl bromide (74-83-9) (Bromomethane)	624/601	5.0	10.0
Methyl chloride (74-87-3) (Chloromethane)	624	1.0	2.0
Methylene chloride (75-09-2)	624	5.0	10.0
1,1,2,2-Tetrachloroethane (79-34-5)	624	1.9	2.0
Tetrachloroethylene (127-18-4)	624	1.0	2.0
Toluene (108-88-3)	624	1.0	2.0
1,2-Trans-Dichloroethylene (156-60-5) (Ethylene dichloride)	624	1.0	2.0
1,1,1-Trichloroethane (71-55-6)	624	1.0	2.0
1,1,2-Trichloroethane (79-00-5)	624	1.0	2.0
Trichloroethylene (79-01-6)	624	1.0	2.0
Vinyl chloride (75-01-4)	624/SM6200B	1.0	2.0

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. ***(if available)***	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL)[2]** ***µg/L unless specified***
BASE/NEUTRAL COMPOUNDS (compounds in bold are Ecology PBTs)			
Acenaphthene (83-32-9)	625	0.2	0.4
Acenaphthylene (208-96-8)	625	0.3	0.6
Anthracene (120-12-7)	625	0.3	0.6
Benzidine (92-87-5)	625	12	24
Benzyl butyl phthalate (85-68-7)	625	0.3	0.6
Benzo(*a*)anthracene (56-55-3)	625	0.3	0.6
Benzo(b)fluoranthene (3,4-benzofluoranthene) (205-99-2)[7]	610/625	0.8	1.6
Benzo(j)fluoranthene (205-82-3)[7]	625	0.5	1.0
Benzo(k)fluoranthene (11,12-benzofluoranthene) (207-08-9)[7]	610/625	0.8	1.6
Benzo(r,s,t)pentaphene (189-55-9)	625	0.5	1.0
Benzo(*a*)pyrene (50-32-8)	610/625	0.5	1.0
Benzo(*ghi*)Perylene (191-24-2)	610/625	0.5	1.0
Bis(*2-chloroethoxy)*methane (111-91-1)	625	5.3	21.2
Bis(*2-chloroethyl*)ether (111-44-4)	611/625	0.3	1.0
Bis(*2-chloroisopropyl*)ether (39638-32-9)	625	0.3	0.6
Bis(*2-ethylhexyl*)phthalate (117-81-7)	625	0.1	0.5
4-Bromophenyl phenyl ether (101-55-3)	625	0.2	0.4
2-Chloronaphthalene (91-58-7)	625	0.3	0.6
4-Chlorophenyl phenyl ether (7005-72-3)	625	0.3	0.5
Chrysene (218-01-9)	610/625	0.3	0.6
Dibenzo (a,h)acridine (226-36-8)	610M/625M	2.5	10.0
Dibenzo (a,j)acridine (224-42-0)	610M/625M	2.5	10.0
Dibenzo(a-*h*)anthracene (53-70-3)(1,2,5,6-dibenzanthracene)	625	0.8	1.6
Dibenzo(a,e)pyrene (192-65-4)	610M/625M	2.5	10.0
Dibenzo(a,h)pyrene (189-64-0)	625M	2.5	10.0
3,3-Dichlorobenzidine (91-94-1)	605/625	0.5	1.0
Diethyl phthalate (84-66-2)	625	1.9	7.6
Dimethyl phthalate (131-11-3)	625	1.6	6.4
Di-n-butyl phthalate (84-74-2)	625	0.5	1.0
2,4-dinitrotoluene (121-14-2)	609/625	0.2	0.4
2,6-dinitrotoluene (606-20-2)	609/625	0.2	0.4

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. ***(if available)***	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL)[2]** ***µg/L unless specified***
BASE/NEUTRAL COMPOUNDS (compounds in bold are Ecology PBTs)			
Di-n-octyl phthalate (117-84-0)	625	0.3	0.6
1,2-Diphenylhydrazine (*as Azobenzene*) (122-66-7)	1625B	5.0	20
Fluoranthene (206-44-0)	625	0.3	0.6
Fluorene (86-73-7)	625	0.3	0.6
Hexachlorobenzene (118-74-1)	612/625	0.3	0.6
Hexachlorobutadiene (87-68-3)	625	0.5	1.0
Hexachlorocyclopentadiene (77-47-4)	1625B/625	0.5	1.0
Hexachloroethane (67-72-1)	625	0.5	1.0
Indeno(*1,2,3-cd*)Pyrene (193-39-5)	610/625	0.5	1.0
Isophorone (78-59-1)	625	0.5	1.0
3-Methyl cholanthrene (56-49-5)	625	2.0	8.0
Naphthalene (91-20-3)	625	0.3	0.6
Nitrobenzene (98-95-3)	625	0.5	1.0
N-Nitrosodimethylamine (62-75-9)	607/625	2.0	4.0
N-Nitrosodi-n-propylamine (621-64-7)	607/625	0.5	1.0
N-Nitrosodiphenylamine (86-30-6)	625	0.5	1.0
Perylene (198-55-0)	625	1.9	7.6
Phenanthrene (85-01-8)	625	0.3	0.6
Pyrene (129-00-0)	625	0.3	0.6
1,2,4-Trichlorobenzene (120-82-1)	625	0.3	0.6

Pollutant & CAS No. ***(if available)***	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL)[2]** ***µg/L unless specified***
DIOXIN			
2,3,7,8-Tetra-Chlorodibenzo-P-Dioxin (176-40-16) (2,3,7,8 TCDD)	1613B	1.3 pg/L	5 pg/L

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. ***(if available)***	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL)[2]** ***µg/L unless specified***
PESTICIDES/PCBs			
Aldrin (309-00-2)	608	0.025	0.05
alpha-BHC (319-84-6)	608	0.025	0.05
beta-BHC (319-85-7)	608	0.025	0.05
gamma-BHC (58-89-9)	608	0.025	0.05
delta-BHC (319-86-8)	608	0.025	0.05
Chlordane (57-74-9) [8]	608	0.025	0.05
4,4'-DDT (50-29-3)	608	0.025	0.05
4,4'-DDE (72-55-9)	608	0.025	0.05
4,4' DDD (72-54-8)	608	0.025	0.05
Dieldrin (60-57-1)	608	0.025	0.05
alpha-Endosulfan (959-98-8)	608	0.025	0.05
beta-Endosulfan (33213-65-9)	608	0.025	0.05
Endosulfan Sulfate (1031-07-8)	608	0.025	0.05
Endrin (72-20-8)	608	0.025	0.05
Endrin Aldehyde (7421-93-4)	608	0.025	0.05
Heptachlor (76-44-8)	608	0.025	0.05
Heptachlor Epoxide (1024-57-3)	608	0.025	0.05
PCB-1242 (53469-21-9) [9]	608	0.25	0.5
PCB-1254 (11097-69-1)	608	0.25	0.5
PCB-1221 (11104-28-2)	608	0.25	0.5
PCB-1232 (11141-16-5)	608	0.25	0.5
PCB-1248 (12672-29-6)	608	0.25	0.5
PCB-1260 (11096-82-5)	608	0.13	0.5
PCB-1016 (12674-11-2) [9]	608	0.13	0.5
Toxaphene (8001-35-2)	608	0.24	0.5

1. Detection level (DL) or detection limit means the minimum concentration of an analyte (substance) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero as determined by the procedure given in 40 CFR part 136, Appendix B.

2. Quantitation Level (QL) also known as Minimum Level of Quantitation (ML) – The lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that the lab has used all method-specified sample weights, volumes, and cleanup procedures. The QL is calculated by multiplying the MDL by 3.18 and rounding the result to the number nearest to (1, 2, or 5) x 10^n, where n is an integer. (64 FR 30417).
   ALSO GIVEN AS:
   The smallest detectable concentration of analyte greater than the Detection Limit (DL)

where the accuracy (precision & bias) achieves the objectives of the intended purpose. (Report of the Federal Advisory Committee on Detection and Quantitation Approaches and Uses in Clean Water Act Programs Submitted to the US Environmental Protection Agency December 2007).

3. Soluble Biochemical Oxygen Demand method note: First, filter the sample through a Millipore Nylon filter (or equivalent) - pore size of 0.45-0.50 um (prep all filters by filtering 250 ml of laboratory grade deionized water through the filter and discard). Then, analyze sample as per method 5210-B.

4. NWTPH Dx - Northwest Total Petroleum Hydrocarbons Diesel Extended Range – see http://www.ecy.wa.gov/biblio/97602.html

5. NWTPH Gx - Northwest Total Petroleum Hydrocarbons Gasoline Extended Range – see http://www.ecy.wa.gov/biblio/97602.html

6. 1, 3-dichloroproylene (mixed isomers) You may report this parameter as two separate parameters: cis-1, 3-dichlorpropropene (10061-01-5) and trans-1, 3-dichloropropene (10061-02-6).

7. Total Benzofluoranthenes - Because Benzo(b)fluoranthene, Benzo(j)fluoranthene and Benzo(k)fluoranthene co-elute you may report these three isomers as total benzofluoranthenes.

8. Chlordane – You may report alpha-chlordane (5103-71-9) and gamma-chlordane (5103-74-2) in place of chlordane (57-74-9). If you report alpha and gamma-chlordane, the DL/PQLs that apply are 0.025/0.050.

9. PCB 1016 & PCB 1242 – You may report these two PCB compounds as one parameter called PCB 1016/1242.

APPENDIX H

REFERENCES AND PUBLICATIONS

APPENDIX H

REFERENCE PUBLICATIONS

Information on sewage treatment theory and application may be obtained from the following recommended publications:

- *Operation of Wastewater Treatment Plants*, by Ken Kerri, known as *The Sacramento Manual*. This is a comprehensive field study training program.
- *Wastewater Engineering*, by Metcalf & Eddy, Inc., published by McGraw-Hill.
- *Sewerage & Sewage Treatment*, by Babbit & Baumann, published by Wiley, Inc.
- *Pump Operation and Maintenance*, by H. B. Hicks, published by McGraw-Hill.
- *Chlorine Manual*, The Chlorine Institute.
- *Manual of Practice No. 1, Safety and Health in Wastewater Systems*, by Water Pollution Control Federation, Alexandria, Virginia.
- *Manual of Practice No. 7, Operation and Maintenance of Collection Systems*, by Water Pollution Control Federation, Alexandria, Virginia.
- *Operations Forum: A WPCF Publication for Wastewater Professionals*, by Water Pollution Control Federation.
- *What Every Supervisor Should Know*, 3rd Edition, L. R. Bittel, published by McGraw-Hill.
- *First Aid Handbook*, published by the American Red Cross.

A list of available reference documents with information pertaining to the wastewater system and facility is provided below.

- ***Plan As-builts***, *Town of Ferndale Sewage System Improvements, Treatment and Pumping Facilities, Schedule I*, Stevens, Thompson and Runyan, Inc., January 1969.

- ***Plan As-builts,*** *City of Ferndale Wastewater Treatment Plant Improvements,* Harper-Owes, July 1988.

- ***Plan As-builts***, *Leachate Pre-treatment Facility at the City of Ferndale Wastewater Treatment Plant,* Harper-Owes, December 1987.

- ***Plan As-builts***, *City of Ferndale Wastewater Treatment Plant, Effluent Scum Removal Facilities,* Harper-Owes, February 1990.

- ***Plan As-builts***, *City of Ferndale Wastewater Treatment Plant 1992 Improvements,* Harding Lawson Associates, December 1992.

- ***Biosolids Management Plan****, City of Ferndale Biosolids Management Plan*, Vasey Engineering, January 1996.

- ***Facilities Plan/Engineering Report,*** *City of Ferndale Comprehensive Wastewater Facilities Plan,* Vasey Engineering, February 1996.

- ***Addendum to the Facilities Plan/Engineering Report****, City of Ferndale Comprehensive Wastewater Facilities Plan,* Vasey Engineering, May 1996.

- ***Geotechnical Report,*** *City of Ferndale Wastewater Treatment Plant Improvements,* GeoEngineers, June 1996.

- ***Contract Record Drawings,*** *City of Ferndale Wastewater Treatment Plant Expansion Phase I Improvements,* (Draft), Vasey Engineering, February 1998.

- ***Geotechnical Report and Addendum,*** *Proposed Headworks and Sewer Lines, Ferndale, Washington,* GeoEngineers, February 1997 (report) and March 1997 (addendum).

- ***Construction Contract Documents (plans and specifications),*** *City of Ferndale Wastewater Collection and Treatment System Phase II Improvements,* Vasey Engineering, March 1998.

- ***WSDOT Standard Specifications for Road, Bridge, and Municipal Construction****, 1998 Edition.*

- ***Contract Record Drawings,*** *City of Ferndale Phase II Improvements,* Berryman & Henigar, 1999.

- ***Instruction and Maintenance Catalogs***, Wastewater Treatment Plant Expansion Phase I Improvements, Vasey Engineering, 1997.

- ***Instruction and Maintenance Catalogs***, Wastewater Collection and Treatment System Phase II Improvements, Berryman & Henigar, 1999.

- ***Facilities Plan**, City of Ferndale Wastewater Treatment Plant Facilities Plan,* Wilson Engineering, October 2016.

- ***Sewer Plan**, City of Ferndale Comprehensive Sewer Plan,* Wilson Engineering, December 2016.

- ***Plan As-Builts**, City of Ferndale Wastewater Treatment Plant Mechanical Screen Upgrade*, Wilson Engineering, May 2013.

- ***Geotechnical Engineering Report**, Ferndale Wastewater Facility Improvements,,* GeoEngineers, September 2019 (report).

- ***Plan As-Builts**, City of Ferndale Wastewater Treatment Plant Upgrade*, Wilson Engineering, September 2022.

- ***WSDOT Standard Specifications for Road, Bridge, and Municipal Construction**, 2022 Edition.*

APPENDIX I

BASIN DRAINING SOP

APPENDIX I

BASIN DRAINING SOPs

East Grit Chamber.....1
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Aeration Basin Flow Splitter.....3
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East Grit Chamber

To drain the East Grit Chamber:

1. Confirm influent flow rate is appropriate for shutdown. Grit basins should not be shut down during peak flow events when large amounts of grit are anticipated.
2. Shut off the air supply to the East Grit Chamber by closing the ball valve that carries air from the blowers in the Blower Building to the grit chambers. This valve is located just inside the grit chamber. This is valve **BV-260**.
3. Shut off the activated sludge supply that flows to the grit chamber from the secondary clarifiers, by closing the pipe with the plug valve: **PV-254**.
4. Shut off the inlet flow to the chamber by closing the slide gate: **SG-201**.
5. Allow the flow to enter the West Plant Drain Pump Station by opening the plug valve: **PV-201**.
    a. This must be done slowly to avoid flooding the flow meter vault and to avoid overwhelming the pump station.
6. Close the outlet flow once the chamber has drained to below the outlet piping level to ensure that there is no backflow. This is done by closing the slide gate: **SG-203**.
7. Once the East Grit Chamber is empty, close the drain valve (PV-201) to eliminate the risk of backflow from the West Plant Drain Pump Station.

Warnings:

To drain the East Grit Chamber, all of the influent flow must be diverted to the West Grit Chamber. A single grit chamber can hydraulically handle the design Peak Hour Flow, but the grit chamber may see a reduced efficiency of grit removal at flows above 8.2 MGD. It is not advised to drain the East Grit Chamber during periods of high flow.

All valves should be opened slowly to avoid sudden changes to the system and the possibly of overfilling wet wells.

While the grit chamber is draining to the West Plant Drain Pump Station, the water level in the pump station wet well should be monitored to ensure that it does not over fill. If the water level in the pump station wet well appears too high, the drain valve (PV-201) should be closed slightly to reduce the flow rate into the pump station.

Due to the changes in hydraulic pressure from draining the grit chamber, there is a risk that the flow pattern in the piping from the equipment to the drain pump station is disrupted and backflow may occur. As the chamber drains to the West Plant Drain Pump Station, the water level in the grit chamber should be monitored. If backflow does occur, the drain valve (PV-201) should be closed immediately.

West Grit Chamber

To drain the West Grit Chamber:

1. Confirm influent flow rate is appropriate for shutdown. Grit basins should not be shut down during peak flow events when large amounts of grit are anticipated.
2. Shut off the air supply to the West Grit Chamber by closing the ball valve that carries air from the blowers in the Blower Building to the grit chamber. This valve is located just inside the grit chamber. This is valve: **BV-261**.
3. Shut off the activated sludge supply that flows to the grit chamber from the secondary clarifiers, by closing the pipe with the plug valve: **PV-255**.
4. Shut off the inlet flow to the chamber by closing the slide gate: **SG-202**.
5. Allow the flow to enter the West Plant Drain Pump Station by opening the plug valve: **PV-200**.
    a. This must be done slowly to avoid flooding the flow meter vault and to avoid overwhelming the pump station.
6. Close the outlet flow once the chamber has drained to below the outlet piping level to ensure that there is no backflow. This is done by closing the slide gate: **SG-204**.
7. Once the West Grit Chamber is empty, close the drain valve (PV-200) to eliminate the risk of backflow from the West Plant Drain Pump Station.

Warnings:

To drain the West Grit Chamber, all of the influent flow must be diverted to the East Grit Chamber. A single grit chamber can hydraulically handle the design Peak Hour Flow, but please be aware that the grit chamber may see a reduced efficiency of grit removal at flows above 8.2 MGD. It is not advised to drain the West Grit Chamber during periods of high flow.

All valves should be opened slowly to avoid sudden changes to the system and the possibly of overfilling wet wells.

While the grit chamber is draining to the West Plant Drain Pump Station, the water level in the pump station wet well should be monitored to ensure that it does not over fill. If the water level in the pump station wet well appears too high, the drain valve (PV-200) should be closed slightly to slow the flow into the pump station.

Due to the changes in hydraulic pressure from draining the grit chamber, there is a risk that the flow pattern in the piping from the equipment to the drain pump station is disrupted and backflow may occur. As the chamber drains to the West Plant Drain Pump Station, the water level in the grit chamber should be monitored. If backflowing does occur, the drain valve (PV-200) should be closed immediately.

Aeration Basin Flow Splitter

The Aeration Basin Flow Splitter should rarely require draining. The weir gates in the flow splitter can be maintained without draining the structure, and flow splitter should not experience much grit accumulation due to the upstream grit chambers. If the flow splitter develops a sludge blanket that needs to be removed, or if the weir gates or concrete structure require repair, the Aeration Basin Flow Splitter can be drained using the built-in drain on the northwest corner of the structure. However, since the Aeration Basin Flow Splitter cannot be drained without diverting the entire plant's influent flow, it may be preferable to use a Vactor truck to perform the required maintenance, if possible.

To drain the Aeration Basin Flow Splitter:

1. Turn off the inlet flow to the aeration basin flow splitter. This is done by closing the slide gates at the outlet of the grit basin: **SG-203 and SG-204**.
2. Open the plug valve to allow the flow to drain to the West Plant Drain Pump Station, using the plug valve: **PV-310**.
3. Close the Aeration Basin Flow Splitter outlet valves once the wet well drains to below the outlet level to reduce the risk of backflow. These valves include the two (2) Aeration Basin influent flow meter isolation valves, and all three (3) outlets from the flow splitter, leading to the North Aeration Basin, South Aeration Basin, and the Long-Term Digestion Basin. To shut off these outlets, close the following plug valves and slide (weir) gates: **PV-560**, **PV-561**, **WG-211**, **WG-212**, and **WG-213**.
4. Close the drain valve (PV-310) again once the basin is drained to avoid the possibility of backflow.

Warnings:

All valves should be opened slowly to avoid sudden changes to the system and the possibly of overfilling wet wells.

While the flow splitter is draining to the West Plant Drain Pump Station, the water level in the pump station wet well should be monitored to ensure that it does not over fill. If the water level in the pump station appears too high, the drain valve (PV-310) should be closed slightly to slow the flow into the pump station.

Due to the changes in hydraulic pressure from draining the flow splitter, there is a risk that the flow pattern in the piping from the equipment to the drain pump station is disrupted and backflow may occur. As the flow splitter drains to the West Plant Drain Pump Station, the water level in the flow splitter should be monitored. If backflowing does occur, the drain valve (PV-310) should be closed immediately.

North Aeration Basin

There is no built-in drain in the North Aeration Basin. The aeration basins should rarely require draining, since the fine bubble diffusers are the only equipment in the basin, and they can be removed without draining the basin. However, it is possible the aeration basins may benefit from occasional dewatering for sludge and grit removal.

To drain the North Aeration Basin:

1. Turn off the air flow from the blowers in the Blower Building to the North Aeration Basin. To turn off aeration in the North Aeration Basin, but maintain air flow in the South Aeration Basin and Grit Basins, the following butterfly valves must be closed: **BT-908**, **BT-909**, and **BT-910**.
2. Stop the sludge return flow to the North Aeration Basin. To turn off this flow, the downstream actuated plug valve in the RAS valve box on the piping from North Clarifier must be closed. This valve is: **PV-533**
3. Use portable pumps and drain the water out of the basins. The outlet of these pumps should drain into the West Drain Pump Station.
4. When the basin is drained below the level of the outlet piping, the effluent should be shut off to avoid any accidental backflow back into the outlet. Do this by closing the Slide (Weir) Gate, **WG-310**.

Warnings:

It is important that the air flow to the North Aeration Basin be turned off prior to draining the basin. The fine bubble diffusers sit approximately one foot above the bottom of the basin, so there is risk of damaging the diffusers if they continue to operate at a lowered water level and hit the bottom of the basin.

It is important to avoid draining the North Aeration Basin during times of high ground water. If the groundwater level is higher than the bottom of the aeration basin, it is possible that the liner system may start to “float”, which could damage the liner and significantly impair operation of the basin. High groundwater could also cause the sides slopes of the basin to become unstable and cause damage to the liner. Draining the aeration basin should only be performed during drier periods in the summer, when the groundwater level is comfortably below the basin bottom elevation of 12.0 ft.

While the aeration basin is draining to the West Plant Drain Pump Station, the water level in the pump station wet well should be monitored to ensure that it does not over fill. If the water level in the pump station wet well appears too high, the pumping rate should be slowed to reduce the flow rate entering the pump station.

South Aeration Basin

There is no built-in drain in the South Aeration Basin. The aeration basins should rarely require draining, since the fine bubble diffusers are the only equipment in the basin, and they can be removed without draining the basin. However, it is possible the aeration basins may benefit from occasional dewatering for sludge and grit removal.

To drain the South Aeration Basin:

1. Turn off the air flow from the blowers in the Blower Building to the South Aeration Basin. To turn off aeration in the South Aeration Basin, but maintain air flow in the North Aeration Basin and Grit Basins, the following butterfly valves must be closed: **BT-907**, **BT-909**, and **BT-911**.
2. Stop the sludge return flow to the South Aeration Basin. To turn off this flow, the downstream actuated plug valve in the RAS valve box on the piping from South Clarifier must be closed. This valve is: **PV-534**
3. Use portable pumps and drain the water out of the basins. The outlet of these pumps should drain into the West Drain Pump Station.
4. When the basin is drained below the level of the outlet piping, the effluent should be shut off to avoid any accidental backflow back into the outlet. Do this by closing the Slide (Weir) Gate, **WG-311**.

Warnings:

It is important that the air flow to the South Aeration Basin be turned off prior to draining the basin. The fine bubble diffusers sit approximately one foot above the bottom of the basin, so there is risk of damaging the diffusers if they continue to operate at a lowered water level and hit the bottom of the basin.

It is important to avoid draining the South Aeration Basin during times of high ground water. If the groundwater level is higher than the bottom of the aeration basin, it is possible that the liner system may start to “float”, which could damage the liner and significantly impair operation of the basin. High groundwater could also cause the sides slopes of the basin to become unstable and cause damage to the liner. Draining the aeration basin should only be performed during drier periods in the summer, when the groundwater level is comfortably below the basin bottom elevation of 12.0 ft.

While the aeration basin is draining to the West Plant Drain Pump Station, the water level in the pump station wet well should be monitored to ensure that it does not over fill. If the water level in the pump station appears too high, the pumping rate should be slowed to reduce the flow into the pump station.

Clarifier Flow Splitter

The Clarifier Flow Splitter should rarely require draining. The weir gates in the flow splitter can be maintained without draining the structure, and flow splitter should not experience much grit accumulation due to the upstream grit chambers. However, if the flow splitter develops a sludge blanket that needs to be removed, or if the weir gates or concrete structure require repair, the Clarifier Flow Splitter can be drained using the built-in drain on the northeast corner of the structure.

To drain the Clarifier Flow Splitter:

1. Turn off the polymer feed system in the Blower Building.
2. Shut off the incoming flow to the Clarifier Flow Splitter by turning off the Mixed Liquor Pump Station.
3. Allow contents of the flow splitter to drain the West Plant Drain Pump Station by opening the drain plug valve, **PV-502**.
4. Once the flow splitter has drained to below the outlet level, close the outlet valves to reduce the risk of backflow. These outlets feed the North Clarifier, South Clarifier, and the possible future third clarifier. To shut off the outlets, close the slide (weir) gates: **WG-511**, **WG-512**, and **WG-513**.
5. Once the wet vault of the Clarifier Flow Splitter is empty, the drain valve (PV-502) should be closed to avoid the risk of accidental backflow into the basin.

Warnings:

All valves should be opened slowly to avoid sudden changes to the system and the possibly of overfilling wet wells.

While the flow splitter is draining to the West Plant Drain Pump Station, the water level in the pump station wet well should be monitored to ensure that it does not over fill. If the water level in the pump station appears too high, the drain valve (PV-502) should be closed slightly to slow the flow into the pump station.

Due to the changes in hydraulic pressure from draining the flow splitter, there is a risk that the flow pattern in the piping from the equipment to the drain pump station is disrupted and backflow may occur. As the flow splitter drains to the West Plant Drain Pump Station, the water level in the flow splitter should be monitored. If backflow does occur, the drain valve (PV-502) should be closed immediately.

North Clarifier

To drain the North Clarifier:

1. Turn off the mechanical clarifier equipment in the North Clarifier. Follow all lockout/tagout and any other safety procedures.
2. Turn off the 3W water supply to the clarifier sprayers. To do this, close the plug valve, **PV-510**, to shut off the inlet well spray header supply. Also close the ball valve, **BV-520**, to shut off the hot-dip galvanized supply ring supply.
3. Disable the sludge flow system by closing the plug valves that drain sludge from the North Clarifier. To stop the Return Activated Sludge (RAS) flow from the North Clarifier, close the valve **PV-531**. To shut off the flow of waste activated sludge (WAS) to the digestion basin, close the valve **PV-538**. To shut off the activated sludge (AS) flow to the Grit Basins, close the valve **PV-250**. If desired, activated sludge dosing to the East Grit Basin can be maintained during North Clarifier shut-down by opening the crossover valve **PV-256** to send active sludge from the South Clarifier to both East and West Grit Basins.
4. Turn off the influent flow to the clarifier using the Slide (Weir) Gate: **WG-511**, located in the Clarifier Flow Splitter.
5. Open the plug valve to allow the clarifier to drain into the West Plant Drain Pump Station. This valve is **PV-500** and should only be open a small amount to limit the flow rate out of the clarifier.
6. Once the basin is drained, the drain valve (**PV-500**) should be closed to lower the risk of accidental backflow.

Warnings:

All valves should be opened slowly to avoid sudden changes to the system and the possibly of overfilling wet wells.

While the clarifier is draining to the West Plant Drain Pump Station, the water level in the pump station wet well should be monitored to ensure that it does not over fill. If the water level in the pump station appears too high, the drain valve (PV-500) should be closed slightly to slow the flow into the pump station.

Due to the changes in hydraulic pressure from draining the clarifier, there is a risk that the flow pattern in the piping from the equipment to the drain pump station is disrupted and backflow may occur. As the clarifier drains to the West Plant Drain Pump Station, the water level in the clarifier should be monitored. If backwashing does occur, the drain valve (PV-500) should be closed immediately.

South Clarifier

To drain the South Clarifier:

1. Turn off the mechanical clarifier equipment in the South Clarifier. Follow all lockout/tagout and any other safety procedures.
2. Turn off the 3W water supply to the South Clarifier sprayers. To do this, close the plug valve, **PV-511**, to shut off the inlet well spray header supply. Also close the ball valve, **BV-521**, to shut off the hot-dip galvanized supply ring supply.
7. Disable the sludge flow system by closing the plug valves that drain sludge from the South Clarifier. To stop the Return Activated Sludge (RAS) flow from the South Clarifier, close the plug valve **PV-532**. To shut off the flow of waste activated sludge (WAS) to the digestion basin, close the valve **PV-539**. To shut off the activated sludge (AS) flow to the East Grit Basin, close the valve **PV-250**. If desired, activated sludge dosing to the West Grit Basin can be maintained during South Clarifier shut-down by opening the crossover valve **PV-256** to send active sludge from the North Clarifier to both East and West Grit Basins.
3. Turn off the influent flow to the clarifier, using the Slide (Weir) Gate: **WG-512**, located in the Clarifier Flow Splitter.
4. Open the plug valve to allow the clarifier to drain into the West Plant Drain Pump Station. This valve **PV-501** and should only be open a small amount to limit the flow rate out of the clarifier.
5. Once the basin is drained, the drain valve (PV-501) should be closed to lower the risk of accidental backflow.

Warnings:

All valves should be opened slowly to avoid sudden changes to the system and the possibly of overfilling wet wells.

While the clarifier is draining to the West Plant Drain Pump Station, the water level in the pump station wet well should be monitored to ensure that it does not over fill. If the water level in the pump station appears too high, the drain valve (PV-501) should be closed slightly to slow the flow into the pump station.

Due to the changes in hydraulic pressure from draining the clarifier, there is a risk that the flow pattern in the piping from the equipment to the drain pump station is disrupted and backflow may occur. As the clarifier drains to the West Plant Drain Pump Station, the water level in the clarifier should be monitored. If backflow does occur, the drain valve (PV-501) should be closed immediately.

UV Disinfection Channel

The UV Disinfection Channel may require occasional draining to clean the channel. There is no backup chlorination or other disinfection system in place, so final effluent cannot be discharged from the system during UV channel draining events.

To drain the UV Disinfection Channel:

1. Stop the secondary effluent flow coming from the North and South Clarifiers. This will require shutting off flow feeding the clarifiers, and/or bringing the water level in the clarifier(s) down to allow some amount of storage before water starts overflowing the effluent weir. There are various methods to stop the flow of secondary effluent for at least a few hours, including the following:
    a. Turn off the Mixed Liquor Pump Station and store flow in the Aeration Basins. Additional storage capacity is available from the normal Aeration Basin operation level of 24.0 to the high water Aeration Basin operation level of 25.0. One (1) foot of excess storage is equal to approximately 400,000 gallons.
    b. For more storage capacity, the weir gates at the outlets of the North and South Aeration Basin can be lowered to the minimum elevation of 22.0 to lower the water levels in the aeration basins: WG-310 and WG-311. These weir gates should then be raised to the normal operation elevation of 24.0 to allow for two additional feet of storage in both aeration basins. The mixed liquor pump station can also be temporarily turned off to allow additional storage in the pump station. This will provide a few hours, depending on influent flow, during which the UV channel can be drained and cleaned.
    c. One clarifier can be drained in preparation to drain the UV channel. Once the clarifier is drained, the incoming mixed liquor flow should be redirected from the still-full clarifier to the now-empty clarifier by shutting and opening the respective weir gate in the Clarifier Flow Splitter. Sending the entire mixed liquor flow to the empty clarifier will provide several hours, depending on influent flow, during which the UV channel can be drained and cleaned.
2. Open the UV channel drain to drain the UV channel into the East Plant Drain Pump Station by opening the gate valve: **GV-600**.

Warnings:

All valves should be opened slowly to avoid sudden changes to the system and the possibly of overfilling wet wells.

While the UV channel is draining to the East Plant Drain Pump Station, the water level in the pump station wet well should be monitored to ensure that it does not over fill. If the water level in the pump station appears too high, the drain valve (GV-600) should be closed slightly to slow the flow into the pump station.

Due to the changes in hydraulic pressure from draining the UV channel, there is a risk that the flow pattern in the piping from the equipment to the drain pump station is disrupted and backflow may occur. As the UV channel drains to the East Plant Drain Pump Station, the water level in the UV channel and the East Plant Drain Pump Station should be monitored. If backflow does occur, the drain valve (GV-600) should be closed immediately.