



Moses Lake Industries Inc.
Process Wastewater Copper Removal
Moses Lake, Washington

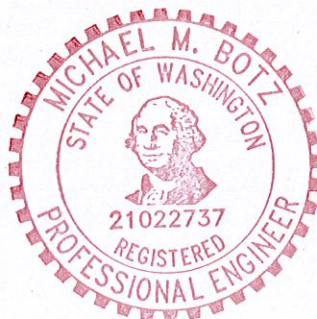
Engineering Report for Industrial Wastewater Facility

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January 4, 2023



PRELIMINARY

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1.0 Introduction

Moses Lake Industries Inc. (MLI) sells high-purity copper sulfate solution that is packaged for sale in 1000-liter returnable totes. Totes returned to MLI from its customers are fully emptied and then triple-rinsed with ultra-high purity water (UPW). The tote rinse waters, plus other copper-bearing wastewaters from associated production facilities, are currently collected and shipped off site as non-hazardous waste. The wastewater has an acidic pH and primarily contains copper sulfate as the contaminant. The cost for off-site disposal of the wastewater is increasingly expensive and MLI is planning to construct a facility to treat the wastewater on site rather than continuing to ship off site. It is being proposed to discharge the treated copper wastewater through existing Outfall 004 to the Port of Moses Lake. Reverse osmosis reject water is currently discharged through Outfall 004 and the treated copper wastewater would be discharged along with the reverse osmosis reject water in Outfall 004. Wastewaters received by the Port of Moses Lake are used beneficially for crop irrigation. This document is intended to meet the requirements for an Engineering Report per WAC 173-240 for construction of an industrial wastewater treatment facility.

2.0 Engineering Report

This section is the Engineering Report for the Process Wastewater Copper Removal project being proposed by MLI. The topics addressed in the following sections follow those listed in WAC 173-240-130 (a) through (y).

WAC 173-240-130 Engineering report. (2) The engineering report shall include the following information together with any relevant data as requested by the department:

2.1 Industry Type

WAC 173-240-130 (2) (a) Type of industry or business;

MLI manufactures and repackages specialty chemicals for the semiconductor industry. Products include: (1) the manufacture of tetramethylammonium carbonate (TMAC) solutions in water (SIC 2869), (2) manufacture of tetramethylammonium hydroxide (TMAH) solutions in water (SIC 2869), (3) manufacture of organic polymer (SIC 2869), (4) manufacture of copper(II) sulfate and purification of cobalt sulfate (SIC 2819), (5) manufacture and formulation of copper and cobalt electroplating solutions (SIC 2819), (6) formulation of plating additive solutions (SIC 2819), (7) formulation of laboratory reagents (SIC 2819), (8) DI water production, and (9) QA/QC laboratory operations. The primary SIC code for the facility is 2869 “Industrial Organic Chemicals, Not Elsewhere Classified” and the secondary SIC code is 2819 “Industrial Inorganic Chemicals, Not Elsewhere Classified”.

2.2 Finished Products

WAC 173-240-130 (2) (b) The kind and quantity of finished product;

The kind and type of finished products are listed in Table 2.2-1.

**Table 2.2-1
Kind and Quantity of Finished Products**

Type	Quantity
Tetramethylammonium Hydroxide (TMAH) Solution	CBI
Copper and Cobalt Plating and Plating Additive Solutions	CBI
Tetramethylammonium Carbonate (TMAC)	CBI
Methanol Co-Product Generated/Used by TMAC Process and Ultimately Consumed On Site as Boiler Fuel	CBI
Organic Polymer	CBI

CBI: Confidential Business Information

2.3 Water Consumption and Disposal

WAC 173-240-130 (2) (c) The quantity and quality of water used by the industry and a description of how it is consumed or disposed of, including:

(i) The quantity and quality of all process wastewater and method of disposal;

2.3.1 Potable Water

MLI obtains potable water from the City of Moses Lake. A portion of the City water is directly used for domestic purposes (restrooms, showers, sinks, etc.) and as a source of firewater. The estimated average consumption of potable water supplied by the City is approximately 110,000 gallons per day.

2.3.2 Reverse Osmosis Reject Water

Before use as process water, MLI treats City water by reverse osmosis (RO), thereby generating a relatively high quality permeate and a reject stream. Some RO permeate is used directly as make-up to boilers and cooling towers, while the remainder is further treated by ion exchange to produce ultra-high purity water (UPW). All ion exchange resins are shipped off site for regeneration.

RO reject water is discharged from site through Outfall 004 to the Port of Moses Lake. The discharged water is subsequently used beneficially by the Port of Moses Lake for crop irrigation. The quality of RO reject water is equivalent to the quality of City water but with the dissolved constituents concentrated by a factor of about 3.3. That is, about 70% of City water treated in the RO systems is produced as high-quality permeate, while most of the dissolved constituents are concentrated into the smaller RO reject stream. The total RO reject flow averaged about 31,000 gallons per day in 2020-2021 with a maximum flow of about 52,000 gallons per day.

In the past, MLI utilized some RO reject water for onsite irrigation purposes through Outfall 003. RO reject water is no longer used for this purpose and Outfall 003 is currently inactive.

2.3.3 TMAH Wastewater

Process wastewater is generated from container cleaning in the TMAH repackaging area. Generally, customers return used TMAH containers to MLI for cleaning and reuse. Any residual TMAH liquid is pumped from the containers and handled as a dangerous waste due to high pH. The containers are then rinsed with UPW prior to refilling with TMAH product. The TMAH wastewater generated from container rinsing is collected and treated on site for pH neutralization. The treated wastewater is then discharged through Outfall 001 to the City of Moses Lake POTW. The total flow of the wastewater averaged about 4,300 gallons per day in 2020-2021 with a maximum flow of about 11,000 gallons per day.

2.3.4 Cooling Tower and Boiler Blowdowns

Until recently, blowdowns from the MLI cooling towers (non-contact) and boilers were collected and shipped off site for disposal. In September 2022 MLI resumed the discharge of the blowdowns to the City of Moses Lake POTW through Outfall 002. Discharge of these wastewaters to the City was previously suspended by MLI after a small heat exchanger leak resulted in contamination of boiler blowdown with copper. MLI subsequently installed redundant instrumentation and diversion valves to automatically prevent the discharge of boiler blowdown in the event of a heat exchanger leak. Revised operating

procedures were also implemented to prevent a recurrence. The instrumentation, control valves, and procedures have proven effective. The State of Washington approved the resumption of the discharge through Outfall 002 in August 2022. The flow rate of the blowdowns is expected to average about 10,000 to 15,000 gallons per month.

2.3.5 Copper Wastewater

Copper wastewater is generated from tote rinsing and associated copper sulfate production facilities. Generally, customers return used copper sulfate containers to MLI for cleaning and reuse. Any residual copper sulfate liquid is pumped from the containers and afterwards the containers are rinsed with UPW prior to refilling with copper sulfate product. Copper wastewater is also generated from scrubber blowdowns in the copper sulfate production area. The copper wastewater is currently collected and shipped off site as non-hazardous waste. The average copper wastewater flow rate ranged from about 29,000-58,000 gallons per month in 2020-2021. The future flow rate of the copper wastewater is expected to increase to about 145,000 gallons per month. MLI plans to construct and operate a copper wastewater treatment facility so that the treated wastewater can be discharged through Outfall 004 rather than continue to be shipped off site. The future discharge of treated copper wastewater through Outfall 004 is the primary subject of this engineering report.

2.3.6 Other Wastewaters

Other miscellaneous process wastewaters are handled as dangerous wastes and shipped off site or treated on site in a Treatment by Generator (TBG) system and evaporated or shipped off site as non-hazardous waste. This includes wastewaters that cannot be discharged by MLI under existing permits but meet TBG rules for treatment and disposal.

2.3.7 Wastewater Discharges

The quantities and qualities of wastewaters discharged through Outfalls 001, 002 and 004 during 2020-2021 are summarized in Tables 2.3-1 through 2.3-3.¹ These data were sourced from MLI discharge monitoring reports (DMR) submitted to the State of Washington during 2020-2021.

¹ Washington State Waste Discharge Permit ST0005375 identifies Outfall 001 as process wastewater and identifies Outfall 002 as the combination of Outfall 001 (process wastewater) plus sanitary waste. However, the City of Moses Lake Industrial Discharge Permit No. 10 identifies the combination of process wastewater plus sanitary waste as Outfall 001. The State terminology is utilized in this Engineering Report.

Table 2.3-1
Outfall 001 – Discharge to City of Moses Lake POTW (Process Wastewater)

Parameter	Units	Average Value	Maximum Value
Flow	gpd	4,300	11,000
Conductivity	µmhos/cm	252	999
Biological Oxygen Demand (BOD ₅)	mg/L	26	71
Total Dissolved Solids (TDS)	lbs/day	5	19
Total Kjeldahl Nitrogen (TKN)	mg/L	5	22
Total Suspended Solids (TSS)	mg/L	<10	100
Nitrate + Nitrite	mg/L as N	1.3	3.4
Ammonia	mg/L as N	2.5	31
Chloride	mg/L	5	12
Sodium	mg/L	23	220
Sulfate	mg/L	16	70
Parameter	Units	Minimum Value	Maximum Value
pH	s.u.	6.1	9.2

Table 2.3-2
Outfall 002 – Discharge to City of Moses Lake POTW (Process Wastewater plus Sanitary Waste)

Parameter	Units	Average Value	Maximum Value
Flow	gpd	9,000	33,100
Conductivity	µmhos/cm	758	1,681
Biological Oxygen Demand (BOD ₅)	mg/L	187	330
Total Suspended Solids (TSS)	mg/L	102	270
Parameter	Units	Minimum Value	Maximum Value
pH	s.u.	3.7	9.1

Table 2.3-3
Outfall 004 – Discharge to Port of Moses Lake (Reverse Osmosis Reject)

Parameter	Units	Average Value	Maximum Value	
Flow	gpd	31,000	52,000	
Conductivity	µmhos/cm	1,095	1,300	
Total Dissolved Solids (TDS)	mg/L	784	900	
Total Kjeldahl Nitrogen (TKN)	mg/L	<1	1	
Nitrate	mg/L as N	1.9	2.8	
Calcium	mg/L	110	150	
Magnesium	mg/L	41	53	
Sodium	mg/L	72	130	
Potassium	mg/L	24	28	
Chloride	mg/L	25	34	
Sulfate	mg/L	66	81	
Carbonate Alkalinity	mg/L as CaCO ₃	<20	<20	
Bicarbonate Alkalinity	mg/L as CaCO ₃	559	780	
Total Phosphorus	mg/L as P	0.9	1.4	
Parameter	Units	Minimum Value	Maximum Value	
pH	s.u.	7.5	8.2	
Parameter (Port of Moses Lake Local Limits)	Units	Number Samples	Minimum Value	Maximum Value
Aluminum	mg/L	2	<0.1	<0.1
Arsenic	mg/L	2	<0.015	<0.1
Beryllium	mg/L	2	<0.001	<0.1
Biological Oxygen Demand (BOD ₅)	mg/L	2	<2.0	<4.8
Boron	mg/L	2	<0.1	<0.1
Cadmium	mg/L	2	<0.005	<0.5
Chromium	mg/L	2	<0.01	<0.1
Cobalt	mg/L	2	<0.01	<0.1
Copper	mg/L	2	<0.015	<0.1
Oil and Grease (HEM)	mg/L	2	<4.8	<5.8
Fluoride	mg/L	2	<0.5	0.96
Iron	mg/L	2	<0.1	<0.1
Lead	mg/L	2	<0.009	<0.9
Lithium	mg/L	2	<0.02	<0.4
Manganese	mg/L	2	<0.01	<0.1
Mercury	mg/L	2	<0.0003	<0.2
Molybdenum	mg/L	2	<0.02	<0.2
Nickel	mg/L	2	<0.04	<0.4
Total Nitrogen	mg/L as N	8	1.3	4.0
Selenium	mg/L	2	<0.008	<0.02
Silver	mg/L	2	<0.01	<0.1
Sodium Adsorption Ratio (SAR)	--	2	1.1	3.9
Vanadium	µg/L	2	<0.01	0.027
Zinc	mg/L	2	<0.02	<0.02

(ii) *The quantity of domestic wastewater and how it is disposed of;*

An average of about 4,800 gallons per day of domestic wastewater (sanitary waste) was produced in 2020-2021. Domestic wastewater is combined with treated wastewater that is discharged through Outfall 001 and the combination of these two streams is then discharged from site through Outfall 002. Outfall 001 is internal to the plant, while Outfall 002 includes both domestic wastewater plus the wastewater discharged through Outfall 001.

(iii) *The quantity and quality of noncontact cooling water (including air conditioning) and how it is disposed of; and*

Blowdown from the MLI cooling towers (non-contact) is currently being discharged from site through Outfall 002 to the City of Moses Lake POTW. The estimated average flow of cooling tower blowdown during 2020-2021 is 2,500 gallons per day. Refer to Section 2.3.4 for further information about cooling tower blowdown.

Reverse osmosis permeate is used for cooling tower make-up water. As the water evaporates in the cooling towers, the concentration of the dissolved constituents increases. The blowdown rates from the cooling towers are regulated by the conductivity of cooling water (500 $\mu\text{mhos/cm}$).

(iv) *The quantity of water consumed or lost to evaporation.*

Water is evaporated at the MLI site from cooling towers and from thermal wastewater evaporators. The estimated average amount of water evaporated during 2020-2021 is 1,500 gallons per day.

UPW is largely used for product formulations and the estimated average amount used for this purpose during 2020-2021 is 7,400 gallons per day.

2.4 Chemicals

WAC 173-240-130 (2) (d) The amount and kind of chemicals used in the treatment process, if any;

Chemicals that will be utilized in the proposed copper wastewater treatment facility are the following:

Sodium hydroxide will be used to neutralize the copper wastewater to a pH of approximately 9.0-10.5. It is anticipated sodium hydroxide will be purchased in 330-gallon totes at a strength of 25% NaOH. The consumption is estimated to average about 20 gallons per day.

Flocculant will be used to optimize the settling of precipitated solids in the clarifier. Flocculant will be purchased in 330-gallon totes or 55-gallon drums. The consumption is estimated to be <1 gallon per day.

Sulfuric acid will be used, if necessary, to reduce the final pH of treated wastewater to meet applicable discharge limitations. Sulfuric acid will be purchased in bulk and stored in a tank at a strength of 93% H_2SO_4 . The consumption is estimated to be <1 gallon per day.

Coagulant may be used in the future if needed to improve solids setting in the clarifier. Provision for the dosing of coagulant will be included in the design. It is expected coagulant (if used) would be purchased in 330-gallon totes or 55-gallon drums. The consumption would be expected to be <1 gallon per day.

Sulfide may be used in the future if needed to improve the efficiency of copper precipitation. Provision for the dosing of sulfide is being included in the design. It is expected sulfide, if used, would be purchased in 330-gallon totes or 55-gallon drums from a specialty chemical provider. The consumption would be expected to be <1 gallon per day.

2.5 Basic Design Data and Sizing Calculations

WAC 173-240-130 (2) (e) The basic design data and sizing calculations of the treatment units;

The treatment facility will be designed to treat and discharge an average of 145,383 gallons per month. Operation of the facility is currently planned for five days per week, 52 weeks per year, which equates to a total of 260 days per year of operation. Thus, the average treatment rate during actual operation of the facility will be approximately 6,710 gallons per day. Operation of the facility for eight hours per day will require the throughput to average about 14 gallons per minute. The treatment facility could be operated more than 8 hours per day to accommodate occasional larger influent flows, should they occur. For equipment sizing purposes, a maximum wastewater feed rate of 15 gallons per minute has been adopted. The average copper concentration expected in the untreated wastewater is expected to be 689 mg/L, within an overall range of 170 mg/L (minimum) to 2,000 mg/L (maximum). Other characteristics expected for the copper wastewater are shown in Table 2.5-1.

Table 2.5-1
Expected Average Characteristics of Untreated Copper Wastewater

Parameter	Value
Flow (gal/month)	145,383
pH	2.67
Conductivity (μ S/cm)	2,560
Copper (mg/L)	689
Sodium (mg/L)	24
Sulfate (mg/L)	1,200

The basic design data and sizing calculations for the major process equipment to be included in the treatment facility are summarized in Table 2.5-2.

Table 2.5-2
Basic Sizing Calculations for Major Process Equipment¹

Equipment	Calculation Basis	Sizing Criteria
Collection Tanks	1 day wastewater storage (each tank) 2 identical tanks installed	7,400 gallons total capacity (each tank) 11'-10" diameter × 15'-3" height 30° sloped bottom
Neutralization Tank	15 minutes retention time	300 gallons working capacity minimum ²
Mix Tank	15 minutes retention time	300 gallons working capacity minimum ²
Clarifier	0.35 gpm/ft ² hydraulic rise rate ³	9 ft diameter estimated ²
Overflow Tank	15 minutes retention time	225 gallons working capacity minimum
Effluent Filter	15 gpm maximum throughput	18 gpm sizing basis (20% margin) 10-25 µm cartridge or bag design
Sludge Holding Tank	3 days holding time 5% solids slurry 3.97 s.g. solids	1,500 gallons working capacity minimum ⁴
Filter Press	215 lbs/day solids throughput (dry basis) ⁴ 60% moisture filter cake 89 lbs/ft ³ filter cake wet bulk density 1 filtration cycle/day	6.1 ft ³ /day filter cake production ⁴
Effluent Tanks	1 day wastewater storage (each tank) 3 identical tanks installed	7,400 gallons total capacity (each tank) 11'-10" diameter × 15'-3" height 30° sloped bottom

Notes:

1. Adjustments to equipment sizes and the basis for sizing may occur during detailed design according to standard equipment available from vendors.
2. Sizing based on maximum treatment facility throughput (15 gpm) with an allowance for up to 5 gpm of additional recycle sludge and filtrate.
3. Clarifier sizing basis recommended by WesTech Engineering based on results from laboratory treatability testwork.
4. Sizing based on maximum treatment facility throughput with maximum influent copper concentration for 8 hrs/day operation.

2.6 Site Suitability

WAC 173-240-130 (2) (f) A discussion of the suitability of the proposed site for the facility;

The treatment facility will be constructed on the MLI property in Moses Lake, Washington. The site is appropriate for the facility since the wastewater to be treated is generated on site. There is sufficient space available for installation and operation of the facility, as shown on the drawings provided in Attachments B and C. The planned construction site is not located in a flood plain nor adjacent to or on existing wetlands. Many construction activities have historically taken place at the site and the soil characteristics are well-understood and suitable for the type of construction proposed. The MLI property is zoned Heavy Industrial.

2.7 Treatment Process Description

WAC 173-240-130 (2) (g) A description of the treatment process and operation, including a flow diagram;

MLI is proposing to treat the copper wastewater through pH neutralization to precipitate copper as a solid. Flow diagrams illustrating the treatment concept are shown on the drawings in Attachment D. The major process steps in the treatment facility are described in the following paragraphs.

2.7.1 Wastewater Collection

Process wastewaters containing copper are batch-generated at multiple locations at MLI. The wastewaters will be pumped to the treatment facility and collected in two large bulk tanks for blending and equalization. One tank will be in service for ongoing collection of copper wastewater, while the other tank will be used to feed wastewater to the treatment facility. There will also be connections on the tanks to allow for in-plant manual transfers of copper wastewater from totes or trucks into the tanks. A pump and eductor system will be installed to allow for the recirculation and mixing of each tank's contents.

2.7.2 Treatment Facility Feed

Copper wastewater will be pumped from one of the collection tanks to the neutralization tank at a steady flow rate. A control valve downstream of the feed pumps will be used to automatically control the wastewater flow rate. The flow rate is expected to average about 14 gpm while the facility is operating, but control in the range of about 5-15 gpm will be provided.

2.7.3 pH Neutralization

Copper wastewater will enter the neutralization tank where sodium hydroxide (25% NaOH solution) will be injected to raise the pH to approximately 9.0-10.5. The target pH will be adjusted as necessary during actual facility operation to achieve acceptable copper removal. Control of the neutralization tank pH will be automatic using a pH probe installed in the neutralization tank and a variable speed metering pump. The neutralization tank will be agitated to achieve a consistent, homogenous outlet. Wastewater will overflow from the neutralization tank into the mix tank via gravity. The mix tank will also be agitated to provide additional reaction time for pH neutralization and copper precipitation. If during operation the need for dosing a coagulant is identified, the coagulant would be dosed into the mix tank. However, the need for coagulant dosing is not currently anticipated.

2.7.4 Flocculation & Clarification

Wastewater will overflow from the mix tank and enter the clarifier via gravity. Flocculant polymer solution will be injected into the clarifier feed piping. The initial flocculant dosage is expected to be about 5-10 mg/L into the clarifier feed, but this will be adjusted as needed to achieve good clarity in the clarifier overflow solution.

The clarifier will be a conventional circular design, likely with a bottom sludge rake mechanism. Overflow from the clarifier will flow into the overflow tank via gravity. The overflow tank will be continually agitated to provide for a homogenous outlet. If required, sulfide will be dosed into the overflow tank to provide for further precipitation of residual copper. The need for sulfide dosing is not currently anticipated.

Underflow sludge from the clarifier is expected to contain about 1-10% solids by weight and 5% solids is currently anticipated as the average. A portion of the sludge will be pumped back into the neutralization tank, such that the clarifier feed contains roughly 1% by weight solids (operational target, if achievable). Maintaining this solids concentration in the clarifier feed will be beneficial in maintaining good overflow clarity and solids settling rates. The balance of the underflow sludge will be pumped into the sludge holding tank.

2.7.5 Solids Filtration

Underflow sludge from the clarifier will be pumped to the sludge holding tank. The sludge holding tank will be agitated to prevent settling of solids. The pressure filter press will be operated on a batch basis, as required to manage level in the sludge holding tank and to dewater the sludge. The filtered solids (filter cake) will be discharged by gravity from the filter into supersacks and/or drums. Supersacks and/or drums containing the filter cake will be shipped off site for disposal or for beneficial recycling of the contained copper. Filtrate solution will be discharged into a sump and then pumped back into one of the wastewater influent collection tanks. A separate floor trench and sump system may be installed to collect miscellaneous leaks from the filters so that any contained solids can be returned to the sludge holding tank.

2.7.6 Effluent Filtration

Clarified wastewater will be pumped from the overflow tank to the effluent filters. The flow rate of wastewater to the filters will be controlled to maintain level in the overflow tank. The effluent filters will be of a cartridge or bag design for removal of suspended solids at about 10-25 μm .

2.7.7 Final pH Adjustment

The filtered wastewater will be collected in one of the three effluent holding tanks. Each holding tank will be in one of the following services:

- Collecting filtered wastewater from the effluent filters
- Undergoing final pH adjustment with sulfuric acid, if necessary
- Holding treated wastewater while sampling and analysis are underway to qualify the contents as acceptable for discharge
- Batch-discharging of the treated wastewater from site
- Recycling off-specification wastewater back into one of the influent collection tanks

A pump and eductor system will be installed to allow for the recirculation and mixing of each tank's content.

2.7.8 Effluent Qualification and Discharge

Batches of treated wastewater will be held until confirmed acceptable for discharge. Once confirmed acceptable for discharge, the treated wastewater will be discharged via gravity to the Port of Moses Lake through Outfall 004. Since treated wastewater in a tank will be homogenous, a grab sample will be adequate for quality monitoring. In the event there is more than one tank discharge per day, effluent samples will be composited with an automatic sampling system or will be manually composited. If a batch of wastewater is found to be unsuitable for discharge, the wastewater will either be re-treated or shipped off site. The rate of discharge from a tank will be regulated to prevent excessive flow.

2.8 Maps and Layouts

WAC 173-240-130 (2) (h) All necessary maps and layout sketches;

The planned location of the treatment facility is shown on the drawing provided in Attachment B, while the layout of equipment within the new building is shown on the drawing provided in Attachment C. The copper wastewater treatment facility will be located in the west half of the new building shown on the drawings in Attachments B and C. The east half of the new building is being reserved for installation of additional treatment by generator (TBG) equipment unrelated to the copper wastewater treatment facility.

2.9 Provisions for Bypass

WAC 173-240-130 (2) (i) Provisions for bypass, if any;

The treatment facility will not be designed with provisions for bypass and there is no intention of bypassing the treatment facility.

2.10 Spill Containment

WAC 173-240-130 (2) (j) Physical provision for oil and hazardous material spill control or accidental discharge prevention or both;

The treatment facility will be located within a new building that will be provided with perimeter concrete curbing and a sloped concrete floor. A floor trench and sump system will be used to collect any drains, spills, or leakage and the collected materials will be pumped into one of the storage tanks in the building. The totes and/or drums used to store chemical reagents will likely be placed on dedicated secondary containment pallets. The bulk sulfuric acid tank will be located outdoors adjacent to the treatment facility building. This tank will be a double-wall design for spill prevention.

2.11 Wastewater Characteristics

WAC 173-240-130 (2) (k) Results to be expected from the treatment process including the predicted wastewater characteristics, as shown in the waste discharge permit, where applicable;

In 2021 MLI subcontracted with WesTech Engineering (Salt Lake City, UT) to perform laboratory wastewater treatability testwork. WesTech was provided with samples of the copper wastewater and was requested to perform a range of neutralization, precipitation, flocculation, and solids settling tests. The batch testwork involved neutralizing samples of the wastewater with either sodium hydroxide (NaOH) or

lime ($\text{Ca}(\text{OH})_2$), flocculating and settling the precipitated solids, and then analyzing the treated solutions for copper. Several tests were also conducted where sulfide was dosed following pH adjustment and solids settling, to evaluate the improvement sulfide may have with respect to copper removal. A summary of results from the treatability tests is provided in Table 2.11-1.

The copper concentration in the treated copper wastewater is expected to average <0.1 mg/L, consistent with data shown in Table 2.11-1 for neutralization to a pH of 9.0-10.5. The test results with sulfide addition were variable and inconclusive; therefore, sulfide dosing in the facility is not currently planned but equipment for sulfide dosing will be installed as a contingency.

Table 2.11-1
Summary of Copper Wastewater Laboratory Batch Treatability Test Results

Test No.	Neutralization Reagent ¹	Sulfide Dose	Neutralization pH ²	Conductivity ³ (mmho/cm)	Copper ⁴ (mg/L)	Sodium (mg/L)	Sulfate (mg/L)
Untreated	--	--	2.67	2.56	689	23.8	1,200
1	NaOH	0 ppm	6.54	2.31	1.50	--	--
2	NaOH	0 ppm	8.50	2.38	0.197	--	--
3	NaOH	0 ppm	8.82	2.41	0.114	--	--
4	NaOH	0 ppm	9.31	2.49	0.115	--	--
5	NaOH	0 ppm	10.52	2.56	0.014	--	--
6	Ca(OH) ₂	0 ppm	6.80	1.69	0.683	--	--
7	Ca(OH) ₂	0 ppm	8.31	1.71	0.241	--	--
8	Ca(OH) ₂	0 ppm	9.06	1.76	0.059	--	--
9	Ca(OH) ₂	0 ppm	9.50	1.76	0.032	--	--
10	Ca(OH) ₂	0 ppm	10.57	1.79	0.067	--	--
11	NaOH	2 ppm	8.51	2.37	0.189	--	--
12	NaOH	10 ppm	8.56	2.53	0.718	--	--
13	Ca(OH) ₂	2 ppm	8.43	1.74	<0.01	--	--
14	Ca(OH) ₂	10 ppm	8.47	1.95	0.844	--	--
15	NaOH	10 ppm	8.51	2.67	0.015	--	--
16	NaOH	10 ppm	9.30	2.73	0.003	--	--

Notes:

1. Reagent used for pH neutralization and copper precipitation, either sodium hydroxide (NaOH) or calcium hydroxide (lime) (Ca(OH)₂).
2. The pH value listed for the untreated sample is the average of the measured values for the series of tests.
3. The conductivity value listed for the untreated sample is the average of the measured values for the series of tests.
4. Dissolved concentrations.

2.12 Water Discharge

WAC 173-240-130 (2) (l) A description of the receiving water, location of the point of discharge, applicable water quality standards, and how water quality standards will be met outside of any applicable dilution zone;

It is proposed to discharge the treated copper wastewater to the Port of Moses Lake through existing Outfall 004. The physical location of Outfall 004 will be moved approximately 150 feet to the east, as denoted by (7) on the drawing in Attachment B. This relocation will provide a length of piping for the treated copper wastewater to thoroughly mix with RO reject water ahead of the compliance point.

Selected effluent limits for Outfall 004 are listed in Table 2.12-1 for those constituents that would be most relevant to the treated copper wastewater. MLI reports the copper wastewater contains only copper, sulfate, and sodium as dissolved constituents, while other organic (e.g., BOD, FOG, TKN) or metallic constituents (e.g., aluminum, arsenic, etc.) are not present. The effluent limits shown in Table 2.12-1 are the current and most restrictive as listed in WDOE State Waste Discharge Permit Number ST0005375 and Port of Moses Lake Facility Use Resolution No. 1336. The average monthly flow limit of 80,000 gallons per day was established on January 26, 2020 through communication between MLI and WDOE.

**Table 2.12-1
Selected Effluent Limits for Outfall 004 – Current Permit**

Parameter	Most Restrictive Effluent Limit ¹			
	Minimum	Maximum	6 Month Avg	Avg Monthly
Flow (gpd)				80,000
pH	5.0	9.0	5.5-8.0	
Conductivity (µS/cm)		3,130	1,600	
Total Dissolved Solids (mg/L)		2,000	1,000	
Sodium (mg/L)		230	115	
Sulfate (mg/L)		500	250	
Sodium Adsorption Ratio		9.0	6.0	
Copper (mg/L)		5.0	0.03	

Notes:

1. Effluent limits sourced from State Waste Discharge Permit Number ST0005375 and Port of Moses Lake Facility Use Resolution No. 1336.
2. Table includes only those constituents most relevant to the treated copper wastewater quality. Refer to the discharge permits for a full listing of all effluent limits.

The calculated quality of Outfall 004 that would result if the treated copper wastewater were discharged along with RO reject water is shown in Table 2.12-2. The ranges shown are subject to adjustment following the completion of any additional laboratory or pilot testwork.

Table 2.12-2
Calculated Outfall 004 Effluent Quality
Reverse Osmosis Reject Water Plus Treated Copper Wastewater

Parameter	Expected Range
pH	7.3 – 8.4
Conductivity (µS/cm)	990 – 1,680
Total Dissolved Solids (mg/L)	850 – 1,010
Sodium (mg/L)	145 – 195
Sulfate (mg/L)	215 – 270
Sodium Adsorption Ratio	3.3 – 5.5
Copper (mg/L)	0.02

In comparing the calculated Outfall 004 effluent quality (Table 2.12-2) with the current effluent limits (Table 2.12-1), it was determined that revised effluent limits would be needed so that the treated copper wastewater could be discharged from site through Outfall 004. Specifically, the affected constituents are conductivity, total dissolved solids, sodium, sulfate, and copper. Proposed changes to the current effluent limits are identified in Table 2.12-3 for these constituents. MLI will be preparing a permit application addressing proposed changes to the current Outfall 004 effluent limits.

Table 2.12-3
Selected Effluent Limits for Outfall 004 – Proposed Permit Modifications¹

Parameter	Most Restrictive Limit			
	Minimum	Maximum	6 Month Avg	Avg Monthly
Flow (gpd)				80,000
pH	5.0	9.0	5.5-8.0	
Conductivity (µS/cm)		3,130	1,600 2,000	
Total Dissolved Solids (mg/L)		2,000	1,000 2,000	
Sodium (mg/L)		230	115 200	
Sulfate (mg/L)		500	250 350	
Sodium Adsorption Ratio		9.0	6.0	
Copper (mg/L)		5.0 3.2	0.03 0.1	

Notes:

- Proposed changes to the current Outfall 004 effluent limits are shown in strikethrough & bold. Values not in strikethrough & bold are unchanged from the current effluent limits.
- Lowering of the maximum copper effluent limit is based on 40 CFR 415.364 “Pretreatment Standards for Existing Sources”.
- Table includes only those constituents most relevant to the treated copper wastewater quality. Refer to the discharge permits for a full listing of all effluent limits.

2.13 Outfall Analysis

WAC 173-240-130 (2) (m) Detailed outfall analysis;

Not applicable to this project. Treated copper wastewater from the facility will be discharged to the Port of Moses Lake through existing Outfall 004. The Port of Moses Lake will beneficially reuse the treated wastewater for crop irrigation. Wastewaters received by the Port of Moses Lake have already been considered and allocated in permits that the Port operates under.

2.14 Relation to Existing Treatment Facilities

WAC 173-240-130 (2) (n) The relationship to existing treatment facilities, if any;

MLI currently operates a treatment facility for TMAH wastewater (refer to Section 2.3.3) and this facility is denoted as number (3) on the drawing in Attachment B. This existing treatment facility is being relocated north to the location denoted as number (1) on the drawing in Attachment B. The copper wastewater treatment facility will be housed inside of a new building at the location denoted as number (2) on the drawing in Attachment B.

2.15 Discharge to Municipal Sewerage System

WAC 173-240-130 (2) (o) Where discharge is to municipal sewerage system, a discussion of that system's ability to transport and treat the proposed industrial waste discharge without exceeding the municipality's allocated industrial capacity. Also, a discussion on the effects of the proposed industrial discharge on the use or disposal of municipal sludge;

Not applicable to this project. Treated copper wastewater from the facility will be discharged to the Port of Moses Lake.

2.16 Discharge Through Land Application

WAC 173-240-130 (2) (p) Where discharge is through land application, including seepage lagoons, irrigation, and subsurface disposal, a geohydrologic evaluation of factors such as:

- (i) Depth to groundwater and groundwater movement during different times of the year;*
- (ii) Water balance analysis of the proposed discharge area;*
- (iii) Overall effects of the proposed facility upon the groundwater in conjunction with any other land application facilities that may be present;*

Treated copper wastewater from the facility will be discharged to the Port of Moses Lake through existing Outfall 004. The Port of Moses Lake will beneficially reuse the treated wastewater for crop irrigation. Wastewaters received by the Port of Moses Lake have already been considered and allocated in permits that the Port operates under.

2.17 Engineering Justification

WAC 173-240-130 (2) (q) A statement expressing sound engineering justification through the use of pilot plant data, results from other similar installations, or scientific evidence from the literature, or both, that the effluent from the proposed facility will meet applicable permit effluent limitations or pretreatment standards or both;

Laboratory treatability testwork performed in 2021 demonstrates the capability of the proposed pH neutralization process to achieve <0.1 mg/L copper in the treated wastewater. It is expected wastewater discharged through Outfall 004 will meet the proposed effluent limits shown in Table 2.12-3.

2.18 Sludge Disposal

WAC 173-240-130 (2) (r) A discussion of the method of final sludge disposal selected and any alternatives considered with reasons for rejection;

Sludge will be generated in the treatment facility as a result of precipitating copper as a solid from the wastewater. The sludge is anticipated to consist predominantly of copper oxide/hydroxide solids. The solids will be settled in a clarifier and then dewatered in a pressure filter to remove free-draining moisture. The moist filter cake will then be placed into supersacks or drums for transport off site. At this time, it is anticipated the filter cake will be disposed off site in a landfill. As an alternative, MLI is investigating the possibility of shipping the filter cake off site to a metals recycling facility for the value of contained copper. The sludge generation is expected to average about 75 lbs/day (dry basis).

2.19 Owner and Operator

WAC 173-240-130 (2) (s) A statement regarding who will own, operate, and maintain the system after construction;

Moses Lake Industries will own, operate, and maintain the treatment facility.

2.20 Water Quality Management Plan Compliance

WAC 173-240-130 (2) (t) A statement regarding compliance with any state or local water quality management plan or any plan adopted under the Federal Water Pollution Control Act as amended;

It is expected wastewater discharged through Outfall 004 will meet the proposed effluent limits shown in Table 2.12-3. Batches of treated wastewater will be collected and held in effluent tanks while the quality is being confirmed as acceptable for discharge. If a batch of treated wastewater is found to be unsuitable for discharge, the wastewater will either be re-treated or shipped off site. This manner of handling the treated copper wastewater will ensure compliance with Outfall 004 effluent limits.

2.21 Future Plans

WAC 173-240-130 (2) (u) Provisions for any committed future plans;

MLI does not have any committed future plans for the treatment facility. However, MLI may consider installing a batch tank for treatment of higher-strength copper wastewaters, should this appear to be beneficial in the future. This batch tank and the associated equipment are shown on the flow diagrams in Attachment D within the boundary marked "FUTURE".

2.22 Alternatives Evaluated

WAC 173-240-130 (2) (v) A discussion of the various alternatives evaluated, if any, and reasons they are unacceptable;

MLI plans to utilize sodium hydroxide for pH neutralization in the treatment facility. Sodium hydroxide is effective for pH neutralization, easy to handle in liquid form, readily available, and relatively inexpensive. Alternatives to sodium hydroxide that have been evaluated by MLI are the following:

1. Potassium hydroxide is similar in many respects to sodium hydroxide, in that it is effective for pH neutralization, easy to handle in liquid form, and readily available. However, potassium hydroxide is more expensive than sodium hydroxide. For this reason, potassium hydroxide is not currently being considered for the treatment facility.
2. Calcium hydroxide (lime) is also effective for pH neutralization, readily available, and relatively inexpensive. However, lime is supplied in solid form as a powder. Lime use would require installation of a slurry mixing and pumping system, which would be more complex and expensive in comparison to a sodium hydroxide pumping system. Lime slurry systems are prone to fouling and plugging, and therefore, usually involve higher levels of maintenance and repairs. Lime slurry systems are widely used in wastewater treatment facilities, but normally only in applications involving higher consumptions. For the copper wastewater treatment facility, the consumption of sodium hydroxide (25% NaOH solution) is estimated to be about 20 gallons per day, which is a relatively low consumption. In view of the foregoing, lime is not currently being considered for the treatment facility.

2.23 Timetable for Design and Construction

WAC 173-240-130 (2) (w) A timetable for final design and construction;

The overall timetable for design and construction of the treatment facility is anticipated to be approximately as shown below. This timetable may be adjusted based on the availability of equipment, materials, and construction contractors.

- | | |
|---|---------|
| • Submittal of Engineering Report | Q1 2023 |
| • Submittal of Plans & Specifications | Q2 2023 |
| • Complete Engineering and Design | Q3 2023 |
| • Complete Facility Construction | Q4 2023 |
| • Submittal of Operation and Maintenance Manual | Q4 2023 |
| • Treatment Facility Startup | Q4 2023 |

2.24 Compliance with SEPA and NEPA

WAC 173-240-130 (2) (x) A statement regarding compliance with the State Environmental Policy Act (SEPA) and the National Environmental Policy Act (NEPA), if applicable;

MLI will be separately addressing the required SEPA submittals as related to this project and other planned construction projects at the site. MLI will be working with a specialty consulting firm to ensure compliance with SEPA.

2.25 Solid Waste Leachate Treatment System

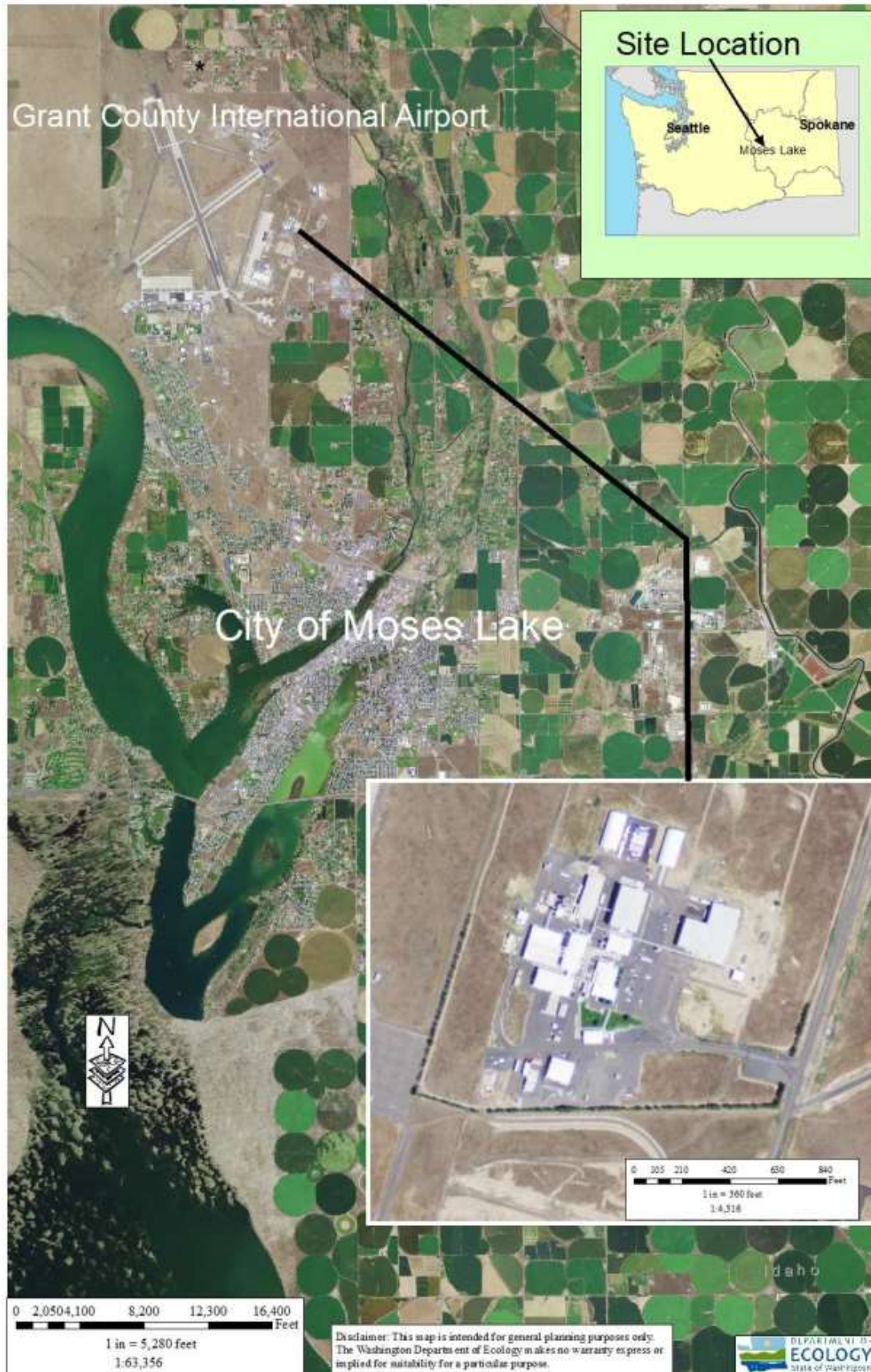
WAC 173-240-130 (2) (y) Additional items to be included in an engineering report for a solid waste leachate treatment system are:

- (i) A vicinity map and also a site map that shows topography, location of utilities, and location of the leachate collection network, treatment systems, and disposal;*
- (ii) Discussion of the solid waste site, working areas, soil profile, rainfall data, and groundwater movement and usage;*
- (iii) A statement of the capital costs and the annual operation and maintenance costs*
- (iv) A description of all sources of water supply within two thousand feet of the proposed disposal site. Particular attention should be given to showing impact on usable or potentially usable aquifers.*

Not applicable to this project. The treatment facility will not involve a solid waste leachate treatment system.

Attachment A

Site Location Map



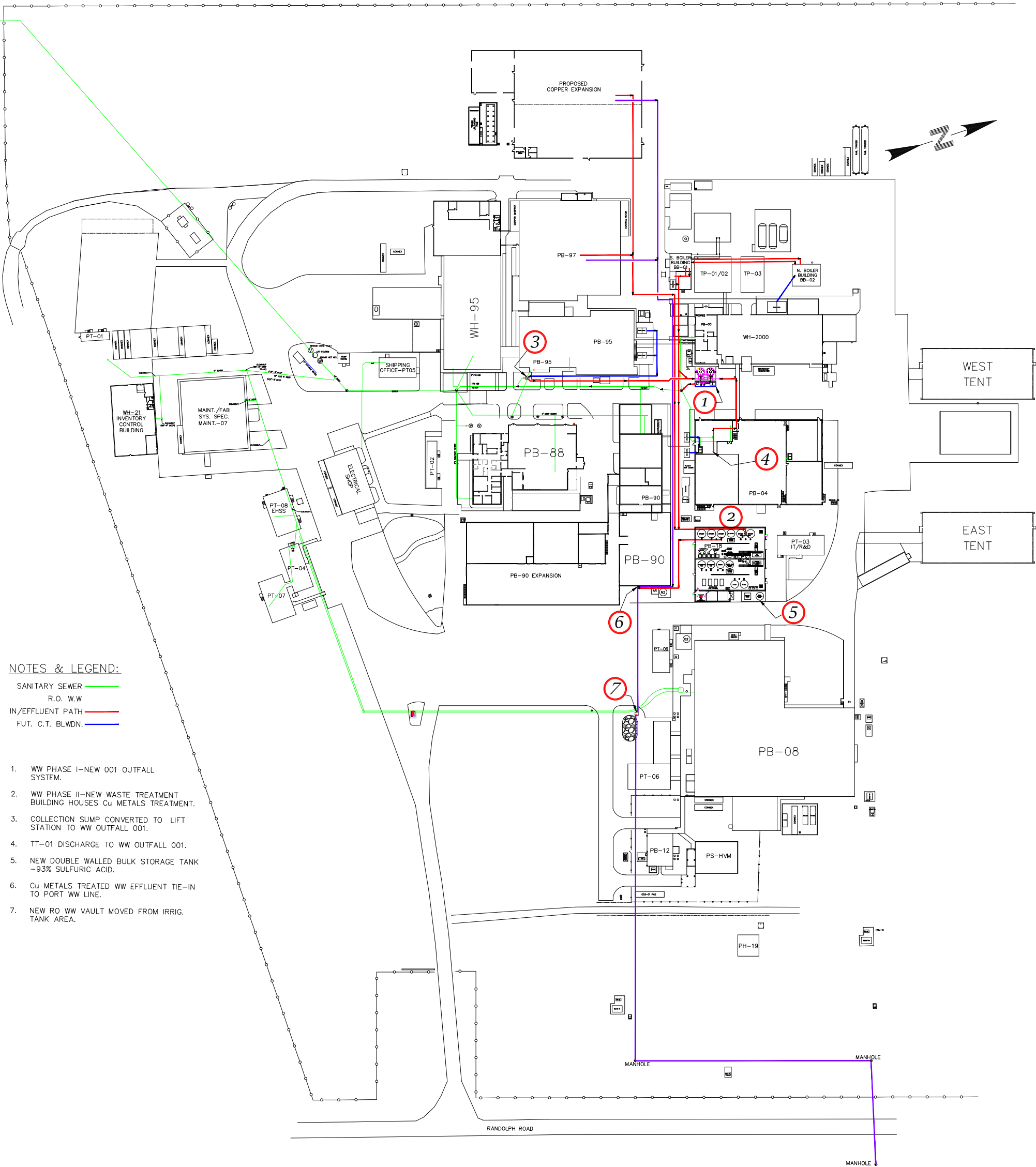
Attachment B

Wastewater Facility Location Plan Drawing

NOTES & LEGEND:

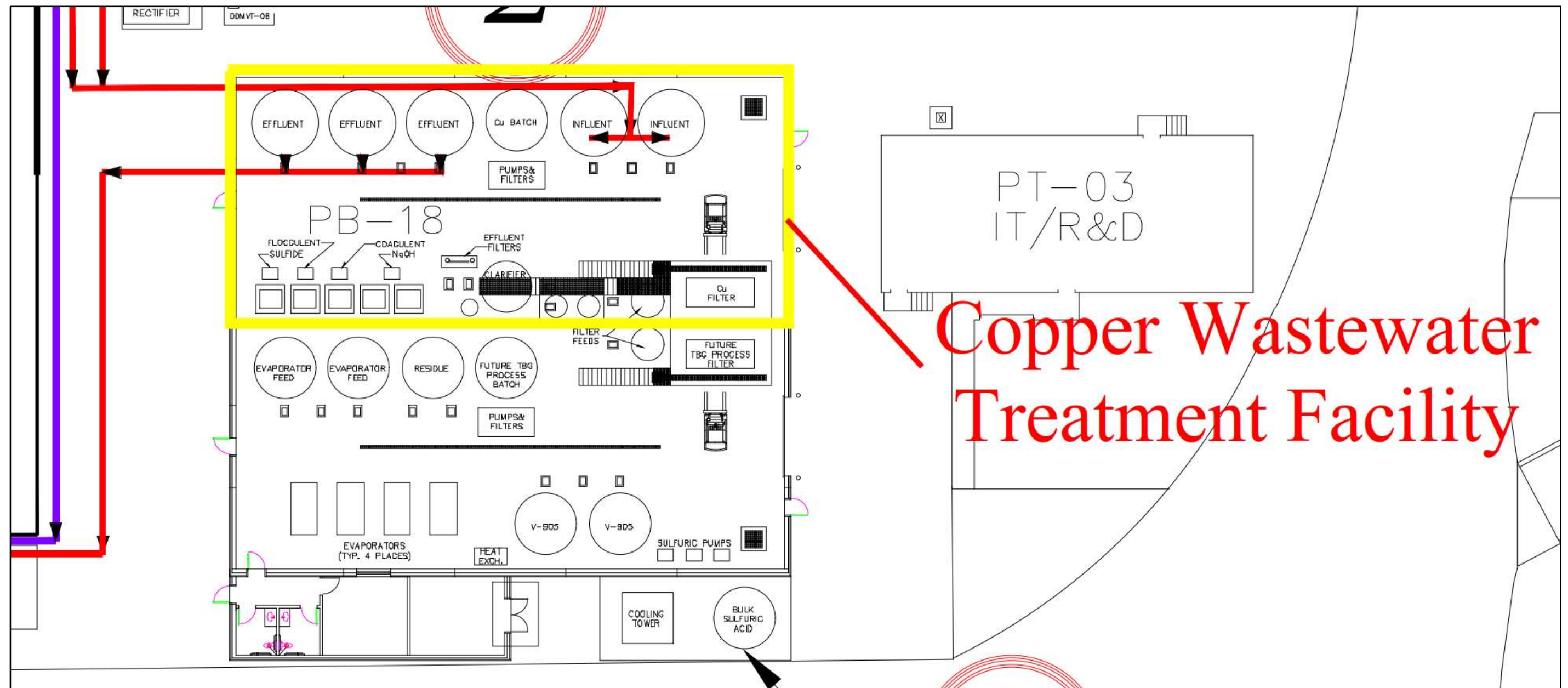
- SANITARY SEWER ———
- R.O. W.W ———
- IN/EFFLUENT PATH ———
- FUT. C.T. BLWDN. ———

1. WW PHASE I—NEW 001 OUTFALL SYSTEM.
2. WW PHASE II—NEW WASTE TREATMENT BUILDING HOUSES Cu METALS TREATMENT.
3. COLLECTION SUMP CONVERTED TO LIFT STATION TO WW OUTFALL 001.
4. TT-01 DISCHARGE TO WW OUTFALL 001.
5. NEW DOUBLE WALLED BULK STORAGE TANK —93% SULFURIC ACID.
6. Cu METALS TREATED WW EFFLUENT TIE-IN TO PORT WW LINE.
7. NEW RO WW VAULT MOVED FROM IRRIG. TANK AREA.



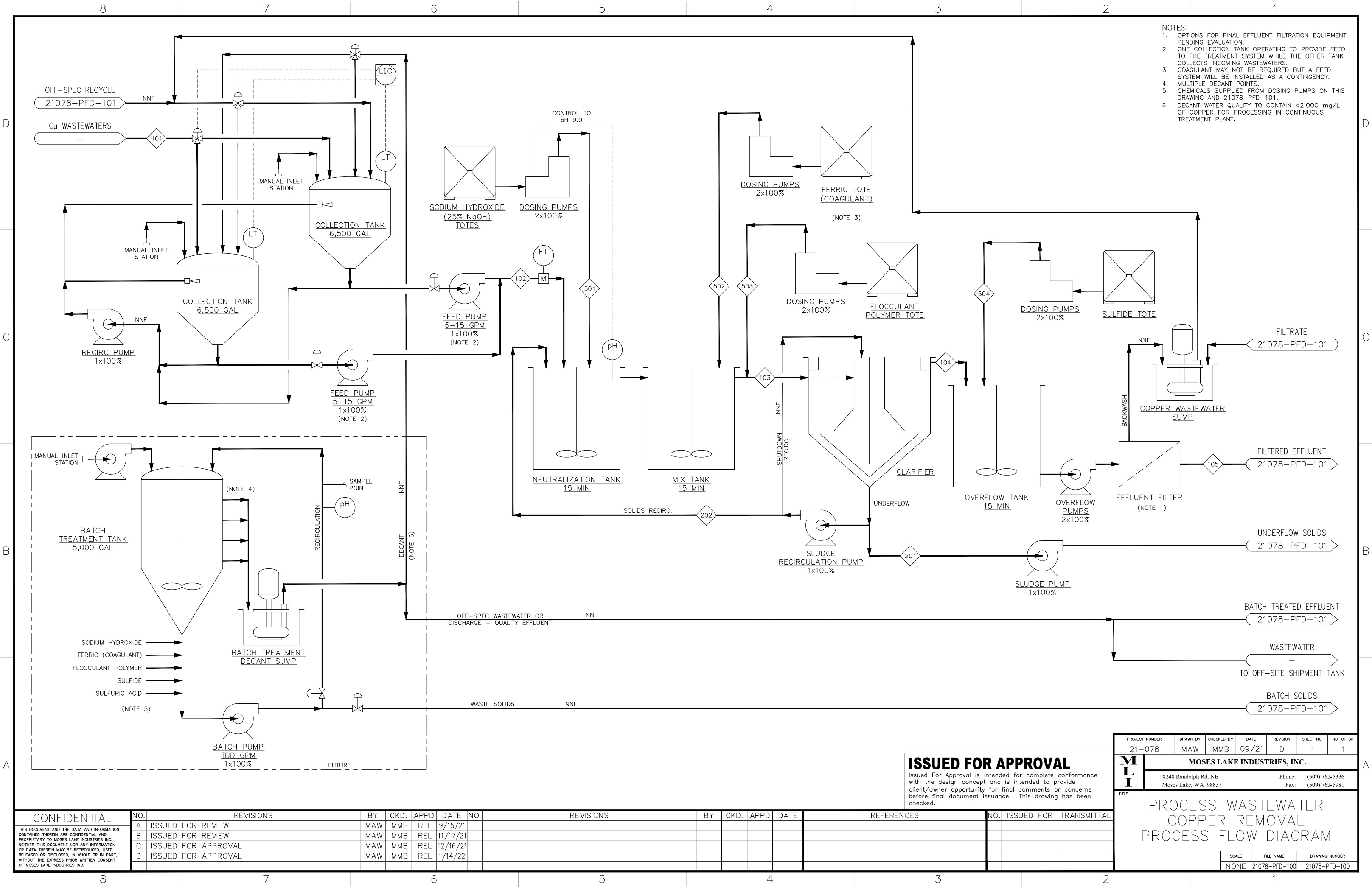
Attachment C

Equipment Layout Plan Drawing



Attachment D

Process Flow Diagrams



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										REVISIONS									
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										B	ISSUED FOR REVIEW	MAW	MMB	REL	11/17/21				
										C	ISSUED FOR APPROVAL	MAW	MMB	REL	12/16/21				
										D	ISSUED FOR APPROVAL	MAW	MMB	REL	1/14/22				

ISSUED FOR APPROVAL

Issued For Approval is intended for complete conformance with the design concept and is intended to provide client/owner opportunity for final comments or concerns before final document issuance. This drawing has been checked.

PROJECT NUMBER	DRAWN BY	CHECKED BY	DATE	REVISION	SHEET NO.	NO. OF SH
21-078	MAW	MMB	09/21	D	1	1
MOSES LAKE INDUSTRIES, INC.						
8248 Randolph Rd. NE Moses Lake, WA 98837			Phone: (509) 762-5336 Fax: (509) 762-5981			

PROCESS WASTEWATER
COPPER REMOVAL
PROCESS FLOW DIAGRAM

SCALE	FILE NAME	DRAWING NUMBER
NONE	21078-PFD-100	21078-PFD-100

