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APONOWICH, DRISCOLL & ASSOCIATES, INC.

August 7, 2020

Mr. Randall Bailey
Oregon Department of Environmental Quality
Northwest Region
700 NE Multnomah St., Suite 600
Portland, Oregon 97232

Re: Proposed NW Natural Pretreatment Expansion--Interim Trench Project
NW Natural Source Control Groundwater Treatment Facility
7900 NW St. Helens Road, Portland
NPDES Permit Number 103061 (permit renewal pending with DEQ)

Dear Mr. Bailey:

This is to notify you of proposed modifications to be made to the NW Natural Pretreatment Plant on the NW Natural site, required under the NPDES Permit Section D1. We have attached the Design Report for the expansion of the NW Natural Pretreatment Plant for review and approval.

Background

In April 2020, the Oregon Department of Environmental Quality (DEQ) directed NW Natural to install and operate an interim source control measure, consisting of a groundwater interceptor trench system and a network of piezometers and monitoring wells for monitoring the performance of the interceptor trenches (DEQ 2020).

Previous groundwater data and groundwater data collected subsequent to the LNG Basin project showed increases in benzene concentrations in the fill downgradient of the LNG Basin from late 2018 through 2019. As a result, the construction of two Interim Water-Bearing Zone (WBZ) trenches will begin in October 2020: a primary trench to be constructed in the PacTerm Basin and a secondary trench near existing well MW-49F on the north corner of the LNG Basin.

NW Natural Pretreatment Plant Expansion

Groundwater drains, cleanout risers, sumps, and vertical risers will be installed in the trenches to recover groundwater flowing through the contaminated Fill to prevent contaminants from reaching the shoreline wells or the Willamette River. These wells will ultimately discharge to an expanded NW Natural Pretreatment Plant to remove specific constituents (benzene, naphthalene and possibly free product (oil)) prior to discharge of the water to the main Groundwater Treatment Plant. The unit processes to be added are the same as the existing processes.

Rather than sizing the Interim Trench treatment processes only for the estimated Interim Trench flows and loads, the sizing of the expanded facilities includes the ability to handle a part of the flow and load from the existing NW Natural Wells. The expanded plant will also be designed with provisions to dampen the high peak flows to the current plant which occur when certain wells start up.

Major advantages to this approach are a reduction in flows, particularly the peak flows to and from the existing NW Natural Pretreatment Plant and additional future capacity if needed. Reducing the flow and flow peaks to the current components of the NW Natural Pretreatment Plant will improve its operation, particularly the existing Oil-Water Separator. The reduced peak flows will also enhance operations inside the building, particularly the IPCs.

The attached Design Report describes the addition of supplemental units to the NW Natural Pretreatment Plant to expand capacity for the flows and pollutants from the Interim Trench. Effluent from the expanded NW Natural Pretreatment Plant will continue to discharge to the main Groundwater Treatment System as before.

Besides treating the additional groundwater from the Interim Trench, the process tanks will also collect and treat volatile organic vapors from the new wells. The Oil-Water Separator will be equipped with a passive vapor-phase carbon system to capture any volatilized hydrocarbons as the flow enters the tank. Vapors from the new Air Stripper will be pumped to the existing Vapor-Phase Carbon units for removal. Groundwater flows from the Interim Trench will be measured and recorded within the plant's SCADA system.

In order to comply with DEQ's requirements for the construction of the Interim Trench components, we are attempting to complete the expansion of the NW Natural Pretreatment Plant by the end of November 2020. Stamped design drawings for the project will be stored at the plant site for your review.

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We would appreciate an expeditious review of the project so that we may complete the project on this timeline.

Please contact me if you have questions.

Very truly yours,

Terence P Driscoll

Terence P. Driscoll P.E., BCEE
President

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NW Natural

Interim Trench
NW Natural Pretreatment Plant Expansion
Wastewater Treatment Design Report

August 2020

ADA

APONOWICH, DRISCOLL & ASSOCIATES, INC.

NW Natural Interim Trench Wastewater Treatment Plant Design Report

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Background

In April 2020, the Oregon Department of Environmental Quality (DEQ) directed NW Natural to install and operate an interim source control measure, consisting of a groundwater interceptor trench system and a network of piezometers and monitoring wells for monitoring the performance of the interceptor trenches (DEQ 2020). The purpose of the interim measure is to control groundwater in the Fill WBZ downgradient of the LNG Basin. Groundwater flow patterns in this area had been affected by construction in the LNG Tank Basin and the former Koppers Tank Basin.

Previous groundwater data and groundwater data collected subsequent to the LNG Basin project showed increases in benzene concentrations in the fill downgradient of the LNG Basin from late 2018 through 2019. As a result, the construction of two Interim Water-Bearing Zone (WBZ) trenches will begin in October 2020: a primary trench to be constructed in the PacTerm Basin and a secondary trench near existing well MW-49F on the north corner of the LNG Basin.

Groundwater drains, cleanout risers, sumps, and vertical risers will be installed in the trenches to recover groundwater flowing through the contaminated Fill to prevent contaminants from reaching the shoreline wells or the Willamette River. These wells will ultimately discharge to an expanded NW Natural Pretreatment Plant to remove specific constituents (benzene, naphthalene and possibly free product (oil)) prior to discharge of the water to the main Groundwater Treatment Plant.

This Design Report will describe the addition of a supplemental unit to the NW Natural Pretreatment plant to expand capacity for the flows and pollutants from the Interim Trench. Effluent from the expanded NW Natural Pretreatment Plant will discharge to the main Groundwater Treatment System.

Flows and Pollutants

Groundwater modeling of the Interim Trench project was performed by Anchor QEA, LLC for wet-season conditions (December—March) and for dry-season (June-September) conditions, as well as the annual average condition.

Projected Flows from the Interim Trenches

Table 1 is a summary of the results of the modeling which will be utilized for design of a new unit at the NW Natural Pretreatment Plant to treat flows from the trench system. Table 1 also includes the value to be used for design of the new units, recognizing that individual factors, principally rainfall events and river stage, could result in higher daily flows.

Table 1: Projected Flows from Interim Trench System

Condition	Annual Average	Wet Season (Dec-Mar)	Dry Season (Jun-Sep)
River Stage, ft COP gage	8.84	10.20	7.19
Rainfall, in/month	3.9	7.2	0.95
Total Projected Flow, gpm	**20**	**35**	**5.7**
Design Max Day Flow, gpm	**30**	**60**	**12**

Projected Groundwater Quality from Interim Trenches

Based upon past sampling of representative monitoring wells, particularly MW-10-25, it is projected that the benzene concentration in the groundwater pumped from the new interim trench system could be as high as 100 mg/L. Other expected contaminants include polycyclic aromatic hydrocarbons, largely naphthalene at approximately 10 mg/L. In addition, some amount of free product (oil) could be expected.

Table 2 is a summary of flows and pollutant loads to be used in the design of the new units. The design loadings of the new units have assumed the projected maximum-day flows and loadings and is conservative for typical annual flows and loads.

Table 2: Summary of Design Flows and Loads for Maximum Interim Trench Groundwater Flows and Concentrations

Design	Interim Trench	Comments/Assumptions
Peak Flow, gpm	60	Peak hour estimate
Maximum Day Flow, gpm	35	From model
VOCs, mg/L	120	MW-10-25 (mostly benzene)
, lbs/day	50.5	
SVOCs, mg/L	13	MW-10-25 (mostly naphthalene)
, lbs/day	5.5	
Oil, mg/L	100	Estimate
, lbs/day	42.1	

The Interim Trench treatment processes are intended to address the following components:

- VOCs, particularly benzene at approximately 100 mg/L;
- PAHs, particularly naphthalene at approximately 10 mg/L; and
- Possible free product (concentrations unknown).

In addition, ferrous iron is assumed to be present at high concentrations.

Design Concept

Process Sizing

The NW Natural Pretreatment Plant must be expanded to handle a design wet weather flow from the interim trench system.

Rather than sizing the Interim Trench treatment processes only for the estimated Interim Trench flows and loads, the sizing of the expanded facilities will include the provision to handle a part of the flow and load from the existing NW Natural Hydraulic Control and Containment (HC&C) System. The expanded plant will also be designed with provisions to dampen the high peak flows to the current plant which occur when certain wells start up.

Major advantages to this approach are a reduction in flows, particularly the peak flows to and from the existing NW Natural Pretreatment Plant, and the presence of additional capacity if needed in the future. Reducing the flow and flow peaks to the current components of the NW Natural Pretreatment Plant will improve its operation, particularly the existing Oil-Water Separator. The reduced peak flows will also enhance operations inside the building, particularly the Inclined-Plate Clarifiers (IPCs).

The design data and process sizing for the new Interim Trench facilities are shown in Appendix A.

Treatment Processes Used

Because the main pollutants (VOCs, SVOCs, free product and iron) are similar to those experienced in the NW Natural Pretreatment Plant, <u>the new processes will be identical to the existing NW Natural Pretreatment Plant</u>. The new process equipment will be selected and installed to both address the constituents in the new trench and improve the reliability and performance of the existing NW Natural Pretreatment Plant processes as follows:

- **Oil-Water Separator** (Weir Tank) designed to remove both LNAPL and DNAPL. The new Oil-Water Separator will accommodate the new trench flow as well as a portion of influent flow as desired from the existing NW Natural Pretreatment flow. Passive capture of incoming volatile vapors will take place in a vapor-phase carbon canister;
- **Caustic Addition** to increase pH to facilitate rapid ferrous iron oxidation and precipitation, and to facilitate cyanide oxidation in the main Groundwater Treatment System. The new caustic pump is identical to the existing pumps and will be piped to the same manifold, allowing any caustic pump to feed any Air Stripper.
- **An Air Stripper** with a new variable-speed blower. The new Air Stripper is capable of handling all flow from the Interim Trench as well as up to 265 gpm from the existing NW Natural Pretreatment flows. The new variable-speed blower is identical to the two existing blowers and will be manifolded to the existing blowers to increase overall system reliability.
- **A Vapor-Phase Blower** to remove stripped organics from the Air Stripper and discharge to existing Vapor-Phase Carbon vessels.

Process Description

Flow Routing. Flow routing for the combined system is shown on the Process Flow Diagram and the Piping and Instrumentation Diagram and is described in this section.

Flow from the Interim Trench will be pumped into the Interim Trench Pretreatment Units via a 2-inch steel pipeline and pass through a 2-inch magnetic flow meter. A tap and 2-inch static mixer ate provided for de-emulsifying chemicals prior to the new Oil-Water Separator.

A separate 6-inch line will be piped directly to the new Air Stripper and will divert a portion of the flow as desired from the existing NW Natural HC&C System. The flow will be discharged to one or a combination of three locations, depending upon the desired outcome and operating conditions:

1. Directly to the existing Effluent Wet Well for conveyance to the Main Treatment Plant;
2. Recirculated to the existing NW Natural Pretreatment Plant, or
3. Recirculated back to the new Air Stripper if volatile organic compounds are still present in significant concentrations.

Oil-Water Separator. The design of the Interim Well Treatment units will include an 18,000-gallon oil-water separator, which will be capable of handling up to half of the current flow to the NW Natural Pretreatment, as well as the new Interim Trench flows. The Oil-Water Separator will be capable of handling up to 325 gpm of combined flow from the Interim Trench system and the existing NW Natural HC&C System.

The larger oil-water separator will also be capable of handling the potential free product from the trenches, as well as a portion of the DNAPL directed to the existing oil-water separator. The Oil-Water Separator will be equipped with a vent for passive removal of vaporized volatile compounds through a vapor-phase carbon vessel.

Oil De-Emulsifier System. Historically, the oily groundwater entering the NW Natural Pretreatment Plant has been an emulsion, with water and oil thoroughly mixed and difficult to separate in the existing oil-water separator. As a result, the oily sludge from the existing plant contains a significant amount of water.

Past bench-scale studies with de-emulsifying agents showed some promise in improving oil-water separation. As a result, an oil-de-emulsifier system (insertion quill and static mixer) will be installed in the influent lines from the Interim Trench and the diversion line from the NW Natural HC&C System, to feed de-emulsifying chemicals as desired prior to entry to the Oil-Water Separator. De-emulsifying chemicals can be useful in modifying the structure of the incoming oily groundwater and permitting better separation and removal of oil from the water.

Caustic Feed System. A new caustic feed pump identical to the existing two caustic feed pumps will be provided to raise the pH of the groundwater to 10.0-10.5 from the Interim Trench. The rates of iron and manganese oxidation are both greatly accelerated at higher pH.

The new pump will be piped together with the other pumps to provide additional reliability. A pH controller will be installed in the new Air Stripper to control the pH in the tank.

Air Stripper. A closed 18,000-gallon air stripper will be provided and will be capable handling up to 325 gpm of combined flow from the Interim Trench and the existing NW Natural Pretreatment Plant. The air stripper will consist of two compartments each 6,000 gallons in capacity, with a 6,000-gallon wet well.

At a maximum projected flow of 60 gpm from the Interim Trench, up to 265 gpm of the current flow to the NW Natural Pretreatment could be routed through the new pretreatment units as desired. This represents almost all of the current flow to the existing NW Natural Pretreatment Plant.

Air Stripper Blower. A new 1,200-cfm positive-displacement blower would be purchased to run the new air stripper. The blower will be identical to the two existing blowers and tied into the existing piping, providing additional reliability for the entire NW Natural Pretreatment Plant.

The new blower is designed to provide a minimum air-water ratio of 30:1 at all flows to the new system: including both flows from the Interim Trench as well as the diverted flows from the existing NW Natural Pretreatment Plant.

All contaminated air will be collected from the air space in the air stripper and discharged to the existing Vapor-Phase Carbon Vessels.

Process Control and Monitoring

All processes and control loops will be controlled and monitored by the existing SCADA system. The following control loops will be incorporated into the new facilities:

Flow Control Loops. Referring to the Piping and Instrumentation Diagram, a flow meter will be installed on the new line from the Interim Trench system to provide a readout of incoming flow from the trench system. Expected flows are expected to range from approximately 6 gpm to 60 gpm.

A control loop will be installed on the diversion line from the existing NW Natural Pretreatment Plant. A designated diversion flow rate from 0-265 gpm of NW Natural Pretreatment flows will be manually selected and the flow controlled via a control valve on the diversion line.

Two separate control loops will be installed on the Oil-Water Separator and Air-Stripper because of the desire to reduce peak flows resulting from simultaneous starting of wells in the existing NW Natural HC&C System, as well as the new Interim Trench system. A constant-flow rate will be programmed into the flow meter from each operation, which will control the speed of the process pumps to produce a nearly constant output to the downstream process. This dampening of the flows will improve operations in both the existing NW Natural Pretreatment Plant and in the Main Groundwater Treatment System, particularly in the Inclined-Plate Clarifiers.

Air Flow Control Loop. The existing Air Stripper air flow is controlled by the influent flow meter and the output of the Air Stripper Blowers. The key process variable for effective air stripping is known as the air: water ratio, defined as:

$$Air{:}\,Water\ \left(\frac{A}{W}\right) Ratio = \frac{Air\ Flow, scfm * 7.48}{Flow, gpm}$$

Rearranging the equation provides the method of controlling the air flow rate for a selected air: water ratio:

$$\frac{A{:}\,W\ Ratio * Flow, gpm}{7.48} = Air\ Flow, scfm$$

For example, for a 30: 1 A/W ratio and a flow rate of 200 gpm, the airflow rate to produce this ratio is:

$$\frac{30 * 200}{7.48} = 802\ scfm$$

The air flow control loop measures the incoming flow continuously and applies a pre-set multiplier (the A: W ratio) and a 4-20 milliampere signal to adjust the output of the Air Stripper

Blower to continuously produce the desired A: W ratio. This target A: W ratio may be adjusted in response to actual organics concentrations and observed performance of the Air Stripper in removing incoming organics.

pH Control Loop. Oxidation of ferrous iron occurs more rapidly at elevated alkaline pH levels. In addition, any cyanide gas release is minimized by such levels. A 25% solution of liquid sodium hydroxide (caustic) is currently used for this purpose in the existing NW Natural Pretreatment Plant. Liquid caustic will also be used in the Interim Trench facilities.

The existing pH target range in the NW Natural Pretreatment Plant is 10.0-10.5. This range will be maintained in the new Air Stripper by a pH controller located in the Air Stripper and a caustic addition direct to the Air Stripper.

Level Indication and Shutdown Loop. Level will be indicated in the wet wells of the Oil-Water Separator and the Air Stripper. The constant output setting on the process pumps will allow flow surges to be manifested in rising or lowering of the wet wells, thus producing an equalized flow. In the event that actual influent flows exceed the constant-flow setpoint the wet well level will rise. If this rise continues for a significant time, a high-level condition will necessitate the pump to speed up and will also generate a HIGH-LEVEL alarm on the SCADA system.

Similarly, if the flow to the plant drops below the flow setpoint for a significant time, the wet well level will drop, potentially causing pump cavitation or damage to the pump. In that case a LOW-LEVEL cutoff will shut down the pump until the water level rises to an acceptable level when the pump will re-start to the prior setpoint.

Pretreatment Plant Location

The new pretreatment components will be located adjacent to the existing Pretreatment Plant.

The additional units (Air Stripper, Air Stripper Blower and caustic feed pump) will be the same size as the existing units and will be tied in with the existing units providing an extra measure of reliability and extra capacity, particularly in the Air Stripping operation.

All units will be placed within a new secondary containment area adjacent to the existing secondary containment area for the NW Natural Pretreatment Plant.

Appendix A—Interim Trench Process Design Data

NW NATURAL PRETREATMENT FACILITIES– INTERIM TRENCH ADDITION			
INTERIM TRENCH	**FLOW CONDITION: INTERIM TRENCH ONLY**	**FLOW CONDITION: INTERIM TRENCH + OTHER NWN WELLS**	
PEAK FLOW, GPM	60	60	
MAXIMUM DAY FLOW, GPM	35	35	DURING WET SEASON (DEC–MAR)
TOTAL VOCS			
BENZENE, MG/L	100	100	
, LBS/DAY	42.1	42.1	
OTHER VOCS, MG/L	20	20	
, LBS/DAY	8.4	8	
TOTAL VOCS, LBS/DAY	**50.5**	**50.5**	
TOTAL SVOCS			
NAPHTHALENE, MG/L	10	10	
, LBS/DAY	4.2	4.2	
OTHER SVOCS, MG/L	3	3	
, LBS/DAY	1.3	1.3	
TOTAL SVOCS, LBS/DAY	**5.5**	**5.5**	
+ OTHER NWN WELL FLOWS			
TOTAL OTHER WELL FLOW, GPM	0	265	Diveretd flow from Existing NW Natural Pretreatment
TOTAL VOCS, MG/L	–	0.50	
, LBS/DAY	0	1.6	
TOTAL SVOCS, MG/L	–	2.0	
, LBS/DAY	0	6.4	
TOTAL FLOW AND LOAD TO PLANT			
AVERAGE COMBINED FLOW, GPM	35	300	
PEAK COMBINED FLOW, GPM	60	325	
TOTAL VOCS, LBS/DAY	**50.5**	**52.1**	
TOTAL SVOCS, LBS/DAY	**5.5**	**11.8**	
OIL-WATER SEPARATOR / EQUALIZATION TANK			
TYPE	WEIR		Covered
NUMBER OF UNITS	1		
PROCESS VOLUME, GALS	12,000		
TOTAL PROCESS VOLUME, GALS	12,000		
DETENTION TIME, MINS @ MAX DAY FLOW	343	40	
DETENTION TIME, MINS @ PEAK FLOW	200	37	
EQUALIZATION WET WELL			
TYPE	WEIR		Covered
NUMBER OF UNITS	1		
PROCESS VOLUME, GALS	6,000		
DETENTION TIME, MINS @ AVERAGE FLOW	171	20	
DETENTION TIME, MINS @ PEAK FLOW	100	18	

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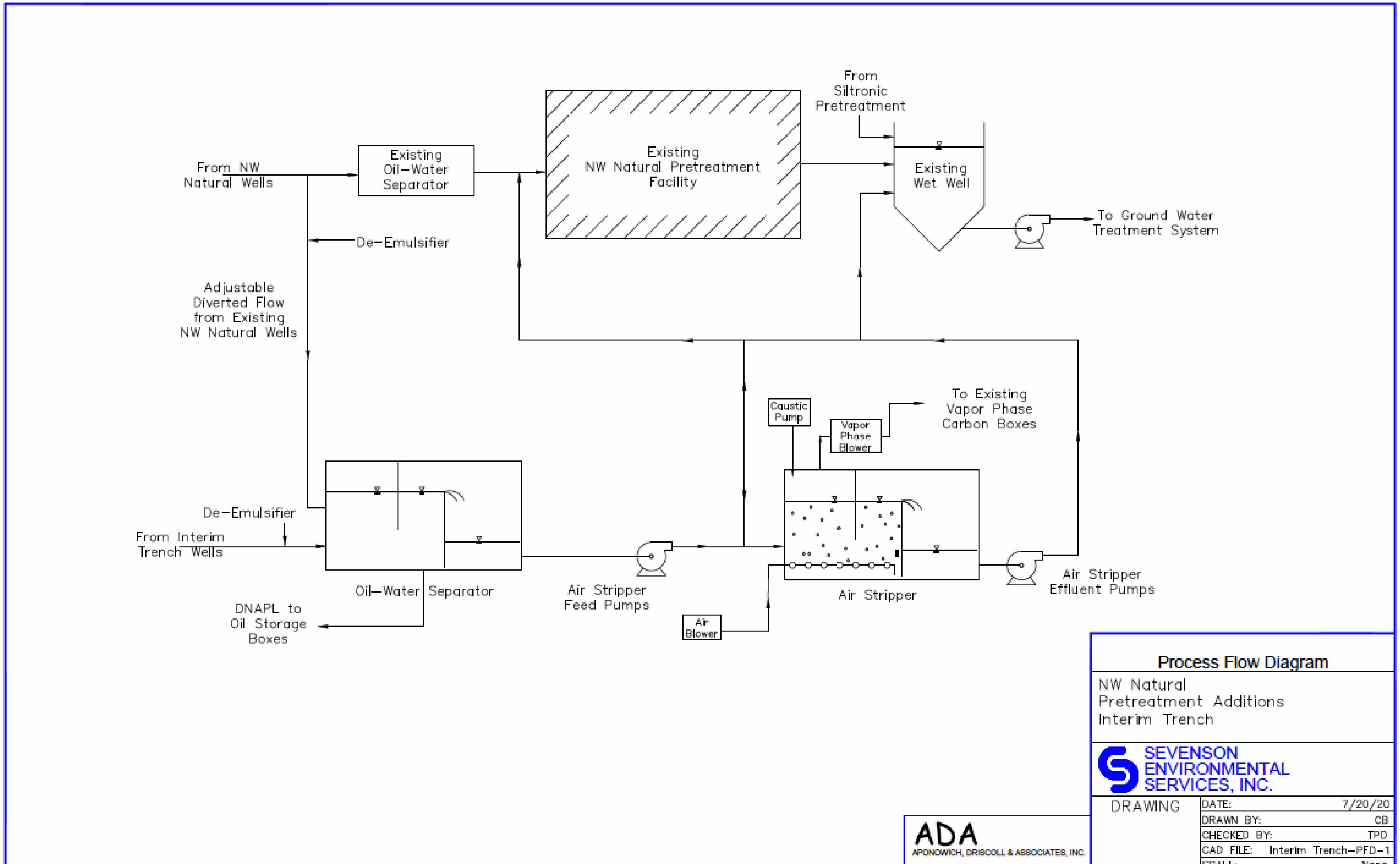
AIR STRIPPER FEED PUMPS		**TO AIR STRIPPER**		
TYPE		**CENTRIFUGAL**		
CONTROL		**CONSTANT FLOW–VFD**		
NUMBER OF UNITS		**2**		**One duty, one standby**
DESIGNFLOW, GPM		**325**		
TOTAL DYNAMIC HEAD, FT		**8**		
HP		**10**		
NW NATURAL CAUSTIC FEED PUMP		**pH Adjustment to 10-10.5**		
TYPE		**DIAPHRAGM**		
CONTROL		**pH**		
NUMBER OF UNITS		**1**		
PROJECTED USAGE, GALS/DAY		**50**	**432**	**25% Solution**
PROJECTED USAGE, LBS/DAY		**539**	**4,622**	
, GALS/HOUR		**2.1**	**18.0**	
UNIT CAPACITY, GALS/HR		**0-20**	**0-20**	
TOTAL CAPACITY, GALS/HOUR		**0–20**	**0–20**	
STORAGE PROVIDED, GALS		**7,500**	**7,500**	**Existing caustic storage tank**
STORAGE PROVIDED, DAYS		**148.8**	**17.4**	
NW NATURAL PRETREATMENT AIR STRIPPER				
TYPE		**WEIR**		**Covered**
NUMBER OF UNITS		**1**		
PROCESS VOLUME, GALS		**12,000**		
TOTAL PROCESS VOLUME, GALS		**12,000**		
DETENTION TIME, MINS @ AVERAGE FLOW		**343**	**40**	
AIR: WATER RATIO @ AVERAGE FLOW	**30: 1**	**256**	**30**	**@ 1,200 cfm**
AIR: WATER RATIO @ PEAK FLOW		**150**	**28**	
INTERIM AIR STRIPPER BLOWER				**Discharge to Vapor-Phase Carbon**
NUMBER OF UNITS		**1**		
TYPE		**PD**		
CONTROL		**VFD**		
AIR FLOW RATE, SCFM		**1,200**		
ESTIMATED STATIC HEAD, PSI		**3.0**		
ESTIMATED DYNAMIC LOSSES, PSI		**1.5**		
TOTAL BLOWER TDH, PSI		**4.5**		
EST BHP		**34**		**@ 2,600 RPM**
MOTOR HP		**50**		
INTERIM VAPOR PHASE BLOWER				
NUMBER OF UNITS		**1**		
TYPE		**PD**		
CONTROL		**VFD**		
AIR FLOW RATE, SCFM		**1,200**		
ESTIMATED STATIC HEAD, PSI		**0.0**		
ESTIMATED DYNAMIC LOSSES, PSI		**1.5**		
TOTAL BLOWER TDH, PSI		**1.5**		
EST BHP		**34**		
EST MOTOR HP		**40**		
AIR STRIPPER EFFLUENT PUMPS		**TO EFFLUENT WET WELL**		
TYPE		**CENTRIFUGAL**		
CONTROL		**FLOW-VFD**		
NUMBER OF UNITS		**2**		**One duty, one standby**
DESIGNFLOW, GPM		**325**		
TOTAL DYNAMIC HEAD, FT		**14**		
HP		**10**		

Air Stripper Process Design		
Wastewater Flow, gpm		**Comments/Assumptions**
Maximum	325	
Minimum	10	
Air Stripper Tank		
TOTAL VOLUME GALS	12,118	
DIMENSIONS		
Length, ft	27.0	
Width, ft	8.0	
Total Wetted Depth, ft	7.5	
DETENTION TIME, MINS		
Maximum flow	37	
Minimum flow	1,212	
AIR: WATER RATIO		
@ Maximum flow	28	: 1
@ Minimum flow	898	: 1
Air Diffuser System		
Air Flow, scfm	1,200	
No of Compartments	2	
Air flow/compartment, scfm	600	
Main air flow line dia, in	10	
Main velocity, fpm	2,201	
Compartment air line dia, in	6	
Compartment velocity, fpm	3,057	
Internal diffuser pipes, no	2	
Air flow per diffuser pipe, scfm	300	
Diffuser air line dia, in	6	
Diffuser pipe velocity, fpm	1,529	
Diffuser Length, ft	10	3 ft on influent end; 1 ft on effluent end
Total Orifices/Tank	96	
Number of Orifices/Compartment	48	@ 1 ft on center both sides + 4 on cross
Number of Orifices/Diffuser	24	
Air flow per orifice, scfm	12.5	
Orifice opening, in	1.5	
Diffuser Velocity, fps	17.0	
Pneumatic Head Losses		
Diffuser Pipe Velocity, fpm	1,529	
Velocity Head, inches (Density*(Velocity/(1096)^2	0.19	Density = 0.0989 lbs/cu ft
Head Loss, inches f*(L/D)* Velocity Head	0.07	f = 0.017
Head Loss, psi	0.002	
Diffuser Head Loss		
K =	0.85	
Diffuser Velocity, fps	17.0	
Head Loss = K x Velocity Head, V2/2g, ft	4.5	
, psi	1.9	Diffuser loss much higher than line--> Good flow distribution throughout line

APPENDIX B—INTERIM TRENCH PRETREATMENT DESIGN DRAWINGS


From NW Natural Wells
Existing Oil–Water Separator
Existing NW Natural Pretreatment Facility
From Siltronic Pretreatment
Existing Wet Well
To Ground Water Treatment System
De–Emulsifier
Adjustable Diverted Flow from Existing NW Natural Wells
Caustic Pump
Vapor Phase Blower
To Existing Vapor Phase Carbon Boxes
De–Emulsifier
From Interim Trench Wells
Oil–Water Separator
DNAPL to Oil Storage Boxes
Air Stripper Feed Pumps
Air Blower
Air Stripper
Air Stripper Effluent Pumps
Process Flow Diagram
NW Natural
Pretreatment Additions
Interim Trench
SEVENSON ENVIRONMENTAL SERVICES, INC.
DRAWING
DATE: 7/20/20
DRAWN BY: CB
CHECKED BY: TPD
CAD FILE: Interim Trench–PFD–1
SCALE: None
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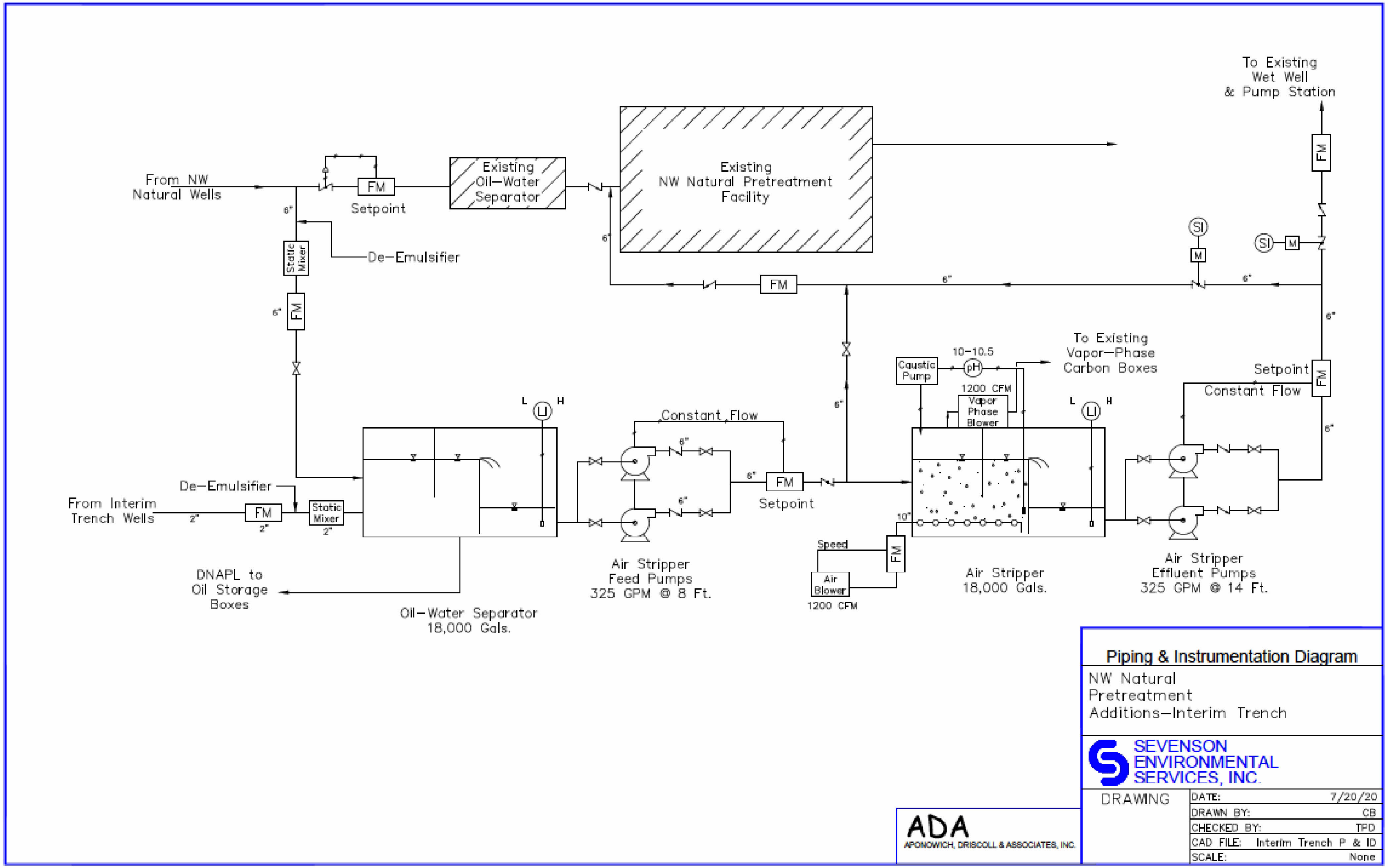
To Existing
Wet Well
& Pump Station
Existing
NW Natural Pretreatment
Facility
Existing
Oil–Water
Separator
From NW
Natural Wells
FM
Setpoint
De–Emulsifier
Static Mixer
SI
M
FM
6"
Caustic Pump
10–10.5
pH
To Existing
Vapor–Phase
Carbon Boxes
1200 CFM
Vapor Phase Blower
Setpoint
Constant Flow
L
H
LI
Constant Flow
From Interim
Trench Wells
2"
De–Emulsifier
Static Mixer
Setpoint
10"
Speed
Air Blower
1200 CFM
DNAPL to
Oil Storage
Boxes
Oil–Water Separator
18,000 Gals.
Air Stripper
Feed Pumps
325 GPM @ 8 Ft.
Air Stripper
18,000 Gals.
Air Stripper
Effluent Pumps
325 GPM @ 14 Ft.
Piping & Instrumentation Diagram
NW Natural
Pretreatment
Additions–Interim Trench
SEVENSON
ENVIRONMENTAL
SERVICES, INC.
DRAWING
DATE: 7/20/20
DRAWN BY: CB
CHECKED BY: TPD
CAD FILE: Interim Trench P & ID
SCALE: None
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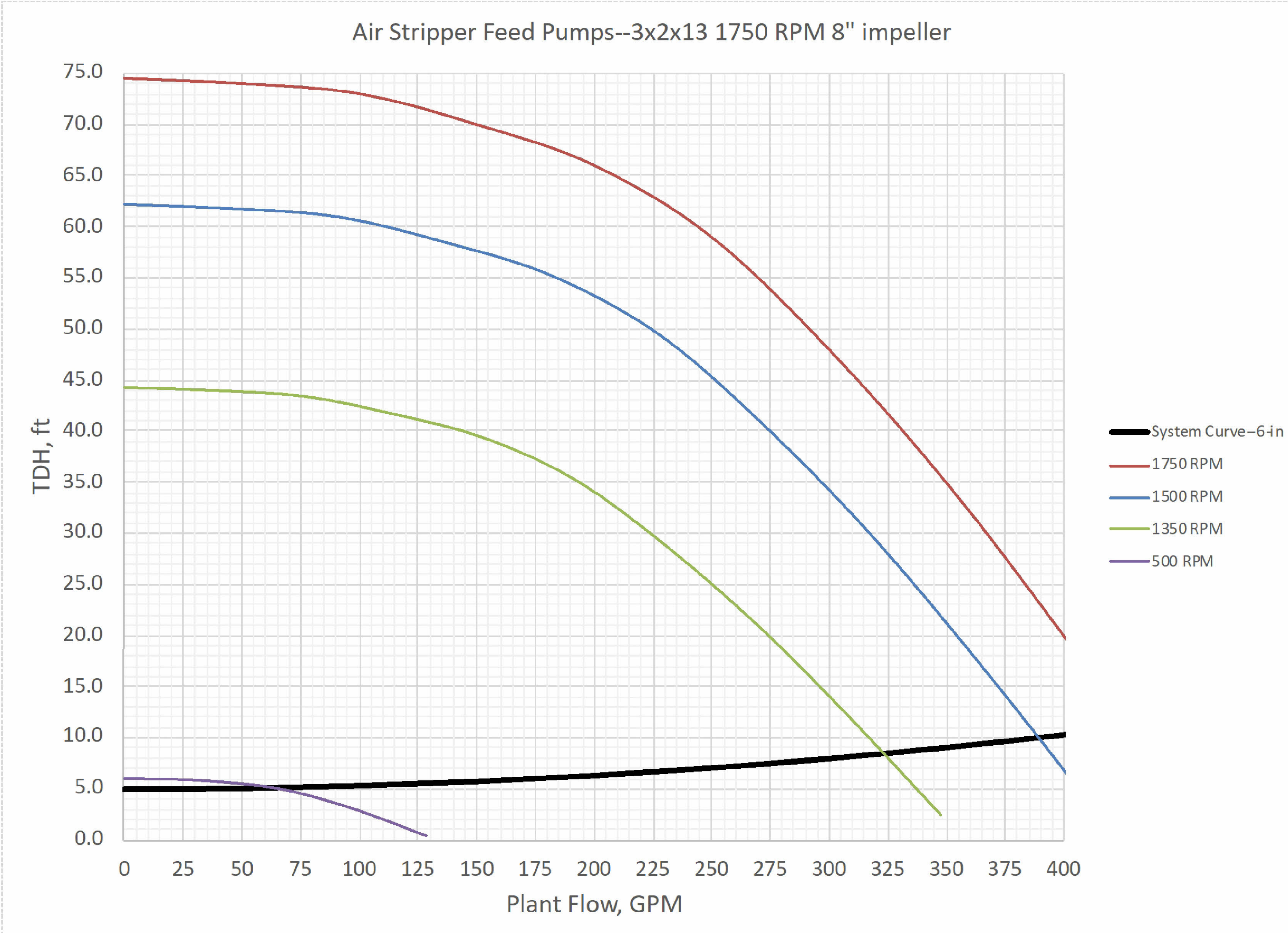

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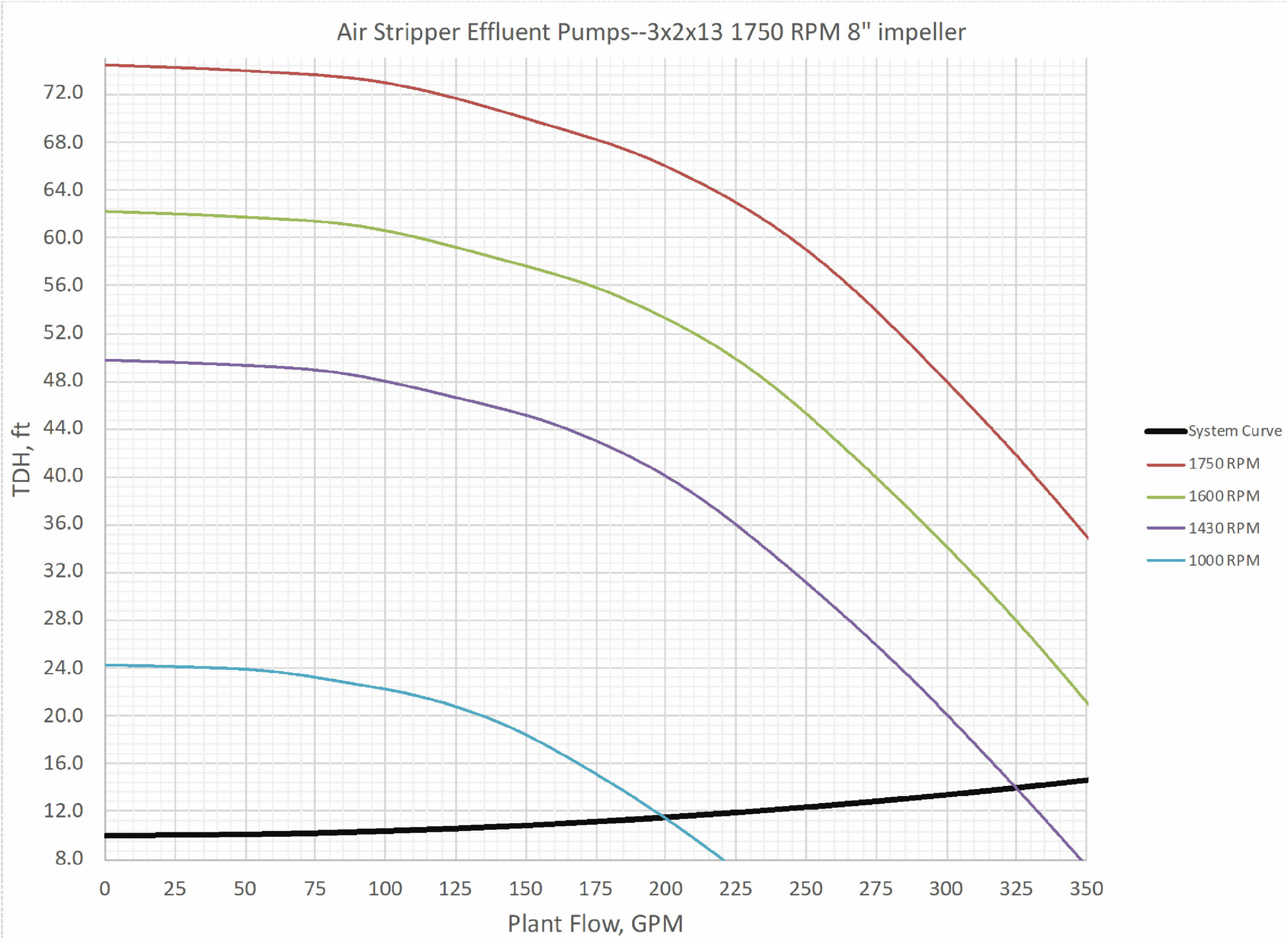
Air Stripper Effluent Pumps--3x2x13 1750 RPM 8" impeller
TDH, ft
72.0
68.0
64.0
60.0
56.0
52.0
48.0
44.0
40.0
36.0
32.0
28.0
24.0
20.0
16.0
12.0
8.0
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
Plant Flow, GPM
System Curve
1750 RPM
1600 RPM
1430 RPM
1000 RPM