Reading Process & Instrumentation Diagrams

Following the lines of monitoring and control

Wednesday 1 May 2024 –
PNWS-AWWA Pre-Con

American Water Works Association
Pacific Northwest Section

PNWS-AWWA
Training
Coordination
Committee

Version 1.1OL – October 2020

Prepared for Pacific Northwest Section AWWA

Content & Goals

To review common symbols and arrangement of P&IDs and to learn how to determine what controls what

Outline:

- ***Reading P&IDs***
  - ***The difference between P&ID and PFD***
  - ***Symbology***
  - ***Equipment***
  - ***Piping that connects the equipment***
  - ***Lines and instruments used to monitor and control the process***
- ***Practice***
- ***Draw your own***

Safety

The cornerstone of everything we do

Safety – Mission Critical

There are many hazards associated with water operations. Some examples include;

- Confined spaces
- Trenching & excavation
- Electrical
- Vehicles & equipment
- Chemicals
- Ergonomic

"If you're not doing the job safely, you are not doing it right."

Photo from Tualatin Valley Water District

Protecting Yourself and Others

Rules to live by:

1. **You** are responsible for your safety and the safety of others
2. Follow the rules
3. If you're not trained for it; Don't do it
4. Work smarter, not harder
5. Don't take short cuts
6. Practice good housekeeping
7. Be Prepared
8. Be a safety advocate

Photo from Tualatin Valley Water District

"It's better to take a minute to save your life than to lose your life in a minute."

Personal Protection Equipment - PPE

Includes but is not limited to:

- Safety Glasses/Shield
- Hard Hat
- Hearing Protection
- Visible Safety Shirt/Jacket
- Protective Toe Footwear
- Gloves
- Gas Monitors
- Harness
- Radio/Flashlight
- *Masks, face shields, gloves*
- *Sanitizer & wipes*

Graphic from Whitney Equipment Company, Inc.

811 – Call Before You Dig – *it's the law*

Utility Notification Center

- Each state operates its own 811 center
  - ID – 811 or 1-800-342-1585 (Boise) & 1-866-729-5140 (CdA)
  - OR – 811 or 1-800-332-2344
  - WA – 811 or 1-800-424-5555
  - Or on-line
- Open 24/7
- May be regional within a state
- 2 days advanced notice is required
- https://youtu.be/ZH7cXJ2PpdY

Graphic from Tualatin Valley Water District

AWWA Commercial Time!

American Water Works Association
Pacific Northwest Section

PNWS Training-in-a-Box (TIAB)

- Workshop curricula prepared by the Section's Training Coordination Committee to increase the quality and consistency of training in PNWS and to increase distribution of that training throughout the Section
- Current programs:
  - ARC Flash & Electrical
  - Basic Waterworks
  - Emergency Preparedness
  - Water Storage Basics
  - Math for Operators / P&IDs
  - Groundwater Basics
- Upcoming programs:
  - Chemistry for Operators
  - Chemical Feed & Storage Systems

American Water Works Association
Pacific Northwest Section
Northwest Washington Subsection

Questions, Comments and Suggestions?

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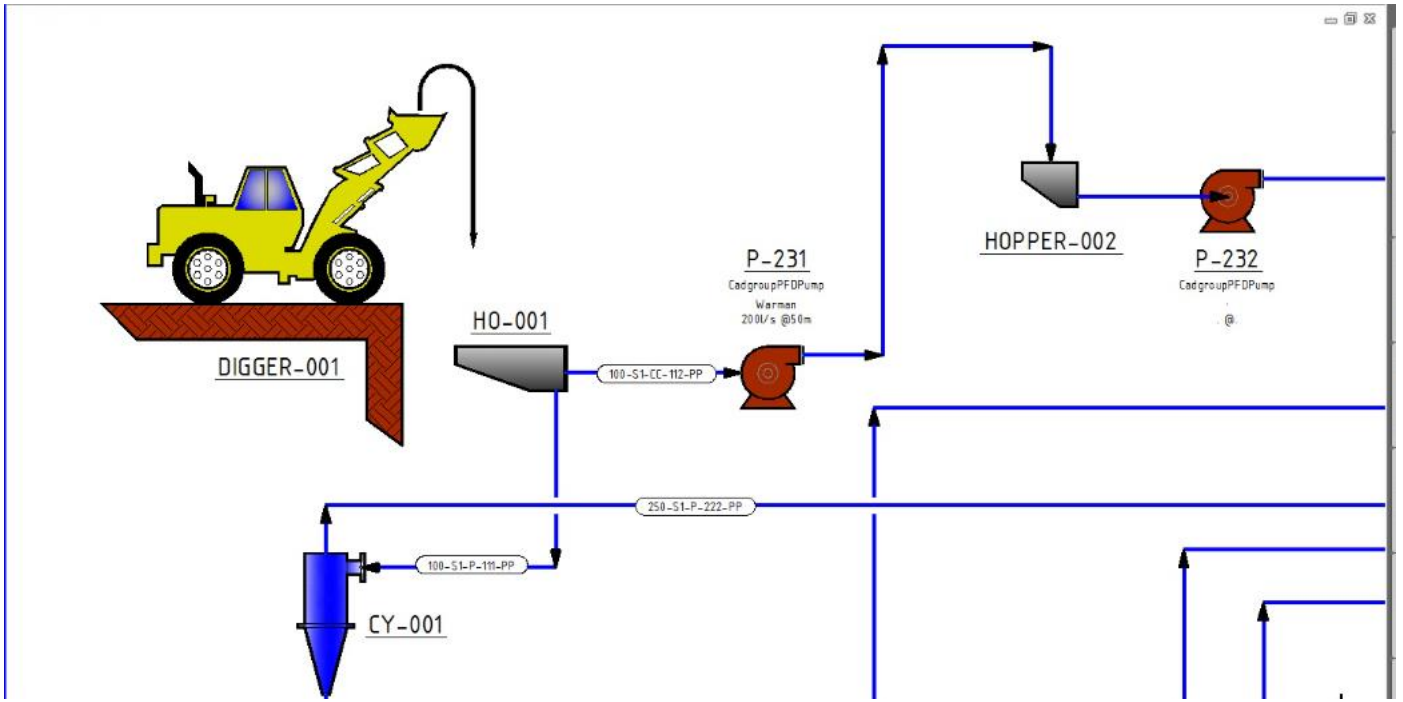
Committee

Prepared for the Pacific Northwest Section - AWWA

Process Flow / Instrumentation Drawings – P&FD / P&ID



It's a detailed story told through *Symbology*

Version – 1.1, October 2020

American Water Works Association
Pacific Northwest Section

Prepared by the Training Coordination Committee, PNWS-AWWA

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Today's Presenters:

Kenny Packard – HDR

Jeff Lundt – KCWTD (almost retired)

Symbology

An 1877 dictionary defines the word as "the art of expressing through symbols."

Content & Goals:

- To provide an understanding of what process flow and instrumentation drawings can tell us about how things work

Outline:

Workshop topics

Understanding a P&ID Layout

- The difference between P&ID and PFD
- Symbology
- Equipment
- Piping that connects the equipment
- Lines and instruments used to monitor and control the process

Symbols – They Tell a Story

Sign of power – worn by chiefs

Toki

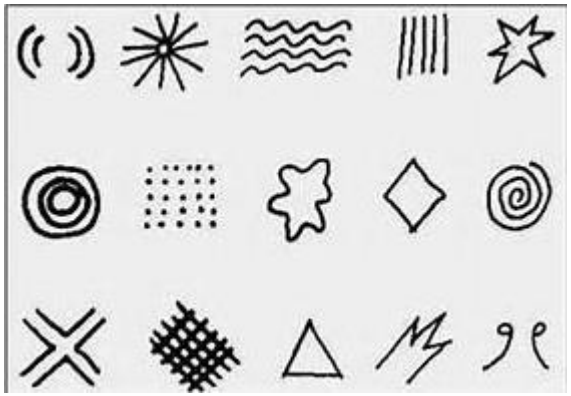
Koru

New life, growth, strength, and peace

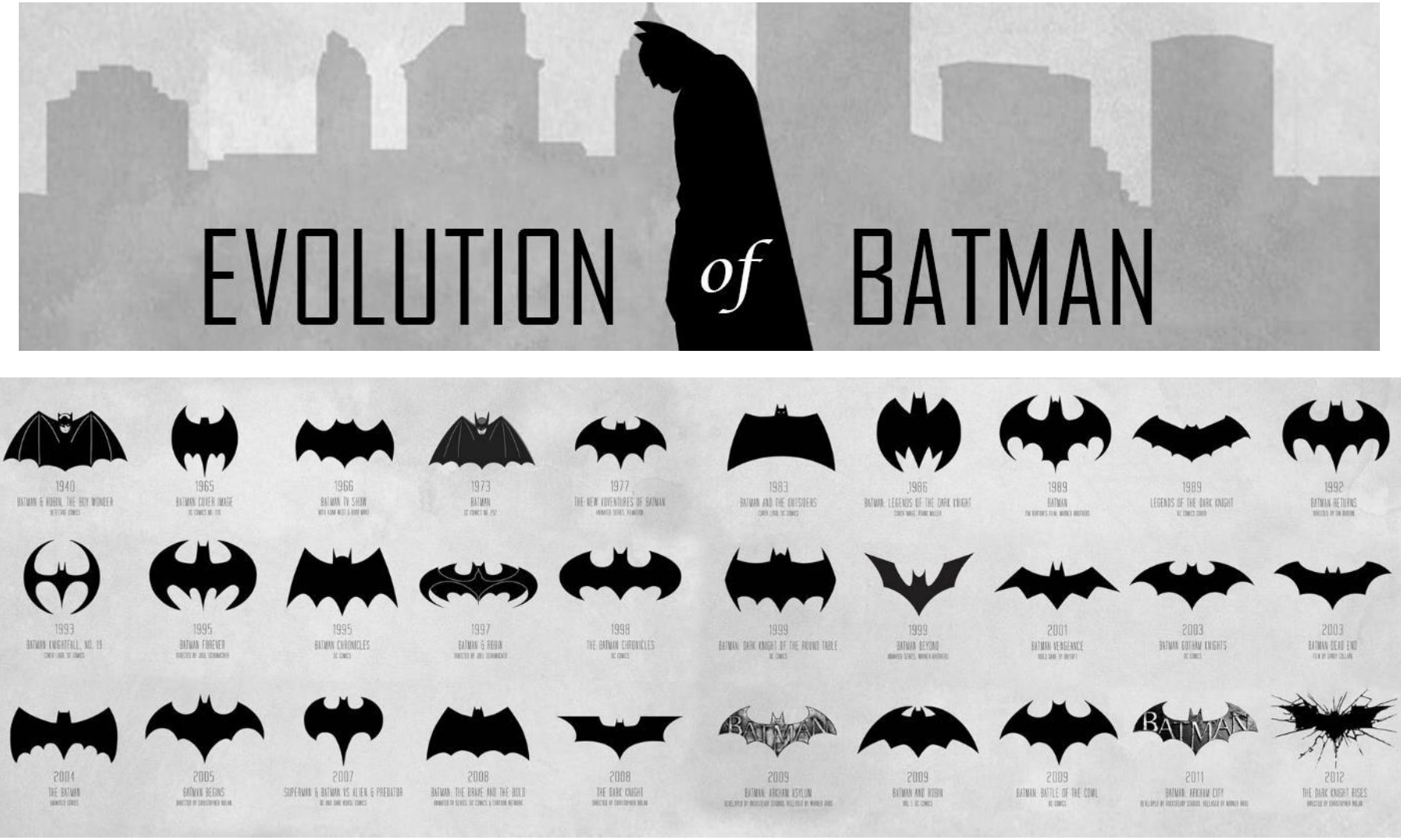
Strength, good luck, and safe travel across water

Hei-Matu

Symbols & Story Telling



Evolution of Symbols



The Basics

- There is a national standard for symbols
  - **AutoCAD P&ID ISA** – International society of automation
  - **AutoCAD P&ID PIP** – Process Industry Practices
  - **AutoCAD P&ID ISO** – International Organization for Standardization
- Plus many user (or designer) defined “unique” symbols
- Symbols change over time
  - Get the symbol guide for when the drawings were developed

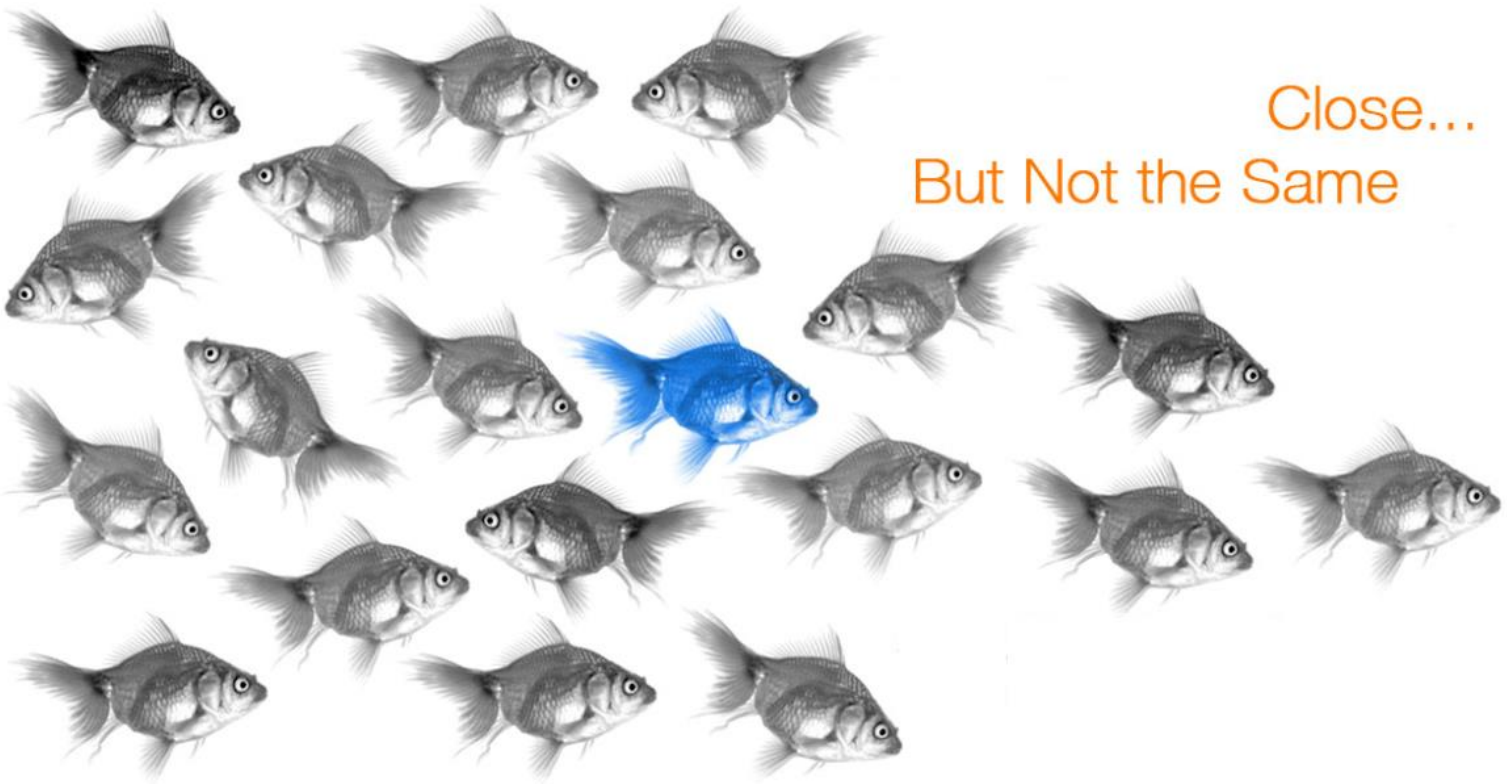
Where Can P&IDs Used?

- Everywhere in our conveyance and treatment systems:
  - Operator training
  - Developing SOPs
  - Process troubleshooting
  - Distribution/conveyance information
  - Storage information

Where Can P&IDs Used?

- Everywhere in our conveyance and treatment systems:
  - Chemical feed systems
  - Hazard monitoring – type and location
  - Sampling type and location
  - Security
  - Auxiliary services

PFD / P&ID Differences



The Process Flow Diagram

- Shows the flow of process or chemical materials and the equipment involved in the process.
- Shows the relationships between the major components in the system and doesn't show details.
- Sometimes used for visitor information and new employee training.

A PFD should include:

- Process Piping

PRIMARY PROCESS FLOW

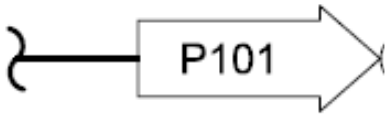
- Major equipment symbols, names and *identification* numbers

PUMP, PERISTALTIC

- Control, valves and valves that affect operation of the system

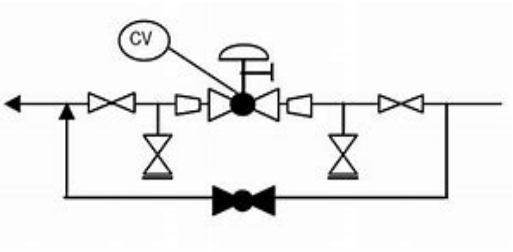
BUTTERFLY VALVE

- Interconnection with other systems



A PFD should include:

- Major bypass and recirculation lines



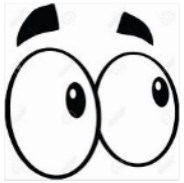
- Sometimes system ratings and operational values as minimum, normal and maximum flow, temperature and pressure

- Composition of fluids

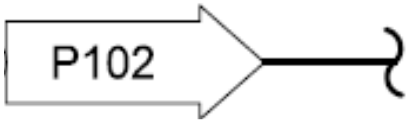
More Basics

- Process always flows from left to right

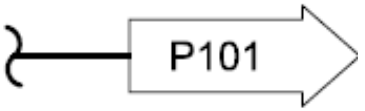
- The whole process doesn't always fit on one drawing

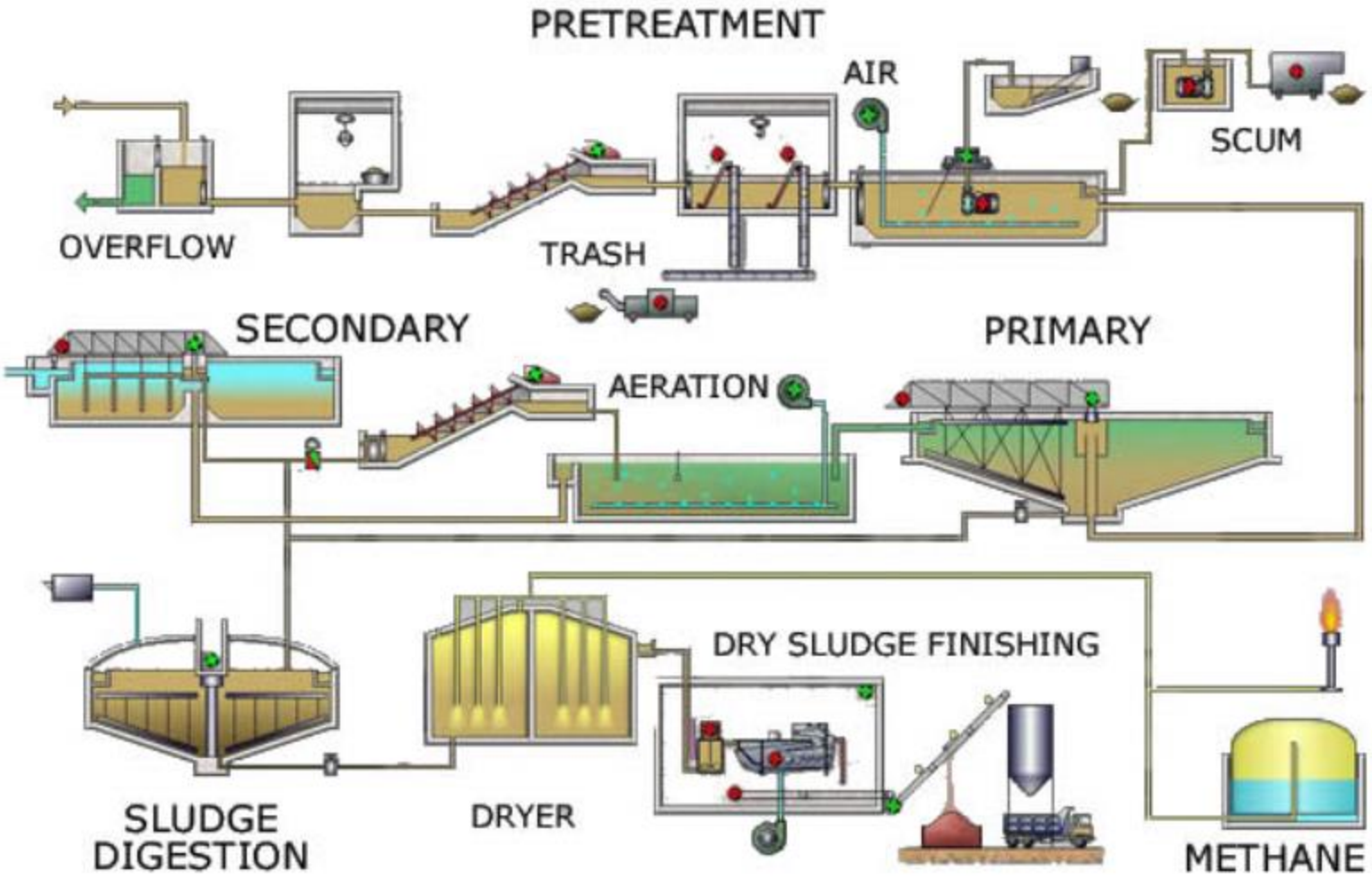


- Drawing numbers on the left side tells where the process is coming from

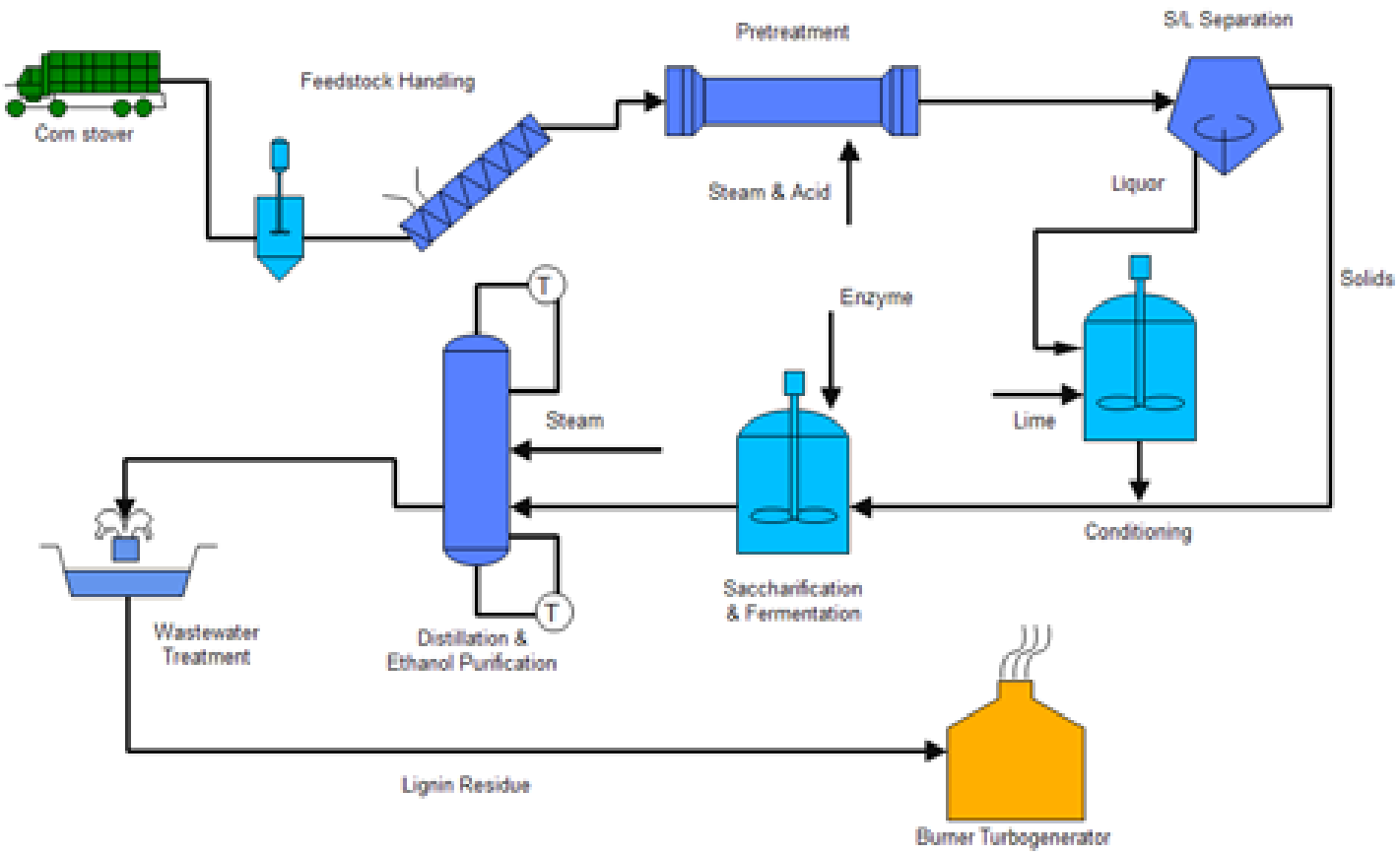


- Drawing number on the right side tells where the process is going to

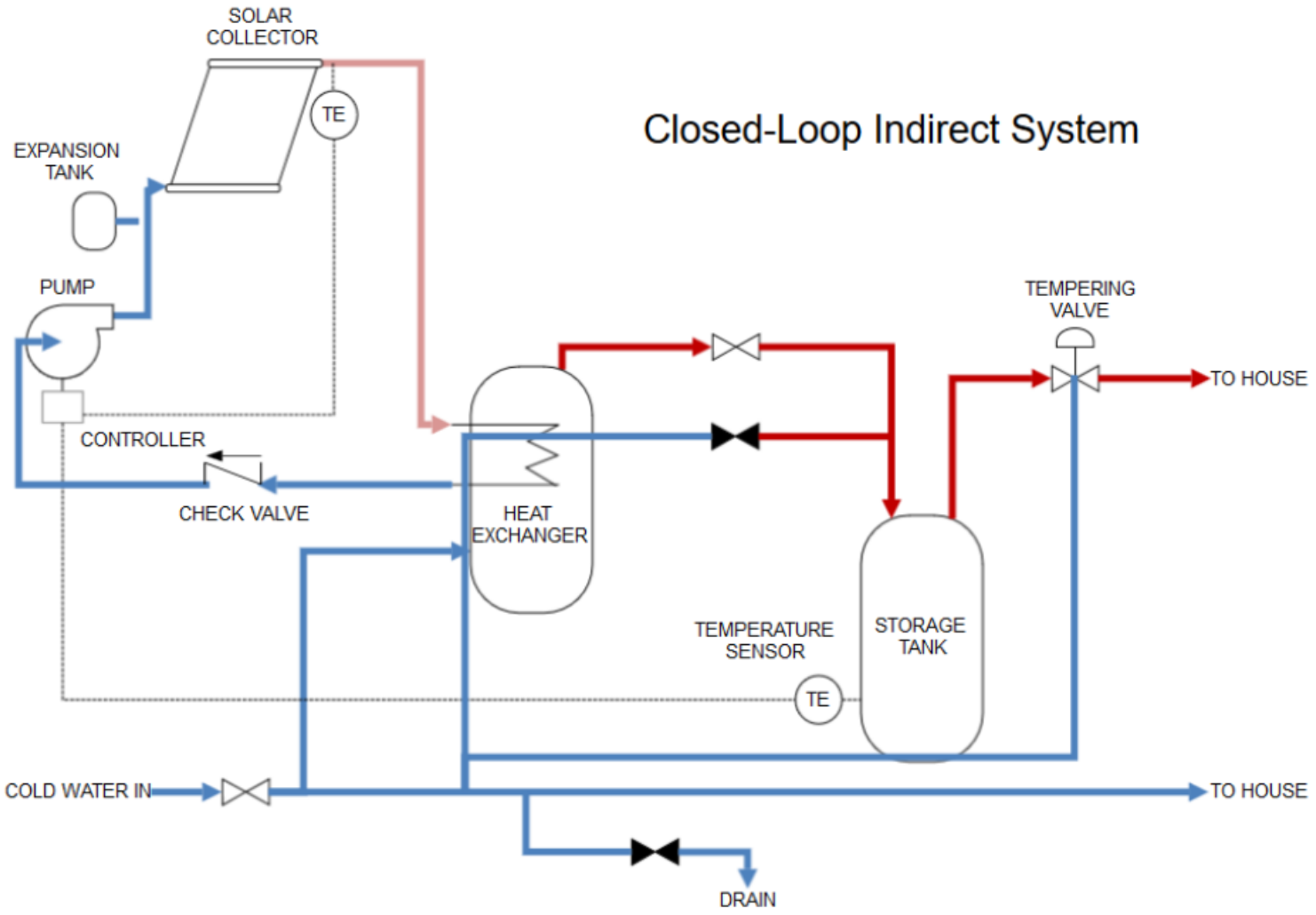



PRETREATMENT
AIR
SCUM
OVERFLOW
TRASH
SECONDARY
PRIMARY
AERATION
DRY SLUDGE FINISHING
SLUDGE
DIGESTION
DRYER
METHANE

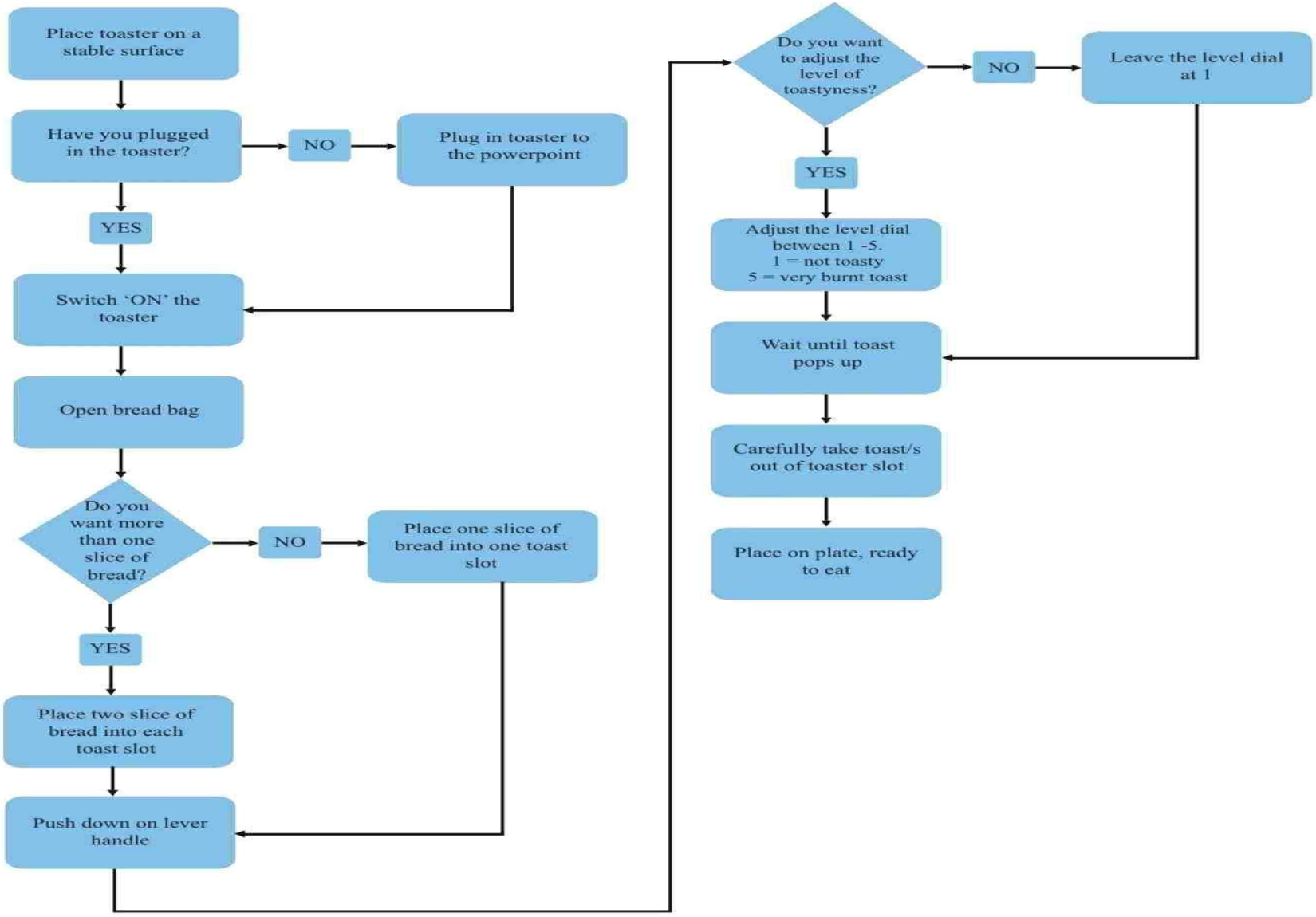
Simple Process Flow



Process Flow Diagram



How To Make Toast



The Process & Instrumentation Diagram

- Process & Instrumentation Diagram (P&ID) show what is in the PFD
  - **plus** the instrumentation to monitor the process
  - **plus** how it is controlled.
- A P&ID shows the relationships between the all components in the system and shows details.
- P&IDs are applied in programming, startup and trouble shooting.

How A P&ID is Set Up

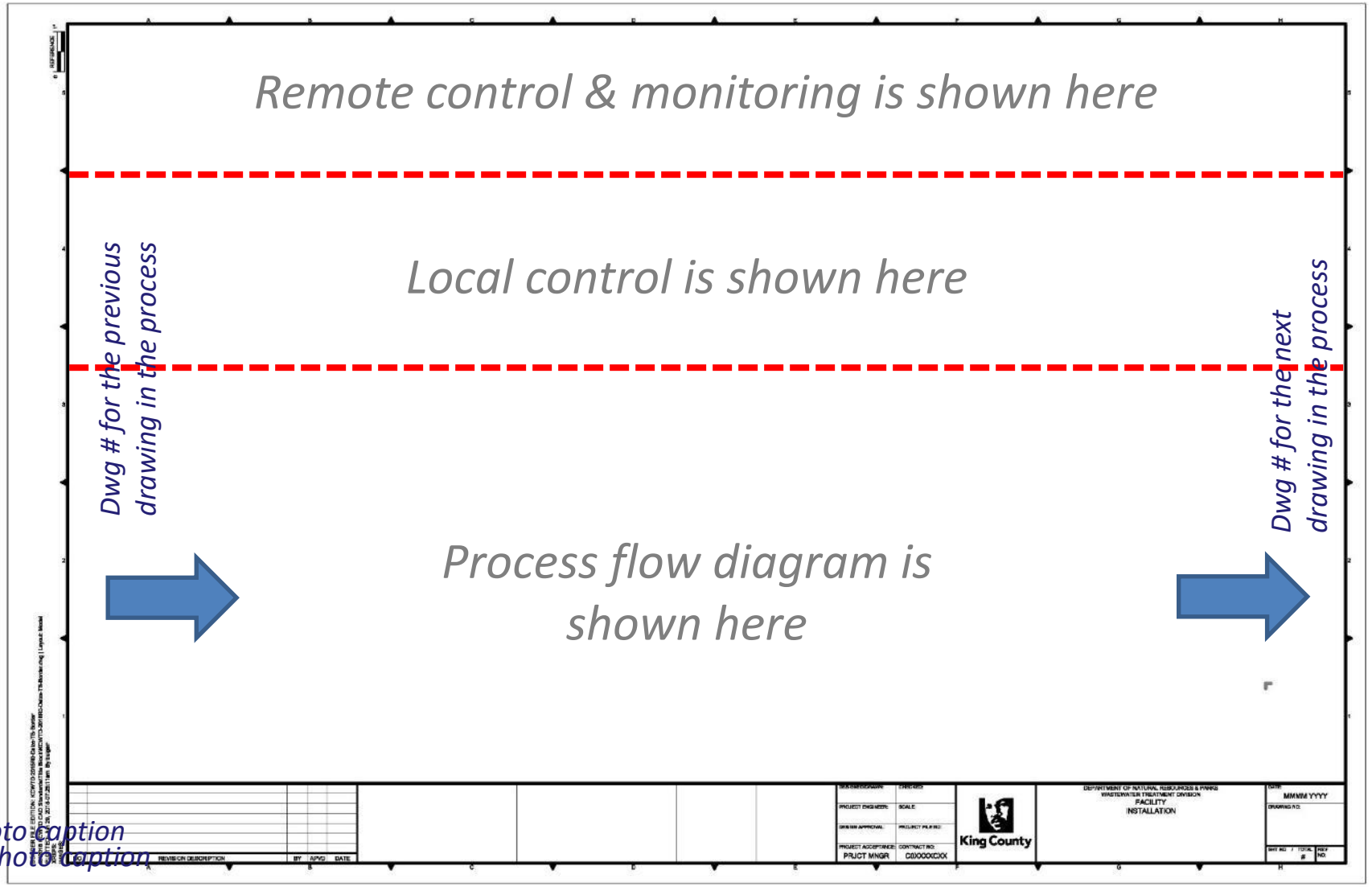


Photo caption
Photo caption

A P&ID Should Include:

- Instrumentation and designations
- Mechanical equipment with names & numbers
- All valves & their identifications
- Process piping, sizes & identification

A P&ID Should Include:

- Miscellaneous – vents, drains, special fittings, sampling lines, reducers & increasers
- Permanent start-up & flush lines
- Flow directions

A P&ID Should Also Include:

- Interconnections references
- Control inputs and outputs, interlocks Interfaces for class changes
- Quality level
- Annunciation inputs

A P&ID Should Also Include:

- Computer control system input
- Vendor and contractor interfaces
- Identification of components and subsystems delivered by others
- Intended physical sequence of the equipment

A P&ID Should Not Include:

- Equipment rating or capacity
- Manual switches and indicating lights
- Primary instrument tubing and valves

A P&ID Should Not Include:

- Pressure temperature and flow data
- Elbows and similar standard fittings
- Extensive explanatory notes

P&IDs Work With the Process Narratives

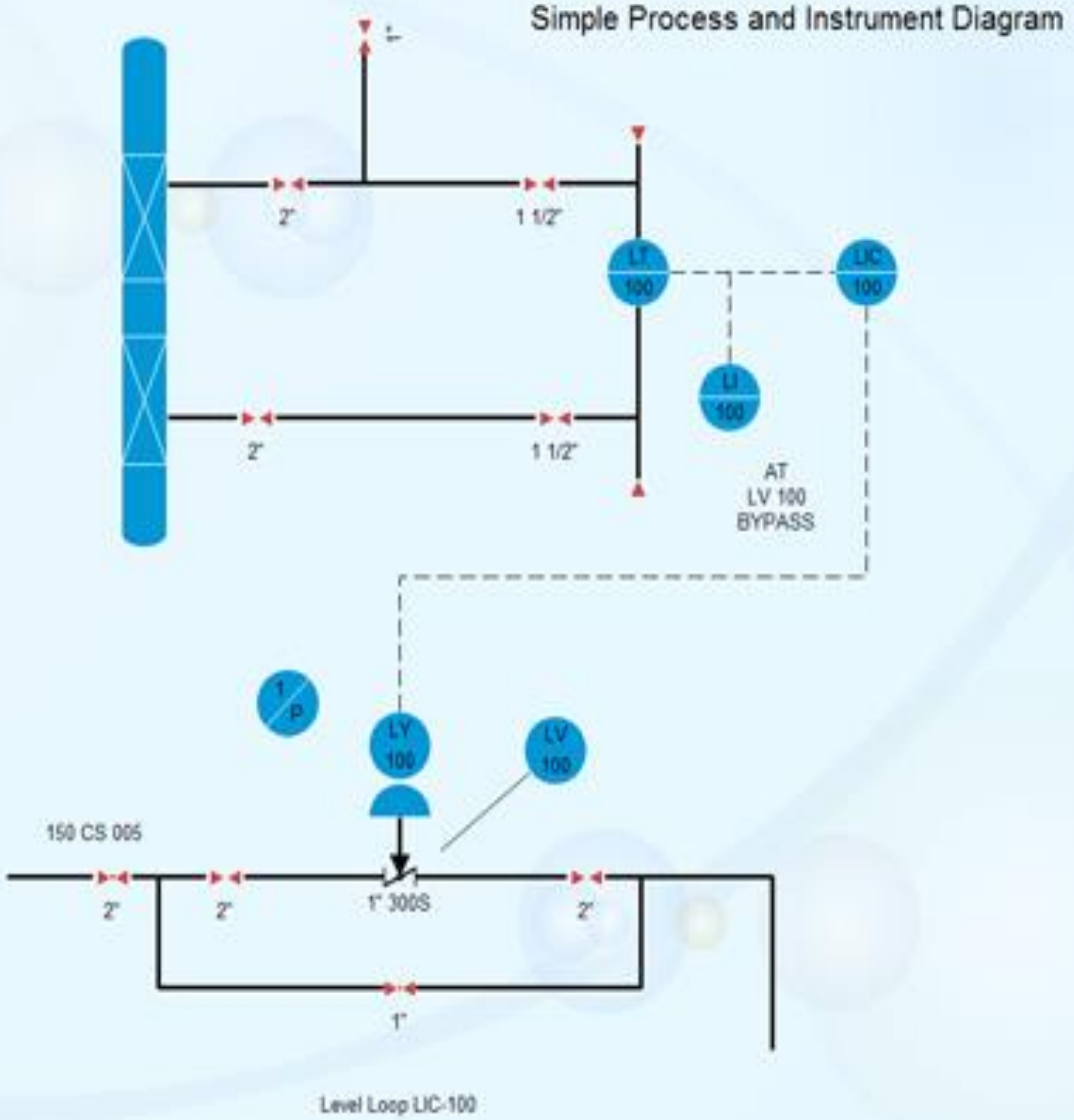
- Process narrative is the text description of the process, instrumentation, monitoring & control

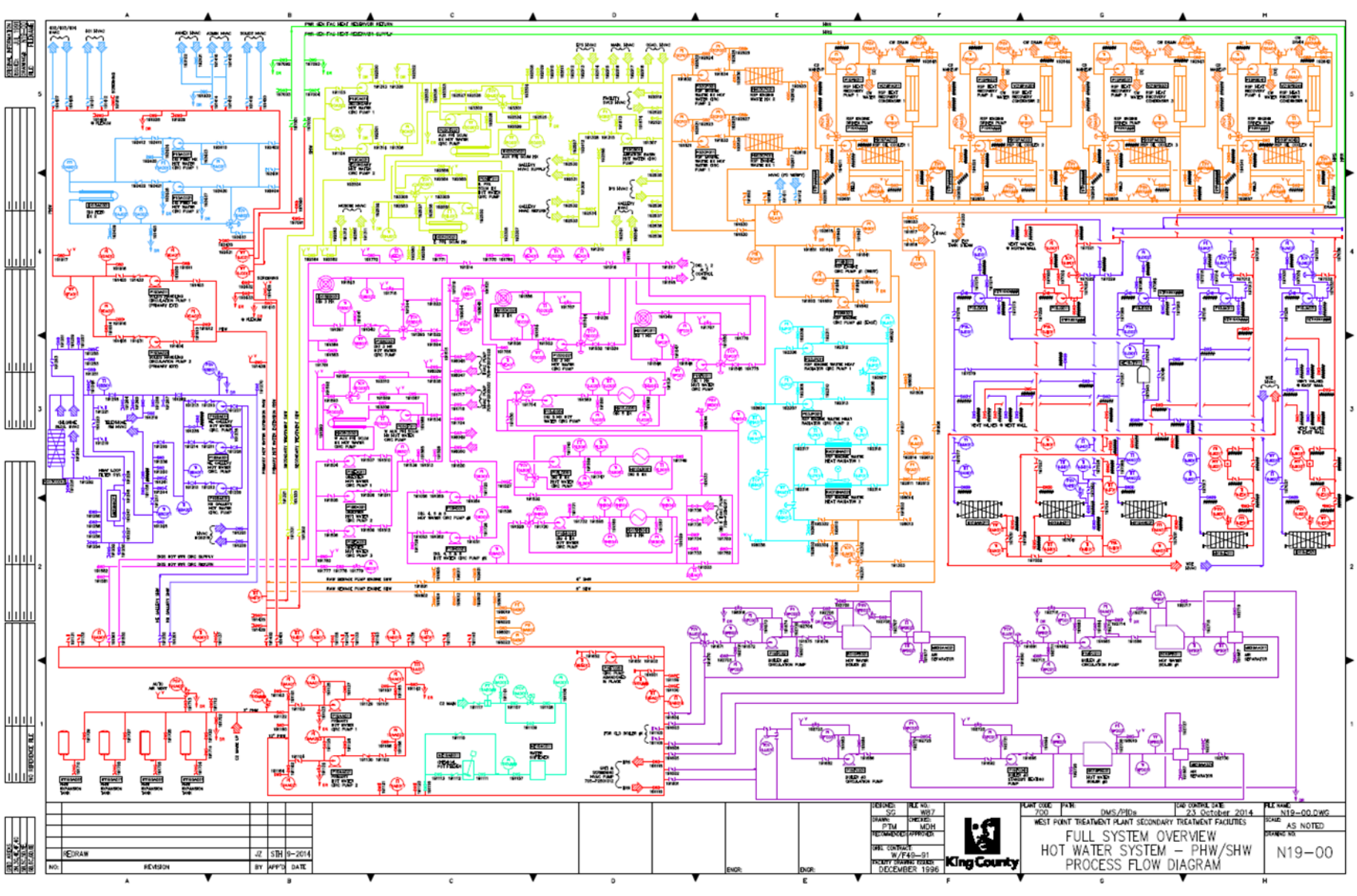
• **Operating set points**	• **Describes the equipment**
• **Decision trees**	• **Manual operation**
• **Describes the process**	• **Automatic operation**

Who Uses P&IDs?

YOU DO! When:

- **Planning a project**
- **Writing a job safety analysis (JSA)**
- **Lockout before a repair or maintenance**
- **Troubleshooting when problems arise**
- **Process hazard review**
- **Training new employees**

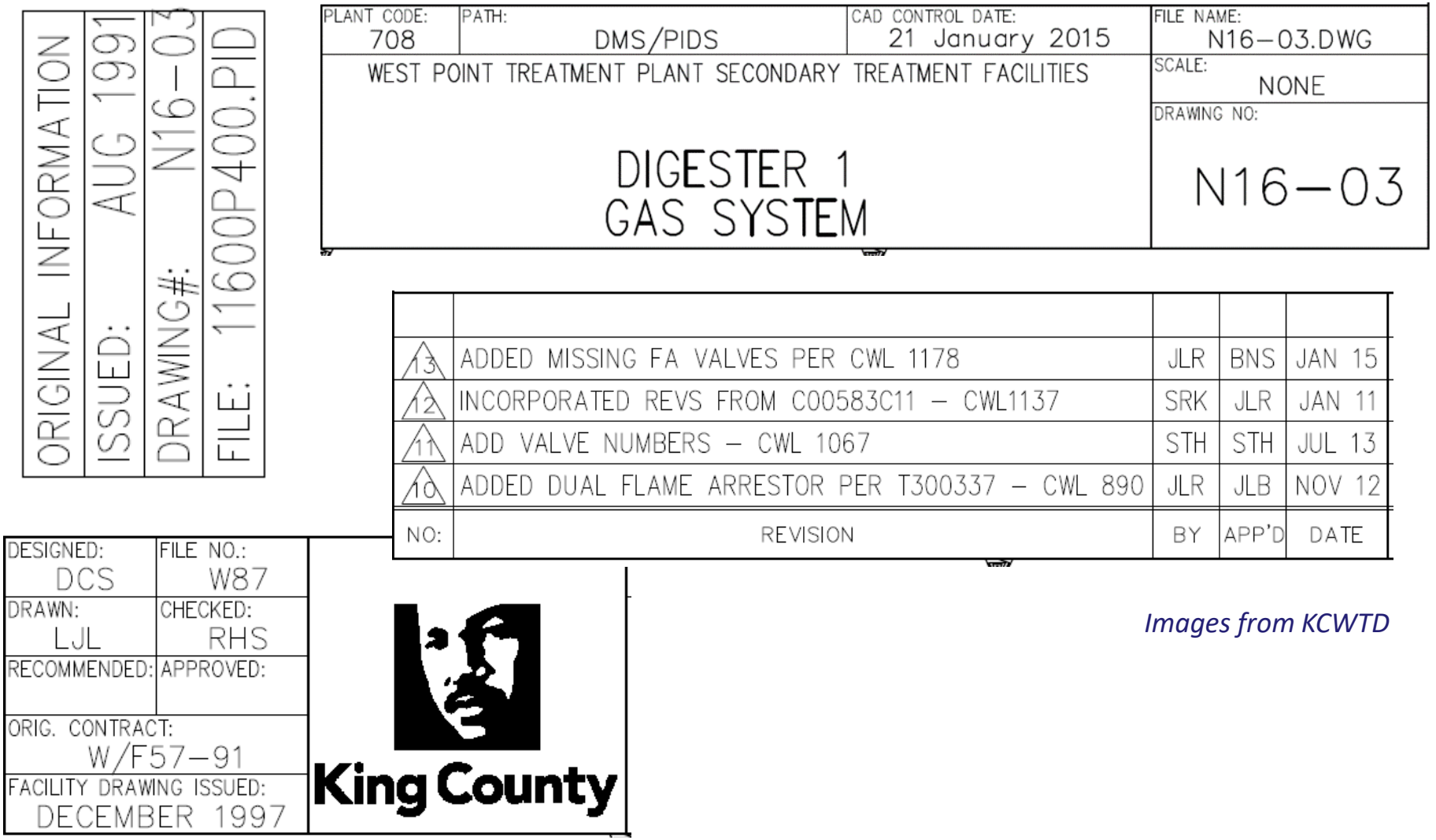

Simple Process and Instrument Diagram
2"
1 1/2"
LT 100
LIC 100
LI 100
2"
1 1/2"
AT
LV 100
BYPASS
I/P
LV 100
LV 100
150 CS 005
2"
2"
1" 300S
2"
1"
Level Loop LIC-100



Graphic from KCWTD

Color can help understanding

What The Parts Tell Us – Title Block



ORIGINAL INFORMATION
ISSUED: AUG 1991
DRAWING#: N16-03
FILE: 11600P400.PID

PLANT CODE: 708	PATH: DMS/PIDS	CAD CONTROL DATE: 21 January 2015	FILE NAME: N16-03.DWG
WEST POINT TREATMENT PLANT SECONDARY TREATMENT FACILITIES			SCALE: NONE
DIGESTER 1 GAS SYSTEM			DRAWING NO: N16-03

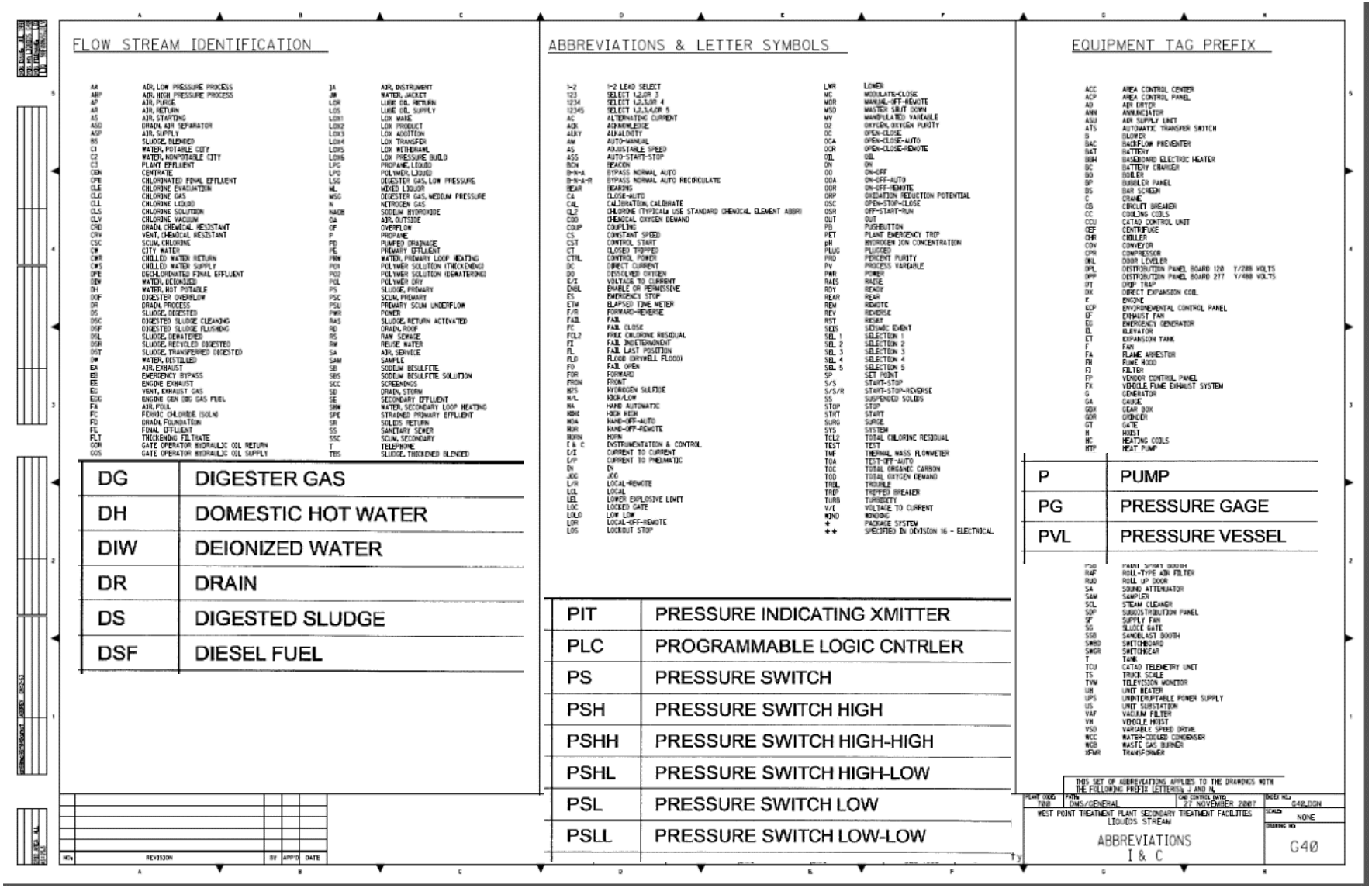
NO:	REVISION	BY	APP'D	DATE
13	ADDED MISSING FA VALVES PER CWL 1178	JLR	BNS	JAN 15
12	INCORPORATED REVS FROM C00583C11 – CWL1137	SRK	JLR	JAN 11
11	ADD VALVE NUMBERS – CWL 1067	STH	STH	JUL 13
10	ADDED DUAL FLAME ARRESTOR PER T300337 – CWL 890	JLR	JLB	NOV 12

DESIGNED: DCS	FILE NO.: W87
DRAWN: LJL	CHECKED: RHS
RECOMMENDED:	APPROVED:
ORIG. CONTRACT: W/F57-91	
FACILITY DRAWING ISSUED: DECEMBER 1997	

King County

Images from KCWTD

Abbreviations



FLOW STREAM IDENTIFICATION

AA	AIR, LOW PRESSURE PROCESS	IA	AIR, INSTRUMENT
AHP	AIR, HIGH PRESSURE PROCESS	JW	WATER, JACKET
AP	AIR, PURGE	LOR	LUBE OIL RETURN
AR	AIR, RETURN	LOS	LUBE OIL SUPPLY
AS	AIR, STARTING	LOX1	LOX MAKE
ASD	DRAIN, AIR SEPARATOR	LOX2	LOX PRODUCT
ASP	AIR, SUPPLY	LOX3	LOX ADDITION
BS	SLUDGE, BLENDED	LOX4	LOX TRANSFER
C1	WATER, POTABLE CITY	LOX5	LOX WITHDRAWAL
C2	WATER, NONPOTABLE CITY	LOX6	LOX PRESSURE BUILD
C3	PLANT EFFLUENT	LPG	PROPANE, LIQUID
CEN	CENTRATE	LPD	POLYMER, LIQUID
CFE	CHLORINATED FINAL EFFLUENT	LSG	DIGESTER GAS, LOW PRESSURE
CLE	CHLORINE EVACUATION	ML	MIXED LIQUOR
CLG	CHLORINE GAS	MSG	DIGESTER GAS, MEDIUM PRESSURE
CLL	CHLORINE LIQUID	N	NITROGEN GAS
CLS	CHLORINE SOLUTION	NAOH	SODIUM HYDROXIDE
CLV	CHLORINE VACUUM	OA	AIR, OUTSIDE
CRD	DRAIN, CHEMICAL RESISTANT	OF	OVERFLOW
CRV	VENT, CHEMICAL RESISTANT	P	PROPANE
CSC	SCUM, CHLORINE	PD	PUMPED DRAINAGE
CW	CITY WATER	PE	PRIMARY EFFLUENT
CWR	CHILLED WATER RETURN	PRW	WATER, PRIMARY LOOP HEATING
CWS	CHILLED WATER SUPPLY	PO1	POLYMER SOLUTION (THICKENING)
DFE	DECHLORINATED FINAL EFFLUENT	PO2	POLYMER SOLUTION (DEWATERING)
DIW	WATER, DEIONIZED	POL	POLYMER DRY
DH	WATER, HOT POTABLE	PS	SLUDGE, PRIMARY
DOF	DIGESTER OVERFLOW	PSC	SCUM, PRIMARY
DR	DRAIN, PROCESS	PSU	PRIMARY SCUM UNDERFLOW
DS	SLUDGE, DIGESTED	PWR	POWER
DSC	DIGESTED SLUDGE CLEANING	RAS	SLUDGE, RETURN ACTIVATED
DSF	DIGESTED SLUDGE FLUSHING	RD	DRAIN, ROOF
DSL	SLUDGE, DEWATERED	RS	RAW SEWAGE
DSR	SLUDGE, RECYCLED DIGESTED	RW	REUSE WATER
DST	SLUDGE, TRANSFERRED DIGESTED	SA	AIR, SERVICE
DW	WATER, DISTILLED	SAM	SAMPLE
EA	AIR, EXHAUST	SB	SODIUM BISULFITE
EB	EMERGENCY BYPASS	SBS	SODIUM BISULFITE SOLUTION
EE	ENGINE EXHAUST	SCC	SCREENINGS
EG	VENT, EXHAUST GAS	SD	DRAIN, STORM
EGG	ENGINE GEN (DG) GAS FUEL	SE	SECONDARY EFFLUENT
FA	AIR, FOUL	SHW	WATER, SECONDARY LOOP HEATING
FC	FERRIC CHLORIDE (SOLN)	SPE	STRAINED PRIMARY EFFLUENT
FD	DRAIN, FOUNDATION	SR	SOLIDS RETURN
FE	FINAL EFFLUENT	SS	SANITARY SEWER
FLT	THICKENING FILTRATE	SSC	SCUM, SECONDARY
GOR	GATE OPERATOR HYDRAULIC OIL RETURN	T	TELEPHONE
GOS	GATE OPERATOR HYDRAULIC OIL SUPPLY	TBS	SLUDGE, THICKENED BLENDED

DG	DIGESTER GAS
DH	DOMESTIC HOT WATER
DIW	DEIONIZED WATER
DR	DRAIN
DS	DIGESTED SLUDGE
DSF	DIESEL FUEL

ABBREVIATIONS & LETTER SYMBOLS

1-2	1-2 LEAD SELECT	LWR	LOWER
123	SELECT 1,2,OR 3	MC	MODULATE-CLOSE
1234	SELECT 1,2,3,OR 4	MDR	MANUAL-OFF-REMOTE
12345	SELECT 1,2,3,4,OR 5	MSD	MASTER SHUT DOWN
AC	ALTERNATING CURRENT	MV	MANIPULATED VARIABLE
ACK	ACKNOWLEDGE	O2	OXYGEN, OXYGEN PURITY
ALKY	ALKALINITY	OC	OPEN-CLOSE
AM	AUTO-MANUAL	OCA	OPEN-CLOSE-AUTO
AS	ADJUSTABLE SPEED	OCR	OPEN-CLOSE-REMOTE
ASS	AUTO-START-STOP	OIL	OIL
BCN	BEACON	ON	ON
B-N-A	BYPASS NORMAL AUTO	OO	ON-OFF
B-N-A-R	BYPASS NORMAL AUTO RECIRCULATE	OOA	ON-OFF-AUTO
BEAR	BEARING	OOR	ON-OFF-REMOTE
CA	CLOSE-AUTO	ORP	OXIDATION REDUCTION POTENTIAL
CAL	CALIBRATION, CALIBRATE	OSC	OPEN-STOP-CLOSE
CL2	CHLORINE (TYPICAL; USE STANDARD CHEMICAL ELEMENT ABBR)	OSR	OFF-START-RUN
COD	CHEMICAL OXYGEN DEMAND	OUT	OUT
COUP	COUPLING	PB	PUSHBUTTON
CS	CONSTANT SPEED	PET	PLANT EMERGENCY TRIP
CST	CONTROL START	pH	HYDROGEN ION CONCENTRATION
CT	CLOSED TRIPPED	PLUG	PLUGGED
CTRL	CONTROL POWER	PRD	PERCENT PURITY
DC	DIRECT CURRENT	PV	PROCESS VARIABLE
DO	DISSOLVED OXYGEN	PWR	POWER
E/I	VOLTAGE TO CURRENT	RAES	RAISE
ENBL	ENABLE OR PERMISSIVE	RDY	READY
ES	EMERGENCY STOP	REAR	REAR
ETM	ELAPSED TIME METER	REM	REMOTE
F/R	FORWARD-REVERSE	REV	REVERSE
FAIL	FAIL	RST	RESET
FC	FAIL CLOSE	SEIS	SEISMIC EVENT
FCL2	FREE CHLORINE RESIDUAL	SEL 1	SELECTION 1
FI	FAIL INDETERMINENT	SEL 2	SELECTION 2
FL	FAIL LAST POSITION	SEL 3	SELECTION 3
FLD	FLOOD DRYWELL FLOOD)	SEL 4	SELECTION 4
FO	FAIL OPEN	SEL 5	SELECTION 5
FOR	FORWARD	SP	SET POINT
FRON	FRONT	S/S	START-STOP
H2S	HYDROGEN SULFIDE	S/S/R	START-STOP-REVERSE
H/L	HIGH/LOW	SS	SUSPENDED SOLIDS
HA	HAND AUTOMATIC	STOP	STOP
HIHI	HIGH HIGH	STRT	START
HOA	HAND-OFF-AUTO	SURG	SURGE
HOR	HAND-OFF-REMOTE	SYS	SYSTEM
HORN	HORN	TCL2	TOTAL CHLORINE RESIDUAL
I & C	INSTRUMENTATION & CONTROL	TEST	TEST
I/I	CURRENT TO CURRENT	TMF	THERMAL MASS FLOWMETER
I/P	CURRENT TO PNEUMATIC	TOA	TEST-OFF-AUTO
IN	IN	TOC	TOTAL ORGANIC CARBON
JOG	JOG	TOD	TOTAL OXYGEN DEMAND
L/R	LOCAL-REMOTE	TRBL	TROUBLE
LCL	LOCAL	TRIP	TRIPPED BREAKER
LEL	LOWER EXPLOSIVE LIMIT	TURB	TURBIDITY
LOC	LOCKED GATE	V/I	VOLTAGE TO CURRENT
LOLO	LOW LOW	WIND	WINDING
LOR	LOCAL-OFF-REMOTE	+	PACKAGE SYSTEM
LOS	LOCKOUT STOP	++	SPECIFIED IN DIVISION 16 - ELECTRICAL

PIT	PRESSURE INDICATING XMITTER
PLC	PROGRAMMABLE LOGIC CNTRLER
PS	PRESSURE SWITCH
PSH	PRESSURE SWITCH HIGH
PSHH	PRESSURE SWITCH HIGH-HIGH
PSHL	PRESSURE SWITCH HIGH-LOW
PSL	PRESSURE SWITCH LOW
PSLL	PRESSURE SWITCH LOW-LOW

EQUIPMENT TAG PREFIX

ACC	AREA CONTROL CENTER
ACP	AREA CONTROL PANEL
AD	AIR DRYER
ANN	ANNUNCIATOR
ASU	AIR SUPPLY UNIT
ATS	AUTOMATIC TRANSFER SWITCH
B	BLOWER
BAC	BACKFLOW PREVENTER
BAT	BATTERY
BBH	BASEBOARD ELECTRIC HEATER
BC	BATTERY CHARGER
BO	BOILER
BP	BUBBLER PANEL
BS	BAR SCREEN
C	CRANE
CB	CIRCUIT BREAKER
CC	COOLING COILS
CCU	CATAD CONTROL UNIT
CEF	CENTRIFUGE
CHR	CHILLER
CON	CONVEYOR
CPR	COMPRESSOR
DKL	DOOR LEVELER
DPL	DISTRIBUTION PANEL BOARD 120 Y/208 VOLTS
DPP	DISTRIBUTION PANEL BOARD 277 Y/480 VOLTS
DT	DROP TRAP
DX	DIRECT EXPANSION COIL
E	ENGINE
ECP	ENVIRONMENTAL CONTROL PANEL
EF	EXHAUST FAN
EG	EMERGENCY GENERATOR
EL	ELEVATOR
ET	EXPANSION TANK
F	FAN
FA	FLAME ARRESTOR
FH	FUME HOOD
FI	FILTER
FP	VENDOR CONTROL PANEL
FX	VEHICLE FUME EXHAUST SYSTEM
G	GENERATOR
GA	GAUGE
GBX	GEAR BOX
GDR	GRINDER
GT	GATE
H	HOIST
HC	HEATING COILS
HTP	HEAT PUMP

P	PUMP
PG	PRESSURE GAGE
PVL	PRESSURE VESSEL

PSB	PAINT SPRAY BOOTH
RAF	ROLL-TYPE AIR FILTER
RUD	ROLL UP DOOR
SA	SOUND ATTENUATOR
SAM	SAMPLER
SCL	STEAM CLEANER
SDP	SUBDISTRIBUTION PANEL
SF	SUPPLY FAN
SG	SLUICE GATE
SSB	SANDBLAST BOOTH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
T	TANK
TCU	CATAD TELEMETRY UNIT
TS	TRUCK SCALE
TVM	TELEVISION MONITOR
UH	UNIT HEATER
UPS	UNINTERRUPTABLE POWER SUPPLY
US	UNIT SUBSTATION
VAF	VACUUM FILTER
VH	VEHICLE HOIST
VSD	VARIABLE SPEED DRIVE
WCC	WATER-COOLED CONDENSER
WGB	WASTE GAS BURNER
XFMR	TRANSFORMER

THIS SET OF ABBREVIATIONS APPLIES TO THE DRAWINGS WITH THE FOLLOWING PREFIX LETTERS: I AND PL

PLANT CODE: 780	PATH: DMS/GENERAL	CAD CONTROL DATE: 27 NOVEMBER 2007	ORDER NO.: G40.DGN

WEST POINT TREATMENT PLANT SECONDARY TREATMENT FACILITIES
LIQUIDS STREAM

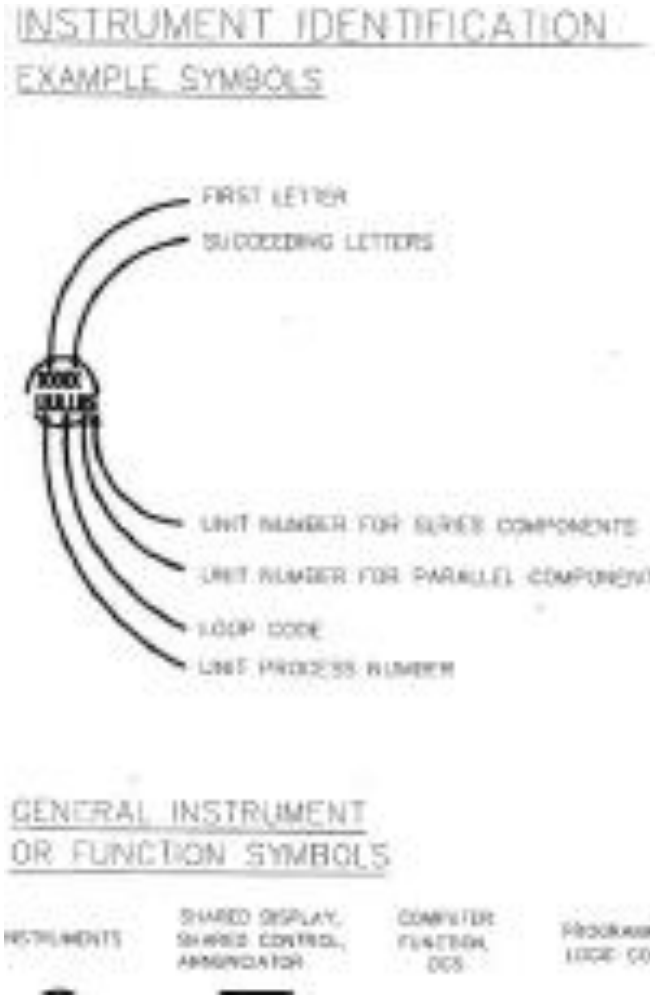
ABBREVIATIONS
I & C

SCALE: NONE

DRAWING NO.: G40

NO.	REVISION	BY	APP'D	DATE

Instrument Identification

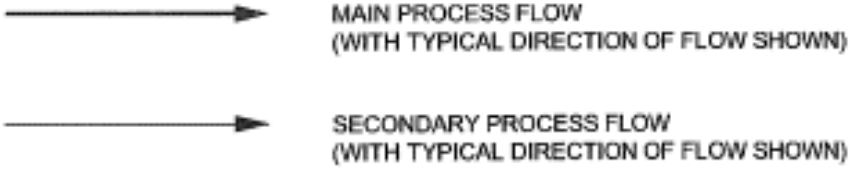


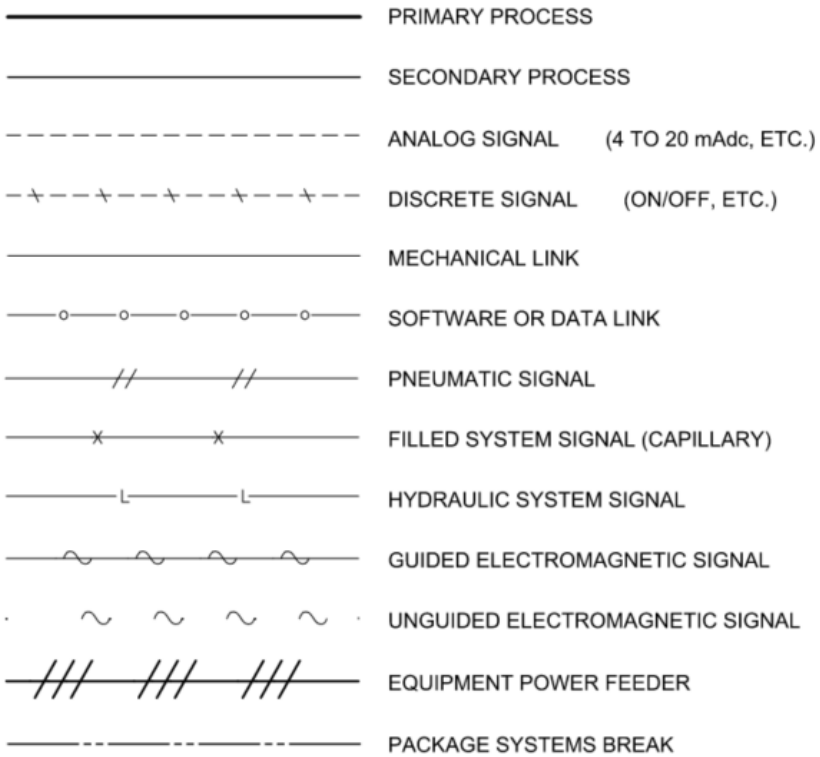
INSTRUMENT SOCIETY OF AMERICA TABLE

FIRST LETTER			SUCCEEDING LETTERS		
MEASURED OR INITIATING VARIABLE		MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM	ALARM	AUTO
B	BURNER FLAME		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY (ELECTRICAL)			CONTROL	CLOSED
D	DENSITY (MASS) OR SPECIFIC GRAVITY	DIFFERENTIAL			FAIL, ERROR ABNORMAL
E	VOLTAGE (EMF)		PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			
G	GAUGING (DIMENSIONAL)		GLASS		READY
H	HAND (MANUALLY INITIATED)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			RUNNING, RUN
K	TIME OR TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	STOP
L	LEVEL		LIGHT (PILOT)		LOW, LOCAL
M	MOTOR OR MOISTURE	MOMENTARY			MID
N	EQUIPMENT				
O	USER'S CHOICE		ORIFICE (RESTRICTION)		OPEN
P	PRESSURE OR VACUUM		POINT (TEST CONNECTION)		
Q	QUANTITY	INTEGRATE OR TOTALIZE			
R	RADIATION		RECORD OR PRINT		REMOTE
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION			VALVE, DAMPER, OR LOUVER	
W	TORQUE, WEIGHT, FORCE		WELL		
X	UNCLASSIFIED		PLC INPUT	UNCLASSIFIED	
Y	EVENT			RELAY OR COMPUTER OR PLC OUTPUT	
Z	POSITION			DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	

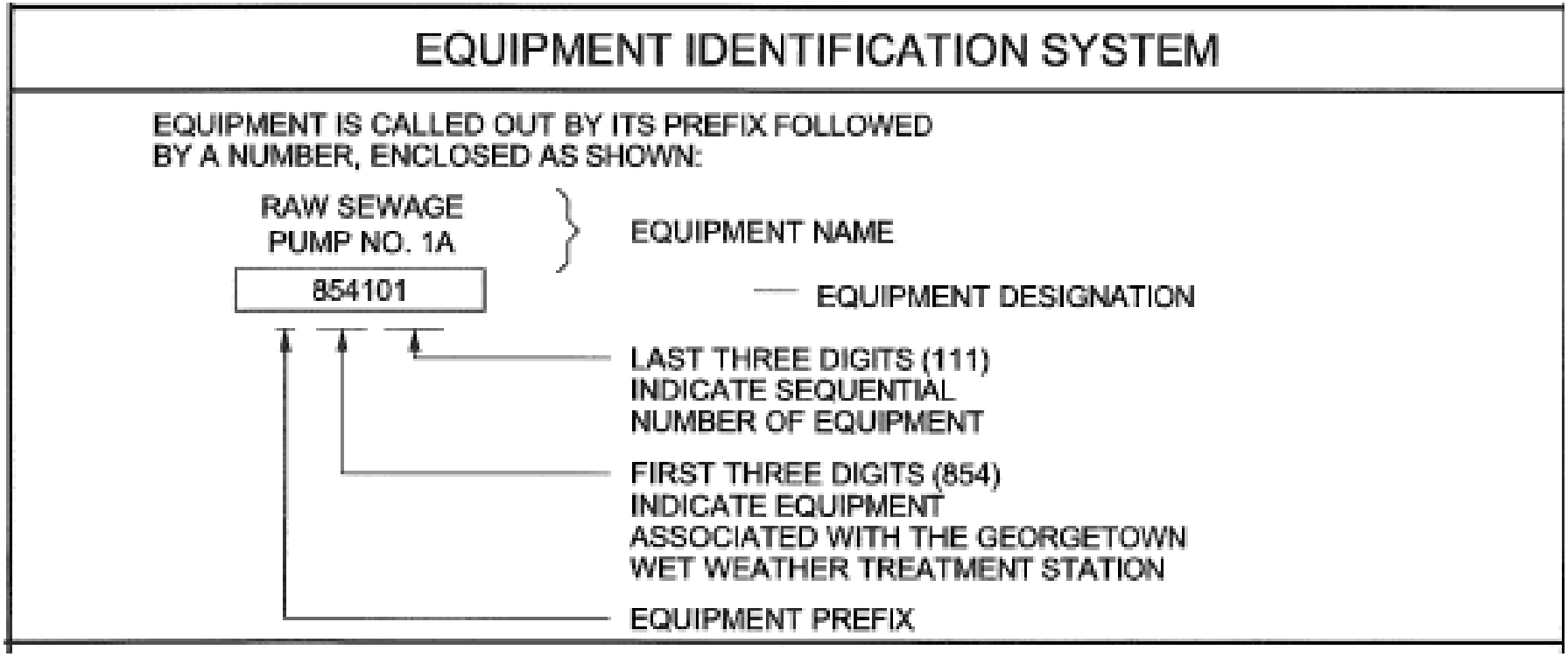
Images from KCWTD

Line Legend

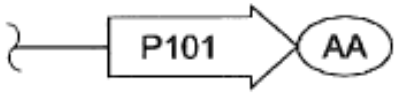

MAIN PROCESS FLOW
(WITH TYPICAL DIRECTION OF FLOW SHOWN)
SECONDARY PROCESS FLOW
(WITH TYPICAL DIRECTION OF FLOW SHOWN)


PRIMARY PROCESS
SECONDARY PROCESS
ANALOG SIGNAL (4 TO 20 mAdc, ETC.)
DISCRETE SIGNAL (ON/OFF, ETC.)
MECHANICAL LINK
SOFTWARE OR DATA LINK
PNEUMATIC SIGNAL
FILLED SYSTEM SIGNAL (CAPILLARY)
HYDRAULIC SYSTEM SIGNAL
GUIDED ELECTROMAGNETIC SIGNAL
UNGUIDED ELECTROMAGNETIC SIGNAL
EQUIPMENT POWER FEEDER
PACKAGE SYSTEMS BREAK
CONNECTING LINES
NON-CONNECTING LINES

Tag Numbers

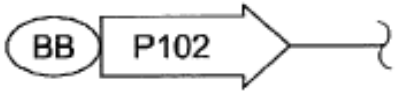

EQUIPMENT IDENTIFICATION SYSTEM
EQUIPMENT IS CALLED OUT BY ITS PREFIX FOLLOWED BY A NUMBER, ENCLOSED AS SHOWN:
RAW SEWAGE PUMP NO. 1A
EQUIPMENT NAME
854101
EQUIPMENT DESIGNATION
LAST THREE DIGITS (111) INDICATE SEQUENTIAL NUMBER OF EQUIPMENT
FIRST THREE DIGITS (854) INDICATE EQUIPMENT ASSOCIATED WITH THE GEORGETOWN WET WEATHER TREATMENT STATION
EQUIPMENT PREFIX

Interface Symbols



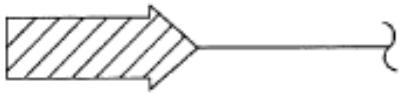
REMARK LINE 1
REMARK LINE 2

PROCESS/
SIGNAL FLOW INTERFACE
AA = CONNECTOR NUMBER
P101 = DESTINATION DRAWING NO.



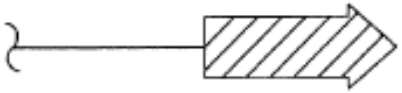
REMARK LINE 1
REMARK LINE 2

PROCESS/
SIGNAL FLOW INTERFACE
BB = CONNECTOR NUMBER
P102 = SOURCE DRAWING NO.



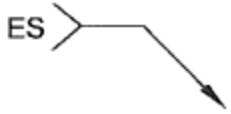
REMARK LINE 1
REMARK LINE 2

FROM PROCESS EXTERNAL
TO PROJECT



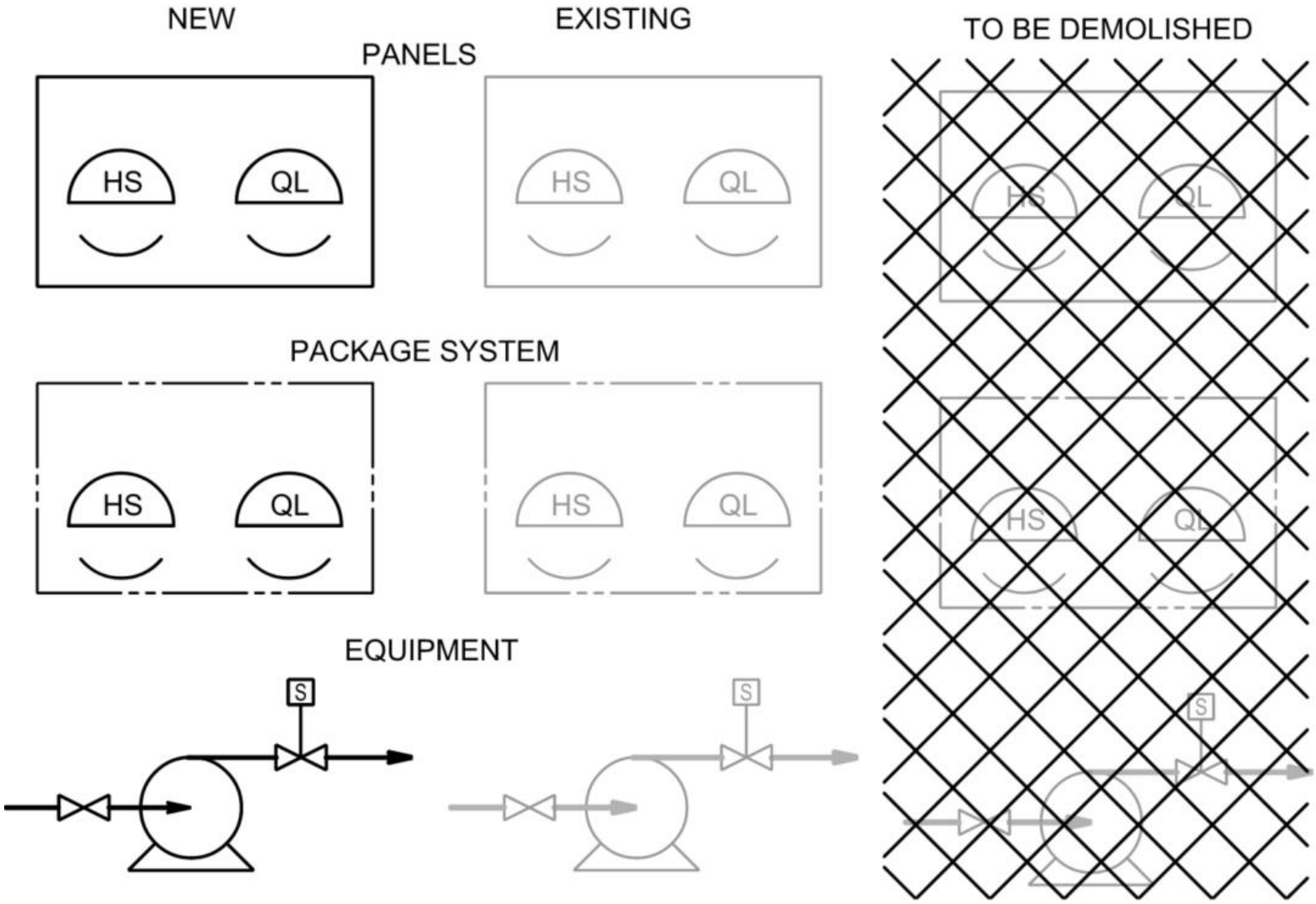
REMARK LINE 1
REMARK LINE 2

TO PROCESS EXTERNAL
FROM PROJECT

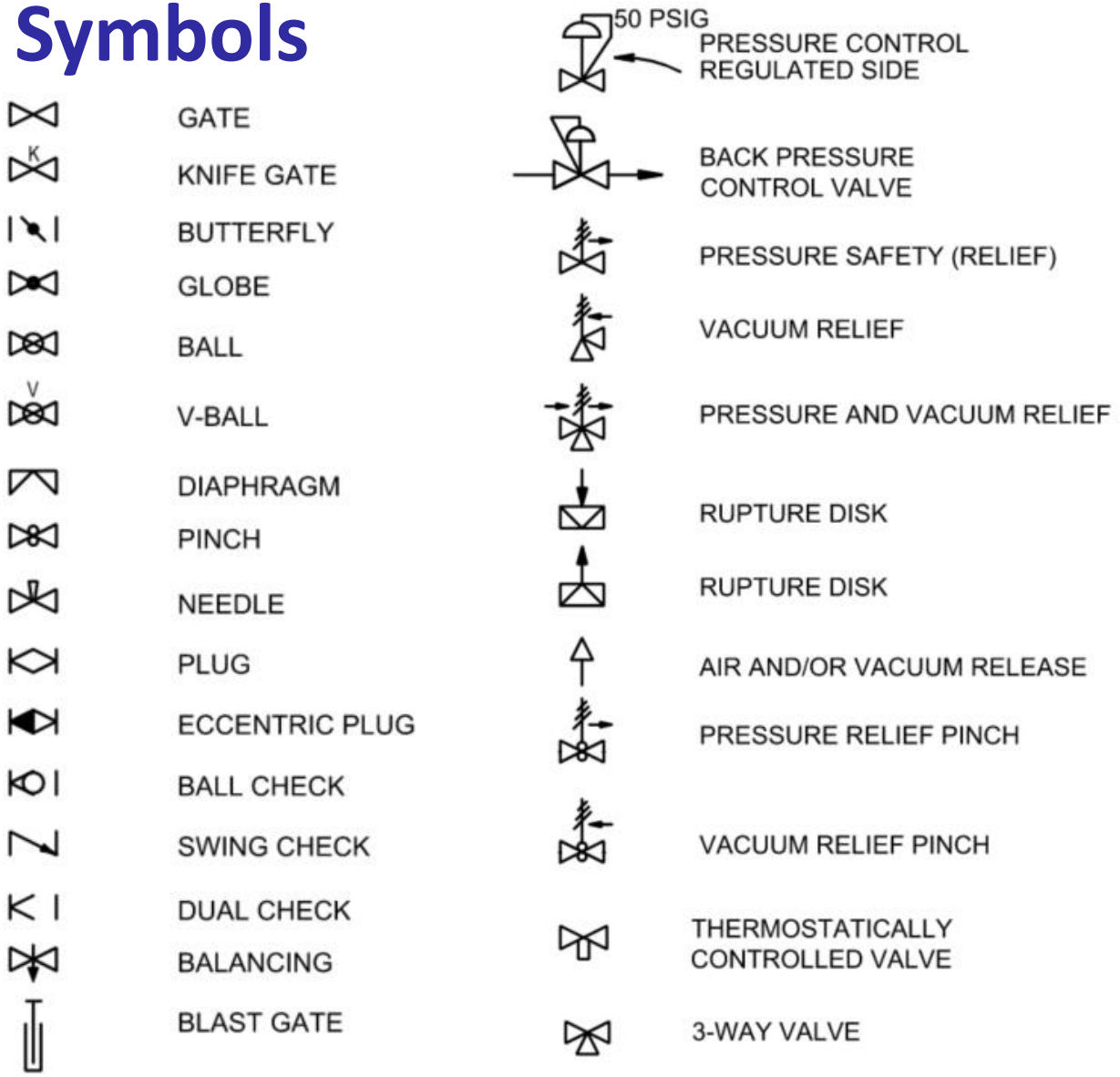


ELECTRIC SUPPLY
ES: DEFINES TYPE OF SUPPLY
EXAMPLE:
120=120VAC, SINGLE PHASE

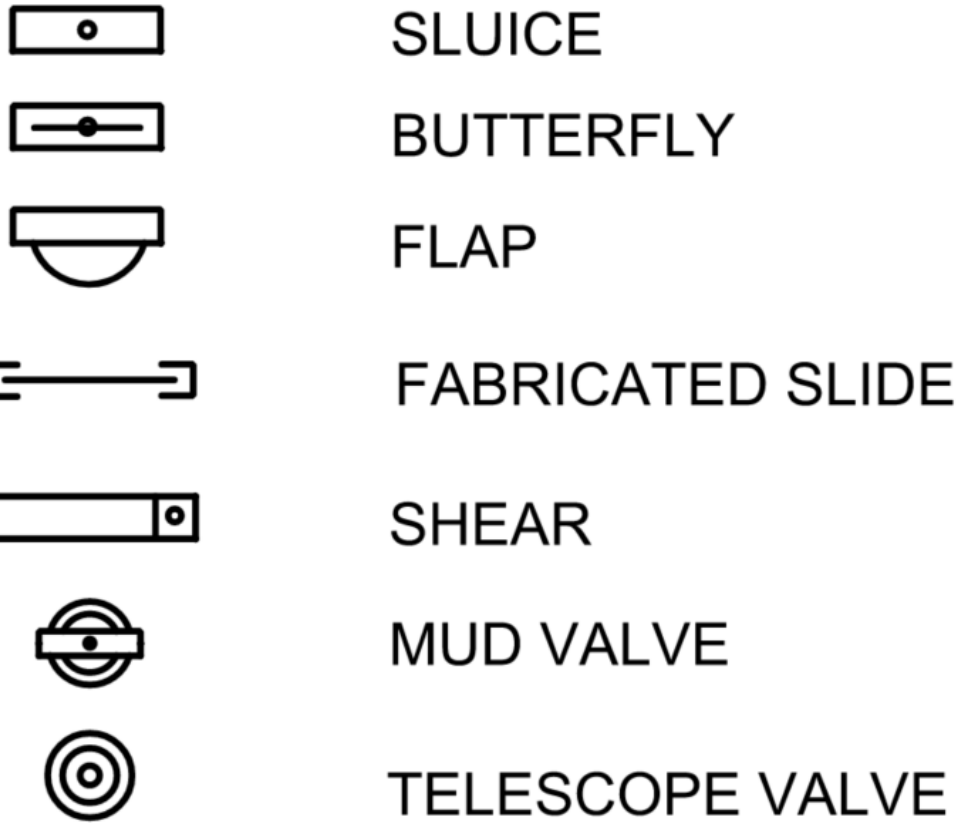
Construction Status



Valve Symbols



Gate Symbols



Actuator Symbols

PNEUMATIC DIAPHRAM
SPRING-OPPOSED

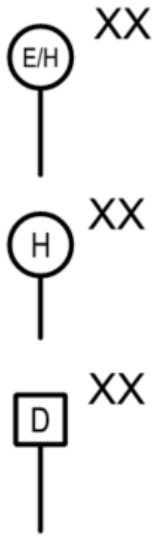
PNEUMATIC CYLINDER
SINGLE OR DOUBLE ACTING
ACTUATED BY ONE INPUT

MANUAL

SPRING

ELECTRIC MOTOR

SOLENOID



ELECTROHYDRAULIC

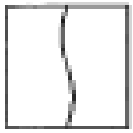
HYDRAULIC

DIGITAL

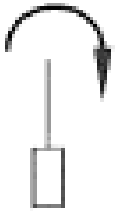
NOTE:
ON LOSS OF PRIMARY POWER
(PNEUMATIC, ELECTRICAL OR HYDRAULIC)

XX: FO = FAIL OPEN
FC = FAIL CLOSED
FL = FAIL TO LAST POSITION
FI = FAIL INDETERMINATE

Mechanical Equipment Symbols



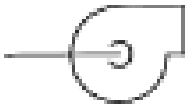
HEATER



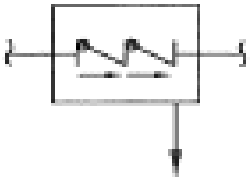
WEIR

GENERATOR

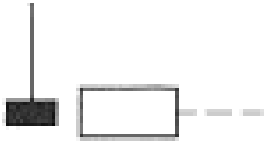
RECEIVER, PRESSURE VESSEL OR SCRUBBER



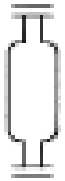
PUMP, CENTRIFUGAL



REDUCED PRESSURE BACKFLOW PREVENTER

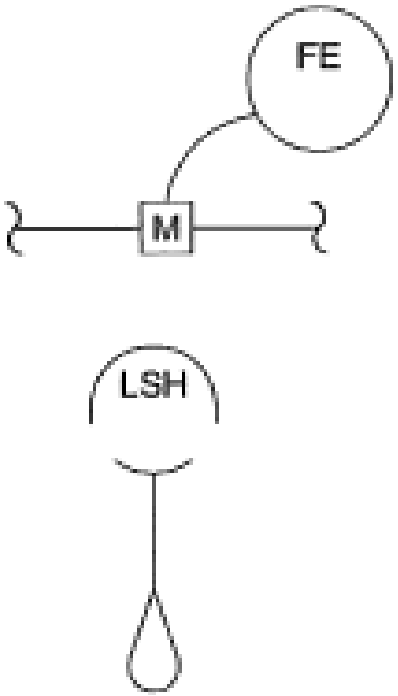


SPEED SENSOR (RPM)



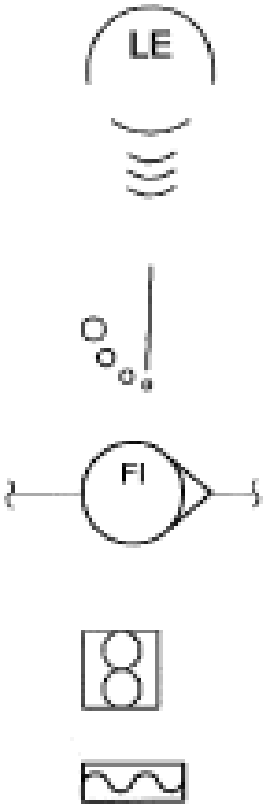
SILENCER

Primary Element Symbols



MAGNETIC FLOW TUBE

FLOAT SWITCH
(HIGH WATER LEVEL)



ULTRASONIC LEVEL ELEMENT

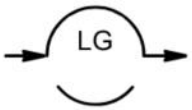
BUBBLER

VARIABLE AREA FLOW INDICATOR (ROTAMETER)

UTILITY METER

DIAPHRAGM SEAL

Miscellaneous Symbols



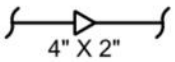
SIGHT GLASS

DIAPHRAGM SEAL

BLIND FLANGE

AIR GAP

VENT TO ATMOSPHERE



PIPE REDUCER

IN-LINE STATIC MIXER

INLET GUIDE VANE

INLET SILENCER/FILTER

INLINE SILENCER

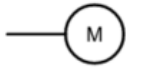
VENT SILENCER

FILTER

MULTIVANE LOUVER/DAMPI

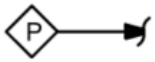
SINGLE VANE LOUVER/DAM

MIXER



ELECTRIC MOTOR

SAMPLE CONNECTION

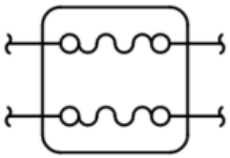


FLUSHING CONNECTION
PURGE OR FLUSHING DEVICE

HOSE ADAPTOR - WITH CAP

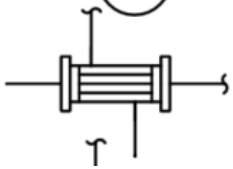
SPIRAL TUBE EXCHANGER

HEAT EXCHANGER



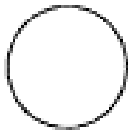
HEAT EXCHANGER, PLATE TYPE

HEAT EXCHANGER,
SPIRAL TYPE

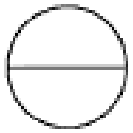


HEAT EXCHANGER,
STRAIGHT TUBE TYPE

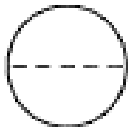
Functional Logic Diagrams



FIELD DEVICE
FOR DESCRIPTION
SEE TABLE

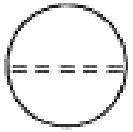


PANEL FRONT
DEVICE

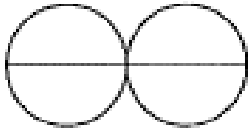


INTERNAL PANEL
DEVICE

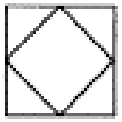
AUXILIARY PANEL
FRONT DEVICE



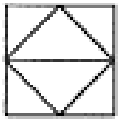
INTERNAL AUXILIARY
PANEL DEVICE



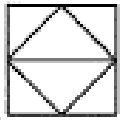
DEVICE INTEGRAL TO
ONE PANEL MOUNTED
DEVICE



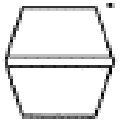
PLC I/O



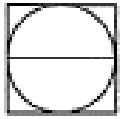
PLC I/O AND
ACCESSIBLE ON
OIT AND SCADA



* PLC I/O AND
ACCESSIBLE ON OIT



METROTEL I/O



* VFD HUMAN
INTERFACE MODULE
OR
MCC HUMAN
MACHINE INTERFACE

* HIM VFD HUMAN
INTERFACE MODULE
OR
HMI MCC HUMAN
MACHINE INTERFACE

Header

PLC INTERFACES

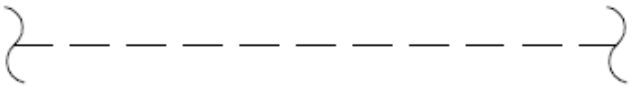
△ ANALOG INPUT
▽ ANALOG OUTPUT

(Analog = continuous)

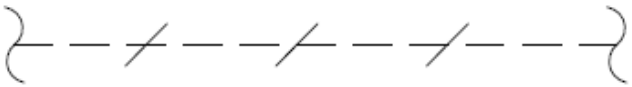
▲ DISCRETE INPUT
▼ DISCRETE OUTPUT

(Discrete = on/off)

□ CABLE CONNECTION



ANALOG SIGNAL LINE

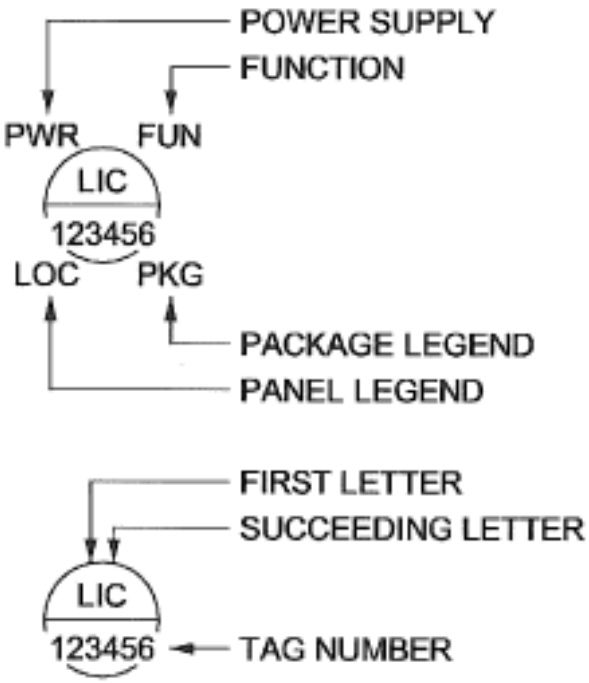


DISCRETE SIGNAL LINE

NETWORK CABLE

Instrumentation Identification

FIRST LETTER			SUCCEEDING LETTERS		
MEASURED OR INITIATING VARIABLE		MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM	ALARM	AUTO
B	BURNER FLAME		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY (ELECTRICAL)			CONTROL	CLOSED
D	DENSITY (MASS) OR SPECIFIC GRAVITY	DIFFERENTIAL			FAIL, ERROR ABNORMAL
E	VOLTAGE (EMF)		PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			
G	GAUGING (DIMENSIONAL)		GLASS		READY
H	HAND (MANUALLY INITIATED)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			RUNNING, RUN
K	TIME OR TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	STOP
L	LEVEL		LIGHT (PILOT)		LOW, LOCAL
M	MOTOR OR MOISTURE	MOMENTARY			MID
N	EQUIPMENT				
O	USER'S CHOICE		ORIFICE (RESTRICTION)		OPEN
P	PRESSURE OR VACUUM		POINT (TEST CONNECTION)		
Q	QUANTITY	INTEGRATE OR TOTALIZE			
R	RADIATION		RECORD OR PRINT		REMOTE
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION			VALVE, DAMPER, OR LOUVER	
W	TORQUE, WEIGHT, FORCE		WELL		
X	UNCLASSIFIED		PLC INPUT	UNCLASSIFIED	
Y	EVENT			RELAY OR COMPUTER OR PLC OUTPUT	
Z	POSITION			DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	



Take a Break


COFFEE
TO GO
FRESH & HOT
CORKY CUP
ECO-FRIENDLY CORK COATED CUP
COFFEE
TO GO
FRESH & HOT
CORKY CUP
ECO-FRIENDLY CORK COATED CUP

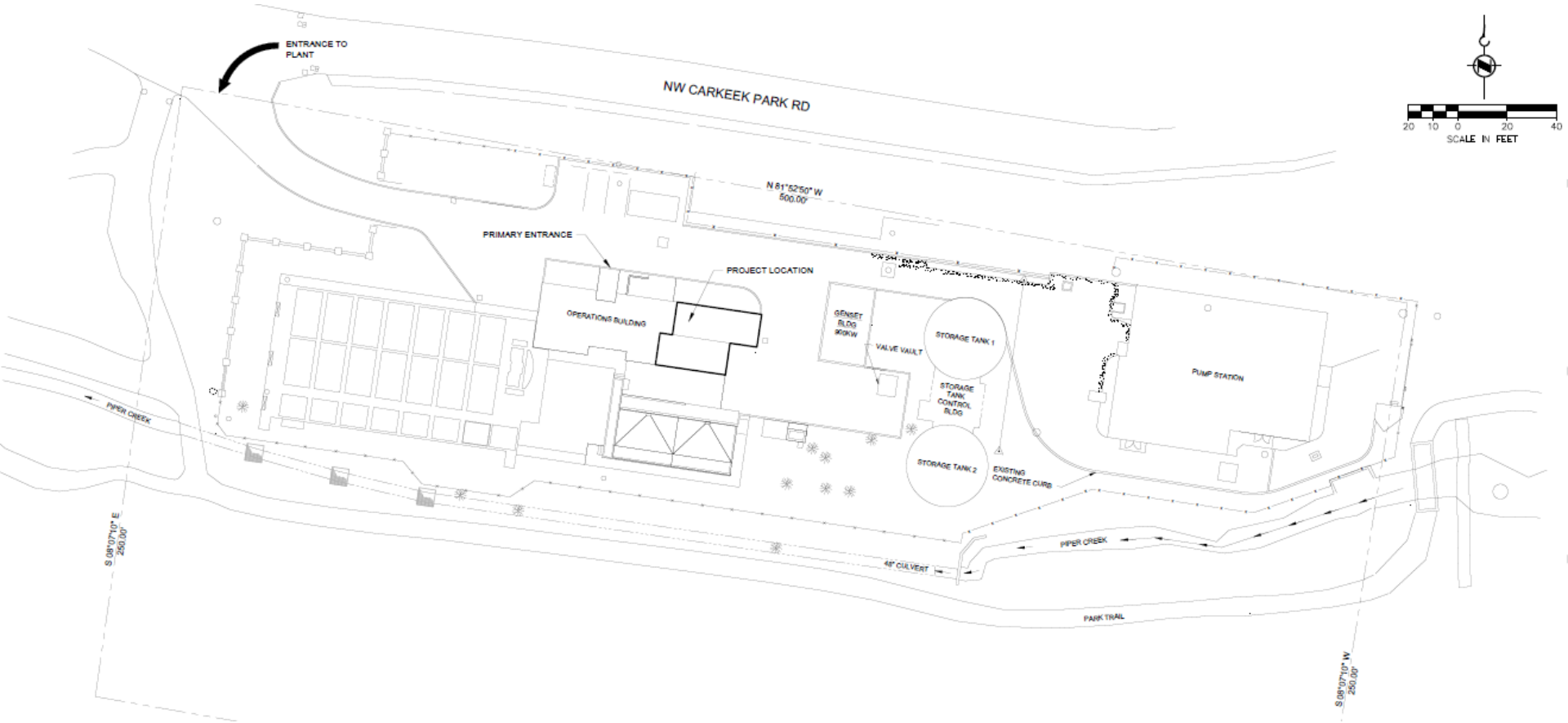
An Example or Two

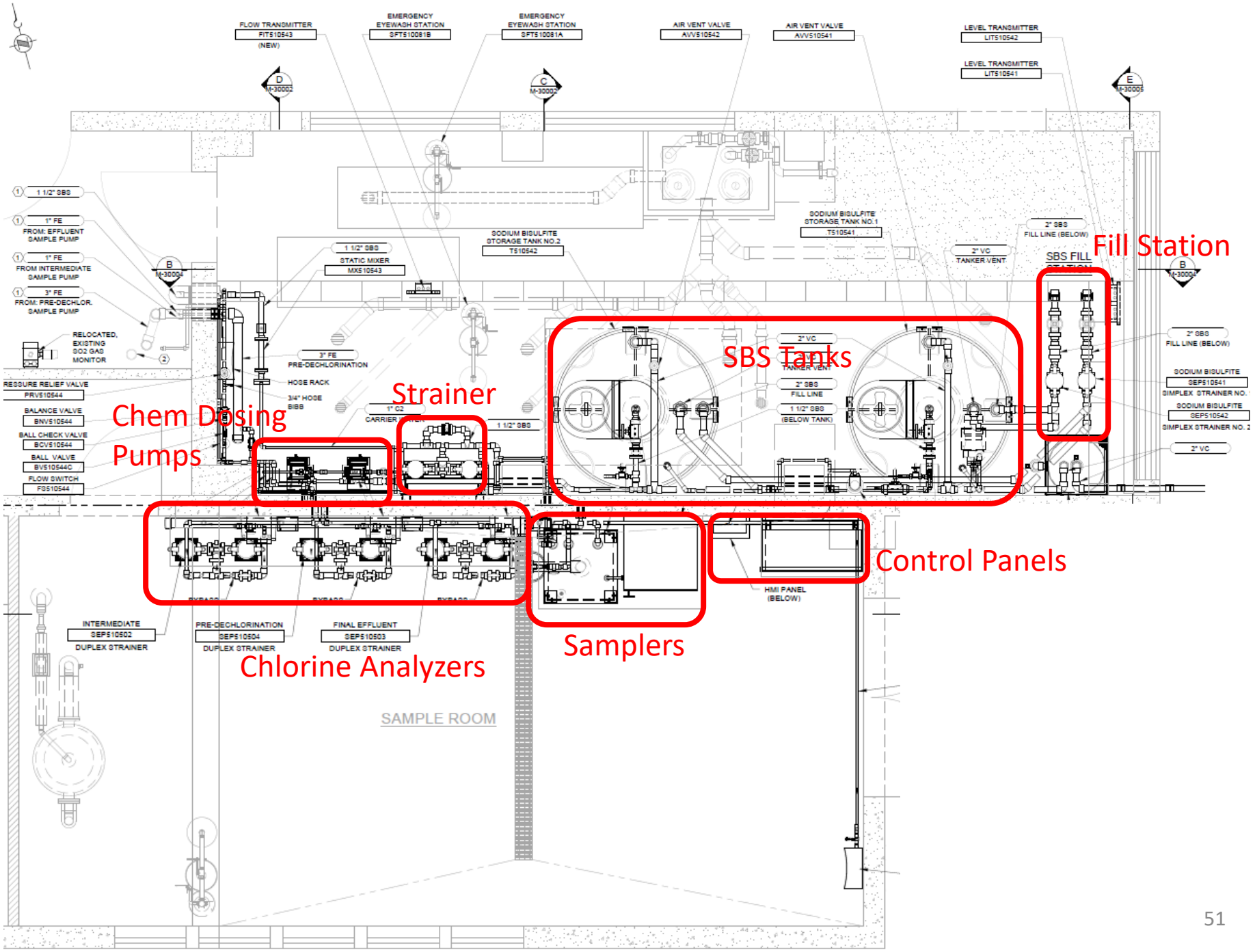
Carkeek Sodium Bisulfite System Replacement

Alki CSO Treatment Plant Sodium Hypochlorite System

Carkeek Wet Weather Treatment System – Sodium Bisulfite Dosing

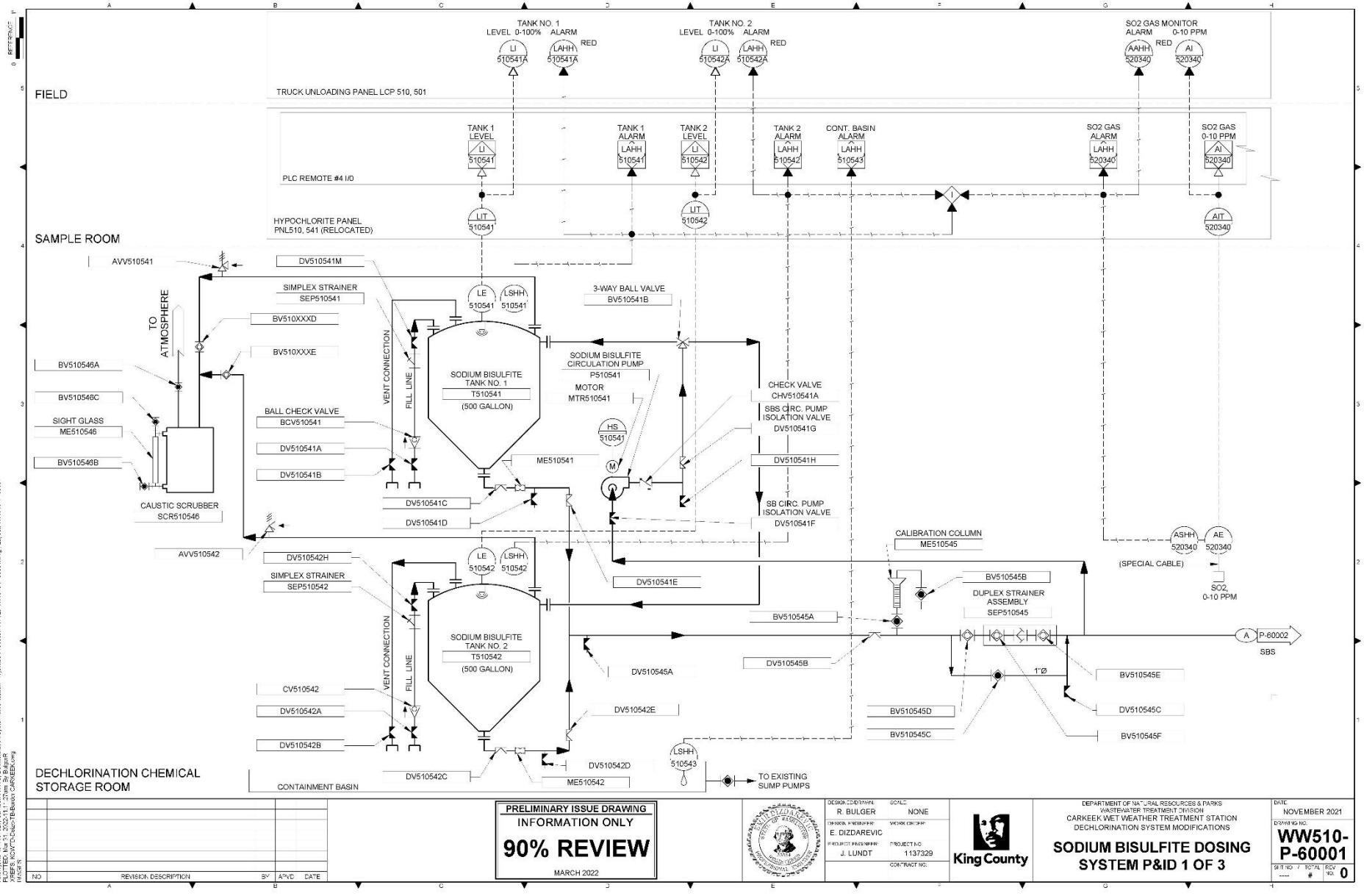
Graphic from KCWTD


ENTRANCE TO PLANT
NW CARKEEK PARK RD
N 81°52'50" W
500.00'
PRIMARY ENTRANCE
PROJECT LOCATION
OPERATIONS BUILDING
GENSET BLDG 360KW
VALVE VAULT
STORAGE TANK 1
STORAGE TANK CONTROL BLDG
STORAGE TANK 2
EXISTING CONCRETE CURB
PUMP STATION
PIPER CREEK
S 08°07'10" E
250.00'
48" CULVERT
PIPER CREEK
PARK TRAIL
S 08°07'10" W
250.00'
20 10 0 20 40
SCALE IN FEET


Fill Station
SBS Tanks
Strainer
Chem Dosing Pumps
Control Panels
Samplers
Chlorine Analyzers
SAMPLE ROOM
FLOW TRANSMITTER FIT510543 (NEW)
EMERGENCY EYEWASH STATION SFTS10081B
EMERGENCY EYEWASH STATION SFTS10081A
AIR VENT VALVE AVV510542
AIR VENT VALVE AVV510541
LEVEL TRANSMITTER LIT510542
LEVEL TRANSMITTER LIT510541
SODIUM BISULFITE STORAGE TANK NO.1 T510541
SODIUM BISULFITE STORAGE TANK NO.2 T510542
STATIC MIXER MXS10543
1 1/2" SBS
1" FE FROM: EFFLUENT SAMPLE PUMP
1" FE FROM INTERMEDIATE SAMPLE PUMP
3" FE FROM: PRE-DECHLOR. SAMPLE PUMP
RELOCATED, EXISTING SO2 GAS MONITOR
3" FE PRE-DECHLORINATION
HOSE RACK
3/4" HOSE BIBB
1" CI2 CARRIER
2" VC TANKER VENT
2" SBS FILL LINE
1 1/2" SBS (BELOW TANK)
2" SBS FILL LINE (BELOW)
SBS FILL STATION
SODIUM BISULFITE SEP510541 SIMPLEX STRAINER NO.
SODIUM BISULFITE SEP510542 SIMPLEX STRAINER NO. 2
PRESSURE RELIEF VALVE PRV510544
BALANCE VALVE BNV510544
BALL CHECK VALVE BCV510544
BALL VALVE BV510544C
FLOW SWITCH FDS10544
HMI PANEL (BELOW)
INTERMEDIATE SEP510502 DUPLEX STRAINER
PRE-DECHLORINATION SEP510504 DUPLEX STRAINER
FINAL EFFLUENT SEP510503 DUPLEX STRAINER

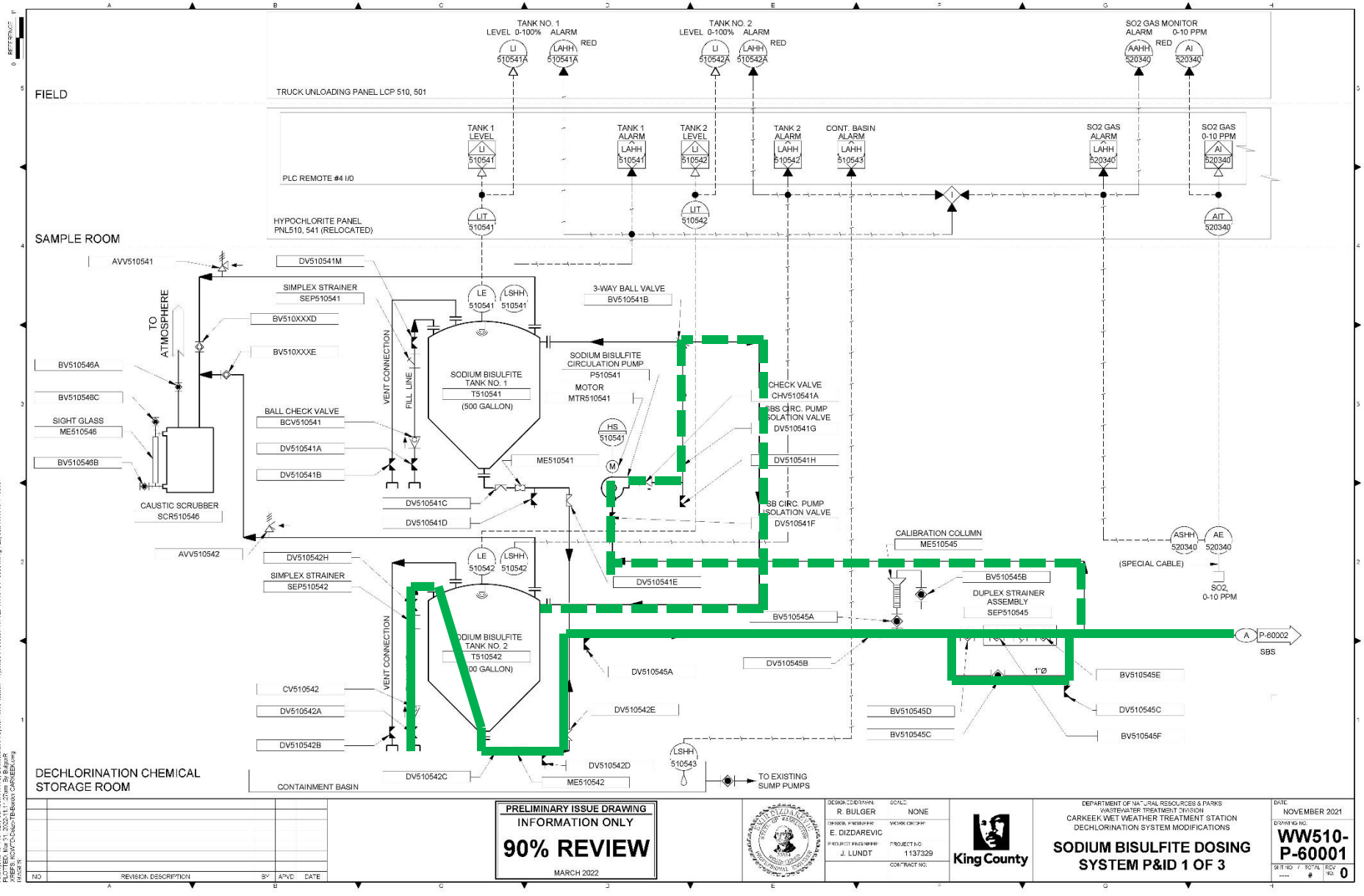
SBS Storage & Strainer

Graphic from KCWTD

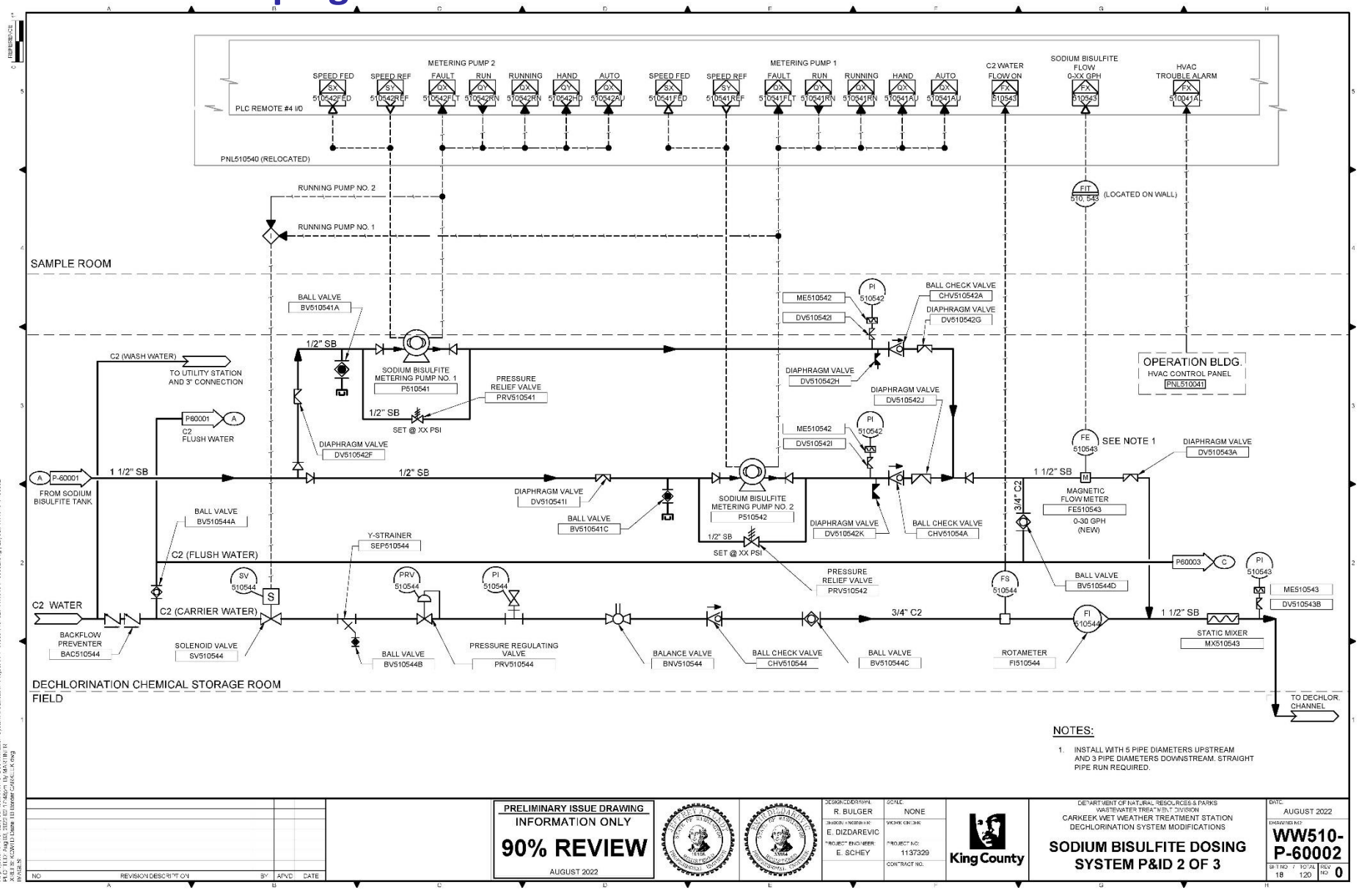


SBS Storage & Strainer

Graphic from KCWTD

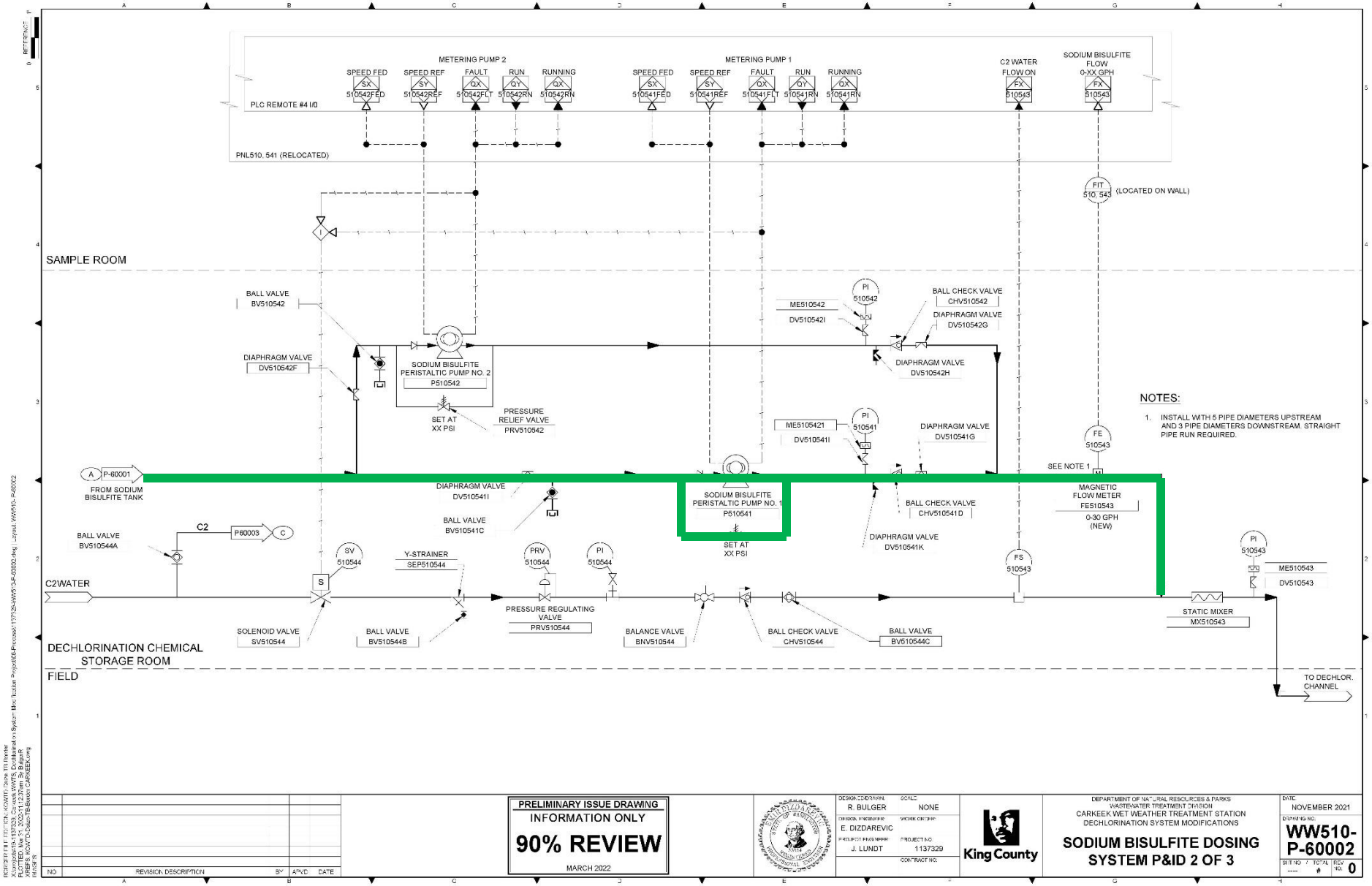


SBS Pumping

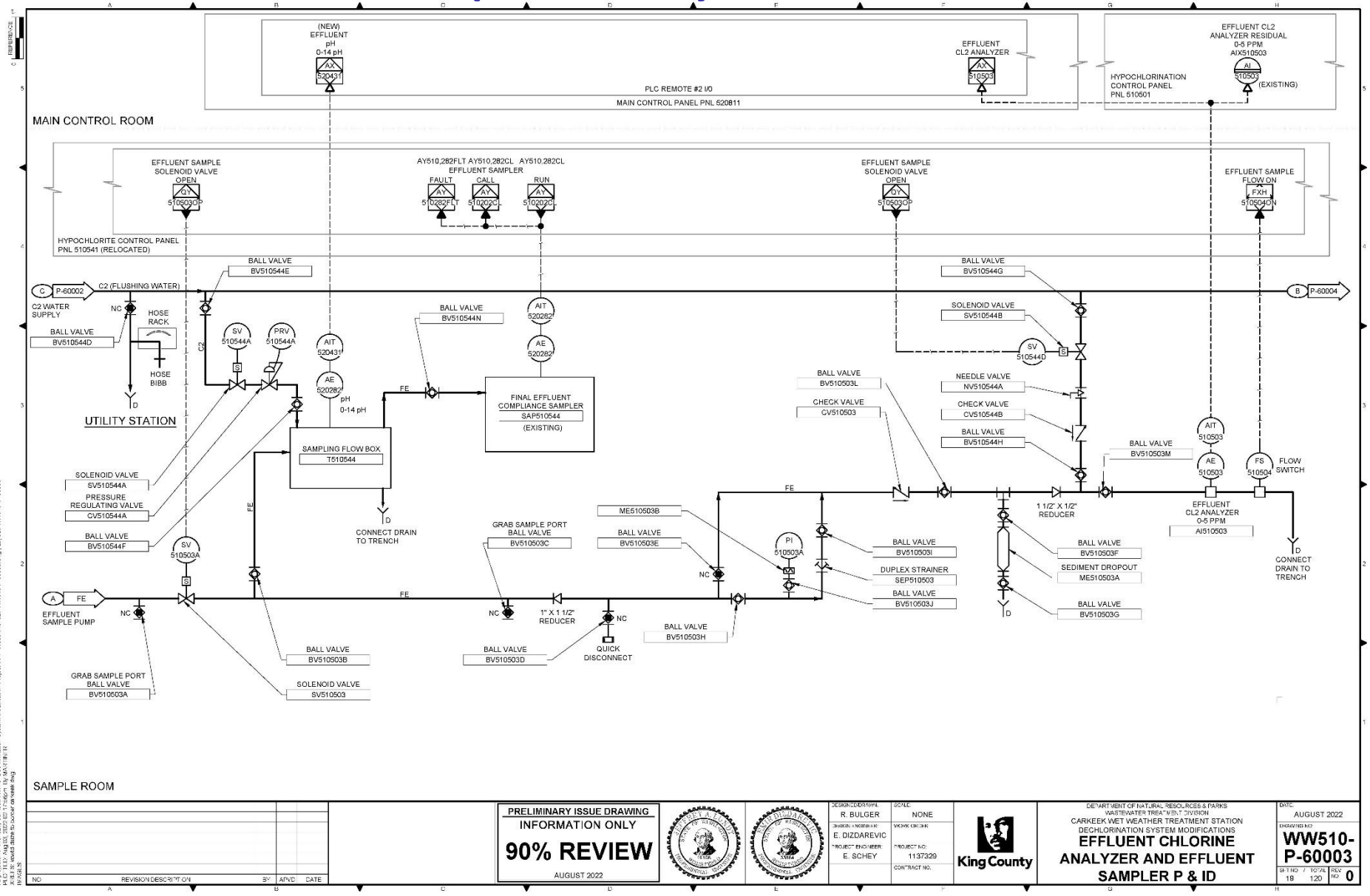

METERING PUMP 2
METERING PUMP 1
SPEED FED
SPEED REF
FAULT
RUN
RUNNING
HAND
AUTO
C2 WATER FLOW ON
SODIUM BISULFITE FLOW 0-XX GPH
HVAC TROUBLE ALARM
PLC REMOTE #4 I/O
PNL510540 (RELOCATED)
RUNNING PUMP NO. 2
RUNNING PUMP NO. 1
FIT 510, 543 (LOCATED ON WALL)
SAMPLE ROOM
BALL VALVE BV510541A
PI 510542
ME510542
DV510542I
BALL CHECK VALVE CHV510542A
DIAPHRAGM VALVE DV510542G
DIAPHRAGM VALVE DV510542H
DIAPHRAGM VALVE DV510542J
OPERATION BLDG.
HVAC CONTROL PANEL
PNL510041
C2 (WASH WATER)
TO UTILITY STATION AND 3" CONNECTION
P80001
C2 FLUSH WATER
1/2" SB
SODIUM BISULFITE METERING PUMP NO. 1
P510541
PRESSURE RELIEF VALVE
PRV510541
SET @ XX PSI
DIAPHRAGM VALVE DV510542F
FE 510543
SEE NOTE 1
DIAPHRAGM VALVE DV510543A
P-60001
FROM SODIUM BISULFITE TANK
1 1/2" SB
DIAPHRAGM VALVE DV510541I
BALL VALVE BV510541C
SODIUM BISULFITE METERING PUMP NO. 2
P510542
DIAPHRAGM VALVE DV510542K
BALL CHECK VALVE CHV51054A
3/4" C2
MAGNETIC FLOW METER
FES10543
0-30 GPH (NEW)
BALL VALVE BV510544A
Y-STRAINER SEP510544
C2 (FLUSH WATER)
SV 510544
PRV 510544
PI 510544
PRESSURE RELIEF VALVE PRV510542
BALL VALVE BV510544D
P60003
PI 510543
ME510543
DV510543B
C2 WATER
C2 (CARRIER WATER)
FS 510544
FI 510544
STATIC MIXER MX510543
BACKFLOW PREVENTER BAC510544
SOLENOID VALVE SV510544
BALL VALVE BV510544B
PRESSURE REGULATING VALVE PRV510544
BALANCE VALVE BNV510544
BALL CHECK VALVE CHV510544
BALL VALVE BV510544C
ROTAMETER FI510544
DECHLORINATION CHEMICAL STORAGE ROOM
FIELD
TO DECHLOR. CHANNEL
NOTES:
1. INSTALL WITH 5 PIPE DIAMETERS UPSTREAM AND 3 PIPE DIAMETERS DOWNSTREAM. STRAIGHT PIPE RUN REQUIRED.
PRELIMINARY ISSUE DRAWING
INFORMATION ONLY
90% REVIEW
AUGUST 2022
R. BULGER
E. DIZDAREVIC
E. SCHEY
NONE
1137329
King County
DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
CARKEEK WET WEATHER TREATMENT STATION
DECHLORINATION SYSTEM MODIFICATIONS
SODIUM BISULFITE DOSING SYSTEM P&ID 2 OF 3
AUGUST 2022
WW510-P-60002
REV NO. 0

SBS Pumping

Graphic from KCWTD

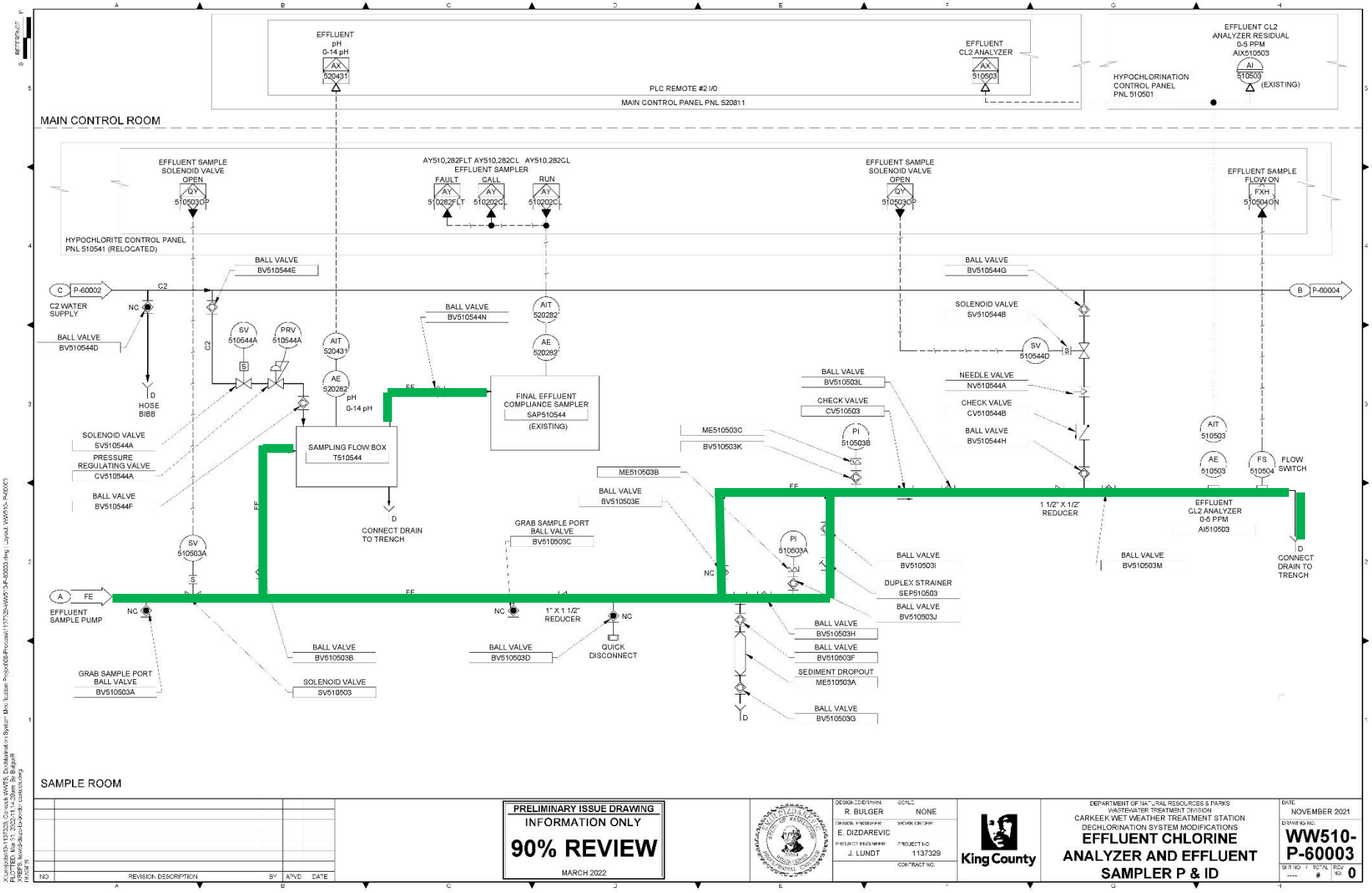


Final Effluent Sampler & Analyzer



Final Effluent Sampler & Analyzer

Graphic from KCWTD



PRELIMINARY ISSUE DRAWING
INFORMATION ONLY
90% REVIEW
MARCH 2022

NO	REVISION DESCRIPTION	BY	APVD	DATE

DESIGN COORDINATOR	R. BULGER
PROJECT ENGINEER	E. DIZDAREVIC
PROJECT MANAGER	J. LUNDT
SCALE	NONE
WORK ORDER NO.	
PROJECT NO.	1137329
CONTRACT NO.	

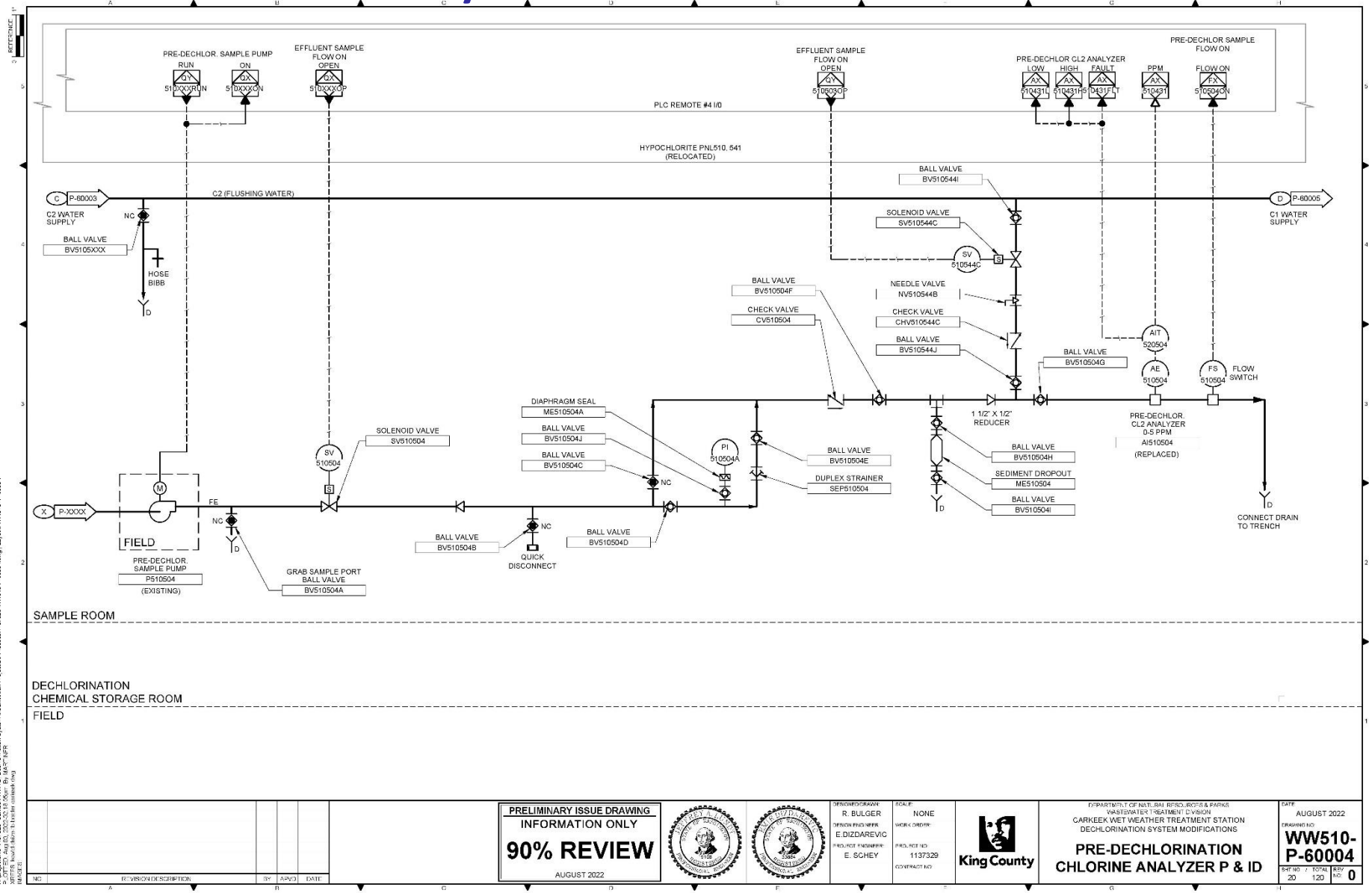
King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
CARKEEK WET WEATHER TREATMENT STATION
DECHLORINATION SYSTEM MODIFICATIONS

EFFLUENT CHLORINE ANALYZER AND EFFLUENT SAMPLER P & ID

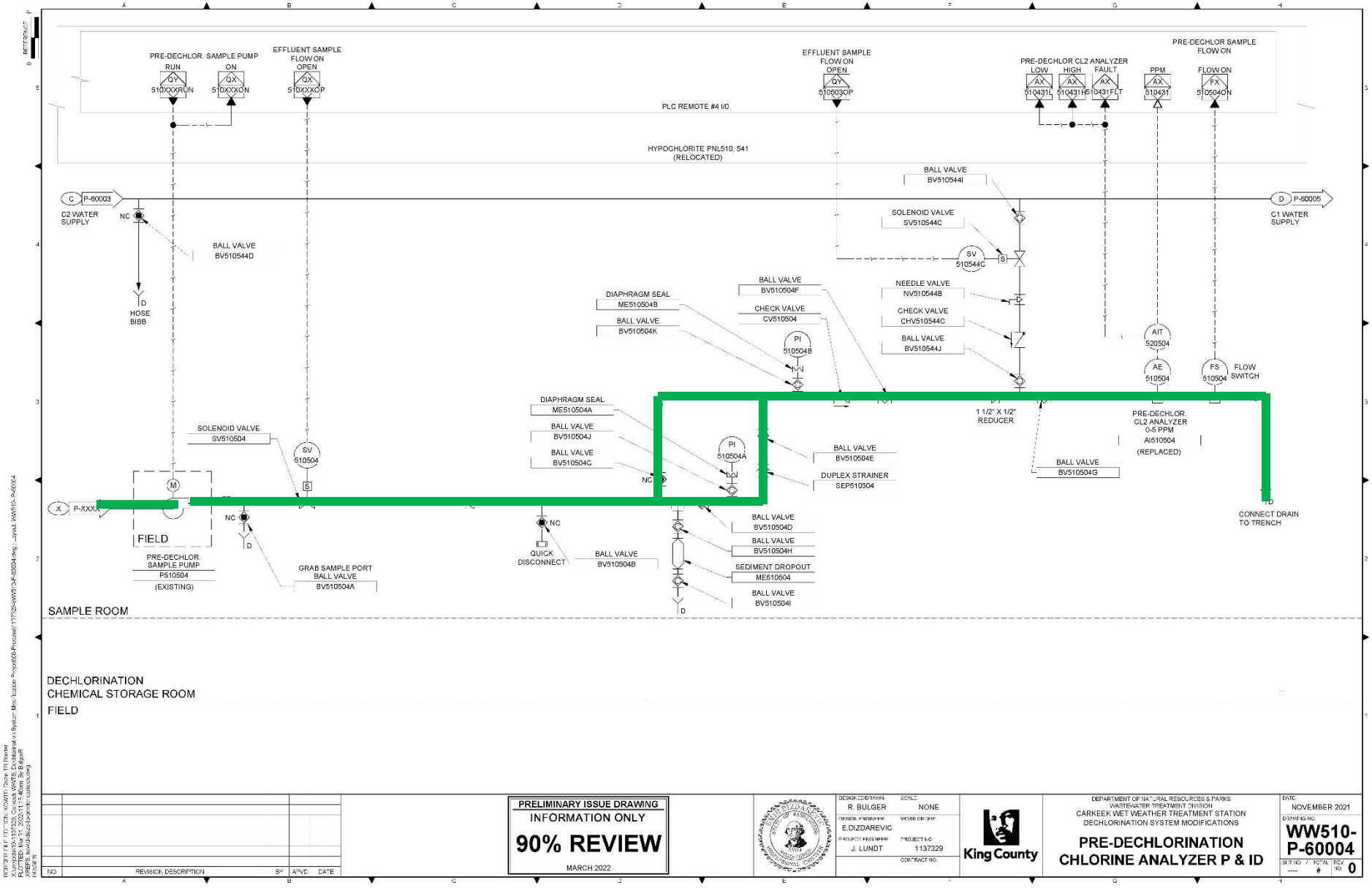
DATE: NOVEMBER 2021
DRAWING NO.: **WW510-P-60003**
SHT NO. / TOTAL: ---- / #
REV NO.: **0**

Pre-Dechlor Analyzer

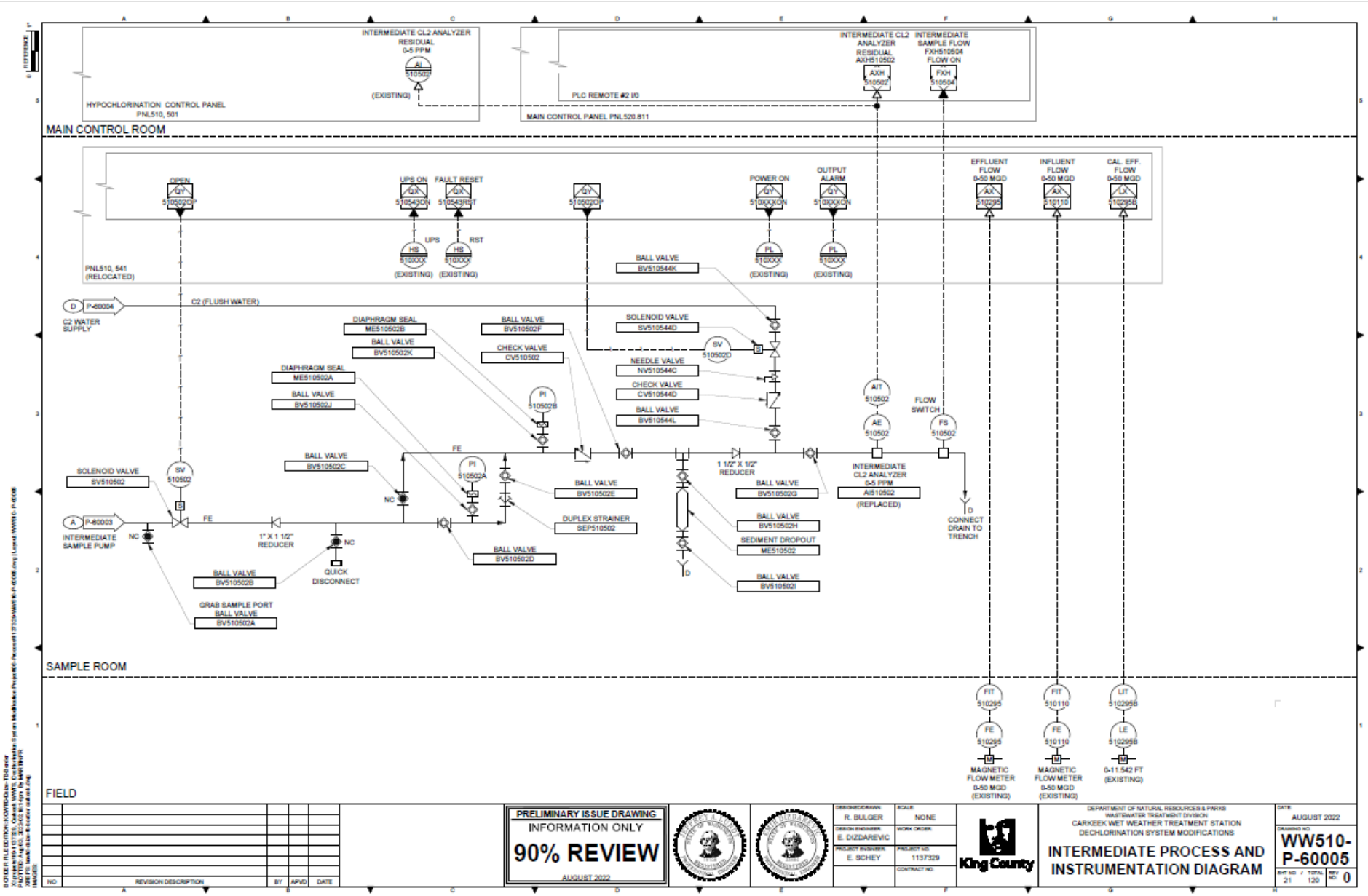


Pre-Dechlor Analyzer

Graphic from KCWTD

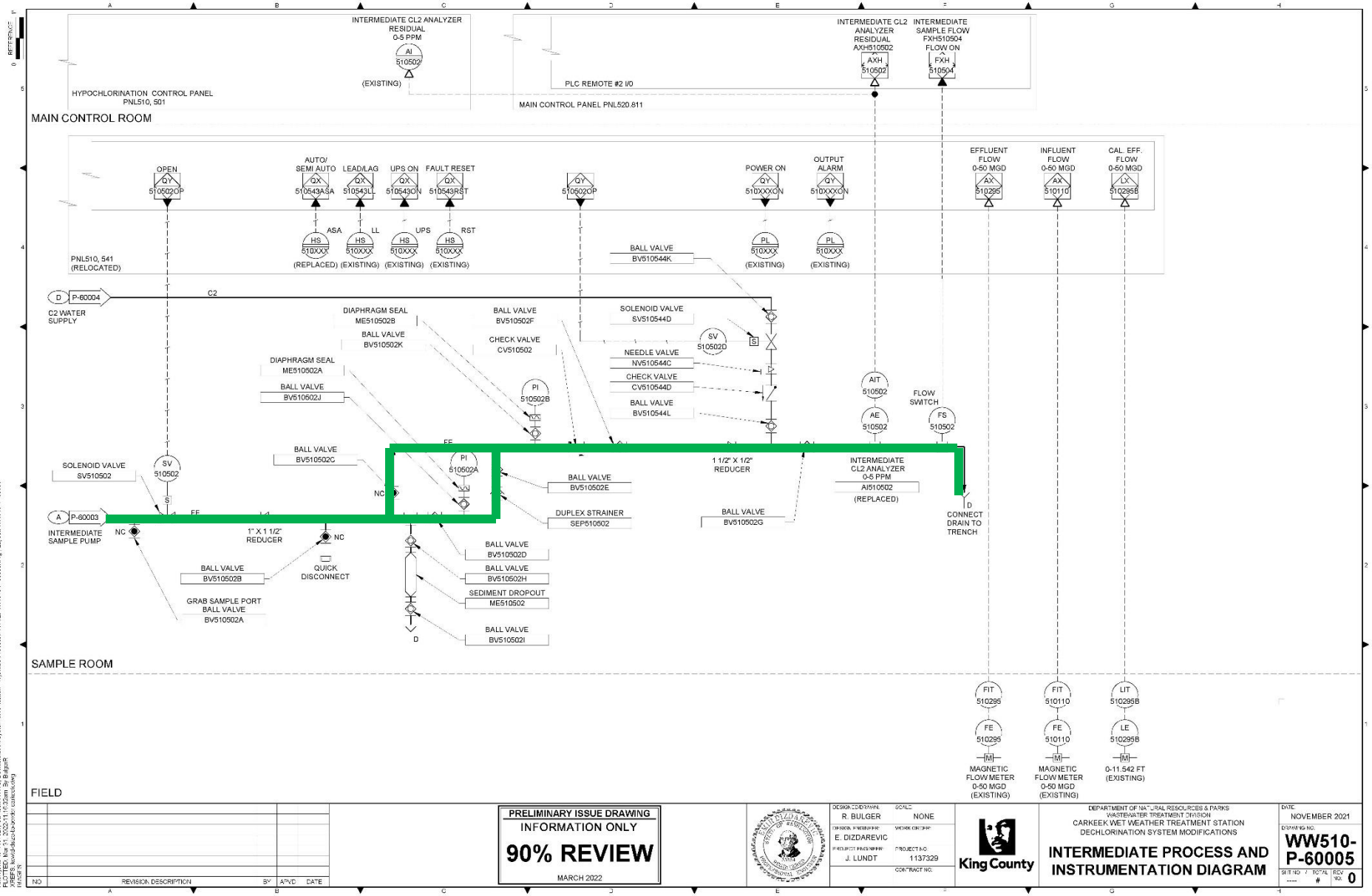


Intermediate Chlorine Analyzer



Intermediate Chlorine Analyzer

Graphic from KCWTD

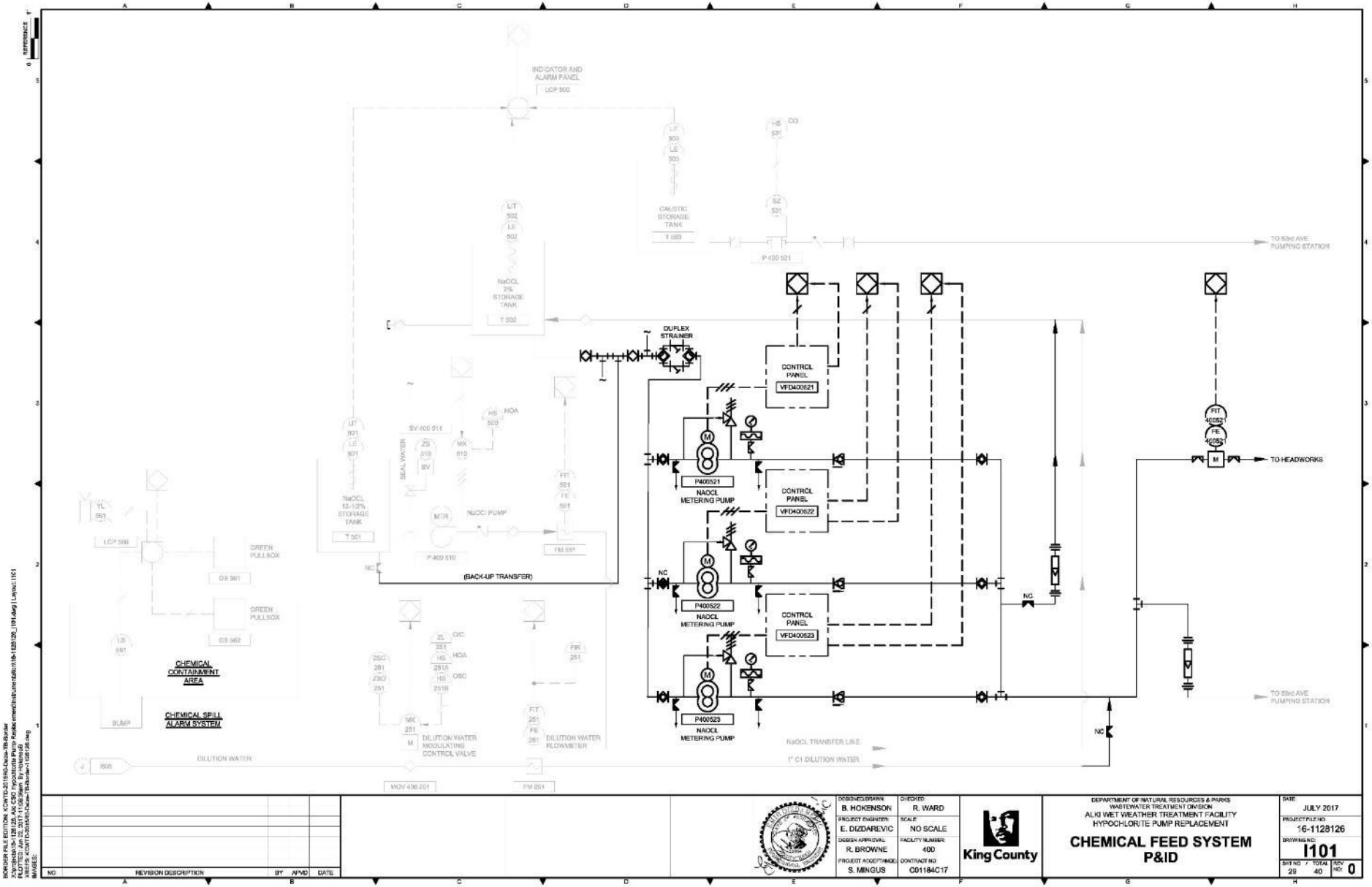


Alki Wet Weather Treatment System Hypochlorite System

Aerial Photo from Google Maps

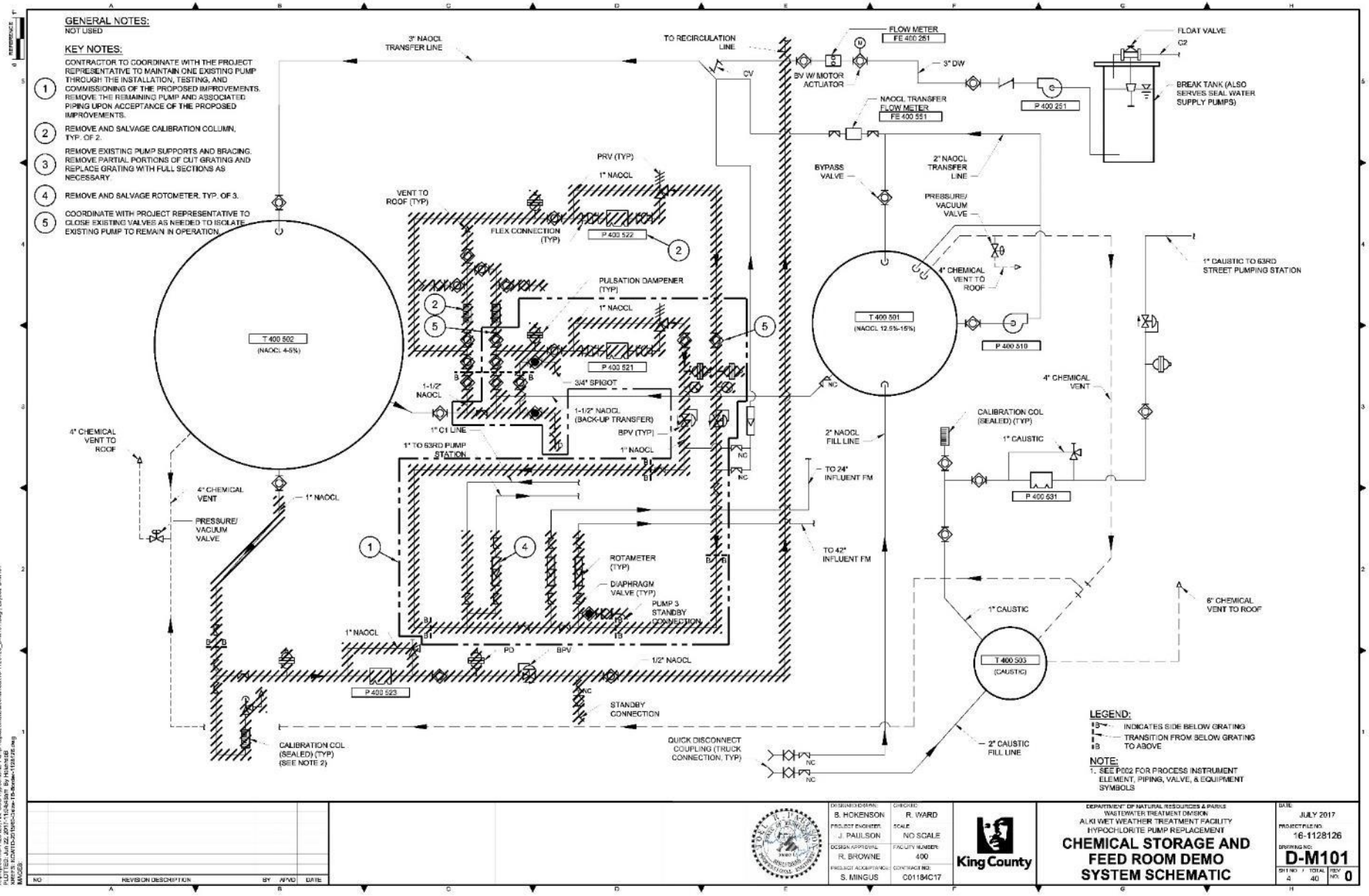
Chemical Feed System P&ID

Graphic from KCWTD



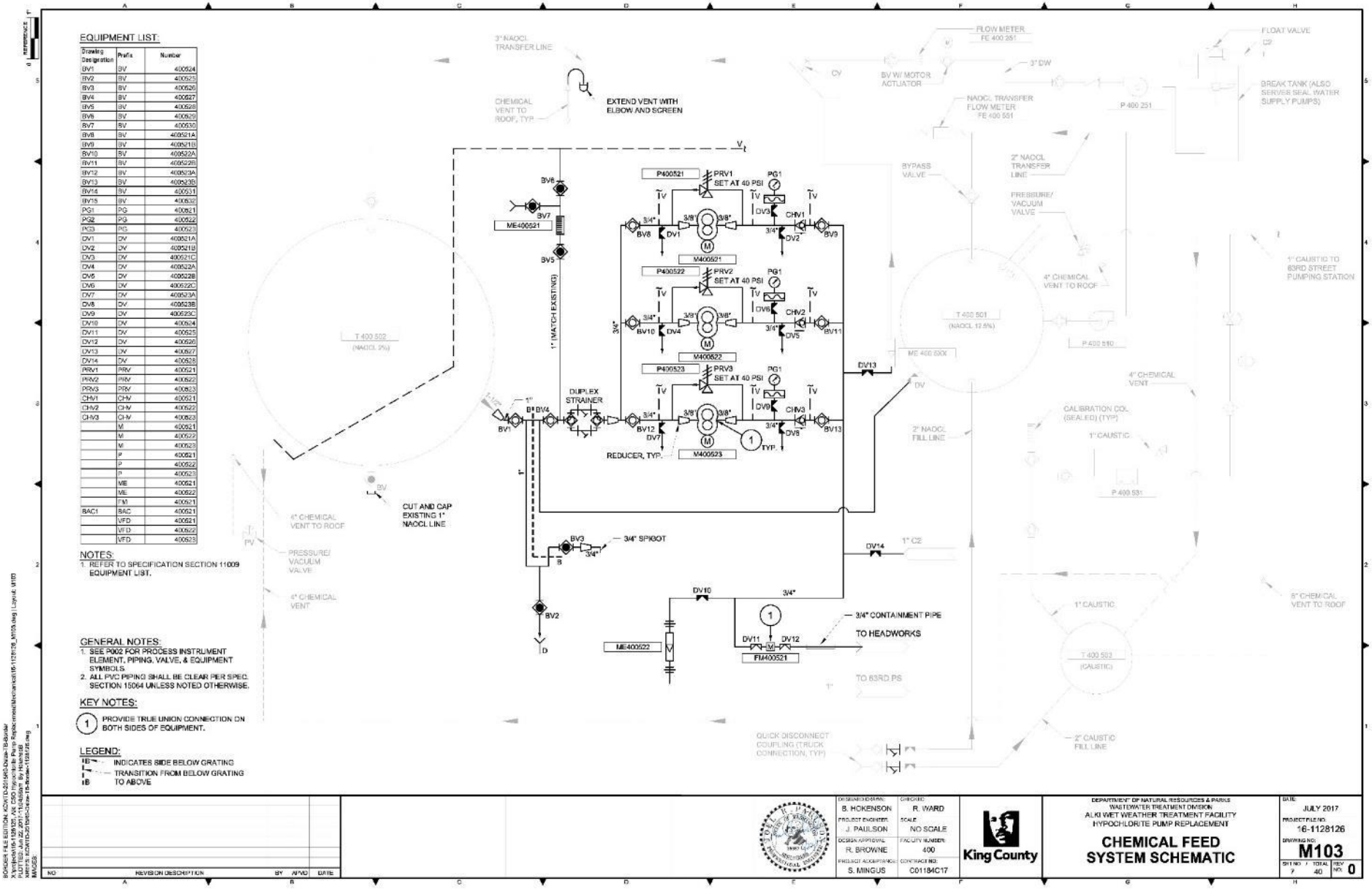
Graphic from KCWTD

Chemical Feed System Schematic



Chemical Feed System Plans

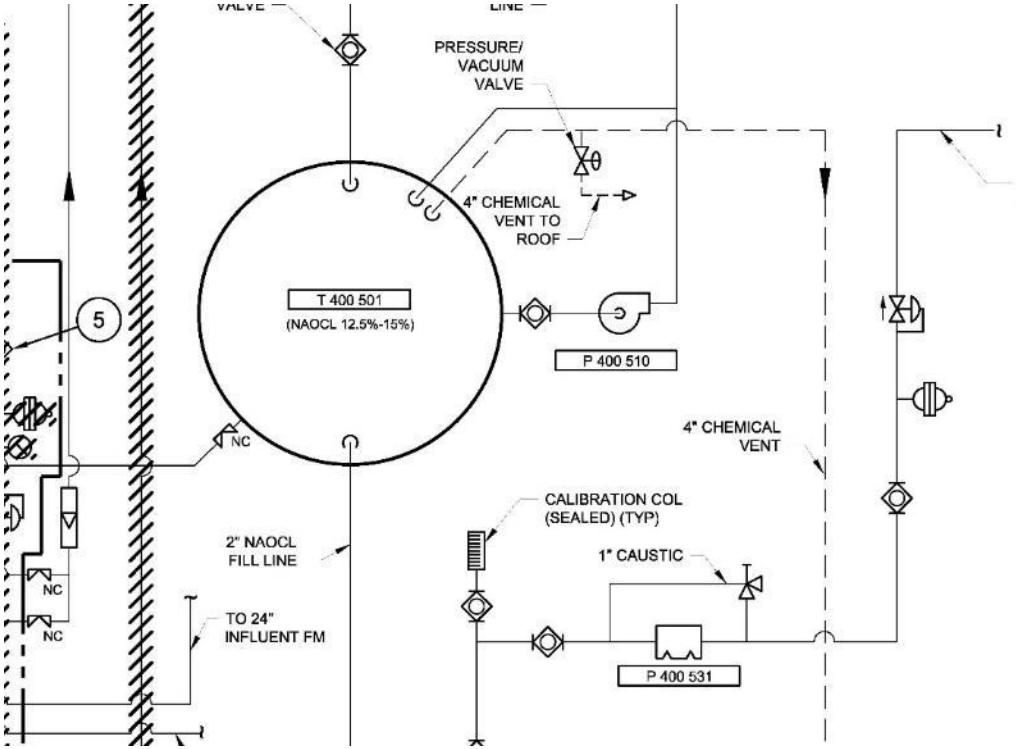
Graphic from KCWTD

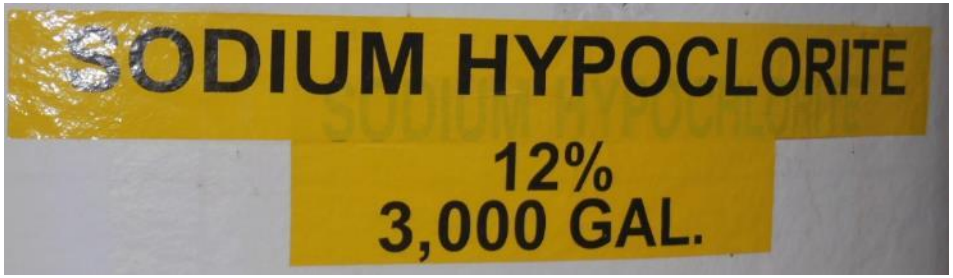


The Real Thing!

Photos from KCWTD

Looking at Each Element - Tanks

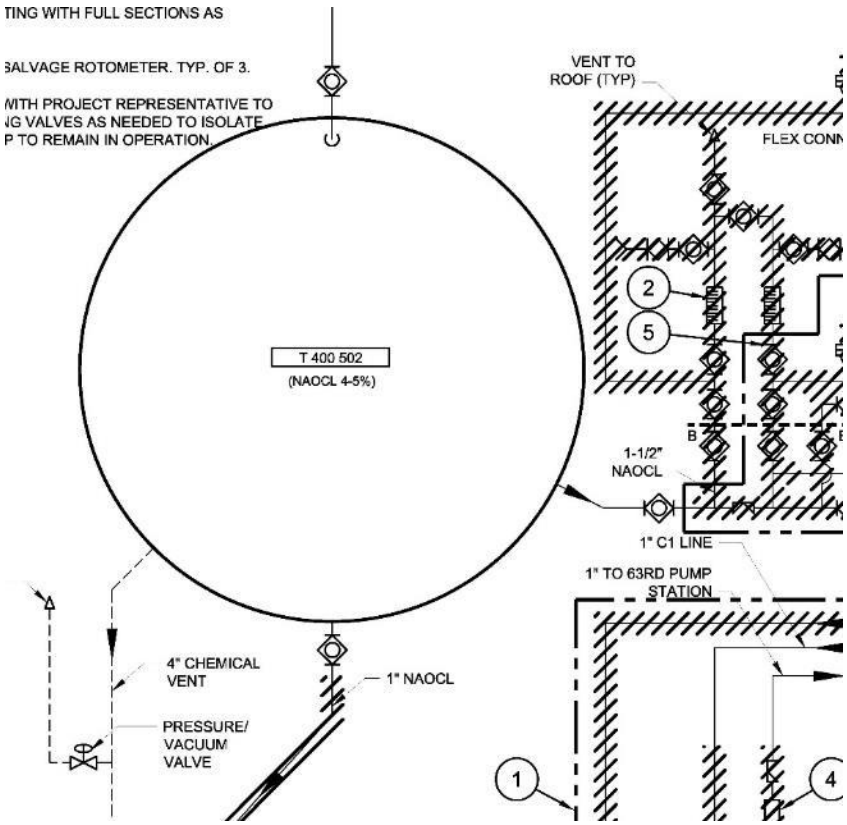




Concentrated hypo tank

Photos & graphics from KCWTD

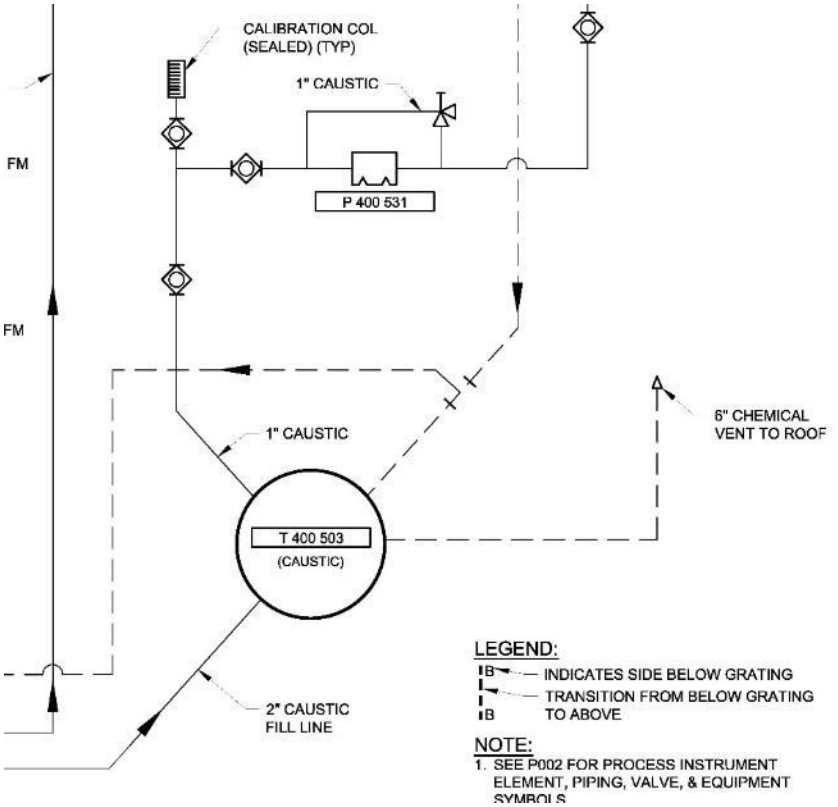
Tanks



Photos & graphics from KCWTD

Diluted hypo tank

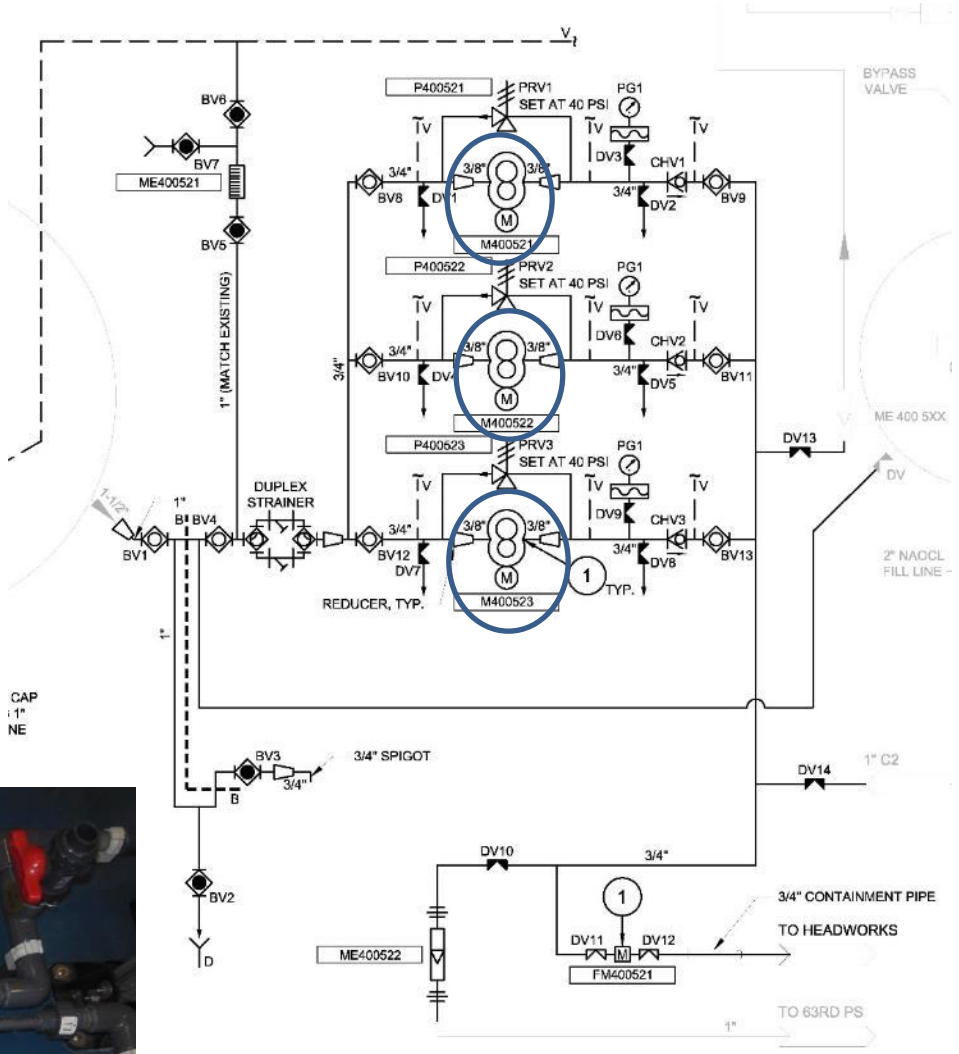
Tanks



Caustic tank

Photos & graphics from KCWTD

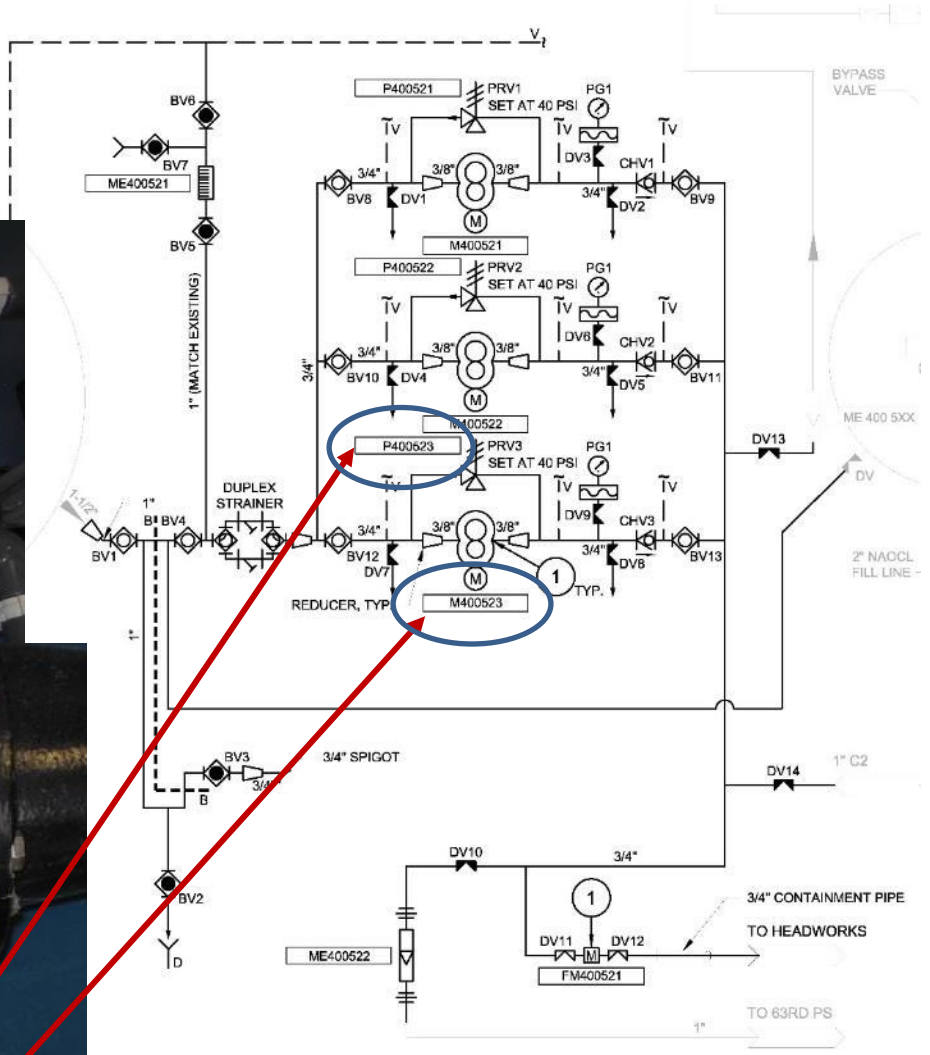
Pumps



Photos & Graphics from KCWTD

Hypochlorite Pumps

Pumps



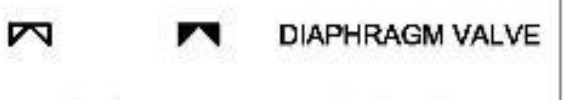
Photos & Graphics from KCWTD

Hypochlorite Pumps

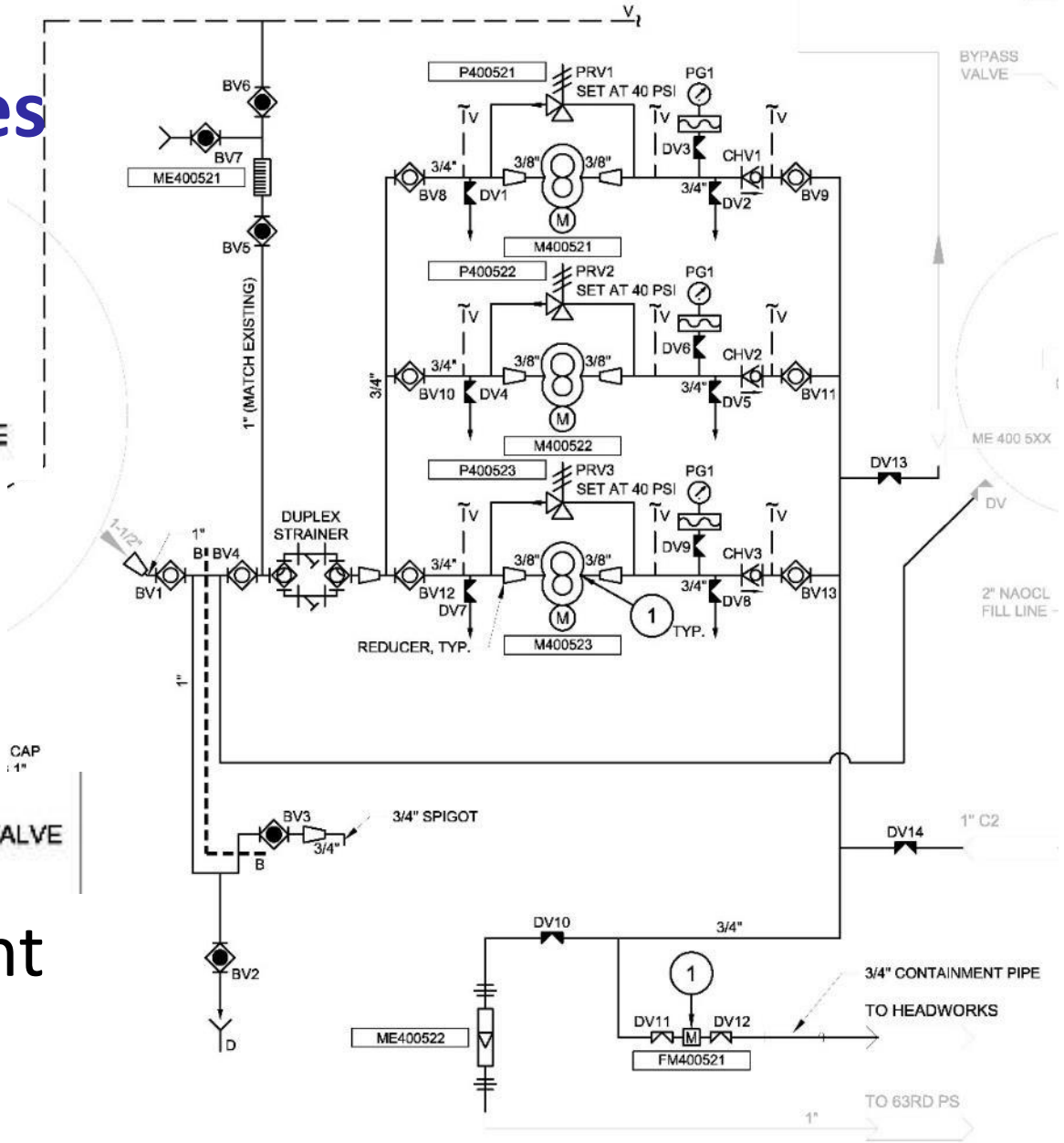
Find the Valves

- Ball valves

- Diaphragm valves

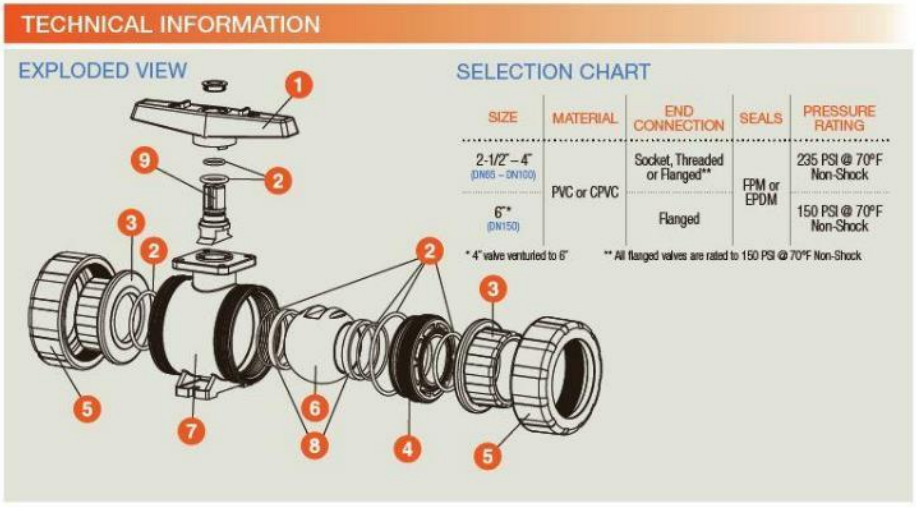


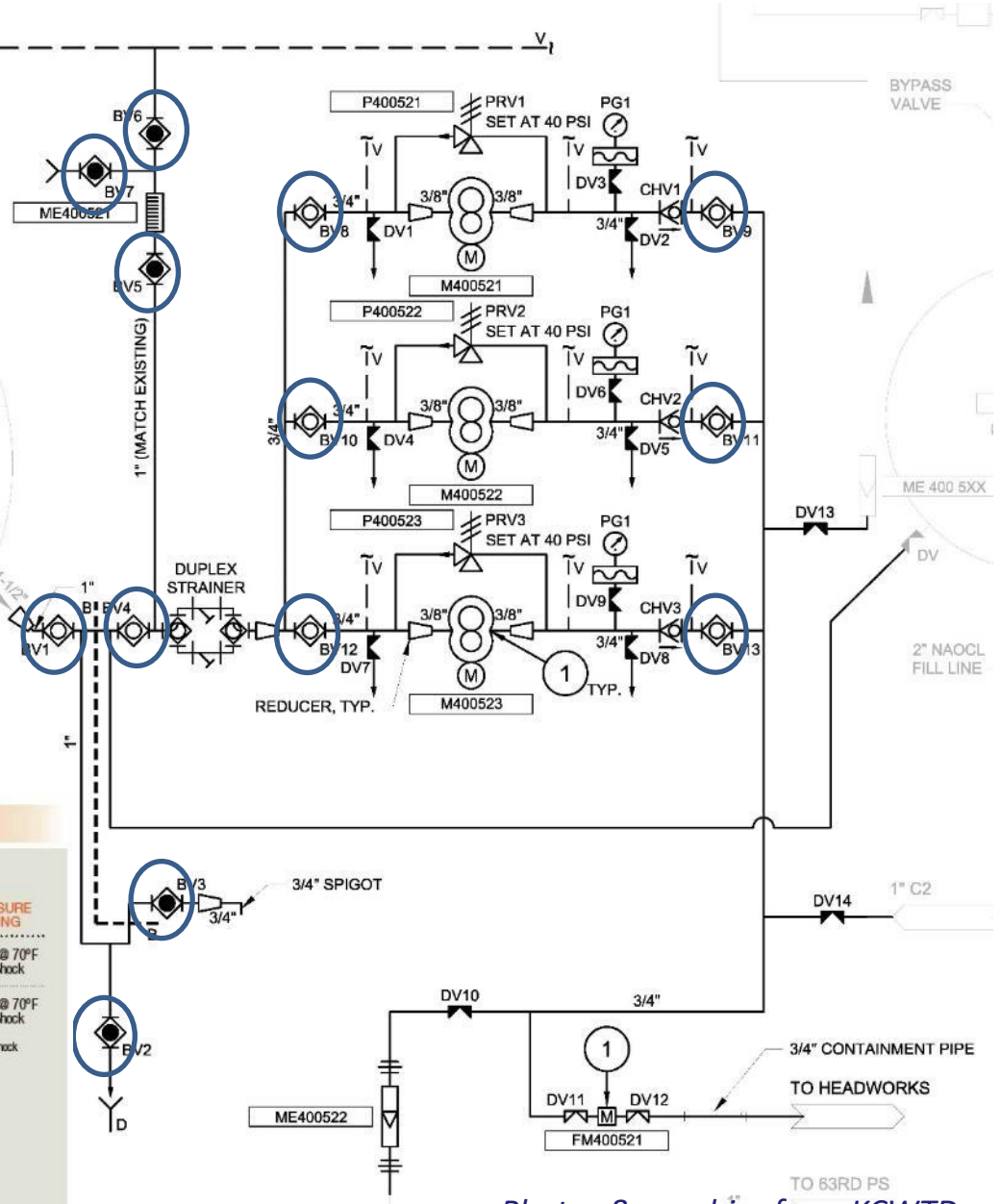
- Circle & count



Graphics from KCWTD

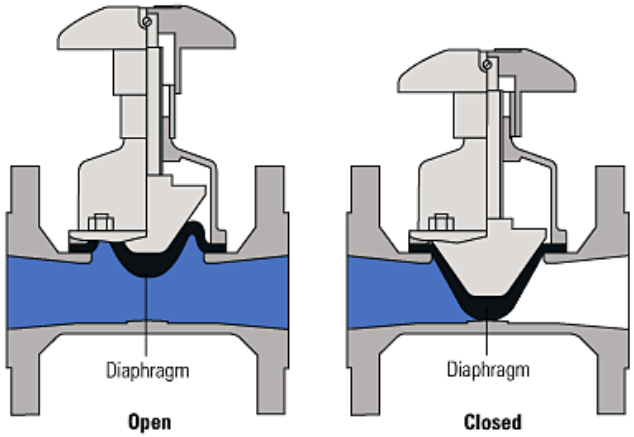
Ball Valves

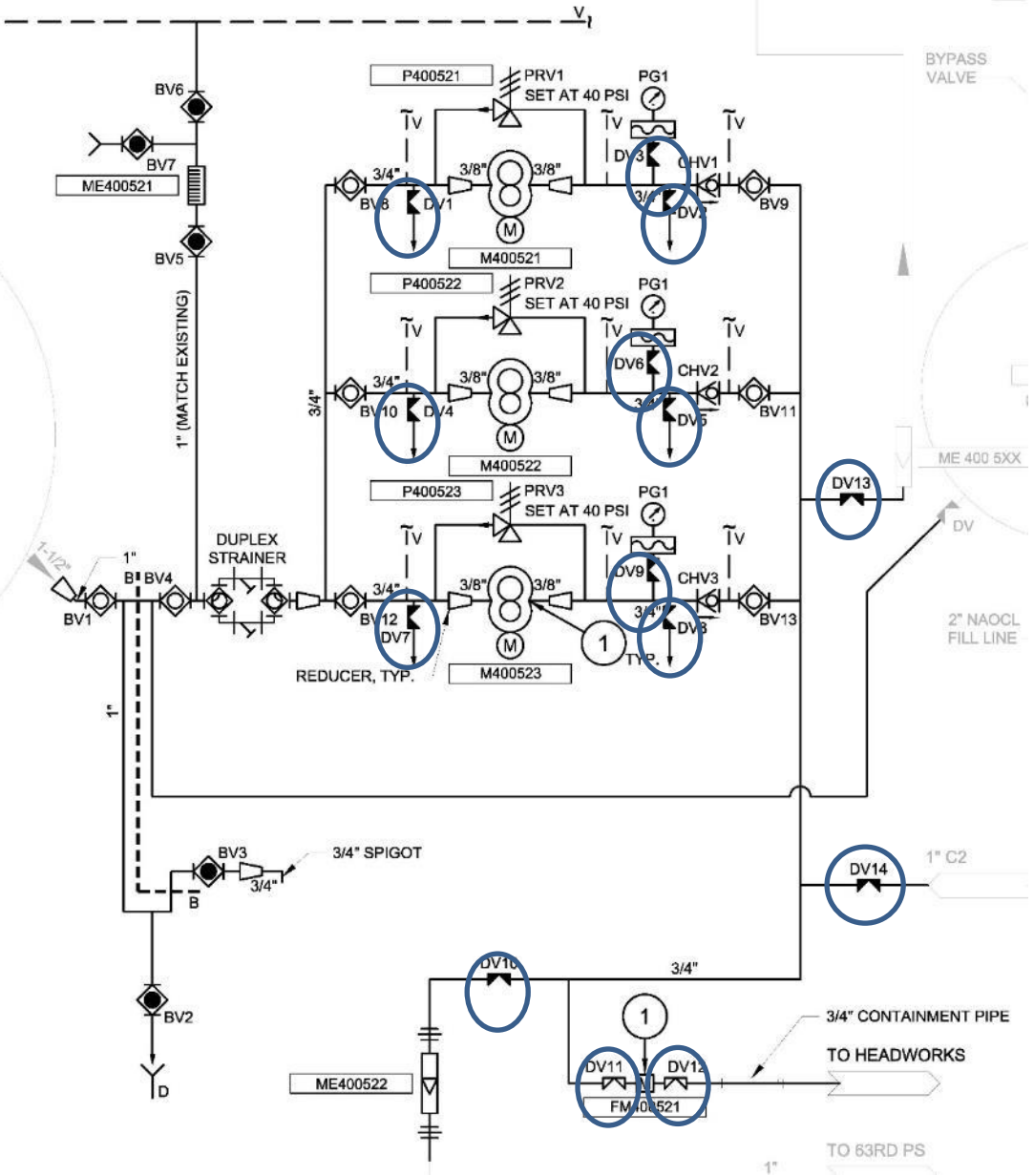




Photos & graphics from KCWTD & Haywood Valve

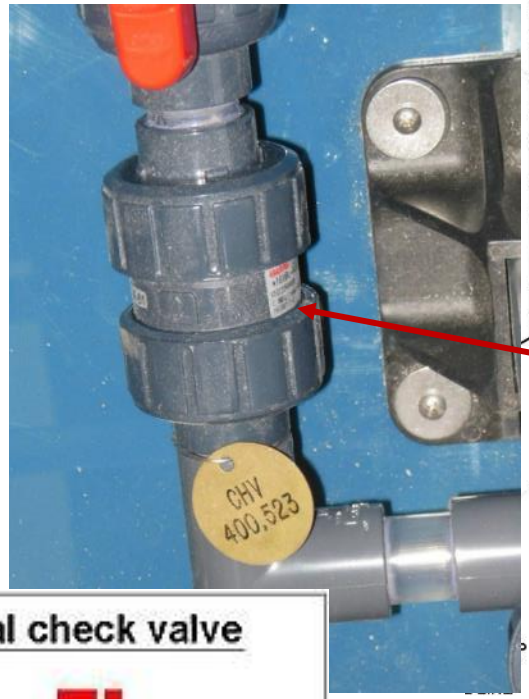
Diaphragm Valves

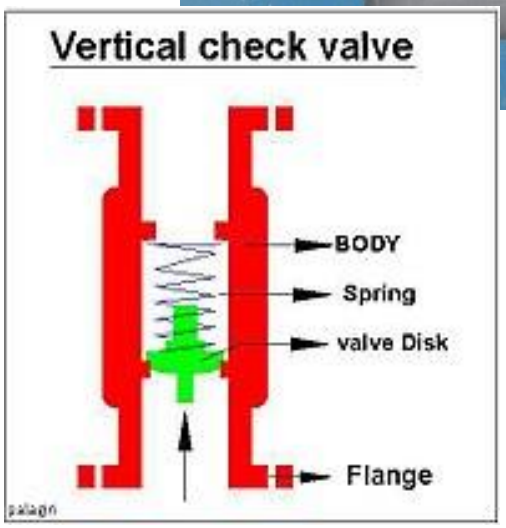


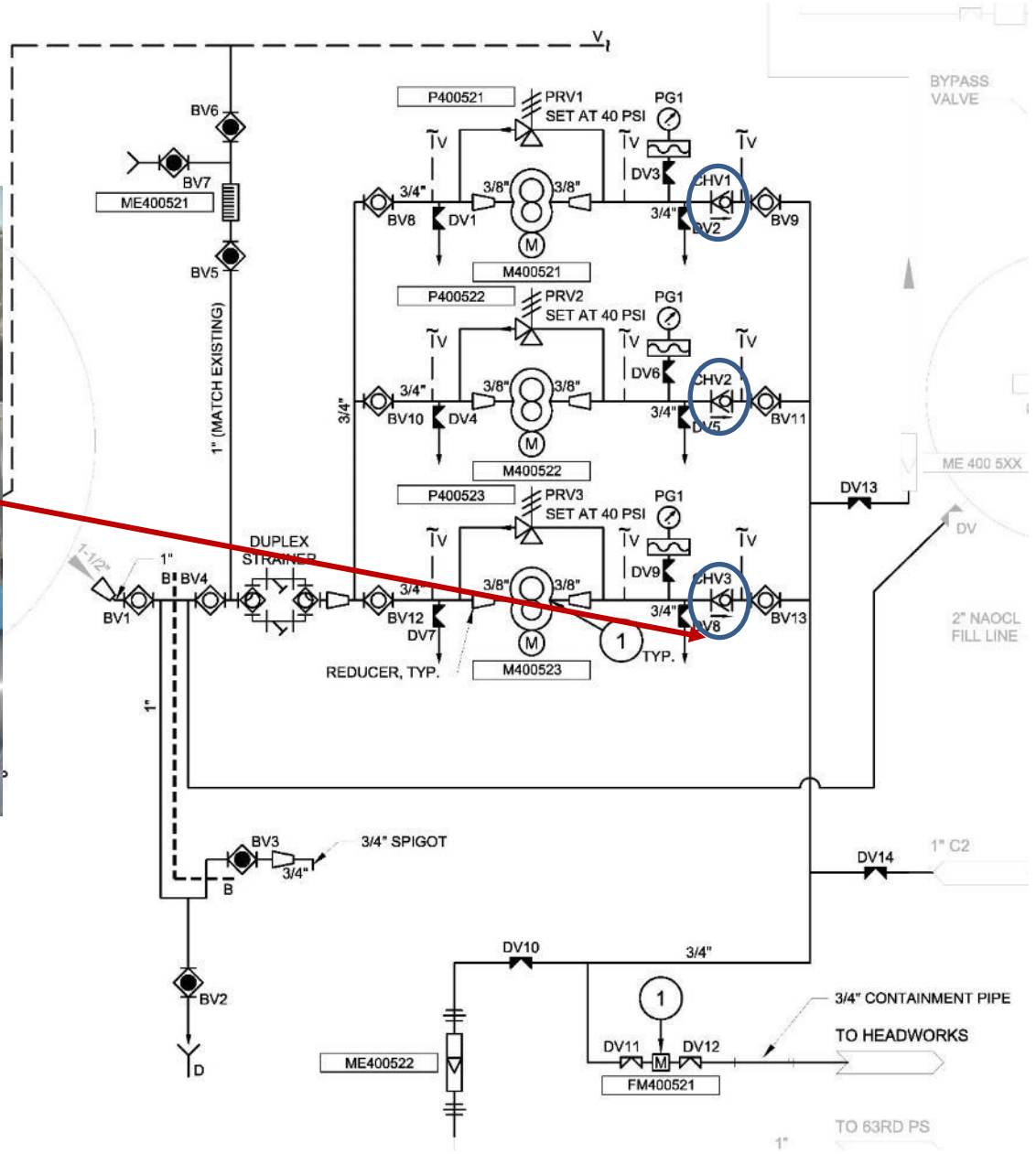


Photos & graphics from KCWTD & GlobalSpec

Check Valves

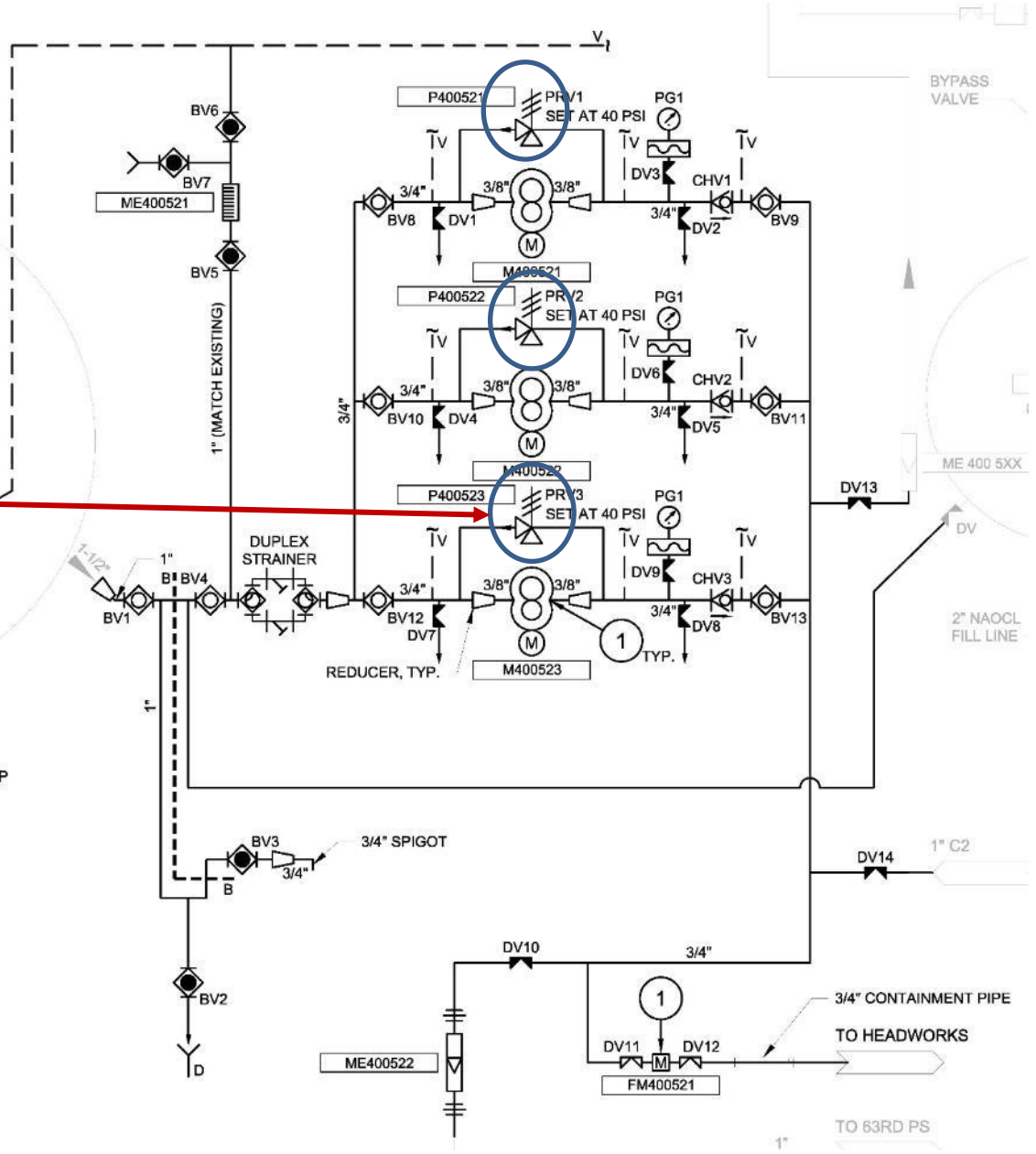






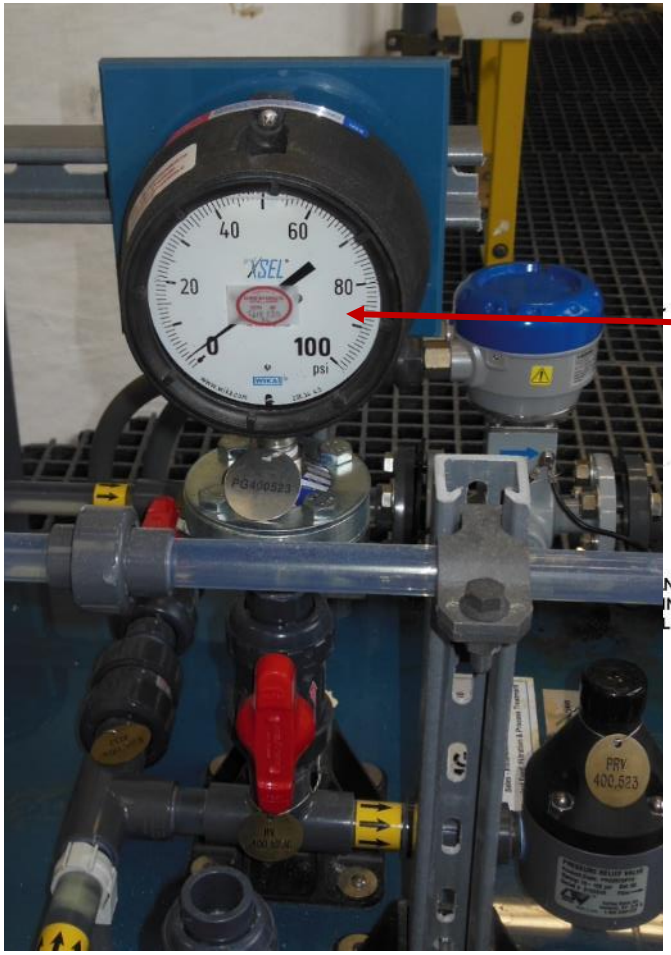
Photos & graphics from KCWTD & Wikipedia

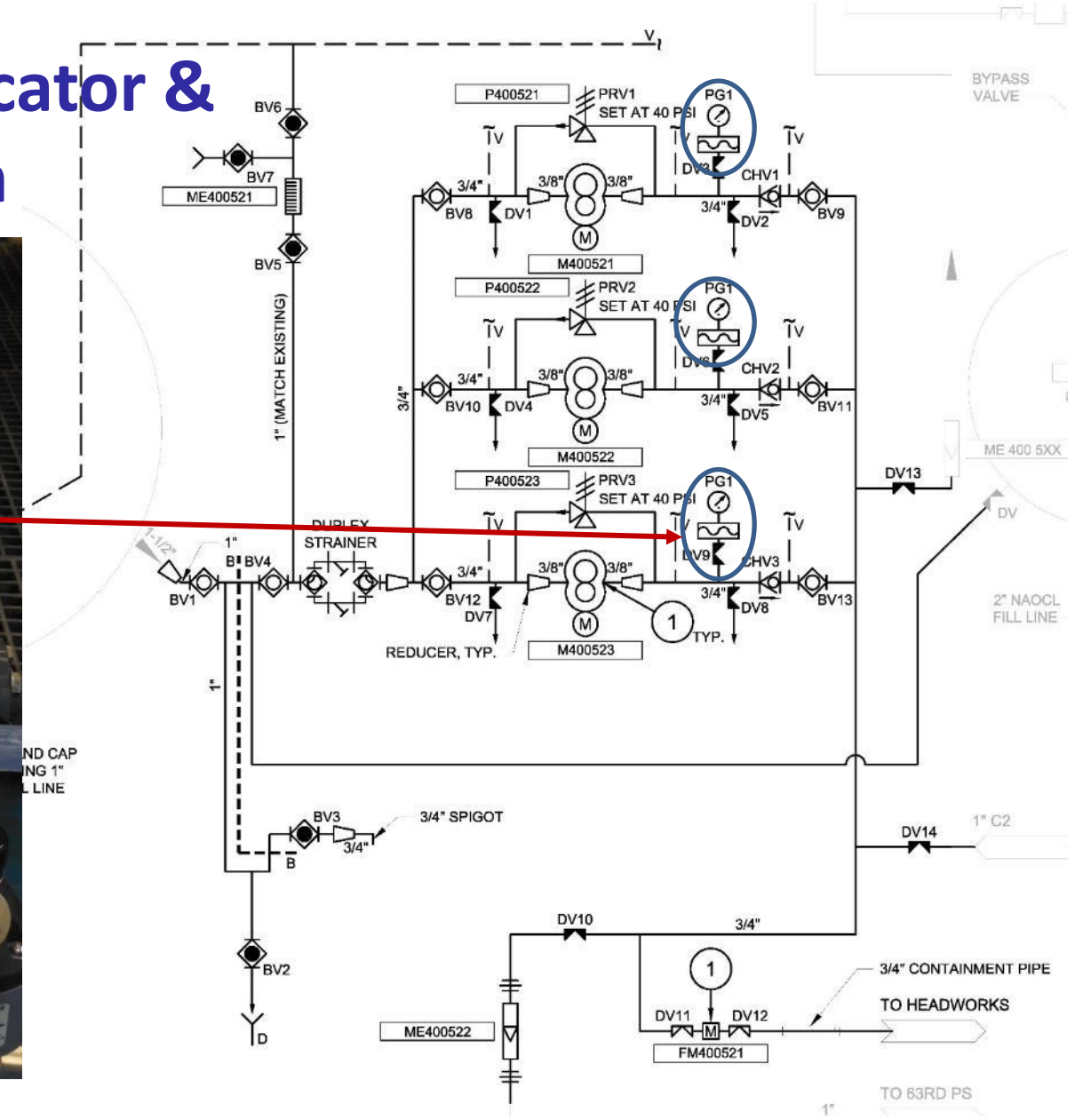
Pressure Relief Valves



Photos & graphics from KCWTD

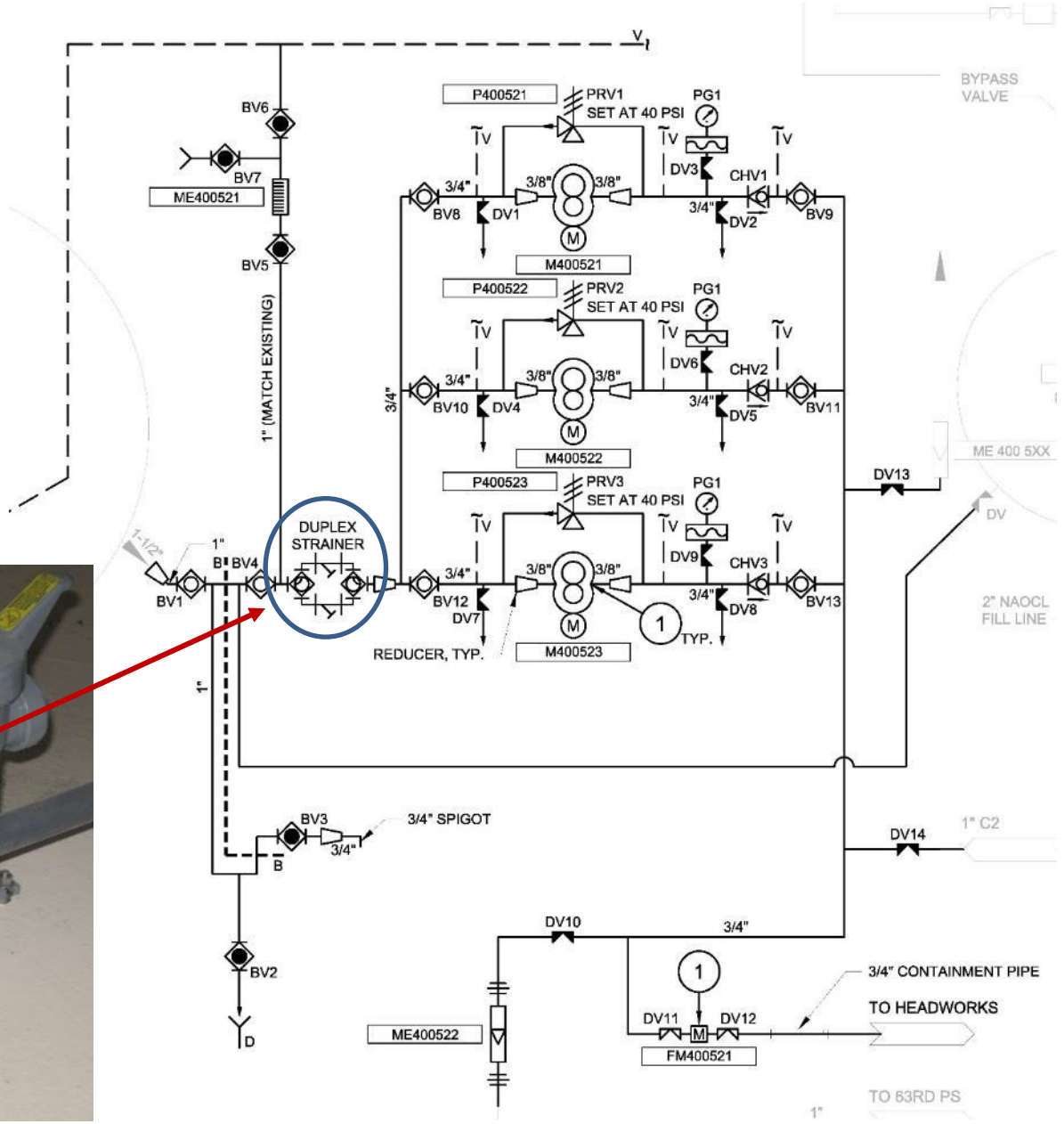
Pressure Indicator & Diaphragm





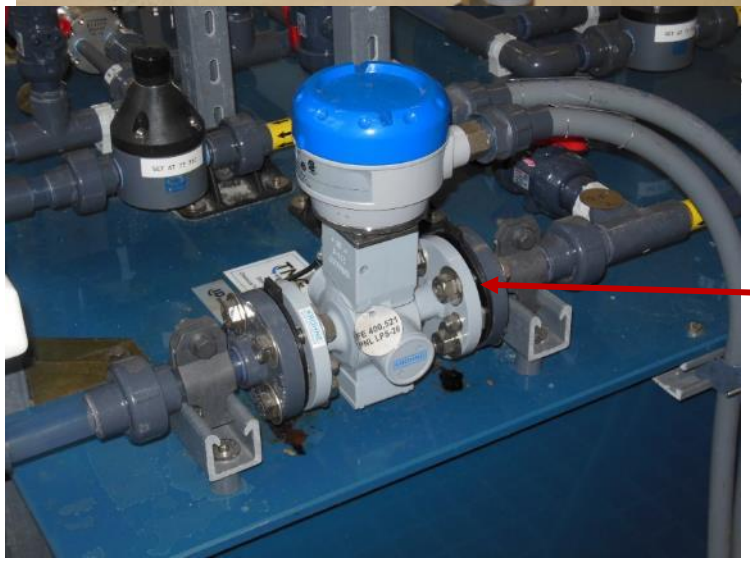
Photos & graphics from KCWTD

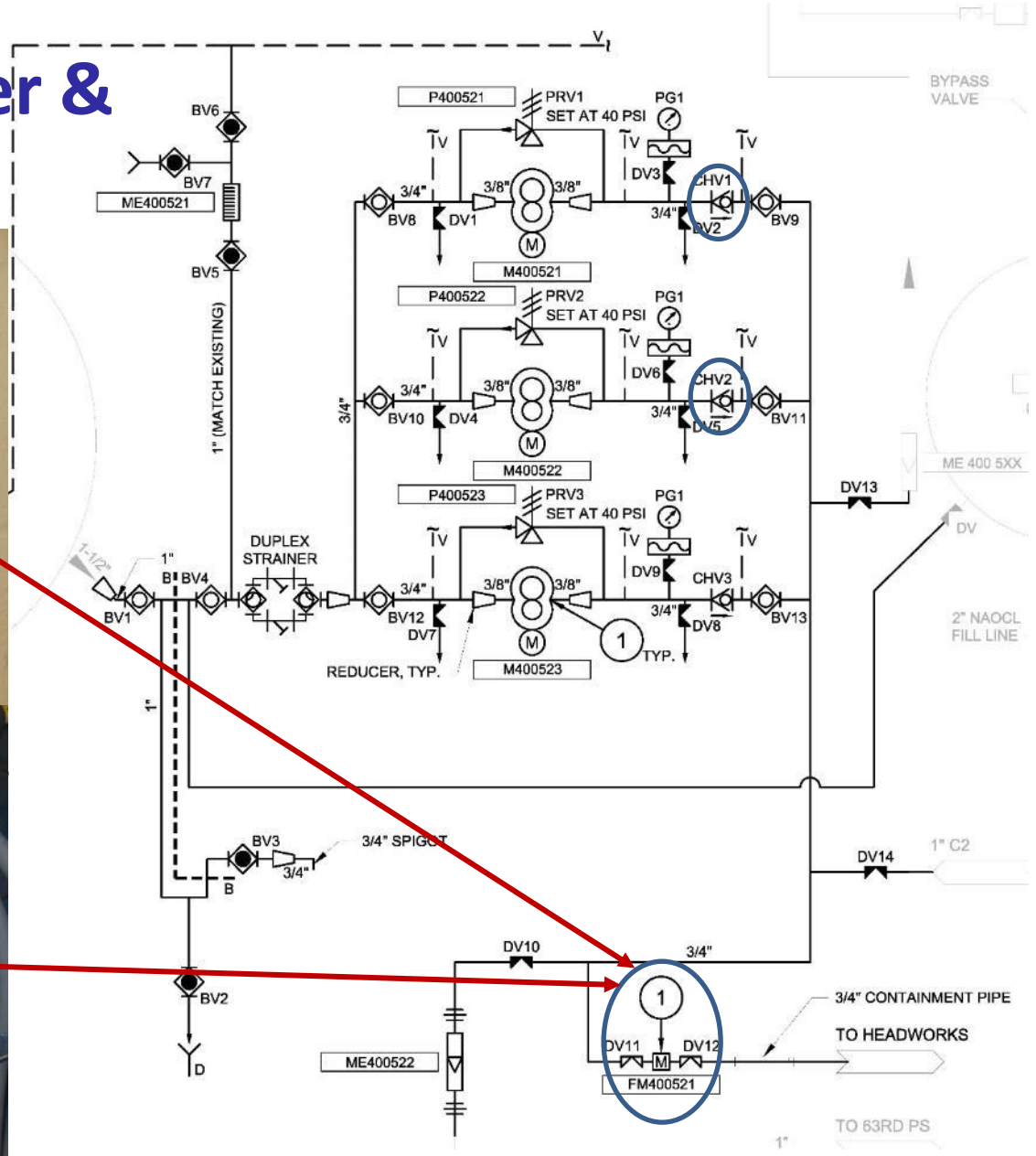
Strainer



Photos & graphics from KCWTD

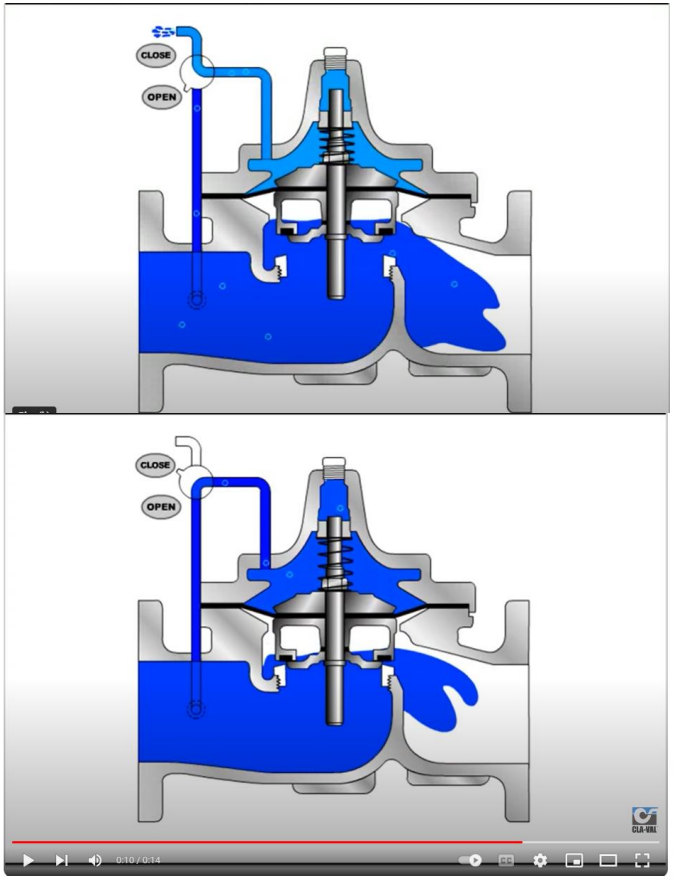
Flow Transmitter & Indicator



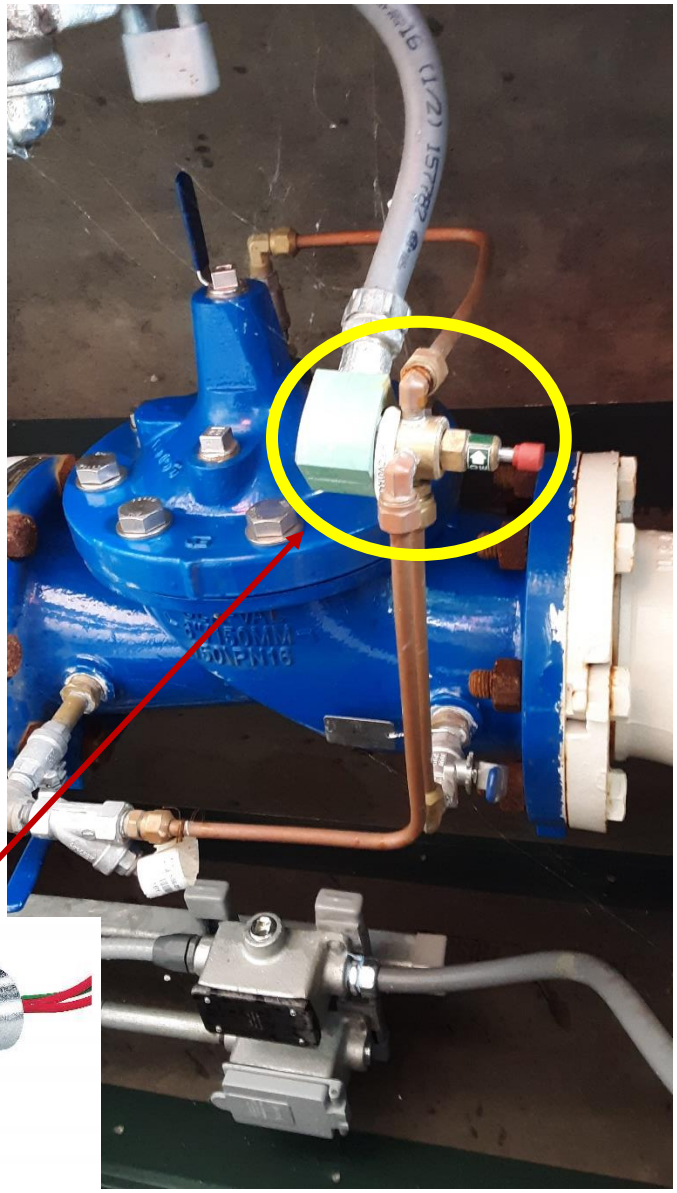


Photos & graphics from KCWTD

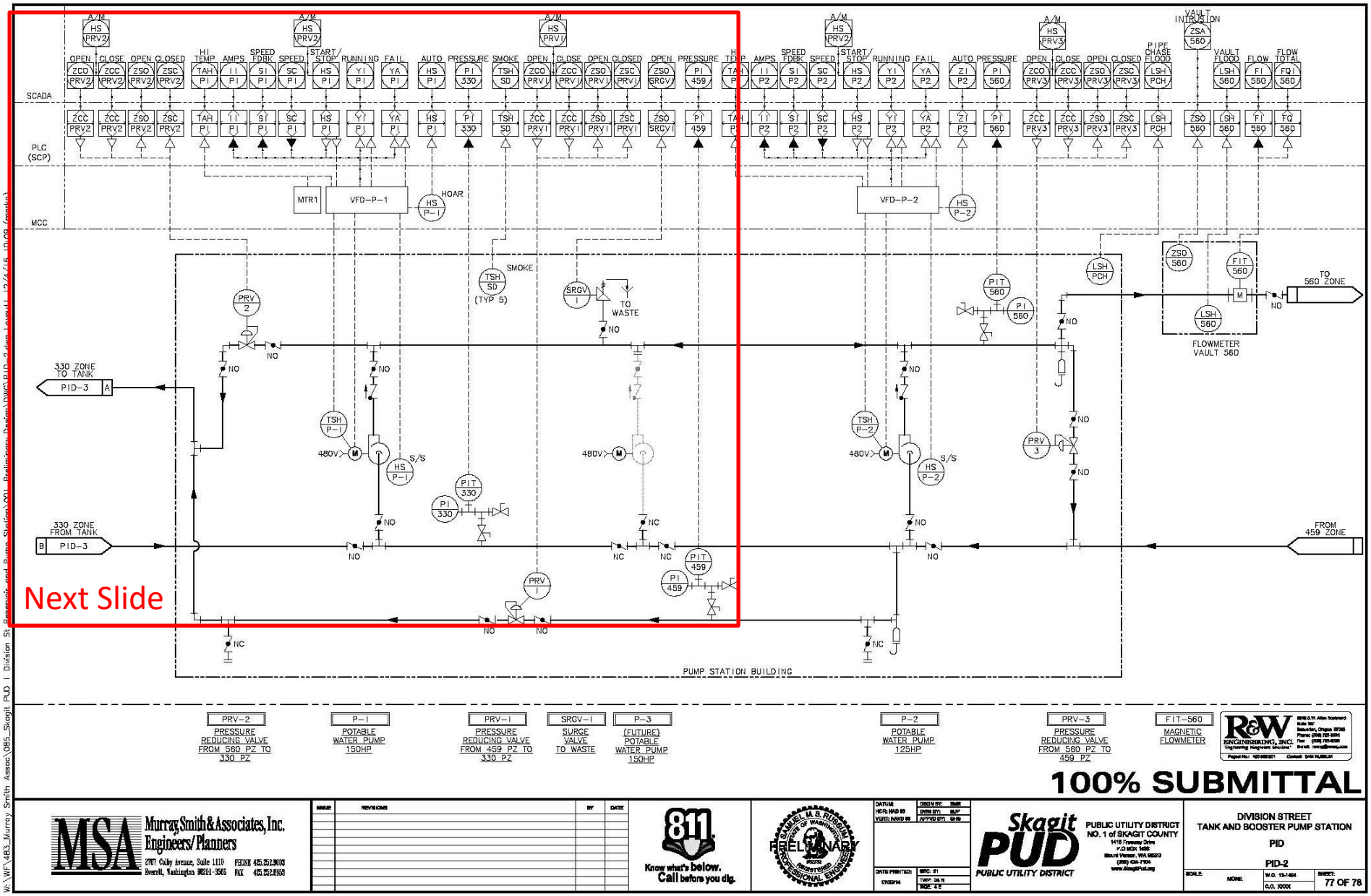
Solenoid Valve

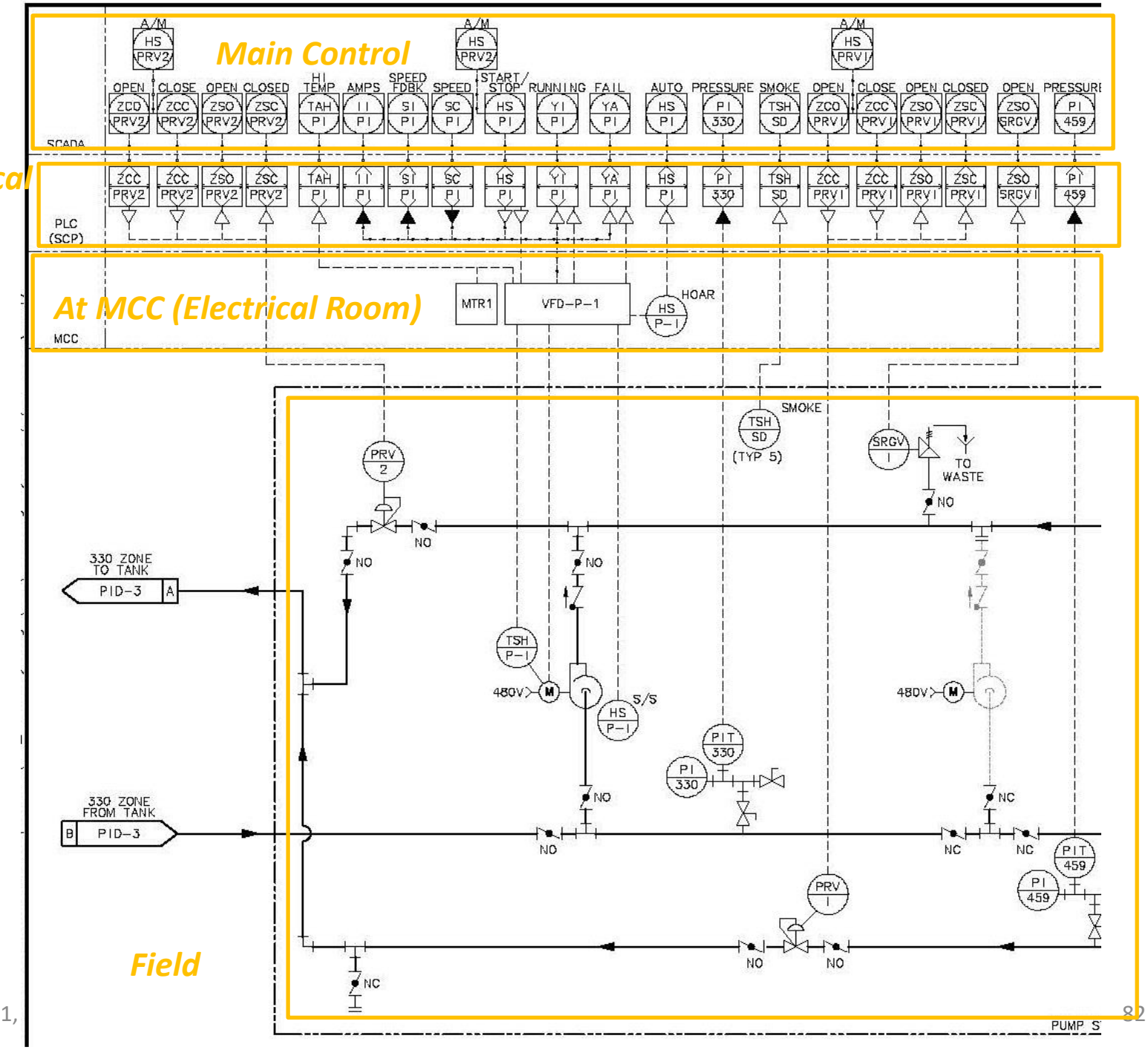


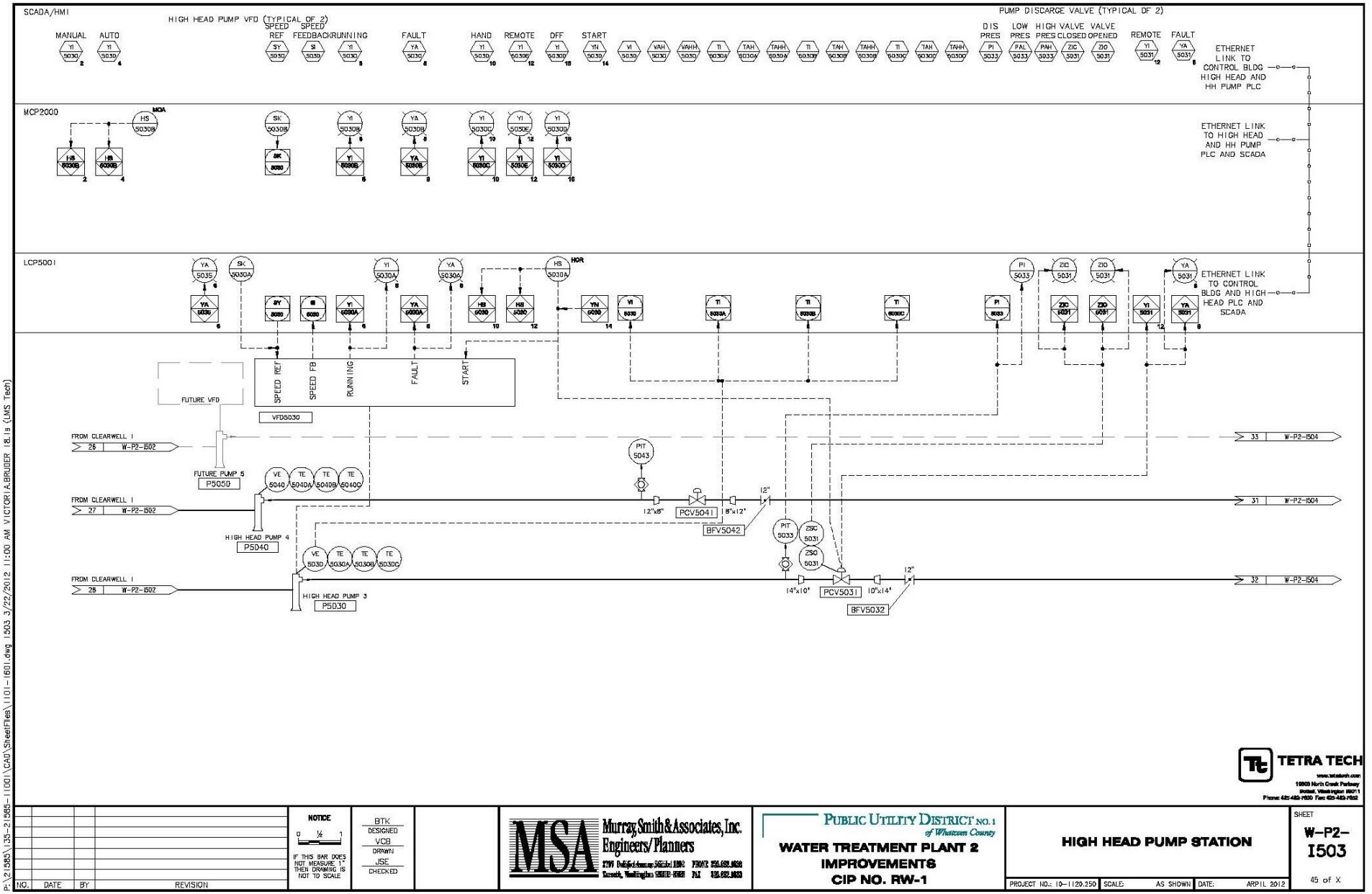
Images from Cla-Val via YouTube
https://www.youtube.com/watch?app=desktop&v=suAV0RiXNsc



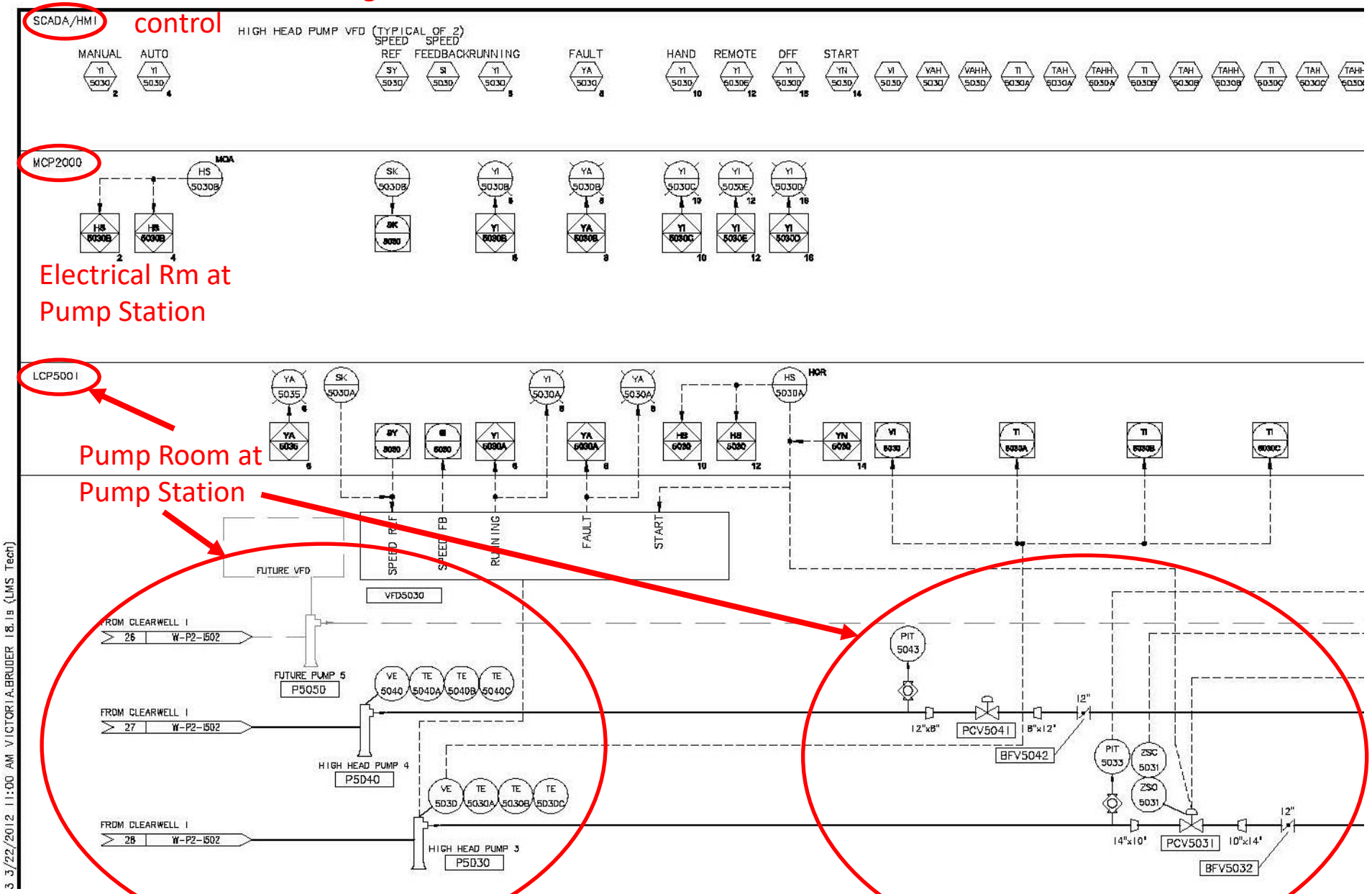
Photos from KCWTD


SCADA
PLC (SCP)
MCC
MTR1
VFD-P-1
VFD-P-2
HOAR
SMOKE
TO WASTE
TO 560 ZONE
FLOWMETER VAULT 560
330 ZONE TO TANK
PID-3
330 ZONE FROM TANK
FROM 459 ZONE
480V
S/S
PUMP STATION BUILDING
Next Slide
PRV-2 PRESSURE REDUCING VALVE FROM 560 PZ TO 330 PZ
P-1 POTABLE WATER PUMP 150HP
PRV-1 PRESSURE REDUCING VALVE FROM 459 PZ TO 330 PZ
SRGV-1 SURGE VALVE TO WASTE
P-3 (FUTURE) POTABLE WATER PUMP 150HP
P-2 POTABLE WATER PUMP 125HP
PRV-3 PRESSURE REDUCING VALVE FROM 560 PZ TO 459 PZ
FIT-560 MAGNETIC FLOWMETER
100% SUBMITTAL
Murray, Smith & Associates, Inc. Engineers/Planners
Know what's below. Call before you dig.
PRELIMINARY
Skagit PUD PUBLIC UTILITY DISTRICT
PUBLIC UTILITY DISTRICT NO. 1 of SKAGIT COUNTY
DIVISION STREET TANK AND BOOSTER PUMP STATION
PID
PID-2
77 OF 78


Main Control
PLC (Electrical Room)
At MCC (Electrical Room)
Field
SCADA
PLC (SCP)
MCC
A/M
HS PRV2
HS PRV1
OPEN
CLOSE
OPEN CLOSED
HI TEMP
AMPS
SPEED FDBK
SPEED
START/ STOP
RUNNING
FAIL
AUTO
PRESSURE
SMOKE
OPEN
CLOSE
OPEN CLOSED
OPEN
PRESSURE
ZCC PRV2
ZCO PRV2
ZSO PRV2
ZSC PRV2
TAH PI
II PI
SI PI
SC PI
HS PI
YI PI
YA PI
HS PI
PI 330
TSH SD
ZCC PRV1
ZCO PRV1
ZSO PRV1
ZSC PRV1
ZSO SRGV
PI 459
MTR1
VFD-P-1
HS P-1
HOAR
TSH SD (TYP 5)
SMOKE
SRGV
TO WASTE
NO
PRV 2
330 ZONE TO TANK
PID-3 A
TSH P-1
480V
M
S/S
HS P-1
PIT 330
PI 330
330 ZONE FROM TANK
B PID-3
NC
PRV 1
PIT 459
PI 459
PUMP S


SCADA/HMI
HIGH HEAD PUMP VFD (TYPICAL OF 2)
PUMP DISCARGE VALVE (TYPICAL OF 2)
MANUAL
AUTO
SPEED REF
SPEED FEEDBACK
RUNNING
FAULT
HAND
REMOTE
OFF
START
DIS PRES
LOW PRES
HIGH PRES
VALVE CLOSED
VALVE OPENED
REMOTE
FAULT
ETHERNET LINK TO CONTROL BLDG HIGH HEAD AND HH PUMP PLC
MCP2000
ETHERNET LINK TO HIGH HEAD AND HH PUMP PLC AND SCADA
LCP5001
ETHERNET LINK TO CONTROL BLDG AND HIGH HEAD PLC AND SCADA
FUTURE VFD
SPEED REF
SPEED FB
RUNNING
FAULT
START
VFD5030
FROM CLEARWELL 1
W-P2-1502
FUTURE PUMP 5
P5050
HIGH HEAD PUMP 4
P5040
HIGH HEAD PUMP 3
P5030
PIT 5043
PCV5041
BFV5042
PIT 5033
ZSC 5031
ZSO 5031
PCV5031
BFV5032
W-P2-1504
TETRA TECH
NOTICE
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE
BTK DESIGNED
VCB DRAWN
JSE CHECKED
NO. DATE BY REVISION
Murray, Smith & Associates, Inc. Engineers/Planners
PUBLIC UTILITY DISTRICT NO. 1 of Whatcom County
WATER TREATMENT PLANT 2 IMPROVEMENTS
CIP NO. RW-1
HIGH HEAD PUMP STATION
PROJECT NO.: 10-1120.250
SCALE: AS SHOWN
DATE: APRIL 2012
SHEET
W-P2-I503
45 of X
P:\2\1503\35-21585-1100\CAD\SheetFiles\1101-1601.dwg 1503 3/22/2012 11:00 AM VICTORIA.BRUDER 18.1s (LMS Tech)

Remote monitoring / control

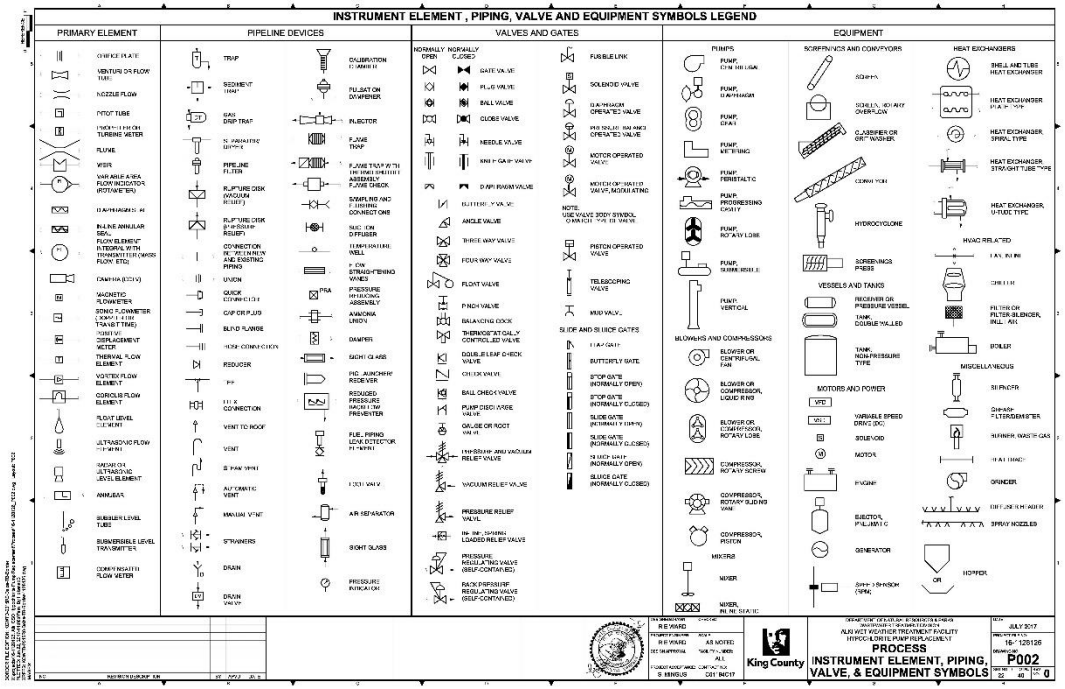


3/22/2012 11:00 AM VICTORIA.BRUDER 18.1a (LMS Tech)

Take a Break

Exercises

Pick some elements



Pick from each section

- One from equipment
- Two from valves and gates
- One from pipeline devices
- One primary element
- Circle selected
- Focus on the Process Flow Diagram

INSTRUMENT ELEMENT , PIPING, VALVE AND EQUIPMENT SYMBOLS LEGEND

PRIMARY ELEMENT x1

- ORIFICE PLATE
- VENTURI OR FLOW TUBE
- NOZZLE FLOW
- PITOT TUBE
- PROPELLER OR TURBINE METER
- FLUME
- WEIR
- VARIABLE AREA FLOW INDICATOR (ROTAMETER)
- DIAPHRAGM SEAL
- IN-LINE ANNULAR SEAL
- FLOW ELEMENT INTEGRAL WITH TRANSMITTER (MASS FLOW, ETC)
- CAMERA (CCTV)
- MAGNETIC FLOWMETER
- SONIC FLOWMETER (DOPPLER OR TRANSIT TIME)
- POSITIVE DISPLACEMENT METER
- THERMAL FLOW ELEMENT
- VORTEX FLOW ELEMENT
- CORIOLIS FLOW ELEMENT
- FLOAT LEVEL ELEMENT
- ULTRASONIC FLOW ELEMENT
- RADAR OR ULTRASONIC LEVEL ELEMENT
- ANNUBAR
- BUBBLER LEVEL TUBE
- SUBMERSIBLE LEVEL TRANSMITTER
- COMPENSATED FLOW METER

PIPELINE DEVICES x1

- TRAP
- SEDIMENT TRAP
- GAS DRIP TRAP
- SEPARATOR/ DRYER
- PIPELINE FILTER
- RUPTURE DISK (VACUUM RELIEF)
- RUPTURE DISK (PRESSURE RELIEF)
- CONNECTION BETWEEN NEW AND EXISTING PIPING
- UNION
- QUICK CONNECTOR
- CAP OR PLUG
- BLIND FLANGE
- HOSE CONNECTION
- REDUCER
- TEE
- FLEX CONNECTION
- VENT TO ROOF
- VENT
- STEAM VENT
- AUTOMATIC VENT
- MANUAL VENT
- STRAINERS
- DRAIN
- DRAIN VALVE
- CALIBRATION CHAMBER
- PULSATION DAMPENER
- INJECTOR
- FLAME TRAP
- FLAME TRAP WITH THERMO SHUTOFF ASSEMBLY
- FLAME CHECK
- SAMPLING AND FLUSHING CONNECTIONS
- SUCTION DIFFUSER
- TEMPERATURE WELL
- FLOW STRAIGHTENING VANES
- PRESSURE REDUCING ASSEMBLY
- AMMONIA UNION
- DAMPER
- SIGHT GLASS
- PIG LAUNCHER/ RECEIVER
- REDUCED PRESSURE BACKFLOW PREVENTER
- FUEL PIPING LEAK DETECTOR ELEMENT
- FOOT VALVE
- AIR SEPARATOR
- SIGHT GLASS
- PRESSURE INDICATOR

VALVES AND GATES x2

NORMALLY OPEN	NORMALLY CLOSED
	GATE VALVE
	PLUG VALVE
	BALL VALVE
	GLOBE VALVE
	NEEDLE VALVE
	KNIFE GATE VALVE
	DIAPHRAGM VALVE

- BUTTERFLY VALVE
- ANGLE VALVE
- THREE WAY VALVE
- FOUR WAY VALVE
- FLOAT VALVE
- PINCH VALVE
- BALANCING COCK
- THERMOSTATICALLY CONTROLLED VALVE
- DOUBLE LEAF CHECK VALVE
- CHECK VALVE
- BALL CHECK VALVE
- PUMP DISCHARGE VALVE
- GAUGE OR ROOT VALVE
- PRESSURE AND VACUUM RELIEF VALVE
- VACUUM RELIEF VALVE
- PRESSURE RELIEF VALVE
- IN-LINE, SPRING LOADED RELIEF VALVE
- PRESSURE REGULATING VALVE (SELF-CONTAINED)
- BACK PRESSURE REGULATING VALVE (SELF-CONTAINED)
- FUSIBLE LINK
- SOLENOID VALVE
- DIAPHRAGM OPERATED VALVE
- PRESSURE BALANCE OPERATED VALVE
- MOTOR OPERATED VALVE
- MOTOR OPERATED VALVE, MODULATING

NOTE:
USE VALVE BODY SYMBOL TO MATCH TYPE OF VALVE.

- PISTON OPERATED VALVE
- TELESCOPING VALVE
- MUD VALVE

SLIDE AND SLUICE GATES

- FLAP GATE
- BUTTERFLY GATE
- STOP GATE (NORMALLY OPEN)
- STOP GATE (NORMALLY CLOSED)
- SLIDE GATE (NORMALLY OPEN)
- SLIDE GATE (NORMALLY CLOSED)
- SLUICE GATE (NORMALLY OPEN)
- SLUICE GATE (NORMALLY CLOSED)

EQUIPMENT x1

PUMPS

- PUMP, CENTRIFUGAL
- PUMP, DIAPHRAGM
- PUMP, GEAR
- PUMP, METERING
- PUMP, PERISTALTIC
- PUMP, PROGRESSING CAVITY
- PUMP, ROTARY LOBE
- PUMP, SUBMERSIBLE
- PUMP, VERTICAL

BLOWERS AND COMPRESSORS

- BLOWER OR CENTRIFUGAL FAN
- BLOWER OR COMPRESSOR, LIQUID RING
- BLOWER OR COMPRESSOR, ROTARY LOBE
- COMPRESSOR, ROTARY SCREW
- COMPRESSOR, ROTARY SLIDING VANE
- COMPRESSOR, PISTON

MIXERS

- MIXER
- MIXER, INLINE STATIC

SCREENINGS AND CONVEYORS

- SCREEN
- SCREEN, ROTARY OVERFLOW
- CLASSIFIER OR GRIT WASHER
- CONVEYOR
- HYDROCYCLONE
- SCREENINGS PRESS

VESSELS AND TANKS

- RECEIVER OR PRESSURE VESSEL
- TANK, DOUBLE WALLED
- TANK, NON-PRESSURE TYPE

MOTORS AND POWER

- VFD
- VARIABLE SPEED DRIVE (DC)
- VSD
- S SOLENOID
- M MOTOR
- ENGINE
- EJECTOR, PNEUMATIC
- GENERATOR
- SPEED SENSOR (RPM)

HEAT EXCHANGERS

- SHELL AND TUBE HEAT EXCHANGER
- HEAT EXCHANGER, PLATE TYPE
- HEAT EXCHANGER, SPIRAL TYPE
- HEAT EXCHANGER, STRAIGHT TUBE TYPE
- HEAT EXCHANGER, U-TUBE TYPE

HVAC RELATED

- FAN, INLINE
- CHILLER
- FILTER OR FILTER-SILENCER, INLET AIR
- BOILER

MISCELLANEOUS

- SILENCER
- GREASE FILTER/DEMISTER
- BURNER, WASTE GAS
- HEAT TRACE
- GRINDER
- DIFFUSER HEADER
- SPRAY NOZZLES
- HOPPER OR

NO	REVISION DESCRIPTION	BY	APVD	DATE

DESIGNED/DRAWN: R E WARD	CHECKED:
PROJECT ENGINEER: R E WARD	SCALE: AS NOTED
DESIGN APPROVAL:	FACILITY NUMBER: ALL
PROJECT ACCEPTANCE: S. MINGUS	CONTRACT NO: C01184C17

King County

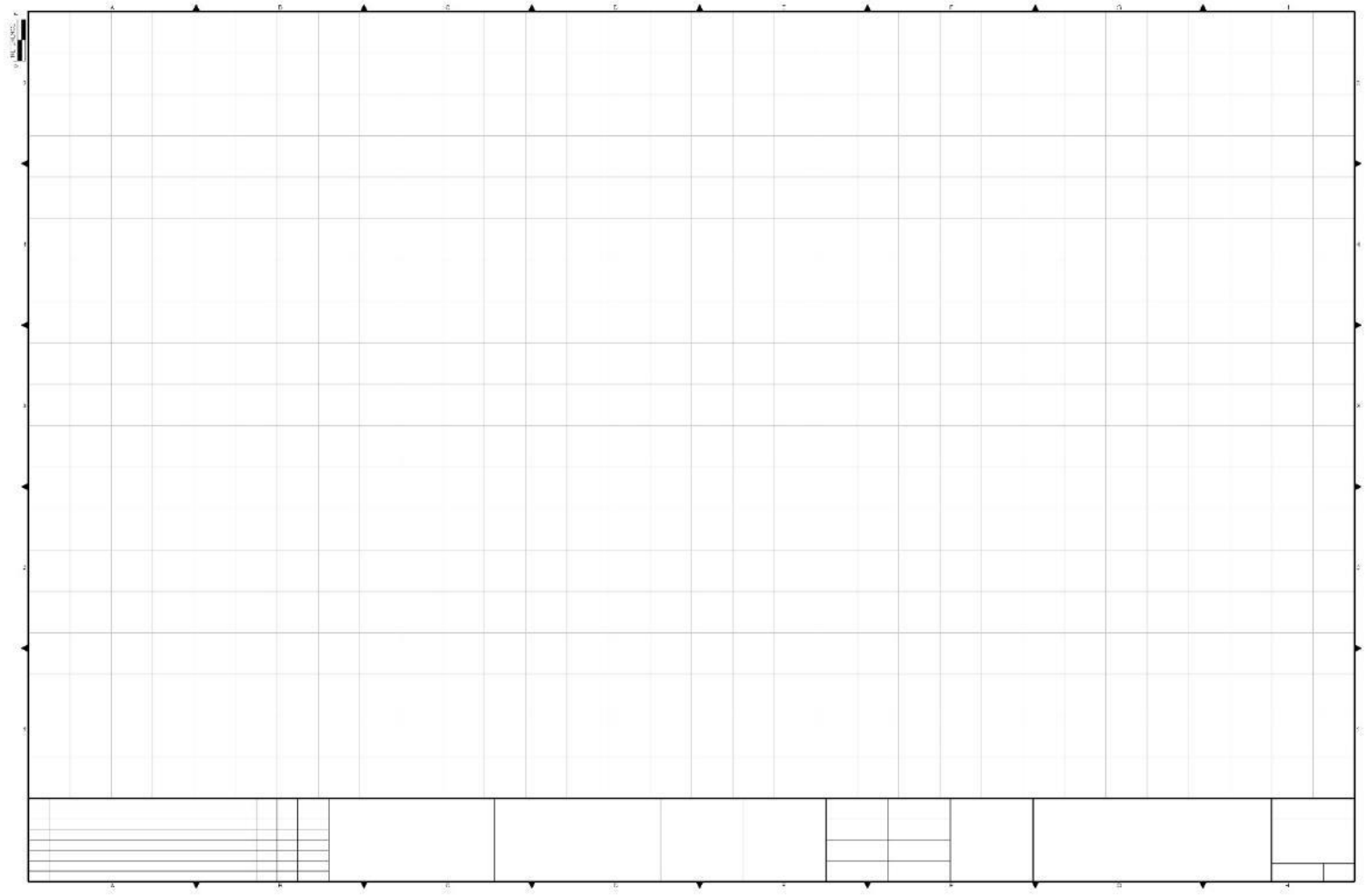
DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
ALKI WET WEATHER TREATMENT FACILITY
HYPOCHLORITE PUMP REPLACEMENT

PROCESS
INSTRUMENT ELEMENT, PIPING, VALVE, & EQUIPMENT SYMBOLS

DATE: JULY 2017
PROJECT FILE NO: 16-1128126
DRAWING NO: P002
SHT NO: 22 TOTAL: 40
REV NO: 0

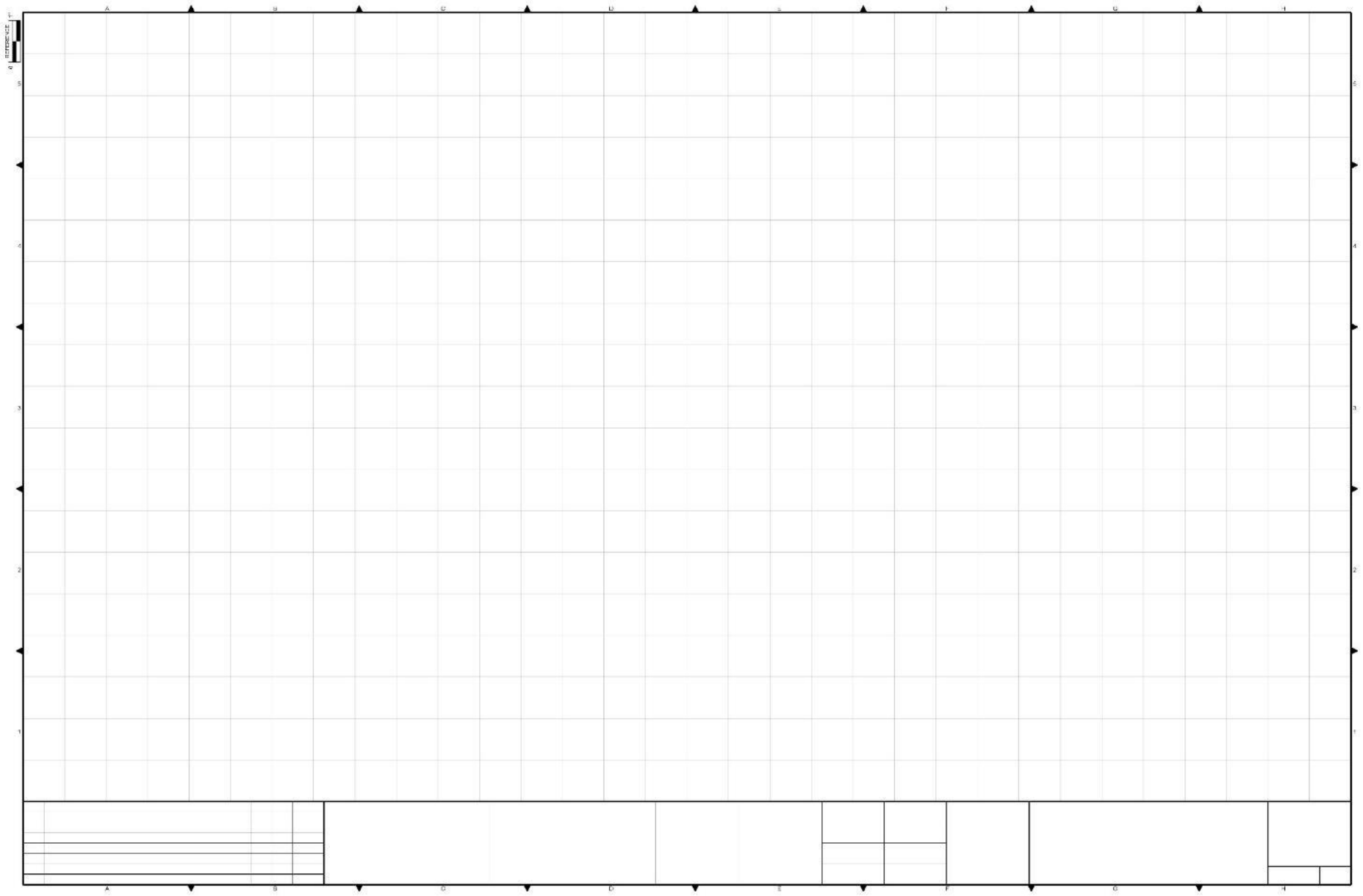
Make up a P&ID

- Using the symbols selected



Draw A Part of Your System

Can you think of a part of your system and sketch it up?



Questions, Comments and Suggestions?