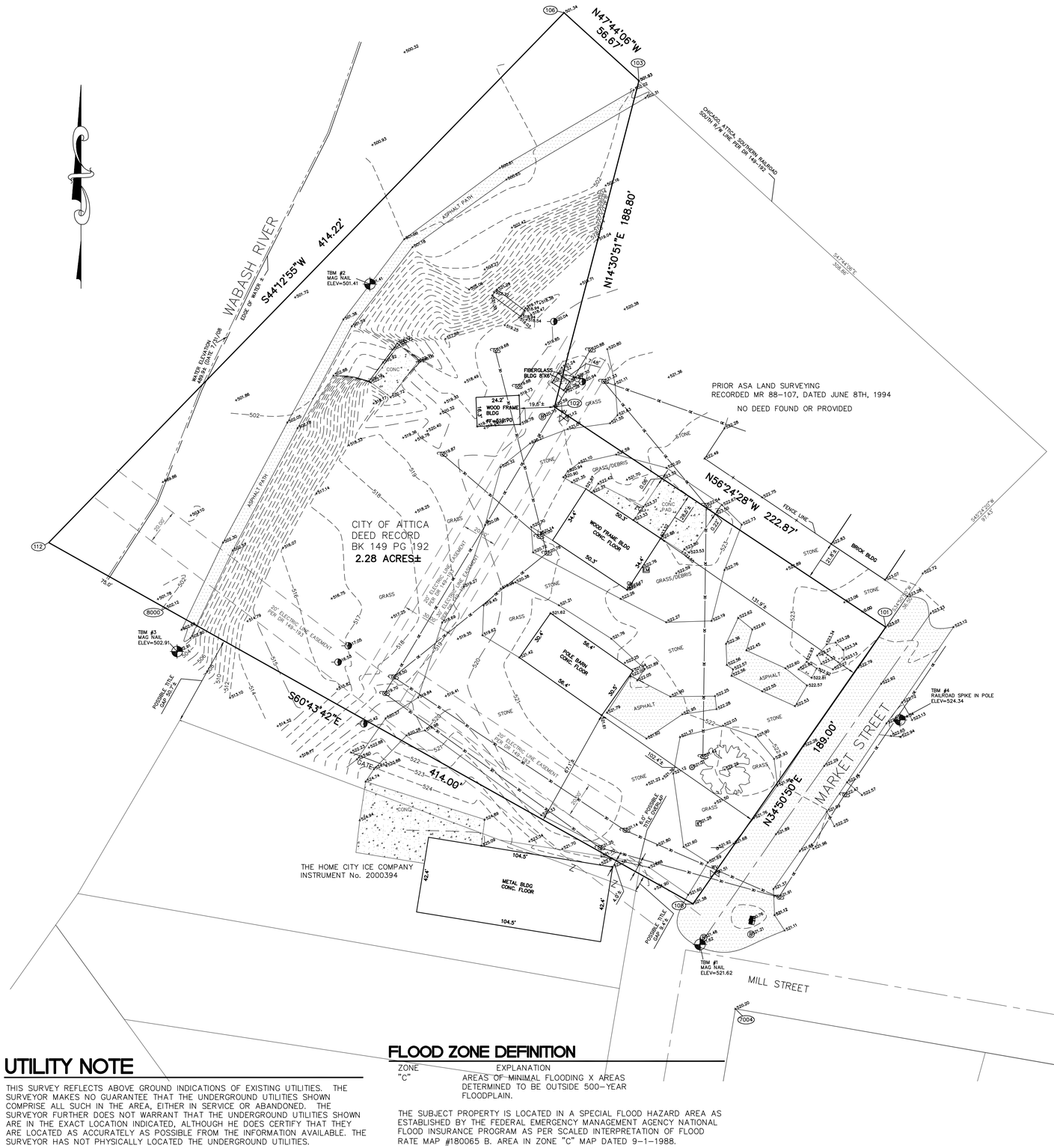
APPENDIX A

WELLFIELD PROPERTY BOUNDARY SURVEY

RETRACEMENT SURVEY

WITH TOPOGRAPHIC SURVEY

PART OF THE NORTH HALF, SECTION 6, T21N,
R7W CITY OF ATTICA, FOUNTAIN COUNTY, INDIANA
HOLLINGSWORTH'S ADDITION ATTICA, INDIANA



LAND DESCRIPTION

DESCRIPTION OF REAL ESTATE PER DEED RECORD 149 PAGE 192

BEGINNING AT A POINT IN THE CITY OF ATTICA WHERE THE WESTERLY LINE OF MAIN AVENUE, INTERSECTS AND CROSSES THE WESTERLY CONTINUATION OF MILL STREET, SAID CONTINUATION BEING THE LEVEE OR APPROACH TO THE HIGHWAY BRIDGE ACROSS THE WABASH RIVER, THENCE NORTH 34 DEGREES 50 MINUTES 50 SECONDS EAST ALONG THE WESTERLY LINE OF MAIN AVENUE ONE HUNDRED EIGHTY-NINE (189) FEET TO A POINT; THENCE NORTH 56 DEGREES 24 MINUTES 28 SECONDS WEST TWO HUNDRED TWENTY-THREE AND THIRTY-THREE HUNDREDTHS (223.33) FEET TO A POINT, THENCE NORTH 14 DEGREES 30 MINUTES 32 SECONDS EAST ONE HUNDRED EIGHTY-EIGHT AND EIGHTY HUNDREDTHS (188.80) FEET TO A POINT ON THE RIGHT OF WAY LINE OF THE CHICAGO, ATTICA AND SOUTHERN RAILROAD; THENCE NORTH 47 DEGREES 45 MINUTES WEST ALONG SAID RIGHT OF WAY LINE FIFTY-SEVEN AND SIXTY-SEVEN HUNDREDTHS (57.67) FEET TO THE WABASH RIVER; THENCE SOUTHERLY WITH SAID RIVER ON A CHORD BEARING SOUTH 44 DEGREES 00 MINUTES 26 SECONDS WEST FOR A DISTANCE OF FOUR HUNDRED FOURTEEN AND TWENTY-TWO HUNDREDTHS (414.22) FEET; THENCE SOUTH 60 DEGREES 45 MINUTES EAST FOR A DISTANCE OF FOUR HUNDRED FOURTEEN (414) FEET TO THE PLACE OF BEGINNING, AND CONTAINING IN SAID TRACT OF LAND 2.285 ACRES, MORE OR LESS.

BENCHMARK

BM #7000
BRONZE DISK
ELEV=523.24

TBM #1
MAG NAIL
ELEV=521.62

TBM #2
MAG NAIL
ELEV=501.41

TBM #3
MAG NAIL
ELEV=502.91

TBM #4
RAILROAD SPIKE IN POLE
ELEV=524.34

LEGEND

- OVERHEAD UTILITY
- ELECTRIC METER
- GAS METER
- CURB INLET
- STORM MANHOLE
- WATER VALVE
- UTILITY POLE
- GUY ANCHOR
- LIGHT POLE
- BM / TBM

SURVEYOR'S REPORT

IN ACCORDANCE WITH TITLE 865, ARTICLE 1, CHAPTER 12 OF THE INDIANA ADMINISTRATIVE CODE ("RULE 12"), THE FOLLOWING OBSERVATIONS AND OPINIONS ARE SUBMITTED REGARDING THE VARIOUS UNCERTAINTIES IN THE LOCATIONS OF THE LINES AND CORNERS ESTABLISHED THIS SURVEY AS A RESULT OF UNCERTAINTIES IN REFERENCE MONUMENTATION; IN RECORD DESCRIPTIONS AND PLATS; IN LINES OF OCCUPATION; AND AS INTRODUCED BY RANDOM ERRORS IN MEASUREMENT ("RELATIVE POSITIONAL ACCURACY"). THERE MAY BE UNWRITTEN RIGHTS ASSOCIATED WITH THESE UNCERTAINTIES. THE CLIENT SHOULD ASSUME THERE IS AN AMOUNT OF UNCERTAINTY ALONG ANY LINE EQUAL IN MAGNITUDE TO THE DISCREPANCY IN THE LOCATION OF THE LINES OF POSSESSION FROM THE SURVEYED LINES.

THERE MAY BE DIFFERENCES OF DEED DIMENSIONS VERSUS MEASURED DIMENSIONS ALONG THE BOUNDARY LINES SHOWN HEREON AND LIKEWISE, THERE MAY BE FOUND SURVEY MARKERS NEAR, BUT NOT PRECISELY AT, SOME BOUNDARY CORNERS. IN CASES WHERE THE MAGNITUDE OF THESE DIFFERENCES ARE LESS THAN THE RELATIVE POSITIONAL ACCURACY AND LESS THAN THE UNCERTAINTY IDENTIFIED FOR THE REFERENCE MONUMENTATION (DISCUSSED BELOW), THE DIFFERENCES MAY BE CONSIDERED INSIGNIFICANT AND ARE SHOWN ONLY FOR PURPOSES OF MATHEMATICAL CLOSURE. SUCH DIFFERENCES THAT ARE GREATER THAN THE RELATIVE POSITIONAL ACCURACY AND THE UNCERTAINTY IN REFERENCE MONUMENTATION SHOULD BE CONSIDERED WORTHY OF NOTICE AND ARE THEREFORE DISCUSSED FURTHER BELOW.

THIS SURVEY AND REPORT ARE BASED IN PART UPON OPINIONS FORMED IN ACCORDANCE WITH AN INDIANA LAND SURVEYOR'S RESPONSIBILITY TO CONDUCT A SURVEY IN ACCORDANCE WITH "LAW OR A PRECEDENT" (865 IAC 1-12-11(5), RULES OF THE INDIANA STATE BOARD OF REGISTRATION FOR LAND SURVEYORS). SINCE INDIANA HAS NO STATUTES ADDRESSING HOW TO RESOLVE BOUNDARY LINES, A SOLUTION BASED ON PRINCIPLES DERIVED FROM COMMON LAW PRECEDENT MUST BE RELIED UPON AS THE BASIS FOR A BOUNDARY RESOLUTION. UNLESS OTHERWISE NOTED OR DEPICTED HEREON, THERE IS NO EVIDENCE OF OCCUPATION ALONG THE PERIMETER LINES OF THE SUBJECT TRACT. ALL SURVEY MONUMENTS SET OR FOUND THIS SURVEY ARE FLUSH WITH EXISTING GRADE UNLESS OTHERWISE NOTED.

THE RELATIVE POSITIONAL ACCURACY (DUE TO RANDOM ERRORS IN MEASUREMENT) OF THE CORNERS OF THE SUBJECT TRACT ESTABLISHED THIS SURVEY DOES NOT EXCEED THAT ALLOWABLE FOR A RURAL CLASS SURVEY (0.26 FEET PLUS 200 PPM) AS DEFINED IN IAC 865.

THE WITHIN SURVEY IS A RETRACEMENT SURVEY OF A TRACT OF REAL ESTATE DESCRIBED IN DEED RECORD BOOK 149 PAGE 192. THE SUBJECT PARCEL WAS ESTABLISHED PER FOUND MONUMENTS AND A PRIOR ASA LAND SURVEYING RECORDED MR 88-107, DATED JUNE 8TH, 1994 AND A PRIOR STARR ASSOCIATES SURVEY RECORDED AS INSTRUMENT No. 2000628, DATED JANUARY 18TH, 2000.

BASIS OF BEARING: ASSUMED BEARING (BASIS OF BEARING IS BASED A ASA LAND SURVEYING RECORDED MR 88-107, DATED JUNE 8TH, 1994)

CONTROLLING MONUMENTS: SEE POINT INVENTORY

IN MY OPINION, THERE IS 0.5 FEET OF UNCERTAINTY IN THE LOCATION OF THESE MONUMENTS.

1. POSSESSION TO THE EAST IS THE IMPROVEMENTS OF MARKET STREET. POSSESSION TO THE NORTH IS TO THE EXISTING FENCING. THE POSSESSION TO THE WEST TO THE WABASH RIVER. NO EVIDENCE OF POSSESSION WAS FOUND TO THE SOUTH.

THERE IS A POSSIBLE 9.4'± TO 50.7'± TITLE "GAP" EXISTS TO ADJACENT TO THE SOUTH BOUNDARY LINE 107-108. THERE IS A POSSIBLE TITLE OVERLAP OF 6.0'± AT THE SOUTHEAST CORNER OF THE SUBJECT PARCEL. THERE WERE NO TITLE GAPS OR OVERLAPS FOUND WITH THE NORTH ADJOINER.

2. THE ACCURACY OF ANY FLOOD HAZARD DATA SHOWN ON THIS REPORT IS SUBJECT TO MAP SCALE UNCERTAINTY AND TO ANY OTHER UNCERTAINTY IN LOCATION OR ELEVATION ON THE REFERENCED FLOOD INSURANCE RATE MAP. THE WITHIN DESCRIBED TRACT OF LAND LIES WITHIN FLOOD HAZARD ZONE "C" AS SAID TRACT PLOTS BY SCALE ON COMMUNITY PANEL NUMBER 180065 B OF THE FLOOD INSURANCE RATE MAPS FOR FOUNTAIN COUNTY, INDIANA (MAPS DATED 9/01/1988)

3. OWNERSHIP INFORMATION INDICATED HEREON IS AS IDENTIFIED IN COUNTY RECORDS.

4. THE WITHIN PLAT AND SURVEY WERE PREPARED WITHOUT BENEFIT OF A CURRENT TITLE POLICY FOR THE SUBJECT TRACT OR ADJOINERS AND ARE THEREFORE SUBJECT TO ANY STATEMENT OF FACTS REVEALED BY EXAMINATION OF SUCH DOCUMENTS.

POINT INVENTORY

POINT #	REMARKS
(106) (108) (8000)	5/8" IRON ROD WITH YELLOW CAP STAMPED MILLER SURVEYING SET
(103)	5/8" IRON ROD WITH YELLOW CAP STAMPED STANLEY
(101) (102)	5/8" IRON ROD WITH YELLOW CAP
(7004) (7005)	5/8" IRON ROD WITH YELLOW CAP STAMPED STARR

THE WITHIN PLAT AND SURVEY WAS PREPARED WITHOUT THE BENEFIT OF A CURRENT TITLE POLICY AND ARE THEREFORE SUBJECT TO ANY STATEMENT OF FACTS REVEALED BY EXAMINATION OF SCHEDULE "A" AND SCHEDULE "B" OF A TITLE POLICY.

THIS SURVEY PLAT HAS BEEN PREPARED FOR USE ON THIS PARTICULAR PROJECT AND FOR THE EXCLUSIVE USE OF THE PERSON(S) OR ENTITY HEREON NAMED AND IS NOT CERTIFIED TO OR TO BE USED BY ANY OTHER PARTY. THE EVIDENCE, POSSESSION, OWNERSHIP, CONDITIONS ETC. COULD CHANGE CONSTANTLY AND THE USE OF THIS SURVEY IS LIMITED ONLY TO THE DATE INDICATED HEREIN.

THE LOCATION OF THE TITLE LINES AND CORNERS ARE SUBJECT TO THE EVIDENCE FOUND IN THE PERFORMANCE OF THIS SURVEY. ADDITIONAL EVIDENCE PRESENTED TO MILLER SURVEYING, INC. MAY ALTER THE LOCATION OF THE TITLE LINES AND CORNERS.

UTILITY NOTE

THIS SURVEY REFLECTS ABOVE GROUND INDICATIONS OF EXISTING UTILITIES. THE SURVEYOR MAKES NO GUARANTEE THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED, ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM THE INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.

FLOOD ZONE DEFINITION

ZONE	EXPLANATION
"C"	AREAS OF MINIMAL FLOODING X AREAS DETERMINED TO BE OUTSIDE 500-YEAR FLOODPLAIN.

THE SUBJECT PROPERTY IS LOCATED IN A SPECIAL FLOOD HAZARD AREA AS ESTABLISHED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY NATIONAL FLOOD INSURANCE PROGRAM AS PER SCALED INTERPRETATION OF FLOOD RATE MAP #180065 B. AREA IN ZONE "C" MAP DATED 9-1-1988.

GRAPHIC SCALE
0 15 30 60
SCALE : 1" = 30'

REVISIONS

REV. DATE	BY	DESCRIPTION

R.L.S. LS20400007 DATE: 8/11/2008

MILLER SURVEYING INC.
948 CONNER STREET
NOBLESVILLE INDIANA 46060
PH. # (317) 773-2644 FAX 773-2694

LOCATION: PART OF THE NORTH HALF, SECTION 6, T21N, R7W CITY OF ATTICA, FOUNTAIN COUNTY, INDIANA		DRAWN BY: KNA	CHK'D BY: KNA
		SCALE: 1" = 30'	FIELD BOOK: 554
FIELD WORK COMPLETED: 7/31/2008		DATE: 8/11/2008	PAGE: 119
CLIENT: CRA STEVE DAVIS		JOB NUMBER	SURVEY 4 FILE:
DESCRIPTION: RETRACEMENT SURVEY W/ TOPO		B32360	32 ATTICA

APPENDIX B

DELTA DESIGN CALCULATIONS

Packed Column Air Stripping Tower Data Sheet:

A. Design Basis for (1) Tower at 2,000 gpm @ 55°F Water Temp.

Design Contaminant	Minimum Removal Efficiency Required	Calculated Removal Efficiency
TCE	95%	95+%

B. Design Parameters

Variable	Value
Tower Model Number	ΔS9-200DF
Tower Inside Diameter	108"
Packing Bed Depth	20'-0"
Packing Media	Delta-Pak
Air Flow Rate	10,700 cfm
Air to Water Ratio	40:1
Blower Design SP	3.5" W.C.
Blower Horsepower	10.0 HP

C. Typical Materials of Construction

Component	Material
Tower Shell	DION VER 9102 NSF Certified Resin
Distributor & Internals	304 Stainless Steel
Influent Piping	Schedule 80 PVC
Tower Inlet Ductwork	FRP
Blower Inlet Ductwork	FRP
Mist Eliminator Pad	12" Thick PVC A-B Type
Packing Support	FRP Grating
Bolting	304 Stainless Steel

AIR STRIPPER PROCESS DESIGN

FORM A

AIR STRIPPING RELATIONSHIPS
(Water-air systems)

Consistent Units are used throughout, except as noted.

(1) $$R = \left(\frac{H}{P_t}\right)\left(\frac{G}{L}\right)$$

(2) $$NTU = \frac{R}{R-1}\ln\frac{\frac{C_i}{C_o}(R-1)+1}{R}$$

(3) $Z = (HTU)\,(NTU)$

(4) $$HTU = \frac{L}{K_L a}M_w$$

note: HTU value entering on line 19, Form B is usually taken from HTU curves for Delta SH packing. If computed, refer to form D.

H,	Henry's Law Constant, H=H(t),	atm
P_t,	process pressure	atm
G/L,	molar ratio of gas and liquid rates,	mol/mol
R,	stripping factor,	1
C_i/C_o,	ratio of influent and effluent concentrations	1
NTU,	number of transfer units	1
HTU,	height of transfer unit	length
Z,	height of packing ("effective")	length
L,	molar liquid loading rate	mol/time/area
Mw	molar density of water	mol/volume
K_La,	product of overall liquid mass transfer coefficient K_L and specific interfacial area a	1/time

AIR STRIPPER PROCESS DESIGN FORM B PROCESS DESIGN PARAMETERS		DELTA JOB # PROJECT REFERENCE: By: Joe Homza DATE:	63440 City of Attica, IN 29-May-09	
Air Stripper Identification/Model Number			S9-200DF	
Line No.		Unit	DELTA PAK	
1	Design water flow *	gpm	2,000	
2	Column diameter *	ft	9.0	
3	Nominal cross section	ft^2	63.59	
4	Liquid loading	gpm/ft^2	31.45	
5	Design air flow	scfm	10,700	
6	Gas loading *	scfm/ft^2	168	
7	Air to water ratio	1	40	
8	Packing used	-	Delta-Pak	
9	Compound analyzed	-	TCE	
10	Temperature *	°F	55	
11	H *	atm	550.00	
12	R	1	132.00	
13	Influent concentration *	ppb	10	
14	Effluent concentration *	ppb	0.5	
15	Ci/Co	1	20.00	
16	NTU	1	3.01	
17	HTU *	ft	4.72	
18	Z	ft	14.2	
19	Packing height provided *	ft	20.0	
20	End conditions	ft	0	
21	Net packing height	ft	20.0	
22	Safety factor	1	1.41	
23	Design Percent removal	%	95.00	

AIR STRIPPER PROCESS DESIGN FORM C OPERATIONAL / MECHANICAL PARAMETERS	DELTA JOB # PROJECT REFERENCE: By: Kevin Fitzpatrick DATE: 29-May-09	63440 City of Attica, IN
Air Stripper Identification/Model Number		S9-200DF

Line No.		Unit	
1	Unit packing and static pressure loss at design G and design L	in. W.C./ft.	0.1
2	Total packing pressure loss	in. W.C.	2
3	Other Air Stripper static pressure losses	in. W.C.	1.50
4	Total system static pressure loss	in. W.C.	3.50
5	Design Air flow (Form B, Line 5)	scfm	10,700
6	Rated Horsepower of provided blower motor	Hp	10.00

Design Data Red Highlight Requires Input

Tower inside diameter, d_i (in.)	=	108	
Overall Height, H (ft.)	=	34.27	

Thickness Schedule, in.:

	Elev.,ft.	X, ft.	t, in.
c	0	10	0.49
b	10	20	0.49
a	20	34.27	0.49

Resin: Isophthalic polyester		Isophthalic polyester
Construction: ASTM 4097/PS15-69		ASTM 4097 / PS15-69

Design Loads

Wind Load:	=	80 Exposure C
Seismic Load:	=	Zone 1
Internal Pressure, in. w.c.:	=	3.5
Auxillary Loads:	=	0
Internals dry, lbs.:	=	4200
Max. operating, lbs.:	=	41000
Eccentric Load, lbs.:	=	0
Live Load, lbs.:	=	0
Bottom Weight (lbs.)	=	331
Tower weight w/o Packing (lbs)	=	10200
Tower weight dry, W_o (lbs.)	=	14400
Tower Max. operating, $W_{max.}$ (lbs.)	=	41000

1. Empty Cantilevered Vessel Under Wind Load

A. Wind Load

D_i = diameter inside, ft.	=	9
D_o = diameter outside, ft.	=	10
H = overall ht., ft.	=	34.27
SF = Shape Factor	=	0.8
q = Design wind Pressure, psf	=	17
F = Design Factor for operating loads	=	10
F_w= Design Factor for wind, seismic and snow loads=F/1.2	=	8.33
U = (SF)qD *	=	136.00 lb/ft of height

* No exposure or importance factor per RTP-1

B. Bending Moment at base of the vessel

$M_w = .5UH^2$ = 79861.44 ft-lbs

C. Bending Moment at distance h_T from top due to Wind

at h_T , ft.	=	14.27
$M_T = 0.5Uh_T^2$	=	13847.037 ft-lbs
at h_T, ft.	=	24.27
$MT = 0.5Uh_T^2$	=	40054.237 ft-lbs

D. Lateral Force

W = UH = 4660.72 lbf

E. Lateral Force at distance h_T from top due to Wind

at h_T , ft.	=	14.27
W = UH	=	1940.72 lbf
at h_T, ft.	=	24.27
W = UH	=	3300.72 lbf

2. Seismic Loading on Vessels

Z = Seismic zone factor	=	0.075
I = Importance Factor	=	1
Rw = Type of Structural Resistance to Lateral Load	=	4
S = Site Soil Profile Factor	=	1
g = acceleration due to gravity, in/s^2	=	386.4
w = Contents loading per unit length = W_{max}/H, lbs/in	=	99.70

A. Natural Period

where I = moment of inertia

$T = ((2*pi*H^2)/3.52)(w/(EIg))^{1/2}$ = 0.067

Rigid Structure if T<= to 0.06 sec = NON RIGID

B. Base Shear- Non Rigid Structure

$C = \min (1.25S/T^{(2/3)}, 2.75)$ = 2.75

$V_{fm} = ZICW_f/R_w$ = 2114.06 lbf

C. Moment at Base- Non Rigid Structure

F_t = Horizontal Seismic force at top

$F_t = 0$ (for T<=0.7), $F_t = 0.07TV$ = 0

F_t cannot exceed $.25V$, F_t = = 0

$M = (F_tH + (V-F_t)(2H/3))$ = 579591.38 in-lbs

D. Base Shear - Rigid Structure

$V = 0.5ZIW$ = 1537.5 lbf

E. Moment at Base- Rigid Structure

M_b = VH, where H is dist. of combined center of gravity = 316140.75 in-lbs

F. Moment at Base due to Seismic

NON RIGID

M_b = = 579591.38 in-lbs

G. Base Shear due to Seismic

NON RIGID

V = = 2114.06 lbf

H. Moment at height h_T from top due to Seismic

at h_T, ft	=	14.27
M = (FtH + (V-Ft)(2H/3))	=	175521.00 in-lbs
at h_T, ft	=	24.27
M = (FtH + (V-Ft)(2H/3))	=	298521.00 in-lbs

I. Base Shear at height h_T from top due to Seismic

at h_T, ft	=	14.27
Vfm = ZICWf/Rw	=	880.29 lbf
at h_T, ft	=	24.27
Vfm = ZICWf/Rw	=	1497.18 lbf

3. Stress Analysis

Elevation		0-10 ft		10-20 ft		20-34.27 ft
A. Comparison of Wind and Seismic Loads						
Proceed with Greater of Seismic Load or Wind Load	=	WIND	=	WIND	=	SEISMIC
Shear	=	958337.25 in-lbs	=	480650.85 in-lbs	=	175521.00 in-lbs
	=	4660.72 lbf	=	3300.72 lbf	=	1940.72 lbf
B. Shell Thickness						
next thickness standard for type II laminate	=	0.49 in	=	0.49 in	=	0.49 in
		No part of a vessel shall be less than .22" per RTP-1				
Material Properties (based on type II laminate)						
Ultimate Tensile Stress, S_u (psi):	=	15000	=	15000	=	15000
Ultimate Flexural Stress, S_f (psi):	=	22000	=	22000	=	22000
Tensile Modulus, E (psi)	=	1500000	=	1500000	=	1500000
C. Axial Stress at Base						
W_T =Weight Thru bottom=Tower Weight - Bottom Weight, lbs	=	14069.00	=	10198.07	=	5996.15
$f_a = -W_T / (piDt)$	=	-76.16 psi	=	-55.21 psi	=	-32.46 psi
D. Axial Stess from Wind Moment						
I = moment of inertia, in^4	=	3500475.63	=	3500475.63	=	3500475.63
C = axis, in	=	60	=	60	=	60
$f_b = -MC/I$	=	-16.43 psi	=	-8.24 psi	=	-3.01 psi

E. Shear Stress

$f_v = W / (piD_it)$	=	28.03 psi	=	19.85 psi	=	11.67 psi
if f_v < 200 psi, criterion for type II laminates applies	=	TRUE	=	TRUE	=	TRUE

F. Total Axial Stress

total axial stress = $f_a + f_b$	=	-92.59 psi	=	-63.45 psi	=	-35.47 psi
Allowable Stress = S_u/F_w	=	1800 psi	=	1800 psi	=	1800 psi
Acceptable for load on tank, as far as strength if $abs(f_a+f_b)<S_u/F_w$	=	TRUE	=	TRUE	=	TRUE

G. Elastic Stability

Critical Buckling stress for axial compression $f_{cra} = 0.3Et/R$	=	4083.33 psi	=	4083.33 psi	=	4083.33 psi
Critical Stress for Buckling from bending under wind moment $f_{crb} = 1.3f_{cra}$	=	5308.33 psi	=	5308.33 psi	=	5308.33 psi
Shear Critical Buckling Stress for thin walled tube, circular $f_{crv} = 0.695E(t/R)^{(5/4)}(R/H)^{(1/2)}$	=	1057.98 psi	=	1057.98 psi	=	1057.98 psi
Design Factor for Buckling	=	5	=	5	=	5
Buckling Interaction Equation $abs(f_aF/f_{cra})+abs(f_bF/f_{crb})+(f_vF/f_{crv})^2$	=	0.126	=	0.084	=	0.046
$abs(f_aF/f_{cra})+abs(f_bF/f_{crb})+(f_vF/f_{crv})^2<1$	=	TRUE	=	TRUE	=	TRUE

if Buckling or Strength are FALSE, increase thickness to next standard type II laminate

4. Flat Bottom Vessel Under Operating Conditions

F = Design Factor = F/1.2	=	8.33

Assume tower is completely filled with water

A. Hoop Stress

f_h = PR/t	=	1651.36 psi
simplified criterion applies if both = TRUE		
shear stress < 200 psi	=	TRUE
Total Axial Stress < Allowable Stress	=	TRUE
Hoop Stress = f_h < Allowable Stress	=	TRUE

if FALSE, increase thickness to next standard type II laminate

5. Anchor Lug Pull-out Load

Net uplift, Unet = U - W + 4 M / D

P_G=Uplift coefficient	=	0.88
U = wind uplift on roof of vessel = $A_t P_G q$	=	0 lbs
Wo = dry weight , lbs	=	14,400 lbs
M = overturning moment, ft-lb.	=	79861.44 ft-lb
D = diameter, ft.	=	9 ft
Unet	=	21093.97 lbf
Number of hold - down (need to be a multiple of 4)	=	8
Load per Lug / Bolt	=	2636.75 lbf
Allowable Anchor Bolt Stress	=	18000 sqin

Anchor Bolt Sizing:

R = Bolt Circle radius	=	57 in
A_B = Area within bolt circle, in^2	=	10207.03 in^2
C_B = Circumference of bolt circle, in	=	358.14 in

Maximum Tension

$T = (12M/A_B) - (W/C_B)$	=	53.68 lb/in. in.

Required Area of (1) bolt

$B_A = (TC_B)/(S_B N)$	=	0.134 in^2
Next Bolt Size from Table in Pres. Ves. Handbook	=	0.625 in
Bolt Root Area from Table in Pres. Ves. Handbook	=	0.202 in^2

Check Stress in Anchor Bolt

$S_B = (TC_B)/(B_A N)$	=	11897.20 psi
Stress Ratio	=	0.661
Design Pass or Fail (SR < 1)	=	PASS

Note: Corrosion allowance not added due to use of stainless steel bolting. Add 1/8" corrosions allowance for non-stainless steel bolting.

DISTRIBUTOR TRAY DESIGN

JOB NAME: City of Attica, IN
LOCATION: Attica, IN
JOB No. : 63440

OPERATING CONDITIONS	
2000	Design Flow, gpm
400	Minimum Flow, gpm
10700	Air Flow, cfm
6	Overflow Height, inches

Hydraulic Design:

$Q = 11.978*(d)^2*(h)^1/2$

Variables:
Q = flow rate, gpm
d = dia of hole, in
h = Depth of Water at orifice, ft

User Input	
206	Number of Holes Selected
1.25	Hole Diameter, in

Calculated Output	
3.23	Tray Level @ Design Flow, in
0.13	Tray Level @ Minimum Flow, in

Stack Design:

Max velocity through stack can not exceed:
1500 ft/min

Stack Size (in)	Number of Stacks Required	
2	327	
4	82	
6	37	
8	21	
10	14	
12	10	
14	7	
16	6	<==Selected

APPENDIX C

CRA PUMP SIZING CALCULATIONS

Process Pump Calculation Sheet - Overall Data Sheet

DATE OF LAST REVISION: 17 January 2001 Saved as: C:\Kraft, Indiana\Pump Calculations\[suction calcsrev1.xls]Overall Data Sheet

Process Engineer: John Joy

DATE: 26-Nov-08 **PROJECT NO.:** 19190
CLIENT: City of Attica **P&ID No.:**
LOCATION: Attica, IN **PUMP NUMBER/IDENTIFICATION:**
COOLING WATER OR PROCESS LIQUID P **PUMP SERVICE:** Water
LIQUID PUMPED: Water
PUMPING TEMPERATURE: 55 deg F
(PHYSICALS AT PUMPING TEMPERATURE)

VISCOSITY:	1.000	CP
VAPOR PRESSURE:		PSIA
SPECIFIC GRAVITY:	1.000	
DENSITY:	62.40	LBS/CU.FT.
FLOW RATE:	1000	GPM
		LBS/HR
DESIGN FLOW RATE:		PERCENT

SUCTION CONDITIONS

ORIGIN PRESSURE:	14.70	PSIA
STATIC HEAD:	4.0	FT
		PSI
EQUIVALENT LINE LENGTH:		FT
LINE FRICTION LOSS:		PSI/100 FT
Calculated Suction Line Loss	2.4	PSI

DISCHARGE CONDITIONS

DELIVERY PRESSURE:		PSIA
STATIC HEAD:	196	FT
		PSI
EQUIVALENT LINE LENGTH:		FT
LINE FRICTION LOSS:		PSI/100 FT
EQUIVALENT LINE LENGTH:		FT
LINE FRICTION LOSS:		PSI/100 FT
Calculated Discharge Line Loss	17.0	PSI

PRESSURE DROP ALLOWANCES FOR:		
CONTROL VALVES:		PSI
EXCHANGERS:		PSI
FURNACES:		PSI
ORIFICES:		PSI
FILTERS:		PSI
FLOW ELEMENTS:		PSI
OTHER (LIST):		
		PSI
		PSI
		PSI
Pump Dynamic Losses	2	PSI
ESTIMATED PUMP EFFICIENCY	65.0	PERCENT

DIFFERENTIAL PRESSURE

DISCHARGE PRESSURE	103.4	PSIA (OR	238.9	FT)
SUCTION PRESSURE	14.1	PSIA (OR	32.5	FT)
TOTAL PUMP delta P	89.4	PSI		
	206.4	FT		
ESTIMATED BRAKE HORSEPOWER	80.2	BHP AT	65.0	PERCENT PUMP EFFICIENCY

LIQUID PUMPED: Water
PUMPING TEMPERATURE: 55 deg F
(PHYSICALS AT PUMPING TEMPERATURE)

VISCOSITY	1.000	CP
VAPOR PRESSURE	0.000	PSIA
SPECIFIC GRAVITY	1.000	
DENSITY	62.400	LBS/CU.FT.
FLOW RATE	1000	GPM
	500573	LBS/HR
DESIGN FLOW RATE	1000	GPM

SUCTION PRESSURE

ORIGIN PRESSURE	14.7	PSIA
STATIC HEAD	1.7	PSI
LINE LOSS	2.4	PSI
PUMP SUCTION PRESSURE	14.1	PSIA

NET POSITIVE SUCTION HEAD

STATIC HEAD	4	FEET
LINE LOSS	5.4	FEET
ORIGIN - VAPOR PRESSURE	34.0	FEET
AVAILABLE NPSH	32.5	FEET

DISCHARGE PRESSURE

DELIVERY PRESSURE	0.0	PSIA
STATIC HEAD	84.4	PSI
LINE LOSS	17.0	PSI
PRESSURE DROP ALLOWANCES FOR:		
CONTROL VALVES	0.0	PSI
EXCHANGERS	0.0	PSI
FURNACES		PSI
ORIFICES	0.0	PSI
FILTERS	0.0	PSI
FLOW ELEMENTS	0.0	PSI
OTHER:		
0	0.0	PSI
0		PSI
0		PSI
Dynamic Losses	2	PSI
PUMP DISCHARGE PRESSURE	103.4	PSIA

Remarks Do not exceed the Yellowed area

PUMP CALCULATION SHEET

CLIENT: **City of Attica**

PUMP NO.:

LOCATION: **Attica, IN**

Put system sketch here

Indicate pressure and elevations for each equipment item

SUCTION PRESSURE	LOOP	A	B
ORIGIN PRESSURE	psia	14.7	
STATIC HD (ft x sp.gr. x 0.433)	psi	1.7	
- loss (Line, Other) dP	psi	2.4	
PUMP SUCTION PRESSURE	psia	14.1	
NET POSITIVE SUCTION HEAD			
STATIC HEAD	feet	4.0	
- LINE LOSS (psi x 2.31 / sp.gr.)	feet	5.4	
+ (Orig.Pr. - Vap.Pr.) x (2.31 / sp.gr)	feet	34.0	
AVAILABLE NPSH	feet	32.5	
DISCHARGE PRESSURE			
DELIVERY PRESSURE	psia	0.0	
STATIC HEAD	psi	84.4	
LINE LOSS	psi	17.0	
ΔP CONTROL VALVES	psi	0.0	
ΔP EXCHANGERS	psi	0.0	
ΔP FURNACES	psi		
ΔP ORIFICES	psi	0.0	
ΔP FILTERS	psi	0.0	
ΔP FLOW ELEMENTS	psi	0.0	
OTHER	psi	0.0	
	psi		
	psi		
Pump Dynamic Loss	psi	2	
PUMP DISCHARGE PRESSURE	psia	103.4	
DIFFERENTIAL PRESSURE			
DISHARGE PRESSURE	psia	103.4	
SUCTION PRESSURE	psia	14.1	
TOTAL PUMP ΔP	psi	89.4	
	feet	206.4	

SERVICE	**Water**
LIQUID PUMPED	**Water**
PUMPING TEMPERATURE (P.T.), °F	**55**
VISCOSITY @ P.T., cP	**1.000**
VAPOR PRESSURE @ P.T., PSIA	**0.0**
SPECIFIC GRAVITY @ P.T.	**1.000**
FLOW, NORMAL @ 60 F, GPM	
FLOW, NORMAL @ P.T., GPM	**1000**
FLOW, DESIGN @ P.T., GPM	**1000**

REMARKS

ESTIMATED BRAKE HORSEPOWER

1000 (gpm) x 89.4 (psi) / 1715 x 65.0 (pump eff)

Loop A only shown above

LOOP	A	B
	80.2	

MADE BY	John Joy	DATE 26-Nov-08
CKD BY		DATE
APD BY		DATE

CRA ENGINEERING GROUP, INC.

REVISION NO.		
1		
2		
3		
4		

CRA EG PROJECT NO: **19190**

P & ID NO: **0**

File C:\Kraft Indiana\Pump Calculations\[suction calcsrev1.xls]Pump Calculation Sheet

PUMP SUCTION LINE CALCULATION SHEET PUMP NO.:

CLIENT: **City of Attica** LOCATION: **Attica, IN**

Segment 1

Sp. Gravity		Density		lb/ft³	Viscosity	cP	Flow Rate	lb/hr	2000 GPM
Line From	Discharge Supply Tank			Line To	8-inch reducer		Fluid Name	Water	
Nominal Pipe Size	12			Service			Line Number		
Pipe Schedule	**Std**			Liquid Volume Flow Rate	2000	GPM	Safety Factor	Percent	
Pipe Roughness	0.0018	inches		Liquid Mass Flow Rate	1001146	Lb/hr	DP / 100 ft. (w / o SF)	**0.333**	PSI
Pipe ID	11.938	inches		Reynolds Number	529170		Total Equivalent Feet of Piping	**523**	Feet
Pipe ID used	**11.938**	inches		Darcy Friction Factor	0.0149		Pressure Loss This Segment	**1.741**	PSI
Fluid Velocity	5.7	FPS		Max Recommended Vel.	5	FPS	Max Recommended ΔP / 100 ft.		PSI
Straight Length of Pipe	5	feet		**Check Valves**			**Pipe Fittings**		
				Type	No.		Type	No.	
Manual Flow Control Valves				Angle Check			Long Radius 90° Elbow		
Type	No.			Ball Check			Short Radius 90° Elbow		
Angle				Lift Check			45° Elbow		
Ball				Swing Check			Tee w/ Run Flow		
Butterfly	1			Foot Valve			Tee w/ Branch Flow	1	
Diaphragm									
Gate				**Flow Entrance / Exit Piping**			**Pipe Reducers/ Enlargers**		
Globe				Pipe Entrance	1		Small Pipe I.D., inches	7.981	
Y-Globe				Pipe Exit			Gradual Reducer		
Plug				Y-Strainer	1		Sudden Reducer	1	
3-way Plug w/ Run Flow				Unsleeved Expansion Joint			Large Pipe I.D., inches	11.938	
3-way Plug w/ Branch Flow				Sleeved Expansion Joint			Gradual Enlarger		
							Sudden Enlarger		
User Defined	**"L/D"**			**User Defined**	**"Equivalent Feet"**				

Equivalent Length of Fittings 518 feet

Segment 2

Sp. Gravity		Density		lb/ft³	Viscosity	cP	Flow Rate	lb/hr	1000 GPM
Line From	8-inch reducer			Line To	Pump Suction		Fluid Name	Water	
Nominal Pipe Size	8			Service			Line Number		
Pipe Schedule	**Std**			Liquid Volume Flow Rate	1000	GPM	Safety Factor	Percent	
Pipe Roughness	0.0018	inches		Liquid Mass Flow Rate	500573	Lb/hr	DP / 100 ft. (w / o SF)	**0.669**	PSI
Pipe ID	7.981	inches		Reynolds Number	395767		Total Equivalent Feet of Piping	**92**	Feet
Pipe ID used	**7.981**	inches		Darcy Friction Factor	0.0161		Pressure Loss This Segment	**0.617**	PSI
Fluid Velocity	6.4	FPS		Max Recommended Vel.	3	FPS	Max Recommended ΔP / 100 ft.		PSI
Straight Length of Pipe	3	feet		**Check Valves**			**Pipe Fittings**		
				Type	No.		Type	No.	
Manual Flow Control Valves				Angle Check			Long Radius 90° Elbow		
Type	No.			Ball Check			Short Radius 90° Elbow		
Angle				Lift Check			45° Elbow		
Ball				Swing Check			Tee w/ Run Flow		
Butterfly				Foot Valve			Tee w/ Branch Flow	1	
Diaphragm									
Gate	1			**Flow Entrance / Exit Piping**			**Pipe Reducers/ Enlargers**		
Globe				Pipe Entrance	1		Small Pipe I.D., inches	6.065	
Y-Globe				Pipe Exit			Gradual Reducer		
Plug				Y-Strainer			Sudden Reducer	1	
3-way Plug w/ Run Flow				Unsleeved Expansion Joint			Large Pipe I.D., inches	7.981	
3-way Plug w/ Branch Flow				Sleeved Expansion Joint			Gradual Enlarger		
							Sudden Enlarger		
User Defined	**"L/D"**			**User Defined**	**"Equivalent Feet"**				

Equivalent Length of Fittings 89 feet

Pressure Loss In These Two Segments **2.358** **PSI**

CRA ENGINEERING GROUP, INC.

MADE BY	DATE
John Joy	26-Nov-08
CKD BY	DATE
APD. BY	DATE

REVISION NO			
	1		CRA EG PROJECT NO
	2		19190
	3		P & ID NO.
	4		0

File: C:\Kraft, Indiana\Pump Calculations\[suction calcsrev1.xls]Pump Suction Line - Page 1

PUMP DISCHARGE LINE CALCULATION SHEET PUMP NO.:

CLIENT: **City of Attica** LOCATION: **Attica, IN**

Segment 1

Sp. Gravity		Density		lb/ft^3	Viscosity		cP	
Line From	**Pump Discharge**			Line To	**12-inch discharge line**			
Nominal Pipe Size	**8**			Service				
Pipe Schedule	**Std**			Liquid Volume Flow Rate		1000	GPM	
Pipe Roughness	**0.0018**	inches		Liquid Mass Flow Rate		500573	Lb/hr	
Pipe ID	**7.981**	inches		Reynolds Number		395767		
Pipe ID used	**7.981**	inches		Darcy Friction Factor		0.0161		
Fluid Velocity	6.4	FPS		Max Recommended Vel.		12.8	FPS	
Straight Length of Pipe	6	feet		**Check Valves**				
				Type		No.		
Manual Flow Control Valves				Angle Check				
Type		No.		Ball Check				
Angle				Lift Check				
Ball				Swing Check				
Butterfly				Foot Valve				
Diaphragm								
Gate		1		**Flow Entrance / Exit Piping**				
Globe				Pipe Entrance				
Y-Globe				Pipe Exit		1		
Plug				Y-Strainer				
3-way Plug w/ Run Flow				Unsleeved Expansion Joint				
3-way Plug w/ Branch Flow				Sleeved Expansion Joint				
User Defined	**"L/D"**			**User Defined**	**"Equivalent Feet"**			

Flow Rate	lb/hr	1000	GPM
Fluid Name	Water		
Line Number			
Safety Factor		Percent	
DP / 100 ft. (w / o SF)		**0.669**	PSI
Total Equivalent Feet of Piping		**55**	Feet
Pressure Loss This Segment		**0.368**	PSI
Max Recommended ΔP / 100 ft.		2.5	PSI

Pipe Fittings

Type	No.
Long Radius 90° Elbow	
Short Radius 90° Elbow	
45° Elbow	
Tee w/ Run Flow	
Tee w/ Branch Flow	

Pipe Reducers/ Enlargers

Small Pipe I.D., inches	4.026
Gradual Reducer	
Sudden Reducer	
Large Pipe I.D., inches	7.981
Gradual Enlarger	
Sudden Enlarger	1

Equivalent Length of Fittings 49 feet

Segment 2

Sp. Gravity		Density		lb/ft^3	Viscosity		cP	
Line From	**12-inch discharge**			Line To	**Tower**			
Nominal Pipe Size	**12**			Service				
Pipe Schedule	**Std**			Liquid Volume Flow Rate		2000	GPM	
Pipe Roughness	**0.0018**	inches		Liquid Mass Flow Rate		1001146	Lb/hr	
Pipe ID	**11.938**	inches		Reynolds Number		529170		
Pipe ID used	**11.938**	inches		Darcy Friction Factor		0.0149		
Fluid Velocity	5.7	FPS		Max Recommended Vel.		16.3	FPS	
Straight Length of Pipe	5,000	feet		**Check Valves**				
				Type		No.		
Manual Flow Control Valves				Angle Check				
Type		No.		Ball Check				
Angle				Lift Check				
Ball				Swing Check				
Butterfly				Foot Valve				
Diaphragm								
Gate				**Flow Entrance / Exit Piping**				
Globe				Pipe Entrance				
Y-Globe				Pipe Exit				
Plug				Y-Strainer				
3-way Plug w/ Run Flow				Unsleeved Expansion Joint				
3-way Plug w/ Branch Flow				Sleeved Expansion Joint				
User Defined	**"L/D"**			**User Defined**	**"Equivalent Feet"**			

Flow Rate	lb/hr	2000	GPM
Fluid Name	Water		
Line Number			
Safety Factor		Percent	
DP / 100 ft. (w / o SF)		**0.333**	PSI
Total Equivalent Feet of Piping		**5000**	Feet
Pressure Loss This Segment		**16.633**	PSI
Max Recommended ΔP / 100 ft.		2	PSI

Pipe Fittings

Type	No.
Long Radius 90° Elbow	
Short Radius 90° Elbow	
45° Elbow	
Tee w/ Run Flow	
Tee w/ Branch Flow	

Pipe Reducers/ Enlargers

Small Pipe I.D., inches	
Gradual Reducer	
Sudden Reducer	
Large Pipe I.D., inches	
Gradual Enlarger	
Sudden Enlarger	

Equivalent Length of Fittings 0 feet

Pressure Loss In These Two Segments **17.001** **PSI**

CRA ENGINEERING GROUP INC.

MADE BY	DATE				
John Joy	26-Nov-08				
CKD. BY	DATE	REVISION	1		CRA EG PROJECT NO
			2		19190
APD BY	DATE	NO.	3		P & ID NO.
			4		0

File: C:\Kraft, Indiana\Pump Calculations\[suction calcsrev1.xls]Pump Discharge Line - Page 1

Form Last Revised 19 Oct 2001

APPENDIX D

GEOTECHNICAL INVESTIGATION

INSPECSOL ENGINEERING INC.
MEMBER OF THE CRA FAMILY OF COMPANIES

14496 Sheldon Road, Suite #200
Plymouth, Michigan 48170
Telephone: (734) 453-5123 Fax: (734) 453-5201
www.inspecsol.com

MEMORANDUM

TO: Steven Davis, PE – CRA Indianapolis

REF. NO.: 019190

FROM: Rebecca E. Bentley/Michael C. Gentner/ma/1

DATE: October 29, 2008

RE: City Water Treatment System
Treatment Building Geotechnical Recommendations
Attica, Indiana

This memo summarizes the geotechnical evaluation and analysis for the proposed equipment control building construction for the City of Attica, Indiana water treatment system. Specifically, geotechnical recommendations are provided with respect to foundation construction and settlement. Kraft is planning to construct a wood-framed building that will house an air stripper, discharge supply tank, and various pumps at the City of Attica, Indiana facility. The operating weight of the air stripper is approximately 42,550 lbs. The discharge tank will hold 12,000 gallons, and will weigh approximately 100,000 lbs. An existing pole barn will be demolished and replaced with the proposed equipment control building.

Two borings were drilled outside the existing pole barn (SB-1 and SB-2) to 20 feet below grade. SB-1 was drilled near the southwest corner of the existing barn, and SB-2 was drilled near the northeast barn corner. A boring location diagram, boring logs and laboratory results are attached to this memo.

SB-1 encountered very loose to loose granular fill to approximately 10 feet, then compact native sands (SP and SC) to 20 feet. Standard Penetration Test (SPT) "N" values ranged from 1 to 11 blows per foot (bpf), with an average N-value of 8. Moisture contents for SB-1 ranged from 7 to 24 percent. SB-2 encountered approximately 2 feet of fill at the surface, and then very dense native sand (SP) to 20 feet. Split spoon refusal was typical, with refusal being defined as more than 50 bpf necessary to advance the split spoon sampler through a 6-inch interval. Moisture contents in SB-2 ranged from 4 to 16 percent. Groundwater was not encountered at either soil boring location during or immediately after drilling.

Our recommendations are based on the results of the field and laboratory testing, and our geotechnical analysis. All footings and floor slabs of the existing pole barn within the footprint of the proposed building should be entirely removed. Fill soil should be removed to a minimum depth of 2 feet below final design bottom of footing grades, and the exposed subgrade compacted by vibratory means before replacing with engineered fill. Engineered fill should extend outward on a 2H:1V slope below design bottom of footing elevations. Engineered fill should consist of granular material free of deleterious matter and cobbles greater than 3 inches in size, meeting INDOT Class B standards. The engineered fill should be placed in maximum 10-inch loose lifts, and compacted to a minimum of 95% of the maximum dry density as determined by a Modified Proctor. The footings can then be placed to bear on the engineered fill at the Indiana frost depth of 48 inches, or as dictated by local building code. Since the actual lateral and vertical extent of the existing fill is unknown, we recommend an experienced geotechnical engineer be on-site during excavation and engineered fill placement to assess actual fill conditions, to confirm the suitability of the exposed subgrade, and perform in-place density tests on the engineered fill. Due to the inconsistent nature of uncontrolled and undocumented fills, we recommend the heavier equipment loads on the slab be placed near the north and northeast part of the building, where competent native bearing soil is present near the surface.

Following the above recommendations, the footings can be designed for a net allowable soil bearing pressure of 1,500 psf, resulting in a total settlement of less than 0.5 inches. Strip footings should be designed with a minimum width of 18 inches, and individual footings designed with a minimum width of 2 feet.

REFERENCE No.: 019190 ENCLOSURE No.:

INSPECSOL ENGINEERING INC.

BOREHOLE No.: SB-1
ELEVATION: ft

BOREHOLE REPORT

Page: 1 of 1

CLIENT: CRA
PROJECT: RMC Site
LOCATION: Attica, IN
DESCRIBED BY: R. Bentley CHECKED BY: M. Gentner
DATE (START): October 21, 2008 DATE (FINISH): October 21, 2008
DRILLER: Boart Longyear DRILL RIG: CME 75

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL
- GS - GRAB SAMPLE

Depth	Elevation (ft)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Moisture Content	Blows per 6 in.	Penetraion Index
Feet			GROUND SURFACE			%			N
			(FILL) Gravelly FILL with brick/concrete debris, loose, black, moist.		S-1	44	24	1-1-1	2
					S-2	33	21	1-1/12"	1
5			5.0 (FILL) Fine sand FILL, trace silt, loose brown, moist.		S-3	33	9	5-2-6	8
			8.0 (FILL) Fine sand FILL with clay and silt, trace brick debris, brown, moist.		S-4	33	13	9-5-3	8
10			10.0 (SP) Fine sand, trace silt and gravel, compact, brown, moist.						
					S-5	22	7	2-6-5	11
15			18.5 (SC) Clayey SAND with silt, compact, dark brown/black, moist.		S-6	100	23	1-3-7	10
20			20.0 END OF BORING @ 20.0 feet.						

Unconfined Compressive Strength (Qu) (tons/sq.ft.) △ Hand Penetrometer ☐ Torvane
○ Water content (%)
Atterberg limits (%) W_p W_l
● "N" Value (blows / 12 in.)

0 1 2 3 4 5
0 10 20 30 40 50

Borehole advanced using hollow stem augers, and backfilled with auger cuttings.

WL: None ft.
WL (AB): None ft.
CAVE IN: None ft.

SOIL LOG WITH GRAPH 019190 RMC ATTICA.GPJ CRA PLYMOUTH.GDT 10/28/08

REFERENCE No.: 019190 ENCLOSURE No.:

INSPECSOL ENGINEERING INC.

BOREHOLE No.: SB-2
ELEVATION: ft

BOREHOLE REPORT

Page: 1 of 1

CLIENT: CRA
PROJECT: RMC Site
LOCATION: Attica, IN
DESCRIBED BY: R. Bentley CHECKED BY: M. Gentner
DATE (START): October 21, 2008 DATE (FINISH): October 21, 2008
DRILLER: Boart Longyear DRILL RIG: CME 75

LEGEND

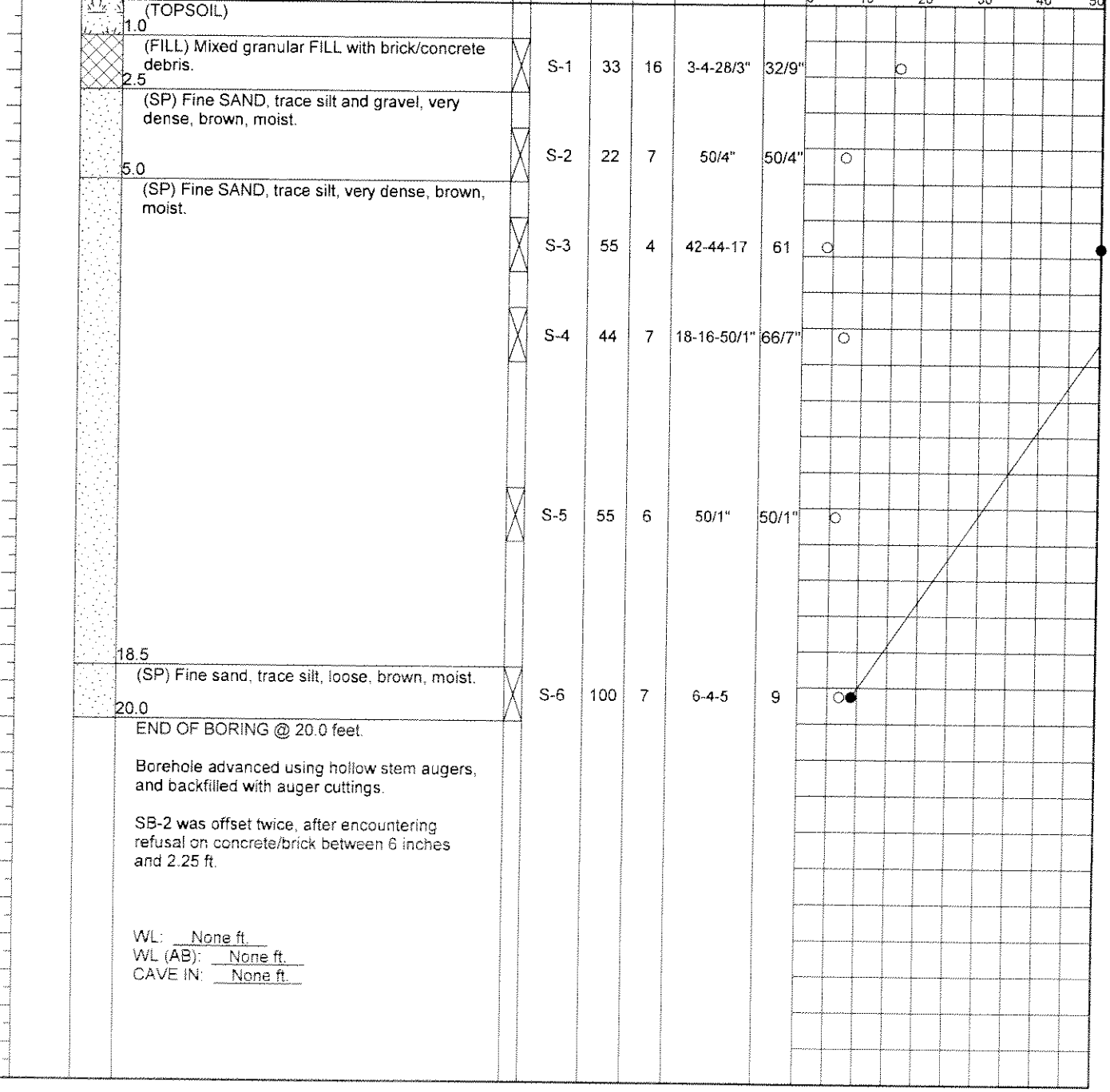
- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL
- GS - GRAB SAMPLE

Depth (Feet)	Elevation (ft)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery (%)	Moisture Content	Blows per 6 in.	Penetraion Index (N)
			GROUND SURFACE						
			(TOPSOIL) 1.0						
			(FILL) Mixed granular FILL with brick/concrete debris. 2.5		S-1	33	16	3-4-28/3"	32/9"
			(SP) Fine SAND, trace silt and gravel, very dense, brown, moist. 5.0		S-2	22	7	50/4"	50/4"
5			(SP) Fine SAND, trace silt, very dense, brown, moist.		S-3	55	4	42-44-17	61
					S-4	44	7	18-16-50/1"	66/7"
10									
					S-5	55	6	50/1"	50/1"
15			18.5						
			(SP) Fine sand, trace silt, loose, brown, moist. 20.0		S-6	100	7	6-4-5	9
20			END OF BORING @ 20.0 feet.						
			Borehole advanced using hollow stem augers, and backfilled with auger cuttings.						
			SB-2 was offset twice, after encountering refusal on concrete/brick between 6 inches and 2.25 ft.						
25									

WL: None ft.
WL (AB): None ft.
CAVE IN: None ft.

Unconfined Compressive Strength (Qu) (tons/sq.ft.) △ Hand Penetrometer ☐ Torvane
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.)

0 1 2 3 4 5
0 10 20 30 40 50



SOIL LOG WITH GRAPH 019190 RMC ATTICA.GPJ CRA PLYMOUTH.GDT 10/29/08

Y OF ATTICA
D RECORD
149 PG 192
28 ACRES±

N56°24'28"W 222.87'

FENCE LINE

STONE

GRASS/DEBRIS

EXISTING BUILDING TO BE DEMOLISHED

WOOD FRAME BLDG
CONC. FLOOR
34.4'
50.3'

CONC PAD

28.5'±

0.06'

0.22'

PROPOSED BUILDING LOCATION

BRICK BLDG

21.6'±

131.9'±

GRASS

STONE

POLE BARN
CONC. FLOOR
30.4'
56.4'

ASPHALT

30.5'

102.4'±

189.00'

ET STREET

20' ELECTRIC LINE EASEMENT PER DR 149-193

20' ELECTRIC LINE EASEMENT PER DR 149-193

TBM #4
RAILROAD SPI
ELEV=524.34

PRELIMINARY

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial
A	PRELIMINARY - FOR REVIEW	9/26/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

CITY WATER TREATMENT SYSTEM

SITE PLAN

CRA CONESTOGA-ROVERS & ASSOCIATES

Source Reference			Date: AUGUST 2008
Project Manager: S. WARNER	Reviewed By: J. THORNTON	Designed By: J. JOY	Drawn By: S. PAGE
Scale: 1" = 10'	Project No: 18190-10	Report No: 021	Drawing No: CI-01

18190-10(021)GN-EU001 AUG 29/2008

APPENDIX E

DESIGN DOCUMENTS AND SPECIFICATIONS

DRAWING INDEX

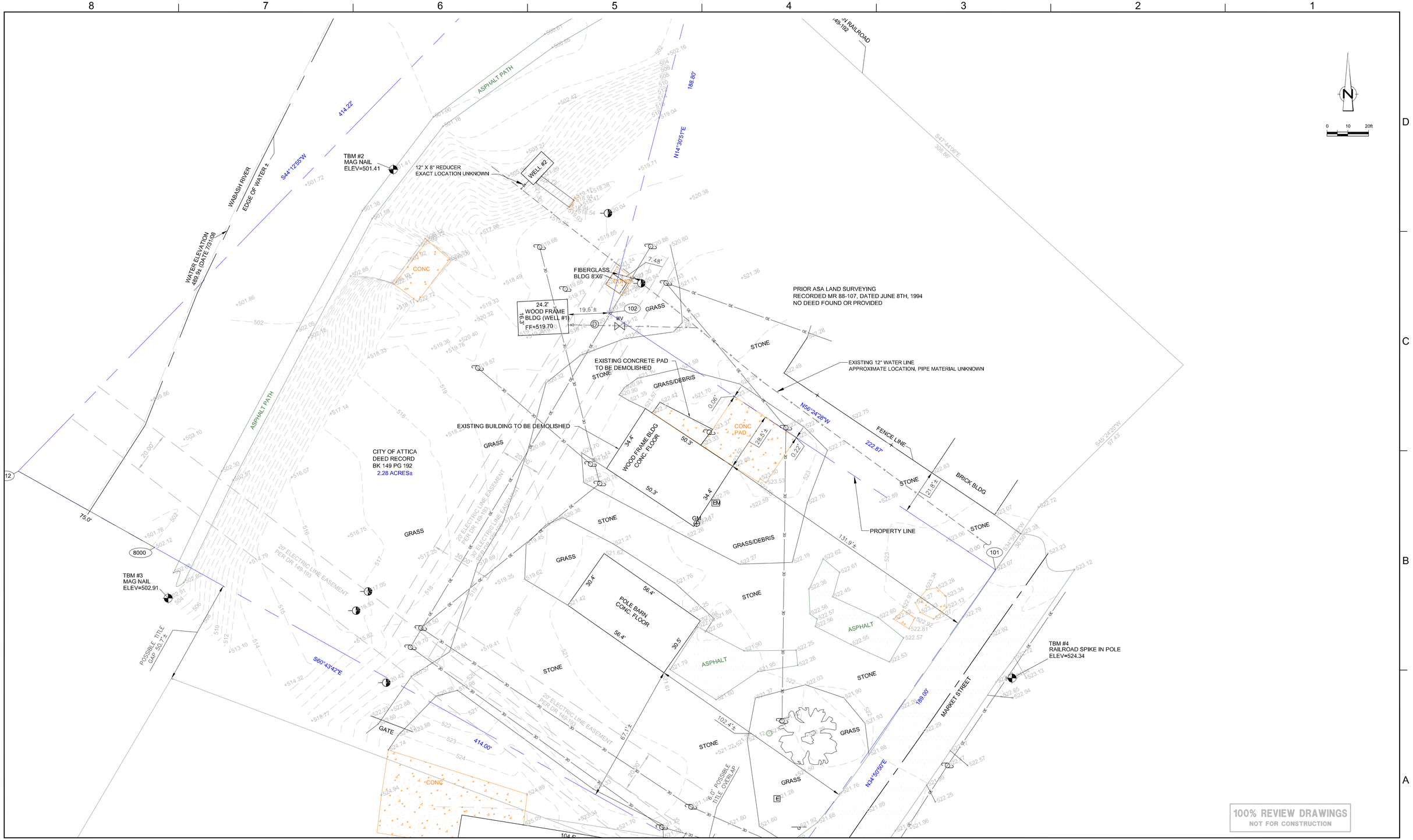
DWG. Nº	REV. Nº	DATE	TITLE
CIVIL			
CI-01	B	11/21/08	EXISTING CONDITIONS
CI-02	A	11/21/08	SITE PLAN
CI-03	A	11/21/08	CIVIL DETAILS
FLOW SHEETS			
PF-01	B	11/21/08	PROCESS FLOW SHEET
EF-00	B	11/21/08	ENGINEERING FLOW SHEET LEGEND
EF-01	B	11/21/08	ENGINEERING FLOW SHEET
STRUCTURAL			
ST-01	B	11/21/08	TREATMENT BUILDING - GENERAL NOTES
ST-02	B	11/21/08	TREATMENT BUILDING - FOUNDATION AND FLOOR PLANS
ST-03	B	11/21/08	TREATMENT BUILDING - ELEVATIONS
ST-04	B	11/21/08	TREATMENT BUILDING - FOOTING AND PAD DETAILS
ST-05	A	11/21/08	TREATMENT BUILDING - ROOF PLAN AND PAD DETAILS
ST-06	A	11/21/08	AIR STRIPPER PLATFORM - PLAN, SECTION & DETAILS
ST-07	A	11/21/08	AIR STRIPPER PLATFORM - LADDER AND RAILING DETAILS
MECHANICAL			
ME-01	B	11/21/08	TREATMENT BUILDING - EQUIPMENT PLAN
ME-02	B	11/21/08	TREATMENT BUILDING - PIPING SECTIONS
ME-03	A	11/21/08	TREATMENT BUILDING - PIPING SECTIONS
ME-04	B	11/21/08	TREATMENT BUILDING - PIPE SUPPORT DETAILS
ELECTRICAL			
EL-01	B	11/21/08	TREATMENT BUILDING - SINGLE LINE DIAGRAM
EL-02	B	11/21/08	TREATMENT BUILDING - GROUNDING PLAN & DETAILS
EL-03	B	11/21/08	TREATMENT BUILDING - LIGHTING PLAN & DETAILS
EL-04	B	11/21/08	TREATMENT BUILDING - POWER PLAN AND DETAILS
EL-05 SHT. 1	B	11/21/08	TREATMENT BUILDING - SCHEMATIC WIRING DIAGRAMS
EL-05 SHT. 2	B	11/21/08	TREATMENT BUILDING - SCHEMATIC WIRING DIAGRAMS
EL-05 SHT. 3	A	11/21/08	TREATMENT BUILDING - SCHEMATIC WIRING DIAGRAMS
EL-06	B	11/21/08	TREATMENT BUILDING - INSTRUMENTATION PLAN AND DETAILS
EL-07	B	11/21/08	TREATMENT BUILDING - NETWORK ARCHITECTURE
EL-08	B	11/21/08	TREATMENT BUILDING - PLC CONTROL PANEL-001 ARRANGEMENT
EL-09 SHT. 1	B	11/21/08	PLC CONTROL PANEL - POWER DISTRIBUTION DIAGRAM
EL-09 SHT. 2	B	11/21/08	TREATMENT BUILDING - PLC CONTROL PANEL WIRING DIAGRAM
EL-09 SHT. 3	B	11/21/08	TREATMENT BUILDING - PLC CONTROL PANEL WIRING DIAGRAM
EL-09 SHT. 4	B	11/21/08	TREATMENT BUILDING - PLC CONTROL PANEL WIRING DIAGRAM
EL-09 SHT. 5	B	11/21/08	TREATMENT BUILDING - PLC CONTROL PANEL WIRING DIAGRAM
EL-09 SHT. 6	B	11/21/08	TREATMENT BUILDING - PLC CONTROL PANEL WIRING DIAGRAM
EL-09 SHT. 7	B	11/21/08	TREATMENT BUILDING - PLC CONTROL PANEL WIRING DIAGRAM

CITY OF ATTICA
ATTICA, INDIANA

CITY WATER TREATMENT SYSTEM
100% DESIGN

19190-03(021)

CONESTOGA-ROVERS & ASSOCIATES



100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

LEGEND

- OVERHEAD UTILITY
- ELECTRIC METER
- GAS METER
- CURB INLET
- STORM MANHOLE
- WATER VALVE
- UTILITY POLE
- GUY ANCHOR
- LIGHT POLE
- BM / TBM

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial
C	ISSUED FOR 100% DESIGN	1/30/09	JJ
B	ISSUED FOR 95% DESIGN	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW	9/26/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

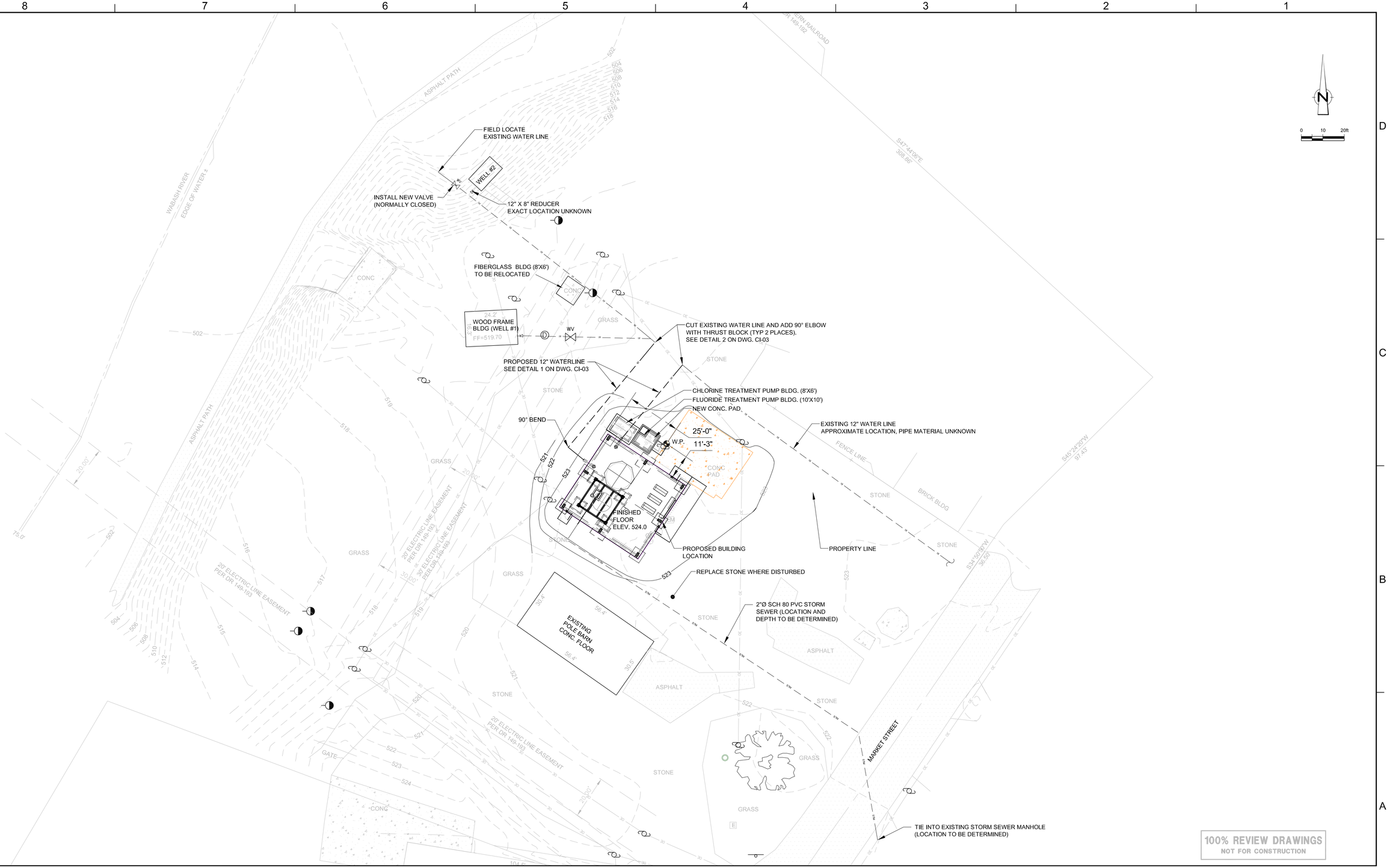
CITY WATER TREATMENT SYSTEM

EXISTING CONDITIONS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. THORNTON	Designed By: J. JOY	Drawn By: S. PIKE
Scale: 1" = 20'	Project No: 19190-03	Report No: 021	Drawing No: CI-01

19190-03(021)CI-BU001 NOV 21/2008



100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

LEGEND

	OVERHEAD UTILITY		WATER VALVE
EM	ELECTRIC METER		UTILITY POLE
GM	GAS METER		GUY ANCHOR
	CURB INLET		LIGHT POLE
D	STORM MANHOLE		BM / TBM

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CITY OF ATTICA
ATTICA, INDIANA

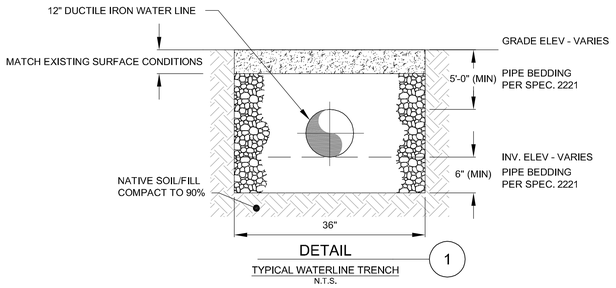
CITY WATER TREATMENT SYSTEM

SITE PLAN

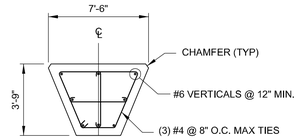
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. THORNTON	Designed By: J. JOY	Drawn By: S. PIKE
Scale: 1" = 20'	Project No: 19190-03	Report No: 021	Drawing No: CI-02

19190-03(021)CI-BU002 JAN 30/2009



DETAIL 1
TYPICAL WATERLINE TRENCH
N.T.S.



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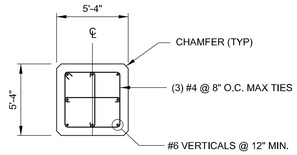

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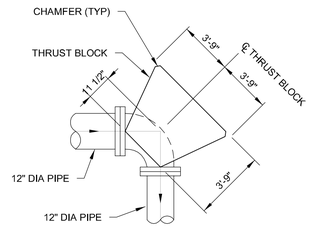
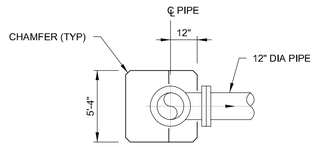
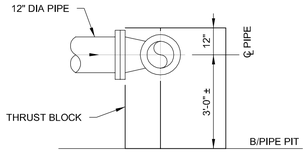


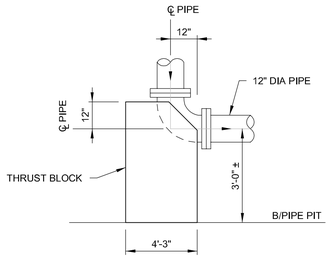
PLAN



PLAN



ELEVATION
ELBOW - HORIZONTAL



ELEVATION
ELBOW - VERTICAL

DETAIL 2
THRUST BLOCK DETAILS
N.T.S.

Minimum Lengths of Restrained Joint Pipe		
Diameter (in)	Fitting	L (ft)
12	90° Bend	26
12	45° Bend	11
12	22.5° Bend	5
12	11.25° Bend	3
12	Tee	20
12	Dead End	46

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

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CITY OF ATTICA
ATTICA, INDIANA

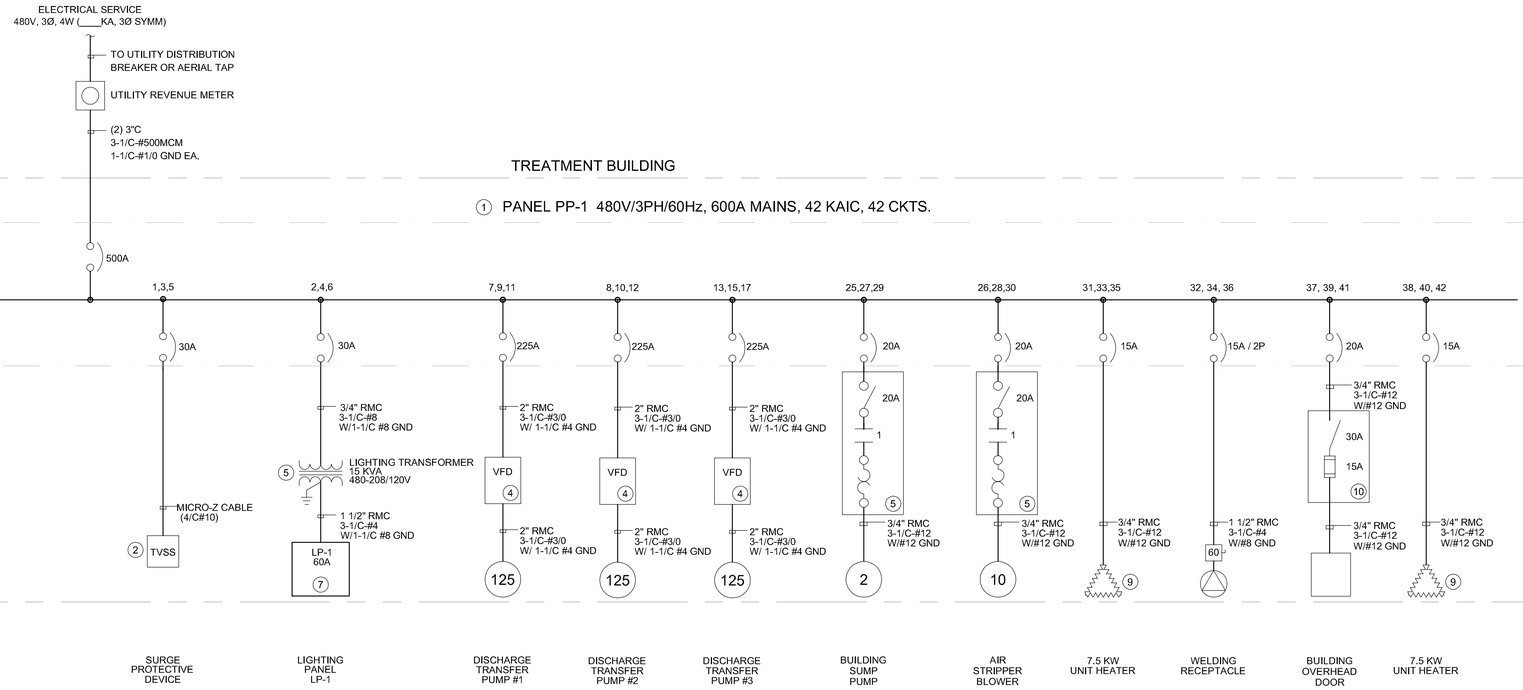
CITY WATER TREATMENT SYSTEM

CIVIL DETAILS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. THORNTON	Designed By: L. ARMBRUSTER	Drawn By: S. PIKE
Scale: HORZ_SC	Project No: 19190-03	Report No: 021	Drawing No: CI-03

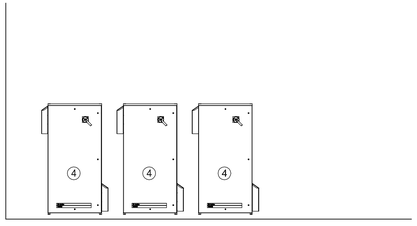
19190-03(021)CI-BU003 NOV 21/2008



SINGLE LINE DIAGRAM

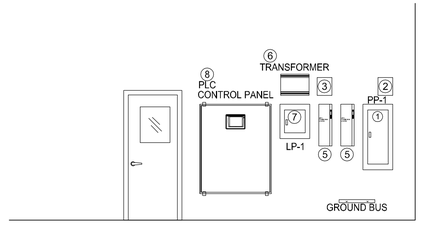
EQUIPMENT SCHEDULE

ITEM	DESCRIPTION	MANUFACTURE OR EQUAL	PART/MODEL NUMBER
1	POWER PANELBOARD, PP1	SQUARE D	TYPE NF NEMA 3R
2	TRANSIENT VOLTAGE SURGE SUPPRESSOR	MCG	160M-480D W/CONNECTING MICRO-Z CABLE, NEMA 4X
3	TRANSIENT VOLTAGE SURGE SUPPRESSOR	MCG	202XT-120Y W/CONNECTING MICRO-Z CABLE, NEMA 4X
4	VARIABLE SPEED DRIVE	ALLEN-BRADLEY	POWER FLEX 400, 23C-D142X103NNBANN-LR
5	COMBINATION SIZE 1 STARTER	CUTLER-HAMMER	FREEDOM NEMA 3R
6	LIGHTING TRANSFORMER	SQUARE D	15T2FSS
7	LIGHTING PANEL, LP1	SQUARE D	NQOD. NEMA 3R
8	PLC CONTROL PANEL		
9	UNIT HEATER	CHROMALOX	LUH-07-43-32
10	30A FUSED DISCONNECT SWITCH	SQUARE-D	H361AWK NEMA 12, 3R COMPLETE W/BUSSMANN FRS-R FUSE (SIZE AS INDICATED)



WEST ELEVATION

1/4"=1'-0"



EAST ELEVATION

1/4"=1'-0"

REFERENCE DRAWINGS

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

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CITY OF ATTICA
ATTICA, INDIANA

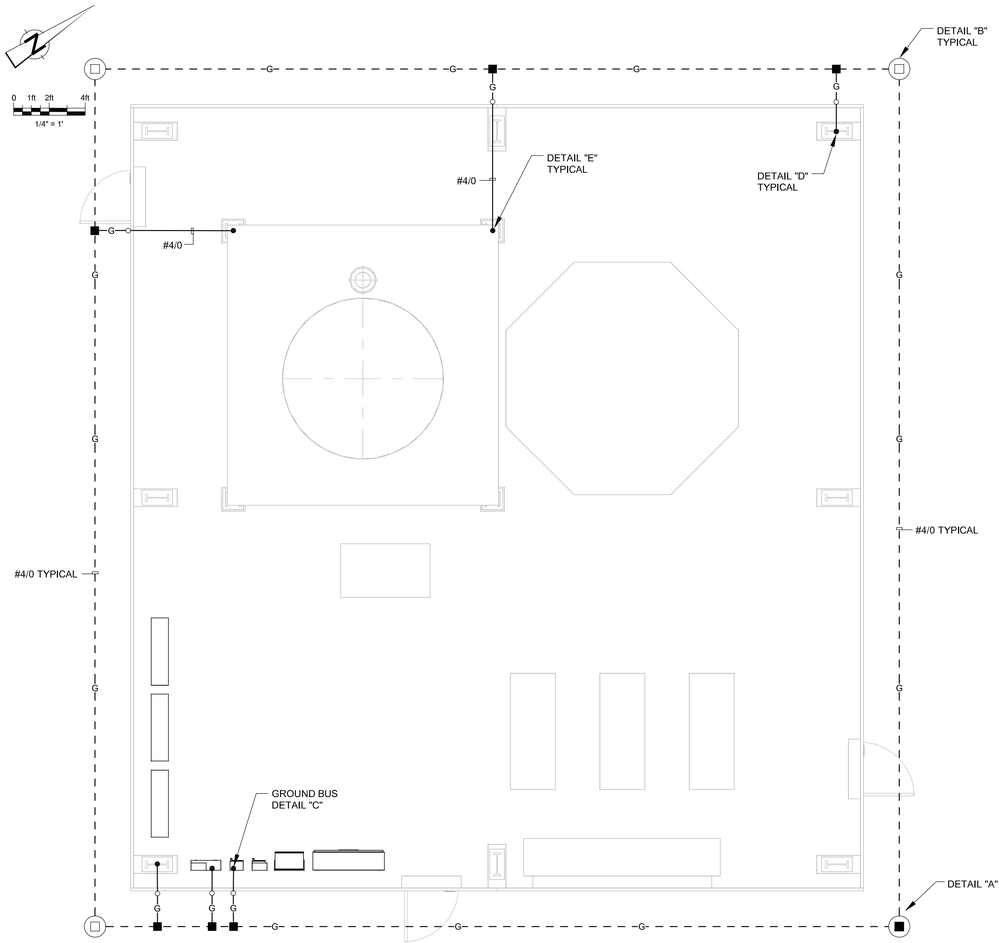
CITY WATER TREATMENT SYSTEM

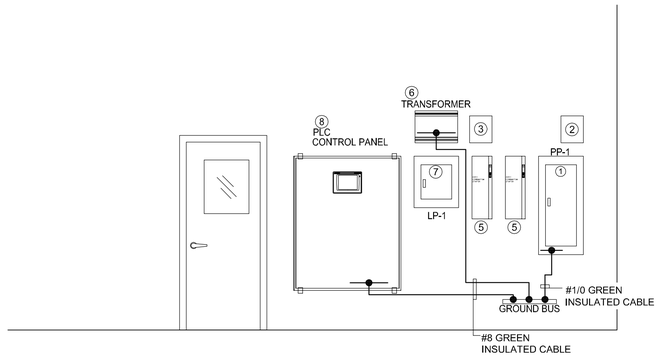
TREATMENT BUILDING
SINGLE LINE DIAGRAM

CONESTOGA-ROVERS & ASSOCIATES

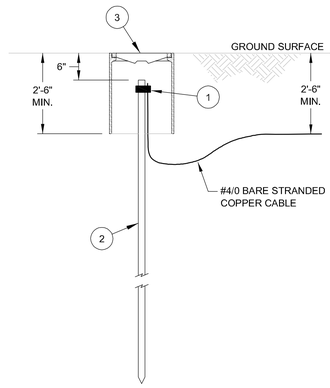
Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: B. ELKIN	Designed By: J. CASSIDY	Drawn By: J. PAUTLER
Scale: NONE	Project No: 19190-03	Report No: 021	Drawing No: EL-01

19190-10(021)EL-BU001 NOV 19/2008



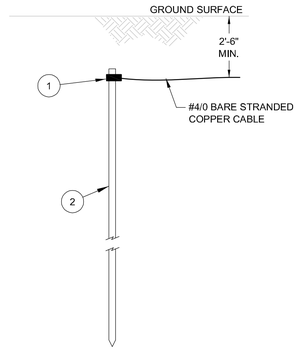


EAST ELEVATION
3/8" = 1'-0"



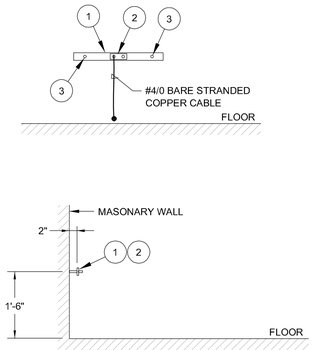
1	CONNECTOR:	BURNDY CAT. No. GAR-6426 (1 CABLE) OR GP6426 (2 CABLES)
2	GROUND ROD:.	COPPERWELD, 3/4" DIA. x 10' LG.
3	INSPECTION WELL:	KISTNER PULL-BOX W/CAST IRON FRAME & COVER 15" DIA. x 20" LG., PART No. PB-15S

DETAIL A
GROUNDING ROD INSTALLATION - INSPECTION TYPE
N.T.S.



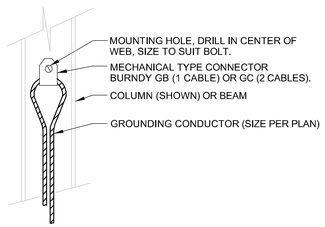
1	CONNECTOR:	BURNDY CAT. No. GAR-6426 (1 CABLE) OR GP6426 (2 CABLES)
2	GROUND ROD:	COPPERWELD, 3/4" DIA. x 10' LG.

DETAIL B
GROUNDING ROD INSTALLATION - BURIED TYPE
N.T.S.

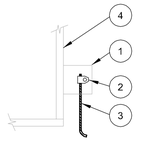


1	COPPER BUS:	3/8" x 2" x 24" WITH 9/16" DIA. HOLES, PREDRILLED TO ACCOMMODATE CONNECTORS AND MOUNTING BOLTS
2	CONNECTOR TO FLAT BAR:	BURNDY CAT. No. GB26
3	MOUNTING:	1/2" x 2 1/2" GALVAN. BOLT; 3/4" x 2" GALVAN. PIPE SPACER; LEAD CLINCH SPACER

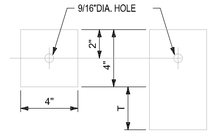
DETAIL C
GROUND BUS INSTALLATION
N.T.S.



DETAIL D
GROUNDING - TYPICAL CONNECTIONS TO STRUCTURAL STEEL
N.T.S.



DETAIL D1



DETAIL D2
NO INSULATION TYPE

DETAIL D3
INSULATION TYPE
T= INSULATION THICKNESS

1	WELDED TAB,1/4x4" STEEL, SEE DETAILS 6E AND 6F FOR DIMENSIONS. WELD TO TOP OR SIDE OF PIPE, POST, TANK LEG OR EQUIPMENT, NOT ON BOTTOM. DO NOT WELD TO LINED PIPE OR EQUIPMENT.
2	GROUNDING CONNECTOR, CONDUCTOR TO FLAT BAR, BURNDY GB OR GC
3	GROUNDING CONDUCTOR (SIZE PER PLAN)
4	EQUIPMENT, TANK

DETAIL E
GROUNDING - TYPICAL WELDED TAB CONNECTION
N.T.S.

GROUNDING LEGEND

G	BARE GROUND CONDUCTOR - BURIED 30" BELOW GRADE
G	BARE GROUND CONDUCTOR - RUN EXPOSED
	COPPER GROUND ROD - COPPERWELD 3/4" DIA. 10 -0" LONG (MIN.) OR AS SPECIFIED ON THE DRAWINGS, BURIED TYPE.
	GROUND CONNECTOR - IRREVERSIBLE COMPRESSION TYPE

GROUNDING GENERAL NOTES

1. ALL GROUND WIRE SHALL BE SIZE #4/0 COPPER (BARE FOR BURIED AND THHN/THWN GREEN INSULATION FOR EXPOSED) EXCEPT LIGHTNING SYSTEM ROOF AND DOWN CONDUCTORS WHICH SHALL BE BARE CONDUCTORS UNLESS OTHERWISE NOTED. THE UNDERGROUND LOOP SHALL BE BURIED 30" BELOW GRADE.
2. IRREVERSIBLE COMPRESSION CONNECTORS SHALL BE ACCEPTABLE METHOD OF CONNECTION OR SPLICING GROUND CABLE.
3. ALL HARDWARE SHALL BE UL - APPROVED COPPER COMPONENTS SIZED TO SUIT.
4. GROUND CABLES INSIDE BUILDING SHALL BE RUN SO THAT THEY DO NOT CONSTITUTE A TRIPPING HAZARD.
5. ROUTE CABLE ALONG SUPPORT STEEL AS REQUIRED
6. LOCATE EXISTING BURIED UTILITIES PRIOR TO INSTALLATION.

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

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CITY OF ATTICA
ATTICA, INDIANA

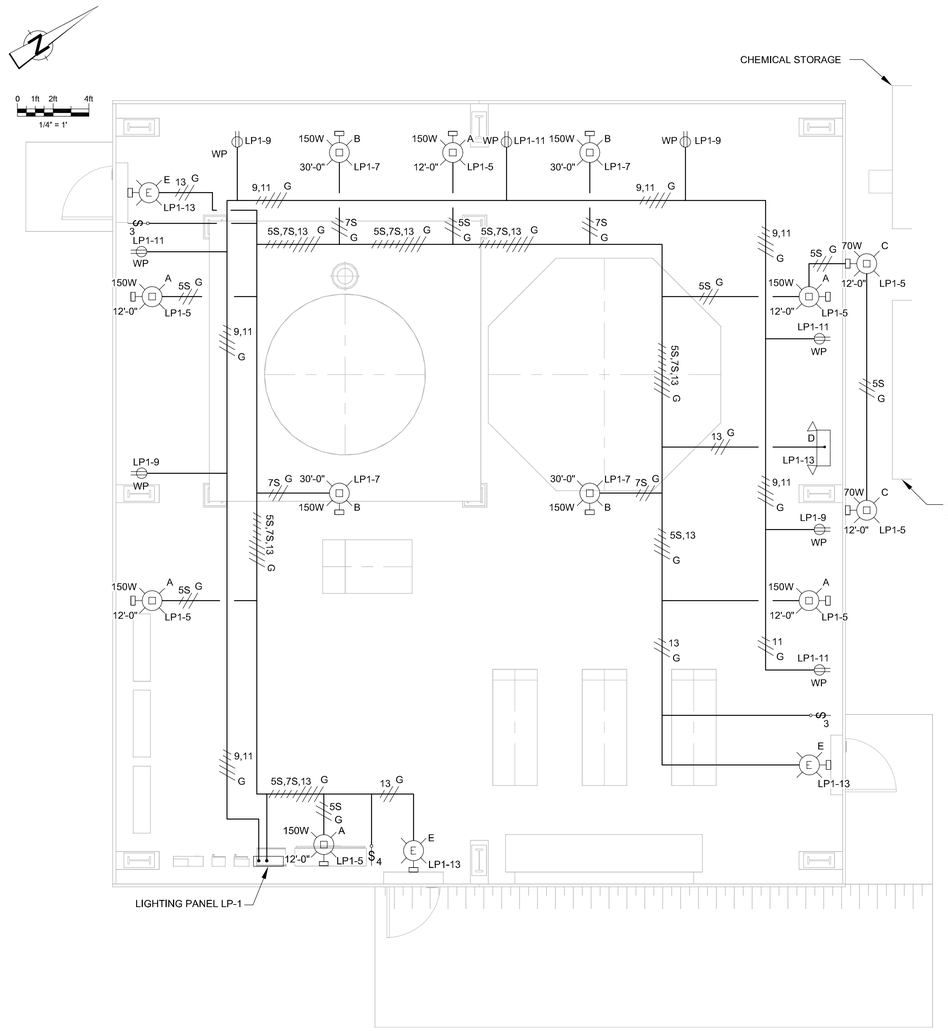
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
GROUNDING PLAN & DETAILS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: B. ELKIN	Designed By: J. CASSIDY	Drawn By: J. PAUTLER
Scale: 1/4" = 1'-0"	Project No: 19190-03	Report No: 021	Drawing No: EL-02

19190-10(021)EL-BU002 SEP 26/2008



LIGHTING PANEL "LP-1" SCHEDULE
208/120V, 60Hz, 3Ø, 4 WIRE

SERVICE DESCRIPTION	#	WATTS	WIRE SIZE	CKT. NO.	BRANCH CB	A B C N	BRANCH CB	CKT. NO.	WIRE SIZE	WATTS	#	SERVICE DESCRIPTION
TVSS		*	12	1	20A		20A	2	12	*		PLC CONTROL PANEL
				3								
LIGHTS		*	12	5	20A		20A	6	12	*		FLUORIDE PUMP #1
LIGHTS		*	12	7	20A		20A	8	12	*		CHLORINE PUMP #1
RECEPTACLES		*	12	9	20A		20A	10	12	*		CHLORINE PUMP #2
RECEPTACLES		*	12	11	20A		20A	12	12	*		EXHAUST FAN
BUILDING EMERGENCY LIGHTING		*	12	13	20A		20A	14	12	*		FIT-200, LIT-200
SPARE		*	12	15	20A		20A	16	12	*		FLUORIDE PUMP #2
SPARE		*	12	17	20A		20A	18	-	*		SPARE
SPARE		*	-	19	20A		20A	20	-	*		SPARE
						N						
						G						

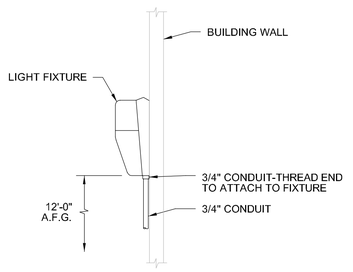
PANEL MTD.:	SURFACE	ENCLOSURE:	NEMA 3R
MANUFACTURER:	SQUARE-D	TYPE:	NQOD
MAIN BREAKER:	60A (QOB)	MAIN LUGS:	60A
FEEDER SIZE:	4#6 & 1#8 GND	FEEDER ENTRY:	TOP

LIGHTING LEGEND

SYMBOL	DESCRIPTION
A	LITHONIA WALL-PAK INDOOR LIGHTING FIXTURE 125W HIGH PRESSURE SODIUM CAT. #TWR1C 150S 120 LPI MOUNTING HEIGHT TO BE 12'-0"BOF. SEE DETAIL A.
B	LITHONIA WALL-PAK INDOOR LIGHTING FIXTURE 125W HIGH PRESSURE SODIUM CAT. #TWR1C 150S 120 LPI MOUNTING HEIGHT TO BE 30'-0"BOF. SEE DETAIL B.
C	LITHONIA WALL-PAK OUTDOOR LIGHTING FIXTURE 70W HIGH PRESSURE SODIUM CAT. #TWH 70S 120 SF RHP WG, WITH PHOTO CELL MOUNTING HEIGHT TO BE 10'-0"BOF. SEE DETAIL C.
D	LITHONIA EMERGENCY LIGHTING FIXTURE CAT. #ELU4X-N1812 MOUNTING HEIGHT TO BE 8'-0"BOF UNLESS NOTED OTHERWISE ON PLAN.
E	LITHONIA EXIT LIGHTING FIXTURE, 120VAC RED LED W/BATTERY BACK-UP CAT. #LQM S W 1 R 120 EL MOUNTING HEIGHT TO BE 7'-0"BOF UNLESS NOTED OTHERWISE ON PLAN.
WP	HUBBELL DUPLEX RECEPTACLE, 20A, 125V, 3-WIRE, GROUNDED CAT. #53CM62, MOUNTED IN BOX #60CM83 W/COVER #52CM21 TO BE MOUNTED 4'-0" AFF UNLESS NOTED OTHERWISE ON PLAN.
$_3$	HUBBELL THREE WAY LIGHTING TOGGLE SWITCH, 20A, 120V CAT. #CS 1223, MOUNTED IN BOX W/COVER #A1 TO BE MOUNTED 4'-6" AFF UNLESS NOTED OTHERWISE ON PLAN.
$_4$	HUBBELL FOUR WAY LIGHTING TOGGLE SWITCH, 20A, 120V CAT. #CS 1224, MOUNTED IN BOX W/COVER #A1 TO BE MOUNTED 4'-6" AFF UNLESS NOTED OTHERWISE ON PLAN.

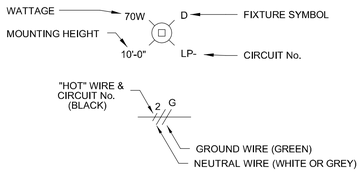
LIGHTING GENERAL NOTES

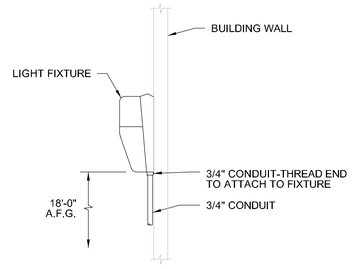
1. GRADE ELEVATION IS APPROXIMATELY 100'-0" (FINISHED FLOOR).
2. ALL CONDUIT TO BE RIGID (RGS), EXCEPT AS NOTED. MINIMUM CONDUIT SIZE TO BE 3/4".
3. EXPOSED CONDUIT TO BE SUPPORTED EVERY 10'-0" MINIMUM (RMC) AND SHALL BE INSTALLED IN A MANNER SUCH THAT THEY DO NOT CONSTITUTE A TRIPPING HAZARD OR INFRINGE UPON THE 8'-0" MINIMUM HEAD CLEARANCE.
4. ALL WALL-THRU CONDUIT PENETRATIONS TO BE WEATHER SEALED WITH APPROVED SILICONE SEALER.
5. ALL LIGHTING WIRING TO BE No. 12 AWG THHN, UNLESS OTHERWISE NOTED.
6. EACH LIGHTING CIRCUIT SHALL BE PROVIDED WITH A DEDICATED NEUTRAL.
7. ALL WIRE SHALL BE TAGGED WITH APPROPRIATE CIRCUIT NUMBERS AT BOTH TERMINAL ENDS.
8. SUPPORTS AND HANGERS: ALL EQUIPMENT/DEVICE/FIXTURE SUPPORTS AND HANGERS SHALL BE HOT DIPPED GALVANIZED STEEL ANGLE OR CHANNEL OR PIPE OR OTHER STRUCTURAL SHAPE OF 1/4" THICK MINIMUM. DO NOT USE RNC CONDUIT AS EQUIPMENT/DEVICE/FIXTURE SUPPORTING MEMBER.



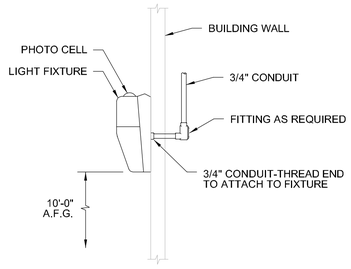
DETAIL A
WALL MOUNTED INDOOR FIXTURE
N.T.S.

LEGEND





DETAIL B
WALL MOUNTED INDOOR FIXTURE
N.T.S.



DETAIL C
WALL MOUNTED OUTDOOR FIXTURE
N.T.S.

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial
C	ISSUED FOR 100% DESIGN	1/30/09	JJ
B	ISSUED FOR 95% DESIGN	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW	9/26/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

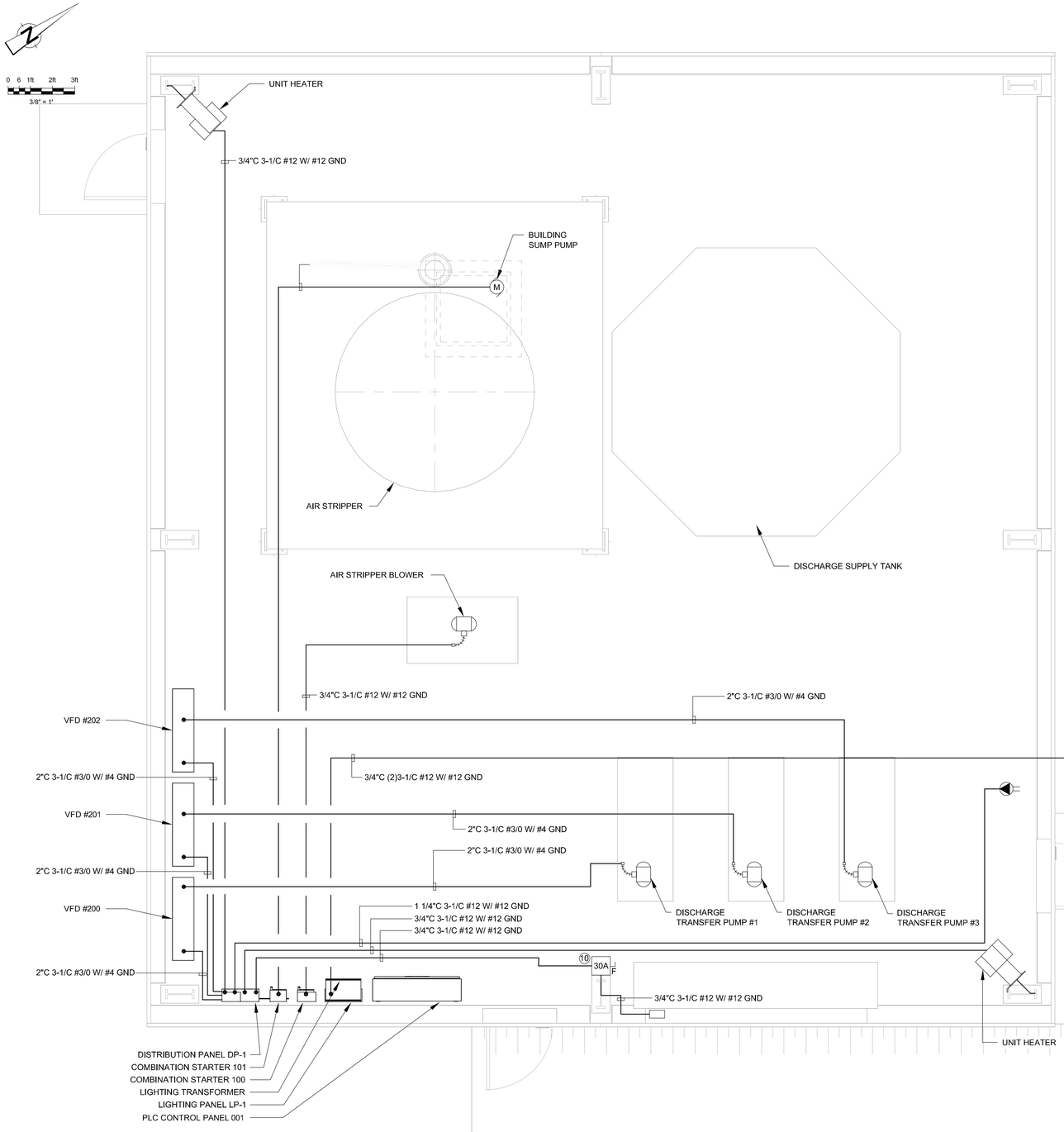
CITY WATER TREATMENT SYSTEM

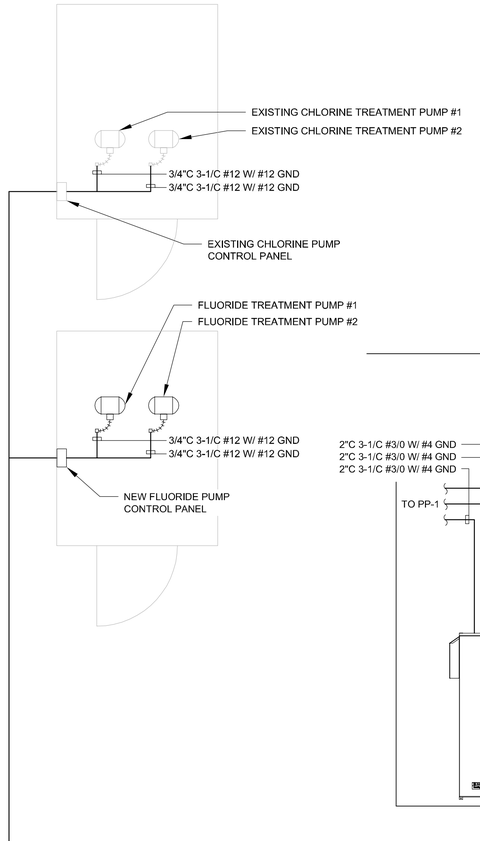
TREATMENT BUILDING
LIGHTING PLAN & DETAILS

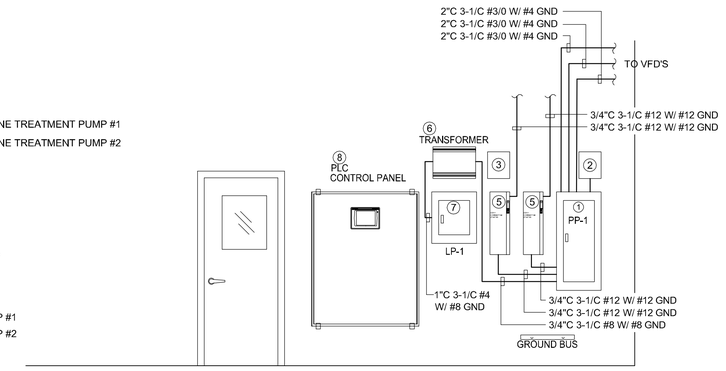
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: B. ELKIN	Designed By: J. CASSIDY	Drawn By: J. PAUTLER
Scale: 1/4" = 1'-0"	Project No: 19190-03	Report No: 021	Drawing No: EL-03

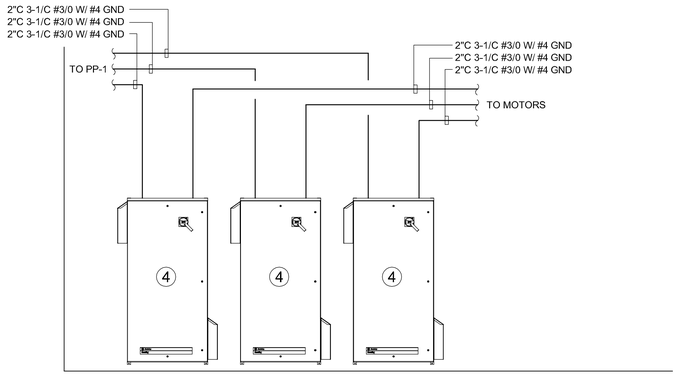
19190-03(021)EL-BU003 JAN 26/2009



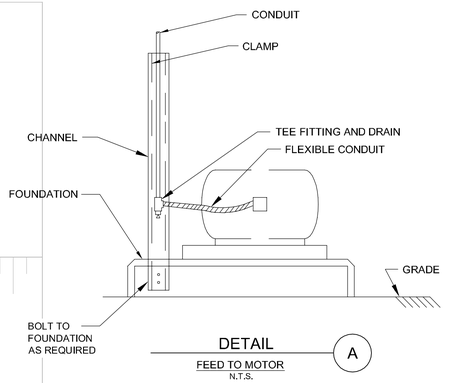




EAST ELEVATION



WEST ELEVATION



DETAIL A
FEED TO MOTOR
N.T.S.

LEGEND

- MOTOR
- (M) VERTICAL MOTOR
- CROUSE-HINDS WELDING RECEPTACLE, 60A, 600VAC COMPLETE WITH DISCONNECT SWITCH CAT. #NSR6351 MOUNTING HEIGHT TO BE 4'-0" UNLESS OTHERWISE NOTED ON PLAN.

NOTES

1. ALL CONDUIT TO BE RIGID (RGS), EXCEPT AS NOTED. MINIMUM CONDUIT SIZE TO BE 3/4".
2. CONDUIT TO BE SUPPORTED EVERY 10'-0" MINIMUM (RGS) AND SHALL BE INSTALLED IN A MANNER SUCH THAT THEY DO NOT CONSTITUTE A TRIPPING HAZARD OR INFRINGE UPON THE 8'-0" MINIMUM HEAD CLEARANCE.
3. ALL WALL-THRU CONDUIT PENETRATIONS TO BE WEATHER SEALED WITH APPROVED SILICONE SEALER.
4. ALL WIRE SHALL BE TAGGED WITH APPROPRIATE CIRCUIT NUMBERS AT BOTH TERMINAL ENDS.

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A	PRELIMINARY - FOR REVIEW	9/26/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
POWER PLAN AND DETAILS

CONESTOGA-ROVERS & ASSOCIATES

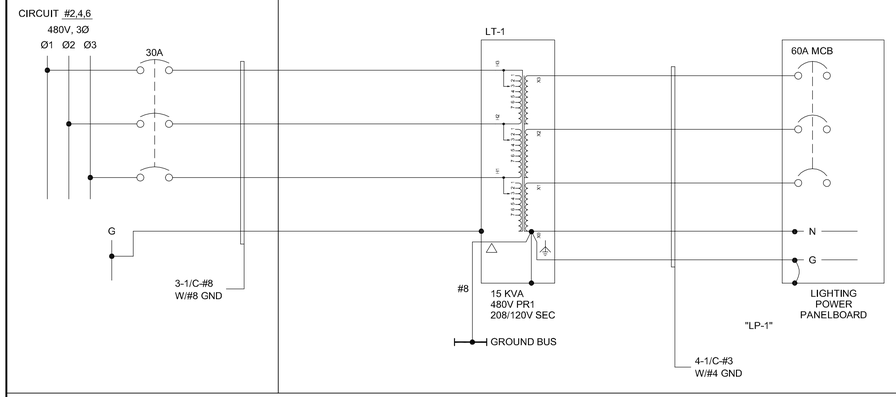
Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: B. ELKIN	Designed By: J. CASSIDY	Drawn By: J. PAUTLER
Scale: 3/8" = 1'-0"	Project No: 19190-03	Report No: 021	Drawing No: EL-04

19190-03(021)EL-BU004 JAN 30/2009

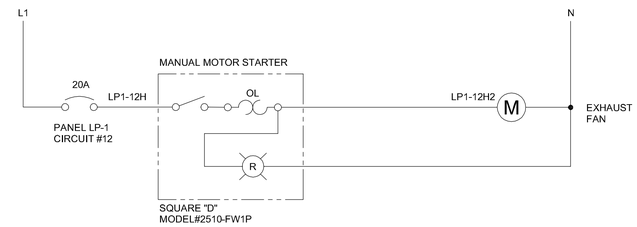
8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

TREATMENT BUILDING

POWER PANEL PP-1



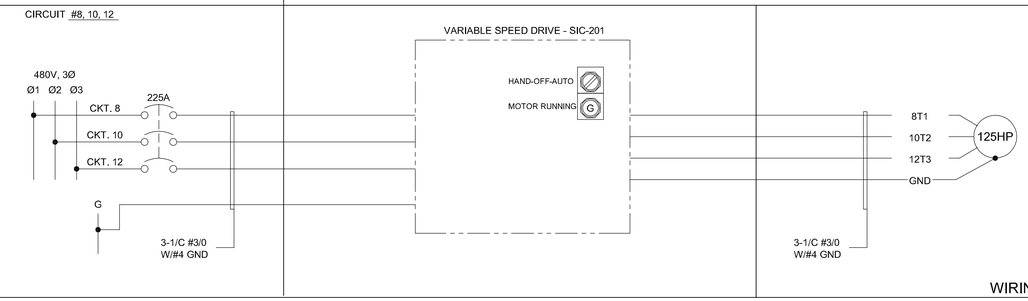
LIGHTING POWER PANELBOARD LP-1



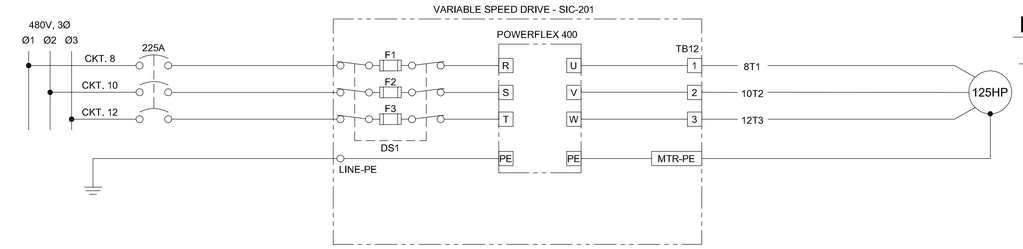
EXHAUST FAN SCHEMATIC DIAGRAM

TREATMENT BUILDING

POWER PANEL PP-1



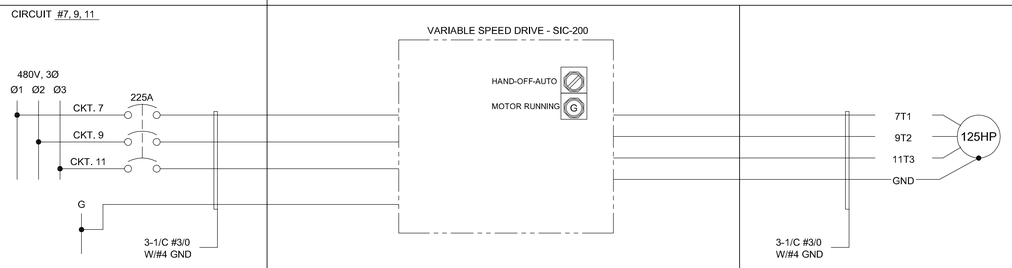
WIRING DIAGRAM
SCHEMATIC DIAGRAM



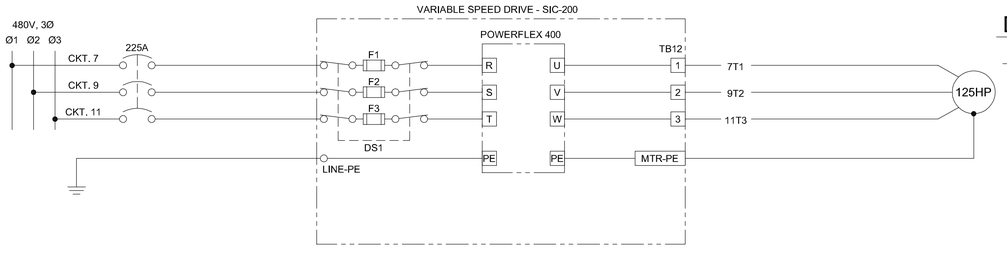
DISCHARGE TRANSFER PUMP #2

TREATMENT BUILDING

POWER PANEL PP-1



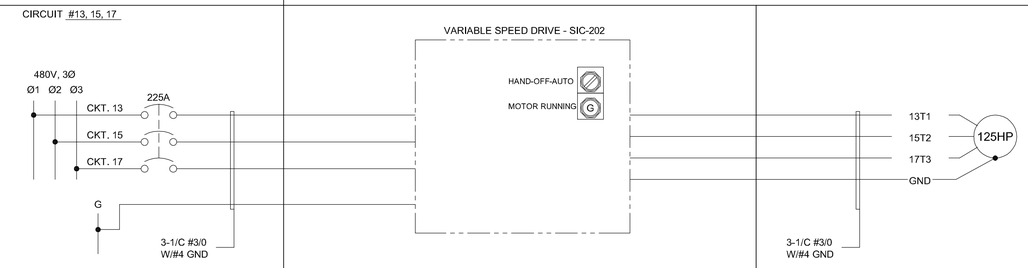
WIRING DIAGRAM
SCHEMATIC DIAGRAM



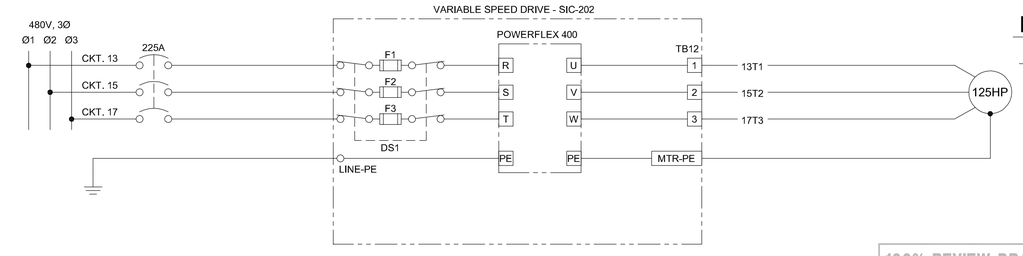
DISCHARGE TRANSFER PUMP #1

TREATMENT BUILDING

POWER PANEL PP-1



WIRING DIAGRAM
SCHEMATIC DIAGRAM



DISCHARGE TRANSFER PUMP #3

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

D C B A

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial
C	ISSUED FOR 100% DESIGN	1/30/09	JJ
B	ISSUED FOR 95% DESIGN	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW	9/26/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
SCHEMATIC WIRING DIAGRAMS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: B. ELKIN	Designed By: J. CASSIDY	Drawn By: J. PAUTLER
Scale: NONE	Project No: 19190-03	Report No: 021	Drawing No: EL-05 SHT. 1

19190-10(021)EL-BU005 NOV 19/2008

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

D

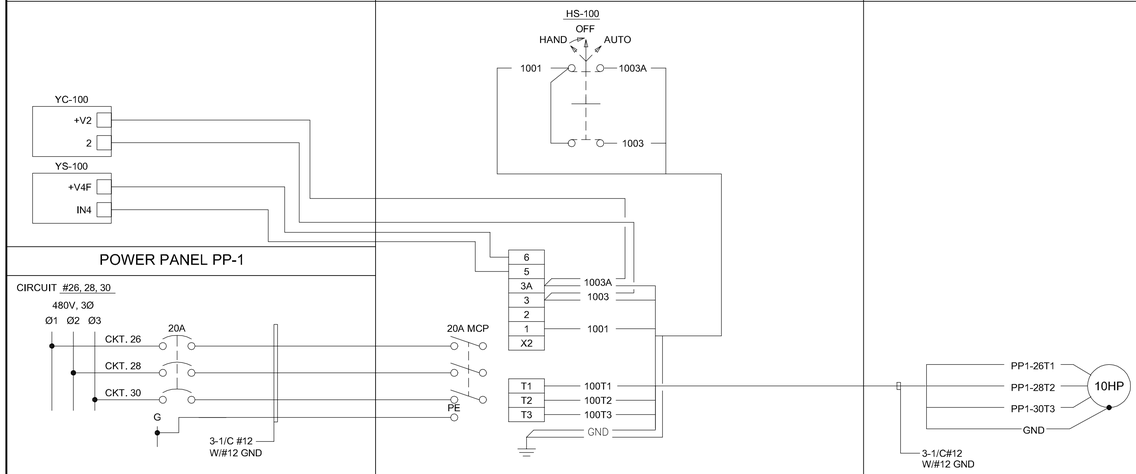
C

B

A

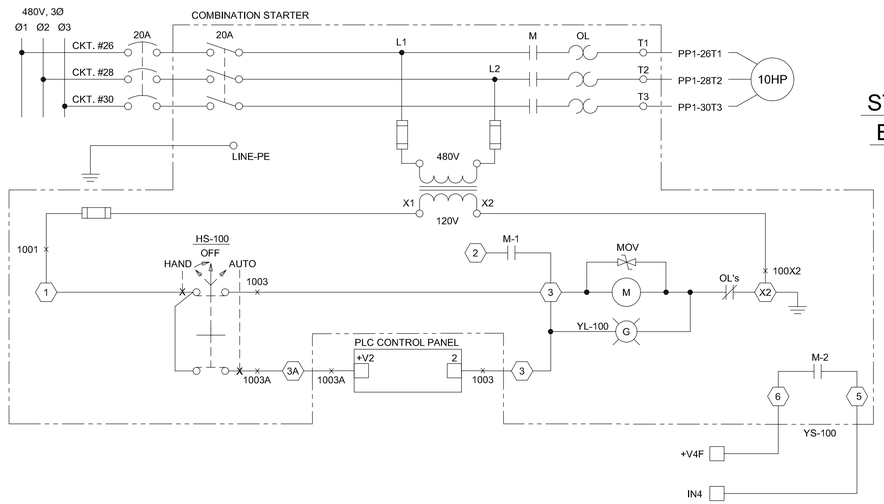
TREATMENT BUILDING

PLC CONTROL PANEL 001 | COMBINATION STARTER 100



WIRING DIAGRAM

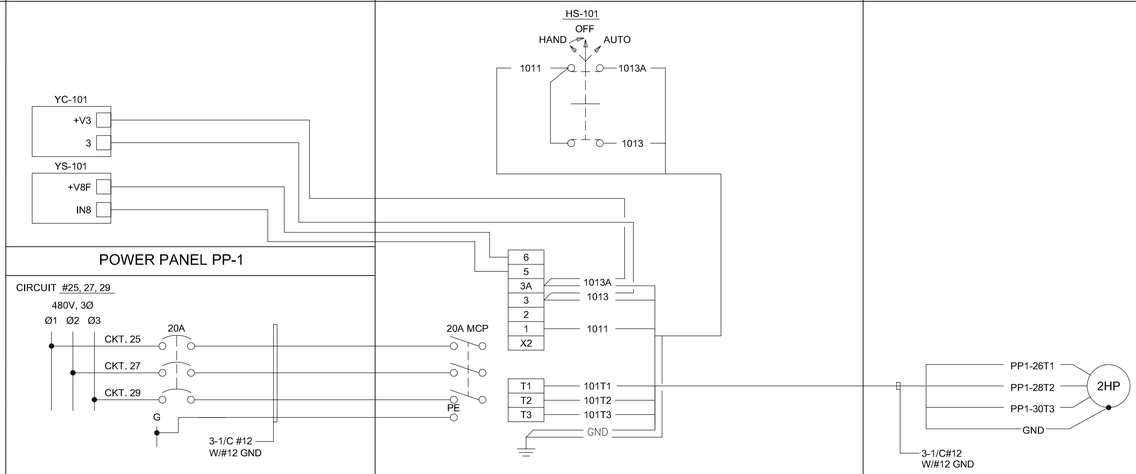
SCHEMATIC DIAGRAM



AIR STRIPPER BLOWER

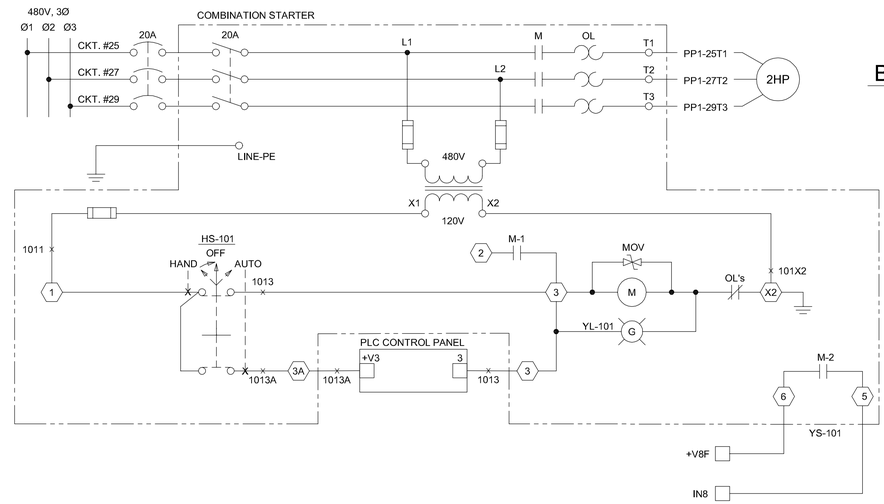
TREATMENT BUILDING

PLC CONTROL PANEL 001 | COMBINATION STARTER 101



WIRING DIAGRAM

SCHEMATIC DIAGRAM



BUILDING SUMP PUMP

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

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CITY OF ATTICA
ATTICA, INDIANA

CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
SCHEMATIC WIRING DIAGRAMS

CONESTOGA-ROVERS & ASSOCIATES

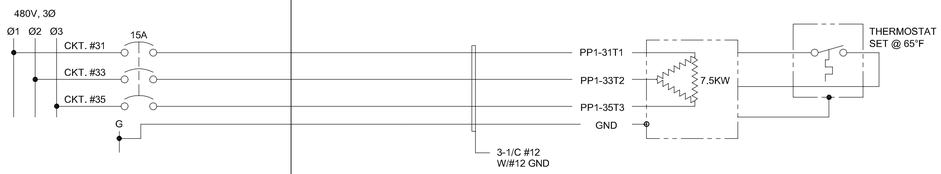
Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: B. ELKIN	Designed By: J. CASSIDY	Drawn By: J. PAUTLER
Scale: NONE	Project No: 19190-03	Report No: 021	Drawing No: EL-05 SHT. 2

19190-10(021)EL-BU006 NOV 19/2008

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

POWER PANEL PP-1

CIRCUIT #31, 33, 35

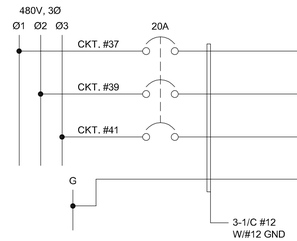


TREATMENT BUILDING

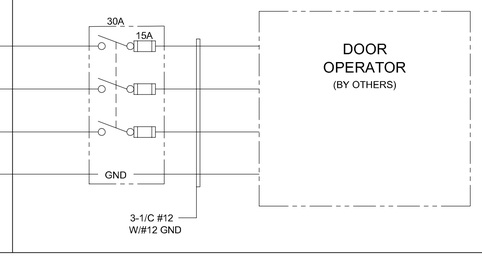
UNIT HEATER

POWER PANEL PP-1

CIRCUIT# 37, 39, 41



TREATMENT BUILDING



BUILDING OVERHEAD DOOR

WIRING DIAGRAM

POWER PANEL PP-1

CIRCUIT #38, 40, 42

TREATMENT BUILDING

UNIT HEATER

D C B A

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

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A	ISSUED FOR 95% DESIGN	11/21/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

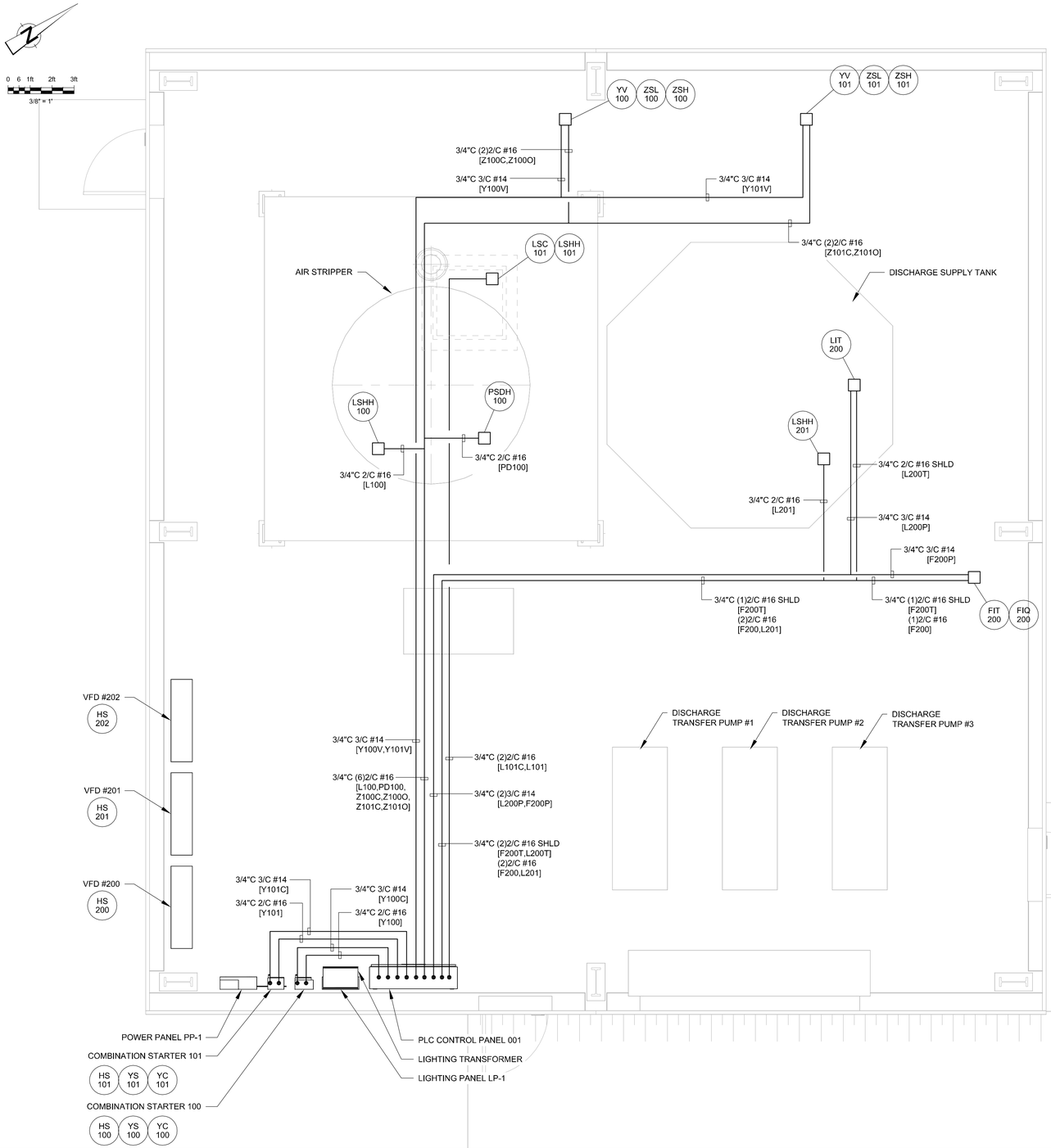
CITY WATER TREATMENT SYSTEM

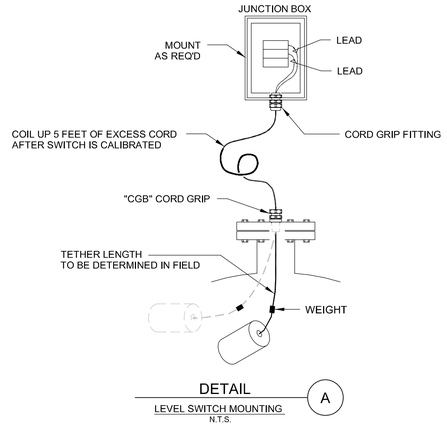
TREATMENT BUILDING
SCHEMATIC WIRING DIAGRAMS

CONESTOGA-ROVERS & ASSOCIATES

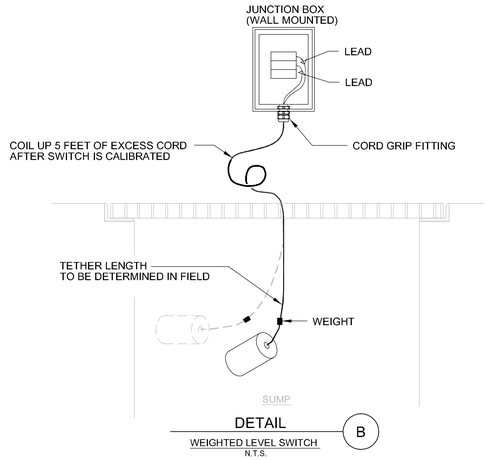
Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: B. ELKIN	Designed By: J. CASSIDY	Drawn By: J. PAUTLER
Scale: NONE	Project No: 19190-03	Report No: 021	Drawing No: EL-05 SHT. 3

19190-10(021)EL-BU017 NOV 19/2008

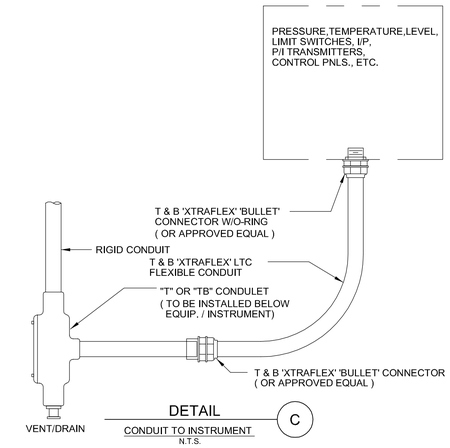




DETAIL A
LEVEL SWITCH MOUNTING
N.T.S.



DETAIL B
WEIGHTED LEVEL SWITCH
N.T.S.



DETAIL C
CONDUIT TO INSTRUMENT
N.T.S.

NOTES

1. ALL CONDUIT TO BE RIGID (RGS), EXCEPT AS NOTED. MINIMUM CONDUIT SIZE TO BE 3/4".
2. CONDUIT TO BE SUPPORTED EVERY 10'-0" MINIMUM (RGS) AND SHALL BE INSTALLED IN A MANNER SUCH THAT THEY DO NOT CONSTITUTE A TRIPPING HAZARD OR INFRINGE UPON THE 8'-0" MINIMUM HEAD CLEARANCE.
3. ALL WALL-THRU CONDUIT PENETRATIONS TO BE WEATHER SEALED WITH APPROVED SILICONE SEALER.
4. ALL WIRE SHALL BE TAGGED WITH APPROPRIATE CIRCUIT NUMBERS AT BOTH TERMINAL ENDS.

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

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CITY OF ATTICA
ATTICA, INDIANA

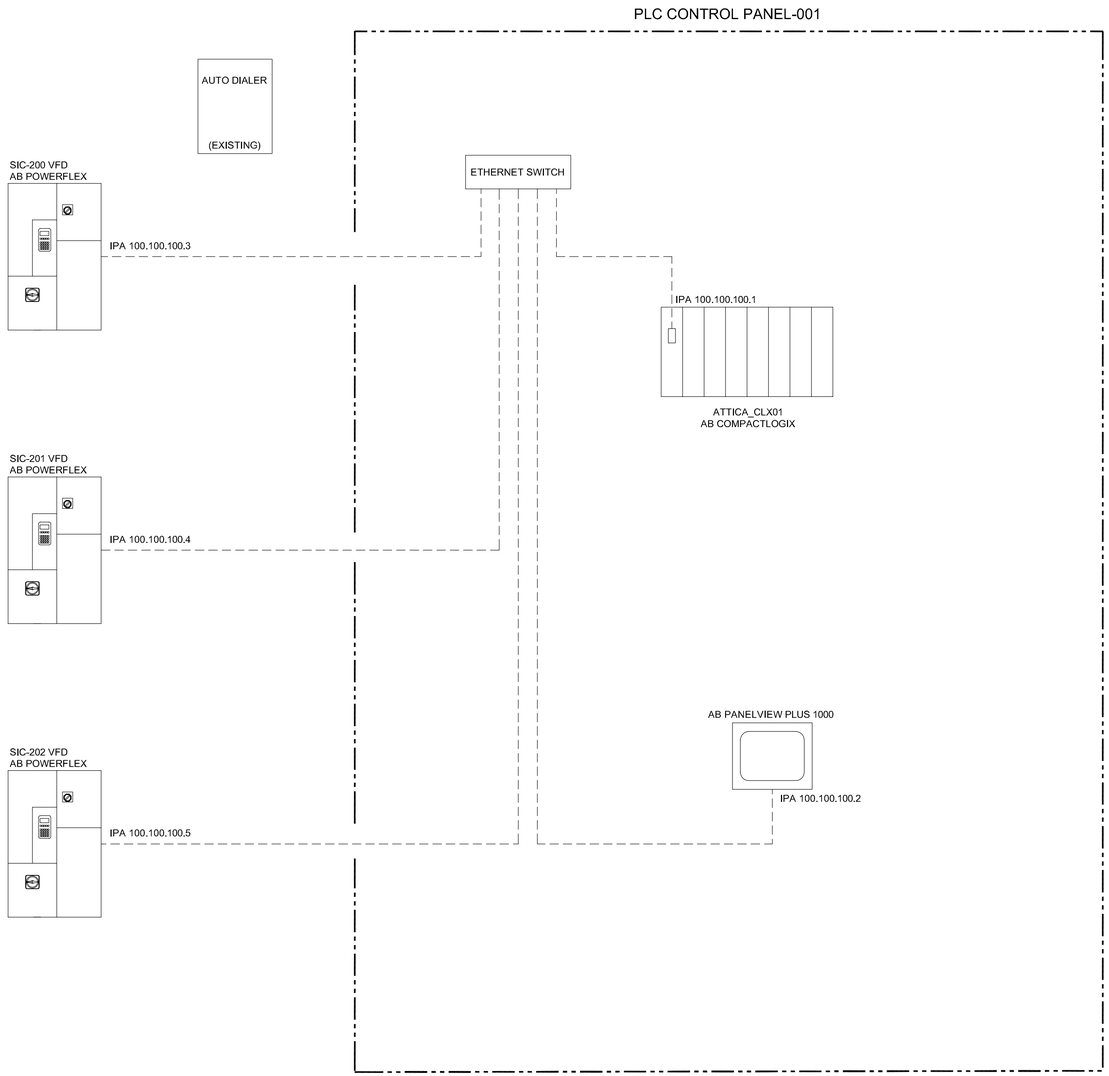
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING INSTRUMENTATION PLAN AND DETAILS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: B. ELKIN	Designed By: J. CASSIDY	Drawn By: J. PAUTLER
Scale: 3/8" = 1'-0"	Project No: 19190-03	Report No: 021	Drawing No: EL-06

19190-10(021)EL-BU007 NOV 17/2008



IP ADDRESS	100.100.100.XXX
SUBNET MASK	255.255.255.0
DEFAULT GATEWAY	NA

LEGEND

- - - - - - INDICATES CAT 5e EHTERNET CABLE (UNLESS MARKED OTHERWISE)

——————— INDICATES DF1 COMMUNICATION CABLE (UNLESS MARKED OTHERWISE)

REFERENCE DRAWINGS

EL-08 TREATMENT BUILDING PLC CONTROL PANEL-001 ARRANGEMENT

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

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CITY OF ATTICA
ATTICA, INDIANA

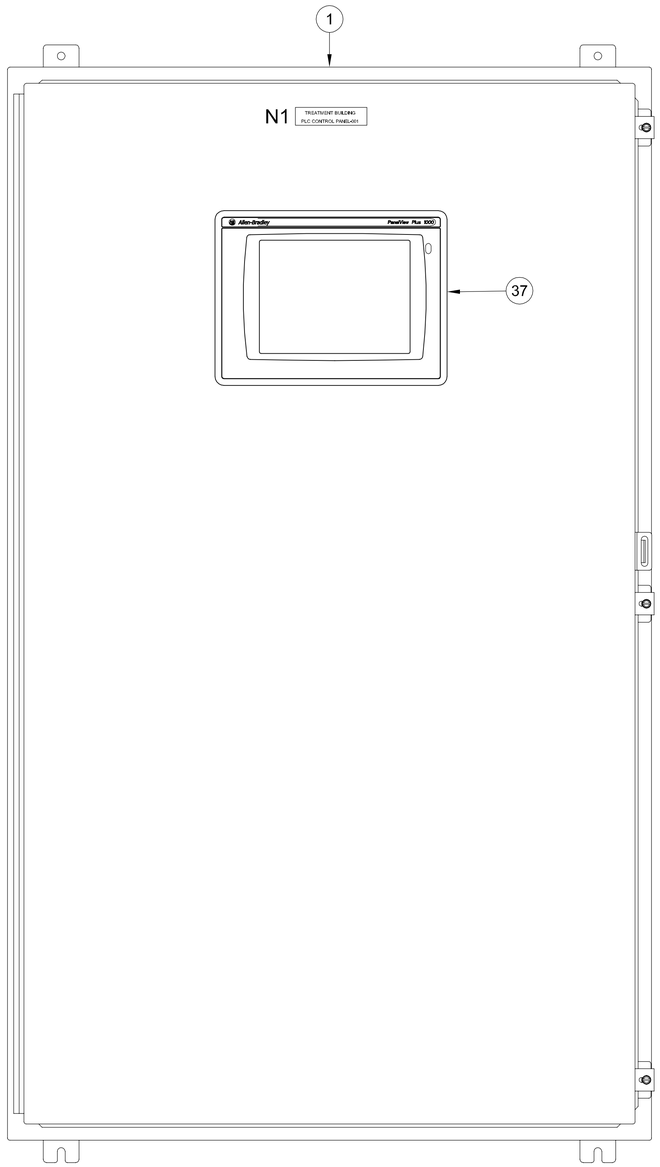
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
NETWORK ARCHITECTURE

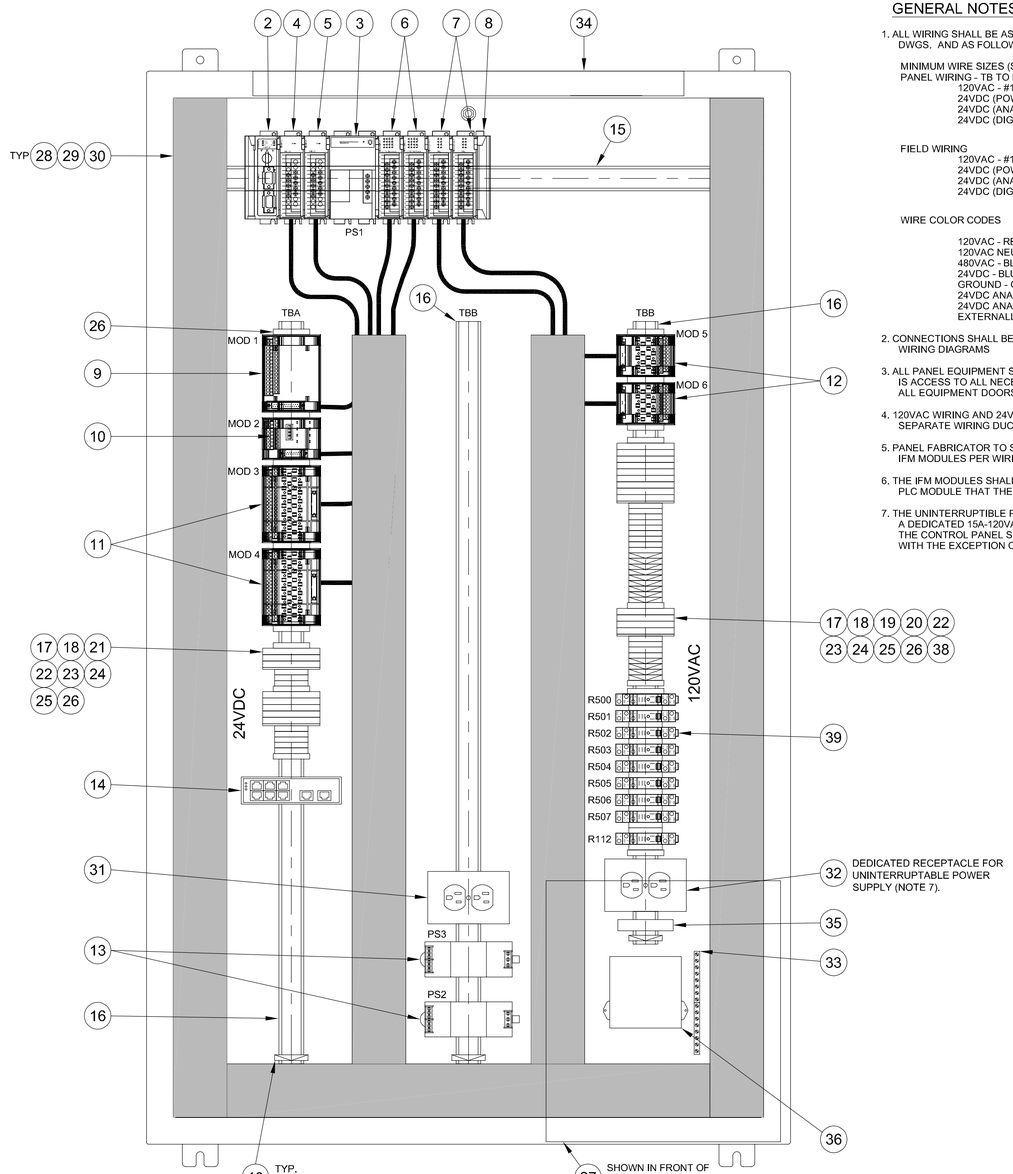
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. GEE	Designed By: J. EZAK	Drawn By: J. PAUTLER
Scale: NONE	Project No: 19190-03	Report No: 021	Drawing No: EL-07

19190-10(021)EL-BU008 SEP 24/2008



FRONT VIEW



FRONT VIEW
WITH DOOR REMOVED

NAMEPLATE ENGRAVING

N1	TREATMENT SYSTEM	4" x 1" WHITE SURFACE
	PLC CONTROL PANEL-001	3/16" HIGH BLACK LETTERING

GENERAL NOTES

1. ALL WIRING SHALL BE AS DIRECTED ON DWGS, AND AS FOLLOWS:

   MINIMUM WIRE SIZES (SIZE PER SCHEMATIC DIAGRAM)
   PANEL WIRING - TB TO PLC
   120VAC - #14 AWG MTW
   24VDC (POWER) - #18 AWG MTW
   24VDC (ANALOG) - 2/C#18 SHLD
   24VDC (DIGITAL) - 2/C#18 TW

   FIELD WIRING
   120VAC - #14 AWG MTW
   24VDC (POWER) - #16 AWG MTW
   24VDC (ANALOG) - 2/C#16 SHLD
   24VDC (DIGITAL) - 2/C#16 TW

   WIRE COLOR CODES

   120VAC - RED
   120VAC NEUTRAL - WHITE
   480VAC - BLACK
   24VDC - BLUE
   GROUND - GREEN
   24VDC ANALOG (+) - RED
   24VDC ANALOG (-) - BLACK
   EXTERNALLY POWERED AC CONTROL- YELLOW

2. CONNECTIONS SHALL BE MADE TO DEVICES PER SCHEMATIC WIRING DIAGRAMS
3. ALL PANEL EQUIPMENT SHALL BE INSTALLED SO THAT THERE IS ACCESS TO ALL NECESSARY COMPONENTS AND SO THAT ALL EQUIPMENT DOORS CAN OPEN 90°.
4. 120VAC WIRING AND 24VDC WIRING SHALL BE ROUTED IN SEPARATE WIRING DUCT.
5. PANEL FABRICATOR TO SUPPLY AND INSTALL ALL FUSING FOR IFM MODULES PER WIRING DIAGRAMS PLUS 10% SPARE.
6. THE IFM MODULES SHALL BE LABELLED PER WHICH PLC MODULE THAT THEY ARE CONNECTED TO.
7. THE UNINTERRUPTIBLE POWER SUPPLY SHALL BE FED FROM A DEDICATED 15A-120VAC POWER SOURCE, ALL EQUIPMENT IN THE CONTROL PANEL SHALL BE POWERED FROM THE UPS, WITH THE EXCEPTION OF THE CONTROL PANEL RECEPTACLE.

BILL OF MATERIAL

ITEM	NO.	DESCRIPTION
1	1	HOFFMAN NEMA 12 ENCLOSURE 60"H x 48W x 12"D CAT. #A604812LP W/PANEL A60P48
2	1	ALLEN-BRADLEY COMPACTLOGIX PROCESSOR CAT. #1769-L32E W/ COMPACT FLASH 1784-CF64
3	1	ALLEN-BRADLEY COMPACTLOGIX POWER SUPPLY CAT. #1769-PA4
4	1	ALLEN-BRADLEY COMPACTLOGIX ANALOG INPUT MODULE CAT. #1769-IF8
5	1	ALLEN-BRADLEY COMPACTLOGIX ANALOG OUTPUT MODULE CAT. #1769-OF4CI
6	2	ALLEN-BRADLEY COMPACTLOGIX DIGITAL INPUT MODULE CAT. #1769-IQ16
7	2	ALLEN-BRADLEY COMPACTLOGIX RELAY OUTPUT MODULE CAT. #1769-OW8I
8	1	ALLEN-BRADLEY COMPACTLOGIX RIGHT END CAP CAT. #1769-ECR
9	1	ALLEN-BRADLEY INTERFACE MODULE CAT. #1492-AIFM8-3 WITH CABLE #1492-ACAB005ED69 (FOR IF8 MODULE)
10	1	ALLEN-BRADLEY INTERFACE MODULE CAT. #1492-AIFM4-3 WITH CABLE #1492-ACAB005BD69 (FOR OF4CI MODULE)
11	2	ALLEN-BRADLEY INTERFACE MODULE CAT. #1492-IFM20F-F24A-2 WITH CABLE #1492-CAB010B69 (FOR IQ16 MODULE)
12	2	ALLEN-BRADLEY INTERFACE MODULE CAT. #1492-IFM20F-FS120-2 WITH CABLE #1492-CAB005D69 (FOR OW8I MODULE)
13	2	SOLA HEVI-DUTY 24VDC POWER SUPPLY, 2.5A CAT. #SDN 2.5-24-100P
14	1	BRAD COMMUNICATIONS (WOODHEAD) ETHERNET SWITCH CAT. #DRL-380
15	2'-6"	ALLEN-BRADLEY DIN MOUNTING RAIL CAT. #199-DR1
16	10'-0"	ALLEN-BRADLEY DIN MOUNTING RAIL CAT. #1492-DR6
17	31	ALLEN-BRADLEY IEC FEED-THROUGH TERMINAL BLOCK CAT. #1492-J6
18	2	ALLEN-BRADLEY TERMINAL BLOCK END BARRIER CAT. #1492-EBJ3
19	13	ALLEN-BRADLEY GROUNDING TERMINAL BLOCK CAT. #1492-JG6
20	10	ALLEN-BRADLEY FUSE TERMINAL BLOCK CAT. #1492-H4
21	8	ALLEN-BRADLEY FUSE TERMINAL BLOCK CAT. #1492-H5
22	4	ALLEN-BRADLEY FUSE TERMINAL END BARRIER CAT. #1492-N37
23	27	FUSE ELEMENTS - LITTLEFUSE OR EQUAL SEE SCHEMATIC DIAGRAMS FOR FUSE SIZE
24	2	ALLEN-BRADLEY TERMINAL GROUP MARKER CAT. #1492-GM35
25	2	ALLEN-BRADLEY TERMINAL MARKER (1-100) CAT. #1492-SM8X12H1-100
26	16	ALLEN-BRADLEY END ANCHOR CAT. #1492-EA35
27	1	APC UNTERRUPTIBLE POWER SUPPLY 1500VA 120VAC CAT. #BR1500
28	19'-0"	WIREWAY MODULAR WIRING DUCT COVER 3" CAT. #C37
29	19'-0"	WIREWAY MODULAR WIRING DUCT 3" BASE CAT. #B37
30	19'-0"	WIREWAY MODULAR WIRING DUCT SIDE 4" BASE CAT. #S47AB
31	1	HUBBELL DIN RAIL BOX W/GFR5252GYA GROUND FAULT RECEPTACLE CAT. #DRUBGFI15
32	1	HUBBELL DIN RAIL BOX W/CR5252GY RECEPTACLE CAT. #DRUB15
33	2	SQUARE-D GROUND BAR KIT CAT. #PK6GTA6
34	1	HOFFMAN FLUORESCENT LIGHT FIXTURE CAT. #ALF16D24R
35	1	ALLEN-BRADLEY RELAY W/ SOCKET, 120VAC COIL CAT. #700-HP32A1 W/ SOCKET #700-HN123
36	1	NORTHERN TECHNOLOGIES SURGE ARRESTER CAT. #TCS-HWR
37	1	ALLEN-BRADLEY PANELVIEW PLUS 1000 DISPLAY (10.4 IN.) CAT. #2711P-T10C4D2
38	2	ALLEN-BRADLEY TERMINAL BLOCK END BARRIER CAT. #1492-EB10-Y
39	9	ALLEN-BRADLEY SOCKET BASE, RELAY, SCREW TERMINAL (120VAC) CAT. #700-HN121 W/ RELAY CAT. #700-HK36A1
40	5	ATIVA ETHERNET CAT 5e CABLE (NOT SHOWN) LENGTH TO FIT

REFERENCE DRAWINGS

EL-07 TREATMENT BUILDING NETWORK ARCHITECTURE
EL-11 PLC CONTROL PANEL PLC CONTROL PANEL WIRING DIAGRAM

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial
C	ISSUED FOR 100% DESIGN	1/30/09	JJ
B	ISSUED FOR 95% DESIGN	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW	9/26/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

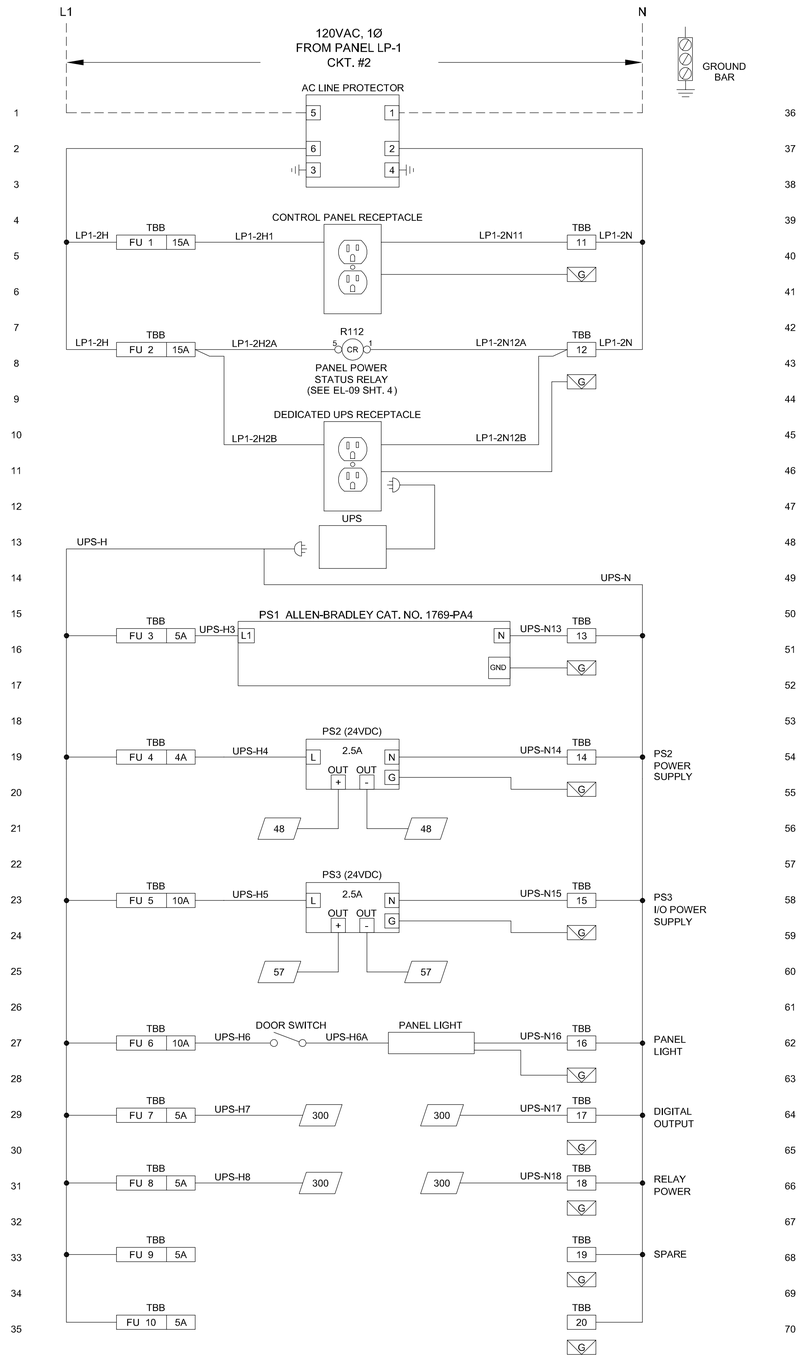
CITY WATER TREATMENT SYSTEM

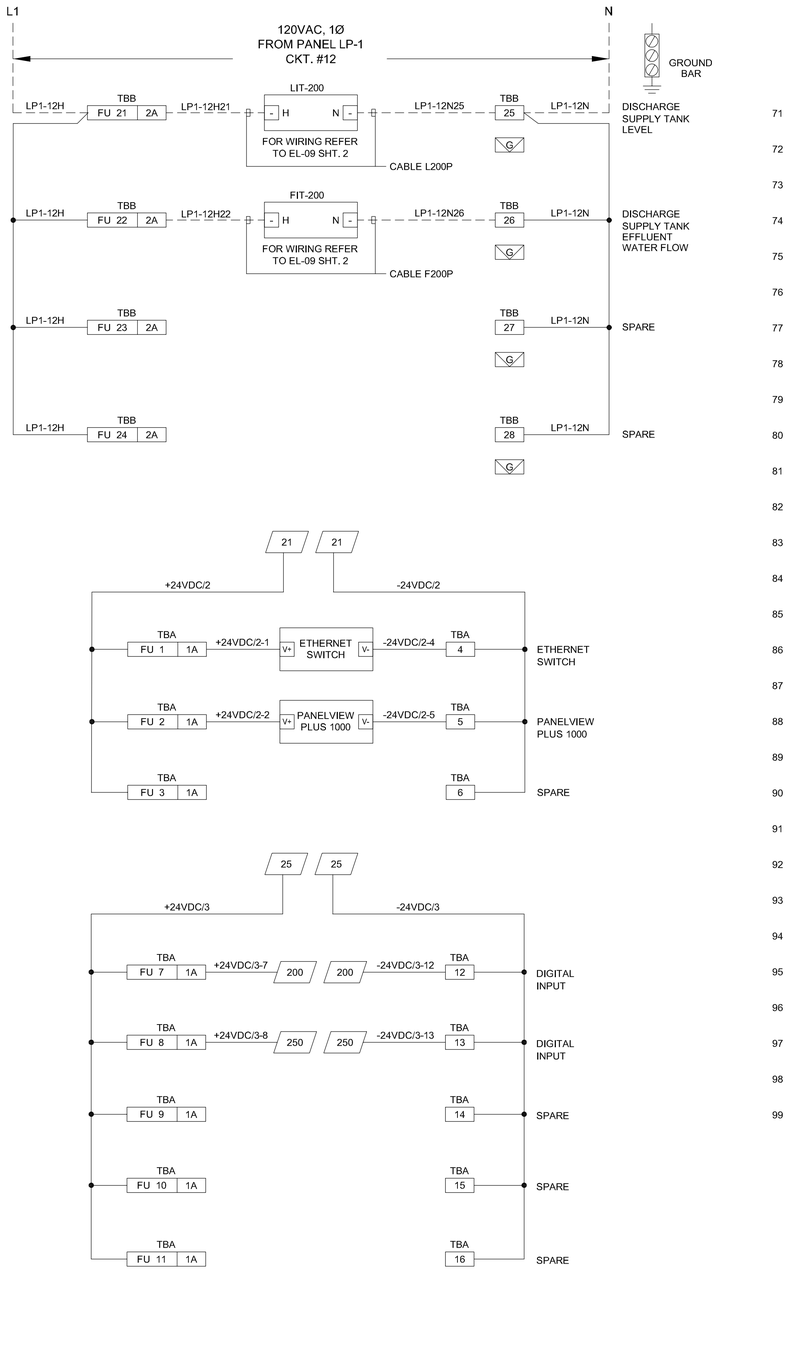
TREATMENT BUILDING
PLC CONTROL PANEL-001 ARRANGEMENT

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. GEE	Designed By: J. EZAK	Drawn By: J. PAUTLER
Scale: 1 1/2" = 1'-0"	Project No: 19190-03	Report No: 021	Drawing No: EL-08

19190-10(021)EL-BU009 SEP 25/2008





REFERENCE DRAWINGS

EL-08 PLC CONTROL PANEL-001 ARRANGEMENT
EL-11 SCHEMATIC/WIRING DIAGRAMS

LEGEND

- - - - - INDICATES EXTERNAL TO CONTROL PANEL WIRING
——— INDICATES PLC WIRING

NOTES

1. REFER TO DRAWING EL-08 FOR WIRE SIZE AND COLOR CODE.

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

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CITY OF ATTICA
ATTICA, INDIANA

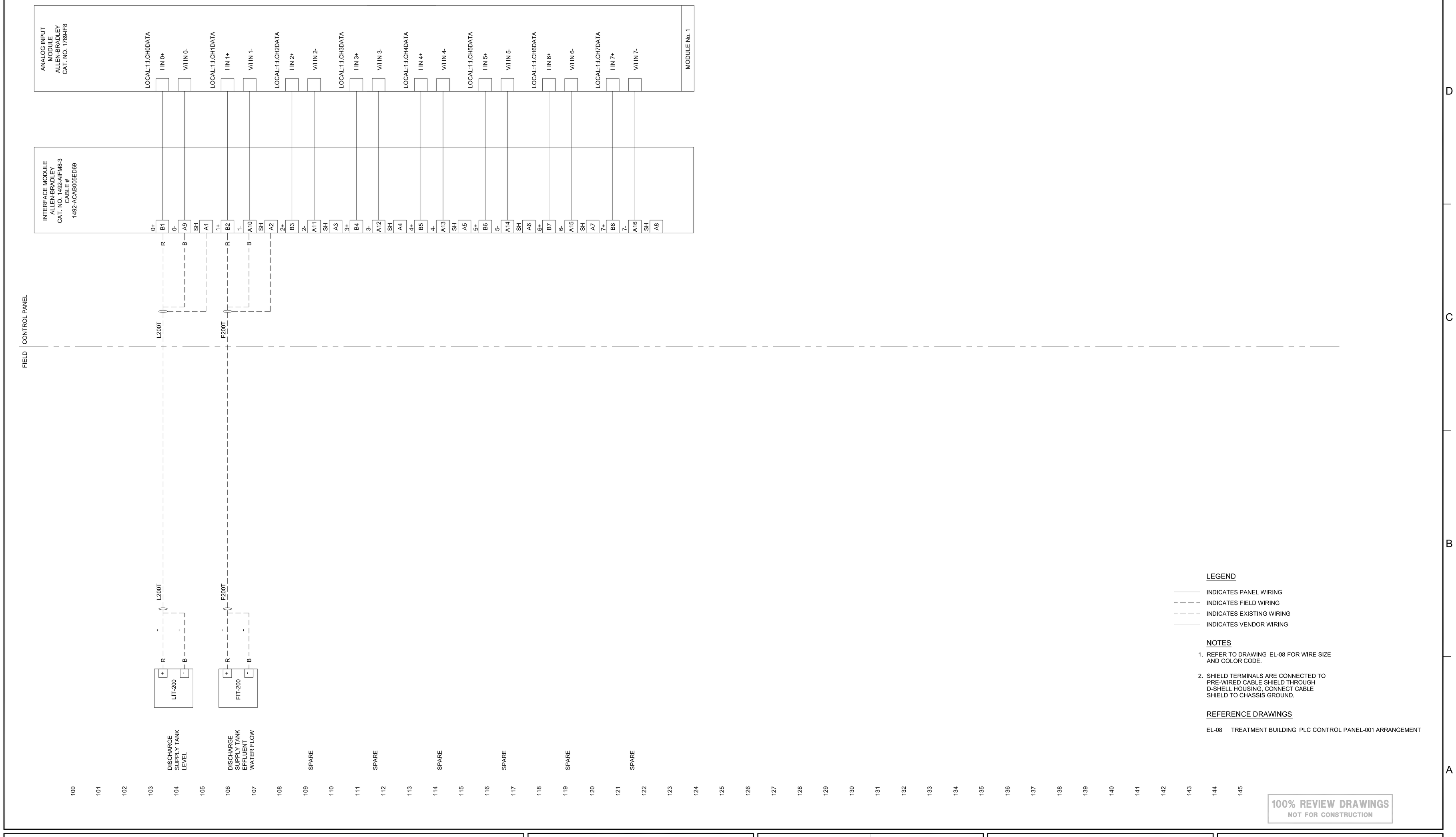
CITY WATER TREATMENT SYSTEM

PLC CONTROL PANEL
POWER DISTRIBUTION DIAGRAM

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. GEE	Designed By: J. EZAK	Drawn By: J. PAUTLER
Scale: NONE	Project No: 19190-03	Report No: 021	Drawing No: EL-09 SHT. 1

19190-10(021)EL-BU010 SEP 25/2008



LEGEND

- INDICATES PANEL WIRING
- INDICATES FIELD WIRING
- INDICATES EXISTING WIRING
- INDICATES VENDOR WIRING

NOTES

1. REFER TO DRAWING EL-08 FOR WIRE SIZE AND COLOR CODE.
2. SHIELD TERMINALS ARE CONNECTED TO PRE-WIRED CABLE SHIELD THROUGH D-SHELL HOUSING. CONNECT CABLE SHIELD TO CHASSIS GROUND.

REFERENCE DRAWINGS

EL-08 TREATMENT BUILDING PLC CONTROL PANEL-001 ARRANGEMENT

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

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CITY OF ATTICA
ATTICA, INDIANA

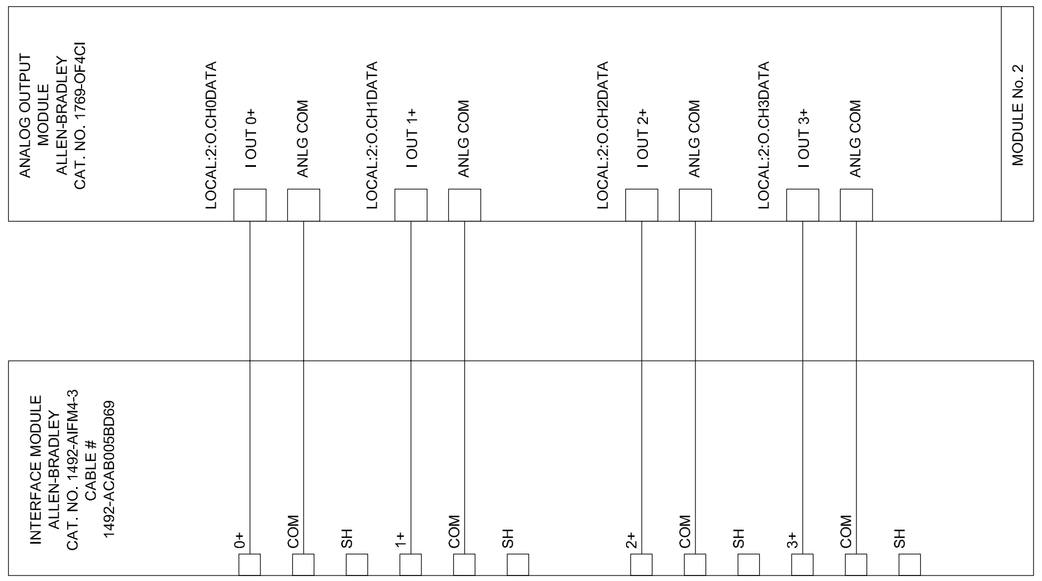
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING PLC CONTROL PANEL WIRING DIAGRAM

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. GEE	Designed By: J. EZAK	Drawn By: J. PAUTLER
Scale: NONE	Project No: 19190-03	Report No: 021	Drawing No: EL-09 SHT. 2

19190-10(021)EL-BU011 SEP 24/2008



FIELD | CONTROL PANEL

SPARE SPARE SPARE SPARE

150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194

LEGEND

- INDICATES PANEL WIRING
- INDICATES FIELD WIRING
- INDICATES EXISTING WIRING
- INDICATES VENDOR WIRING

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CITY OF ATTICA
ATTICA, INDIANA

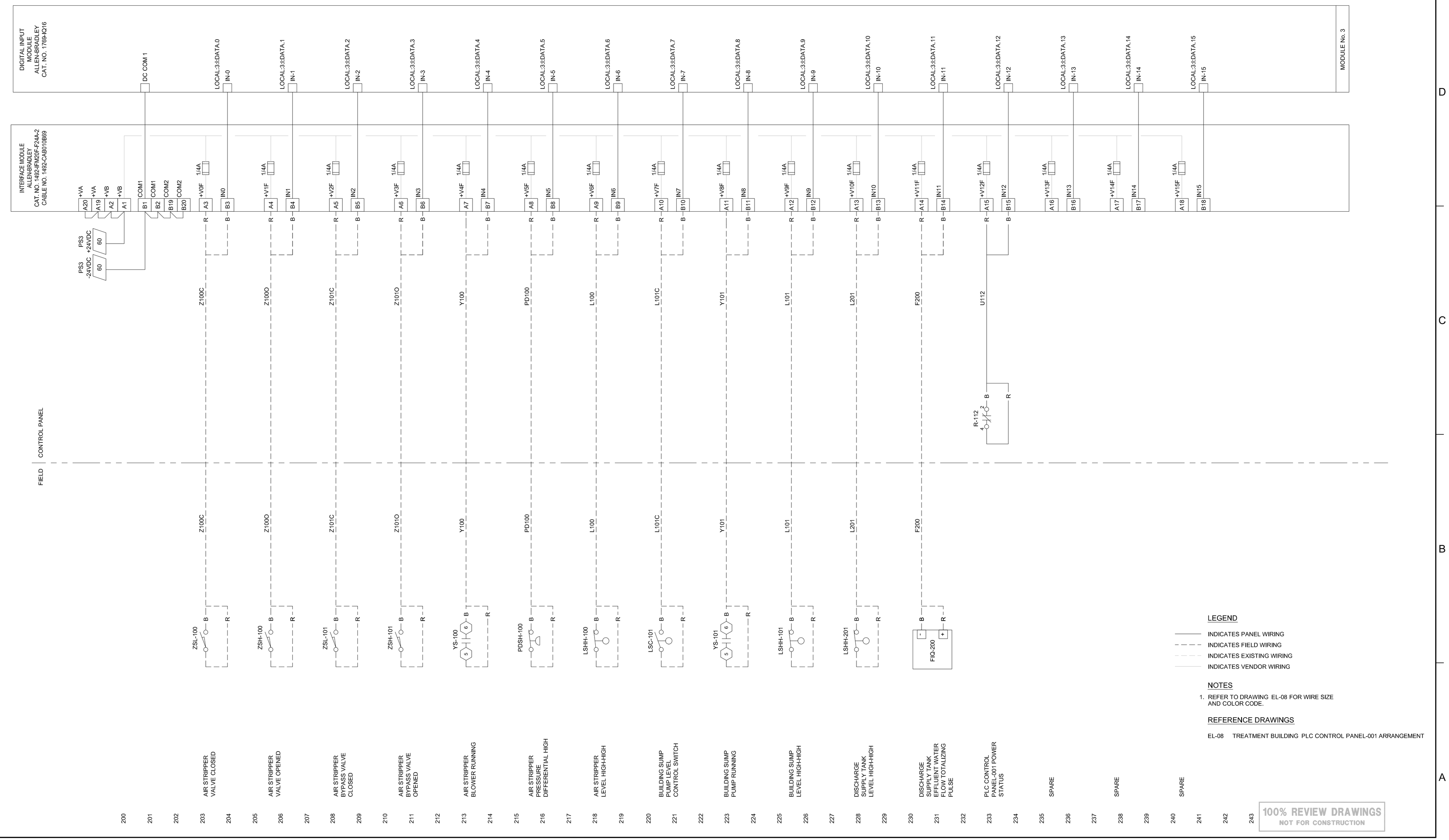
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
PLC CONTROL PANEL WIRING DIAGRAM

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. GEE	Designed By: J. EZAK	Drawn By: J. PAUTLER
Scale: NONE	Project No: 19190-03	Report No: 021	Drawing No: EL-09 SHT. 3

19190-10(021)EL-BU012 SEP 24/2008



LEGEND

- INDICATES PANEL WIRING
- INDICATES FIELD WIRING
- INDICATES EXISTING WIRING
- INDICATES VENDOR WIRING

NOTES

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EL-08 TREATMENT BUILDING PLC CONTROL PANEL-001 ARRANGEMENT

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CITY OF ATTICA
ATTICA, INDIANA

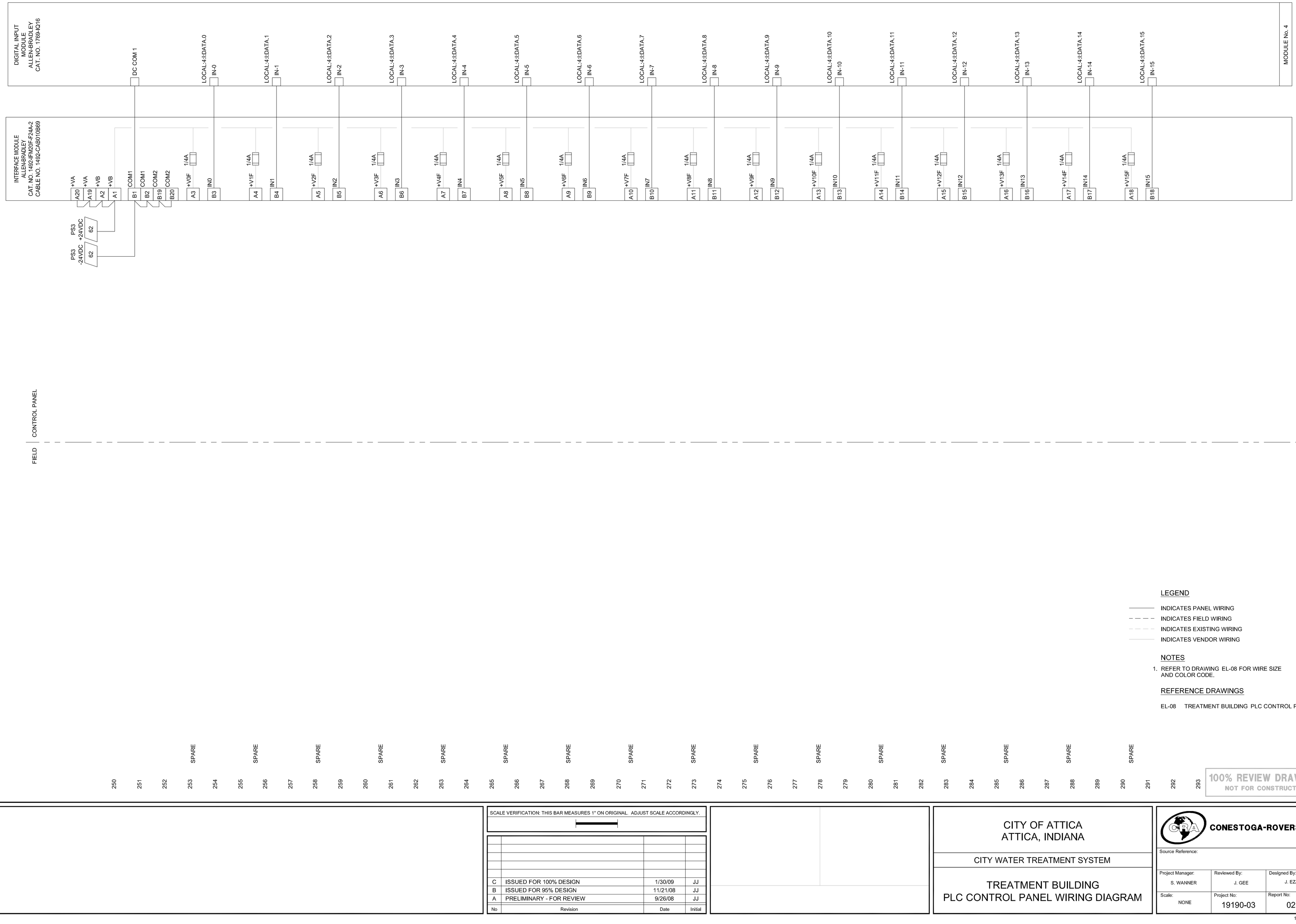
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
PLC CONTROL PANEL WIRING DIAGRAM

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. GEE	Designed By: J. EZAK	Drawn By: J. PAUTLER
Scale: NONE	Project No: 19190-03	Report No: 021	Drawing No: EL-09 SHT. 4

19190-10(021)EL-BU013 SEP 25/2008



LEGEND

- INDICATES PANEL WIRING
- INDICATES FIELD WIRING
- INDICATES EXISTING WIRING
- INDICATES VENDOR WIRING

NOTES

1. REFER TO DRAWING EL-08 FOR WIRE SIZE AND COLOR CODE.

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EL-08 TREATMENT BUILDING PLC CONTROL PANEL-001 ARRANGEMENT

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CITY OF ATTICA
ATTICA, INDIANA

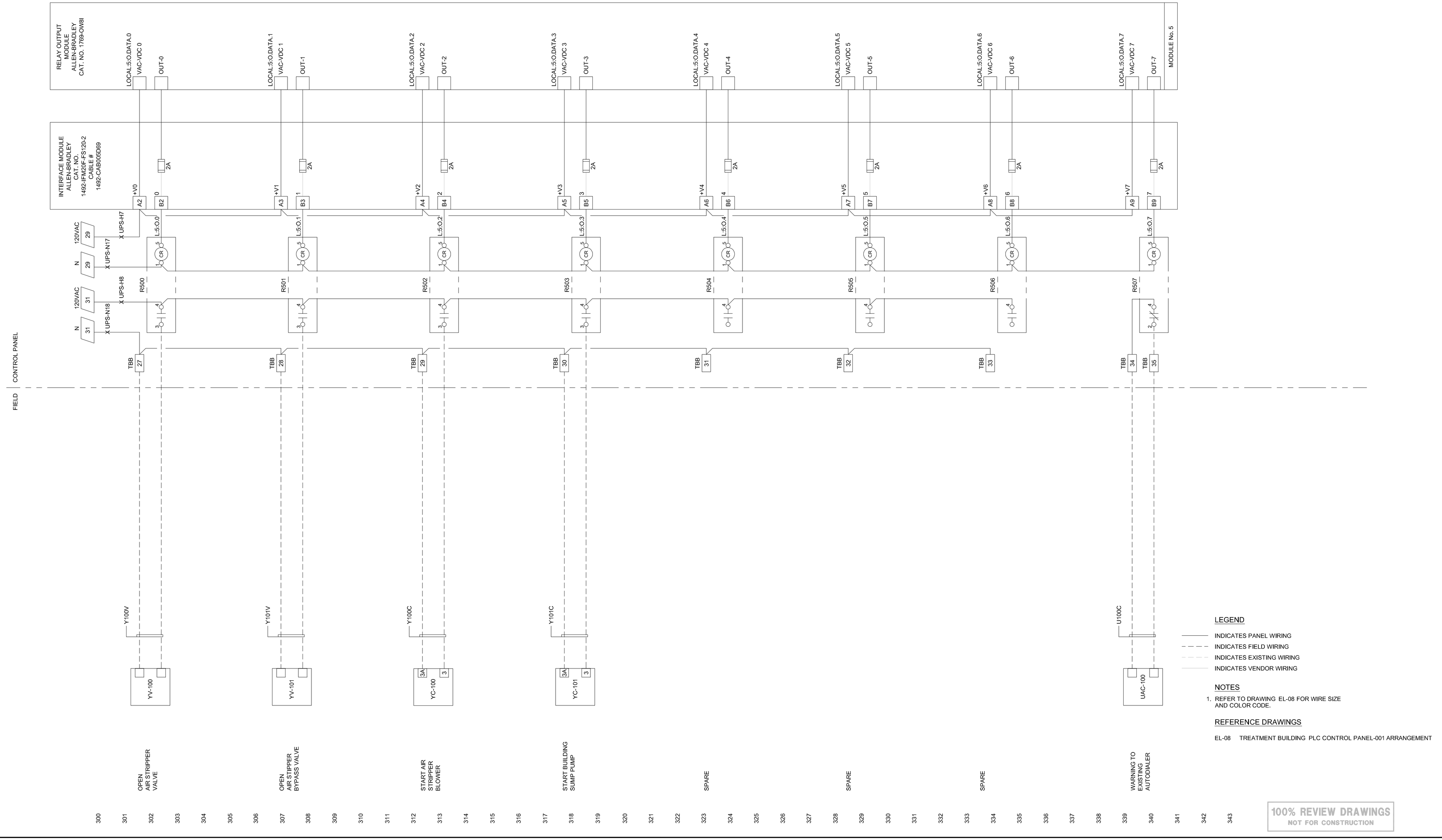
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
PLC CONTROL PANEL WIRING DIAGRAM

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. GEE	Designed By: J. EZAK	Drawn By: J. PAUTLER
Scale: NONE	Project No: 19190-03	Report No: 021	Drawing No: EL-09 SHT. 5

19190-10(021)EL-BUI014 SEP 25/2008



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B	ISSUED FOR 95% DESIGN	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW	9/26/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

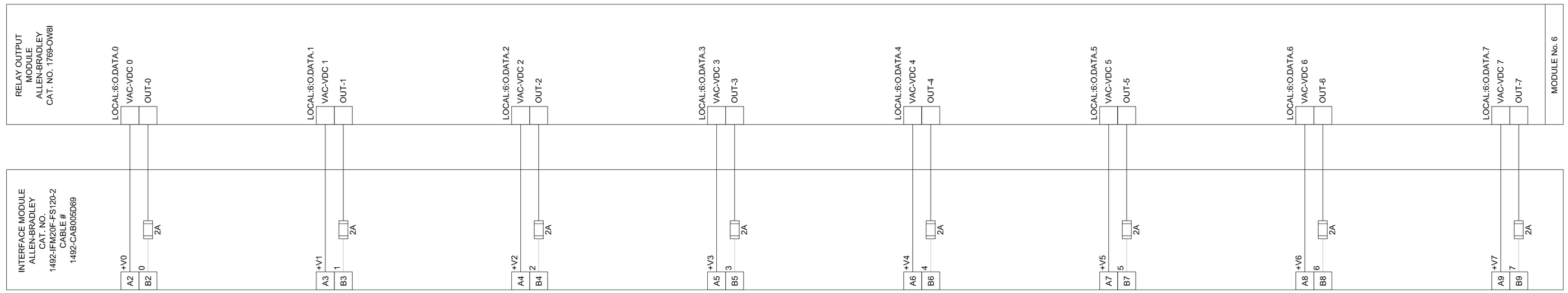
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING PLC CONTROL PANEL WIRING DIAGRAM

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. GEE	Designed By: J. EZAK	Drawn By: J. PAUTLER
Scale: NONE	Project No: 19190-03	Report No: 021	Drawing No: EL-09 SHT. 6

19190-10(021)EL-BU015 SEP 25/2008



FIELD | CONTROL PANEL

SPARE 350 351 352 353 354 355 356 SPARE 357 358 359 360 361 SPARE 362 363 364 365 366 SPARE 367 368 369 370 371 372 SPARE 373 374 375 376 377 SPARE 378 379 380 381 382 383 SPARE 384 385 386 387 388 SPARE 389 390 391 392 393

LEGEND

INDICATES PANEL WIRING
INDICATES FIELD WIRING
INDICATES EXISTING WIRING
INDICATES VENDOR WIRING

NOTES

1. REFER TO DRAWING EL-08 FOR WIRE SIZE AND COLOR CODE.

REFERENCE DRAWINGS

EL-08 TREATMENT BUILDING PLC CONTROL PANEL-001 ARRANGEMENT

100% REVIEW DRAWINGS
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CITY OF ATTICA
ATTICA, INDIANA

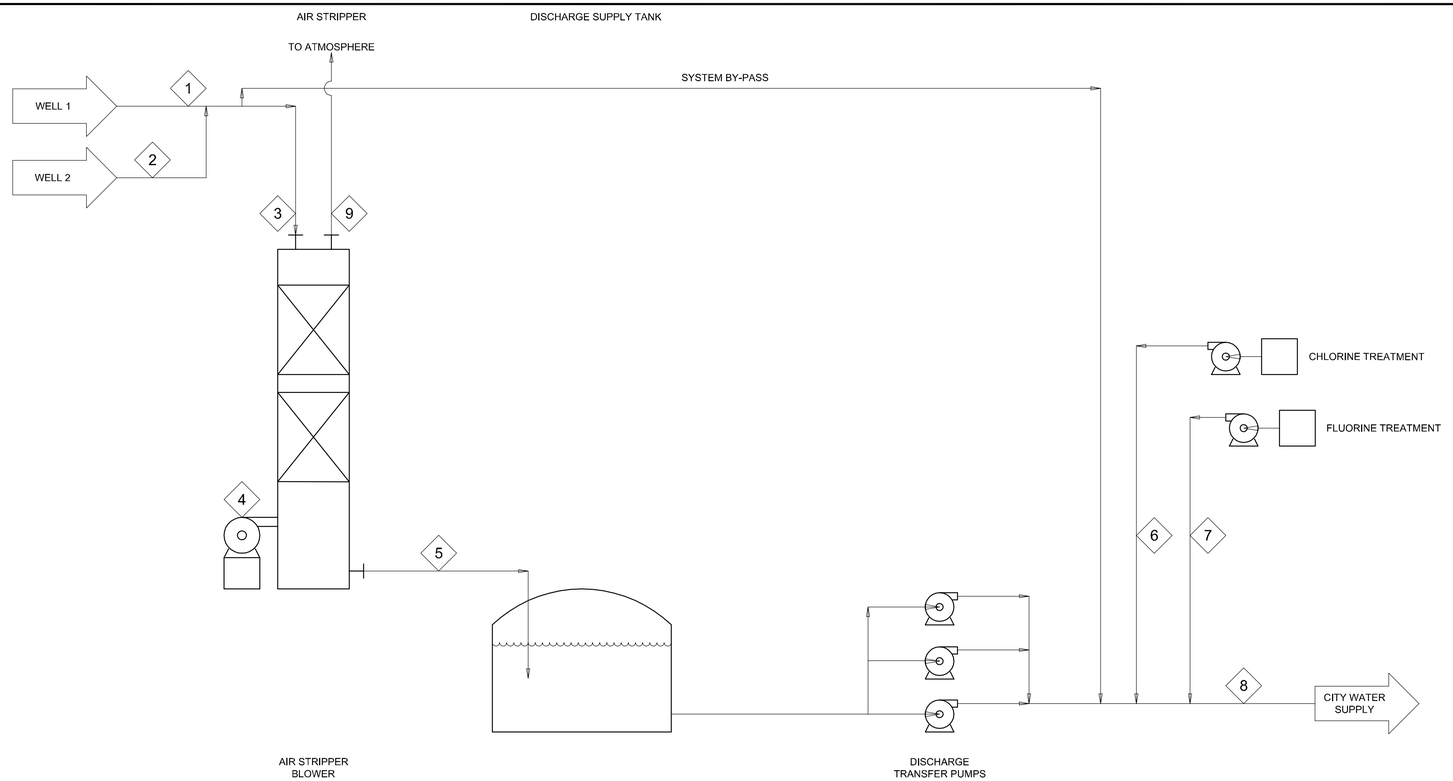
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
PLC CONTROL PANEL WIRING DIAGRAM

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. GEE	Designed By: J. EZAK	Drawn By: J. PAUTLER
Scale: NONE	Project No: 19190-03	Report No: 021	Drawing No: EL-09 SHT. 7

19190-10(021)EL-BU016 AUG 12/2008



MATERIAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
TRICHLOROETHYLENE (LBS. / DAY)	0.120 (10 ppb)	0.120 (10 ppb)	0.240 (10 ppb)	ND	0.012 (0.5 ppb)	ND	ND	0.012 (0.5 ppb)	0.228																
CHLORINE	ND	ND	ND	ND	ND				ND																
FLUORINE	ND	ND	ND	ND	ND				ND																
WATER (LBS/DAY)	11952000	11952000	23904000	-	23904000			23904000	-																
WATER (GPM)	1000	1000	2000	-	2000			2000	-																
AIR (LBS/DAY)				1155600					1155600																
AIR (CFM)				107000					107000																

LEGEND

- STREAM NUMBER
- GPM
- POUNDS/HR.
- SCFM
- TEMPERATURE F
- PSIA

MATERIAL BALANCE FIGURES IN:
POUNDS PER DAY WITH DESIGN CAPACITY OF 2000 GALLONS / MINUTE AT 24 HOURS / DAY

ND (< 5 ppb>

INFLUENT CONCENTRATION WERE BASED ON MAXIMUM LOADING OF 0.240 LBS/DAY OR 10 ppb

No	Revision	Date	Initial
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B	ISSUED FOR 95% REVIEW	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW		

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

CITY OF ATTICA
ATTICA, INDIANA

CITY WATER TREATMENT SYSTEM

PROCESS FLOW SHEET

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: MAY 2008
Project Manager: SW	Reviewed By: JJJ	Designed By: JJJ	Drawn By: B. SUCHAN
Scale: NONE	Project No: 19190-10	Report No: 021	Drawing No: PF-01

19190-03(021)PF-BU001 NOV 21/2008

PROCESS / INSTRUMENT LINES

- MAIN PROCESS LINE
- SECONDARY PROCESS LINE
- UNDEFINED SIGNAL
- PNEUMATIC SIGNAL
- ELECTRICAL SIGNAL
- CAPILLARY TUBE, FILLED SYSTEM
- ELECTROMAGNETIC OR SONIC SIGNAL (GUIDED)
- ELECTROMAGNETIC OR SONIC SIGNAL (NOT GUIDED)
- INTERNAL SYSTEM LINK
- HYDRAULIC SIGNAL
- MECHANICAL LINK
- ELECTRICAL BINARY SIGNAL
- TO / FROM SHEET No. — OFF PAGE CONNECTOR
- UTILITY — UTILITY IN/OUT
- 2 / I — HARDWIRED INTERLOCK LOGIC (-1,2,3...IS OPTIONAL REFERENCE TO INTERLOCK DETAIL DESCRIPTION)

VALVE SYMBOLS

- BA- " — BALL VALVE
- BU- " — BUTTERFLY VALVE
- CH- " — CHECK VALVE
- GA- " — GATE VALVE
- GL- " — GLOBE VALVE
- THREE WAY VALVE (FAIL OPEN TO PATH A-C)
- FOUR WAY VALVE (FAIL OPEN TO PATH A-C AND B-D)
- DAMPER OR LOUVER

GENERAL INSTRUMENT SYMBOLS

- LOCALLY MOUNTED INSTRUMENTS
- PRIMARY PANEL MOUNTED INSTRUMENTS
- IPx — AUXILARY PANEL MOUNTED INSTRUMENTS WHERE x = PANEL No. WHEN MORE THAN ONE PANEL IS PRESENT
- BEHIND BOARD MOUNTED INSTRUMENTS
- INSTRUMENTS SHARING COMMON HOUSING
- IN LINE INSTRUMENTS AS INDENTIFIED
- XY — SIGNAL CONVERTER (INPUT/OUTPUT)
  - * E - VOLTAGE, I - CURRENT, P - PNEUMATIC, B - BINARY (MODBUS, R5232...)
- COLOR — PILOT LIGHT
  - A = AMBER, B = BLUE, C = CLEAR, G = GREEN, R = RED, W = WHITE, Y = YELLOW

DISTRIBUTED CONTROL / SHARED DISPLAY INSTRUMENTS

- INDICATOR/CONTROLLER/RECORDER OR ALARM POINTS - USUALLY USED TO INDICATE VIDEO DISPLAY (DCS OR HMI CONFIGURATIONS) * NORMALLY ACCESSIBLE TO OPERATOR
- NORMALLY BLIND OPERATION * NOT NORMALLY ACCESSIBLE TO OPERATOR
- DISTRIBUTED CONTROL INTERCONNECTING LOGIC CONTROLLER OR PLC WITH BINARY OR SEQUENTIAL LOGIC FUNCTIONS. * NORMALLY ACCESSIBLE TO OPERATOR

- NORMALLY BLIND OPERATION * NOT NORMALLY ACCESSIBLE TO OPERATOR
- 1 / PLCx — INTERLOCK LOGIC IN CONTROLLER OR PLC WHERE: - 1,2,3.....IS OPTIONAL REFERENCE TO INTERLOCK DETAIL DESCRIPTION - x = PLC No. WHEN MORE THAN ONE PLC IS PRESENT IN THE SYSTEM

MISCELLANEOUS SYMBOLS

- REDUCER
- FLEXIBLE PIPE EXPANSION JOINT
- BLIND FLANGE
- HOSE CONNECTION
- SCREWED CAP, CLEANOUT
- Y-LINE STRAINER
- SPECIFICATION CHANGE
- FUNNEL DRAIN
- STATIC MIXER
- FILTER/REGULATOR/LUBRICATOR
- ANNUNCIATOR HORN
- FILTER/REGULATOR
- X" — EQUIPMENT INSULATED WITH X" OF INSULATION
- R — RESET FOR LATCH-TYPE ACTUATOR
- VENT — OPEN VENT TO ATMOSPHERE
- INLINE BLANK
- RESTRICTION ORIFICE
- AIR EJECTOR
- T — TRAP
- PULSATION DAMPER
- BB — BLOCK & BLEED ASSEMBLY
- TP 1 — TIE POINT TO EXISTING SYSTEM
- DRAIN (FLOOR, SEWER, ETC.)
- FLOW STRAIGHTENING VANE
- SP 4 — SPECIALITY PART
- AV — AIR VENT, AUTOMATIC
- SLUICE GATES
- AIR FILTER

SELF-ACTUATED REGULATORS, VALVES, AND OTHER DEVICES

- PRESSURE RELIEF VALVE
- VACUUM RELIEF VALVE
- PRESSURE REDUCING REGULATOR (SELF CONTAINED)
- BACKPRESSURE REGULATOR (SELF CONTAINED)

- V P — CONSERVATION VENT
- XF — FLAME ARRESTOR

PRIMARY ELEMENT SYMBOLS

- FI — VARIABLE AREA FLOWMETER
- PI — DIAPHRAM SEAL WITH PRESSURE LEAD LINE
- PI — DIAPHRAM SEAL (LINE-MOUNTED)
- TE RTD — TEMPERATURE ELEMENT WITH THERMOWELL (OPTIONAL ELEMENT DESCRIPTION RTD, TYPE K...)
- FG — FLOW SIGHT GLASS (LG - LEVEL SIGHT GLASS, SG - GENERAL SIGHT GLASS)
- LEVEL DEVICE, FLOAT TYPE

ACTUATOR SYMBOLS

- DIAPHRAM ACTUATOR
- CYLINDER ACTUATOR
- M — ROTARY MOTOR ACTUATOR
- S — SOLENOID ACTUATOR
- HAND ACTUATOR OR HANDWHEEL
- D — AIR ACTUATED VALVE W/POSITIONER OPTIONAL: D - DIRECT ACTING POSITIONER, R - REVERSE ACTING POSITIONER
- FC — VALVE FAIL SYMBOLS: FO - FAIL OPEN, FC - FAIL CLOSED, FL - FAIL LOCKED (LAST POSITION), FI - FAIL INDETERMINATE
- ZSL — LIMIT SWITCH ACTIVATED WHEN VALVE CLOSED (ZSH ACTIVATED WHEN VALVE OPEN)

ABBREVIATIONS:

POWER SUPPLY OR PURGE FLUID TYPES

AS - AIR SUPPLY
IA - INSTRUMENT AIR
PA - PLANT AIR
ES - ELECTRICAL SUPPLY
GS - GAS SUPPLY
HS - HYDRAULIC SUPPLY
NS - NITROGEN SUPPLY
SS - STEAM SUPPLY
WS - WATER SUPPLY

THE SUPPLY LEVEL MAY BE ADDED TO THE INSTRUMENT SUPPLY LINE, E.G., AG-100, A 100-PSI AIR SUPPLY; ES-24DC, A 24-VOLT DIRECT CURRENT POWER SUPPLY.

INSTRUMENTS:

HOA - HAND/OFF/AUTO
LOR - LOCAL/OFF/REMOTE
OPN - OPEN
CLS - CLOSE
SP - SETPOINT

INSTRUMENT / PROCESS LINES DESIGNATIONS

000	UNDERGROUND INSTRUMENTS
100	PROCESS INSTRUMENTS
200	VENDOR SUPPLIED INSTRUMENTS
300	UTILITY INSTRUMENTS
0000	UNDERGROUND LINES
1000	PROCESS LINES
2000	VENDOR SUPPLIED LINES
3000	UTILITY LINES
CS	CARBON STEEL PIPE
CSVD	CARBON STEEL VENT DUCT (12 GAUGE)
DVW	DRAIN VENT WASTE PIPE
HDPE	HIGH DENSITY POLYETHYLENE PIPE
KYA	KYNAR
PDE	CPVC, SOLID
PVC	POLYVINYL CHLORIDE PIPE SCHEDULE 40
PVE	POLYVINYL CHLORIDE PIPE SCHEDULE 80
PPL	POLYPROPYLENE LINED/LINED DUCTILE PIPE
SS	STAINLESS STEEL
TFD	TEFLON
B	BARE
I	INSULATED
J	JACKETED AND INSULATED
TE	ELECTRICALLY TRACED AND INSULATED

TYPICAL ISA LETTER COMBINATIONS

First-Letters	Initiating or Measured Variable	Controllers: Recording	Controllers: Indicating	Controllers: Blind	Controllers: Self-Actuated Control Valves	Readout Devices: Recording	Readout Devices: Indicating	Switches and Alarm Devices *: High **	Switches and Alarm Devices *: Low	Switches and Alarm Devices *: Comb	Transmitters: Recording	Transmitters: Indicating	Transmitters: Blind	Solenoids, Relays, Computing Devices	Primary Element	Test Point	Well or Probe	Viewing Device, Glass	Safety Device	Final Element
A	Analysis	ARC	AIC	AC		AR	AI	ASH	ASL	ASHL	ART	AIT	AT	AY	AE	AP	AW			AV
B	Burner/Combustion	BRC	BIC	BC		BR	BI	BSH	BSL	BSHL	BRT	BIT	BT	BY	BE		BW	BG		BZ
C	User's Choice																			
D	User's Choice																			
E	Voltage	ERC	EIC	EC		ER	EI	ESH	ESL	ESHL	ERT	EIT	ET	EY	EE					EZ
F	Flow Rate	FRC	FIC	FC	FCV, FICV	FR	FI	FSH	FSL	FSHL	FRT	FIT	FT	FY	FE	FP		FG		FV
FQ	Flow Quantity	FQRC	FQIC			FQR	FQI	FQSH	FQSL			FQIT	FQT	FQY	FQE					FQV
FF	Flow Ratio	FFRC	FFIC	FFC		FFR	FFI	FFSH	FFSL						FE					FFV
G	User's Choice																			
H	Hand		HIC	HC						HS										HV
I	Current	IRC	IIC			IR	II	ISH	ISL	ISHL	IRT	IIT	IT	IY	IE					IZ
J	Power	JRC	JIC			JR	JI	JSH	JSL	JSHL	JRT	JIT	JT	JY	JE					JV
K	Time	KRC	KIC	KC	KCV	KR	KI	KSH	KSL	KSHL	KRT	KIT	KT	KY	KE					KV
L	Level	LRC	LIC	LC	LCV	LR	LI	LSH	LSL	LSHL	LRT	LIT	LT	LY	LE		LW	LG		LV
M	User's Choice																			
N	User's Choice																			
O	User's Choice																			
P	Pressure/Vacuum	PRC	PIC	PC	PCV	PR	PI	PSH	PSL	PSHL	PRT	PIT	PT	PY	PE	PP			PSV, PSE	PV
PD	Pressure, Differential	PDRC	PDIC	PDC	PDCV	PDR	PDI	PDSH	PDSL		PDRT	PDIT	PDT	PDY	PE	PP				PDV
Q	Quantity	QRC	QIC			QR	QI	QSH	QSL	QSHL	QRT	QIT	QT	QY	QE					QZ
R	Radiation	RRC	RIC	RC		RR	RI	RSH	RSL	RSHL	RRT	RIT	RT	RY	RE		RW			RZ
S	Speed/Frequency	SRC	SIC	SC	SCV	SR	SI	SSH	SSL	SSHL	SRT	SIT	ST	SY	SE					SV
T	Temperature	TRC	TIC	TC	TCV	TR	TI	TSH	TSL	TSHL	TRT	TIT	TT	TY	TE	TP	TW		TSE	TV
TD	Temperature, Differential	TDRC	TDIC	TDC	TDCV	TDR	TDI	TDSH	TDSL		TDRT	TDIT	TDT	TDY	TE	TP	TW			TDV
U	Multivariable					UR	UI							UY						UV
V	Vibration/Machinery Analysis					VR	VI	VSH	VSL	VSHL	VRT	VIT	VT	VY	VE					VZ
W	Weight/Force	WRC	WIC	WC	WCV	WR	WI	WSH	WSL	WSHL	WRT	WIT	WT	WY	WE					WZ
WD	Weight/Force, Differential	WDRC	WDIC	WDC	WDCV	WDR	WDI	WDSH	WDSL		WDRT	WDIT	WDT	WDY	WE					WDZ
X	Unclassified																			
Y	Event/State/Presence		YIC	YC		YR	YI	YSH	YSL				YT	YY	YE					YZ
Z	Position/Dimension	ZRC	ZIC	ZC	ZCV	ZR	ZI	ZSH	ZSL	ZSHL	ZRT	ZIT	ZT	ZY	ZE					ZV
ZD	Gauging/Deviation	ZDRC	ZDIC	ZDC	ZDCV	ZDR	ZDI	ZDSH	ZDSL		ZDRT	ZDIT	ZDT	ZDY	ZDE					ZDV

Note: This table is not all-inclusive.

* A, alarm, the annunciating device, may be used in the same fashion as S, switch, the actuating device.

** The letters H and L may be omitted in the undefined case.

Other Possible Combinations:

FO (Restriction Orifice)
FRK, HIK (Control Stations)
LLH (Level Light High)
LCH (Level Control High)
KQI (Running Time Indicator)
HMS (Hand Momentary Switch)
LCL (Level Control Low)

IDENTIFICATION LETTERS

	FIRST-LETTER: MEASURED OR INITIATING VARIABLE	FIRST-LETTER: MODIFIER	SUCCEEDING-LETTERS: READOUT OR PASSIVE FUNCTION	SUCCEEDING-LETTERS: OUTPUT FUNCTION	SUCCEEDING-LETTERS: MODIFIER
A	Analysis		Alarm		
B	Burner/Combustion		User's Choice	User's Choice	User's Choice
C	User's Choice			Control	
D	User's Choice	Differential			
E	Voltage		Sensor (Primary Element)		
F	Flow Rate	Ratio (Fraction)			
G	User's Choice		Glass, Viewing Device		
H	Hand				High
I	Current (Electrical)		Indicate		
J	Power	Scan			
K	Time, Time Schedule	Time Rate of Change		Control Station	
L	Level		Light		Low
M	User's Choice	Momentary			Middle, Intermediate
N	User's Choice		User's Choice	User's Choice	User's Choice
O	User's Choice		Orifice, Restriction		
P	Pressure, Vacuum		Point (Test) Connection		
Q	Quantity	Integrate, Totalize			
R	Radiation		Record		
S	Speed, Frequency	Safety		Switch	
T	Temperature			Transmit	
U	Multivariable		Multifunction	Multifunction	Multifunction
V	Vibration, Machinery Analysis			Valve, Damper, Louver	
W	Weight, Force		Well		
X	Unclassified	X Axis	Unclassified	Unclassified	Unclassified
Y	Event, State, or Presence	Y Axis		Relay, Compute, Convert	
Z	Position, Dimension	Z Axis		Driver, Actuator, Unclassified Final Control Element	

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial
C	ISSUED FOR 100% DESIGN	1/30/09	JJ
B	ISSUED FOR 95% DESIGN	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW	9/26/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

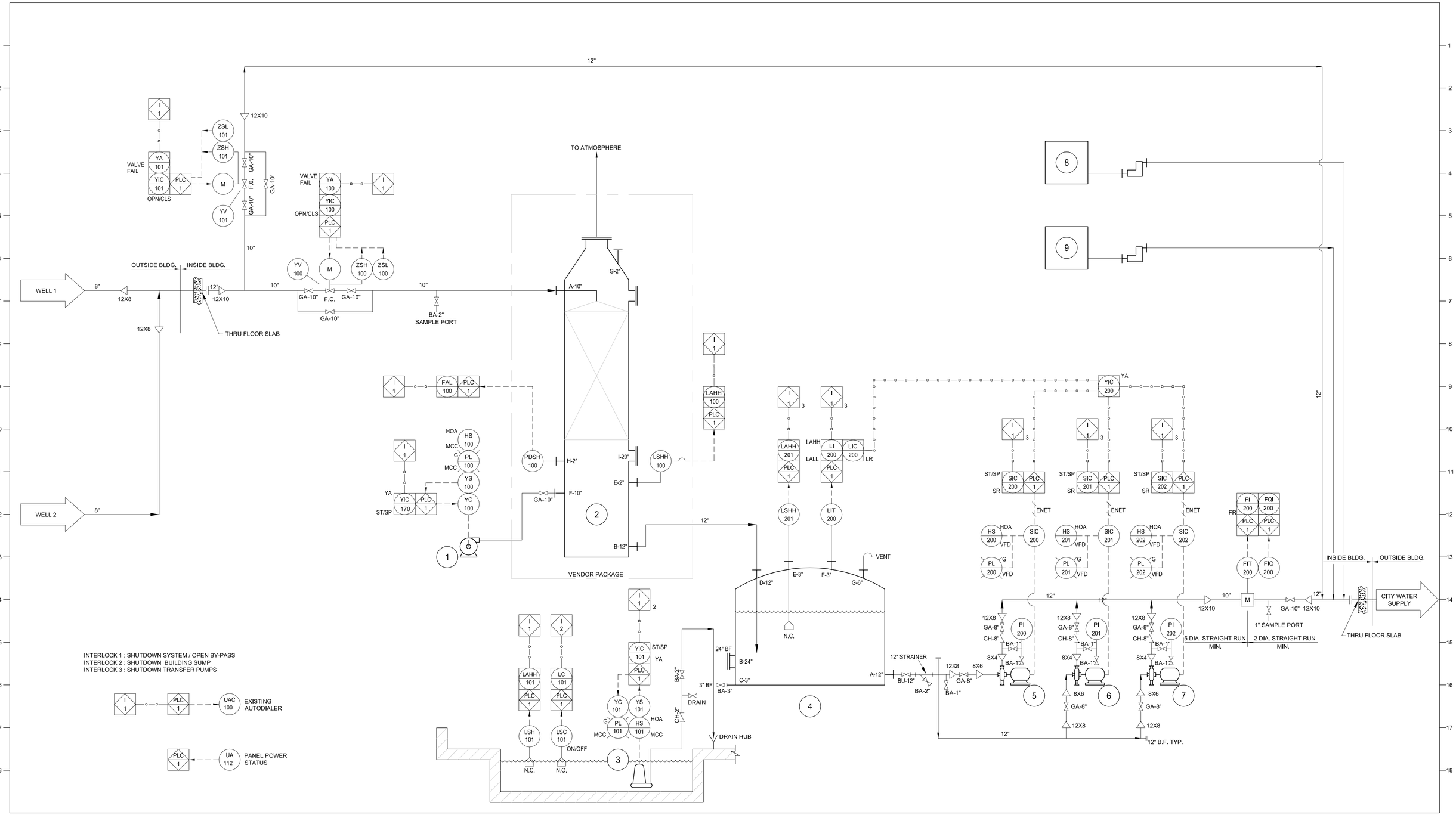
CITY WATER TREATMENT SYSTEM

LEGEND
ENGINEERING FLOWSHEET

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: SEPTEMBER 2008
Project Manager: S. WANNER	Reviewed By: JJJ	Designed By: JJJ	Drawn By: L. VAN NOTE
Scale: HORZ_SC	Project No: 19190-03	Report No: 021	Drawing No: EF-01

19190-03(021)EF-BU002 NOV 21/2008



PLANT ID.	1	2	3	4	5	6	7	8	9	10	11	12
NAME	AIR STRIPPER BLOWER	AIR STRIPPER	BUILDING SUMP	DISCHARGE SUPPLY TANK	DISCHARGE TRANSFER PUMP No.1	DISCHARGE TRANSFER PUMP No.2	DISCHARGE TRANSFER PUMP No.3	FLUORINE TREATMENT	CHLORINE TREATMENT			
MATERIAL			CI		DI	DI	DI					
SIZE		108"D X 29'-9"H	2000 GPM	12' D X 14'-6" H	4 X 6 - 17	4 X 6 - 17	4 X 6 - 17					
CAPACITY	10,700CFM @ 3.5" W.C.		50 GPM @ 81 TDH	12,000 GALLON	1000 GPM @ 230 TDH	1000 GPM @ 230 TDH	1000 GPM @ 230 TDH					
TEMP/PRESS												
HP/V/RPM	10 / 460 /		2 / 460 / 3500		125 / 460 / 1800	125 / 460 / 1800	125 / 460 / 1800					
WEIGHT												
MANUFACTURE			GOULD GSL		GOULD	GOULD	GOULD					
MODEL		DELTA	3885 W61OH									
VENDOR		S9-200DF										

No	Revision	Date	Initial
C	ISSUED FOR 100% DESIGN	1/30/09	JJ
B	ISSUED FOR 95% DESIGN	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW	9/26/08	JJ

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

CITY OF ATTICA
ATTICA, INDIANA

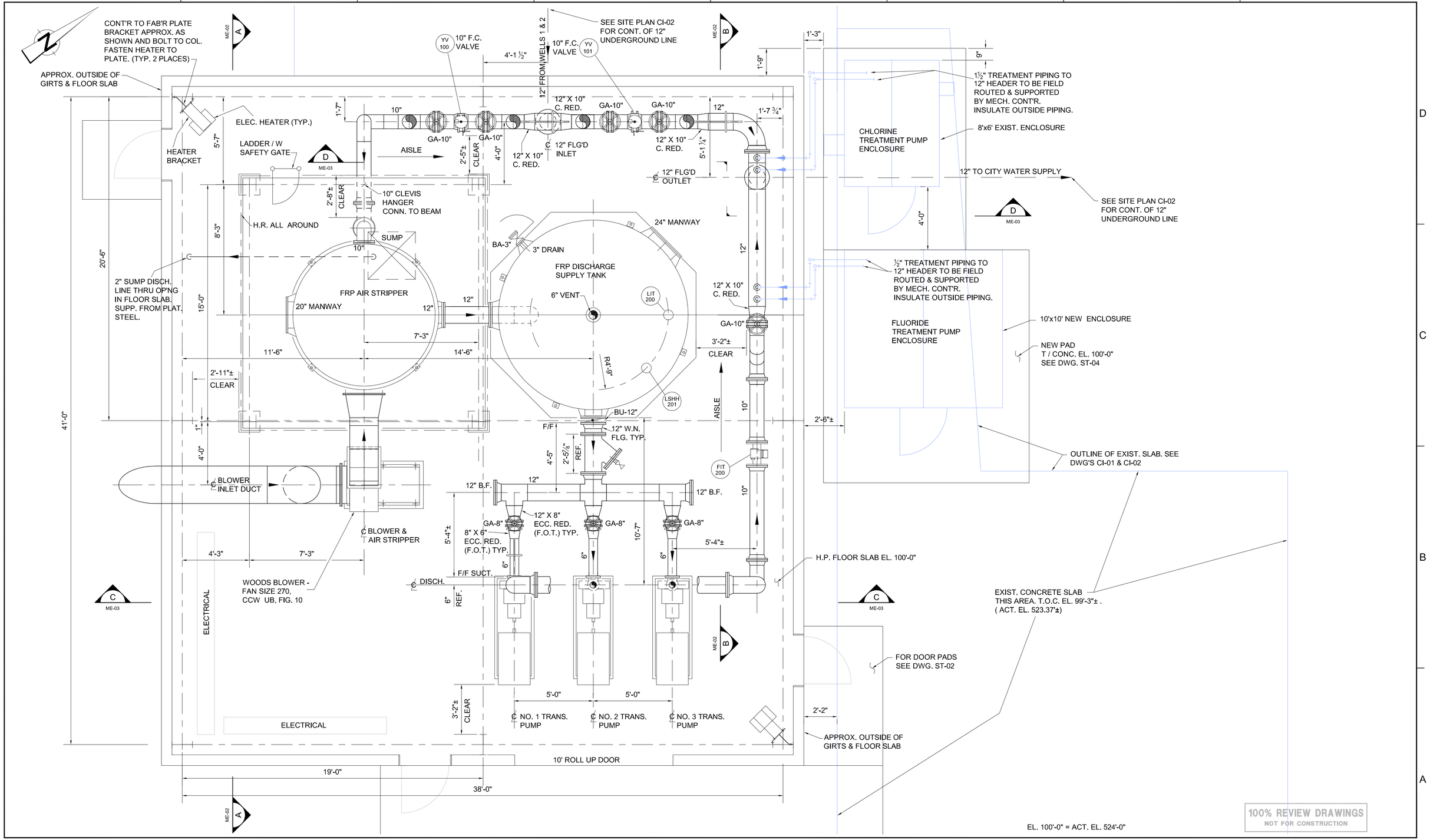
CITY WATER TREATMENT SYSTEM

ENGINEERING FLOW SHEET

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: MAY 2008
Project Manager: SW	Reviewed By: JJJ	Designed By: JJJ	Drawn By: B. SUCHAN
Scale: NONE	Project No: 19190-10	Report No: 021	Drawing No: EF-02

19190-03(021)EF-BU001 NOV 21/2008



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No	Revision	Date	Initial
C	ISSUED FOR 100% REVIEW	1/30/09	JJ
B	ISSUED FOR 95% REVIEW	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW	9/26/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

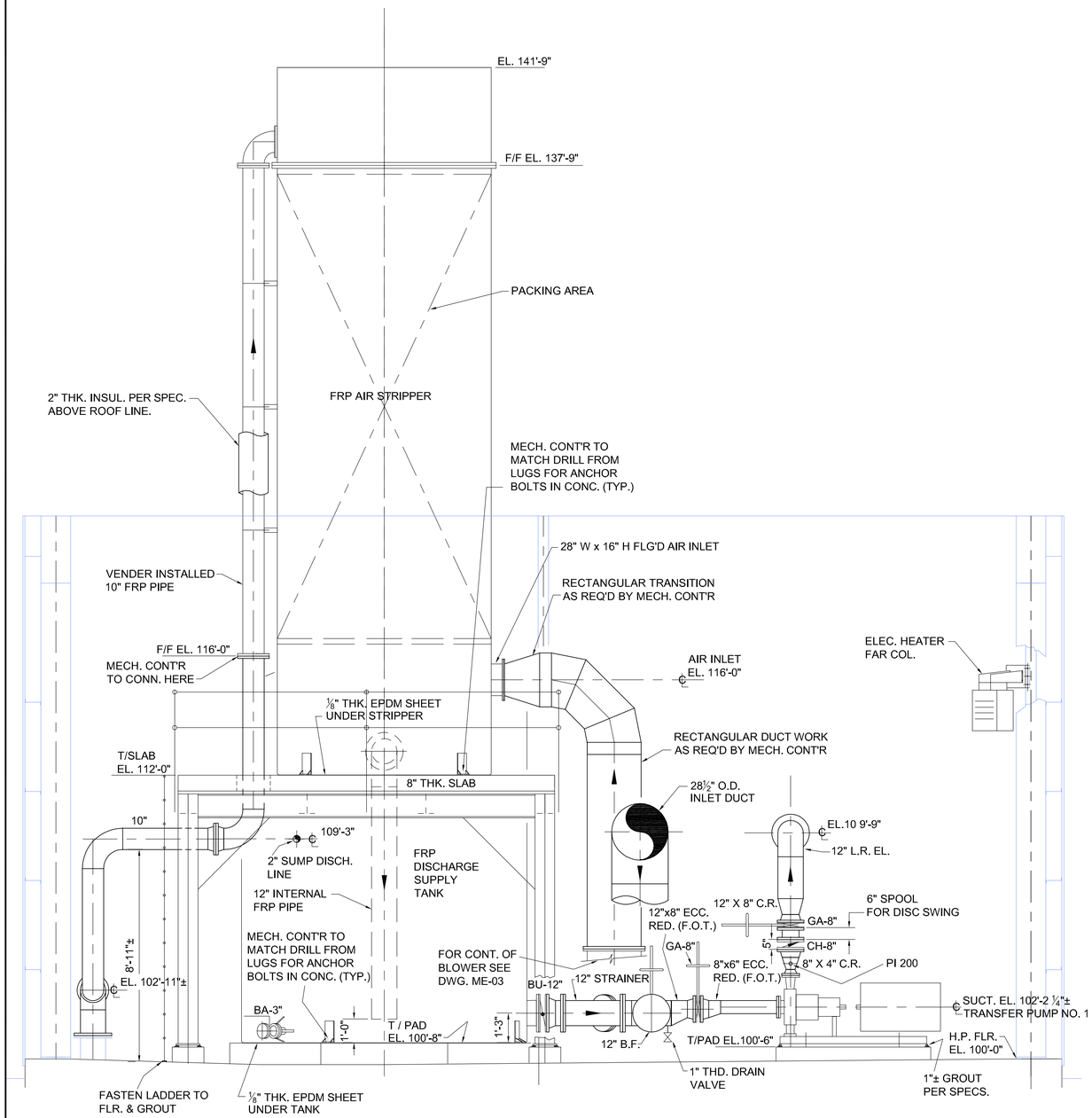
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING EQUIPMENT PLAN

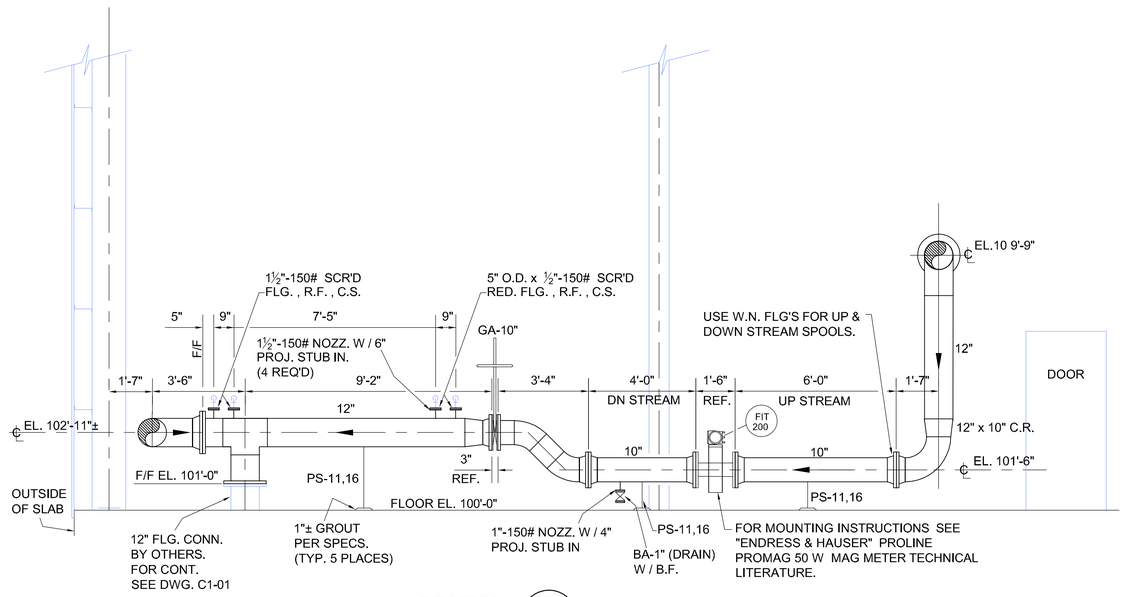
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: SEPTEMBER 2008
Project Manager: SW	Reviewed By: JJJ	Designed By: JFS	Drawn By: JFS
Scale: 3/8"=1'-0"	Project No: 19190-10	Report No: 021	Drawing No: ME-01

19190-03(021)ME-BU001 NOV 21/2008



SECTION A ME-01



SECTION B ME-01

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

EL. 100'-0" = ACT. EL. 524'-0"

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial
C	ISSUED FOR 100% REVIEW	1/30/09	JJ
B	ISSUED FOR 95% REVIEW	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW	9/26/08	JJ

CITY OF ATTICA
ATTICA , INDIANA

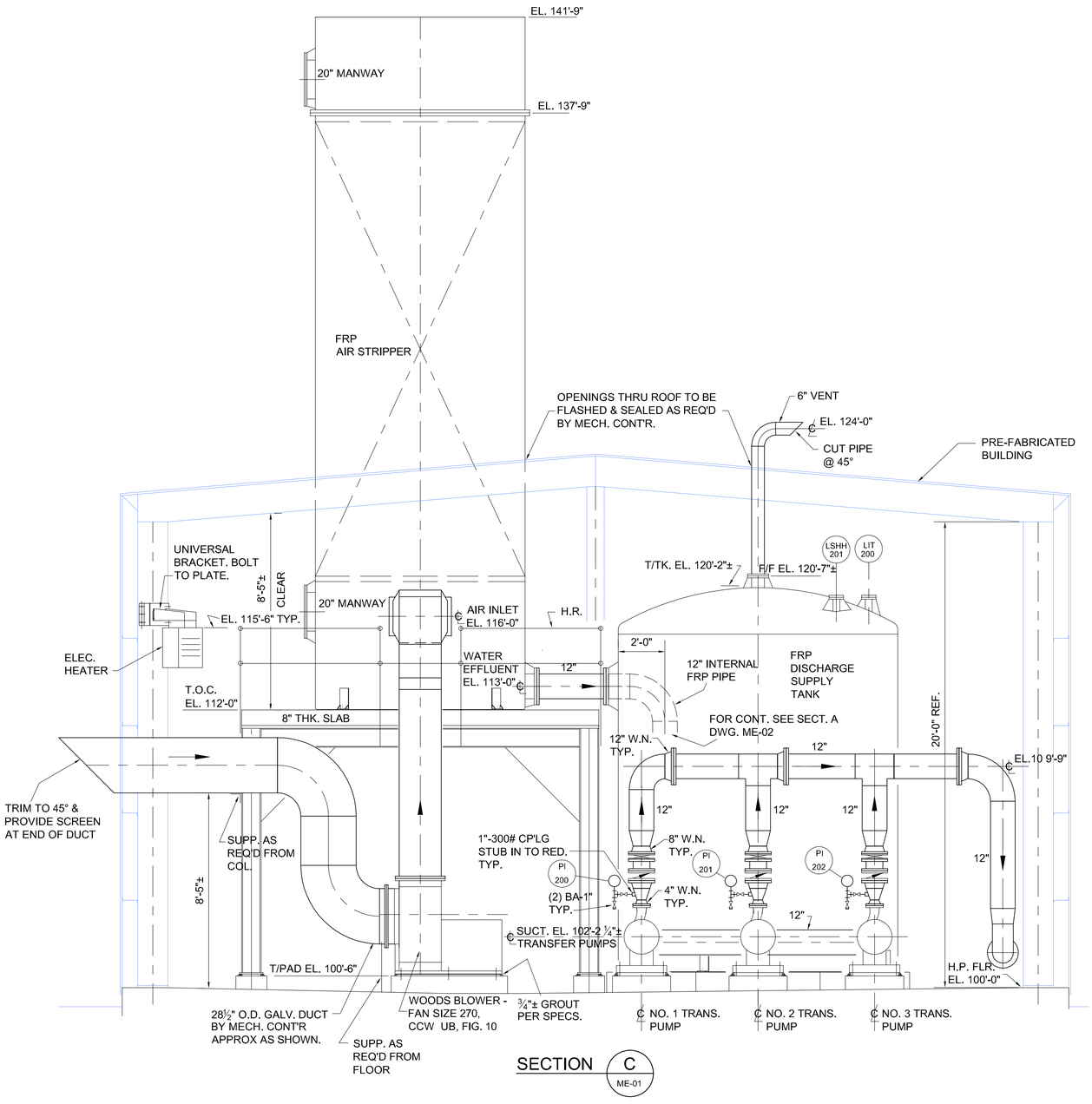
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
PIPING SECTIONS

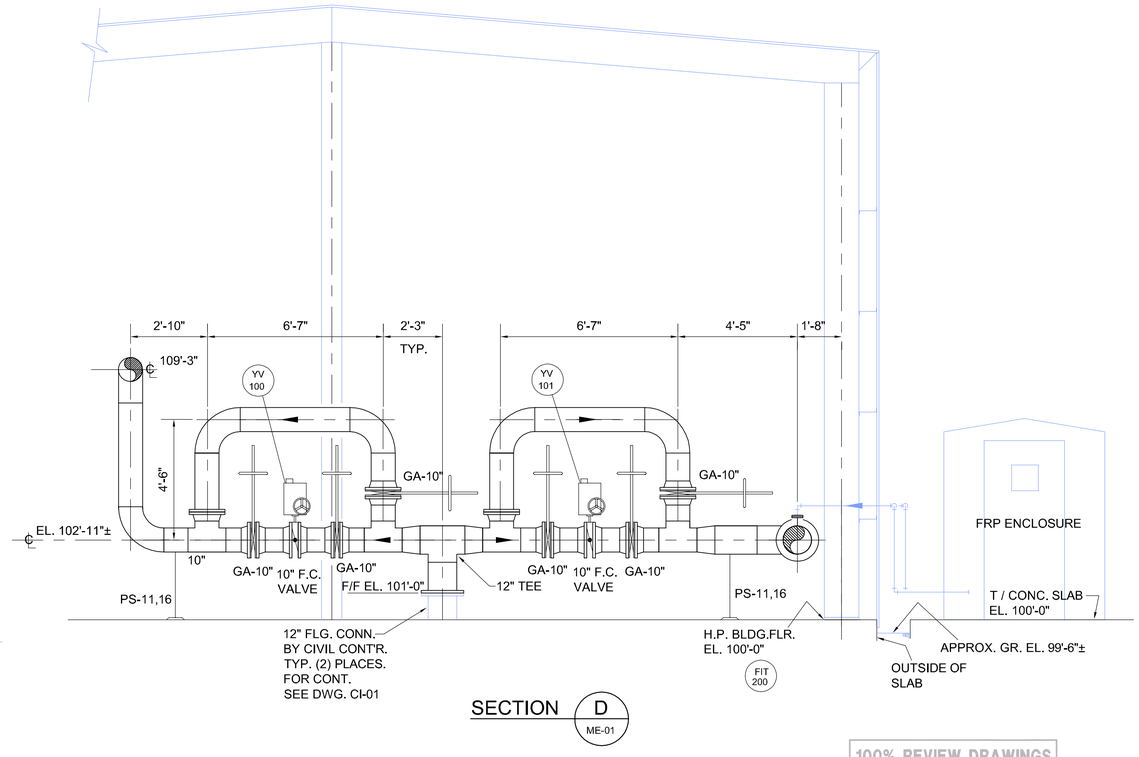
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: SEPTEMBER 2008
Project Manager: SW	Reviewed By: JJJ	Designed By: JFS	Drawn By: JFS
Scale: 3/8"=1'-0"	Project No: 19190-10	Report No: 021	Drawing No: ME-02

19190-03(021)ME-BU001 NOV 21/2008



SECTION C ME-01



SECTION D ME-01

EL. 100'-0" = ACT. EL. 524'-0"

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial
B	ISSUED FOR 100% REVIEW	1/30/09	JJ
A	ISSUED FOR 95% REVIEW	11/21/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

CITY WATER TREAMENT SYSTEM

TREATMENT BUILDING
PIPING SECTIONS

CONESTOGA-ROVERS & ASSOCIATES

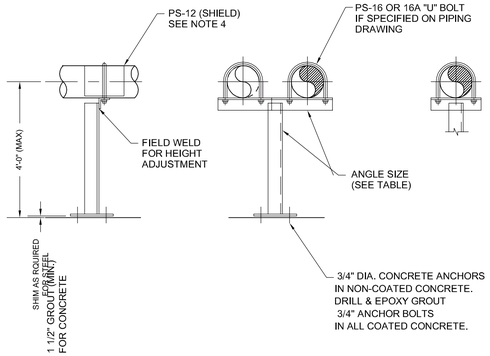
Source Reference:			Date: NOVEMBER 2008
Project Manager: SW	Reviewed By: JJJ	Designed By: JFS	Drawn By: JFS
Scale: 3/8"=1'-0"	Project No: 19190-10	Report No: 021	Drawing No: ME-03

19190-03(021)ME-BU001 NOV 21/2008

1. THESE DRAWINGS ARE NOT TO BE USED FOR SHOP FABRICATION DRAWINGS.
2. FIELD CHECK LOCATION OF ALL ATTACHMENTS TO PIPE BEFORE WELDING.
3. ALL ATTACHMENTS WELDED TO PIPE MUST BE OF SAME MATERIAL AS PIPE. WELDMENT PADS ARE REQUIRED FOR ALLOY PIPE WHEN CARBON STEEL SUPPORTS ARE USED.
4. NO WELDING ALLOWED ON VESSEL AFTER STRESS RELIEVING OR AFTER VESSEL IS LINED.
5. ALL PLATES TO BE 3/8" THICK UNLESS OTHERWISE NOTED.
6. BOLTING TO BE ASTM A-325 OR EQUAL.
7. MATERIAL FOR PLATES AND MEMBERS TO BE ASTM A-36 OR EQUAL.
8. BOLT HOLES TO BE 13/16" DIA. FOR 3/4" DIA BOLTS WITH HEX HEADS AND HEX NUTS UNLESS OTHERWISE NOTED.
9. CONTRACTOR IS TO FURNISH ALL NECESSARY BOLTS AND NUTS.
10. HEAVY LOADS SUCH AS VALVES, LINE MOUNTED INSTRUMENTS, ETC. SHOULD BE GIVEN SPECIAL SUPPORT CONSIDERATION, WHENEVER POSSIBLE VALVES AND INSTRUMENTS SHOULD BE LOCATED AS CLOSE TO SUPPORT AS POSSIBLE.
11. IN PLASTIC PIPING SYSTEMS, VALVES AND INSTRUMENTS SHOULD HAVE INDIVIDUAL SUPPORTS WHENEVER POSSIBLE.
12. LOADS AT PUMP SUCTION AND DISCHARGE SHOULD BE HELD TO A MINIMUM BY PROPER PIPE SUPPORT.
13. THE SUPPORT OF ONE PIPE FROM ANOTHER PIPE, EITHER NEW OR EXISTING IS NOT ALLOWED.
14. MECHANICAL CONTRACTOR MUST PROVIDE ALL HOLES REQUIRED FOR PIPE SUPPORTS. ALL HOLES ARE TO BE DRILLED OR PUNCHED, UNLESS OTHERWISE NOTED. BURNING IS NOT ALLOWED.
15. ALL PIPE SUPPORT CONNECTIONS TO BUILDING STRUCTURE ARE TO BE WELDED; CONTINUOUS ON TOP, STITCH WELDED ON THE BOTTOM UNLESS OTHERWISE NOTED.
16. ALL PIPE SUPPORTS INCLUDING HARDWARE AND MISC. STRUCTURAL STEEL MEMBERS ARE TO BE GALVANIZED PER PROJECT SPECS.
17. PIPING SYSTEMS MUST BE PROPERLY SUPPORTED DURING HYDROTESTING.

GENERAL NOTES

PIPE SUPPORT DETAIL
FOR FABRICATION AND INSTALLATION OF PIPE SUPPORTS

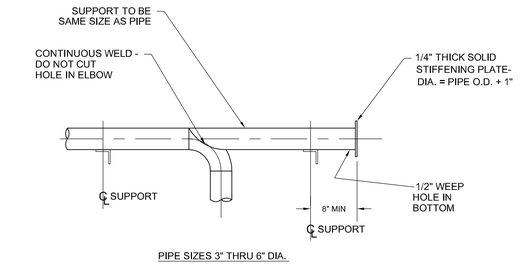


PIPE SIZE	ANGLE SIZE
1" THRU 4"	3" x 3" x 5/16"
6" THRU 12"	4" x 4" x 3/8"

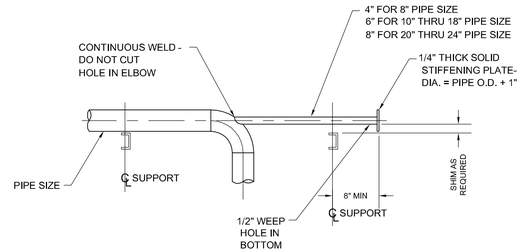
NOTES:
1. SINGLE PIPE TO BE CENTERED ON POST.
2. ALL WELDS TO BE CONTINUOUS.
3. DO NOT SUPPORT ON GRATED FLOOR UNLESS DIRECTLY ABOVE STEEL MEMBER.
4. PROVIDE PS-12 (DETAIL 20) FOR PLASTIC PIPE ONLY.

PS-11

PIPE SUPPORT DETAIL
FOR ALL PIPE THRU 12" DIA.



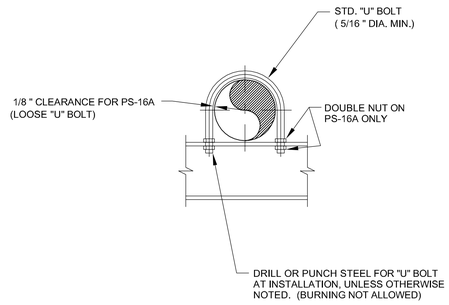
PIPE SIZES 3" THRU 6" DIA.



PIPE SIZES 8" THRU 24" DIA.

PS-17

PIPE SUPPORT DETAIL
FOR BARE AND INSULATED METALLIC PIPE 3" THRU 24" DIA.



NOTES:
1. DO NOT USE PS-16 FOR 4" AND LARGER BARE STEEL OR BARE LINED STEEL PIPES. USE SHOE TYPE SUPPORTS AS REQUIRED (PS-14,20,24 OR 25).

PS-16 (TIGHT "U" BOLT)
PS-16A (LOOSE "U" BOLT)

PIPE SUPPORT DETAIL
FOR BARE AND INSULATED PIPE 1/2 " THRU 24" DIA.

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial
C	ISSUED FOR 100% REVIEW	1/30/09	JJ
B	ISSUED FOR 95% REVIEW	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW	9/26/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
PIPE SUPPORT DETAILS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: SEPTEMBER 2008
Project Manager: SW	Reviewed By: JJJ	Designed By: JJJ	Drawn By: NEM
Scale: 3/8"=1'-0"	Project No: 19190-10	Report No: 021	Drawing No: ME-04

GENERAL NOTES

1. THE CONTRACTOR SHALL NOT SCALE THE DRAWINGS TO ESTABLISH DIMENSIONS. ALL DIMENSIONS SHALL BE CHECKED ON-SITE PRIOR TO ASSEMBLY OR CONSTRUCTION OF ANY WORK.
2. THE STRUCTURE HAS BEEN DESIGNED FOR THE IN-SERVICE LOADS. THE METHODS, PROCEDURES AND SEQUENCES OF CONSTRUCTION ARE THE SOLE RESPONSIBILITY OF THE CONTRACTOR. SUPPORTING FORMWORK FOR CONCRETE CONSTRUCTION SHALL NOT BE REMOVED BEFORE THE CONCRETE HAS GAINED SUFFICIENT STRENGTH TO SAFELY SUPPORT THE DEAD AND SUPERIMPOSED LOADS. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO AVOID OVERLOADS, AND MAINTAIN AND INSURE THE INTEGRITY OF THE STRUCTURE AT ALL STAGES OF CONSTRUCTION.
3. THE CONTRACTOR SHALL REFER TO MECHANICAL & ELECTRICAL DRAWINGS AND SPECIFICATIONS FOR SIZE AND LOCATION OF SLEEVES, ANCHORS, INSERTS AND OPENINGS REQUIRED. PRINCIPAL OPENINGS IN THE STRUCTURE ARE SHOWN ON THE DRAWINGS. SLEEVES AND OPENINGS NOT SHOWN ON STRUCTURAL DRAWINGS SHALL BE SUBJECT TO APPROVAL OF THE ENGINEER.
4. MATERIALS SPECIFIED ON THE DRAWINGS AND/OR IN THE SPECIFICATIONS SHALL BE USED UNLESS THE CONTRACTOR OBTAINS WRITTEN APPROVAL OF THE ENGINEER TO USE ALTERNATIVE MATERIALS. WHEN REQUESTING SUCH APPROVAL, THE CONTRACTOR SHALL PROVIDE ADEQUATE AND DETAILED MANUFACTURER'S LITERATURE AND TECHNICAL DATA FOR EACH MATERIAL PRIOR TO ITS POTENTIAL USE.
5. CONTRACTOR SHALL VERIFY THE LOCATION OF ALL UTILITIES PRIOR TO COMMENCING EXCAVATION.

ARCHITECTURAL NOTES

1. BUILDING SHALL CONSIST OF PRE-ENGINEERED METAL, CLEAR SINGLE SPAN RIGID FRAME WITH STRAIGHT COLUMNS (NON-TAPERED) AND GABLED ROOF BEAMS.
2. ROOF SHALL HAVE A 1:12 PITCH.
3. ROOF PANELS SHALL BE 24 GAUGE STANDING SEAM STEEL.
4. EXTERIOR WALL PANELS SHALL BE 26 GAUGE STEEL.
5. INTERIOR WALL LINER PANELS SHALL BE 28 GAUGE STEEL (STANDARD HEIGHT 8'-3").
6. OPENINGS, CUTOUTS AND HOLES IN ROOF PANELS SHALL BE COMPLETELY SEALED BY MECHANICAL/ELECTRICAL CONTRACTORS WITH FIRE STOP AND WEATHER PROOF MATERIALS.
7. INSTALL PRE-ENGINEERED BUILDING PER MANUFACTURER'S INSTRUCTIONS.

CONCRETE NOTES

1. CONCRETE CONSTRUCTION SHALL CONFORM TO ACI 301, 305, 306, 308, 315, 318 AND 350R SPECIFICATIONS.
2. LATEST REVISION AND/OR VERSION OF ALL CODES AND REFERENCE STANDARDS SHALL BE FOLLOWED.
3. CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI AT 28 DAYS. SLUMP SHALL BE 3 1/2 INCHES ± 1 INCH.
4. CONCRETE SHALL BE AIR ENTRAINED. CEMENT SHALL BE PORTLAND CEMENT CONFORMING TO ASTM C150, TYPE II WITH AIR-ENTRAINING ADMIXTURE CONFORMING TO ASTM C260. AIR CONTENT (% BY VOLUME) SHALL NOT BE LESS THAN 4% NOR GREATER THAN 6.5% AND SHALL DEPEND ON MAXIMUM SIZE AGGREGATE USED.
5. NO ADMIXTURE SHALL CONTAIN CALCIUM CHLORIDE BASED COMPOUNDS.
6. REINFORCING BARS SHALL CONFORM TO ASTM A615 GRADE 60 SPECIFICATIONS.
7. LAP SPLICES IN REINFORCING BARS SHALL BE A MINIMUM 38 TIMES BAR DIAMETERS. THE SPLICES SHALL NOT BE LESS THAN 18 INCHES.
8. CONCRETE PROTECTION FOR REINFORCING BARS (UNLESS OTHERWISE NOTED):
   A. FOOTINGS - 3 INCH BOTTOM AND SIDES, 2 INCH TOP
   B. FORMED SLABS - 1 1/2 INCH TOP AND BOTTOM
   C. PIERS - 1 1/2 INCH (TO TIES)
   D. SLAB ON GRADE - 2 INCH TOP AND 2 1/2 INCH BOTTOM
9. NO CONSTRUCTION JOINT SHALL BE MADE UNLESS SHOWN ON DRAWINGS OR APPROVED IN WRITING BY THE ENGINEER.
10. ANCHOR BOLTS SHALL BE CARBON STEEL CONFORMING TO ASTM F1554 SPECIFICATIONS, WITH HEAVY HEX NUTS AND WASHERS. BOLTS, NUTS AND WASHERS SHALL BE GALVANIZED CONFORMING TO ASTM A123 AND A153 SPECIFICATIONS, AND SHALL BE ACCURATELY PLACED USING TEMPLATES.
11. GROUT IN DRILLED HOLES FOR ANCHOR BOLTS AND REINFORCING STEEL DOWELS, AND UNDER BASE PLATES SHALL BE NON-SHRINK NON-METALLIC "MASTERFLOW 713" OR "MASTERFLOW 928" BY DEGUSSA BUILDING SYSTEMS. MANUFACTURER'S INSTRUCTIONS CONCERNING HOLE SIZE, SURFACE PREPARATION AND INSTALLATION SHALL BE FOLLOWED.
12. RAMPS, PADS AND SLABS SHALL BE TROWEL FINISHED TO WITHIN 1/8 INCH OF ELEVATIONS SHOWN ON DRAWINGS. FOLLOWING TROWELLING, PROVIDE NON-SLIP MEDIUM BROOM FINISH.
13. PROVIDE CORNER REINFORCING BARS TO MATCH HORIZONTAL BARS AT CORNERS AND INTERSECTIONS FOR CONTINUITY.
14. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A82 AND A185 SPECIFICATIONS.
15. PROVIDE MINIMUM OF 6 INCH MECHANICALLY COMPACTED STRUCTURAL FILL UNDER SLABS, FOUNDATIONS AND WHERE OTHERWISE NOTED ON DRAWINGS.
16. JOINT SEALANT SHALL BE ONE-COMPONENT POLYURETHANE "SIKAFLEX-1A" BY SIKA CHEMICAL CORPORATION.

FOUNDATION NOTES

1. FOUNDATION DESIGN IS BASED UPON A NET ALLOWABLE SOIL BEARING CAPACITY OF 1,500 POUNDS PER SQUARE FOOT FOR FOOTINGS BEARING ON APPROVED NATIVE SUBGRADE SOILS OR COMPACT STRUCTURAL GRANULAR FILL PER GEOTECHNICAL RECOMMENDATIONS BY INSPECSOL ENGINEERING, INC. (SEE APPENDIX A).
2. CONTRACTOR SHALL FIELD VERIFY THE FOUNDATION BEARING GRADE MATERIAL AND BEARING CAPACITY DURING CONSTRUCTION. FOUNDATIONS SHALL BE PLACED ON APPROVED BEARING GRADE.
3. NO FOOTING SHALL BEAR ON EXISTING FILL, SOFT/LOOSE, ORGANIC OR OTHER UNSUITABLE SOILS. IF ENCOUNTERED, THE EXISTING FILL AND UNSUITABLE SOILS AT THE FOOTING BEARING GRADE LEVEL SHALL BE REMOVED DOWN TO COMPETENT NATIVE SUBGRADE AND EXCAVATION BACKFILLED WITH COMPACTED STRUCTURAL GRANULAR FILL IN ACCORDANCE WITH THE SPECIFICATION.
4. EXISTING UNDERGROUND PIPING, REINFORCED CONCRETE STRUCTURES, UTILITIES, ELECTRICAL CABLES AND GROUNDING SYSTEMS NOT IDENTIFIED ON THE DRAWINGS MAY EXIST. WHEN UNCOVERED, THE CONTRACTOR MUST REPORT FINDINGS TO THE ENGINEER FOR IDENTIFICATION AND RECOMMENDED ACTION.
5. ALL EXISTING FLOOR SLABS AND FOOTINGS WITHIN THE FOOTPRINT OF THE NEW BUILDING SHALL BE REMOVED.
6. UNDERCUT EACH FOOTER BY 2 FT (MINIMUM), COMPACT THE SUBGRADE AND REPLACE WITH APPROVED STRUCTURAL FILL COMPACTED TO 95% OF THE MAXIMUM DRY DENSITY.
7. NEW SLAB AREA SHALL BE PROOF ROLLED WITH A FULLY LOADED DUMP TRUCK. REMOVE SOFT SPOTS AND REPLACE WITH STRUCTURAL FILL COMPACTED TO 95%.
8. ENGINEER IS THE SOLE AUTHORITY FOR DETERMINING THE SUITABILITY OF BEARING SOILS AND APPROVAL OF THE BEARING GRADE.

STRUCTURAL STEEL NOTES

1. FABRICATION, ERECTION AND WORKMANSHIP SHALL CONFORM TO THE DESIGN DRAWINGS, SCOPE OF WORK AND SPECIFICATIONS, AND SHALL BE IN ACCORDANCE WITH THE AISC SPECIFICATIONS.
2. LATEST REVISION AND/OR VERSION OF ALL CODES AND REFERENCE STANDARDS SHALL BE FOLLOWED.
3. STRUCTURAL STEEL SHALL CONFORM TO FOLLOWING SPECIFICATIONS:
   A. W AND WT SHAPES - ASTM A992, 50 KSI MINIMUM YIELD STRESS, 65 KSI TENSILE STRESS
   B. ANGLES - ASTM A36, 36 KSI MINIMUM YIELD STRESS, 58 KSI TENSILE STRESS
   C. PIPE - ASTM A53 GRADE B, 35 KSI MINIMUM YIELD STRESS, 60 KSI TENSILE STRESS
   D. PLATES - ASTM A36, 36 KSI MINIMUM YIELD STRESS, 58 KSI TENSILE STRESS
4. ALL DIMENSIONS SHALL BE FIELD CHECKED BEFORE FABRICATION MAY BEGIN.
5. WELDING SHALL BE IN ACCORDANCE WITH THE AWS STRUCTURAL WELDING CODE. WELDED CONNECTIONS SHALL BE MADE WITH E70XX ELECTRODES. ROOT PASS AND TACK WELDS SHALL BE MADE WITH E6010 ELECTRODES. FILLET WELDS ON STANDARD FRAMED BEAM CONNECTIONS MAY BE 3/16 INCH MINIMUM. ALL OTHER FILLET WELDS SHALL BE 1/4 INCH MINIMUM.
6. GUSSET PLATES AND CLIP ANGLES SHALL BE 5/16 INCH THICK MINIMUM (UNLESS OTHERWISE NOTED). GENERALLY, ONE-SIDED CONNECTIONS FOR BEAMS SHALL NOT BE USED.
7. SHOP CONNECTIONS MAY BE EITHER WELDED OR BOLTED. FIELD CONNECTIONS SHALL BE BOLTED (UNLESS OTHERWISE NOTED). CONNECTIONS FOR NEW STEEL FRAMING TO EXISTING STEEL SHALL HAVE ONE END OF MEMBER BOLTED TO ALLOW FOR ADJUSTMENTS. WELDED CONNECTIONS, FIELD AND SHOP, SHALL BE CONTINUOUS FULL PENETRATION SEAL WELDS.
8. FASTENERS SHALL BE HIGH STRENGTH ASTM A325-N, 3/4 INCH DIAMETER GALVANIZED BOLTS WITH ASTM A194 GRADE 2H OR A563 GRADE DH NUTS TAPPED OVERSIZE AFTER GALVANIZING AND THREADS LUBRICATED. HARDENED WASHERS SHALL BE PROVIDED UNDER ROTATING PART OF NUT AND BOLT ASSEMBLY. CONNECTIONS NOTED WITH A325-SC BOLTS SHALL BE SLIP CRITICAL PER AISC SPECIFICATIONS.
9. FASTENERS FOR HANDRAIL, LADDER AND STAIR CONNECTIONS SHALL BE 3/4 INCH DIAMETER GALVANIZED BOLTS CONFORMING TO ASTM A307 SPECIFICATIONS.
10. BOLT HOLES SHALL NOT BE LARGER THAN 1/16 INCH PLUS DIAMETER OF THE BOLT. A MINIMUM OF TWO BOLTS PER CONNECTION SHALL BE REQUIRED, UNLESS NOTED OTHERWISE.
11. WHERE BRACING FORCES ARE NOT GIVEN, DESIGN CONNECTIONS AT EACH END FOR 50% OF MEMBER CAPACITY IN TENSION.
12. HANDRAIL SHALL BE 1 1/4 INCH DIAMETER SCHEDULE 40 CARBON STEEL PIPE CONFORMING TO ASTM A53, WITH 1/4 INCH THICK TOE PLATES. TOE PLATES SHALL EXTEND TO 4 INCH ABOVE TOP OF CONCRETE SURFACE. POSTS SHALL BE SPACED ON MAXIMUM 6 FEET CENTERS.
13. HANDRAILS, POSTS, LADDERS AND TOE PLATES SHALL BE PAINTED YELLOW.

GRATING NOTES

1. STEEL GRATING SHALL BE GALVANIZED, NAAMM TYPE W-19-4 (1 1/2 INCH THICK) WITH 3/16 INCH SERRATED BEARING BARS (IKG BORDEN WB 8).
2. STEEL GRATING SHALL HAVE CUT EDGES AND/OR HOLES SEALED WITH GALVANIZE PAINT TO PREVENT CORROSION.

WATERLINE NOTES

1. PIPE SHALL BE DUCTILE IRON CLASS 52 WITH RESTRAINED JOINTS FOR POTABLE WATER SERVICE.

BUILDING CODE DATA

CODE:	INTERNATIONAL BUILDING CODE, 2006
LOCATION:	ATTICA, INDIANA
BUILDING DIMENSIONS:	APPROX. 41' x 44'
BUILDING HEIGHT:	20'-0" INTERIOR CLEARANCE
BUILDING AREA:	APPROX. 1,804 SQUARE FEET (TABLE 503)
OCCUPANCY CLASS:	USE GROUP F-2 FACTORY INDUSTRIAL (SECTION 306.3)
CONSTRUCTION:	NON-COMBUSTIBLE TYPE 2B (SECTION 602.2, TABLE 601)
OCCUPANT LOAD:	ACTUAL - NONE; TABLE - 11 PERSONS (SECTION 1004.1.2)
BUILDING TYPE:	PRE-ENGINEERED METAL, STRUCTURAL STEEL RIGID FRAMED
BUILDING INSULATION:	WALLS - R13, ROOF - R19
FIRE SEPARATION DISTANCE:	> 30 FEET
FIRE RESISTANCE RATING:	EXTERIOR WALL - 0 HR (TABLES 601 & 602)
FIRE SEPARATION ASSEMBLIES:	NOT REQUIRED (TABLE 302.3.2)

STRUCTURAL LOADS (NON-FACTORED)

1. DEAD LOAD	STRUCTURAL, NONSTRUCTURAL, EQUIPMENT, PIPE, CABLE
2. FLOOR LIVE LOAD	
UNIFORMLY DISTRIBUTED LOAD	125 POUNDS PER SQUARE FOOT
CONCENTRATED LOAD	2,000 POUNDS (ON 2 1/2 FT x 2 1/2 FT SQUARE AREA)
3. ROOF LIVE LOAD	
0 - 200 SQUARE FEET TRIBUTARY AREA	20 POUNDS PER SQUARE FOOT
201 - 600 SQUARE FEET TRIBUTARY AREA (A)	20 (1.2-0.001A) POUNDS PER SQUARE FOOT
OVER 600 SQUARE FEET TRIBUTARY AREA	12 POUNDS PER SQUARE FOOT
CONCENTRATED LOAD	200 POUNDS (ON AREA OF ONE SQUARE INCH)
4. ROOF SNOW LOAD	
GROUND SNOW LOAD	20 POUNDS PER SQUARE FOOT (FIGURE 1608.2)
SNOW EXPOSURE FACTOR	1.0 (TABLE 1608.3.1)
SNOW LOAD IMPORTANCE FACTOR	1.0 (SECTION 1604.5)
5. WIND LOAD	
BASIC WIND SPEED (3-SECOND GUST)	90 MILES PER HOUR (FIGURE 1609)
EXPOSURE CATEGORY	C (SECTION 1609.4)
WIND LOAD IMPORTANCE FACTOR	1.0 (SECTION 1604,5)
6. EARTHQUAKE LOAD	
SEISMIC USE GROUP	GROUP I (SECTION 1613.1)
SEISMIC IMPORTANCE FACTOR	1.0 (SECTION 1604.5)
SITE CLASS (SOIL PROFILE)	D (SECTION 1613.5.2)
MAPPED SPECTRAL RESPONSE ACCELERATIONS	
S_S (SHORT PERIOD)	0.305 (FIGURE 1613.5 (1))
S_1 (1-SECOND PERIOD)	0.221 (FIGURE 1613.5 (2))
DESIGN SPECTRAL RESPONSE COEFFICIENTS	
S_{DS} (SHORT PERIOD)	0.203 (SECTION 1613.5.4)
S_{D1} (1-SECOND PERIOD)	0.147 (SECTION 1613.5.4)
SEISMIC DESIGN CATEGORY	C (TABLES 1613.5.6 (1) & 1613.5.6 (2))
ANALYSIS PROCEDURE	EQUIVALENT LATERAL FORCE (SECTION 1613)
BASIC SEISMIC FORCE RESISTING SYSTEM	ORDINARY STEEL MOMENT FRAME
7. DEFLECTION LIMITATION	
EXTERIOR WALL AND ROOF SYSTEMS	NOT TO EXCEED 1/240 OF SPAN OF STRUCTURAL MEMBER
8. FOUNDATION	
NET ALLOWABLE SOIL BEARING PRESSURE FOR SLAB	1,500 POUNDS PER SQUARE FOOT
MODULUS OF SUBGRADE REACTION	-

REFERENCE ELEVATION 100'-0" SHOWN FOR TREATMENT BUILDING
CORRESPONDS TO ELEVATION 524'-0" ABOVE MEAN SEA LEVEL (AMSL)

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial
C	ISSUED FOR 100% DESIGN	01/30/09	JJ
B	ISSUED FOR 95% DESIGN	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW	09/26/08	

CITY OF ATTICA
ATTICA, INDIANA

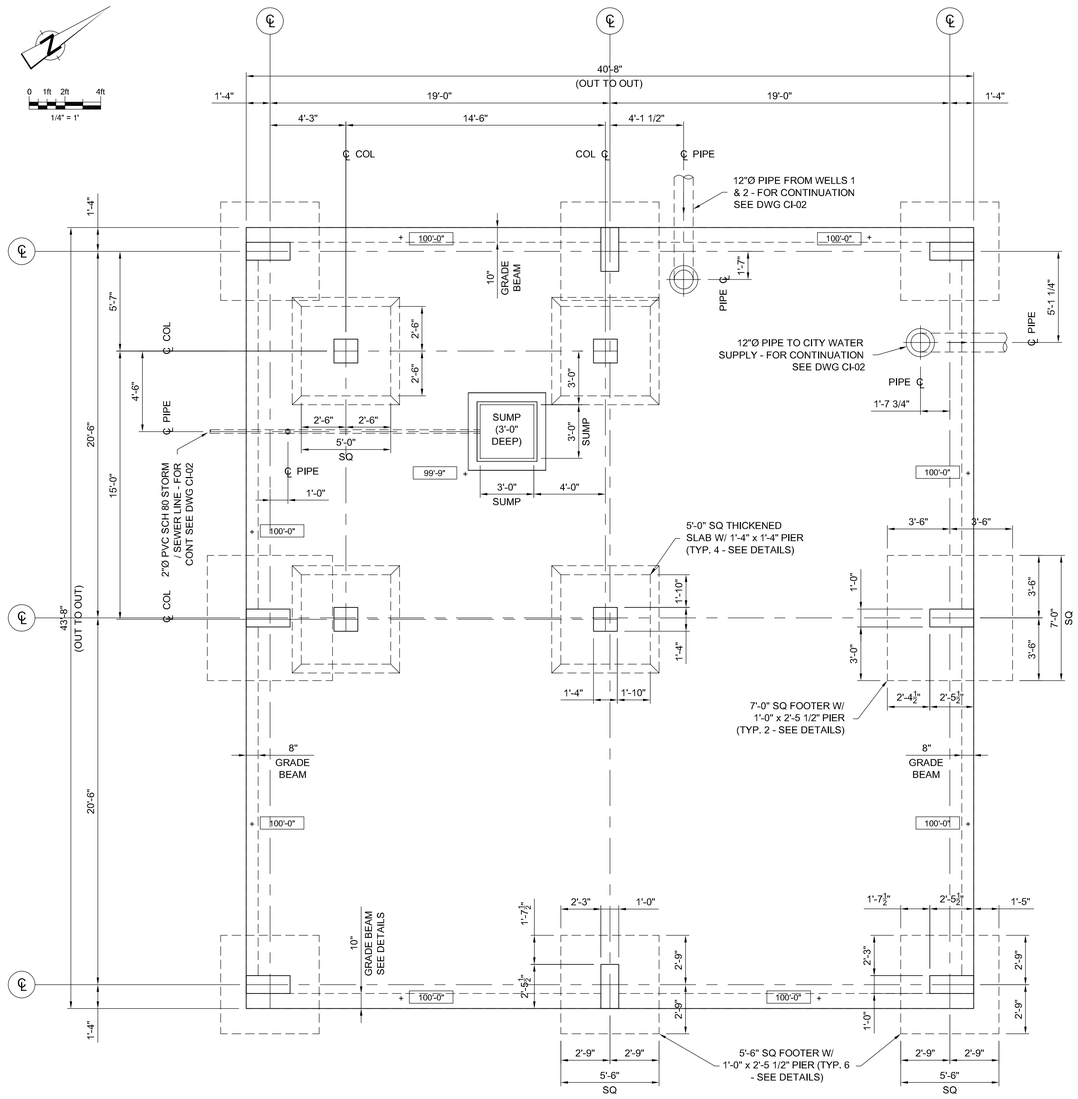
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
GENERAL NOTES

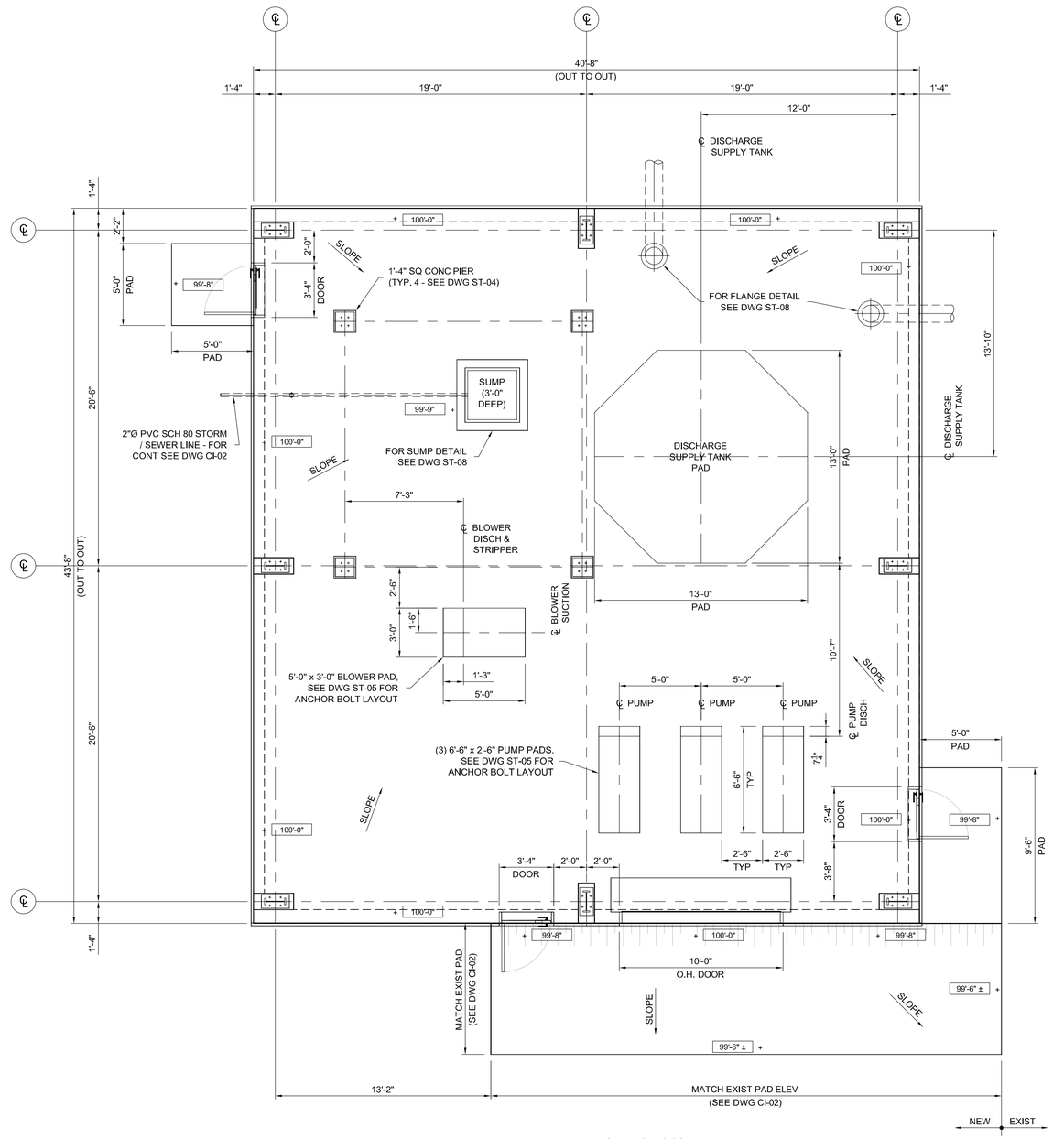
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. THORNTON	Designed By: L. ARMBRUSTER	Drawn By: Z. MATUSZEWSKI
Scale: AS NOTED	Project No: 19190-03	Report No: 021	Drawing No: ST-01

19190-03(021)ST-BU001 JAN 30/2009



TREATMENT BUILDING
FOUNDATION PLAN
1/4" = 1'-0"



TREATMENT BUILDING
FLOOR PLAN
1/4" = 1'-0"

REFERENCE ELEVATION 100'-0" SHOWN FOR TREATMENT BUILDING
CORRESPONDS TO ELEVATION 524'-0" ABOVE MEAN SEA LEVEL (AMSL)

100% REVIEW DRAWINGS
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LEGEND

+ 100'-0"	PROPOSED ELEVATION FEET (REFERENCE)
EXIT	EXIT SIGN INSTALLED ABOVE DOOR
F	FIRE EXTINGUISHER
D1	DOOR
W1	WINDOW
→	DIRECTION OF FLOOR SLOPE
	GYPSUM BOARD WALL (FIRE-RATED)
	WALL INTERIOR PANEL
	BOLLARD
	SPLASH PAD

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CITY OF ATTICA
ATTICA, INDIANA

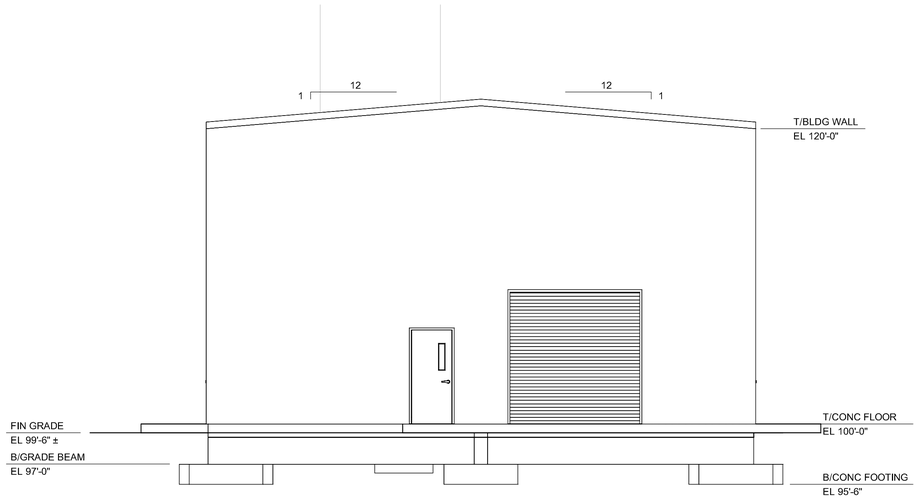
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
FOUNDATION AND FLOOR PLANS

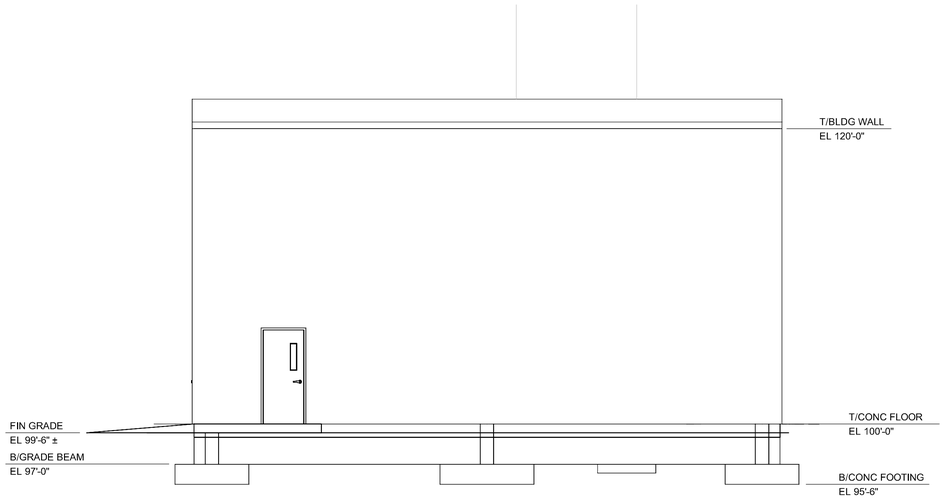
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. THORNTON	Designed By: L. ARMBRUSTER	Drawn By: Z. MATUSZEWSKI
Scale: 1/4"=1'-0"	Project No: 19190-03	Report No: 021	Drawing No: ST-02

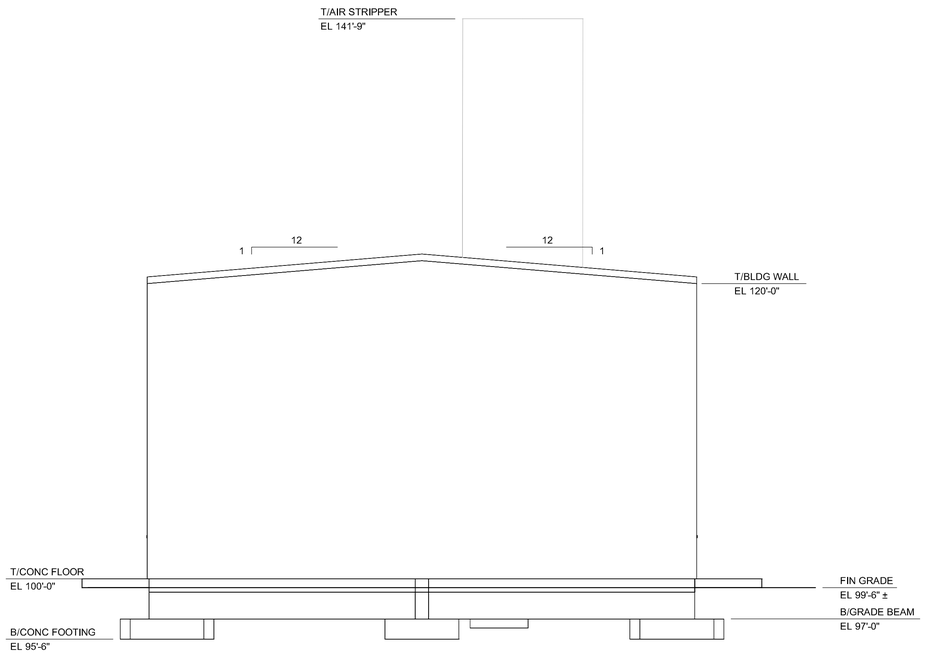
19190-03(021)ST-BU002 JAN 30/2009



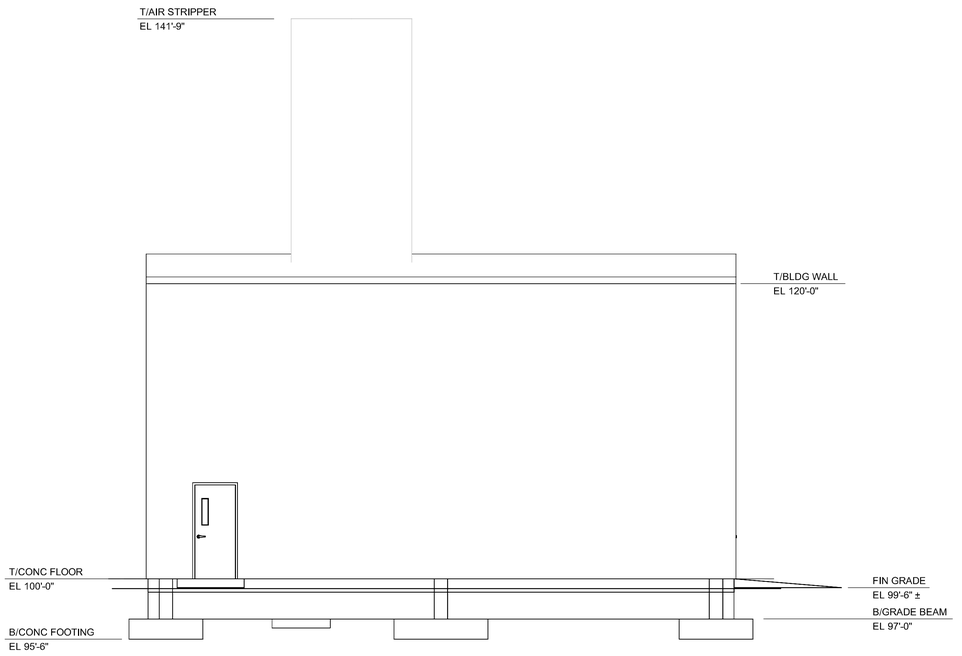
SOUTH-EAST ELEVATION
3/16" = 1'-0"



NORTH-EAST ELEVATION
3/16" = 1'-0"



NORTH-WEST ELEVATION
3/16" = 1'-0"



SOUTH-WEST ELEVATION
3/16" = 1'-0"

REFERENCE ELEVATION 100'-0" SHOWN FOR TREATMENT BUILDING
CORRESPONDS TO ELEVATION 524'-0" ABOVE MEAN SEA LEVEL (AMSL)

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

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B	ISSUED FOR 95% DESIGN	11/21/08	JJ
A	PRELIMINARY - FOR REVIEW	09/26/08	

CITY OF ATTICA
ATTICA, INDIANA

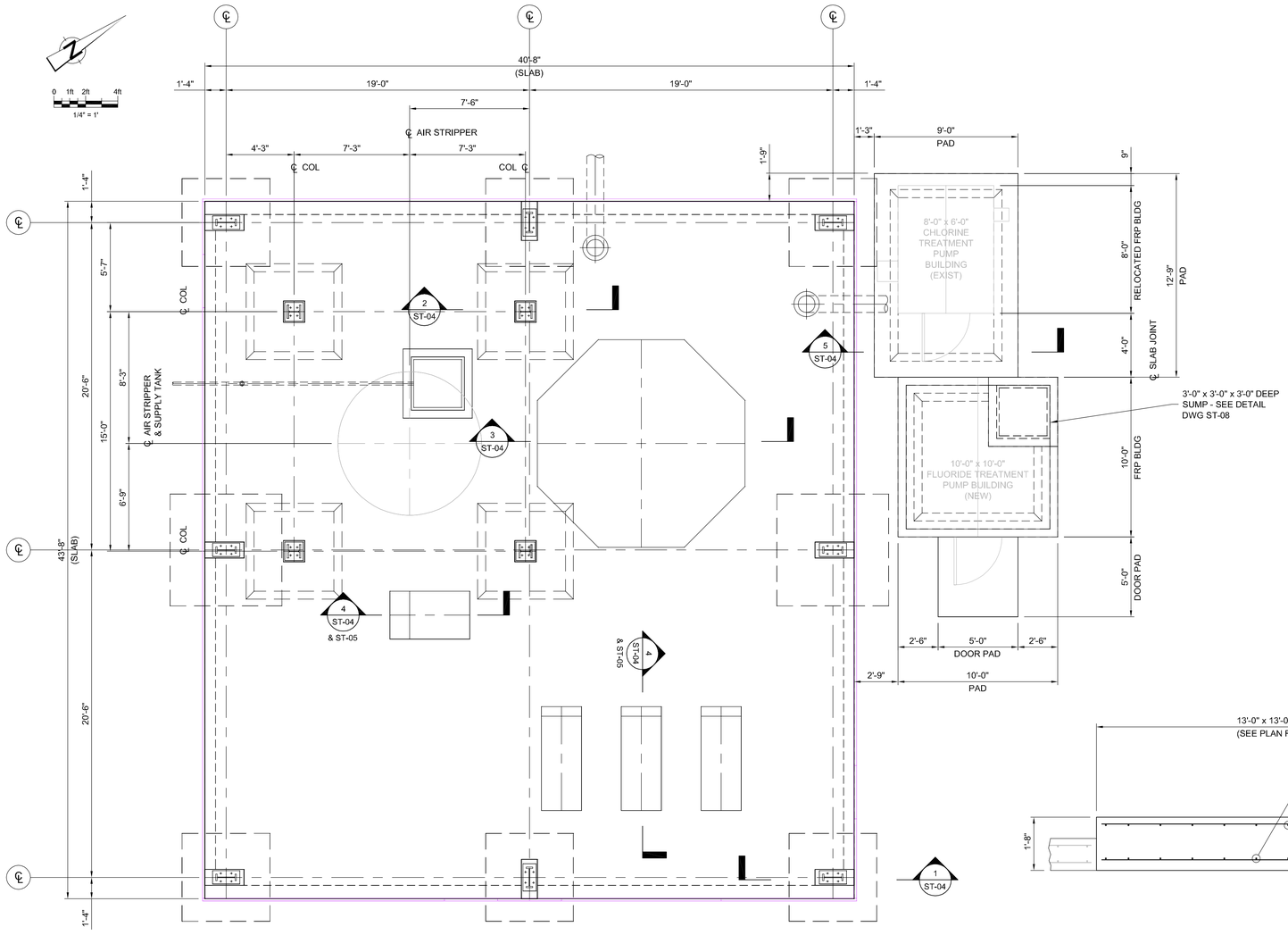
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
ELEVATIONS

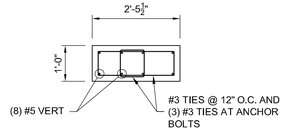
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. THORNTON	Designed By: L. ARMBRUSTER	Drawn By: Z. MATUSZEWSKI
Scale: 3/16"=1'-0"	Project No: 19190-03	Report No: 021	Drawing No: ST-03

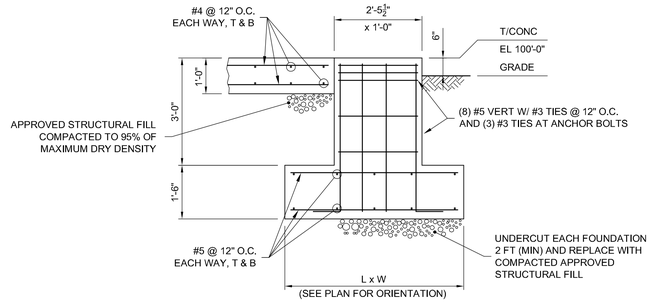
19190-03(021)ST-BU002 JAN 30/2009



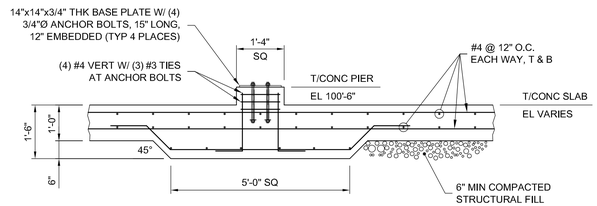
TREATMENT BUILDING
EXTERIOR PAD LAYOUT
1/4" = 1'-0"



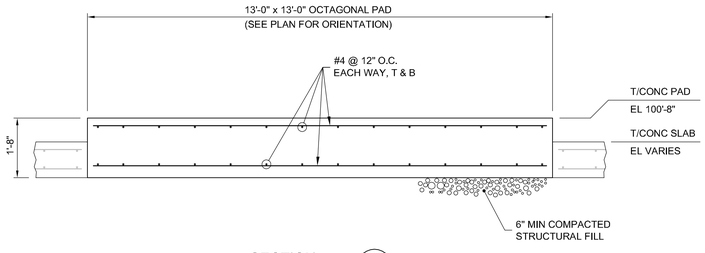
PIER DETAIL



SECTION 1
1/2" = 1'-0"



SECTION 2
1/2" = 1'-0"



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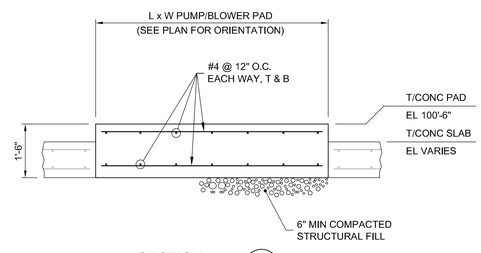

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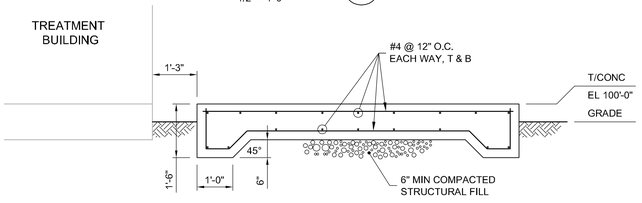

SECTION 5
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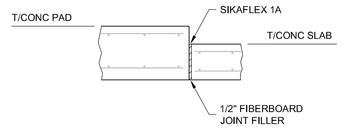

JOINT FILLER DETAIL
1/2" = 1'-0"

REFERENCE ELEVATION 100'-0" SHOWN FOR TREATMENT BUILDING
CORRESPONDS TO ELEVATION 524'-0" ABOVE MEAN SEA LEVEL (AMSL)

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY:

No	Revision	Date	Initial
C	ISSUED FOR 100% DESIGN	01/30/09	JJ
B	ISSUED FOR 95% DESIGN	11/21/08	JJ
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CITY OF ATTICA
ATTICA, INDIANA

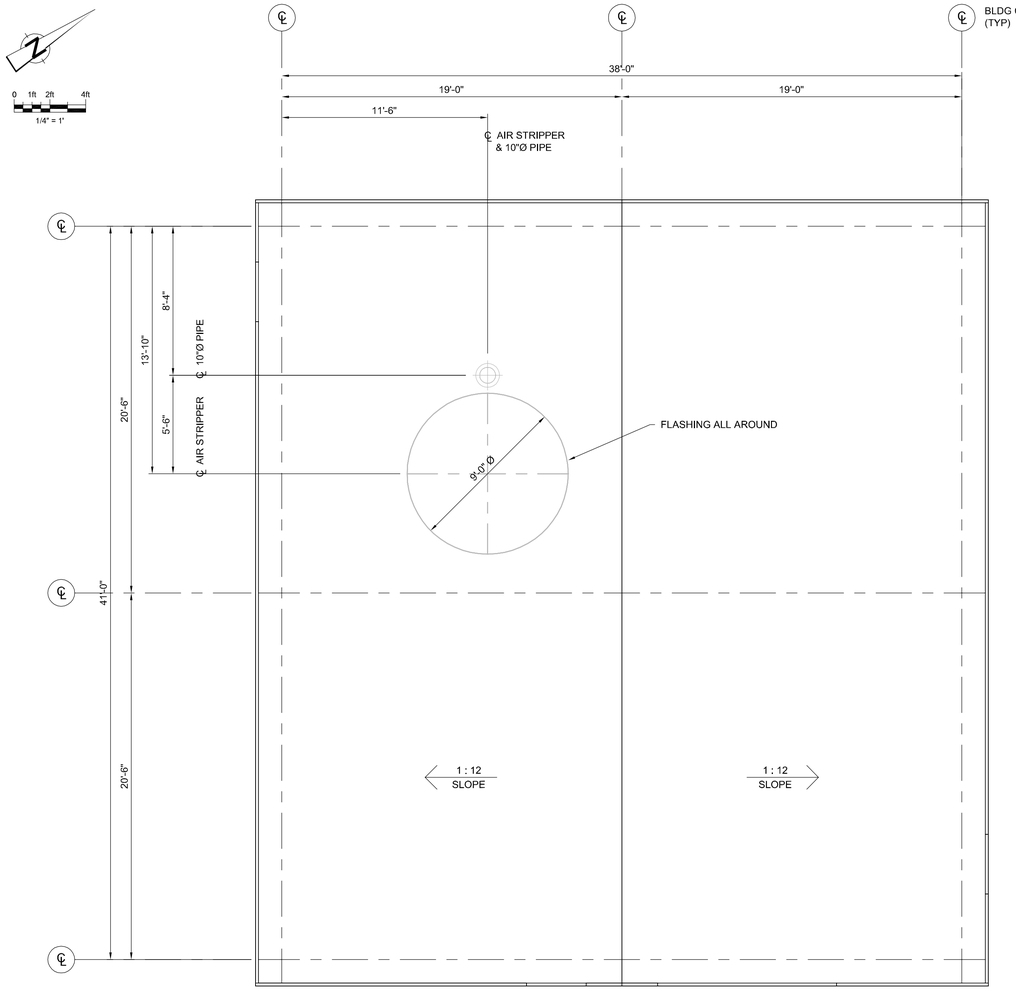
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
FOOTING AND PAD DETAILS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. THORNTON	Designed By: L. ARMBRUSTER	Drawn By: Z. MATUSZEWSKI
Scale: 1/4"=1'-0"	Project No: 19190-03	Report No: 021	Drawing No: ST-04

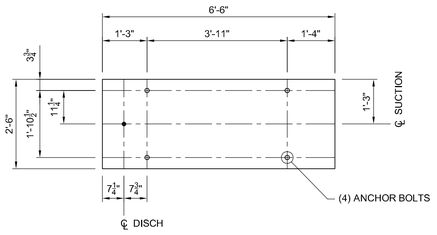
19190-03(021)ST-BU003 JAN 30/2009



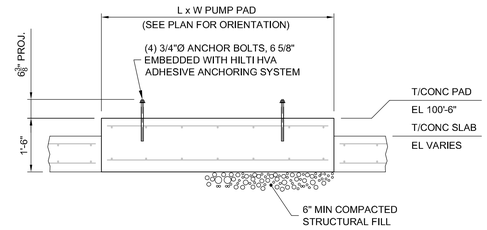
TREATMENT BUILDING ROOF PLAN

1/4" = 1'-0"

REFERENCE ELEVATION 100'-0" SHOWN FOR TREATMENT BUILDING CORRESPONDS TO ELEVATION 524'-0" ABOVE MEAN SEA LEVEL (AMSL)



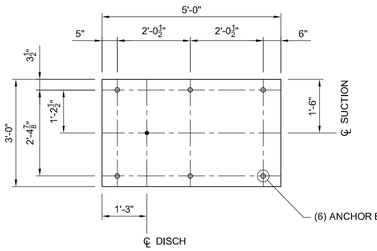
PLAN VIEW



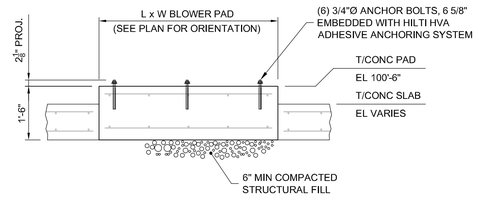
SECTION

PUMP ANCHOR LAYOUT

1/2" = 1'-0"



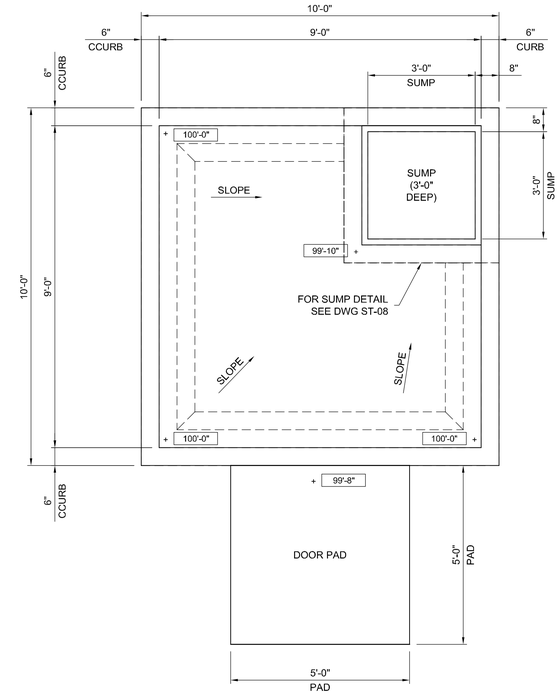
PLAN VIEW



SECTION

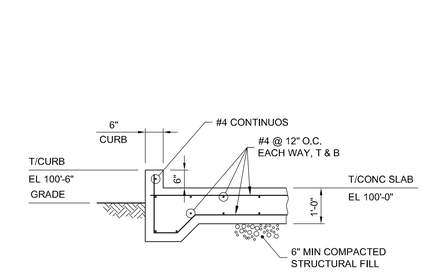
BLOWER ANCHOR LAYOUT

1/2" = 1'-0"



FLUORIDE TREATMENT PUMP BLDG PAD

1/2" = 1'-0"



CURB DETAIL

1/2" = 1'-0"

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

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B	ISSUED FOR 100% DESIGN	01/30/09	JJ
A	ISSUED FOR 95% DESIGN	11/21/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

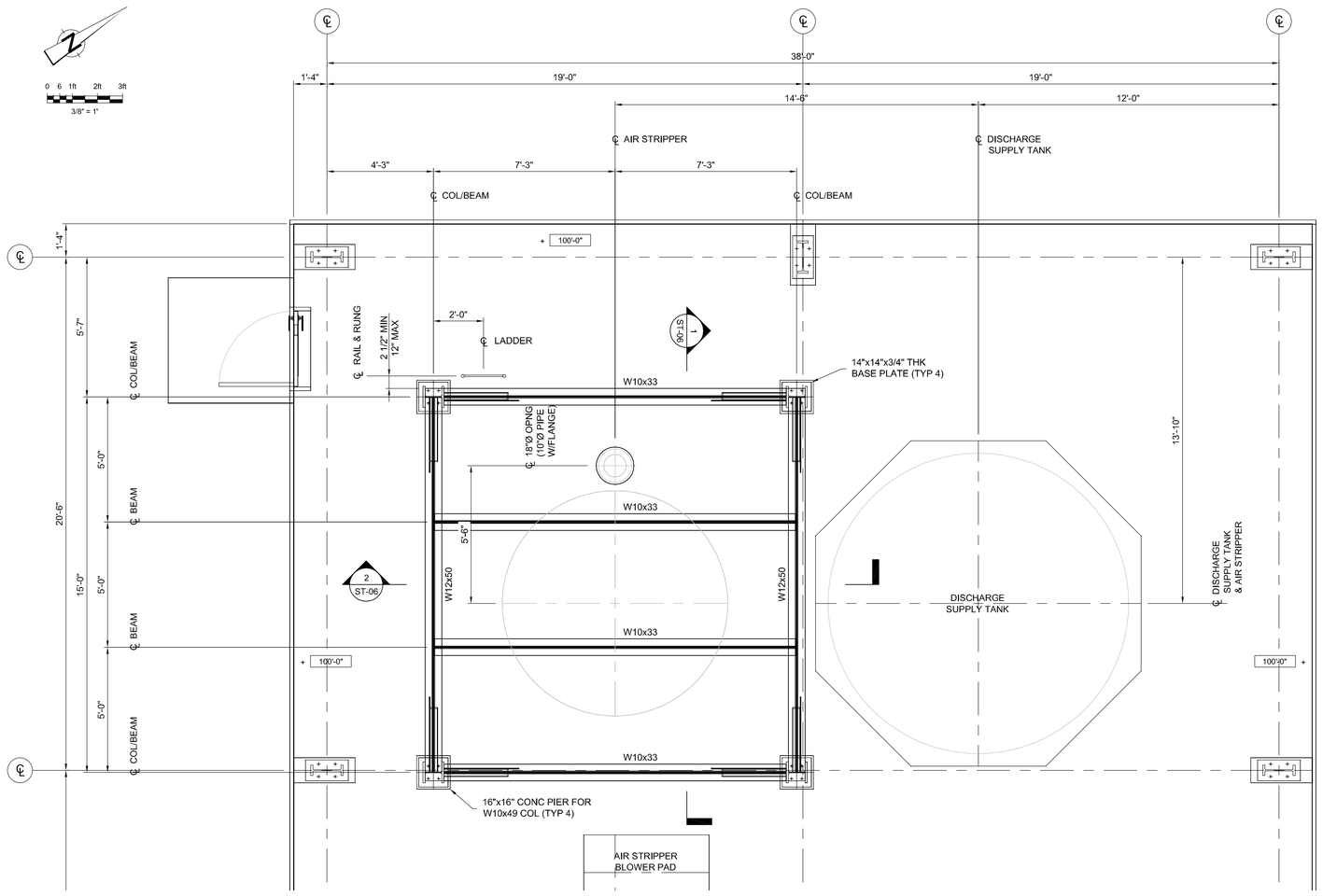
CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
ROOF PLAN AND PAD DETAILS

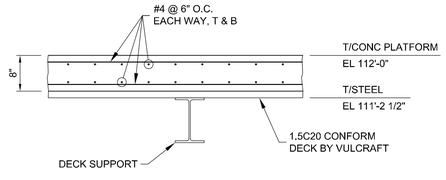
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. THORNTON	Designed By: L. ARMBRUSTER	Drawn By: Z. MATUSZEWSKI
Scale: 1/4"=1'-0"	Project No: 19190-03	Report No: 021	Drawing No: ST-05

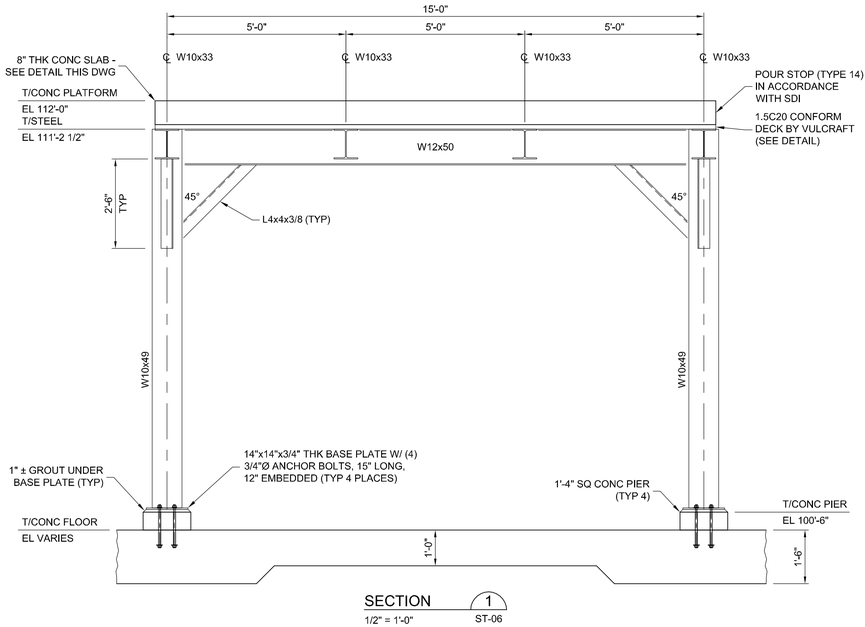
19190-03(021)ST-BU004 JAN 27/2009



AIR STRIPPER PLATFORM
PLAN
3/8" = 1'-0"



CONCRETE DECK DETAIL
3/4" = 1'-0"



SECTION 1
1/2" = 1'-0" ST-06

SECTION 2
1/2" = 1'-0" ST-06

REFERENCE ELEVATION 100'-0" SHOWN FOR TREATMENT BUILDING
CORRESPONDS TO ELEVATION 524'-0" ABOVE MEAN SEA LEVEL (AMSL)

100% REVIEW DRAWINGS
NOT FOR CONSTRUCTION

SCALE VERIFICATION: THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial
B	ISSUED FOR 100% DESIGN	01/30/09	JJ
A	ISSUED FOR 95% DESIGN	11/21/08	JJ

CITY OF ATTICA
ATTICA, INDIANA

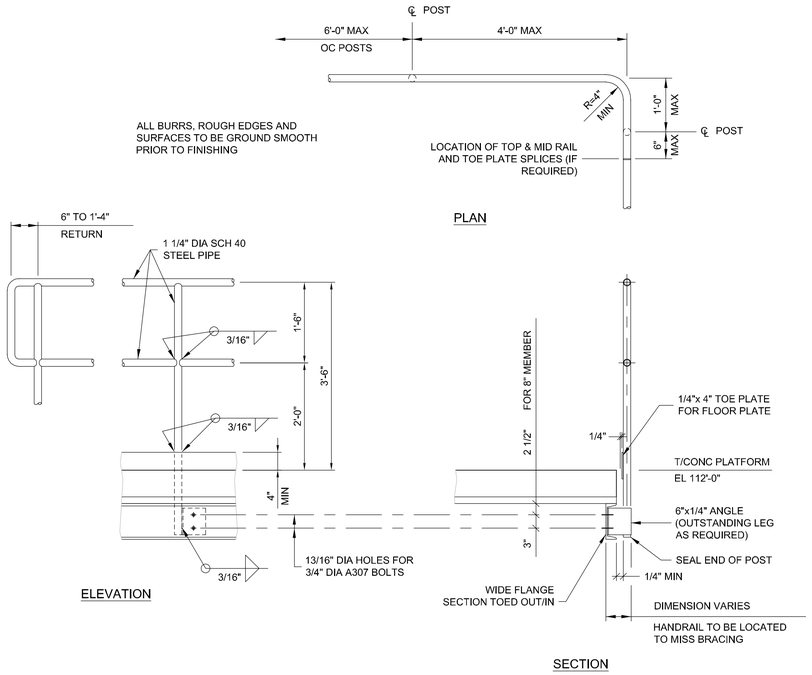
CITY WATER TREATMENT SYSTEM

AIR STRIPPER PLATFORM
PLAN, SECTION & DETAILS

CONESTOGA-ROVERS & ASSOCIATES

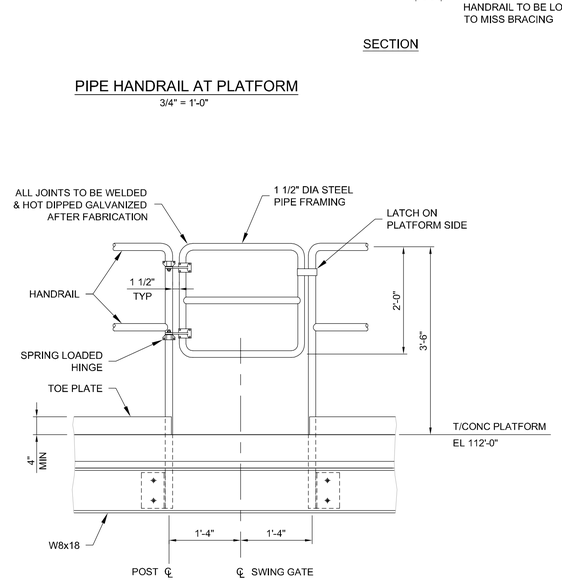
Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. THORNTON	Designed By: L. ARMBRUSTER	Drawn By: Z. MATUSZEWSKI
Scale: 3/8"=1'-0"	Project No: 19190-03	Report No: 021	Drawing No: ST-06

19190-03(021)ST-BU005 JAN 26/2009



PIPE HANDRAIL AT PLATFORM

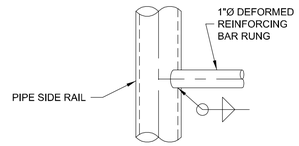
3/4" = 1'-0"



CONTRACTOR MAY USE DOUBLE BAR POLYURETHANE SAFETY GATE WITH GALVANIZED HARDWARE BY INTREPID INDUSTRIES INC, LA PORTE, TEXAS (PHONE: 281-479-8301, WEB: WWW.INTREPIDINDUSTRIES.COM)

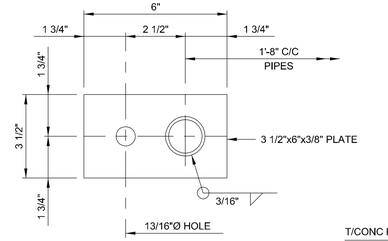
SAFETY GATE

3/4" = 1'-0"



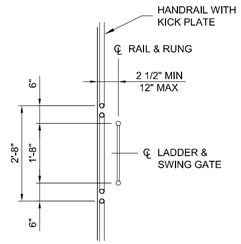
RUNG

NTS

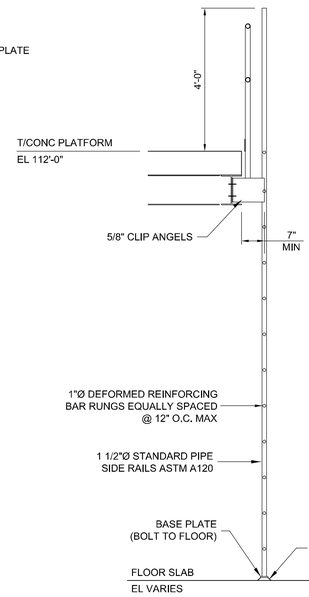


BASE PLATE

3" = 1'-0"



PLAN



ELEVATION

STEP THROUGH LADDER

1/2" = 1'-0"

REFERENCE ELEVATION 100'-0" SHOWN FOR TREATMENT BUILDING CORRESPONDS TO ELEVATION 524'-0" ABOVE MEAN SEA LEVEL (AMSL)

100% REVIEW DRAWINGS
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CITY OF ATTICA
ATTICA, INDIANA

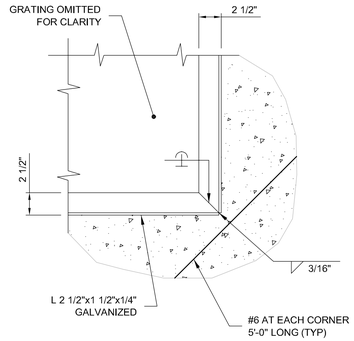
CITY WATER TREATMENT SYSTEM

AIR STRIPPER PLATFORM
LADDER AND RAILING DETAILS

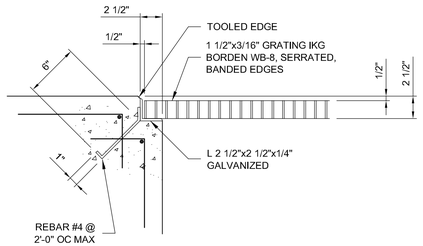
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. THORNTON	Designed By: L. ARMBRUSTER	Drawn By: Z. MATUSZEWSKI
Scale: 3/8"=1'-0"	Project No: 19190-03	Report No: 021	Drawing No: ST-07

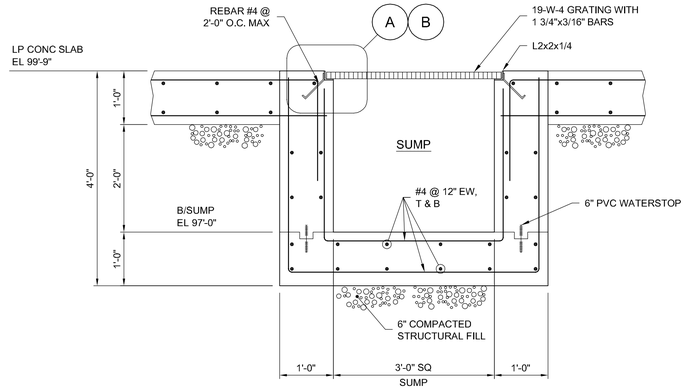
19190-03(021)ST-BU005 JAN 26/2009



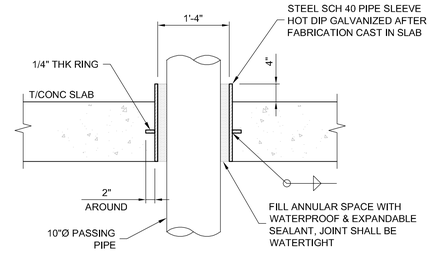
DETAIL A
1 1/2"=1'-0"



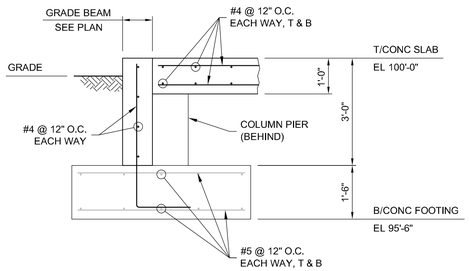
DETAIL B
1 1/2"=1'-0"



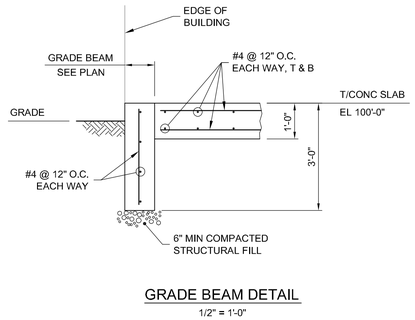
TYPICAL SUMP DETAIL
3/4" = 1'-0"



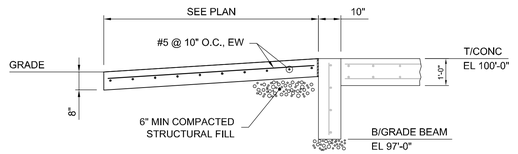
PIPE SLEEVE AT PLATFORM
NTS



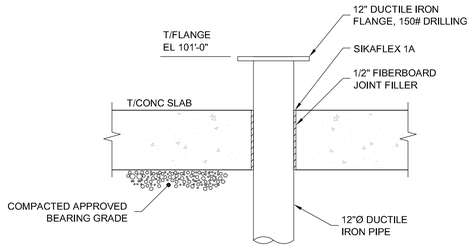
GRADE BEAM AT FOOTER DETAIL
1/2" = 1'-0"



GRADE BEAM DETAIL
1/2" = 1'-0"

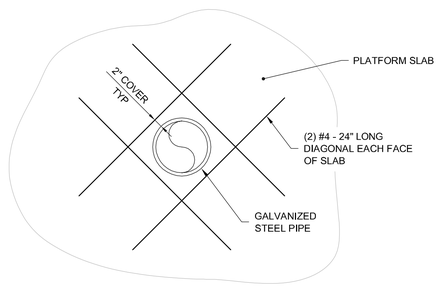


RAMP DETAIL
3/8"=1'-0"



PIPE SLEEVE AT FLOOR SLAB (TYP 2 PLACES)
NTS

DOOR PAD DETAIL
NTS



REINFORCEMENT AROUND PIPE
NTS

REFERENCE ELEVATION 100'-0" SHOWN FOR TREATMENT BUILDING
CORRESPONDS TO ELEVATION 524'-0" ABOVE MEAN SEA LEVEL (AMSL)

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CITY OF ATTICA
ATTICA, INDIANA

CITY WATER TREATMENT SYSTEM

TREATMENT BUILDING
CONCRETE DETAILS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:			Date: AUGUST 2008
Project Manager: S. WANNER	Reviewed By: J. THORNTON	Designed By: L. ARMBRUSTER	Drawn By: Z. MATUSZEWSKI
Scale: 1/4"=1'-0"	Project No: 19190-03	Report No: 021	Drawing No: ST-08

19190-03(021)ST-BU006 JAN 30/2009

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SECTION 01400

QUALITY REQUIREMENTS

1.1 SECTION INCLUDES

A. Quality control.

B. Tolerances.

C. References.

D. Inspecting and testing services.

E. Manufacturers' field services and reports.

F. Measurement and payment.

1.2 QUALITY CONTROL

A. Monitor quality control over Suppliers, products, services, the Site conditions, and workmanship, to produce Works of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with the contract documents, we request clarification from ENGINEER before proceeding.

D. Comply with specified standards as minimum quality for the Works except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work by persons qualified to produce workmanship of specified quality. Use persons licensed to perform the Works where required by these Specifications or Laws and Regulations.

F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

G. Materials furnished and finished or intermediate stages of the Works shall be sampled, tested, and inspected as specified in individual Sections and as required by reference standards.

1.3 TOLERANCES

A. Monitor tolerance control of installed products to produce acceptable Works. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with the contract documents, request clarification from ENGINEER before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable Laws and Regulations.

B. Specific provisions of Laws or Regulations may be referenced in the Project Specifications to assist CONTRACTOR and identify options selected by ENGINEER. Such references do not relieve CONTRACTOR from compliance with other applicable provisions of Laws or Regulations not specifically referenced.

C. No inference or provision of any reference document including but not limited to any standard specification, manual, or code shall be effective to change the relationships, duties, and responsibilities of OWNER, CONTRACTOR, or ENGINEER from those set forth in the contract documents, nor shall it be effective to assign to OWNER or ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Works or any duty or authority to undertake responsibility inconsistent with the provisions of the contract.

D. Publications referred to in these Specifications form part of the Specifications to the extent specified in individual Sections.

E. In case of conflict or discrepancy between a reference standard and the Project Specifications or with another reference standard, the more stringent requirements shall apply.

F. Should specified reference standards conflict with the contract documents, we request clarification from ENGINEER before proceeding.

1.5 INSPECTING AND TESTING SERVICES

A. OWNER shall employ and pay for services of an independent inspecting company and testing laboratory to perform inspecting and testing services as specified in individual Sections.

B. CONTRACTOR Responsibilities:

1. Deliver to inspecting company and testing laboratory at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs for concrete, and other material mixes that require testing by inspecting and testing laboratory.

2. Cooperate with personnel of independent inspecting company and testing laboratory, and provide safe access to the Works and to manufacturer's operations.

3. Provide incidental labor and facilities:

    1. To provide access to the Works to be tested.

    2. To obtain and handle samples at the Site or at source of products to be tested.

    3. To facilitate tests and inspections.

    4. For inspecting company and testing laboratory's exclusive use for storage and curing of test samples.

    5. Forms for preparing concrete test beams and cylinders.

4. Notify ENGINEER and inspecting company and testing laboratory 24 hours prior to expected time for operations requiring inspecting and testing services to allow for assignment of personnel and scheduling of tests.

5. Furnish copies of product test reports.

6. Promptly notify ENGINEER of all observed irregularities or non-conformance of the Works.

7. Retesting required because of CONTRACTOR negligence or non-conformance to specified requirements shall be performed by the same inspecting and testing laboratory on instructions by ENGINEER at CONTRACTOR's expense and at no additional cost to OWNER.

8. If defects or deficiencies are revealed during testing or inspecting, correct such defects and deficiencies and retest affected portions of the Works.

1.6 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual Sections, require Suppliers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, perform startup of equipment, test, adjust, and balance of equipment and certify operation as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to ENGINEER 30 days in advance of required observations. Observer subject to approval of OWNER.

C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

D. Submit report within 14 days of observation to ENGINEER for information.

END OF SECTION

SECTION 01610

TRANSPORTATION AND HANDLING OF MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The CONTRACTORS responsibilities relative to the transportation and handling of materials and equipment.

1.02 RELATED SECTIONS

A. Section 01620 – Storage of Materials.

1.03 TRANSPORTATION AND HANDLING

A. The CONTRACTOR shall make all arrangements for transportation, delivery and handling of equipment and materials required for prosecution and completion of the Work.

B. Shipments of materials to CONTRACTOR or Subcontractors shall be delivered to the site only during regular working hours. Shipments shall be addressed and consigned to the CONTRACTOR giving name of Project, street number and city. Shipments shall not be delivered to OWNER except where otherwise directed.

C. If necessary to move stored materials and equipment during construction, CONTRACTOR shall move or cause to be moved materials and equipment without any additional compensation.

1.04 DELIVERY

A. Arrange deliveries of products in accordance with construction schedules and in ample time to facilitate inspection prior to installation.

B. Coordinate deliveries to avoid conflict with Work and conditions at site and to accommodate the following:

1. Work of other CONTRACTORS or OWNER.

2. Limitations of storage space.

3. Availability of equipment and personnel for handling products.

4. OWNER'S use of premises.

C. Do not have products delivered to project site until related Shop Drawings have been approved by the ENGINEER.

D. Do not have products delivered to site until required storage facilities have been provided.

E. Have products delivered to site in manufacturer's original, unopened, labeled containers. Keep ENGINEER informed of delivery of all equipment to be incorporated in the Work.

F. Partial deliveries of component parts of equipment shall be clearly marked to identify the equipment, to permit easy accumulation of parts and to facilitate assembly.

G. Immediately upon delivery. inspect shipment to assure:

1. Product complies with requirements of Contract Documents and reviewed submittals.

2. Quantities are correct.

3. Containers and packages are intact; labels are legible.

4. Products are properly protected and undamaged.

1.05 PRODUCT HANDLING

A. Provide equipment and personnel necessary to handle products, including those purchased by OWNER, by methods to prevent soiling or damage to products or packaging.

B. Provide additional protection during handling as necessary to prevent scraping, marring, or otherwise damaging products or surrounding surfaces.

C. Handle products by methods to prevent bending or overstressing.

D. Lift heavy components only at designated lifting points.

E. Materials and equipment shall at all times be handled in a safe manner and as recommended by manufacturer or supplier so that no damage will occur to them. Do not drop, roll, or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01620

STORAGE OF MATERIAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The definition of the minimum requirements of the storage of material, by material type and protection required.

1.02 RELATED SECTIONS

A. Section 01610 – Transportation and Handling of Materials and Equipment.

1.03 STORAGE OF MATERIAL

A. Store and protect materials in accordance with recommendations of the manufacturer and requirements of Specifications.

B. CONTRACTOR shall make all arrangements and provisions necessary for the storage of materials and equipment.

C. All excavated materials, construction equipment, and materials and equipment to be incorporated into the Work shall be placed so as not to injure any part of the Work or existing facilities and so that free access can be had at all times to all parts of the Work and to all public utility installations in the vicinity of the Work.

D. Materials and equipment shall be kept neatly and compactly stored in locations that will cause a minimum of inconvenience to other contractors, public travel, adjoining OWNERS, tenants, and occupants. Arrange storage in a manner to provide easy access for inspection.

E. Areas available on the construction site for storage of material and equipment shall be as shown or approved by the ENGINEER.

F. Materials and equipment which are to become the property of the OWNER shall be stored to facilitate their inspection and insure preservation of the quality and fitness of the Work, including proper protection against damage by freezing and moisture. They shall be placed inside storage areas unless otherwise acceptable to OWNER.

G. Lawns, grass plots, or other private property shall not be used for storage purposes without written permission of the OWNER or other person in possession or control of such premises.

H. CONTRACTOR shall be fully responsible for loss or damage to stored materials and equipment.

I. Do not open containers of the manufacturer until time of installation unless recommended by the manufacturer or otherwise specified.

J. Do not store products in the structures being constructed unless approved in writing by the ENGINEER.

1.02 UNCOVERED STORAGE

A. The following types of materials may be stored out-of-doors without cover:

1. Reinforcing steel.

2. Precast concrete items.

3. Masonry block and brick.

4. Castings.

5. Manholes and exterior buried pipe.

B. Store the above materials on wood blocking so there is no contact with the ground.

1.03 COVERED STORAGE

A. The following types of materials may be stored out-of-doors if covered with material impervious to water:

1. Rough lumber.

2. Piping.

B. Tie down covers with rope and slope to prevent accumulation of water on covers.

C. Store materials on wood blocking.

1.04 FULLY PROTECTED STORAGE

A. Store all products not named above in buildings or trailers which have a concrete or wooden floor, a roof, and fully closed walls on all sides.

B. Provide heated storage space for materials which would be damaged by freezing.

C. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.

D. Maintain humidity at levels recommended by manufacturers for electrical and electronic equipment.

1.05 MAINTENANCE OF STORAGE

A. Maintain periodic system of inspection of stored products on scheduled basis to assure that:

1. State of storage facilities is adequate to provide required conditions.

2. Required environmental conditions are maintained on continuing basis.

3. Products exposed to elements are not adversely affected.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

SECTION 01630

SUBSTITUTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submission Procedures

B. CONTRACTOR responsibilities.

C. Acceptance Criteria.

D. Engineering Costs.

1.02 RELATED SECTIONS

A. All technical sections of these specifications.

1.03 SUBMITTALS

A. Any item substituted as an "or equal" shall be considered a substitution.

B. Within thirty (30) days after execution of Agreement, ENGINEER will consider formal request from CONTRACTOR for substitution of products or construction methods.

C. Within thirty (30) days after execution of Agreement, submit five (5) copies of complete list of products proposed for substitution in the Work tabulated by Sections and with complete data and identification. Include in the submission the following:

1. Complete data substantiating compliance of proposed substitution with Contract Documents.

2. For products:

a. Product identification, including the name and address of the manufacturer.

b. Literature of the manufacturer complete with product description, performance and test data, and reference standards.

c. Samples.

d. Name and address of similar projects on which product was used, and date of installation.

3. For construction methods:

a. Detailed description of proposed method.

b. Drawings illustrating methods.

c. Itemized comparison of proposed substitution with product or method specified.

d. Data relating to changes in construction schedule.

e. Relation to separate contracts, if any.

f. Accurate cost data on proposed substitution in comparison with product or method specified.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. In making request for substitution the CONTRACTOR represents:

1. CONTRACTOR has personally investigated proposed product or method, and determined that it is equal or superior in all respects to that specified.

2. CONTRACTOR will provide the same or better guarantee for substitution as for product or method specified.

3. CONTRACTOR will coordinate installation of accepted substitution into Work, making such changes as required in all respects.

4. CONTRACTOR waives all claims for additional costs related to substitution that consequently becomes apparent.

5. Cost data is complete and includes all related costs under this Contract.

1.05 ACCEPTANCE CRITERIA

A. ENGINEER will determine whether substitute brands or products are equal to those specified in the Contract Documents.

B. If the ENGINEER determines that a substitute is not equal to that named in the specification, the CONTRACTOR shall furnish one of the brands or products specified, at no additional cost to the OWNER.

C. Substitutions will not be accepted if:

1. They are only shown or implied on Shop Drawings.

2. Acceptance will require substantial revision of Contract Documents.

3. Substitutions would change design concepts or Specifications.

4. Substitutions would delay completion of the Work.

5. Substitutions involve items for which a manufacturer was declared at time of bidding.

6. Substitution is not compatible with existing equipment.

1.06 ENGINEERING COSTS

A. CONTRACTOR shall reimburse the OWNER for actual evaluation costs of ENGINEER and his consultants if:

1. Proposed substitute does not meet requirements of the Contract Drawings and Specifications and is rejected.

2. Acceptance of proposed substitute requires changes to the Work.

B. CONTRACTOR shall reimburse OWNER for all associated engineering costs, including redesign, additional Shop Drawing reviews, investigations, consultant fees, and revision of the Contract Documents required because of the substitution.

C. Costs of ENGINEER shall be the sum of the following:

1. Salary costs.
2. Overhead costs.
3. Out-of-pocket costs.
4. Consultant fees.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

SECTION 01650

FIELD TESTS OF EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Definition of CONTRACTOR'S responsibility in the startup, commission, and testing of equipment installed under this Contract.

1.02 RELATED SECTIONS

A. Section 01010 - Summary of Work.

B. Section 01660 – Starting of Systems.

C. Section 01700 – Contract Closeout.

1.03 SUBMITTALS

A. CONTRACTOR shall submit a testing plan for each piece of equipment for the OWNER'S/ENGINEER'S approval. The plan shall include, at a minimum, items defined below in Preliminary and Final Testing.

1.04 PRELIMINARY TESTS

A. CONTRACTOR shall make preliminary field tests of equipment as soon as conditions permit. This shall include, but not be limited to, the following:

1. Verification, proper and complete, of lubrication.

2. Verification of electric power, wiring phasing and capacity.

3. Verification of mechanical adjustments and alignments (i.e., seals, couplings, bolt tension, etc.).

4. Verification of operation of ancillary systems such as seal water, lube and cooling water systems, etc.

5. Verification of proper rotation.

6. Verification of foundation and anchor integrity.

B. CONTRACTOR shall furnish all water or chemicals, labor, materials, instruments, fuel, incidentals, and expendables required, unless otherwise provided. Locations of temporary connections for obtaining water shall be designated at the time of approval of CONTRACTOR'S proposed testing plan and schedule.

C. CONTRACTOR shall make all changes, adjustments and replacements required to place equipment in service.

D. OWNER shall provide water for initial field test of equipment. If repeated field tests of equipment are necessary, CONTRACTOR shall pay to the OWNER all costs for water supplied.

E. ENGINEER shall be given sufficient prior notice to witness tests.

1.05 FINAL TESTS

A. Upon completion of the Work, but prior to final acceptance, CONTRACTOR shall perform final field testing on all equipment.

B. CONTRACTOR shall provide the services of the manufacturer's field service representative for the duration of final testing. The field services representative shall be knowledgeable in the startup and troubleshooting of the equipment, and be capable of inspection of equipment installation and approval of the same for operation and acceptable installations.

C. Purpose of the tests is to demonstrate that equipment is:

1. Properly installed. This shall include, but not be limited to, the following:

a. Equipment operates within vibration and temperature tolerances.

b. Equipment can complete intended operation without bending or overload.

2. Completely ready for operation by the OWNER. This shall include, but not be limited to, the following:

a. All controls are in place and function properly, as designed. Equipment sequence, as specified.

b. All subsystems in place and function properly, as designed.

3. In compliance with design conditions and all other Contract Document requirements. This shall include, but not be limited to, the following:

a. Pumps operate at specified design condition through these ranges of operations.

b. Filters and filter backwashes operate at specified design conditions through these ranges of operations.

c. Miscellaneous instruments operate at specified design conditions through these ranges of operations.

d. Heating, ventilation, dehumidification, and cooling equipment operate as specified.

D. CONTRACTOR shall furnish all labor, materials, instruments, and expendables required for the tests.

E. Until final field tests are completed and approved, CONTRACTOR shall make all necessary changes, adjustments and replacements.

F. CONTRACTOR shall submit a written report of equipment testing including alignment results, lubrication verification (quantity and type), etc.

G. CONTRACTOR shall notify ENGINEER at least 24 hours prior to beginning of tests. CONTRACTOR shall keep notes and data on tests and submit copy to the ENGINEER. ENGINEER and OWNER'S operating personnel shall witness all tests.

PART 2 - PRODUCTS – NOT USED.

PART 3 - EXECUTION – NOT USED.

END OF SECTION

SECTION 01660

STARTING OF SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Starting systems.

B. Demonstration and instructions.

1.02 RELATED SECTIONS

A. Section 01010 – Summary of Work.

B. Section 01700 - Contract Closeout.

C. Section 01650 - Field Tests of Equipment.

1.03 SUBMITTALS

A. CONTRACTOR shall submit a System Startup Plan for each system for the OWNER/ENGINEER'S approval. The Plan shall include at a minimum equipment involved, required personnel involvement, schedule, and proposed startup methodology.

1.04 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment systems with the OWNER and all other CONTRACTORS involved in the installation and successful completion of the system.

B. Notify the ENGINEER and OWNER a minimum of seven (7) days prior to start-up of each item.

C. Verify field testing of equipment within the system is complete (refer to Section 01650).

D. Execute startup of systems under supervision of applicable personnel (either the personnel of the CONTRACTOR or the personnel of the manufacturer as specified in the individual technical Specification Sections) in strict accordance with the instructions of the manufacturer.

E. Systems at a minimum shall be cycled through a complete sequence from start to finish, all safety interlocks and controls shall be verified, system capacity and volumes shall be confirmed.

F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

1.05 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to the personnel of the OWNER a minimum of two (2) weeks prior to date of Substantial Completion.

B. Demonstrate new project equipment and instruct the personnel of the OWNER in a classroom type environment by a qualified representative of the manufacturer who is knowledgeable about the project.

C. For equipment or systems requiring seasonal operation, perform demonstration for other season prior to the beginning of the season when the equipment will be utilized.

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with the personnel of the OWNER.

E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at the agreed upon time, at a designated location.

F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 01700

EXECUTION REQUIREMENTS

1.1 SECTION INCLUDES

A. Examination.

B. Preparation.

C. Field surveying.

D. Restoration.

E. Progress cleaning.

F. Final cleaning.

G. Removal and disposal.

H. Starting and adjusting.

I. Protection of installed work.

J. Closeout procedures.

K. Project record documents.

L. Spare parts, maintenance materials, and extra materials.

M. Operation and maintenance data.

N. Warranties.

O. Measurement and payment.

1.2 EXAMINATION

A. Prior to commencement of work at the Site, inspect the Site with ENGINEER to review and establish the condition of surface features including existing roads, parking areas, buildings, wells, trees and other plants, grassed areas, fencing, service poles, wires, paving, and survey bench marks or monuments on or adjacent to the Site which may be affected by the Works. This inventory shall be mutually agreed between ENGINEER and CONTRACTOR and shall not thereafter be subject to dispute. Such inventory as may be amended, from time to time, will be used by ENGINEER to check compliance by CONTRACTOR with the requirements of the contract documents.

B. Provide ongoing review, inspection, and attendance during performance of the Works to properly document conditions. Promptly inform ENGINEER of any existing condition at the Site affected by the Works, which may require restoration, repair, or replacement. Do not cover up any of the Works without prior approval from ENGINEER.

C. Maintain and protect existing Site structures and facilities from damage which may be affected by the Works while work is in progress. Repair or replace damage resulting from the Works to ENGINEER's approval.

D. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance by CONTRACTOR of existing conditions.

E. Verify that existing substrate is capable of structural attachment of new work being applied or attached or that existing or previously constructed surfaces are ready to receive subsequent work.

F. Examine and verify specific conditions described in individual Sections.

G. Verify that utility services are available, of the correct characteristics, and in the correct location.

1.3 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

1.4 FIELD SURVEYING

A. Quality Assurance:

1. Employ a land surveyor registered in the State of Indiana and acceptable to ENGINEER to perform survey work of this Article.

2. ENGINEER may, at any time, check CONTRACTOR's survey and layout work but this shall not relieve CONTRACTOR of any of its responsibilities to carry out the Works to the lines and grades set out in accordance with the Drawings and the Project Specifications or as otherwise necessary for performance of the Works in accordance with the contract documents.

B. Record Documents:

1. Maintain a complete and accurate log of control and survey work as it progresses.

2. Prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction, and the Site work.

3. Submit record documents under provisions of Article 1.12.

C. Survey Reference Points:

1. Locate, preserve, and protect survey control and reference points.

2. Control datum for survey is that established by OWNER.

3. Promptly report to ENGINEER the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

4. Make good any errors entering into the Works through CONTRACTOR failure to notify ENGINEER concerning lack of preservation of such survey reference points.

5. Accurately replace or relocate disturbed reference or survey control points based on original survey control. Make no changes without prior written notice to and approval of ENGINEER.

D. Survey Requirements:

1. Utilize recognized engineering survey practices. Locate and lay out the Works using properly calibrated instrumentation.

2. Establish elevations, lines, and levels.

3. Periodically verify layouts by same means and methods.

4. Establish a minimum of two temporary bench marks on the Site, referenced to established control points. Record locations, with horizontal and vertical data, on Project record documents.

5. Provide reasonable and necessary opportunities and facilities for setting points and making measurements during construction.

6. Develop and make such additional detailed surveys as are needed for construction, such as bench marks, slope stakes, batterboards, stakes for establishing the design elevations of excavations and final grades, and other working points, lines, and elevations. Maintain bench marks and base lines established, existing property boundaries, lines and grade hubs, and other references and construction or survey points.

1.5 RESTORATION

A. As a minimum, restoration shall mean replacement, repairs, or reconstruction to a condition at least as good as or better than the condition prior to commencement of the Works.

B. Except where specifically required otherwise by other Sections, restore areas of the Works and areas affected by the performance of the Works to conditions that existed prior to commencement of the Works and to match condition of similar adjacent, undisturbed areas.

C. Ensure that restored areas match existing grade and surface drainage characteristics, except as otherwise specified, and ensure a smooth transition from restored surfaces to existing surfaces.

D. Do not alter original conditions without prior written approval from ENGINEER.

E. Without limiting the generality of the foregoing or other requirements of the contract documents, preserve and protect existing features encountered at the Site during the performance of the Works including, but not limited to buildings, wells, structures, curbs and gutters, fences, pavement, manholes and catch basins, utilities, railroad sidings, roads, streets, walks, grassed areas, and other graded or improved areas.

F. Utilize construction methods and procedures during the performance of the Works which keeps disturbance and damage of whatever nature to existing conditions to the practical minimum. Where work necessitates root or branch cutting, do not proceed without ENGINEER's prior approval.

G. Ensure that quality, grades, elevations, and extent of bedding, cover, and other backfill materials including subgrades, finish grades, and thickness of pavements for roadways and parking areas are properly documented during their removal to ensure reconstruction to at least their original and functional condition.

H. Restoration Material: New, except as otherwise specified, not damaged or defective, and of the best quality for the purpose intended. Furnish evidence as to type, source, and quality of materials or products furnished when requested by ENGINEER or specified in other Sections.

I. Should any dispute arise as to the quality or fitness of materials, whether obtained on the Site or off the Site, whether previously inspected by ENGINEER prior to use or not, the decision to use any material or product in the finished Works will rest solely with ENGINEER.

J. Remove from the Site clean material not approved for reuse.

K. Handle and store products and materials in a manner to prevent damage, adulteration, deterioration, and soiling and in accordance with manufacturer's instructions when applicable.

L. Prior to commencement of restoration work, inform ENGINEER of proposed material, methods, and procedures to repair, replace, or reconstruct disturbed, damaged, or suspected damage to the Works.

M. Perform cutting, fitting, remedial, and coordination work to make the several parts of the Works fit together.

N. Except as specified otherwise, dismantle and salvage materials for reuse where practicable. Exercise due care when removing material for salvage. Repair or replace materials damaged through improper handling or through loss after removal.

O. Store and protect removed material approved for reuse in approved locations. Beginning of restoration work means acceptance of existing conditions.

P. Unless otherwise specified, restore pavement by:

1. Removing and replacing the entire portions between joints or scores and not merely refinishing or patching localized areas.

2. Saw cutting surfaces, curbs and gutters, and similar structures or surfaces.

3. Protecting adjacent joints and load transfer devices and underlying granular materials.

1.6 PROGRESS CLEANING

A. Execute cleaning during progress of the Works as required, but no less than daily.

B. Requirements of Regulatory Agencies:

1. In addition to the requirements herein, maintain the cleanliness of the Works and surrounding premises within the Works limits so as to comply with federal, state, and local fire and safety laws, ordinances, codes, and regulations.

2. Comply with all federal, state, and local anti-pollution laws, ordinances, codes, and regulations when disposing of waste materials, debris, and rubbish.

C. Coordinate cleaning operations with disposal operations to prevent accumulation of dust, dirt, debris, rubbish, and waste materials on or within the Works or on the premises surrounding the Works.

1.7 FINAL CLEANING

A. Execute final cleaning prior to Substantial Completion of the Works.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.

C. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

D. Clean debris from roofs, gutters, downspouts, and drainage systems.

E. Clean the Site; sweep paved areas, and rake clean landscaped surfaces.

F. Repair pavement, roads, sod, and all other areas affected by construction operations and restore them to original condition or to minimum condition specified.

G. Maintain cleaning until acceptance and occupation by OWNER.

1.8 REMOVAL AND DISPOSAL

A. Remove surplus materials and temporary facilities and controls from the Site.

B. Dispose of all non-contaminated waste materials, litter, debris, and rubbish off Site.

C. Do not burn or bury rubbish and waste materials on the Site.

D. Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.

E. Do not discharge wastes into streams or waterways.

F. Dispose of the following materials at an appropriate off-Site facility identified by CONTRACTOR and approved by OWNER:

1. Debris including excess construction material, non-contaminated litter and rubbish.

2. Spent Tyvek and other disposable PPE worn during final cleaning.

3. Soil cuttings.

4. Well development water.

G. Dispose of materials in accordance State of Indiana regulations and local requirements and as directed by ENGINEER.

1.9 STARTING AND ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

1.10 PROTECTION OF INSTALLED WORK

A. Protect installed work and provide special protection where specified in individual Sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic upon landscaped areas.

G. Maintenance of Flow: Maintain the flow of water in the water distribution system and in existing sewers, drains, and watercourses. In the event that any emergency or situation should arise which requires interruption of normal operation of any existing systems, restore normal operation as soon as possible even though permission for such planned shutdown was obtained.

H. Flotation: Take necessary precautions against the flotation of any structures during construction. Make good any damage caused by flotation.

1.11 CLOSEOUT PROCEDURES

A. Submit written certification that the contract documents have been reviewed, the Works has been inspected, and that the Works is complete in accordance with the contract documents and in compliance with Laws and Regulations including, but not limited to, the provision of all applicable federal, state, and local health, safety, and environmental laws and regulations, including OSHA, and ready for ENGINEER's review.

B. Submit final Application for Payment identifying previous payments and amounts remaining due.

C. Complete and furnish submittals to ENGINEER that are required by governing or other authorities and by the contract documents. Payment shall not become due and payable until all submittals have been made acceptable to ENGINEER.

1.12 PROJECT RECORD DOCUMENTS

A. Maintain one set of the following record documents on the Site; record actual revisions to the Works:

1. Drawings.

2. Specifications.

3. Change Orders and other modifications to the contract.

4. Reviewed Shop Drawings, product data, and Samples.

5. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by OWNER.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record, at each Section of the Specifications, a description of actual products installed, including the following:

1. Manufacturer's name and product model and number.

2. Product substitutions or alternates utilized.

3. Changes made by modifications.

F. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured depths of foundations in relation to finished floor datum.

2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Works.

4. Field changes of dimension and detail.

5. Details not on original Drawings.

G. Remove ENGINEER title block and seal from all documents generated by CONTRACTOR.

H. Submit documents to ENGINEER.

1.13 SPARE PARTS, MAINTENANCE MATERIALS, AND EXTRA MATERIALS

A. Provide products, spare parts, maintenance, and extra materials in quantities specified in individual Sections.

B. Deliver to the Site or other location to be specified; obtain receipt from ENGINEER or OWNER.

C. Provide list of spare parts and maintenance and extra materials furnished prior to final payment.

1.14 OPERATION AND MAINTENANCE DATA

A. Submit data bound in 8 1/2 by 11-inch text pages, 3-D side ring binders with durable plastic covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of Project, and subject matter of binder when multiple binders are required.

C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of ENGINEER, CONTRACTOR, Subcontractors, and major equipment Suppliers.

2. Part 2: Operation and maintenance instructions, arranged by process flow and subdivided by component. For each category identify names, addresses, and telephone numbers of Subcontractors and Suppliers. Identify the following:

1. Significant design criteria.

2. List of equipment.

3. Parts list for each component.

4. Operating instructions.

5. Maintenance instructions for equipment and systems.

3. Part 3: Project documents and certificates, including the following:

1. Shop Drawings and product data.

2. Certificates.

3. Photocopies of warranties and bonds.

E. Submit two draft copies of completed volumes 15 days prior to final inspection. These copies will be reviewed and returned, with ENGINEER's comments. Revise content of all document sets as required prior to final submission.

F. Submit three sets of revised final volumes within 15 days after final inspection.

1.15 WARRANTIES

A. Obtain warranties, executed in duplicate by responsible Subcontractors and Suppliers within 14 days after completion of the applicable item of work. Except for items put into use with OWNER's permission, leave date of beginning of time of warranty open until the date of Substantial Completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties until time specified for submittal.

E. Bind in commercial quality 8 1/2 by 11-inch 3-D side ring binders with durable plastic covers. Identify each binder with typed title WARRANTIES, with title of Project; name, address, and telephone number of CONTRACTOR and equipment Supplier; and name of responsible company principal. Neatly type Table of Contents, in the sequence of the Table of Contents of the contract documents, with each item identified with the number and title of the Section in which specified, and the name of the project or work item. Separate each warranty with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor and Supplier, with name, address, and telephone number of responsible principal.

F. Make submittals within 10 days after the date of Substantial Completion.

G. For items of the Works for which acceptance is delayed beyond the date of Substantial Completion, furnish updated submittal within 10 days after acceptance of the affected item. The date of acceptance of such item shall be the start of the warranty period for that item.

END OF SECTION

SECTION 01800

FACILITY OPERATION

1.1 SECTION INCLUDES

A. Definitions.

B. Progress submittals.

C. Closeout submittals.

D. Qualifications.

E. Pre-commissioning meeting.

F. Sequencing and scheduling.

G. Manufacturer's field services.

H. Commissioning.

I. Demonstration.

J. Training.

K. Turnover.

L. Commissioning report.

M. Schedules.

N. Measurement and payment.

1.2 DEFINITIONS

A. For commissioning purposes, the term "facility" means the Works of this contract entirely.

B. The term "commission" or "commissioning" means the overall process of starting, testing, adjusting, and balancing the various components, equipment, and subsystems of the facility to place the facility into a fully operational condition.

1.3 PROGRESS SUBMITTALS

A. Submit, 14 days prior to start of commissioning, 2 draft copies of the operations and maintenance manuals in accordance with Section 01700.

B. Submit, 14 days prior to start of commissioning, a written procedure to be followed in commissioning the facility, indicating order of specific component, equipment, or subsystems to be commissioned, personnel or resources required, and expected time for each task. Include specific rates, upper and lower limits, duration at each rate, and any special requirements for setup or adjustments to complete each specific task. Indicate any deficiencies in the facility that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

C. Submit, 14 days prior to start of commissioning, sample report forms or outlines indicating adjusting, balancing, and equipment data to be recorded, on forms prepared specifically for commissioning of the facility, containing information as outlined in Article 1.14. Record data in U.S. units. Report actual locations of measurements and approximate position of valves.

D. Submit, 7 days prior to start of commissioning, written confirmation that every individual component and piece of equipment has been installed and tested alone and in combination with related components.

E. Certify to ENGINEER that the facility has been fully and successfully commissioned, prior to start of demonstration period.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for closeout submittals.

B. Submit, within 14 days after completion of commissioning, 2 draft copies of the commissioning report, covering all aspects of the starting, testing, adjusting, and balancing of the individual components, equipment, and subsystems of the facility. Include all completed report forms or outlines, for review and approval of ENGINEER.

1.5 QUALIFICATIONS

A. Provide CONTRACTOR appointed commissioning supervisor, experienced in the installation and operations of the various components, equipment, and subsystems of the facility.

B. Provide personnel experienced in the installation and operations of the various components, equipment, and subsystems of the facility. Personnel to perform work under direct supervision of CONTRACTOR-appointed commissioning supervisor.

1.6 PRE-COMMISSIONING MEETING

A. A pre-commissioning meeting shall be held 7 days prior to commencing work of this Section.

B. Attendance at the pre-commissioning meeting shall include OWNER, ENGINEER, CONTRACTOR-appointed commissioning supervisor, and key CONTRACTOR personnel involved with the commissioning of the Works.

1.7 SEQUENCING AND SCHEDULING

A. Other Sections of the Specifications may contain specific installation, lubrication, cleaning, disinfecting, checking, testing, setting, calibration, adjusting, balancing, or operations requirements, which are to be followed in conjunction with this Section.

B. Every individual component and piece of equipment shall be tested alone and in combination with related components (subsystems) to ensure that the component and the subsystem are in perfect operating condition, comply with specified requirements, and are ready for incorporation in the overall system and entire facility operations.

C. Coordinate schedule for startup and testing of various equipment and systems. Follow the procedure and schedule established for commissioning unless otherwise approved by ENGINEER.

D. Schedule and provide assistance in final adjustment and testing of the fire and security systems with the ENGINEER and local authority.

1.8 MANUFACTURER'S FIELD SERVICES

A. Manufacturer's field services for equipment as specified in other Sections.

1.9 COMMISSIONING

A. Commissioning shall normally proceed in 4 steps:

1. Commissioning of individual components and equipment forming subsystems, ready for subsystem operations.

2. Commissioning of subsystems and the overall facility in its entirety.

3. Demonstration and training of the operations of individual components, equipment, subsystems, and the overall facility.

4. Turn over of facility to OWNER.

B. Commissioning shall be performed by CONTRACTOR, in the presence of ENGINEER and OWNER's personnel. CONTRACTOR's appointed commissioning supervisor is to lead the commissioning group of CONTRACTOR personnel, Subcontractor personnel, and manufacturer/Supplier representatives.

C. During the commissioning and demonstration period, only CONTRACTOR shall operate the facility, ENGINEER and OWNER's personnel shall only observe and receive operations instructions.

D. Starting Systems and Testing:

1. Verify that each component, piece of equipment, or subsystem has been checked for all required connections, proper lubrication, drive rotation, alignment, belt tension, control sequence, safety devices, operating speed, leakage, or for other conditions which may cause damage.

2. Verify that tests, meter readings, and specified electrical and mechanical characteristics for equipment, instruments, and systems, agree with those required by the equipment or system manufacturer. Verify wiring and support components for equipment are completed and tested. Record data for startup and testing against various requirements on prescribed forms.

3. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to ENGINEER and OWNER's personnel to facilitate spot checks.

4. Simulate flow, level, or other signals as needed to troubleshoot the control system. Include the manual or automatic activation of field devices. Verify operations of alarms and related failure logic.

5. Starting systems and testing will be performed by qualified technician or manufacturer's representative who is knowledgeable about the equipment or subsystem under direction of CONTRACTOR's commissioning supervisor.

6. Execute startup under supervision of CONTRACTOR's personnel in accordance with manufacturer's instructions. Record performance of equipment, instrumentation, and systems at startup.

E. Adjusting and Balancing:

1. Adjusting and balancing to be performed under direction of CONTRACTOR's commissioning supervisor by qualified technician or manufacturer's representative knowledgeable about the specific equipment or subsystem.

2. Ensure recorded data represents actual measured or observed conditions.

3. Mark settings of valves, dampers, and other adjustment devices, allowing settings to be restored. Set and lock any memory stops.

4. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

5. Leave systems in proper working order, replacing belt guards, closing access doors, replacing switch box covers, and restoring systems to specified settings.

F. Fulfillment of commissioning period requires CONTRACTOR operation of the facility as a complete system, at nominal rates, for 7 continuous calendar days, without fault in operations. Training period duration will begin only upon successful completion of the commissioning period.

G. In the event that the commissioning, demonstration, or training period has to be extended because of the malfunctioning of or problems with equipment, CONTRACTOR shall be responsible for all costs arising out of any extension of time at no additional cost to OWNER.

H. Inform all Subcontractors and Suppliers/manufacturers of the requirements herein and include all costs for the required services in the Contract Price. Where a minimum amount of time is stated in the Specifications for a manufacturer's services, any additional time required to perform the specified services satisfactorily shall be at no additional cost to OWNER.

1.10 DEMONSTRATION

A. Demonstrate operations, maintenance, and calibration of each piece of equipment, instrument, and system. Instruction to be by a qualified technician or manufacturer's representative who is knowledgeable about the instrument, equipment, or subsystem.

B. Demonstrate startup, operations, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each component or piece of equipment at agreed time.

C. During the demonstration period, CONTRACTOR shall demonstrate that operations of the facility as a whole is correct and in accordance with the contract requirements by demonstrating individual components, equipment, and subsystems.

D. All malfunctions, alarms, safety devices, interlocks, and annunciation, which exist as actual field devices or which may exist as programmable logic control (computer programming), shall be demonstrated by simulation of conditions as necessary.

E. Should the demonstration reveal any defects, then such effects shall be promptly rectified by CONTRACTOR and the demonstration of the equipment repeated to the satisfaction of ENGINEER. Should such repeat demonstration require a second or subsequent visit to the Site by ENGINEER and/or OWNER's personnel, then the additional costs incurred shall, at the discretion of ENGINEER, be paid for by CONTRACTOR.

F. All components shall be demonstrated over the entire range of operations specified, including variations in flow, pressures, speeds and controls. See Schedule provided in this Section for summary of performance characteristics criteria.

1.11 TRAINING

A. Provide a training program to OWNER and any designated personnel assigned for operations and maintenance of the facility.

B. Arrange with suppliers of equipment for the provision of a qualified representative to provide training for OWNER's personnel.

C. Coordinate and establish with each Supplier and Subcontractor the time period necessary to complete training of OWNER's staff. The minimum time for any one session to be allowed for by the Supplier shall be four hours.

D. Arrange for the provision of these training sessions by the Supplier and Subcontractor through ENGINEER, who will coordinate the necessary arrangements with OWNER.

E. Provide for two training sessions. The period between such sessions shall be approximately one week, or as mutually agreed between CONTRACTOR and OWNER.

F. Training of OWNER's Personnel:

1. Throughout the commissioning period, provide access to OWNER’s personnel to observe the operations of the facility. OWNER’s personnel will not operate equipment during the commissioning period.

2. Following successful commissioning of the facility, CONTRACTOR shall train two of OWNER's personnel over a period of one week to operate the facility.

3. CONTRACTOR shall:

1. Demonstrate operations and maintenance of each piece of equipment, instrument, and system.

2. Utilize operations and maintenance manuals as a basis for training. Review contents of manuals with OWNER's personnel in detail, to explain all aspects of operations and maintenance.

3. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during demonstration or training.

4. Establish through verbal examination and demonstration, that OWNER's personnel are fully cognizant of the operations and maintenance requirements of the facility.

1.12 TURNOVER

A. Turnover of the facility for operations by OWNER shall occur only upon completion and acceptance of all demonstration and training of the operations of the facility by ENGINEER.

1.13 COMMISSIONING REPORT

A. Commissioning Report shall include:

1. Title Page:

1. Project name, location, name of ENGINEER and Project reference number, name of CONTRACTOR and Project reference/identification.

2. Name, address, telephone number, and Project reference/identification of testing, adjusting, and balancing agency, and date of report.

2. Summary Comments:

1. Design performance versus final performance.

2. Notable characteristics of system.

3. Description of system operations sequence.

4. Summary of flows, from source to outlet, including any internal circulation lines or secondary processes.

5. Nomenclature used throughout report.

6. Test conditions.

3. Specific Equipment Test Parameters:

1. Instrument List: Unique identification tag, instrument name, manufacturer, model number, serial number, range of instrument, and calibration date.

2. Motor Requirements: Unique identification tag, manufacturer, model/frame, HP/BHP, phase, voltage, amperage (nameplate, actual, and no load conditions), rpm, service factor, starter size and rating, heater elements, and coupling or direct drive information.

3. Blower Data: Unique identification tag, manufacturer, model, orientation, rpm, and flow rate.

4. Pump Data: Unique identification tag, manufacture, size/model, outlet connection size and type, impeller data, service, flow rate and pressure drop across pump, BHP, discharge pressure, suction pressure, total operating head pressure , discharge and suction pressures at shut off, and total head pressure at shutoff. Note: Provide design and actual data where applicable.

5. Sound Level Report: Location, equipment off conditions, and equipment running conditions (provide for multiple run conditions if applicable). Check sound levels inside building and at property line.

6. Vibration Test Report: Location of test points (equipment bearing drive or opposite end, motor bearing drive or opposite end, casing top or bottom, duct connection after flexible connector on suction or discharge side), test readings, normally acceptable readings, unusual conditions at time of test, and vibration source if non-complying.

B. Include all completed test report forms as an appendix to the commissioning report.

C. Include manufacturer's representative's reports in a separate appendix to the report.

1.14 SCHEDULES

A. Performance test equipment and system in accordance with the following:

	Component, Equipment, or Subsystem Commissioning Duration Requirement	*Minimum Rate and Duration*	*Maximum Rate and Duration*	*Nominal Rate and Duration*
1.	Building Sump Pump	- -	- -	50 gpm 4 hours
2.	Air Stripper Blower	- -	- -	10700 scfm 24 hours
3.	Discharge Transfer Pump No.1	- -	- -	1000 gpm at 230 ft TDH 24 hours
4.	Discharge Transfer Pump No.2	- -	- -	1000 gpm at 230 ft TDH 24 hours
5.	Discharge Transfer Pump No.3	- -	- -	1000 gpm at 230 ft TDH 24 hours
6.	Exhaust Fan	- -	- -	2 days
7.	Unit Heater	- -	- -	2 days
8.	Lighting	- -	- -	2 days
9.	Electrical Panel Heater	- -	- -	2 days
10.	Control Components	- -	- -	2 days
11.	Overall Process/Facility	- -	- -	2,000 USgpm 7 days

END OF SECTION

SECTION 02221

TRENCHING, BACKFILLING AND COMPACTING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Excavation classification of materials, backfill and bedding materials, excavation for trenches, structures, and appurtenances, rock and rubble excavating, sheeting, shoring, and bracing, dewatering, backfill for structures and trenches, utility crossings and standard trench section requirements.

B. Measurement and Payment.

1. Payment is incidental and included in the installation unit price of pipe, fittings, valves, hydrants, manholes, inlets, water distribution systems, storm sewer system, sanitary sewer system, and other systems.
2. Rock removal, if applicable, will be paid at the unit price bid. If no bid item is provided for rock removal, price will be negotiated prior to commencement of removal.

1.02 REFERENCES

A. ASTM D 2922 - Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

B. ANSI/ASTM D 698 -Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb. (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

1.03 SUBMITTALS

A. Materials Sources: Submit name of imported materials source.

B. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

C. Compaction Density Test Reports.

1.04 QUALITY ASSURANCE

A The Contractor shall employ and pay for services of the independent testing laboratory for tests required to show compliance with the specifications. Test results shall be submitted directly to the Owner Site Representative. Selection of the testing laboratory is subject to approval of the Owner Site Representative.

B Determine moisture density relations of soils encountered during construction in accordance with Standard Proctor Method. Provide graph of Proctor soil density versus water content for reach soil encountered.

C. Provide gradation and materials tests for pipe bedding and stabilizing material.

D. Test trench backfill soil density and moisture at three tests per three foot (3') lift per four-hundred lineal feet (400LF) of trench under pavements.

If trench backfill or pavement subgrade fail density tests, rework backfill or subgrade and retest until specified density is obtained.

E. Jacking, boring, or tunneling Contractor shall be a company specializing in the applicable jacking, boring or tunneling work with a minimum of 5 years and 25 jobs of satisfactory documented experience.

1.05 SITE CONDITIONS

A. Verify that survey benchmark and intended elevations for the Work are as indicated on Drawings.

1.06 GENERAL REQUIREMENTS

A. Remove excess topsoil and excavated material suitable for backfill to location obtained by the Contractor and/or identified by the Owner as shown on construction drawings.

B. Remove brush, rubbish, spoil, and material not suitable for backfill and dispose to an off-site location obtained by Contractor.
   1. Remove waste material promptly as it is generated by construction operations; do not permit it to accumulate. See also "Cleanup," this Section.
   2. Grade disposal areas periodically to reasonably neat surface to provide for drainage and access by others.
   3. Haul routes:
      a. Determine haul roads with approval of agency having jurisdiction over proposed roadway.
      b. Make condition survey of haul roads prior to use and document with necessary photographs and written descriptions.
      c. Keep reasonably free from dirt, dust, mud, and other debris from construction operations.
      d. Clean a minimum of twice a week.
      e. Repair any damaged haul routes to match existing conditions before use.

1.07 EXISTING UTILITIES

A. Before starting operations in any area in the vicinity of utility facilities, notify each utility of any operation which may affect their facilities. Provide notice to each utility sufficiently in advance of such operations to allow the utility time to mark the location of, relocate, adjust, or otherwise protect their facilities. Reach an agreement with each utility on appropriate action necessary to protect or relocate the utility facilities. The cost of such action to protect the facilities, except for locates, be borne by the Contractor. Utilize local state One-Call System, if available, for locates for those utilities which subscribe to this service. Contact all other utilities that do not subscribe to the One-Call System.

B. At all times conduct operation so that necessary clearances are maintained and said utility facilities are protected. Comply with all local, state, and federal, or other regulations in performing work near utility facilities.

C. Should the Contractor damage any of the utility facilities during Contractor's operations or determine the work cannot be performed safely. Immediately notify the utility involved and cease work until arrangements are made to prevent further damage or a serious accident.

D. Failure of the Contractor to provide timely notice to the utility or to conduct his operations in such manner that proper clearances are maintained and the utility facilities are protected at all times will be grounds for the issuance of a Stop Work Order.

E. Notify Engineer of unexpected subsurface conditions and discontinue Work in area until Engineer provides notification to resume work.

1.08 CLASSIFICATION OF MATERIALS

A. Earth: All materials not classified as rock or rubble includes: clay, silt, sand, gravel, hardpan, disintegrated shale and rock debris, junk, brick, loose stones, and boulders less than 1/3 cubic yards in volume.

B. Rock: Buried boulders larger than 1/3 cubic yards in volume or materials so hard and dense that continuous loosening by pneumatic tools or blasting is required for removal.

C. Rubble: Buried concrete foundations, beams, walls, and other materials which require continuous use of pneumatic tools or blasting.

D. Topsoil: Upper portion of soil profile containing a good supply of humus and a high degree of fertility. Topsoil is free of rocks, clods and other debris larger than 2" in diameter.

1.09 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of utilities remaining, by horizontal dimensions, elevations or inverts, and slope gradients.

PART 2 PRODUCTS

2.01 BACKFILL AND BEDDING MATERIALS

A. Pipe Bedding and Structural Backfill: Select backfill and bedding for pipes and structures shall be approved select material meeting the following gradation. Material to be free of foreign substance, debris, large stones, rocks (1-1/2 in, 37 mm.), roots, organic or frozen material, expansive material and other deleterious materials. See details on Drawings and/or Typical Detail drawings herein for typical extent of bedding and backfill.

Sieve	Percent Passing
1	100
3/4	90-100
3/8"	50-90
No. 4	35-80
No. 10	25-65
No. 40	10-35
No. 200	3-10

B. Topsoil: Fill upper portion of excavation in grass areas with 4 inches minimum of topsoil.

C. Subbase Material: To consist of approved blast furnace slag, stone, sand and gravel or blends of these materials:

Sieve	Percent Passing
3"	100
2"	90-100
1/4"	30-65
No. 40	5-40
No. 200	0-10

D. Stone top: Material to be free of foreign substance, debris, large stones, rocks (1-1/2 in, 37 mm.), roots, organic or frozen material, expansive material and other deleterious materials. See details on Drawings and/or Typical Detail drawings herein for typical extent of bedding and backfill.

Sieve	**Percent Passing**
1	100
3/4	90-100
3/8"	50-90
No. 4	35-80
No. 10	25-65
No. 40	10-35
No. 200	3-10

2.02 ACCESSORIES

A. Filter Fabric: Manufacturer's standard non-woven 8 ounce pervious geotextile fabric of polypropylene, nylon or polyester fibers, or a combination.
   1. Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D 4759 and the referenced standard test methods in parenthesis:
      a. Grab Tensile Strength (ASTM D 4632): 100 pounds.
      b. Apparent Opening Size (ASTM D 4751): #100 U.S. Standard Sieve.
      c. Permeability (ASTM D 4491): 150 Gallons per minute per square foot.

PART 3 EXECUTION

3.01 GENERAL

A. Trenching and backfilling: All excavation, backfilling, compacting, disposal of surplus material, furnishing additional backfill material, and all other work incidental to the construction of trenches, including any additional excavation.

B. Trench Bottom:
1. Provide firm, stable and uniform support for full length of pipe.
2. With acceptable soils, lay pipe on layer of loose material after leveling trench bottom. If no loose material remains, shave soft material from trench walls and compact or granular bedding. *See Part 3.08.*
3. If trench bottom is rocky or hard, over-excavate trench and place select or granular backfill below pipe. Cushion material shall be the same as the specified bedding material.
4. When unstable material is encountered, which may not provide a suitable foundation for pipe, remove unsuitable material and replace with stabilizing material.

C. Trees, Hedges and Shrubbery:
1. Minimize damage caused by construction operations.
2. Trim and repair trees, hedges, and shrubbery damaged by construction operations; remove broken branches.
3. Cut no tree roots larger than 3" diameter (75 mm).
4. Notify Engineer prior to removing trees larger than 2" (50 mm) diameter; and hedges and shrubbery.
5. Dispose of all items to an off-site location obtained by Contractor.

D. Use caution when placing and compacting backfill to avoid placing construction loads on pipe which may damage or displace newly laid pipe.

E. Remove, replace and repair fences, signs and other obstructions as necessary for construction; return all items to equal or better than original conditions.

F. Repair any drainage tile interrupted during the course of construction according to details on Drawings and/or Typical Detail Drawings.

G. Utility mains shown on Drawings, in conflict with new facilities: Perform relocation or make arrangements with utility to perform Work at no additional cost to Owner.

H. Utility mains not shown on Drawings, in conflict with new facilities: Notify Engineer immediately.

I. Excavate all material encountered to depth indicated on Drawings.

J. Schedule work to avoid property owner inconvenience insofar as practicable during construction.

K. Restore obstructions removed to accommodate construction equipment or to facilitate excavation.

L. Exercise care in operating equipment beneath or adjacent to trees to prevent damage.

M. Pile excavated material suitable for backfill in an orderly manner a sufficient distance from edge of excavation to avoid rollbacks, slides, or cave-ins. Stockpile topsoil.

N. Remove spoil not suitable for backfill; waste at disposal area obtained by the Contractor at no cost to the Owner.

O. Excavate in open cut the existing roads, utilities, and structures except as noted on Drawings.

P. Where new construction crosses or closely parallels existing utilities or utility services, excavate in advance of pipe laying to determine location and crossing arrangement, including exact construction line and grade.

Q. Excavations are Contractor's responsibility and must comply with applicable local, state, and federal standards.

R. Contractor responsible for providing adequate barricades and protection around excavation and work areas.

S. Contractor responsible for providing and removing adequate temporary fencing for any fences that are disturbed by construction operations.

T. Maximum length of trench opening at any time: 300 feet (100 m).

U. Sections of the Work conducted in highway rights-of way: Strictly follow local permit requirements. Provide traffic control with signage, flagging, channeling devices, and barricades as required.

V. Temporary, unsupported cut slopes, in native soils with no seepage, shall not be excavated any steeper than 1.5H:1V. If exposed for long periods of time, cover with Visqueen to maintain stability and minimize erosion and continually monitor.

3.02 TRENCH EXCAVATION

A. Strip and stockpile topsoil for use in surface restoration.

B. Keep sides of trench as nearly vertical as practicable within the limits of excavation codes and safety requirements; maintain vertical walls of excavation below top of pipe. Provide trench wall support as needed.

C. Excavate to full depth by machine; level trench bottom to provide uniform bearing and support for full length of pipe.

D. Provide bell holes at each pipe joint; allow access completely around circumference of pipe for proper jointing operations.

E. Conform to common trench bottom construction practices as recommended by pipe manufacturer.

F. Trench bottoms carried below required grade; backfill to property elevation with crushed stone as specified for sewer pipe bedding at no expense to the Owner.

G. When unstable material is encountered, which may not provide a suitable foundation for pipe.
   1. Notify Engineer immediately.
   2. Engineer will investigate questionable material to determine its suitability for pipe foundation.

3. If material is considered unsuitable for pipe foundations, Engineer will specify and authorize remedial measures in writing.
4. If removal of unsuitable material is authorized:
   a. Replace with trench stabilizing material.
   b. Provide minimum of 4 inches (100 mm) of bedding material on top of stabilizing material to prevent point load. Bedding material graded sufficiently coarse to prevent movement and loss of bedding into trench stabilizing material.

H. Minimize the width of trench below the top of the pipe, but maintain trench width of no less than pipe O.D. plus 24".

I. When the material being excavated is such that it is physically impossible to stabilize the trench bottom or secure a uniform bearing using dewatering and a granular foundation and in the judgment of the Engineer concrete encasement, concrete cradling or pilings are necessary to support the pipe, provide such support when directed in writing by the Engineer.

J. Provide cradling or strengthening at Contractor's expense if above trench width is exceeded.

K. Concrete encasement, concrete cradling and pilings, if not shown on the Drawings or indicated in these specifications: paid for as extra work.

L. Excavate by hand:
1. Under and around utilities.
2. Where overhead clearance prevents use of machine.
3. Under trees and shrubs where shown on Drawings.

3.03 ROCK EXCAVATION

A. Rock excavation: Rock requiring the use of pneumatic tools or explosives for removal.

B. When the material can be excavated by means other than pneumatic tools or explosives, such as a ripper, this excavation considered as earth excavation and, as such, no payment made for rock excavation.

C. When rock is encountered at locations generally indicated on the Drawings, excavate and haul all rock to an approved site obtained by the Contractor at no additional cost to the Owner. Where unanticipated rock is encountered, notify Engineer prior to removal.

D. Include the cost for anticipated rock excavation hauling and disposal in the unit price as shown on Form of Proposal. Negotiate the cost for removal of unanticipated rock prior to removal.

E. Excavate to provide pipe bedding cushion for pipeline structures and appurtenances in accordance with Typical Detail Drawings herein.

F. Remove and dispose of excavated rock not suitable for backfill; disposal is incidental to cost of rock excavation.

3.04 RUBBLE EXCAVATION

A. Removal: As specified for rock.

B. Remove and dispose of excavated rubble not suitable for backfill; disposal is incidental to cost of rubble excavation.

3.05 SHEETING, SHORING, AND BRACING

A. Construct sheeting, shoring, and bracing required to hold walls of excavation and to provide safety for workers, to protect existing utilities and structures, and to permit dry conditions for construction.

B. Sheeting: wood or steel.

C. Wood sheeting driven below level of pipe: leave in place to a level 5 ft. (2 m) below finish grade.

D. Pull steel sheeting except where shown on Drawings.

E. When movable trench shield is used below spring line of pipe, lift shield prior to any forward movement to avoid pipe displacement. Fill void left by removal of shield, between consolidated fill and stable trench wall, with consolidated fill of the same type as specified adjacent to the pipe.

F. Sheeting, shoring, and bracing: not paid for as a separate pay item, but considered incidental to the project.

G. Sheeting and shoring in accordance with OSHA and all other governmental regulations. Contractor solely responsible for complying with the regulations.

3.06 DEWATERING

A. Do all work in dry conditions; obtain the Engineer's approval of proposed methods of dewatering.

B. Provide for handling water encountered during construction.

C. Lay no pipe in, and place no concrete on, excessively wet soil.

D. If groundwater is encountered, provide sumps in the trench or some other methods for removal of water and stabilization of trench bottom.

E. Prevent surface water from flowing into excavation; remove water as it accumulates.

F. Divert stream flow and sewage away from areas of construction.

G. Do not pump water to existing sanitary sewers or onto adjacent property without approval of the Engineer and adjacent property owner.

H. Protect against settlement or damage to adjacent property.

I. Trench dewatering is incidental to the project.

3.07 BACKFILL FOR STRUCTURES

A. Backfill after concrete has cured for 5 days and has been reviewed and approved by Owner Site Representative.

B. Backfill with material removed from excavation except where granular backfill is specified; use no debris, frozen earth, large clods, stones, or other unsuitable material.

C. Backfill simultaneously on all sides of structures; protect structures from damage at all times.

D. Compact backfill at structures to density not less than specified for adjacent trench, or as shown on the Drawings.

E. Terminate backfill at finish grade as shown on Drawings; dispose of excess excavated material as directed by Engineer.

F. Prepare backfill for surface restoration as specified for adjacent trench.

G. Construct structures and appurtenances and perform backfilling as work progresses.

3.08 BEDDING AND BACKFILL FOR TRENCHES

A. Place bedding from bottom of pipe trench to pipe spring line as indicated on applicable Typical Detail Drawings contained herein. Bedding includes material below bottom of pipe as specified. Compact bedding below bottom of pipe prior to installation of pipe to minimize settlement. Bedding materials and degree of compaction as follows:

B. Bedding materials and degree of compaction as follows:
1. Bedding for Gravity Lines: Granular pipe bedding material as specified in 2.01 A. Compacted in 6 inch (150 mm) lifts from trench bottom to pipe spring line to a minimum of 90% Standard Proctor Density (ASTM D 698). Thickness of bedding material below the bottom of pipe barrel of 1/8 pipe O.D., or 4 inch (100 mm) minimum.
2. Bedding for Pressure Lines: Granular pipe bedding and backfill material as specified in 2.01 A. Where rock or other unyielding material is encountered in trench bottom, provide a cushion of granular pipe bedding with thickness as shown on Typical Detail Drawing herein. Bedding and cushioning materials compacted in 6 inch (150 mm) lifts from trench bottom to pipe spring line to a minimum of 90% Standard Proctor Density.

C. Backfill trench after locations of connections and appurtenances have been recorded. Conform to applicable Typical Detail Drawings contained herein.

D. Backfill with material removed from excavation except where imported backfill is specified; use no debris, frozen earth, large clods, stones, or other unsuitable material. If native material is too wet or dry to achieve specified compaction, Contractor required to dry or wet material or replace with approved imported material at no additional cost to the Owner.

E. Backfill simultaneously on both sides of pipe to prevent displacement.

F. Place backfill into the trench at an angle to minimize impact on installed pipe is minimized.

G. Percent maximum density shall mean a soil density no less than the stated percent of optimum density for soil as determined by ASTM D 698, Standard Proctor Density or ASTM D 1557, Modified Proctor Density.

H. Rocks 1-1/2" (37 mm) in diameter and larger, wood, frozen earth, clods of earth and/or hard, bulky materials shall be considered as spoil materials and shall not be used as selected material for bedding, initial and trench backfill. Dispose of spoil material by hauling materials to a suitable disposal site obtained by the Contractor.

I. Place all initial backfill in such a manner so not to damage pipe. Compact to minimize settlement of trench backfill and provide optimum support of pipe.

J. Initial Backfill.
   1. Polyvinyl Chloride Pipe: Carefully place and compact initial backfill with pneumatic or mechanical tampers from the spring line to a point 1 foot (1/3 m) above tope of pipe barrel. Backfill material shall be crushed stone as specified for bedding in Part 2.01 A.
   2. Ductile Iron Pipe, Polyvinyl Chloride (pressure) and Reinforced Pipe: Material and compaction as specified for trench backfill.

K. Place trench backfill only after initial backfill has been placed, compacted, and approved. Trench backfill, material and compaction requirements depend on what area the pipe is located beneath as specified. Trench backfill begins 1 foot (1/3 m) above pipe barrel and terminates at final grade or subgrade.

L. Trench Backfill.
   1. Grass Parking Areas and Unpaved Areas: Select material as previously defined. Compact backfill material to a minimum of 90% Standard Proctor Density (ASTM D 698).
   2. Paved Areas: Select material compacted in 6" (150 mm) lifts with pneumatic or mechanical tampers to finish grade or subgrade. Compact to a minimum of 95% Standard Proctor Density (ASTM D 698).

3.10 UTILITY CROSSINGS

A. Provide compacted sand or granular material under all existing utilities or service lines that are located above the new pipeline. Compact material to a minimum of 90% ASTM D 1557 Maximum Dry Density value, except in paved and structural areas, where material shall be compacted to at least 95% Maximum Dry Density value ASTM D 1557.

B. Notify utility companies before excavating; utilize local state One-Call system, if available, conform to current utility notification requirements.

C. Sections of the Work conducted in highway rights-of way: Strictly follow local permit requirements. Provide traffic control with signage, flagging, channeling devices, and barricades as required.

3.11 CLEANUP

A. Clean up each portion of construction as it is completed.

B. Remove unused stockpiled materials, rubbish, and debris and leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

C. Leave site in a clean and neat condition. Grade to prevent standing surface water.

3.12 FIELD QUALITY CONTROL

A. Perform compaction density testing on compacted fill in accordance with ASTM D 1556, ASTM D 2167, ASTM D 2922, or ASTM D 3017.

B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

D. Frequency of Tests: Perform soil density tests uniformly throughout the placing of the fill to maintain quality control at all times. Testing in accordance with ASTM D 2922 and D698.

END OF SECTION

SECTION 02315

EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating for footings, slabs-on-grade, site structures, and utilities within the building.

1.02 PROJECT CONDITIONS

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

1.03 CLASSIFICATION OF MATERIALS

A. See specification 02221 - Trenching, Backfilling and Compacting

1.04 SUMITTALS

A. Excavation Plan: Prior to mobilization to the Site, submit a detailed Excavation Plan demonstrating compliance with specified requirements and to permit Owner Site Representative to schedule testing and measurement activities. Include written procedures, schedules, and drawings as applicable.

PART 2 PRODUCTS -

NOT USED

PART 3 EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities that remain and protect from damage.

C. Notify utility company to remove and relocate utilities.

D. Use special care when excavating under and around existing facilities. Support existing facilities and earth under facilities to prevent settlement resulting from construction operations.

3.02 EXCAVATING - GENERAL

A. General excavation for buildings and structures shall be performed within building lines and sufficiently beyond to allow for proper construction, inspection and to provide ample room for erection and removal of formwork.

B. Excavate to depth indicated on the drawings and remove all loose soil. Where soft spots are encountered, remove all unstable material and replace with structural fill in sufficient depth to develop a firm foundation as directed by the Engineer.

C. The earth surface upon which foundations, footings and structures will be placed is to be mechanically compacted to 95% of the maximum dry density in accordance with ASTM D-1557 for a depth of 12 inches.

D. Apply necessary moisture to the construction area and haul roads to prevent the spread of dust. Following excavation and grading on this project the Contractor shall be responsible for disposing of excess material from the project to a location designated by the Owner.

E. In the event any unsuitable bearing material is encountered at design depth, this condition shall be called to the attention of the Owner, or his representative, by the Contractor and a determination will be made prior to continuance. In the event over-excavation and special backfill are required, the Contractor shall proceed as instructed by the Engineer. If unsuitable bearing subgrade conditions were caused by the Contractor's operations at the site, then the cost of reestablishing suitable bearing conditions shall be at the expense of the Contractor and as directed by the Engineer. If unsuitable bearing conditions are a natural occurrence the extra cost shall be paid by the Owner.

F. Strip grass and vegetation from entire construction area and dispose of at landfill or location obtained by the Contractor.

G. Remove topsoil to minimum depth of eight inches (8") and stockpile for reuse to finish earth surfaces. In rural crop land areas, remove topsoil to a minimum depth of twelve inches (12") and stockpile for replacement on top of excavation.

H. Provide temporary drainage facilities to prevent damage when necessary to interrupt natural drainage or flow of artificial drains.

I. Use special care when excavating under and around existing facilities and structures. Prevent settlement of existing structures which may result from construction operation.

J. Underpin adjacent structures which may be damaged by excavating work.

K. Excavate to accommodate new structures and construction operations.

L. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

M. Do not interfere with 45 degree bearing splay of foundations.

N. Hand trim excavations. Remove loose matter.

O. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.

P. Grade top perimeter of excavation to prevent surface water from draining into excavation.

Q. Remove excavated material that is unsuitable for re-use from site.

R. Stockpile excavated material to be re-used in area designated on site.

3.03 EXCAVATION - SUBSOIL

A. Excavate subsoil from areas to be further excavated or re-graded.

B. Stockpile in area designated on site. Remove excess subsoil not being reused from site.

C. Do not excavate wet subsoil.

D. Stockpile subsoil to depth not exceeding 8 feet.

3.04 EXCAVATION FOR APPURTENANCES

A. Excavate as required for appurtenances.

B. Carry excavation to firm, undisturbed soil.

END OF SECTION

SECTION 03300

CAST IN PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This specification covers the technical requirements for furnishing, delivery, forming, placing, finishing, and curing of plain and reinforced concrete, including the fabrication and placement of reinforcing steel, and the installation of embedded items whether furnished under this specification or not, in accordance with the drawings and as specified herein.

1.02 STANDARDS AND CODES

A. The work covered by this specification shall conform to Building Code Requirements for Reinforced Concrete (ACI 318). Specifications for Structural Concrete for Buildings (ACI 301), and other referenced and related codes and standards as designated herein.

B. All specifications, standards, codes, etc., referred to are the latest edition, and together with all addenda, revisions, and supplements shall be considered part of this specification.

1.03 SUBMITTALS

A. Concrete Mix Data and Test Reports

1. Prior to any concrete placement, the Contractor shall provide the Owner with four (4) copies of the concrete mix data and test reports (trial mix data and/or field strength test) for approval. In addition, laboratory test results on the aggregate and cement shall be submitted with the mix design data. Manufacturer's literature shall also be submitted on all admixtures to be used in the concrete.

B. Working drawings - Erection drawings of reinforcing, showing dimensions, bar schedules, and details shall conform to ACI-315. Submit four (4) copies each for review and approval by Owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland Cement

1. Portland cement shall conform to the “Standard Specifications for Portland Cement,” ASTM C150. Type IA or Type IIA cement with air-entraining agent shall be used in all concrete except where specifically called for on the drawings.

2. Aggregates – Igneous Type

a. All aggregates, unless otherwise specified, shall conform to the Standard Specifications for Concrete Aggregate, ASTM C33. Fine aggregate shall consist of clean, washed, natural or crushed sand of uniform gradation. Coarse aggregate shall consist of washed gravel or washed crushed rock having hard, strong, durable pieces free from adherent coatings or other weak, deleterious substances.
b. Maximum size aggregate shall conform to ACI-31 8. In general, 1-1/2” maximum aggregate shall be utilized unless rebar spacing prohibits.

B. Water

1. Water for mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, sulfates, or other substances that can adversely affect concrete strength, durability and/or chemical resistance.

C. Admixtures

1. Chemical admixtures shall be used in concrete to improve its characteristics in one or more respects, including economy, strength, durability, workability, water-tightness, drying shrinkage behavior and increased resistance to damage from cyclic freezing and thawing.

2. The selection of the admixture(s) to be used in the mix shall be based on an appropriate evaluation of its effects which shows it to be desirable for use in the particular concrete under the conditions of the use intended. The admixtures to be used shall be subject to the approval of the Engineer. Unless otherwise specified, use shall be limited to the types generally recognized as water-reducing, set-controlling, air-entraining, or combinations of these functional types.

3. Water-reducing admixtures shall conform to ASTM C94, Chemical Admixtures for Concrete, potable. High-range water reducers (super plasticizers) may be utilized.

4. Concrete shall contain an air-entraining admixture conforming to ASTM C260.

5. No other admixtures will be permitted. In particular, Calcium Chloride based compounds are specifically prohibited.

6. Contractor and contractor's supplier are also responsible to correct for any and all synergistic effects caused by intermixing of two or more different brands of additives.

D Reinforcement

1. Metal reinforcement shall conform to the requirements of the "Standard Specifications for Billet-Steel Bars for Concrete Reinforcement", ASTM A615, Grade 60, unless otherwise specified. All reinforcing steel shall be epoxy coated per ASTM A934.

E. Expansion Joint Filler

1. Premolded, non-extruding type, ASTM D 1751.

F. Expansion Joint Sealer

1. One component polyurethane "Sikaflex-1A" by Sika Chemical Corporation, or an approved equal.

G. Water Stops

1. Water stops shall be serrated polyvinyl chloride with center bulb similar and equal to Cat. No. RB4-316 by Vinylex Corporation, or approved equal. Size to be as indicated on drawings. All joints and splices shall be one hundred percent (100%) fused.

H. Anchor Bolts

1. Carbon steel, ASTM F 1554, with heavy hex head nuts. Bolts, nuts, and washers shall be galvanized, ASTM A 123, unless indicated otherwise on drawings.

I. Miscellaneous Embedded Steel

1. Carbon Steel, ASTM A 36.

J. Wood Sleepers

1. No. 2 Dimension Douglas Fir or West Coast Hemlock pressure treated against fire and decay using "Non-Com" by Koppers Co., Inc. or approved equal.

PART 3 EXECUTION

3.01 STORAGE OF MATERIALS

A. Cement and aggregates shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter. Liquid admixtures shall be protected from freezing and from settling out of solution. Any deteriorated or damaged materials shall not be used for concrete.

PART 4 CONCRETE QUALITY

A. Concrete Strength

1. All concrete for this specification shall have a minimum 28 day compressive strength of 4,000 psi.

B. Slump

1. Slump of concrete shall be three and a half inches (3-1/2") plus or minus one (1) inch.

2. Slump shall be measured at the discharge of the concrete mixer truck and prior to pumping.

C. Air Content

1. All concrete under this specification shall be air entrained to produce 5% air ± 1 .5% by volume. Concrete within air content greater than 6.5% will be rejected.

PART 5 CONCRETE PROPORTIONS AND CONSISTENCY

A. Concrete shall be proportioned by Method 1 or 2 of ACI 301.

B. Proportions of cement, aggregate and water for concrete shall produce the specified minimum compressive strength of 28 days. Cement quantity shall be the minimum required to achieve the specified strength. The mixture shall work readily into corners and angles of forms and around reinforcement with the method of placing employed but without permitting segregation of material or collection of free water on the surface. Water/cement ratio shall be .45 (max).

C. Slump tests shall be in accordance with ASTM C143. Tests shall be made by the Owner except when indicated otherwise in the project specifications.

D. All concrete for this specification shall contain entrained air.

E. All water shall be added at the batch plant. Water may not be added at the construction site unless approved by the Engineer.

PART 6 FORM WORK

A. Formwork shall conform to ACI 318 and ACI 347.

B. Wood forms for exposed surfaces of concrete shall be of plywood or other dressed wood material and shall be free from knots, warps, breaks, or other defects likely to cause irregular surfaces.

C. Metal forms shall be free from irregularities, dents and sags.

D. Form ties shall be snap-off type with ends terminating 1" below finished concrete surface. Water seal coil type shall be used in walls of water-bearing structures.

E. The contractor shall be responsible for design of formwork, safe practice in removing forms and shoring, and placing adequate reshores.

F. Chamfer Strips - A ¾" chamfer shall be provided at all exposed edges of concrete except the top horizontal edges of pump pads, curbs and piers shall be edge tooled.

G. An approved release agent shall be applied to all forms to facilitate form removal.

PART 7 REINFORCEMENT AND EMBEDMENTS

A. Fabrication and placement of reinforcing steel shall conform to ACI 318.

B. Unless otherwise indicated on the drawings, minimum concrete protection for reinforcement shall conform to ACI 31 8.

C. Water Stops

1. Install in all construction joints where indicated.

2. Install conforming to manufacturer's printed instructions. Take special precautions to avoid bending or displacing water stop while placing concrete around it.

D. The Contractor shall notify the Owner when reinforcement and other inserts are set and ready for inspection.

PART 8 JOINT SYSTEMS

A. Expansion Joints to be located where indicated and provide full isolation between materials.

B. Control joints shall be as indicated on the drawings. Joints shall be sawed as soon as the concrete surface is firm enough not to be torn or damaged by the blade.

C. Construction Joints

1. No construction joints shall be made in slabs, mats, walls, beams, trenches or footings unless shown on the drawings or approved in writing by the Owner.

2. Obtain Owner's approval of joints located by Contractor prior to preparation of reinforcing steel drawings. Locate joints not indicated or specified to least impair the strength of the structure.

PART 9 MIXING AND PLACING CONCRETE

Conform with ACI 301 and as specified herein.

9.1 Mixing

1. Ready-mixed concrete shall be mixed and delivered in accordance with specifications for Ready-Mixed Concrete (ASTM C 94).

2. For job-mixed concrete, the mixer shall be rotated at a speed recommended by the manufacturer. Each batch of 1 cubic yard or less shall be mixed for at least one (1) minute after all materials are in the mixer. The mixing time shall be increased fifteen (15) seconds for each cubic yard or fraction thereof. The entire batch shall be discharged before the mixer is recharged.

9.2 Conveying

1. Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent segregation or loss of materials.

2. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete at the delivery end without segregation of materials.

9.3 Placing of Concrete

1. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. The placing of concrete shall be carried on at such a rate that concrete is at all times plastic and flows readily into the spaces between the bars.

2. When placing is started, it shall be carried on as a continuous operation until placement of the panel or section is completed.

3. Place concrete on properly prepared and unfrozen subgrade and only in dewatered excavation and forms.

4. Use forms for all concrete except where otherwise indicated or specified.

5. Do not use concrete that has partially hardened or has been contaminated by foreign materials.

6. Prevent mud or foreign materials from entering the concrete or forms during placement operations.

9.4 Depositing

1. Place concrete in continuous horizontal lifts not to exceed 18" and place concrete against bulkheads and keyways at vertical joints.

2. Maximum free drop of concrete shall be 5 feet in walls 10 or less in thickness with 1 foot additional drop allowed for each 1" of wall thickness over 10", with a maximum drop of 10 feet.

3. When moisture barrier is used, keep lapped joints closed and take precautions to avoid puncturing the barrier.

9.5 Consolidation of Concrete

1. Consolidate concrete as recommended by the Report of ACI Committee 609. Characteristics and application of concrete vibrators shall be as set forth in Table I of the Report.

2. Provide an adequate number of vibrators of sufficient capacity to keep up with the maximum rate of concrete placement. Keep on hand adequate standby equipment in serviceable condition.

3. Vibrate concrete only until the concrete is thoroughly consolidated and the voids filled as evidenced by the leveled appearance of the concrete at the exposed surface and the embedment of the surface aggregate.

4. Insert internal vibrators vertically to the full depth of the layer being placed and into the previous layer where not hardened. Do not drag vibrators through the concrete. Insert and withdraw slowly with the vibrator running continuously so that no hole will be left in the concrete. Avoid flow of concrete from one location to another by use of a vibrator.

5. Consolidate concrete layer to full depth when using a surface vibrator. Use thinner layers or more powerful vibrator if necessary to achieve complete consolidation.

6. Use form vibrators only where sections are too thin or where sections are inaccessible for internal vibrators.

9.6 Protection

1. Unless adequate protection is provided and acceptance is obtained, concrete shall not be placed during rain, sleet or snow.

2. Spray Confilm, as manufactured by Master Builders, over the surface of the concrete immediately after screeding and or bull floating to reduce rapid evaporation of the free water. Apply per manufacturer's written instructions.

9.7 Hot-Weather Concreting

1. Conform to ACI 305 when temperature is 90°F or above, or is likely to rise above 90°F within the 72 hour period after placing.

2. Concrete shall have an in-place temperature of 85°F or lower.

3. Cool concrete by shading and water fogging for a minimum period of 24 hours, starting immediately after placing.

9.8 Cold-Weather Concreting

1. Conform with ACI 306 when temperature is below 40°F or is likely to fall below 40°F during the 72 hour period after placing.

2. Do not expose fresh concrete to carbon monoxide or carbon dioxide fumes from heaters or engines. Concrete with carbonation shall be repaired or replaced at the contractor's s expense.

3. Place concrete at temperatures recommended in Table 1 of ACI 306.

9.9 Time Requirements

1. Place concrete at a sufficient rate to assure that lifts below have not taken initial set before concrete is deposited. Settlement shrinkage shall have occurred prior to placing subsequent lifts.

2. Place concrete within forty five (45) minutes after mixing, except that this period may be extended to ninety (90) minutes (maximum) if weather conditions are favorable, concrete temperatures have not exceeded specified limits, significant slump loss has not occurred, and the Owner concurs.

PART 10 FINISHES

10.1 General

1. Remove fins and burrs and patch voids on irregularities in all exposed vertical surfaces.

2. Tie holes shall be patched by applying water to saturate the concrete, apply mortar with hammer and ramming rod flush with surface, and rub to finish.

10.2 Slabs

1. Finishing of concrete floors and slabs shall be in accordance with ACI 302. In general, surface of slabs shall be brought to proper level by screeding followed immediately with a wooden bull float. Bull float shall be used only to level the surface, not to close the surface. Bull floating must be completed before any excess water or bleeding water is present at the surface.

   A slight stiffening of concrete with no bleed water present is necessary before proceeding further. When the concrete will bear the weight of a man with a

maximum 1/4” indentation, the concrete shall be floated by hand or by a trowel machine outfitted with float shoes. Finish surface with one pass of a flat steel trowel followed by a light broom finish in the direction of the slope of the slab.

2. Screed level and wood float surface of all equipment pads.

PART 11 CURING AND PROTECTION

11.1 Curing of Concrete

Cure all concrete by the following methods, unless approved otherwise by the Engineer. Curing method shall begin as soon as the surface of the concrete will not be marred by its operation.

1. Leaving in forms for a minimum of seven (7) days. Keep formwork wet to prevent drying of concrete surfaces. Exposed surfaces shall be kept continuously wet.

2. Newly placed concrete shall be kept wet by the continuous application of water with a nozzle, soakers, or wet burlap for the first seven (7) days after the concrete has been placed. Alternatively, use polyethylene sheets applied in full contact with surfaces, and maintain the concrete surfaces wet in an approved manner for a minimum of seven (7) days. This curing water shall be clean and free of contaminating substances that would discolor the concrete.

   Upon approval of the Civil Engineer, the concrete may be dewatered after three (3) days and a membrane curing compound, conforming to ASTM C 309, applied before the concrete surface is dry. The curing compound shall have a fugitive dye and shall be applied according to the manufacturer’s written instructions.

3. The curing methods recommended in ACI 305 and ACI 306 shall be followed for concrete placed during hot or cold weather, except that a membrane curing compound shall not be used for hot weather concrete.

PART 12 CONCRETE TEST AND INSPECTION

12.1 General

1. The Contractor shall employ and pay for services of the independent testing laboratory for tests required to show compliance with the specifications. Test results shall be submitted directly to the Owner Site Representative. Selection of the testing laboratory is subject to approval of the Owner Site Representative.

2. Tests required by the Contractor or his supplier which are necessary to check conformity to the specifications are the responsibility of the Contractor and/or his suppliers.

3. Materials and operations shall be tested and inspected as work progresses. Failure to detect defective work shall not prevent nor inhibit rejection when defect is discovered, nor shall it obligate the Owner for final acceptance.

4. Testing agencies shall meet the requirements of “Recommended Practice for Inspection and Testing Agencies for Concrete and Steel in Construction ASTM E-329-77.

12.2 Tests

1. Fresh concrete will be sampled from each concrete supplier on a daily basis. One strength test, consisting of five (5) test cylinders shall be made from each 50 cubic yards of concrete, or where a days pour does not amount to 50 cubic yards. One cylinder of each set will be broken at the age of seven (7) days, one cylinder at fourteen (14) days, two at twenty eight (28) days and one at forty five (45) days. Samples from which compression test specimens are molded shall be secured in accordance with ASTM C 172.

2. For each strength sample made, slump, air content, fresh-unit weight and concrete temperature will be tested from the same concrete truck. In addition, temperature, air content and slump will be tested regularly to ensure conformance with the specification.

3. Compression test specimens shall be made in accordance with ASTM C 31. Specimens taken to the laboratory for curing will be cured in accordance with ASTM C192. Specimens will be tested in accordance with ASTM C 39.

4. If the average strength of the 28 day test cylinders fall below the required strength, further test samples (taken by the Contractor) may be required by the Owner before the structure will be accepted.

5. Core drilling and testing, if required, will be performed by the Owner in accordance with ASTM C 42 at the expense of the Contractor unless the tests indicate satisfactory construction.

6. The Contractor shall provide and maintain for the use of the Owner’s testing agency adequate facilities for proper curing of concrete specimens on -the project in accordance with Method of Making and Curing Concrete Test Specimens in the Field, ASTM C 31.

7. The Contractor shall provide the Owner with batching tickets from each and every truck. The following information shall be shown:

    1. Truck Number
    2. Ticket number
    3. Time batched
    4. Time arrived on job site
    5. Amount of rock, sand, cement, admixtures and total water
    6. Mix number

8. The Owner’s Quality Control Technician will advise the Owner of any and all noncompliance by the Contractor.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.01 SCOPE

A. This specification establishes requirements for detailing, furnishing, fabricating and erecting structural steel framing and miscellaneous steel. Structural and miscellaneous steel includes all items listed in Section 2.0 Classification of Materials, of AISC code.

1.02 ATTACHMENTS

A. The following attachments form an integral part of this specification:

1. Specification 9900 Paints and Coatings

1.03 CODES, SPECIFICATIONS AND REFERENCES

A. Codes and Specifications -- The detailing, fabrication and erection of structural steel framing shall comply with the latest edition of codes and specifications listed below. Any conflicts between this specification, drawings, and codes shall be brought to Owner's attention. The conflict shall be resolved in writing before work begins.

1. AWS Code – "Structural Welding Code-Steel AWS D1.1," by the American Welding Society.

2. AISC Code – "Code of Standard Practice for Steel Buildings and Bridges," by the American Institute of Steel Construction.

3. AISC Specification – "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, by the American Institute of Steel Construction.

4. Research Council on Structural Connections Specification "Specification for Structural Joints Using ASTM A325 or A490 Bolts," by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

B. References -- The following are referred to elsewhere in this specification or in the above codes and specifications:

1. AISC Manual – "Manual of Steel Construction," by the American Institute of Steel Construction.

2. ASTM Standards – "ASTM Standards," by the American Society for Testing and Materials.

3. ANSI Standards – "American National Standards," by the American National Standards Institute.

C. Design Requirements

1. Substitution of Members — If section designated on drawings cannot be obtained, Contractor may make substitution only after receiving Owner's approval in writing. Substitution shall be section of at least equal strength and shall conform to design requirements.

2. Connections -- The following provisions shall apply to all members except bracings:

   a. If beam reactions are not shown on drawings, design the connections to support one half the total uniform load capacity shown in the Allowable Uniform Load Tables in the AISC Manual, for the given shape, span and specified grade of steel. Generally, one-sided connections shall not be used.

   b. Design the connections without increase in allowable unit stresses. Minimum connection design force shall be equal to the capacity of two 3/4 in. diameter ASTM A325 high strength bolts in single shear.

   c. Design all gusset plates and clip angles of beams subjected to direct tension for the axial load shown on the drawings. Gusset plates and clip angles shall have a minimum thickness of 5/16 in. unless otherwise noted on drawings.

.3 Bracing Connections -- The following provisions shall apply to all bracing members:

   a. If axial bracing loads or connection requirements are not shown on the drawings, minimum bracing connection design force shall be equal to the capacity of two 3/4 in. diameter ASTM A325 high strength bolts in single shear. Design the connections without increase in allowable stresses.

   b. Design all gusset plates, clip angles and connecting plates of members subjected to direct tension/compression for the axial load shown on the drawings or the capacity of the connections if forces are omitted. Gusset plates and clip angles shall have a minimum thickness of 5/16 in. unless otherwise noted on drawings.

4. Bolted Joints -- Bolted joint details shall conform to requirements of the Research Council Specification on Structural Connections per Par. 1 .3.1.4 above.

   a. Main Connections – Use ASTM A325 high strength bolts.

   b. Secondary Connections - Use ASTM A307 unfinished bolts for connection of secondary members such as purlins and girts unless designated otherwise.

   c. Welded Joints — Welded joint details shall conform to the requirements of AWS Code Dl .1 per Par. 1.3.1.1 above.

D.. Drawings

1. Shop Detail Drawings -- Vendor shall furnish completed and checked Shop Detail Drawings. Each drawing shall be referenced to the related Structural Design Drawing. Original tracings of shop detail drawings shall become the Owner's property.

2. Erection Drawings -- Vendor shall furnish completed and checked Erection Drawings. Each drawing shall be referenced to the related Structural Design Drawing. Where field welding is required, show on Erection Drawings the type, size and amount. Vendor shall furnish list showing the types, diameter, length and placement of field bolting. Original Erection Drawings shall become the Owner's property.

3. Submittals — The following indicates the number of sets of drawings to be

furnished by contractor.

a. Contractor shall prepare and submit four (4) prints of all shop details drawings for all structural and miscellaneous steel to Owner for approval prior to fabrication. In general, two (2) prints will be returned to the contractor marked either “Approved as Noted” or “Resubmit for Approval.” One (1) approved set of prints will be sent to the site representative.

b. The contractor shall submit either the originals or mylar sepias of all shop drawings at the end of construction for owner records. This final submittal shall reflect all changes requested by owner on the approval drawings. In addition, all “as built” conditions shall be reflected on the final drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Contractor shall supply materials designated, or equal. Materials shall meet the following requirements, unless designated otherwise on the drawings.

B. Structural Steel W and WT Shapes -- ASTM A992

C. Structural Steel Other shapes, Plates and Bars -- ASTM A36.

D. Grating— For floors or stair treads, welded steel, sized per drawings, with serrated bearing bars and twisted cross bars unless otherwise indicated on drawings.

E. Handrail

1. Pipe Handrail -- 1.25 in. (1.5 in. nominal OD.) standard weight carbon steel pipe, ASTM A53 Grade B. with 1/4 in. thick steel toe plate (see drawings for depth).

2. Angle Handrail -- 2.5 in. by 2.5 in. by 1/4 in., ASTM A36, welded construction, with 1/4 in. thick steel toe plate (see drawings for depth).

F. Door Frames - ASTM A36 steel unless otherwise indicated on drawings.

G. Pipe Ladders - ASTM A53 Grade B standard weight pipe, sizes per drawings.

H. Bolting Materials - Use the type of bolting specified on drawings, in Par. 1.4.4 above and as follows:

1. High Strength -- Tempered carbon steel high strength bolts, ASTM A325, with hardened washers, under rotating part of nut and bolt assembly. Galvanized nuts shall be ASTM A563 Grade DH or ASTM Al 94 Grade 2H.

2. Unfinished Bolts -- Low carbon steel nuts and bolts, ASTM A307. Washers are required.

3. Countersunk Flat Head Bolts -- ASTM A307, ANSI B1 8.5.

4. Headed Stud-Type Shear Connectors -- ASTM A108, Grade 1015 or 1020 with a minimum tensile strength of 60,000 psi.

5. Fasteners For Grating -- Fabco/H-3 stainless steel structural fasteners, No. 14 diameter with Style #1 Weath-R-Seal stainless steel washers, both by Fabricated Products Div., Townsend Co. Assemble with stainless steel saddle clips.

6. Concrete Anchors -- Heavy Duty Anchors by HILTI or Red Head.

I. Nonmetallic Shrinkage-Resistant Grout -- Use one of the following, unless otherwise noted on the drawings, or equal:

1. Five Star Epoxy Grout by Five Start Products, Inc. (preferred).

2. “MASTERFLOW 713” or “MASTERFLQW 928” by MASTER BUILDERS

K. Statements and Reports -- Upon request of owner, vendor shall supply certified statements or copies of mill test reports for specified materials, which are required to conform to indicated ASTM or other standard specifications.

PART 3 EXECUTION

3.01 FABRICATION

A. General — Fabricate all steel for delivery sequence that will expedite erection and minimize field handling of materials. Contractor may utilize shop welded frame construction or field bolted construction at his option, however, all field connections shall be bolted.

B. Marking — All members shall be clearly marked, and erection drawings shall be furnished showing clearly the location of all members for ease in erection.

C. Shop Assembly - Items shall be completely shop assembled, where practicable, ready for field erection. Assemble and weld built-up sections by methods that will produce true alignment of axes without warp. All steel shall be galvanized after fabrication is completed. Welding of units shall be completed before galvanizing starts.

D. Columns - Finish bearing ends to allow full bearing on entire cross-sectional area of member at both column splice and base plate.

E. Handrails - Dimensions and detailing of handrails shall be as shown on standard detail drawings. Perform all welded construction unless indicated otherwise on drawings. Remove all weld spatter, and grind all welds, metal projections and sharp edges to a smooth contour. Use post mounting method designated on drawings.

1. All corner turns for pipe handrail shall be made by bending, except that acute angles of pipe handrail shall be made by mitering. All corner turns of angle handrail shall be made by mitering. Set posts plumb within 1/8 in. of vertical and fasten to stair stringers and/or platform framing. Set longitudinal members parallel with each other and with floor or stair stringers to within 1/8 in. each 10 ft.

2. Field Joints — All pipe handrail joints have been field seal welded. Comply with the following requirements:

a. Use materials and methods that minimize distortion and develop strength and

corrosion resistance of base metals.

b. Obtain fusion without undercut or overlap, and remove welding flux immediately.

c. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and welded surface matches contours of adjoining surfaces.

F. Connections -- Shop-weld or field-bolt connections, unless designated otherwise on drawings.

G. Welding — Shall follow the AWS Code – "Structural Welding Code-Steel AWS D1.1," by the American Welding Society.

H. Tubes & Pipes — All galvanized pipe and tube sections shall have vent holes.

1. All bolts shall be galvanized.

2. Refer to attached project coating schedule for coating requirements.

3.02.DELIVERY, STORAGE, & HANDLING

A. Delivery - Deliver materials to site at such intervals to ensure uninterrupted progress of work.

B. Storage - Structural material, either plain or fabricated, shall be stored above the ground upon skids, blocking or other supports. Material shall be free from dirt, grease and other foreign matter.

C. Handling - Care shall be taken during handling and erection to prevent damage to connections, attachments, and to minimize damage to finished paint. Any damaged paint or galvanized surfaces shall be repaired as per touchup section of attached coating specifications.

3.03 ERECTION

A. General -- Any special instructions noted on Structural Design Drawings shall be followed during erection.

B. Temporary Bracing and Supports -- Provide and maintain temporary bracing as required to develop structural integrity during erection. Remove such bracing upon completion of work.

C. Bolting -- Installation, tension control, type of equipment used and inspection methods shall conform to Research Council On Structural Connections Specification per Par. 1.3.1 .4 above. Bolting materials shall conform to Par. 2.7 and shall be high strength type unless other types are permitted by drawings or by this specification. Bolts identified on the drawings as slip critical or direct-tension shall be installed by “turn of the nut” method, all other bolts shall be brought to a “snug-tight condition only.

D. Field Welding and Cutting — Field welding shall be per design drawings only. Gas blowing and reaming shall not be permitted for making holes, all holes shall be drilled. Cutting or welding to correct fabrication errors shall be done only with consent of

Owner.

E. Anchor Bolts — Anchor bolts will be furnished and installed by concrete contractor.

F. Framing -- Erect framing plumb and true. Connect securely all work as erection progresses, providing for all wind and erection stresses and dead and live loads.

G. Columns — Columns shall be plumb within the tolerance listed in AISC Code, and there shall be uniform bearing pressure under the base plates.

1. Columns shall be set with their base plates fully seated on leveling plates.

2. Columns may be set without leveling plates by shimming and grouting base plates.

H. Milled-End Compression Members - Connect splices only when contact surfaces are fully seated and secured in complete contact.

I. Floor Grating

1 Installation -- Fasten grating with stainless steel fasteners and stainless steel saddle clips per Par. 2.7.5 above. Fasteners shall be provided two per panel at each supporting member.

2. Openings -- All openings in grating shall be banded prior to application of coating.

J. Touch-up Painting – Refer to project painting specifications.

3.04 QUALITY CONTROL

A. Inspection -- Material and workmanship are subject to inspection in mill, shop and field by qualified inspectors supplied by Owner. Failure of Owner to reject defective material or inferior workmanship does not absolve Contractor's responsibility.

B. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be performed.

C. Correct deficiencies in structural and/or miscellaneous steel work that inspections and laboratory tests reports have indicated to be not in compliance with requirements. Perform additional tests, at contractor's expense, as necessary to reconfirm any noncompliance of original work and to show compliance of corrected work.

END OF SECTION

SECTION 09900

PAINT AND COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The contractor shall provide all labor, material, tools, equipment and supervision as required to complete all work as indicated in this section.

B. Work shall include all surface preparation, cleaning and painting, including touch up. Contractor is also responsible for protection of newly painted surfaces during transportation and installation. *The contractor in conformance with this specification shall touch up damaged surfaces.*

1. Material - The contractor shall furnish all materials.

2. Shop Painting - All new steel shall be shop painted. Field painting of new steel shall be limited to touch up as required.

3. Manufacturer's Instructions and Recommendations - The contractor shall be familiar with the manufacturer's instructions as to the surface preparation and installation of all paint. He shall comply with all manufacturers' recommendations. Paint applied contrary to instructions shall be removed, the surface shall be re-prepared and new paint installed at no cost to owner.

   If the contractor chooses a comparative product by a manufacturer other than those listed under Section 2, he shall submit all pertinent product data to owner site representative prior to starting work. He may not apply any paint until he receives approval from Owner's site representative.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials to be used shall comply with one of the following approved paint systems. It should be noted that owner's site representative might substitute comparative products by other manufacturers only with prior approval.

	Devoe
Epoxy Primer	Bar-Rust 235 (Buff Color)
Epoxy Intermediate Coat	Bar-Rust 235(Off White)
Aliphatic Urethane Finish Coat	Devthane 379 High Build Gloss

B. Color - The finish coat color shall be as specified below:

Structural and Miscellaneous Steel	Clay Tan
Handrail and Toe Plate	Safety Yellow

Color Standards	**Devoe**
Clay Tan	#1600
Safety Yellow	#9400

PART 3 EXECUTION

3.01 GENERAL

A. This system includes an epoxy primer followed by an epoxy polyamide intermediate coat and an aliphatic urethane finish coat. The system exhibits a durable high gloss finish with excellent chemical resistance.

B. All coats shall be uniformly applied in a workmanlike manner. Paint shall be thoroughly mixed and applied in accordance with the manufacturer's instructions. Each coat shall be evenly applied free from runs, sags, pinholes and other defects. Successive coats shall be of different colors to facilitate inspection.

C. Film imperfections such as "orange peel" and "dry over-spray" are unacceptable and shall be corrected at no cost to owner.

D. All work shall be done with spray equipment, roller or brush as recommended by the manufacturer

1. Surface Preparation - Prepare surface by sandblasting to near-white metal (SSPC-SP 10).

2. Primer - Priming (1 coat) shall be done immediately after cleaning while the prepared surface is free of dust and other contaminants. The allowable time between cleaning and painting shall be determined by the humidity, cleanliness, etc., of the area. Good judgment shall be used.

   The dry film thickness of the primer coat shall be 2.5 to 3.5 mils.

   Allow a 12-hour cure time before applying the intermediate coat.

3. Intermediate Coat - Apply a polyamide cured epoxy intermediate coat consisting of one coat applied in multiple passes to yield a minimum thickness of 4 mils dry.

   Allow a 12-hour cure time before applying the finish coat

4. Finish Coat - Apply a one-coat aliphatic finish coat consisting of multiple passes to yield 1 1/2 to 2 mils dry.

5. Touch Up - After erection of steel the contractor shall power tool clean, prime and touch up all unpainted, burned and damaged areas. Oil and grease shall first be removed per solvent cleaning SSPC-SP 1.

   Clean all surfaces per SSPC-SP 3 (Power Tool Cleaning). Surface shall not be burnished smooth. The profile depth shall be 1 1/2 to 2 mils.

   Apply one coat of epoxy primer immediately after cleaning. The minimum dry thickness shall be 3 mils dry.

   Intermediate coat application and film thickness shall be the same as for parts 3.3 and 3.4 above.

3.02 INSPECTION

A. Notification - Contractor shall notify the owner site representative or his designate after surface preparation and before the application of each successive coat of paint. Contractor shall allow for inspection of the surface preparation and each coat of paint.

B. Paint Thickness - The paint thickness shall be measured by a magnetic instrument approved by owner or by another appropriate instrument approved by owner.

END OF SECTION

SECTION 11231

AIR STRIPPER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air stripper and associated components.

1.2 PAYMENT (SECTION NOT USED)

1.3 REFERENCES (SECTION NOT USED)

1.4 SYSTEM DESCRIPTION

A. The air stripper (Air Stripper) treatment system will consist of one air stripper unit to remove VOCs from extracted groundwater. The system is designed for 2,000 gpm with an air flowrate of 10,700 cfm. All equipment will be located inside the building in Attica, Indiana.

1.5 PROGRESS SUBMITTALS

A. Shop Drawings: Indicate:

1. Arrangement drawings showing the layout of components and equipment and the dimensions of concrete support structures.

2. Location and size of pipe connections.

3. Loads on the structural floors and distribution of loads.

4. Full dimensional details of stripper piping.

5. Electrical details and power requirements.

6. The make, model number, and full details of all appurtenant equipment such as valves, operators, gauges, and control panel details.

7. Equipment grounding details.

8. Description of the stripper operation, including estimated time duration and manpower requirements.

9. Provide one complete set of the operating and maintenance instructions, including parts lists, to OWNER as soon as possible after review of the equipment is completed. On approval, submit the remaining copies. One set must be available to OWNER and CONTRACTOR at least one month prior to delivery of the equipment.

B. Product Data: Indicate engineering data, head loss, pressure rating, electrical characteristics.

C. Test Reports: Include performance data and head loss curves for piping components.

D Manufacturer's Instructions: Indicate application conditions and limitations or use, include instructions for storing, handling, preparation, installation, setup, and adjustment.

1.6 CLOSEOUT SUBMITTALS

A. Record Documents indicate actual location of equipment and location of interconnecting piping and valves.

B. Operation and Maintenance Data: Indicate operation, maintenance, and parts lists including list of recommended spare parts. Provide six complete copies of the operating and maintenance instructions, including parts lists for all of the equipment. One copy to be single sided for production of additional operation and maintenance manuals. Bind material in sections in hard backed binders.

C. Warranties: Complete warranty forms in OWNER's name and register warranty. Provide 1 year manufacturer's warranty for the system.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept equipment on the Site as delivered by supplier. Inspect for damage.

B. Store in clean and dry area. Protect from excessive heat and cold.

1.9 SYSTEM STARTUP AND COMMISSIONING

A. Start-up and commissioning services can be requested by the OWNER at any time, and the CONTRACTOR or equipment supplier must be capable of supplying this service.

B. Site commissioning services include:

1. Inspecting the installation and certification that installations and connections are satisfactory.

2. Inspecting the interior of the unit to ensure they are clear and clean.

3. Checking that field painting of items primed in the shop has been carried out to the satisfaction of manufacturer before filling system, and that items finish painted in the shop have been touched up as required.

4. Supervising the startup of equipment.

5. Checking controls and instrumentation, and confirming that the process is producing water of specified quality. Completion of calibration and adjustments.

C. Service technicians shall be equipped with necessary equipment including signal generators and pressure calibration kits to verify the setup of controls and instrumentation.

D. The cost of Site services quoted assumes one visit to the Site to carry out the above work, assuming zero defects or problems with the equipment supplied. Allow for two additional days of operator training, which will be performed after but not necessarily subsequent to installation and startup. Additional visits or time on Site, due to equipment problems or defects in the equipment supplied herein, shall be at no additional cost to OWNER.

E. Provide a detailed written report advising the results of Site inspection, startup, and process checking, with numerical data to support the latter.

F. Spare parts are not required, but Vendor shall provide a list of recommended spare parts, complete with prices.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Air stripper system. Acceptable manufacturer:

1. Delta Cooling Towers, Inc. , Rockaway, NJ or approved equal.

B. Design the equipment for continuous operation at peak hydraulic capacity.

C. Design all parts with adequate factors of safety to withstand the maximum mechanical stresses to which they might be subjected during the course of plant operation.

D. The arrangement of parts must be such as to allow ready accessibility for erection, inspection, maintenance, and repair.

E. Include all other equipment required to provide a complete and functional system meeting all performance requirements specified herein.

2.2 PERFORMANCE REQUIREMENTS

A. Under all operating conditions the air stripper system is required to reduce contaminants from the peak influent concentrations to below to the treated water concentrations requirements as stipulated below. Supplier shall be responsible for ensuring and guaranteeing that the design of the equipment and system will meet these objectives. If manufacturer cannot meet these requirements a statement must be included in the bid proposal.

	Influent Concentrations (ppb)	Performance Standard (ppb)
Trichloroethene (TCE)	10	< 0.5

B. Design parameters for Air Stripper:

1. Number of Units: One.

2. Process Design Flow: Water – 2,000 gpm. Air – 10,700 cfm.

3. Model: S9-200DF.

C. Equip stripper with manways for inspection and repair service.

D. Equip system with lifting lugs for installation and maintenance service.

E. Equip stripper with the following connections at a minimum (for location see drawings):

1. Influent: 10-inches.

2. Effluent: 12-inches.

3. Air Inlet: 10-inches.

4. Air Outlet: 10-inches.

5. High level switch: 2-inches.

6. Drain (siphon drain): 2-inches.

7. Sight glass (two connections): 2-inches.

8. Differential pressure switch: 2-inches.

F. Air Stripper Air Blower

1. Performance: 10,700 acfm at 3.5-inches w.c.

2. Blower Motor: 10 hp, 460V, 3-phase. Motor to be specified per Division 16 – Electrical.

3. Blower accessories: Intake screens, manually adjustable inlet guide vanes, casing drain, flexible outlet connection, and ductwork from the blower to the tower.

4. Belt drive.

2.3 MATERIALS

A. All materials used shall be selected for their suitability for each particular duty and will comply with the latest ASTM standards unless otherwise provided.

B. All materials shall be new and of the best quality; all workmanship shall be first class.

C. The mechanical aspects of all equipment shall comply with the latest ASME standards unless otherwise provided.

D. Stripper column shall be FRP.

E. All anchor bolts, nuts, shall be of Type 304 or 316 stainless steel.

F. Piping:

1. Arrange piping so that valves, pressure switches, gages, and other items which may require regular inspection or maintenance are conveniently accessible. Provide piping with drains at all low points, and air release valves at all high points.

2. The design of the piping shall allow for proper restraint under all anticipated conditions, particularly where surges may occur and high transient pressures could result, or where different temperatures occur seasonally.

3. Where piping connections are made between adjacent structures, provide at least 1 flexible coupling if any possibility of settlement or movement exits.

2.4 PROTECTIVE COATINGS

A. Section 09900 - Submittals: Paints and coatings.

B. All pre-finished items such as valves, operators, etc. shall receive Supplier's standard protective coating. Protect machined ferrous surfaces with grease or anti-rusting compound.

2.5 PIPING, VALVES, AND APPURTENANCES

A. Section 15410 – Process Piping and Valves.

B. It is the intent of these specifications to outline components of an air stripper system with a proven performance track record. Air stripper system vendor shall supply face piping described below, at a minimum. The air stripper shall be supplied with pipes and valves for operation as described previously.

1. Water Line: FRP.

2. Air Line: FRP.

C. Butterfly Valves: AWWA C504; as manufactured by Pratt, DeZurik, Keystone or equal. Valves 8 inches and larger shall have gear operators with hand wheel. Butterfly valves shall be cast or ductile iron body, ductile iron with Ni-chrome edge disc, stainless steel shaft, and Buna-N seat.

D. Pressure Gauges: 4 ½-inch nominal diameter, installed with isolation valves. Manufactured by Trerice, Ashcroft or equal.

E. Pipe Hangers and Supports: Provide for all face piping. All pipe supports shall have liberal strength and stiffness to support pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces. Support spacing shall be a maximum of 10 feet with additional support provided at fittings, valves, and changes in direction.

F. Air/Vacuum Valves: Combination air/vacuum valve; APCO Series 14 C as manufactured by Valve and Primer Corporation or equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. General Requirements: Verification of existing conditions before starting work.

B. Verify dimensions and elevations of structures and location and sizes of poured in place anchor bolts. Provide for adjustments in sizes at interconnecting piping where actual dimensions vary from the proposed drawings. Verify that openings, bases, anchorages, sleeves, and hangers are ready for the complete installation of the equipment.

C. Verify that surfaces and Site conditions are ready to receive Work.

3.2 INSTALLATION

A. Installation shall be done by General Contractor, based on detailed written instructions from Supplier. This will include connecting mechanically and electrically any components not base mounted and shop connected, as well as typical field connection of piping and power.

END OF SECTION

SECTION 13121

PRE-ENGINEERED BUILDING INSTALLATION

PART 1 GENERAL

This specification establishes requirements for the installation of a pre-engineered metal building including doors and roof penetrations. The erection of the building shall comply with the latest edition of all codes and specifications, and most stringent criteria.

1.1 SECTION INCLUDES

A. Pre-engineered, shop-fabricated, primed and painted structural steel building frame.

B. Pre-finished, insulated metal wall and sloped roof system including gutters and downspouts, and flashing and sealant for roof penetrations.

C. Exterior doors, and overhead coiling door, with hardware.

1.2 REFERENCES

A. American Institute of Steel Construction, Inc. (AISC):

1. Code of Standard Practice for Steel Buildings and Bridges.

2. Manual of Steel Construction.

3. Specification for Structural Steel for Buildings - Allowable Stress Design and Plastic Design.

4. Quality Certification Program, Category MB.

B. American Society for Testing and Materials (ASTM):

1. A36/A36M - Standard Specification for Carbon Structural Steel.

2. A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

3. A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

4. A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

5. A490 - Standard Specification for Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength.

6. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

7. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

8. A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel

of Structural Quality.

9. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

10. A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

11. C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

C. American Welding Society, Inc. (AWS):

1. A2.4 - Standard Welding Symbols.

2. D1.1 - Structural Welding Code - Steel.

D. Metal Building Manufacturer's Association (MBMA):

1. Metal Building Systems Manual.

2. Low Rise Building Systems Manual.

1.3 DEFINITIONS

A. Rigid Frame: A structural framework in which columns and beams are rigidly connected together without hinged joints. The frame is stable with respect to design loads and does not need bracing in the plane of frame.

B. Sandwich Panel: A panel assembly used as a building covering consisting of insulated cover material between inner and outer metal skins.

1.4 PROGRESS SUBMITTALS

A. Shop Drawings: Indicate assembly dimensions, elevations, locations, sizes and steel grades of structural members, connections, attachments, openings, cambers, and loads; wall and roof system dimensions, panel layout, general construction details, anchorages and method of anchorage; framing base plate and anchor bolt settings, sizes, and locations from datum, and foundation loads; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature of structural engineer licensed in the state where the Site is located.

B. Erection Drawings: Indicate members by label, assembly sequence, and temporary erection bracing.

C. Product Data: Include for profiles, component dimensions, anchor bolts, and fasteners.

D. Samples: Submit 2 samples of precoated metal panels for each color selected, 6 by 6 inch in size, illustrating color and texture of finish.

E. Mill Test Reports: Submit test reports on metal material if requested by ENGINEER.

F. Manufacturer's Certificates: Certify that products meet or exceed specified requirements.

G. Welders Certificates: Certify welders employed on the Works, verifying AWS qualification within the previous 12 months.

H. Manufacturer's Instructions: Indicate preparation requirements, and anchor bolt

placement.

1.5 CLOSEOUT SUBMITTALS

A. Record Documents: Record actual locations of concealed components and utilities.

B. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with AISC Specification for Structural Steel Buildings, AISC Code of Standard Practice, AISC Quality Certification Program, Category MB, MBMA Metal Building Systems Manual, and MBMA Low Rise Building Systems Manual; which ever is most stringent.

B. Comply with International Building Code, 2006, and all applicable local and state building code requirements.

C. Qualify welding process and welding operators in accordance with AWS standards.

D. Weld steel in accordance with AWS standards.

1.7 QUALIFICATIONS

A. Erector: Company specializing in performing the work with minimum 5 years documented experience and approved, under license, by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instructions.

B. Deliver materials to the Site bearing manufacturer's labels and seals intact.

C. Store materials in a weathertight, damp-free structure, and in accordance with manufacturer's instructions.

1.9 SEQUENCING AND SCHEDULING

A. Sequence and schedule work to coordinate with installation of process equipment and mechanical/electrical requirements.

PART 2 PRODUCTS

2.1 BUILDING DESCRIPTION AND SITE LOCATION

A. The building is to be installed where indicated on drawing CI-02, in the City of Attica, Indiana.

B. The building will be used to house an air stripper, discharge supply tank, pumps and various electrical controls.

C. Building Type: Pre-Engineered Metal, Structural Steel Rigid Frame.

D. Building Occupancy Class: F-2 (Factory-Industrial Low Hazard Occupancy).

E. Construction: Non combustible Type 2B (IBC 2006 Section 602.2, Table 1003.2.2.2).

F. Floor Live load: 125 pounds per square foot
2000 lb. concentrated load

G. Ground Snow load: 20 pounds per square foot
Snow exposure factor = 1.0
Snow load importance factor = 1.0.

H. Wind Load: 90 miles per hour
Exposure category C
Wind load importance factor = 1.0.

I. Earthquake Load: Seismic Group = 1
Seismic importance factor = 1.0
Mapped spectral response acceleration - short period = 0.305
Design spectral response coefficient - short period = 0.203
Seismic Design category C

2.2 BUILDING DIMENSIONS

A. Approximately 36'-8 1/2" by 39'-8 1/2" (clear inside dimensions).
20 feet clear inside height
Area = 1471 square feet

2.3 BUILDING ACCESSORIES

A. The building scope of supply to include the supply and installation of the following items and quantities. The location within the structure building is indicated on the drawings

- Three (3) exterior doors (provided by building manufacturer).
- One (1) manually operated overhead door (provided by the building manufacturer).

B. The building shall include the following framed opening in the building roof for equipment installation by others. The location within the structure building to be determined by the Owner Site Representative.

- One (1) 9 foot diameter opening for installation of an air stripper. Needs to be 9'-4"
- One (1) 10 inch diameter opening for installation of air stripper piping.
- One (1) 6 inch diameter opening for installation of discharge tank vent.

C. The building may include framed openings in the building exterior walls for equipment installed by others at a later date. The Contractor shall design the building accordingly.

2.4 MATERIALS - FRAMING

A. Structural Steel Members: ASTM A36.

B. Structural Tubing: ASTM A500 Grade B and ASTM A501.

C. Plate or Bar Stock: ASTM A529.

D. Anchor Bolts: ASTM A307, hot dipped galvanized in accordance with ASTM A153.

E. Connection Bolts, Nuts, and Washers: ASTM A325 and A490, hot dipped galvanized in

accordance with ASTM A153.

F. Welding Materials: AWS D1.1, type required for materials being welded.

G. Grout: ASTM C1107, Non-shrink type, premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 2,400 psi at 2 days and 7,000 psi at 28 days.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that foundation, floor slab, mechanical and electrical utilities, and anchor bolts are in correct position.

B. Verify that the Shop Drawings have been submitted and reviewed by ENGINEER.

3.2 PREPARATION

A. Comply with manufacturer's instructions.

B. Keep units free of temporary construction loads until permanently secured.

C. Protect galvanized or other finished surfaces from damage.

D. Modify framing and/or base plates to correct inaccuracies in foundation anchor bolts placements.

3.3 ERECTION - FRAMING

A. Erect framing in accordance with AISC Specification for Structural Steel for Buildings and manufacturer's instructions. Set structural members level and plumb, in correct position.

B. Provide for erection and wind loads. Provide temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection and installation of permanent bracing.

C. Set column base plates with non-shrink grout to achieve full plate bearing.

D. Do not field cut or alter structural members.

E. After erection, prime welds, abrasions, and surfaces not shop primed.

F. Correct slight inaccuracies in punching by reaming. Do not enlarge holes by drifting.

G. Verify that final connections have been accomplished.

3.4 ERECTION - WALL AND ROOFING SYSTEMS

A. Install wall and roofing systems in accordance with manufacturer's instructions.

B. Exercise care when cutting pre-finished material to ensure cuttings do not remain on finish surface.

C. Fasten cladding system to structural supports, aligned level and plumb.

D. Locate end laps over supports. End laps minimum 2 inches. Place side laps over

bearing.

E. Provide expansion joints where shown on the Drawings.

F. Install flashing, sealant and all other components/parts commonly supplied to complete a watertight seal around the roof penetrations, where indicated on the drawings.

G. Install insulation and vapor retarder utilizing girts and purlins for attachment. Place wire mesh under vapor retarder for support between framing members.

H. Install flashing, sealant, and gaskets to prevent weather penetration.

I. Secure wall assemblies ensuring a completed installation free from noise, rattles, wind whistles, or noise due to thermal movement.

J. Ensure continuous vapor barrier seal by pre-calking female joints.

K. Install base angle/channel, base trim and flashing over perimeter foundation wall insulation.

3.5 ERECTION - GUTTER AND DOWNSPOUT

A. Rigidly support and secure components with self tapping screws. Joint lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.

B. Apply bituminous paint on surfaces in contact with cementitious materials.

C. Slope gutters minimum 1/8 inch per foot.

D. Connect downspouts to storm sewer system and/or install splash pads under each downspout as required.

3.6 INSTALLATION - ACCESSORIES

A. Install door frame, door, overhead coiling door, and hardware in accordance with manufacturer's instructions.

B. Flash and seal wall and roof accessories weathertight with sealant, both sides.

3.7 TOLERANCES

A. Framing Members: 1/4 inch from level; 1/8 inch from plumb.

B. Siding and Roofing: 1/8 inch from true position.

END OF SECTION

SECTION 13200

DISCHARGE TRANSFER TANK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fiber Reinforced Plastic tank.

1.2 REFERENCES (SECTION NOT USED)

1.3 PROGRESS SUBMITTALS

A. Shop Drawings: Indicate tank dimensions, material, wall, head, and bottom thickness fabrication requirements, support and anchoring details, design loads, connection details, orientation, elevations, tolerances, and finish details.

B. Design Data: Indicate manufacturing specification, pressure.

C. Manufacturer's Certificates: Certify that tanks meet or exceed specified requirements.

D. Manufacturer's Instructions: Indicate rigging, lifting, and fastening procedures.

E. Manufacturer's Field Reports: Indicate that tanks have been inspected and tested in accordance with Specifications.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 – Execution Requirements

B. Record Documents: Indicate location of tanks, orientation and location of fittings.

C. Field Test Reports: Indicate results of initial on-Site air pressure test.

D. Operation and Maintenance Data: Indicate inspection, maintenance, and tank testing requirements. Provide six complete copies of the operating and maintenance instructions, including parts lists for all of the equipment. One copy to be single sided for production of additional operation and maintenance manuals. Bind material in sections in hard backed binders.

E. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer. Provide two year manufacturer's warranties for tanks. Warranty to include coverage for defects in material and workmanship.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this Section with minimum two years documented experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept tanks on the Site. Inspect for damage.

B. Protect tanks from damage by weather and construction traffic.

PART 2 PRODUCTS

2.1 FIBER REINFORCED DISCHARGE TRANSFER TANK (AIR STRIPPER DISCHARGE TANK)

A. Round flat-bottom fiber reinforced tank as manufactured by An-cor Industrial Plastics, Inc or equal.

B. Capacity: 12,000 gallons.

C. 1.0 specific gravity hydrostatic capacity.

D. Six hold downs.

E. Three FRP lifting lugs.

F. Post Cure for FDA.

G. FDA tank cleaning.

H. One Vent.

I. Resin: Derakane 411

J. Corrosion Barrier (CB) = (1) Veil, (2) 1.5 oz mat, Level 2 visual quality.

K. Structural layers (SL) = per calculations, Level 2 visual quality.

L. Nozzles, flanged, orientation as shown on Drawings:

1. Inlet: 12-inches.

2. Outlet: 12-inches.

5. Top Manway: 24-inches.

6. Instrument (2): 4-inches.

9. Side Manway: 36-inches

M. Operating Conditions:

1. Liquid: Groundwater.

N. Nozzle and gasket materials suitable for product stored.

O. All drains and pump suction nozzles are to be supplied with siphon drains.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

A. Section 01400 – Quality Control Requirements: Quality Control.

B. Hydrostatically test tank after installation.

3.3 PROTECTION OF FINISHED WORK

A. Section 01700 – Execution Requirements: Protection of installed construction.

B. Protect finished work from construction activities.

END OF SECTION

SECTION 15051

BURIED PIPING INSTALLATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. All types of buried piping unless specifically included under other Sections. These include, but are not limited to: cast iron, ductile iron, and polyvinyl chloride pipe.

B. Supports, restraint, and thrust blocks.

C. Work on existing pipelines.

D. Jointing and gasketing materials, specials, couplings, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods.

1.02 RELATED SECTIONS

A. Section 02221 - Trenching, Backfilling and Compacting.

1.03 REFERENCES

A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. AWWA C 111 (ANSI A21.11), Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings.

2. AWWA C 900, Installation of PVC Water Mains and Appurtenances.

1.04 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this section with a minimum of three (3) years experience.

1.05 SUBMITTALS

A. Shop Drawings: In accordance with the Special Conditions of these specifications, submit for approval the following:

1. Laying schedules and detailed drawings in plan and profile for all piping 16-inch size and larger.

2. Show full details of piping, specials, and connections to existing pipes and structures.

B. Tests: Submit description of proposed testing methods, procedures, and apparatuses. Submit copies of all test reports.

C. Certificates: Submit certificates of compliance with referenced standards.

1.06 RECORD DOCUMENTS

A. Record actual locations of valves, hydrants, and other flow control devices and submit to the ENGINEER in accordance with the Special Conditions of this Contract.

1.07 REGULATORY REQUIREMENTS:

A. Comply with applicable requirements of all governing agencies and the following codes:

1. State and Local Plumbing Codes.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Underground piping shall not be installed when bedding are wet or frozen.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe materials required are shown on the Contract Drawings and are specified in the applicable 15000 Series Section of Specifications. Refer to applicable sections for detailed material specifications.

PART 3 EXECUTION

3.01 EXAMINATION

A. Pipe:

1. All pipe shall be carefully inspected prior to installation.

2. The CONTRACTOR is responsible for assuring that damaged pipe is not used. Defective pipe shall be removed from the site.

3. Any pipe found to be broken or defective after it has been installed shall be removed and replaced at the CONTRACTOR'S expense.

4. If there is a question regarding the quality of any pipe or fittings delivered to the site, the CONTRACTOR will supply to the ENGINEER a certified letter from the pipe vendor stating that the pipe meets all conditions of the Specifications. If certified letter cannot be supplied, questionable material will be replaced at the CONTRACTOR'S expense.

B. Bedding Condition: Pipe shall be installed only on bedding inspected and approved by the Owner Site Representative. Installation shall proceed immediately upon receipt of approval.

C. Request instructions from the ENGINEER when there is a conflict between existing piping systems and equipment and proposed piping to be installed.

3.02 PREPARATION

A. Lines and Grades:

1. Accurately lay pipe to the lines and grades shown on the Contract Drawings and specified herein.

2. Lay pipe on a straight sight line and grade.

3. Any section of pipe found to be laid at the wrong grade or to have settled shall be dug up and relaid to the satisfaction of the ENGINEER at the CONTRACTOR'S expense.

4. The CONTRACTOR is responsible for maintaining lines and grades.

B. Trench:

1. Prepare trench and bedding conditions in accordance with Sections 02221 and the details shown on the Contract Drawings.

2. Dig bell holes sufficiently large to ensure making and checking of joints properly.

C. Pipe:

1. Each piece of pipe or fitting, except straight pipe with no outlets, shall be clearly marked with a designation which shall conform with designations shown on the Shop Drawings.

2. Class designation shall be cast or painted on each piece of pipe or fittings 4-inches in diameter and larger.

3. Piping, 3-inches diameter and less shall be clearly marked by manufacturer as to material, type and rating.

4. Clean pipe thoroughly.

5. Apply lubricant in accordance with the manufacturers written instructions.

6. Insert the gasket and seal it, if required, in accordance with manufacturer's written directions.

7. Field cutting of pipe, if necessary, shall leave a smooth end and be performed in accordance with the manufacturer's written instructions.

3.03 INSTALLATION

A. General:

1. Install piping as shown, specified and as recommended by the manufacturer. As a minimum, conform to AWWA C-600 for installation of ductile iron pipe and fittings and AWWA Manual M23 for PVC pipe as specified herein. (For conflicting requirements, if any, the more stringent shall apply.)

2. Request instructions from the ENGINEER before proceeding if there is a conflict between the manufacturer's recommendations and the Contract Drawings.

3. Pipe, fittings, and accessories that are cracked, damaged or in poor condition or with damaged linings will be rejected and shall be replaced at the CONTRACTOR'S expense.

4. Minimum cover over piping shall be 4.5 feet for all watermain construction unless otherwise shown or approved by the ENGINEER.

5. Earthwork required is included in Section 02221.

B. Pipe Bedding:

1. Bed pipe as specified in Section 02221 and as shown on the Contract Drawings. If a conflict exists, obtain clarification from the ENGINEER before proceeding.

C. Laying Pipe:

1. Conform to manufacturer's instructions and to applicable codes and standards.

2. Install all pipes accurately to line and grade shown unless otherwise approved by the ENGINEER. Remove and relay pipes that are not laid correctly.

3. Slope piping uniformly between elevations given.

4. Ensure that water level in trench is at least 6-inches below bottom of pipe. Do not lay pipe in water. Maintain dry trench until jointing and backfilling are complete.

5. Place bell and spigot pipe so that bells face the direction of laying, unless otherwise approved by the ENGINEER.

6. Excavate around joints in bedding and lay pipe so that only the barrel receives bearing pressure from the trench bottom.

7. Permissible deflections at joints shall not exceed 50 percent of the amount allowed by manufacturer.

8. Prior to laying pipe, every precaution shall be taken to ensure that no foreign material enters the piping.

9. All pipe and fittings shall be carefully examined for cracks, damage or other defects while suspended above the trench before installation. Defective materials shall be immediately removed from site.

10. Interior of all pipe and fittings shall be inspected and all dirt, gravel, sand, debris or other foreign material shall be completely removed from pipe interior before it is moved into the trench. Bell and spigot mating surfaces shall be thoroughly wire brushed and wiped clean and dry immediately before pipe is laid.

11. Every time that pipe laying is not actively in progress the open ends of pipe shall be closed by a watertight plug.

12. Field cutting pipe, where required, shall be made with a machine specially designed for cutting piping. Cuts shall be carefully done, without damage to pipe or lining, so as to leave a smooth end at right angles to the axis of pipe. Cut ends shall be tapered and sharp edges filed off smooth. Flame cutting will not be allowed.

13. Blocking under piping will not be permitted unless specifically excepted by the ENGINEER for special conditions. If permitted, conform to requirements of AWWA C900.

14. Touch up protective coatings in a satisfactory manner prior to backfilling.

15. On watermain construction where the proposed watermain passes above a house sewer, storm sewer or sanitary sewer, a vertical separation of at least 18-inches shall be provided between the

a. A vertical separation of at least 18-inches between the bottom of the sewer and the top of the watermain shall be maintained.

b. The joints of the watermain shall be equi-distant and as far as possible from the sewer.

c. Where the proposed watermain passes under an existing sewer, both pipes will be encased in concrete as shown on the Contract Drawings.

D. Jointing Pipe:

1. Clean completely all jointing surfaces and adjacent areas immediately before making joint.

2. Lubricate and adjust gaskets and "O" rings as recommended by manufacturer.

3. After "O" rings are compressed and before pipe is brought fully home, each gasket shall be carefully checked for proper position around full circumference of the joint.

4. Conform to AWWA Specifications and to all applicable manufacturer recommendations pertaining to jointing pipe.

5. For mechanical joints the plain end shall be centered and pushed into the bell and the gasket shall be firmly pressed evenly into the bell. The gland shall be slid to the bell for bolting. All bolts with oiled threads shall be alternately torque-tightened 180 degrees opposite to each other to seat the gasket evenly. The maximum torque shall be as follows:

Bolt Size (inches)	Applied Torque (ft-lbs)
5/8	50
3/4	80
1	90
1-1/4	110

All bolts and nuts shall be heavily coated with an approved bituminous coating.

6. Use hexagon head nuts and bolts on all flanged joints. Use "Tee" type bolts for all mechanical joints. Refer to Section 15062 for specifications for bolts.

7. Clean and lubricate bolt threads and gasket faces for flanged joints.

E. Restraints, Supports, and Thrust Blocks:

1. Use restrained joints and thrust protection for piping systems where shown on the Contract Drawings. All buried watermain piping shall be restrained for the entire project.

2. Concrete for thrust blocks, if and where ordered by the ENGINEER, shall be of a 4,000-psi mixture and shall be approved by the ENGINEER.

F. Transitions from One Type of Pipe to Another:

1. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

2. Encase all such connecting joints with 6-inches minimum of Class "B" concrete unless otherwise

shown, specified or recommended by manufacturer.

3. Wherever changes in size of pipe occur, change shall be made with reducing fittings. The use of bushings will not be permitted unless otherwise shown or specified.

G. Closures:

1. Provide all closure pieces shown or required to complete the Work.

2. Locate closures in straight runs of pipe.

H. Backfilling:

1. Conform to applicable requirements of Section 02221.

3.04 WORK AFFECTING EXISTING PIPING AND UTILITIES

A. Location of Existing Piping:

1. Locations of existing piping and utilities shown should be considered approximate.

2. The CONTRACTOR is responsible for determining exact location of existing piping and utilities to which he must make connections, or which he may disturb during earth moving operations, or which may be affected by his work in any way.

3. Individual utility service mains are not shown on the Contract Drawings. These may include water, gas, telephone, electric, sanitary sewer or other service mains. The CONTRACTOR is responsible to locate these service mains and protect them from damage or injury during his construction operations.

B. Taking Existing Pipelines Out of Service:

1. Do not take pipelines out of service except those approved by the ENGINEER.

2. Notify the ENGINEER at least 48 hours prior to taking pipeline out of service.

3. CONTRACTOR is responsible to notify all affected agencies and all homeowners or other parties, which will be affected during a shutdown period. He shall coordinate these proposed shutdown periods with the OWNER of existing pipeline or service.

4. Keep shutdown periods to a minimum. The length of any shutdown period shall be as allowed by the OWNER, but under no instance shall a shutdown exceed a 48-hour period.

5. Ensure that all necessary materials, tools, equipment, and labor is on site in order for proper completion of the work prior to the start of any shut-downs or work on any existing pipelines.

END OF SECTION

SECTION 15062

DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Ductile-iron pipe and fittings.

B. Jointing and gasketing materials.

C. Flexible couplings.

D. Mechanical couplings.

E. Restrained Flange Adapters.

F. Tie rods.

G. Harnessing.

H. Other miscellaneous appurtenances, accessories, linings and coatings.

1.02 RELATED SECTIONS

A. Section 02221, Trenching, Backfilling and Compacting.

B. Section 15051, Buried Piping Installation.

1.03 REFERENCES

A. Comply with applicable provisions and recommendations of the following, except as otherwise specified.

1. AWWA C104 (ANSI A21.4), Cement-Mortar Lining for Cast-Iron and Ductile-Iron Pipe and Fittings for Water.

2. AWWA C110 (ANSI A21.10), Gray-Iron and Ductile-Iron Fittings, 2-inch through 48-inch, for Water and Other Liquids.

3. AWWA C111 (ANSI A21.11), Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings.

4. AWWA C115 (ANSI A21.15), Flanged Cast-Iron and Ductile-Iron Pipe with Threaded Flanges.

5. AWWA C150 (ANSI A21.50), Thickness Design of Ductile-Iron Pipe.

6. AWWA C151 (ANSI A21.51), Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

7. AWWA C153 (ANSI A21.53) Ductile Iron Compact Fittings 3-inch through 12-inch for Water and Other Liquids.

8. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.

9. ANSI B18.2.1, Square and Hex Bolts and Screws, Including Askew Head Bolts, Hex Cap Screws, and Lag Screws.

10. ANSI B18.2.2, Square and Hex Nuts.

11. ASTM A 307, Carbon Steel Externally and Internally Threaded Standard Fasteners.

12. ASTM A 354, Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: The piping for each service or system as specified herein shall be provided by a manufacturer who has thoroughly familiarized himself with the design intent of the overall system and will provide piping suitable for the service intended.

B. Source Quality Control: All pipes, fittings and specials shall have the thickness class stenciled thereon. Pipe that has been designed for abnormal load conditions or thrust restraint shall have special markings thereon which can be readily identified. The name or trademark of the manufacturer, and the date and place of manufacturer shall also be stenciled on the pipe, fittings and specials.

C. Each type of pipe, fitting and special shall be obtained from no more than one manufacturer.

D. Inspection: The quality of all materials, process of manufacture and the finished pipe, fittings and specials shall be subject to the inspection and approval of the ENGINEER.

1.05 SUBMITTALS

A. Shop Drawings: Submit for approval, in accordance with the Special Conditions of these specifications, detailed drawings and data on pipe, fittings, specials, gaskets and appurtenances.

B. Certificates: Submit certificates of compliance with referenced standards.

1.06 SPECIAL DELIVERY STORAGE AND HANDLING

A. Storage: All pipe materials shall be stored off the ground. Caps or plugs shall secure pipe ends. Do not store pipe or fittings in sunlight. Pipe shall be stored to prevent sagging or bending. Store off ground, under cover, and in a dry location.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

1. If the type of joint is not specified, provide mechanical joints for all buried piping and

flanged joints for exposed piping unless otherwise noted.

2. Fittings, specials, couplings and appurtenances shall be provided as indicated on the Contract Drawings, specified herein, or required.

B. Pipe and Fittings

1. Pipe (3-inch diameter and larger):

a. Centrifugally cast conforming with the applicable requirements of the American National Standard for Ductile Iron Pipe, Centrifugally Cast In Metal Molds or Sand-Lined Molds, for Water or Other Liquids, ANSI/AWWA A21.15/C151, latest revision.

b. All ductile iron pipe and fittings shall be marked in accordance with ANSI/AWWA A21.51/AWWA C151.

c. Minimum thickness class of all ductile iron piping shall be Class 52 regardless of the type of joint provided. Piping installed within casing pipes under Railroads shall be Class 56.

d. Ductile iron pipe shall be manufactured by U.S. Pipe and Foundry Co., American Cast Iron Pipe Company, or approved equal.

e. Mechanical Joint or push-on type joint pipe:

1) Fabricate in accordance with requirements of ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.51/C151.

2) Gaskets shall be plain tip, made of neoprene.

3) Bolts and Nuts: Bolts and nuts shall be ductile iron and have a fluorocarbon SC-1 coating as manufactured by Standco Industries of Texas, or approved equal, and shall conform to the requirements of ANSI/AWWA A21.11/C111.

4) Standard Mechanical Joint: Standard joint for mechanical joint pipe shall include a standard ductile iron follower gland.

5) Restrained Joint: Restrained joint for ductile iron mechanical joint pipe shall be made up of mechanical joints with retainer glands. Retainer glands shall be provided in lieu of the standard manufacturer's follower gland. Set screws for retainer glands shall be manufactured from ductile iron and shall be bituminous coated. Retainer glands shall be manufactured by EBAA Iron or approved equal.

6) Restrained Joint for Push-on Pipe: Restrained joint for push-on type pipe shall be accomplished by the installation of restrained socket clamps and tie rods. Harnessing shall be continuous and designed for the required pressures. Socket clamps and washers shall conform to the standards set forth in Figures 594 and 595 of Catalog PH-87 Grinnell Company, Inc. or approved equal. Tie rods shall be carbon steel, ASTM A36 conforming to ANSI B18.2.1 and B18.2.2. The minimum yield strength of rods shall be 70,000 psi and the minimum ultimate strength shall be 110,000 psi. All rods shall be bituminous coated conforming to ANSI/AWWWA A21.10/C110. The number, size and location where rods are proposed to be used shall be submitted for approval.

7) Restrained socket clamps and tie rods shall only be used in lieu of retainer glands when specifically approved by the ENGINEER for that application.

2. Fittings (3-inch diameter and larger):

a. Mechanical joint fittings shall be compact body type (Class 350) conforming to ANSI/AWWA A21.53/C153. Mechanical joints shall be in accordance with ANSI/AWWA A21.11/C111.

b. Fittings shall be marked in accordance with ANSI/AWWA A21.53/C153.

c. All fittings shall be furnished with sufficient quantities of accessories for completion of the joint.

d. Nuts, bolts, and gaskets required shall meet the above specifications for mechanical joint pipe.

e. Fittings shall be Trim Tyte Ductile Iron Fittings as manufactured by U.S. Pipe and Foundry Co., or approved equal.

3. Coatings and Linings

a. Potable Water Service Lining:

1) All ductile iron pipe, fittings, and specials shall be lined with a cement-mortar lining in accordance with ANSI/AWWA A21.4/C104 except that the cement lining shall be double the thickness specified.

b. Underground Service:

1) All ductile iron pipe, fittings and specials shall be coated on the outside with a bituminous coating, approximately 1-mil thick, in conformance with ANSI/AWWA A21.51/C151.

2) Piping and fittings, nuts and bolts, which are scratched when installed shall be touched up with an approved bitumastic coating as recommended by the manufacturer.

c. Exposed Service:

1) All ductile iron pipe, fittings, and specials shall be lined with a two-component epoxy material conforming to ASTM standards for ductile iron pipe coatings.

2) Lined pipe shall have a permeability of 0.15 perms in accordance with ASTM-D 1653.

3) Standard thickness of epoxy lining shall be 24 mils, unless otherwise specified.

d. All lining application shall be performed by the pipe manufacturer at the manufacturer's facility in accordance with the section designation provided herein. Linings applied by individuals other than the pipe manufacturer are unacceptable and shall be rejected.

e. Piping and fittings, nuts and bolts, which are scratched when installed, shall be touched up with an approved bitumastic coating as recommended by the manufacturer.

4. Polyethylene Tubing:

a. All buried ductile iron pipe and fittings installed shall be protected with polyethylene tubing.

b. Polyethylene tubes shall conform to ANSI/AWWA A21.5/C-105 and as follows. Thickness shall be a minimum of 8 mils. Pigmentation shall be black – 2.0 to 2.5% well dispersed carbon black with stabilizers.

c. Polyethylene materials shall be virgin polyethylene conforming to ASTM D-1248 specifications. Tubing shall be of the extruded tube form.

d. Plastic adhesive tape will be required to hold overlaps in the applied polyethylene material. Longitudinal seams in the tubing will not be allowed. Tape shall be a minimum of 2 inches wide, plastic backed and shall be Scotchrap # 50 or approved equal.

e. A listing of the minimum flattened polyethylene tube widths for use with specific pipe sizes and joint types are as follows:

Nominal Pipe Sizes (inches)	Mechanical Joint Flat Tube Width (inches)
4	20
6	20
8	24
10	27
12	30
16	37
20	45
24	54

However, the CONTRACTOR will be required to use larger sizes if required to avoid cutting of the tubes and taping of the seams.

C. Couplings, Adapters and Specials

1. Sleeve Type, Mechanical Joint Couplings:

a. Provide at locations shown on the Contract Drawings, as directed by the ENGINEER, or as required to complete the Work.

b. Pressure and Service: Same as connected piping.

c. Materials: Steel.

d. Gaskets: Standard best quality manufacturer's gasket.

e. Bolts and Nuts: Alloy steel, corrosion-resistant, prime coated. Buried couplings shall have galvanized bolts and nuts. Bolt heads and nuts shall be hexagon.

f. The minimum wall thickness of the middle ring or sleeve installed on ductile iron pipe shall be 5/16-inch for pipe smaller that 10 inches in diameter and 3/8-inch for pipe 10 inches in diameter and larger.

g. The minimum length of the middle ring shall be 5 inches for pipe sizes up to 10 inches in diameter, 7 inches for pipe 10 inches to 30 inches in diameter, and 10-inches for pipe 30 inches in diameter and larger.

h. Harnessing:

1) Harness couplings as shown, specified or otherwise required to restrain pressure piping.

2) Conform to dimensions, size spacing and materials for lugs, bolts, washers And nuts as recommended by the manufacturer and approved by the ENGINEER for the pipe size, wall thickness and working pressure required. However, the following minimum bolting shall be provided unless otherwise approved by the ENGINEER:

Pipe Diameter (inches)	Number of Bolts	Bolt Diameter (inches)	Spaced At (inches)
4	2	5/8	180
6-8	2	3/4	180
10-12	2	7/8	180
14-20	3	1	120
24-48	4	1	90

3) Any harnessing shown on the Contract Drawings is shown schematically only.

i. Product and Manufacturer: Provide couplings as manufactured by one of the following:

1) Smith-Blair, Style 411.

2) Or approved equal.

2. Flanged Adapters:

a. Provide at locations shown on the Contract Drawings directed by the ENGINEER, recommended by the manufacturer, or as required to complete the Work.

b. Description: One end of adapter shall be flanged and the other end with a sleeve type flexible coupling.

c. Pressure and Service: Same as connected piping.

d. Material: Ductile iron up to 12-inch diameter, steel larger than 12-inch diameter.

e. Gaskets: Standard best quality manufacturer's gasket.

f. Bolts and Nuts: alloy steel, corrosion-resistant, prime coated. Buried couplings shall have galvanized bolts and nuts. Bolt heads and nuts shall be hexagon.

1) For adapters larger than 12-inch diameter provide split-ring harness clamps with a minimum of four (4) corrosion resistant alloy steel bolts. Harness assembly shall be as designed and recommended by manufacturer for the pipe size, wall thickness, pressure and service condition indicated on the Contract Drawings and specified. Dimensions, sizes, spacings and materials for lugs, tie bolts, washers and nuts shall be suitable for service and conditions encountered and shall be approved by ENGINEER.

2) Any harnessing shown on the Contract Drawings is shown schematically only.

g. Product and Manufacturer: Provide flanged adapters as manufactured by one of the following:

1) Smith-Blair, Style 912 or up to 12-inch diameter.

2) Smith-Blair, Style 913 over 12-inch diameter.

3) Or approved equal.

h. Harnessing:

1) Harness adapters as shown, specified or otherwise required to restrain pressure piping.

2) For 12-inch diameter adapters and less provide ½-inch minimum stainless steel anchor studs installed in a pressure tight anchor boss. Provide the number of studs required to suit pressure and service conditions. Harness shall be designed as recommended by the manufacturer. However, the following minimum anchor studs shall be provided unless otherwise approved by the ENGINEER:

Diameter (inches)	Minimum Required (QTY)
Less than 6	2
6-8	4
8-10	6
10-12	8

3) For adapters larger than 12-inch diameter provide split-ring harness clamps with a minimum of four (4) corrosion resistant alloy steel bolts. Harness assembly shall be as designed and recommended by manufacturer for the pipe size, wall thickness, pressure and service condition indicated on the Contract Drawings and specified herein. Dimensions, sizes, spacings and materials for lugs tie bolts, washers and nuts shall be suitable for service and conditions encountered and shall be approved by ENGINEER.

4) Any harnessing shown on the Contract Drawings is shown schematically only.

3. Restrained Flanged Adapters:

a. Provide at locations shown on the Contract Drawings directed by the ENGINEER, recommended by the manufacturer, or as required to complete the work.

b. Description: One end of adapter shall be flanged Ductile Iron ASTM A536 Grade 65-

45-12 Drilling to ANSI B16.1 - Class 125. The other end with a sleeve type flexible coupling.

c. Pressure and Service: Restrained flanged adapters shall be rated for pressure up to 250 psi.

d. Gaskets shall be AWWA standard Mechanical Joint Gaskets.

e. Set Screws shall be AISI 4140 steel, heat-treated and zinc plated with minimum tensile strength of 190,000 psi.

f. Product and Manufacturer: Provide restrained flanged adapters as manufactured by one of the following:

1) Uni-Flange, Series 1400.

2) Or approved equal.

4. Harness Rods:

a. Harness rods and nuts shall be of heat-treated steel:

1) Minimum yield strength: 70,000 psi.

2) Minimum ultimate strength: 110,000 psi.

3) American Standard course threads.

4) Galvanized or cadmium plated unless otherwise shown or specified.

5. Restrained Joints: Restrained connections to ductile iron mechanical joint fittings and valves shall be a ductile iron clamp, EBAA Iron Sales Megalug Retainer Gland, Series 1100 or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Refer to Section 15051 for buried piping system installation.

3.02 PREPARATION

A. Refer to Section 15051 for buried piping system installation.

3.03 INSTALLATION

A. Refer to Section 15051 for buried piping system installation.

B. Harness rods shall be installed on fittings and flexible pipe couplings where shown on the Contract Drawings.

1. Steel lugs shall be of the type shown on the Contract Drawings.

a. Lugs and welds shall be designed and installed to develop the full strength of the harness rods.

b. Lugs on galvanized pipe shall be galvanized after welding.

2. Socket clamps shall be used on ductile iron pipe.

3. Harness ears shall be as shown on the Contract Drawings.

4. When installed for underground or underwater service, coupling and harness rods shall be coated with two coats of tar pitch preservative coating.

END OF SECTION

SECTION 15075

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Metal tags.

C. Plastic pipe markers.

D. Plastic tape pipe markers.

1.2 PROGRESS SUBMITTALS

A. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

B. Product Data: Include manufacturer's catalog literature for each product required.

1.3 FIELD SAMPLES

A. Section 01400 – Quality Requirements: Requirements for field samples.

B. Provide field Samples of labels.

C. Locate where directed by Owner’s Site Representative.

D. Accepted Sample may remain as part of Works.

1.4 WARRANTY

A. Section 01700 Execution Requirements: Requirements for warranties.

B. Correct defective Works within a 1-year period after the date of Substantial Completion.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Laminated 3-layer plastic with engraved black letters on light contrasting background color, as manufactured by W.H. Brady Co.

2.2 METAL TAGS

A. Brass or Aluminum with stamped letters, tag size minimum 1 1/2 inch diameter with smooth edges.

2.3 PLASTIC PIPE MARKERS

A. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed, as manufactured by W.H. Brady Company.

2.4 PLASTIC TAPE PIPE MARKERS

A. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings, as manufactured by W.H. Brady Company.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Identify pumps, blowers, and water treatment devices with plastic nameplates.

F. Identify control panels and major control components outside panels with plastic nameplates.

G. Tag automatic controls, instruments, and relays. Key to control schematic.

H. Identify piping, concealed or exposed, with plastic pipe markers. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

I. Identify ductwork with plastic nameplates.

J. Identify fire extinguishers with nameplates.

3.3 APPLICATION

A. Apply in accordance with manufacturer's instructions.

B. Apply after painting.

3.4 CLEANING

A. Section 01700 – Execution Requirements: Requirements for cleaning installed work.

B. Clean excess paint and adhesive.

3.5 PROTECTION OF FINISHED WORK

A. Section 01700 – Execution Requirements: Requirements for protecting installed work.

B. Protect finished work using clear plastic and tape.

3.6 SCHEDULES

Service	*Marking Type*	*Letter/ Symbol Color*	*Background Color*	*Required Location*	*Markings*
Process Water	Adhesive Tape	Black	Dark Blue	Terminations and every 12 feet	Service Flow Direction
Process Pumps	Nameplate	Black	White	On Discharge Piping	Service
Exhaust Fans	Nameplate	Black	Yellow	On Fan and Switch	Fan
Air Stripper Blower	Nameplate	Black	Yellow	On Blower	Blower
Heaters	Nameplate	Black	Yellow	On Heater and Thermostats	Heater
Air Stripper	Nameplate	Black	White	On Stripper	Air Stripper
Discharge Tank	Nameplate	Black	White	On Tank	Discharge Supply Tank
Dampers	Nameplate	Black	Red	On Duct	Damper

PART 4 MEASUREMENT AND PAYMENT

4.1 GENERAL

A. Payment Basis: No separate payment will be made. This Section forms part of the Lump Sum price associated with the mechanical portion of the project.

END OF SECTION

SECTION 15235

PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Process pumps and motors.

B. Sump pump and motor.

C. Pump accessories.

1.2 PROGRESS SUBMITTALS

A. Shop Drawings: Indicate outline dimensions, general assembly, components, operating data, system drawings, materials of construction, and wiring diagrams.

B. Product Data: Include engineering data and electrical characteristics.

C. Test Reports: Include performance curves and head loss curves.

D. Manufacturer's Certificates: Certify that products meet or exceed specified requirements.

E. Manufacturer's Instructions: Include instructions for storing, handling, preparation, installation, setup, and adjustment of products.

F. Manufacturer's Field Reports: State that equipment has been installed in accordance with the manufacturer's requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: Indicate actual locations of equipment. Indicate amps and voltage on each phase at startup.

B. Operation and Maintenance Data: Operation, maintenance, and parts lists including list of recommended spare parts. Provide three complete copies of the operating and maintenance instructions, including parts lists for all of the equipment. One copy to be single sided for production of additional operation and maintenance manuals. Bind material in sections in hard backed binders.

C. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer. Provide one year manufacturer's warranty for metals, pumps, and seals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept equipment on the Site in factory containers. Inspect for damage.

B. Store in a clean and dry area. Protect from excessive heat and cold. Ventilate to prevent condensation.

PART 2 PRODUCTS

2.1 PROCESS PUMPS

A. Centrifugal process pump, as manufactured by Goulds or equal.

B. Equipment Tag Numbers: P-200, P-201, and, P-202.

C. Performance of P-200:

1. Flow: 1,000 gpm.

2. Total Dynamic Head: 230 feet.

3. Model: 3196 I-17 4 x 6 - 17.

4. Speed - Maximum: 1,800 rpm.

D. Performance of P-201:

1. Flow: 1,000 gpm.

2. Total Dynamic Head: 230 feet.

3. Model: 3196 I-17 4 x 6 - 17.

4. Speed - Maximum: 1,800 rpm.

E. Performance of P-202:

1. Flow: 1,000 gpm.

2. Total Dynamic Head: 230 feet.

3. Model: 3196 I-17 4 x 6 - 17.

4. Speed - Maximum: 1,800 rpm.

F. Operating Conditions:

1. Liquid: Water.

2. Specific Gravity: 1.0.

G. Pump Motor: 460 volt, 3-phase (inverter duty). Motor to be specified per Division 16 – Electrical.

H. Impeller 16.75 inch.

2.2 SUMP PUMP

A. Sump pump, as manufactured by Goulds or equal.

B. Equipment Tag Numbers: P--101.

C. Performance of P-101 (Treatment Facility Sump Pump):

1. Flow: 50 gpm.

2. Total Dynamic Head: 81 feet.

3. Model: 3885 W61OH.

4. Speed - Maximum: 3,500 rpm.

D. Operating Conditions:

1. Liquid: Water.

2. Specific Gravity: 1.0.

E. Pump Motor: 460 volt, 3-phase. Motor to be specified per Division 16 – Electrical.

PART 3 EXECUTION

3.1 PUMP AND DRIVER INSTALLATION

A. The pumps shall be installed by qualified tradesmen having experience in the installation of this type of equipment.

B. Install in accordance with the manufacturers' recommendations. Mount pumps as shown on the Drawings. Where used, anchor bolt size and material shall be as shown in reviewed manufacturer's shop drawings. Bolts shall be accurately placed with templates. Coat bolt thread projections with lubricant to facilitate future nut removal.

C. All strain from attached piping shall be eliminated from the pumps and any evidence of pump or driver misalignment, noisy operation, or other signs of improper setting shall be corrected by CONTRACTOR.

3.2 PAINTING

A. Submerged metal surfaces of the new pumps, motors, and accessories specified herein shall be factory prepared and primed with the manufacturer's standard primer and finish coating. Stainless steel accessories shall not be painted.

3.3 FIELD TESTS

A. Functional Test: Prior to facility startup, all equipment shall be inspected for proper alignment, operation, connection, and satisfactory performance by means of a functional test.

B. Performance Test: Prior to acceptance of the installed pump, demonstrate proper operation of the pump at the guarantee point, at which time data shall be recorded on the total head, capacity, and power requirements of the pump. Driving motor voltage and amperage to be measured for each phase.

C. Testing Equipment: Furnish all instruments and labor as required for this procedure.

D. Test Failure: A unit failing the performance test shall be realigned and retested. If a pump fails the second test, the unit will be rejected and CONTRACTOR shall furnish a unit that will perform as specified.

END OF SECTION

SECTION 15410

PROCESS PIPING AND VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and pipe fittings.

B. Pipe supports and hangers.

C. Valves.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. B16.1 - Cast Iron Pipe Flanges and Flange Fittings.

2. B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.

3. B16.4 - Cast Iron Threaded Fittings Class 125 and 250.

4. B16.18 - Cast Bronze Solder-Joints Pressure Fittings.

5. B16.22 - Wrought Copper and Bronze Solder Joints Pressure Fittings.

B. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications.

C. American Society for Testing and Materials (ASTM):

1. A36/A36M - Standard Specification for Carbon Structural Steel.

2. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

3. A350 - Standard Specifications for Forgings, Carbon and Low-Allow Steel.

4. B32 - Standard Specification for Solder Metal.

5. B88 - Standard Specification for Seamless Copper Water Tube.

6. D1784 - Standard Specifications for Rigid Chlorinated Polyvinyl Chloride (CPVC) Compounds.

7. F441 - Standard Specification for Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe, Schedules 40, 80, and 120.

D. American Water Works Association (AWWA):

1. C110 - Ductile - Iron and Gray - Iron Fittings, 3 Inch Through 48 Inch for Water or Other Liquids.

2. C151 - Ductile - Iron Pipe, Centrifugally Cast, for Water or Other Liquids.

3. American Water Works Association (AWWA): C504 - Standard for Rubber - Seated Butterfly Valves.

1.3 PROGRESS SUBMITTALS

A. Shop Drawings: Indicate piping arrangements for tanks, pumps, and equipment.

B. Product Data: Include material specifications and statements from manufacturer that materials will meet corrosion, temperature, pressure, and etc. requirements.

C. Test Reports: Indicate results on shop and field-testing.

D. Certificates: Certify that products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Record Documents indicate location and size of pipes.

B. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this Section with minimum three documented years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept pipes on Site. Inspect for cleanliness and damage.

B. Protect pipes from dirt by closing ends.

PART 2 PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Carbon Steel Pipe: ASTM A53 Schedule 80 threaded, Schedule 40 welded.

1. Pipe Joints:

a. Diameter up to 2-Inch: Threaded or welded.

b. Diameter over 2-Inch: Welded.

c. At Valves/Equipment: Flanged or threaded.

2. Malleable Iron Fittings: ANSI B16 Class 125 or 250, screwed.

3. Flanges: ANSI B16.1.

4. Gaskets: EPDM.

B. Glass Fiber Reinforced Plastic Ducts: Glass fiber reinforced plastic with minimum 3/16-inch wall thickness as manufactured by Belco Manufacturing or equal. ASTM D 3567, ASTM C 582, AWWA M-45, ASTM D 3982.

2.2 PIPE SUPPORTS AND HANGERS

A. Piping shall be supported, in general, as described hereinafter and as shown by the Pipe Support Details on the Drawings. Manufacturers' catalogue figure numbers are typical of the types and quality of standard pipe supports and hangers to be employed. Special support and hanger details are shown to cover typical locations where standard catalogue supports are inapplicable.

B. No attempt has been made to show all required pipe supports and restraints in all locations, either on the Drawings or in the details, standard or custom made. Where pipe supports are shown on the Drawings, the intent is to present the general arrangement of pipe supports in the area represented as typical of similar arrangements to be used throughout the plant. THE ABSENCE OF PIPE SUPPORTS, RESTRAINTS, AND DETAILS ON ANY DRAWINGS SHALL NOT RELIEVE CONTRACTOR OF THE RESPONSIBILITY FOR PROVIDING THEM THROUGHOUT THE PLANT.

C. Pipe support and restraining system components shall withstand the dead loads imposed by the weight of the pipes filled with water and shall have a minimum safety factor of 5. Pipe supports shall withstand live loads created by pumped fluid thrust and shall be adequately anchored to resist such forces without undue shock, vibration, or damage to the piping system or related equipment.

D. Hangers:

1. As manufactured by Grinnel or equal:

2. Type: As shown on Drawings.

E. Unistrut and unistrut pipe clamps for small diameter lines.

F. Stands: Fabricated steel or reinforced concrete.

G. All piping shall be supported in a manner that will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Pipe supports and hangers shall not be installed in equipment access areas.

2.3 BUTTERFLY VALVES

A. Model 42, as manufactured by Crane or equal.

B. Type: lug.

C. Class: 150 pounds.

D. Fully conform to AWWA C504 for Class 150B.

E. Shaft: Type 316 stainless steel.

F. Disk: Ductile iron.

G. Seat: BUNA N.

H. Operators: Valves 6-inches and less provide with lever. Valves over 6-inches provide with gear box and wheel operator.

I. Accessories: For valves mounted over 5-feet above floor level provide chain wheel operator.

2.4 GATE VALVES

A. Model 150 cast stainless steel full port, as manufactured by Sure Flow Equipment Inc or approved equal.

B. Type: Knife gate, ANSI 150 lbs, full lug type, full port.

C. Seat: Viton.

2.5 CONTROL VALVES

A. Coated ductile Iron body, lug style, butterfly valve, nylon coated ductile iron disc, as manufactured by BVC Butterfly Valves and Controls Inc or approved equal.

B. Size: 10-inch.

C. Class: 150 pounds.

D. Actuator: Normally closed electric actuators, as manufactured by BVC Butterfly Valves and Controls Inc. Controls shall be suitable for an operating ambient temperature range of 30 to 125 degrees F.

D. Series: EOM-4.

2.6 CHECK VALVES

A. Duo-Chek Valves wafer cast iron body, Buna-N seat, as manufactured by Crane or approved equal.

B. Class: 150 pounds.

C. Size: 8-inch.

2.7 STRAINER

A. Model YF150, as manufactured by Sure Flow Equipment Inc, or approved equal.

B. Carbon Steel body and cover;

C. Class: 150 pounds.

D. Size: 12-inch.

PART 3 EXECUTION

3.1 PREPARATION

A. Inspect and clean pipe before installation.

B. Blow out with compressed air before installation.

C. Up-end pipe before installation and clear of scale.

D. Clean screwed joints with solvent before applying sealant to threads.

3.2 PIPE SUPPORT ISOLATION

A. Provide dielectric insulation on pipe hangers and supports to prevent electrolysis between dissimilar materials throughout.

3.3 INSTALLATION

A. Locate piping as shown on Drawings.

B. Pitch water lines 1-inch in 40-feet in the direction of flow; provide low points with drain plugs.

C. Route piping in an orderly manner and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Install per manufacturer's recommendations.

3.4 PIPE SUPPORTS AND HANGERS

A. Do not use bolts of pipe flanges, equipment, etc. for anchoring pipe supports. Adequately support piping systems to prevent strain on pump heads, valves, fittings, and equipment.

B. Support Spacing: Maximum distance between pipe supports as set out below unless otherwise indicated on Drawings:

C.

	Maximum Distance Between Support Points		
	FRP	*DIP, SST, STL*	*PVC*
Up to ¾-inch Diameter	-	6'6"	4'
1-inch to 1 ½-inches	-	10'	5'
2-inches to 3-inches	-	15'	6'
3-inches to 4-inches	-	15'	-
5-inches to 8-inches	8'6"	15'	-

* Spacings above are for specific gravity of 1.0; reduce spacings for greater specific gravities. Reduce spacings to 50 percent of above where valves occur in lines. Actual spacing to depend on pipe size and special loading conditions.

D. Support pipes within 12-inches of an elbow or tee.

E. Install pipe hangers vertical and true.

F. Provide properly sized galvanized insulation shields where insulated pipe passes through hangers.

3.5 FLANGED JOINTS

A. Tighten flange bolts so that gasket is uniformly compressed and sealed.

B. Do not distort flanges.

C. Leave flange bolts projecting no more than ½-inch or no less than ¼-inch.

D. Bolts shall be no more than 1/8-inch less than the diameter of the hole.

E. Provide flanges at connections to equipment, valves, and instruments.

3.6 UNIONS

A. On threaded and solvent welded lines, provide unions at connections to equipment, valves, and instruments.

B. Spacing of unions not to exceed 40-feet measured along the centerline of the pipe.

3.7 GALVANIC CORROSION

A. Provide dielectric unions at interconnections between fittings of dissimilar materials.

3.8 TOLERANCES

A. Maximum Variation from Plumb: ½-inch in 10-feet.

B. Maximum Offset from True Alignment: ½-inch.

3.9 FIELD QUALITY CONTROL

A. Hydrostatic Testing:

1. Test in accordance with ASME 31.1.

2. Check test equipment before applying test.

3. Test with clean water.

4. Purge air pockets while components or system is filling.

5. Test at 1.5 times the design pressure.

6. Hold test pressure for minimum 10 minutes.

7. Reduce pressure to design pressure and examine for leakage. Hold design pressure for minimum 8 hours.

8. Repair leaks and repeat test and design pressure testing sequence.

3.10 SCHEDULE - PROCESS PIPING

Service	*Pipe Material*	*Class, Schedule Rating*	*Joints and Fittings*
Process lines	Carbon Steel	Schedule 40	Flanged
	HDPE	SDR 11	Butt fused/flanged
Potable water	Copper	hard drawn	Solder

3.11 ADJUSTING

A. Adjust pipe hangers and supports as required.

3.12 CLEANING

A. Clean piping and fittings prior to painting.

3.13 PIPE CODING

A. Painting of piping and other materials is specified in Section 09900.

B. Color Coding Labels:

1. Process Piping:

Type of Piping	*Background Color*	*Lettering*
Groundwater (GW)	Light Brown	Black
Potable Water	Dark Blue	Black

2. Band Color Codes:

Dangerous Materials	Yellow
Safe Materials	Green
Protective Materials	Blue
Fire Protection	Red

C. Mark lines by using the proper paint or adhesive color tape located in conspicuous locations along each line at a maximum distance of 8-feet apart with identification lettering applied to the background color.

D. Apply arrows indicating the direction of flow and maximum operating pressure for pressure piping.

E. Lettering and marking size shall be in proportion to the size of lines to be coded.

F. Valves shall be tagged as required by the specifications.

END OF SECTION

SECTION 15625

UNIT HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Building unit heater.

1.2 REFERENCES

A. National Electrical Manufacturers Association (NEMA): ICS 6 - Enclosures for Industrial Controls and Systems.

B. National Fire Protection Association, Inc. (NFPA): 70 - National Electrical Code.

C. Underwriters Laboratories Inc. (UL): 1278 – Movable and Wall- or Ceiling-Hung Electric Room Heaters.

1.3 SUBMITTALS

A. Shop Drawings: Indicate assembly, required clearances, and locations and sizes of field connections.

B. Product Data: Include manufacturer's literature and data indicating rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

D. Operation and Maintenance Data: Indicate operating instructions, maintenance instructions and procedures, and parts lists including recommended spare parts. Provide six complete copies of the operating and maintenance instructions, including parts lists, for all of the equipment. Bind material in sections in hard backed binders.

1.4 QUALIFICATIONS

A. Section 01800 – Facility Operation: Requirements for qualifications.

B. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 10 years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept unit on Site in original packaging. Inspect for damage.

B. Unload equipment and store in a clean and dry area. Protect from damage by excessive heat, excessive cold, vandalism, or accident.

1.6 WARRANTY

A. Section 01700 – Execution Requirements: Requirements for examination.

B. Fill out original warranty forms in OWNER's name and register with manufacturer.

PART 2 PRODUCTS

2.1 ELECTRICAL UNIT HEATER

A. Description: Electric unit heater for suspended mounting, with fan forced air distribution over electric resistance heating coils and horizontal discharge.

1. Model LUH-07-43-32 horizontal mount industrial/commercial unit heater as manufactured by Chromalox.

B. Input Voltage: 480 volts, 60 Hz, 3 phase.

C. Output Rating: 7.5 KW.

D. Contactor: Provide integral contactor control for unit.

E. Thermostat: Provide integral line voltage thermostat to control integral contactor.

F. Mounting Bracket: Wall mounted bracket model WHU-02, PCN 300484.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that space is ready for installation of units and openings are as indicated on Shop Drawings.

B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install as shown on Drawings and in accordance with manufacturer's instructions.

B. Support units from building structure using bolts. Welding to painted surfaces is not allowed.

C. Install units with sufficient clearance from adjacent construction, and all other obstructions to allow access or service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Section 01400 – Quality Requirements: Requirements for field inspection and testing.

B. On completion, demonstrate to Owner’s Site Representative the units' proper installation and operation.

PART 4 MEASUREMENT AND PAYMENT

4.1 GENERAL

A. Payment Basis: No separate payment will be made. This section forms part of the lump sum price associated with the mechanical portion of the project.

END OF SECTION

SECTION 15830

FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall exhausters.

1.2 REFERENCES

A. Section 01400 – Quality Requirements: Requirements for references.

B. Air Movement Control Association (AMCA):

1. 99 - Standards Handbook.

2. 210 - Laboratory Methods of Testing Fans for Rating Purposes.

3. 261 - Directory of Products Licensed to Bear the AMCA Certified Ratings Seal.

4. 300 - Test Code for Sound Rating Air Moving Devices.

5. 301 - Method of Publishing Sound Ratings for Air Moving Devices.

C. National Electrical Manufacturers Association (NEMA): MG 1 - Motors and Generators.

D. National Fire Protection Association, Inc. (NFPA): 70 - National Electrical Code.

E. Underwriters Laboratories Inc. (UL): 705 - Power Ventilators.

1.3 PROGRESS SUBMITTALS

A. Shop Drawings: Indicate assembly, required clearances, locations, and size of field connections.

B. Product Data: Include for fans and accessories including fan curves with specified operating point clearly plotted, sound power levels at rated capacity, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 – Execution Requirements: Requirements for closeout submittals.

B. Record Documents: Indicate location and designation of fans on the Drawings.

C. Operation and Maintenance Data: Indicate instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

D. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

PART 2 PRODUCTS

2.1 WALL EXHAUSTERS

A. Fan Unit: Wall mounted, direct driven, 24-inch propeller exhaust fan with spun aluminum housing; resiliently mounted motor; 1/2-inch mesh, 16 gage aluminum bird screen;

B. Acceptable manufacture:

1. Loren Cook Company or approved equal.

C. Performance:

1. Air Flow: 4000 cfm at .125 inches wg.

2. Motor: 1/2 hp, 120 volt, single phase, 60 Hz.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 – Execution Requirements: Verification of existing conditions before starting work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 16005

ELECTRICAL INSTALLATION

PART 1 - GENERAL

1.01 INTENT

A. These Specifications and Contract Drawings are not intended to cover every detail or variation for the installation or provide for every possible installation contingency. It is expected that the Work will be supervised and performed by qualified persons familiar with electrical construction practices, electrical equipment, and safety within a process facility.

B. The Contract Drawings show the principal engineering design elements, such as general orientation of mechanical and electrical equipment to piping, foundations, and buildings, and are not intended to be used as detailed installation documents.

C. The Contract Drawings show the approximate size and location of electrical equipment and instrumentation devices. The CONTRACTOR shall determine the exact location based on actual equipment supplied and field conditions.

D. The Contract Drawings, the Specification, and CONTRACTOR furnished reference drawings shall be deemed adequate for the completion of all electrical work by the CONTRACTOR. No additional ENGINEER supplied drawings, documents, or schedules will be furnished.

E. These are Standard Technical Specifications, and as such, may include information pertaining to equipment and/or devices that are not required to complete the Work and therefore do not appear on the Contract Drawings.

F. When legends appear within the Contract Drawings, these are standard industry recognized drawing legends, and as such, may include symbols and abbreviations pertaining to equipment and/or devices that are not required to complete the Work and therefore appear only in the legend.

G. Standard details, where shown, are included in the Contract Documents to establish the minimum quality of the installation. Actual field conditions may require that the components be arranged in a different manner.

H. When “HOLD” appears on a Contract Drawing, the CONTRACTOR shall understand that this only applies to the actual construction or fabrication. The Contract Bid Price shall include all costs to perform the Work.

I. In the event of conflict between this Specification and the Contract Drawings, this Specification shall govern.

J. Reference to standards, specifications, manuals, and/or codes of any technical society, organization, or association or reference to the laws and/or regulations of any jurisdiction or authority, whether such references be specified or implied, shall mean the latest version in effect on the date the Contract and Agreement is executed.

1.02 QUALITY ASSURANCE

A. Electrical equipment shall be installed with the following priorities.

1. Safety of operations and maintenance personnel.

2. Reliability.

3. Maintainability

B. Unless noted otherwise, all current carrying components shall be Copper (Cu).

C. Unless noted otherwise, all material and equipment shall be new, UL approved where applicable, and UL labeled if applicable.

D. All components shall be standard manufactured items. No custom components are acceptable.

E. All components and assemblies (i.e. motor starters) shall be standard NEMA rated or NEMA/IEC rated. Strictly IEC rated equipment will not be accepted.

F. All components shall be standard industrial grade or better. No commercial or residential components are acceptable.

G. Submittals For Approval shall include, at a minimum, manufacturer's literature, specifications, wiring diagrams, installation diagrams, and engineering data necessary to fully describe the electrical materials and/or equipment and to substantiate complete compliance with the Contract Documents.

H. It shall be the complete responsibility of the CONTRACTOR to coordinate with manufacturers as to the physical size of their equipment. Shipping size must permit moving the equipment through available accesses. Final size must ensure that the equipment will fit in the space it is allocated on the Contract Drawings. Any extra expense due to equipment not fitting in the allocated space shall be borne by the CONTRACTOR.

I. When an item of material or piece of equipment is described in the Contract Documents by using a proprietary name, the information is only intended to establish the type, function, and/or quality required.

J. All work shall be performed by qualified electrical personnel utilizing certified electrical products.

K. The CONTRACTOR shall remove all temporary shipping hardware and completely assemble and connect, per the manufacturer's instructions, any electrical equipment that is shipped in pieces or any accessories shipped separately.

1.03 IDENTIFICATION

A. The CONTRACTOR shall supply and install engraved lamacoid nameplates for all equipment supplied and installed under Section 16000. Nameplates shall be provided for: transformers, starters, panelboards, disconnect switches, transfer switches, special purpose receptacles, control panels, etc.

B. Equipment operated from a "NORMAL" power system shall bear a white nameplate with 3/8-inch, minimum, engraved black lettering.

C. Equipment operated from a "STAND BY" or "EMERGENCY" power system shall bear a red nameplate with 3/8-inch, minimum, engraved white lettering.

D. Submit a list of nameplates for review prior to engraving.

E. Nameplates shall be anchored with permanent waterproof adhesive or stainless steel screws. Anchoring shall not void the integrity (NEMA rating) of the enclosure.

F. The CONTRACTOR shall supply and install weatherproof self-adhesive type voltage level labels on convenience receptacles, special purpose receptacles, and any other equipment required by OSHA.

G. CONTRACTOR furnished starters and/or control panels and cabinets that are supplied power by more than one source or that are interlocked to other power sources shall be provided with a warning sign to indicate separate control power presence. The warning sign shall be mounted inside the enclosure and be in plain site.

H. Any CONTRACTOR supplied enclosure, panel, cabinet, or pull box that allows access to medium (1000V) or high voltage equipment and/or cables shall be identified with a weatherproof self-adhesive “Danger – Keep Out” warning sign.

I. Electrical phasing in motor control centers, switchgear, panelboards, etc. shall be A-B-C, left-to-right, top-to-bottom, and front-to-back as viewed from the front face of the enclosure.

END OF SECTION

SECTION 16010

ELECTRICAL CONDITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section includes minimum general requirements for the CONTRACTOR'S electrical Work.

1.02 SCOPE OF WORK

A. CONTRACTOR shall provide all labor, materials, equipment, services and incidentals necessary and required to complete a fully operational project as described in the Contract Scope of Work, shown on the Contract Drawings, specified in the Work Related Sections and herein. This task includes supply, installation, connection, commissioning and startup all project electrical equipment and systems.

1.03 RELATED SECTIONS

A. The project electrical Work shall be as specified in the following related sections:

1. Section 16005 – Electrical Installation.
2. Section 16010 – Electrical Conditions.
3. Section 16060 – Grounding and Bonding.
4. Section 16070 – Electrical Hangers and Supports.
5. Section 16075 – Electrical Identification.
6. Section 16110 – Conduit.
7. Section 16120 – Wire and Cable.
8. Section 16140 – Wiring Devices.
9. Section 16160 – Lighting Panelbords.
10. Section 16265 – 480V Adjustable Speed Drives.
11. Section 16405 – Utility Services.
12. Section 16500 – Lighting.
13. Section 16680 – Surge Protection.

1.04 REFERENCE CLAUSES

A. The Information to Bidders, Proposal Form, Contract and Agreement, General Conditions, Special Conditions, Related Sections and the Contract Drawings are all a part of the CONTRACTOR'S Work. CONTRACTOR shall refer to them for further instructions pertaining to his Work.

B. "CONTRACTOR," "The CONTRACTOR," "This CONTRACTOR," "EC," as used herein and in Division 16000 specifications, means the Electrical Contractor.

C. “Furnish,” "Supply,” “Install,” “Construct,” "Furnish and Install," "Supply and Install" as used herein and in the Work Related Sections, means a workable, complete and industry-acceptable electrical supply and installation by CONTRACTOR.

1.05 REFERENCES

A. All electrical Work supplied and installed by CONTRACTOR shall comply with the most recent requirements of all applicable codes, standards, guides and practices issued by the following organizations at the time of bidding:

1. ANSI – American National Standards Institute.
2. IEEE – Institute of Electrical and Electronic Engineers.
3. NEMA – National Electrical Manufacturer’s Association.
4. NFPA – National Fire Protection Association.
5. OSHA – Occupational Safety and Health Act.
6. UL – Underwriter’s Laboratories, Inc.
7. IBC – International Building Code.
8. IFC – International Fire Code.
9. ICEA – Insulated Cable Engineers Association.
10. All state and local authorities having jurisdiction.

B. In the event of conflict between the codes and standards listed by the above organizations, the more stringent regulation shall govern and be considered the minimum standard.

C. In the event of conflict between Division 16000 specifications and the standards listed by the above organizations, the standard shall govern unless specifications are in excess of standards.

1.06 QUALITY ASSURANCE

A. CONTRACTOR’S Work quality of shall be in accordance with the industry accepted practices.

B. CONTRACTOR shall have in place an approved Quality Assurance Program for the project Work execution.

B. CONTRACTOR shall be inspected periodically by OWNER, Contract Administrator and/or their representative solely for the purpose of determining general quality of Work and not for any other purpose.

C. Guidance will be offered to CONTRACTOR in interpretation of the Contract Drawings and Division 16000 specifications to assist him in carrying out the Work as intended.

D. OWNER and ENGINEER guidance and inspections do not relieve CONTRACTOR from his responsibility to maintain the approved quality assurance program for the project.

1.07 HEALTH AND SAFETY

A. CONTRACTOR shall abide by OWNER’S Health and Safety requirements and all applicable OSHA rules and regulations.

1.08 EXISTING FACILITY OPERATION

A. The project electrical Work shall be in the existing operational facility. CONTRACTOR'S strict adherence to OWNER'S rules and regulations shall be required. CONTRACTOR shall not impede nor in any way interfere with the OWNER'S facility operation.

1.09 SITE COORDINATION

A. CONTRACTOR shall be responsible for coordinating the electrical Work with other trades Working on this facility and with the facility OWNER. See Project Coordination Section for further details.

B. Furnish and file with the local authorities having jurisdiction all drawings and information required by them in connection with the Work.

C. Obtain all permits, licenses, and inspections and pay all legal and proper fees and charges pertaining to the project.

D. CONTRACTOR shall note that existing facility operation takes precedence over any construction activities. If CONTRACTOR does not accomplish this requirement, ENGINEER reserves the right to demand such changes as necessary to avoid further operational interference and such changes shall not be considered an extra expense to the project and OWNER. See Coordination with OWNER'S Operations Section for further details.

E. When CONTRACTOR has occasion to Work on the existing plant equipment, OWNER shall de-energize the equipment. Both OWNER and CONTRACTOR shall tag and lockout the equipment. When newly installed equipment reaches the state of being ready to be energized, CONTRACTOR shall tag and lockout the equipment.

1.10 ON-SITE WORK SUPERVISION

A. CONTRACTOR shall provide the services of a full-time, on-site, experienced and competent supervisor to direct and oversee the Work until successful completion of the project.

B. The on-Site supervisor shall have sufficient experience to run a project construction within a facility similar to the project site.

C. OWNER'S and ENGINEER'S guidance, directions and inspections do not relieve CONTRACTOR from his responsibility to supervise the Work.

1.11 CONTRACTOR'S EMPLOYEES

A. All CONTRACTOR'S employees shall be skilled in the Work performed to which they shall be assigned.

B. Any CONTRACTOR'S employee incompetent or careless shall be removed from the project when directed by OWNER and/or ENGINEER.

1.12 WORK AREAS

A. The project electrical Work shall be within the NCSD No 1 property line as shown on the Contract Drawings.

1.13 ELECTRICAL CLASSIFICATION OF WORK AREAS (SECTION NOT USED)

1.14 SCHEDULE

A. CONTRACTOR shall, in liaison with OWNER and ENGINEER, develop a project schedule to insure, without delays, the sequencing, demolition, installation, testing, and commissioning of the project electrical Work.

B. The CONTRACTOR'S schedule shall be based on the requirements of the Scope of Work and Limitation and Constrains Sections, and it shall not allow for interruption of the existing facility operation.

C. The CONTRACTOR'S schedule shall be subject to OWNER'S review and approval.

D. CONTRACTOR shall maintain the OWNER-approved schedule until successful completion of the project.

1.15 SITE PROGRESS MEETINGS

A. CONTRACTOR shall attend all construction progress meetings as scheduled by OWNER and ENGINEER.

B. CONTRACTOR shall be prepared to discuss the schedule progress, Work quality, interference with other Work or the existing facility operation, health and safety, and any other project-related issues.

1.16 CONFLICT OF DOCUMENTATION

A. Anything mentioned in the reference specifications and not shown on the drawings, or not mentioned in the specifications and shown on drawings shall be of like effect as if shown or mentioned in both.

B. In event of any conflict between the drawings and specifications or between the specifications or between the drawings, CONTRACTOR shall bring it to ENGINEER'S attention for review and resolution. This shall be done during CONTRACTOR'S bidding stage. CONTRACTOR shall be liable for any Work performed without following this procedure, and shall remedy the situation at his own expense as requested by ENGINEER at no cost to the project and OWNER.

1.17 SUBMITTALS

A. CONTRACTOR'S submittal requirements are detailed in Division 16000 sections. The following is a brief summary of the minimum documents, which shall be submitted to ENGINEER'S for review and approval prior to commencing construction:

1. OWNER-approved Work Schedule showing all construction tasks, milestones, duration and sequences.

2. All corrected Contract Drawings.

3. All required Shop Drawings.

4. All CONTRACTOR- supplied equipment and material manufacturer's data including, but not be limited to: catalog cuts, equipment data sheets, approval drawings, performance and test data, recommended spare parts, installation manuals, operation and maintenance manuals, and the like.

B. CONTRACTOR shall be liable for any Work performed without following the submittal procedure at no cost to the project and OWNER.

C. Review of the submittals by ENGINEER shall not relieve CONTRACTOR from responsibility for errors or omissions.

1.18 CONTRACT DRAWINGS

A. The Contract Drawings are engineering type drawings showing principal engineering design elements and they do not intend to be used as detailed construction drawings.

B. The Contract Drawings show the project equipment recommended equipment layouts, interconnecting wiring routing, and the equipment, conductor and raceways sizes based on the project preliminary data available to the ENGINEER during the project design phase.

C. The Contract Drawings do not cover every detail of the proposed installation or variation for construction or provide for every possible installation contingency.

D. The Contract Drawings do not provide the equipment point-to-point field interconnecting wiring and shall not be additionally furnished by ENGINEER. CONTRACTOR shall develop these drawings during the construction shop drawings phase, when the project progresses to the point that the CONTRACTOR-supplied equipment wiring termination information becomes available.

E. Unless dimensioned, the Contract Drawings show the approximate size and location of the equipment, devices, and building services. The CONTRACTOR shall determine exact equipment locations and sizes based on actual equipment supplied and field conditions.

F. Standard details, where shown, are included in the Contract Drawings to establish the minimum quality of the installation. Actual field conditions may require that the components be arranged in a different manner.

G. When “HOLD” appears on a Contract Drawing, the CONTRACTOR shall understand that this only applies to the actual construction or fabrication. The Contract Bid Price shall include all costs to provide the Work.

H. The Contract Drawings as provided to CONTRACTOR, shall be deemed adequate for completion of all project electrical Work. It is expected that the project electrical Work will be supervised and performed by qualified persons familiar with electrical equipment, electrical construction practices, and health and safety requirements within an operational facility similar to the project site.

I. Immediately after the Contract is signed, CONTRACTOR shall obtain a complete set of the Contract Drawings from ENGINEER. CONTRACTOR shall verify, confirm and/or review the Contract Drawings based on the actual site conditions and the actual equipment data. CONTRACTOR shall make all necessary and required corrections to the Contract Drawings, and have the corrected Contract Drawings reviewed and approved by ENGINEER prior to commencing construction.

J. CONTRACTOR shall be liable for any Work performed without following the above submittal procedure at no cost to the project and OWNER.

K. Review of the corrected Contract Drawings by ENGINEER shall not relieve CONTRACTOR from responsibility for errors or omissions.

1.19 SHOP DRAWINGS

A. CONTRACTOR’S required shop drawings shall be based on the actual site conditions and the actual equipment data. As a minimum, the required shop drawings shall include, but not be limited to the following documents:

1. Equipment layout plans, elevations and dimensions.

2. Wiring routing plans and raceways.

3. Equipment installation details.

4. Panel layouts and bill of materials.

5. Equipment/System schematic diagrams.

6. Equipment/System point-to-point field wiring connection diagrams showing identified cable bundles, cable conductors and all terminating points.

7. Required construction calculations (an example of the required construction calculation is wire sizing and raceway fill calculation).

8. All CONTRACTOR-supplied equipment and system documentation (further details on this submittal requirements are under the heading “O&M Manual”).

B. CONTRACTOR shall review the Shop Drawing Submittal Section for requirements of the CONTRACTOR’S Submittals procedure.

C. All CONTRACTOR’S shop drawings shall be subject to ENGINEER’S review and approval prior to commencing the project equipment/system installation. CONTRACTOR shall be liable for any Work performed without following the submittal procedure at no cost to the project and OWNER.

D. Review of the Shop Drawing submittals by ENGINEER shall not relieve CONTRACTOR from responsibility for errors or omissions.

1.20 CONSTRUCTION DRAWINGS

A. All CONTRACTOR-corrected Contract Drawings and all CONTRACTOR-provided Shop Drawings shall form a complete set of the project Construction Drawings.

1.21 RECORD DRAWINGS

A. CONTRACTOR shall maintain a complete set of Record Drawings for construction. As project progresses, CONTRACTOR shall daily update the Record Drawings to show the Work as actually installed with particular reference to the Work areas which will subsequently become inaccessible, such as buried and concealed services.

B. The daily updated Record Drawings shall be available to ENGINEER for periodic reviews.

C. On completion of the project, CONTRACTOR shall provide three (3) sets of prints of the final "AS-BUILT" Record Drawings to OWNER.

1.22 OPERATION AND MAINTENACE MANUAL

A. The project Operating and Maintenance (O&M) Manual shall be a compilation of typewritten and/or printed documentation for every electrical equipment/system component supplied by CONTRACTOR. As a minimum, the O&M Manual shall contain the following:

1. Overall index.

2. Index tabs to designate different section of the supplied equipment and systems.

3. All factory and field equipment and system inspection and test reports. This information is subject to ENGINEER’S review and approval.

4. All ENGINEER-approved as-built equipment/system documentation including equipment plans, elevations, dimensional data, weights, material lists, schematics, wiring and connection diagrams, and the like.

5. All recommended spare parts.

6. All equipment installation, operation and maintenance instructions.

B. On completion of the project, CONTRACTOR shall supply three (3) complete sets of operating and maintenance (O&M) manuals to OWNER.

1.23 VERIFICATION OF MEASUREMENT

A. Before ordering any materials or equipment, CONTRACTOR shall verify all measurements at the project site and shall be responsible for the correctness of the same.

B. No extra charge or compensation shall be allowed on account of difference between actual dimensions and the measurements derived from the Contract Drawings.

C. CONTRACTOR shall be responsible to check with equipment manufacturers as to the physical size of their equipment. The CONTRACTOR must ensure that the equipment will fit in the space allocated on the Contract Drawings. Any extra expense due to equipment not fitting in the allocated space shall be borne by the CONTRACTOR.

D. CONTRACTOR shall instruct manufacturers as to the maximum shipping size of equipment that shall permit moving the equipment through available accesses.

1.24 RIGGING AND LIFTING

A. CONTRACTOR shall provide all project-required electrical equipment rigging and lifting equipment and tools.

B. All project electrical equipment rigging and lifting shall be by qualified and experienced personnel.

C. All lifts shall be planned, and shall be in accordance with the equipment manufacturer's instructions and in close communication with OWNER.

1.25 EQUIPMENT AND MATERIAL – GENERAL REQUIREMENTS

A. All CONTRACTOR-supplied project electrical equipment and material shall be as specified in Division 16000 section. As a minimum, the following shall apply:

1. All electrical equipment and material shall be new and of standard products. All electrical components shall be properly selected, sized and approved for application.

2. Each piece of material and equipment shall be installed with the name or trademark of the manufacturer, rating nameplate, and approval label as required.

1.26 WORK INSTALLATION GUIDELINES – GENERAL REQUIREMENTS

A. All project electrical components including motor control centers, panels, transformers, wiring raceways, and the like shall be installed as follows:

1. Adhere to the location shown on the drawings as far as possible.

2. Do not install electrical and control equipment at locations where process equipment is to be installed.

3. Do not obstruct walkways, or makes inaccessible or hard equipment maintenance access.

4. All Work shall be constructed plumb square, level, and true to lines and surfaces indicated, in a neat, substantial, and workmanlike manner, and in such a way as to properly serve the purpose indicated.

5. Assure that the space about all electrical equipment is in accordance with NEC.

1.27 COMMISSIONING AND STARTUP

A. Equipment and system inspection, testing and commissioning shall be as described in Division 16000 specifications. As a minimum, the following shall apply:

1. CONTRACTOR shall inspect, test and commission all Work done under this Contract and prove to the ENGINEER that all equipment is correctly connected and adjusted to fully function as intended under all operation conditions.

2. CONTRACTOR shall provide all tools and qualified personnel for commissioning.

3. CONTRACTOR shall rectify all deficiencies found during commissioning at no cost to the project and OWNER.

4. During the process equipment start-up, CONTRACTOR shall provide tools and a qualified electrician for one week of the start-up assistance as required.

1.28 TRAINING

A. CONTRACTOR shall be responsible for training of OWNER'S personnel assigned to operate and maintain the project equipment and systems.

B. CONTRACTOR'S training activities shall start at the beginning of the project in liaison with OWNER and ENGINEER. The actual training shall begin during the final stages of the construction Work and prior to the project commissioning.

C. As a minimum, CONTRACTOR'S training activities shall include the following:

1. Provide a team of experienced and qualified personnel for training purposes.

2. Develop OWNER-approved training plan and schedule.

D. As a minimum, the training shall cover the following:

1. Review of the project O&M Manual.

2. Review of each project equipment and system description, operation, maintenance, spare parts, troubleshooting, and health and safety issues.

3. Review and practicing of the project equipment/system proposed and recommended operation.

1.29 PROJECT CLOSE-OUT

A. Clean-up: At completion of Work, and prior to the final acceptance inspection, CONTRACTOR shall remove all temporary structures, scaffolding, tools, surplus material, waste and trash from the Work areas leaving the project site clean and ready for immediate use.

B. Touch-up Painting: At completion of Work, and prior to the final acceptance inspection, CONTRACTOR shall "touch-up" all minor nicks and scratches on all equipment enclosures and raceways, with two coats of matching paint.

C. Restoration: At completion of Work, and prior to the final acceptance inspection, CONTRACTOR shall provide all properly compacted backfill, grade, and refinish to match the existing surrounding areas.

D. Demolished and Loose Equipment: At completion of the Work, and prior to the final acceptance inspection, CONTRACTOR shall demonstrate to OWNER that all project demolished and loose equipment have been returned to OWNER, and safely and securely placed in the designated areas.

E. As-Built Documentation: Upon completion of Work, and prior to the final acceptance inspection, CONTRACTOR shall provide all specified as-built documentation including Record Drawings and O&M manuals as specified.

F. Final Acceptance: Acceptance of individual Work items is described in Division 16000 sections. At the project closeout, but prior to CONTRACTOR leaving the Site, the final acceptance of Work shall be by CONTRACTOR, OWNER and ENGINEER. During this inspection CONTRACTOR shall demonstrate to OWNER and ENGINEER that the entire electrical construction has been completed as specified. The inspection shall result in either a written CONTRACTOR'S Final Acceptance Report signed by OWNER and ENGINEER or a written Punch List containing items requiring corrections, followed by another inspection. This process shall be repeated until OWNER and ENGINEER sign off the Final Acceptance Report.

1.30 GUARANTEE

A. CONTRACTOR shall guarantee all his Work including equipment, material and installation for a period of one (1) year after acceptance by OWNER. Any defects occurring within the guarantee period shall be rectified as quickly as possible by the CONTRACTOR, at no expense to the project and OWNER.

B. The above general guarantee shall not act as a waiver of any specified guarantee or special equipment guarantee covering a greater length of time.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 16060

GROUNDING AND BONDING

PART 1 - GENERAL

1.01 SECTION INCUDES

A. This section includes minimum requirements for the project grounding and bonding in all project locations as shown on the drawings and specified herein.

1.02 RELATED SECTIONS

A. The following sections relate to this section Work:

1. Section 16005 – Electrical Installation.
2. Section 16010 – Electrical Conditions.
3. Section 16060 – Grounding and Bonding.
4. Section 16070 – Electrical Hangers and Supports.
5. Section 16075 – Electrical Identification.
6. Section 16110 – Conduit.
7. Section 16120 – Wire and Cable.
8. Section 16140 – Wiring Devices.
9. Section 16160 – Lighting Panelboards.
10. Section 16265 – 480V Adjustable Speed Drives.
11. Section 16405 – Utility Services.
12. Section 16500 – Lighting.
13. Section 16680 – Surge Protection.

1.03 REFERENCES

A. CONTRACTOR'S Work shall comply with the latest requirements of all applicable codes, standards, guides, practices and local regulations pertaining to the job at the time of bidding, and it shall carry approval labels where required. As a minimum, the following shall apply:

1. ANSI/NFPA 70 – National Electrical Code.
2. ANSI/IEEE C2 – National Electrical Safety Code.
3. OSHA CER 1910, Subpart S – Electrical General, Parts 1 & 2.

1.04 SUBMITTALS FOR REVIEW

A. CONTRACTOR shall submit, for approval, catalog cut sheets for each type of conductor and component, and also connection method proposed for this section Work.

1.05 SUBMITTALS FOR CLOSEOUT

A. On completion, CONTRACTOR shall submit, for approval, all accurately completed project record drawing showing actual location and routing of all project ground rods and underground conductors.

PART 2 - PRODUCTS

2.01 MATERIAL – GENERAL REQUIREMENTS

A. All grounding system materials shall be UL-approved components.

2.02 GROUND RODS

A. Ground rods shall be 3/4-inch-diameter copper-clad steel ten feet in length.

2.03 CONDUCTORS

A. All buried ground conductors shall be stranded soft drawn annealed uncoated bare copper.

B. All exposed ground shall be stranded soft drawn annealed uncoated copper with green PVC insulation and nylon jacket (THHN/THWN).

C. All exposed instrumentation ground shall be stranded soft drawn annealed uncoated copper with green PVC insulation, a yellow stripe, and an overall nylon jacket (THHN/THWN).

D. All ground conductor sizes shall be as indicated on the Contract Drawings or per the NEC.

2.04 GROUND WELL COMPONENTS

A. All ground wells shall be eight-inch diameter by 24 inches long fiberglass pipe with belled end.

B. The ground well covers shall be made of iron with a word “Ground” embossed on the cover.

PART 3 - EXECUTION

3.01 INSTALLATION – GENERAL REQUREMENTS

A. Complete installation of the project grounding and bonding in accordance with NEC Article 250, and as shown on Drawings. Install all grounding system components in accordance with the manufacturer's recommendations.

B. CONTRACTOR shall coordinate the installation of buried ground conductors and conductor PVC sleeves with the other trades located on the project site.

C. All metallic raceways, conduit, electrical enclosures, motor frames, pump bases, metallic devices, fences surrounding electrical equipment, and the like shall be grounded as shown on the Contract Drawings and required by NEC.

D. All non-metallic raceways shall be provided with a system ground conductor sized according to the NEC and included within the raceway.

E. All ground connections shall be compressed or bolted. Soldering shall not be allowed.

F. Where ground conductor passes through floors, slabs, walls, etc. and are not encased in a raceway, the CONTRACTOR shall furnish and install schedule 80 PVC sleeves of the required size and length. Sleeve to extend a minimum of 2" beyond finished floor, slab wall, etc. to provide physical protection. Under electrical equipment, stub-up shall be flush with finish floor. Minimum size of the sleeve shall be 3/4 inch.

G. Bond jumpers shall be installed where required to maintain grounding continuity. Jumpers shall be sized per the NEC.

H. Provide a ground conductor to all miscellaneous building services such as light switches, receptacles, and light fixtures.

I. Transformer neutrals shall be grounded only at the transformer.

J. Ground conductors shall not be installed in any way that would interfere with electrical, mechanical, or piping equipment removal.

K. Only conditioned power (isolated) exposed ground risers shall use green with yellow stripe conductors.

L. Underground connections for the grounding system shall be compression type or exothermic welded type (Cadweld or equal).

M. When indicated on the Contract Drawings, provide ground test wells for inspection and testing. Install inspection well covers flush with surrounding finished grade.

N. Verify that final backfill and compaction has been completed before driving ground rods.

O. Copper main ground conductor to be buried a minimum of 30” below finished grade with sufficient slack to prevent damage.

P. Unless noted otherwise on the Contract Drawings or required by local building code, the top of ground rods shall be driven to a depth of 12” below finished grade.

Q. Any buried ground conductor damaged during construction shall be repaired by the CONTRACTOR before being covered over.

R. For all new construction or existing building work, ground conductors shall be bonded to the base of the nearest building column.

S. Grounding conductors installed inside the building shall be neatly clipped and installed as inconspicuously as possible. In routing to the nearest building ground, the conductor should be attached to structural steel and avoid interference with any other equipment.

T. Where the ground conductor bonds to building steel, the location shall not be subject to mechanical damage. Bond points shall be accessible for inspection.

U. Where connections have been made to structural steel, the CONTRACTOR shall furnish and apply touch-up-point to match the steel finish. The steel surface shall be adequately prepared by wire brush cleaning.

3.02 FIELD QUALITY CONTROL

A. Demonstration: On completion, demonstrate to ENGINEER that all project grounding has been installed as specified and shown on the drawings, and that all new underground system components have been extended to the existing facility's grounding system.

END OF SECTION

SECTION 16070

ELECTRICAL HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes minimum requirements for the project electrical equipment and wiring hangers and supports in all project locations as shown on the drawings and as specified herein. This shall include provision of all necessary anchors and fasteners as required to provide a complete equipment and wiring supporting system for the project.

1.02 RELATED SECTIONS

A. The following sections relate to this section Work:

1. Section 16005 – Electrical Installation.
2. Section 16010 – Electrical Conditions.
3. Section 16060 – Grounding and Bonding.
4. Section 16070 – Electrical Hangers.
5. Section 16075 – Electrical Identification.
6. Section 16110 – Conduit.
7. Section 16120 – Wire and Cable.
8. Section 16140 – Wiring Devices.
9. Section 16160 – Lighting Panelboards.
10. Section 16265 – 480V Adjustable Speed Drives.
11. Section 16405 – Utility Services.
12. Section 16500 – Lighting.
13. Section 16680 – Surge Protection.

1.03 REFERENCES

A. CONTRACTOR'S Work shall comply with the latest requirements of all applicable codes, standards, guides, practices and local regulations pertaining to the job at the time of bidding, and it shall carry approval labels where required. As a minimum, the following shall apply:

1. ANSI/NFPA 70 – National Electrical Code.
2. ANSI/IEEE C2 – National Electrical Safety Code.
3. OSHA CER 1910, Subpart S – Electrical General, Parts 1 & 2.
4. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

5. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

6. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

1.04 SUBMITTALS FOR REVIEW

A. CONTRACTOR shall submit, for approval, catalog cut sheets for each component proposed for this section Work.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS

A. Furnish products listed and classified by UL as suitable for purpose specified and shown.

B. Provide material, sizes, and types of hangers and supports, anchors and fasteners to carry the loads of the project wiring and equipment. Consider weight of wire in conduit when selecting products for support of the project wiring.

C. Supports: Fabricate supports from structural steel or steel channels. Steel channels shall be heavy duty, 12-gage channel system as manufactured by Aickinstrut, Unistrut or approved equal. All steel supports shall be hot-dip galvanized after fabrication.

D. Anchors and Fasteners:

1. Concrete Structural Elements and Concrete Floor Surfaces: Use expansion anchors.

2. Steel Structural Elements: Use beam clamps, spring steel clips, welded fasteners and continuous thread rods.

3. Hollow Masonry: Use toggle bolts and hollow wall fasteners.

4. Solid Masonry Walls: Use expansion anchors.

5. Sheet Metal: Use sheet metal screws.

6. Product Finishes: Hot-dip galvanizing after fabrication system confirming to ASTM 123.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as shown on the drawings.

B. All wiring conduit and equipment shall be supported from the building or equipment support structural members only. Do not support conduit or any equipment from the pipe, duct, other conduit and the like.

C. Do not burn or weld to structural members.

D. Do not use spring steel clips and clamps.

E. Do not use powder-actuated anchors.

F. Use spring lock washers under all nuts.

G. Install surface-mounted cabinets and panelboards with minimum of 4 anchors.

H. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1-inch off wall.

I. Use steel channels to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

J. Repair all scratched galvanized surfaces as follows. Clean damaged surface in accordance with SSPC SP1 following by immediate application of AMCO 322 galvanizing stick or approved equal.

3.02 FIELD QUALITY CONTROL

A. Demonstration: On completion, demonstrate to ENGINEER that all project raceway and equipment hangers and supports have been supplied and installed as specified.

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes minimum requirements for the project electrical identification means in all project locations as shown on the drawings and as specified herein. This shall include equipment and device nameplates and labels, wire and cable markers, and the underground wiring warning tape.

1.02 RELATED SECTIONS

A. The following sections relate to this section Work:

1. Section 16005 – Electrical Installation.
2. Section 16010 – Electrical Conditions.
3. Section 16060 – Grounding and Bonding.
4. Section 16070 – Electrical Hangers and Supports.
5. Section 16075 – Electrical Identification.
6. Section 16110 – Conduit.
7. Section 16120 – Wire and Cable.
8. Section 16140 – Wiring Devices.
9. Section 16160 – Lighting Panelboards.
10. Section 16265 – 480V Adjustable Speed Drives.
11. Section 16405 – Utility Services.
12. Section 16500 – Lighting.
13. Section 16680 – Surge Protection.

1.03 REFERENCES

A. CONTRACTOR'S Work shall comply with the latest requirements of all applicable codes, standards, guides, practices and local regulations pertaining to the job at the time of bidding, and it shall carry approval labels where required. As a minimum, the following shall apply:

1. ANSI/NFPA 70 – National Electrical Code.
2. NFPA 70E – Standard for Electrical Safety in the Workplace.
3. ANSI/IEEE C2 – National Electrical Safety Code.
4. OSHA CER 1910, Subpart S – Electrical General, Parts 1 & 2.

1.04 SUBMITTALS FOR REVIEW

A. CONTRACTOR shall submit, for approval, catalog cuts for all wire, cable, markers, and underground warning tape proposed for this section Work.

B. CONTRACTOR shall submit identification nameplate and label legends, for approval, with the equipment shop drawing submittals which pertain to the other sections work (reference Related Sections).

PART 2 PRODUCTS

2.01 NAMEPLATES AND LABELS

A. Nameplates: Engraved 3-layer laminated plastic, black letters on white background. This shall be provided for all electrical equipment and device enclosures (if not furnished by the equipment supplier). The nameplates shall have 1/4-inch letters for identifying individual equipment and loads, 1/2-inch letters for identifying grouped equipment and loads.

B. Labels: Embossed adhesive tape, with 3/16-inch white letters on black background. Use only for identification of individual wall switches and receptacles, and control device stations.

2.02 WIRE MARKERS

A. Tubing type wire marker with typed in legend. The markers shall be by Thomas and Betts. Other acceptable manufacturers shall be Burndy, Panduit, or 3M Electrical Products.

B. Locations: Each conductor at panelboard gutters, outlet and junction boxes, control panels, and instruments.

C. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number as shown on the drawings.

2. Control and Instrumentation Circuits: Wire and circuit designation as indicated on the schematic and interconnection drawings.

2.03 UNDERGROUND WARNING TAPE

A. Underground warning tape as manufactured by LEM Products. Other acceptable manufactures shall be Thomas and Betts and 3M Electrical Products.

B. Tape Description: 6-inch wide plastic tape, detectable type, colored red, with warning legend "BURIED ELECTRICAL LINE BELOW."

PART 3 - EXECUTION

3.01 INSTALLATION – GENERAL REQUIREMENTS

A. Degrease and clean surfaces to receive nameplates and labels.

B. Install nameplates and labels parallel to equipment lines.

C. Secure nameplates to equipment front using stainless rust resistant screws.

D. Identify underground conduits using underground warning tape. Install one tape per trench at 6 inches below finished grade.

3.02 FIELD QUALITY CONTROL

A. Demonstration: On completion, demonstrate to ENGINEER that all project identification means have been supplied and installed as specified.

END OF SECTION

SECTION 16110

CONDUIT

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. This section includes minimum requirements for the project conduit in all project locations as shown on the drawings and as specified herein. This shall include all project conduit and fittings and all associated pull and junction boxes.

1.02 RELATED SECTIONS

A. The following sections relate to this section Work:

1. Section 16005 – Electrical Installation.
2. Section 16010 – Electrical Conditions.
3. Section 16060 – Grounding and Bonding.
4. Section 16070 – Electrical Hangers and Supports.
5. Section 16075 – Electrical Identification.
6. Section 16120 – Wire and Cable.
7. Section 16140 – Wiring Devices.
8. Section 16160 – Lighting Panelboards.
9. Section 16265 – 480V Adjustable Speed Drives.
10. Section 16405 – Utility Services.
11. Section 16500 – Lighting.
12. Section 16680 – Surge Protection.

1.03 REFERENCES

A. CONTRACTOR'S Work shall comply with the latest requirements of all applicable codes, standards, guides, practices and local regulations pertaining to the job at the time of bidding, and it shall carry approval labels where required. As a minimum, the following shall apply:

1. ANSI/NFPA 70 – National Electrical Code.
2. NFPA 70E – Standard for Electrical Safety in the Workplace.
3. ANSI/IEEE C2 – National Electrical Safety Code.
4. OSHA CER 1910, Subpart S – Electrical General, Parts 1 & 2.
5. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated, and C80.5 – Rigid Aluminum Conduit.

6. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

7. Underwriters Laboratories Inc. (UL).

1.04 SUBMITTALS FOR REVIEW

A. CONTRACTOR shall submit, for approval, catalog cuts for all conduit, fittings and boxes proposed for this section Work.

B. CONTRACTOR shall submit, for approval, all revised Contract Drawings showing revised conduit routing and conduit sizes as specified in Section 16010, Electrical Conditions.

1.05 SUBMITTALS FOR CLOSEOUT

A. On completion, CONTRACTOR shall submit, for approval, accurately completed project Record Drawing showing actual location and routing of all exposed and all concealed conduit work.

PART 2 – PRODUCTS

2.01 MATERIAL - GENERAL REQUIREMENTS

A. Furnish products listed and classified by UL as suitable for purpose specified and shown.

B. Aboveground Installation: Use rigid metal conduit, sizes as shown on the drawings and/or per NEC, ¾ inch minimum size.

C. Underground Installation: Use rigid metal conduit, sizes as shown on the drawings and/or per NEC, 1-inch minimum size.

2.02 RIGID METAL CONDUIT

A. It shall be NEC type RMC; rigid hot dipped galvanized steel conduit or rigid aluminum conduit as shown on the drawings. Conduit shall be furnished in manufacturer's standard lengths. Each conduit length shall be threaded on both ends. One end shall have a factory coupling and the other end shall have a plastic thread-protecting sleeve. Each length shall bear the UL label and the manufacturer's name.

B. Conduit fittings and bodies shall match the conduit system.

C. Condulets used outdoors or in wet locations shall utilize a neoprene gasket between the cover and body.

D. Approved Manufacturers: Allied Tube & Conduit, Wheatland Tube Company or approved equal.

2.03 LIQUID- TIGHT FLEXIBLE METAL CONDUIT

A. It shall be NEC type LFMC, interlocked steel helically wound strip type with PVC liquid-tight jacket.

C. Approved Manufacturers: Anaconda Sealtite; Carol Cable Co., Superflex or approved equal.

2.04 PULL AND JUNCTION BOXES

A. Outdoor pull boxes shall be NEC 3R.

B. Indoors, damp or wet, non-corrosive locations such as below grade basements and piping equipment utility rooms: NEMA 12.

C. Indoors, damp or wet, corrosive environments: FRP NEMA 4X.

D. Indoors, dry locations such as office spaces and electrical rooms: gasketed NEMA 1.

E. All pull boxes shall be fabricated of galvanized sheet steel or fiberglass reinforced polyester and shall have a single, screwed cover or a single, hinged door.

F. All pull and junction boxes provided to modify the existing conduit system shall match the existing installation.

2.05 UTILITY MARKING TAPE

A. Underground conduits shall be designated with a corrosion resistant detectable utility marking tape.

B. Material shall be 0.35 mil thick solid foil core encased in a protective jacket.

C. Color for electrical work shall be safety red.

D. Material shall be as manufactured by: Magnatec; Terra Tape, Sentry Line 620; or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. The conduit quantity, size and routings, as shown on the Contract Drawings shall not be considered absolute. This information, as indicated on the Contract Drawings or in this specification, is based on preliminary engineering data available to ENGINEER during preparation of the Contract Documents. CONTRACTOR shall completely revise the Contract Drawings, as specified in Section 16010, Electrical Conditions and based on the equipment data and actual field conditions, and furnish all necessary project conduit as required.

3.02 INSTALATION - GENERAL REQUIREMENTS

A. CONTRACTOR shall coordinate and properly schedule, so as not to cause project delays, with other trades the placement of conduits and/or sleeves in concrete or through walls, floors, and ceilings. CONTRACTOR shall be responsible for supplying and installing the conduits and/or sleeve materials.

B. CONTRACTOR shall be responsible for all trenching, excavation, backfill, disposal of excess material, and restoration required to install all underground conduits and/or ductbanks. Work shall be completed in accordance with the Excavation and Backfill technical specification section.

C. When indicated on the Contract Drawings, conduits passing through new walls, floors, and foundations shall be sleeved. Sleeves shall be either steel or PVC as indicated on the Contract Drawings, and, if necessary, shall be sealed with a fire stopping material similar in appearance to the surrounding area.

D. Core drill for individual conduits passing through existing concrete slabs or walls. In existing facilities, obtain authorization from OWNER before core drilling. Check existing drawings to locate possible existing embedded conduits. Seal spaces around new conduits with waterproof grout similar in appearance to the surrounding area.

E. Unless reusing existing conduit, all conduits, supports, hardware and the like shall be new materials.

F. All miscellaneous hardware such as nuts, bolts, screws, washers, etc. shall be furnished and installed by CONTRACTOR and shall be, at a minimum, either hot-dipped galvanized steel or zinc plated.

G. All metallic conduits shall be installed as a complete continuous system to NEC before any conductors are laid or pulled in. The conduits shall be installed so that a continuous grounding system will be maintained from the furthest point to the building grounding system.

H. Where any component of the conduit system is damaged prior to final acceptance by OWNER, this CONTRACTOR shall be required to replace or provide a new conduit at no expense to the project and OWNER.

I. To reused existing conduit:

1. Remove all wire and cable from the conduit.

2. Pull rag swabs through the conduit to remove water and to clean the conduit prior to installing new conductors.

3. Repeat swabbing until all foreign matter is removed.

J. Embedded conduits shall be protected immediately (before concrete is placed) by installing polyethylene plugs, designed for this purpose, at each end. The plug shall not be removed until cable is ready to be installed.

K. Open ends of spare conduits shall be capped with a threaded steel bushing and a flat (solid) washer immediately after installation. The use of wooden plugs or duct tape shall not be allowed. Exact location of spare conduits shall indicate on the “Record” Contract Drawings.

L. A heavy-duty pull string shall be installed in each spare or empty conduit.

M. Whenever possible, there shall not be more than the equivalent of three quarter bends or 270^{o} total between pull points such as condulets or pull boxes.

N. Rigid metal conduit that connects to metal enclosures or pull boxes shall use double lock nuts and a protective bushing. One lock nut shall be used on the outside and the second lock nut and bushing shall be utilized inside. The bushing must be screwed on fully before the lock nuts are set.

O. Rigid metal conduit shall be provided with grounding fittings as necessary to provide bonding connections.

P. Rigid metal conduit cut in the field shall have ends cut square. Cut ends shall be reamed to remove burrs and sharp edges. All field threads shall be cut to the same dimensions and taper as the factory cut threads.

3.03 UNDERGROUND INSTALLATION

A. CONTRACTOR shall coordinate all underground work with OWNER for possible interference with the existing underground facilities. All CONTRACTOR’S underground work shall be reviewed and approved by OWNER prior to commencing construction. CONTRACTOR shall be liable for any work performed without following this procedure.

B. All underground conduit shall be buried to a depth of at least 24 inches below final grade unless shown otherwise on the drawings. A 6-inch wide red caution tape "BURIED ELECTRICAL LINE BELOW" shall be placed at a depth of 12 inches below the final grade the entire length of the underground line.

C. Where requested by OWNER, the utility marker tape shall be applied for the underground installation.

3.04 ROUTING AND SIZING

A. When the routing of conduits is shown on the Contract Drawings, this information is provided only as a guide and shall not be considered absolute. The Contract Drawings only indicate the approximate location of conduit installation. The CONTRACTOR shall determine exact locations by field verifying each route before beginning work.

B. The sizes of conduit indicated on the Contract Drawings are based on preliminary engineering data. The CONTRACTOR shall determine actual conduit sizes based on the outside diameter of the actual cable and wire supplied.

C. The quantity of conduits indicated on the Contract Drawings or in this specification is based on preliminary engineering data. The CONTRACTOR shall supply and install all conduits required to maintain the installation recommendations of NEC, IEEE, and the supplied equipment manufacturers.

D. Conduits shall not be smaller than the size required by the NEC for the conductors enclosed and shall be larger where so specified or indicated on the Contract Drawings.

E. Unless otherwise noted on the Contract Drawings as large radius (sweeps), all 90° conduit elbows shall be standard radius or field bent conduit with a radius of a standard elbow. To ease cable-pulling tensions, CONTRACTOR may elect to install large radius elbows.

F. No conduit shall be reduced in size in a ductbank or embedded conduit run.

G. Conduit shall not be embedded in concrete slabs and/or walls having a thickness of 6 inches or less.

H. When indicated in a standard detail on the Contract Drawings, conduit may be installed below a grade floor slab. CONTRACTOR shall excavate, bed the conduit in stone, cover the conduit with stone, and backfill.

I. Conduit may be embedded in concrete slabs and/or walls having a thickness of more than 6 inches. CONTRACTOR shall submit installation details for review by the ENGINEER. All embedded conduits shall have a minimum of 2 inches of concrete cover.

J. Exact location of conduit in slabs with respect to reinforcing shall be as directed by the ENGINEER. Crossing of conduit in a floor slab shall not be permitted except as approved by the ENGINEER.

K. All exposed conduits shall be installed parallel to or perpendicular to the building walls and ceiling unless otherwise indicated on the Contract Drawings.

L. All conduits and supports shall be installed so as not to interfere with normal passage of personnel, mobile equipment, and/or vehicles. Maintain a minimum headroom clearance of eight feet.

M. To avoid possible injuries to operators and/or maintenance personnel, under no circumstance shall conduit be installed across the top of a floor surface.

N. Conduits shall be run to avoid adverse conditions such as heat and moisture and to avoid all materials and equipment of other trades. Conduits shall maintain a minimum clearance of 6-inches from all hot water pipes, flues, or any high temperature piping or ductwork. Should it be necessary to install conduits closer than this to hot water pipes, an insulating type covering shall be used to protect the conduit from high temperature.

O. Provide suitable fittings to accommodate expansion and/or deflection where conduits cross building expansion joints.

P. All exterior vertical conduit runs with an elevation change greater than five (5) feet shall include proper conduit vents and drains.

Q. CONTRACTOR shall increase conduit size, as required, where wire size has been increased for voltage drop.

3.05 SEPARATION

A. In order to maintain a separation of electrical noise sources from signal and instrumentation cabling, the CONTRACTOR shall group cables within a conduit system according to IEEE standard 518 level designations.

1. Level 1: Analog signals of less than 50V. Digital signals of less than 15V.

2. Level 2: Analog signals greater than 50V. Control/switching circuits operated by less than 50V. Analog tachometer signals.

3. Level 3: Control/switching circuits operated by 50V or greater but less than 20 amps. AC feeders less than 20 amps.

4. Level 4: Power circuits of 0-1000V. Power circuits of 20-800A.

5. Level 5: Power circuits above 1000V. Power circuits above 800A.

3.06 RIGID STEEL CONDUIT

A. All conduit joints shall be made with three-piece unions; running threads shall not be permitted.

3.07 RIGID ALUMINUM CONDUIT

A. Rigid aluminum conduit shall only be installed when indicated on the Contract Drawings, and it shall not have any direct contact with unpainted steel, copper (of any form), or cement products such as concrete or grout.

3.08 LIQUID - TIGHT FLEXIBLE METAL CONDUIT

A. It shall be installed for the final conduit connection to all motors and any other device, such as valves or fans and the like, subject to movement or vibration.

B. The minimum length shall be 12 inches and the maximum length shall be 36 inches.

C. The size shall be the same as the conduit it is connected to. When connecting to a single device, such as a solenoid or limit switch, the final length of flexible conduit may be ½-inch diameter.

D. Proper terminations and bonding jumpers shall be used to maintain the integrity of the grounding system.

3.09 CONDUIT FITTINGS AND BOXES

A. CONTRACTOR shall install all conduit fittings, pull and junction boxes as indicated on the Contract Drawings and as required to meet NEC, or where necessary to facilitate the installation of conductors.

B. All box conduit entry holes shall be cut, drilled, or punched. Torch cutting shall not be permitted. Holes shall be deburred from both sides.

C. All boxes shall be supported independently of all conduits and shall be secured in place.

3.10 SUPPORTS

A. CONTRACTOR shall be responsible for supply, proper application, installation, and location of all necessary, required and approved conduit system supports and hangers for a complete conduit system. This shall be provided as specified in Section 16070, Hangers and Supports.

B. The conduit supports shall be from the building structural steel members only. Do not support conduit from the pipe, duct, conduit and the like. Do not burn or weld to structural members.

C. As a minimum, conduit supports shall be spaced as required by the NEC.

311 FIELD QUALITY CONTROL

A. Demonstration: On completion, demonstrate to ENGINEER that all project conduit and boxes have been supplied and installed as specified.

END OF SECTION

SECTION 16120

WIRE AND CABLE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes minimum requirements for the project wire and cable in all project locations as shown on the drawings and as specified herein. This shall include all project wire, cable, wiring identification, and terminations.

1.02 RELATED SECTIONS

A. The following sections relate to this section Work:

1. Section 16005 – Electrical Installation.
2. Section 16010 – Electrical Conditions.
3. Section 16060 – Grounding and Bonding.
4. Section 16070 – Electrical Hangers and Supports.
5. Section 16075 – Electrical Identification.
6. Section 16110 – Conduit.
7. Section 16120 – Wire and Cable.
8. Section 16140 – Wiring Devices.
9. Section 16160 – Lighting Panelboards.
10. Section 16265 – 480V Adjustable Speed Drives.
11. Section 16405 – Utility Services.
12. Section 16500 – Lighting.
13. Section 16680 – Surge Protection.

1.03 REFERENCES

A. CONTRACTOR'S Work shall comply with the latest requirements of all applicable codes, standards, guides, practices and local regulations pertaining to the job at the time of bidding, and it shall carry approval labels where required. As a minimum, the following shall apply:

1. ANSI/NFPA 70 – National Electrical Code.
2. NFPA 70E – Standard for Electrical Safety in the Workplace.
3. ANSI/IEEE C2 – National Electrical Safety Code.
4. OSHA CER 1910, Subpart S – Electrical General, Parts 1 & 2.

5. Underwriters Laboratories Inc. (UL).

1.04 SUBMITTALS FOR REVIEW

A. CONTRACTOR shall submit, for approval, catalog cuts for all wire and cable proposed for this section Work.

B. CONTRACTOR shall submit, for approval, all revised Contract Drawings showing revised wiring routing and wire sizes as specified in Section 16010, Electrical Conditions.

C. CONTRACTOR shall submit, for approval, all required interconnecting wiring termination drawings as specified in Section 16010, Electrical Conditions.

1.05 SUBMITTALS FOR CLOSEOUT

A. On completion, CONTRACTOR shall submit, for approval, accurately completed project Record Drawing showing actual location, routing and termination details of all wire and cable work.

PART 2 – PRODUCTS

2.01 MATERIAL - GENERAL REQUIREMENTS

A. All wire, cable and terminations for the project shall be NEC compliant, UL-approved product.

2.02 HIGH VOLTAGE POWER CABLE

A. Description: NEC MV type, single-conductor, 175 mil 100% insulated, copper tape shielded cable for use in aerial, direct burial, conduit and underground duct installations.

B. Conductor: Class B stranded, soft or annealed copper, sizes as shown on the drawings.

C. Voltage Rating: 15KV.

D. Insulation: EPR.

E. Temperature Rating: 90 degrees C.

F. Overall Jacket: Black sunlight resistant PVC.

G. Approved Manufacturer (s): Southwire or approved equal.

2.03 LOW VOLTAGE POWER AND CONTROL CABLE

A. Description: NEC general wiring type, single-conductor cable.

B. Conductor: Class B stranded, annealed copper, sizes as shown on the drawings.

C. Voltage Rating: 600 volts.

D. Insulation: 75 /90 degrees C, THHN/THWN type (above ground) and XHHW type (below ground).

E. Approved Manufacturer (s): General Cable, Okonite, Southwire, or approved equal.

2.04 INSTRUMENTATION CABLE

A. Analog Cable: 600V, 16AWG copper twisted shielded pair with overall PVC jacket, Belden 9342.

B. Digital Cable: 600V, 16AWG copper twisted unshielded pair with overall PVC jacket, Belden 9487.

2.05 HIGH VOLTAGE CABLE TERMINATIONS

A. All high voltage shielded cable terminations at the transformers, shall be made with Cooper Power Systems or 3M 15kV, 200A rated loadbreak elbow connectors.

B. All high voltage shielded cable terminations at the 13.2kV main switchgear and 13.2kV pad-mounted switches, shall be made with Raychem TFT-E or approved equal 15kV-rated stress relief connectors.

2.06 LOW VOLTAGE WIRING CONNECTORS

A. All 480 V power terminations at motors and buswork shall be made with Burndy two-hole “Hylug” or approved equal compression type connectors.

B. All instrumentation wiring terminating at screw type terminals shall be made with Thomas & Betts “Sta-Kon” or approved equal insulated “fork-type” spring connectors.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. The wire and cable quantity and sizes, as shown on the Contract Drawings shall not be considered absolute. This information, as indicated on the Contract Drawings or in this specification, is based on preliminary engineering data available to ENGINEER during preparation of the Contract Documents. CONTRACTOR shall completely revise the Contract Drawings, as specified in Section 16010, Electrical Conditions and based on the equipment data and actual field conditions, and furnish all necessary project wire and cable as required.

3.02 INSTALLATION – GUIDELINES

A. The wire and cable installation shall include wire and cable handling, cutting, training, pulling, termination and testing.

B. All wiring and cable shall be enclosed in conduit, except temporary wiring installation, which shall comply with NEC requirements for temporary installations and as instructed by OWNER and /or by the local authority having jurisdiction.

C. All wiring shall be properly grounded, color-coded, phased and/or polarized throughout. The wiring color code shall be as follows:

1. AC Power and Lighting Wiring: Black phase markings in accordance with NEC.

2. AC Control Wiring: Red.

3. Ground: Green.

4. Instrumentation Analog and Digital Cable: White (+), black (-).

D. No conductor shall be installed until the raceway system that contains it is complete.

E. Install wire and cable in accordance with manufacturer's instructions. Employ manufacturer recommended tools and installation methods. Never exceed manufacturer's recommended cable bending radiuses and pull tensions. Pull all conductors into raceway at the same time. Use manufacturer recommended greaseless conductor pulling compound only.

F. All conductors shall be installed in continuous runs, from origin to equipment, without splices or joint unless specifically indicated on the Contract Drawings.

G. Cable splices, if any, and terminations shall carry full ampacity of conductors with no perceptible temperature rise.

H. All wire/cable terminations shall be made to terminal blocks, bus, or connectors in approved enclosures.

I. All conductors shall be installed and terminated without nicking the insulation.

J. Neatly train and lace wiring inside boxes, equipment, and panelboards.

K. All cables, cables conductors and wires shall be clearly identified with identification numbers, as indicated on the drawings, at all pull boxes, equipment and devices enclosures, and at the terminating points. Identify each cable, cable conductor, or wire by a marker at each terminating point in accordance with Section 16075,Electrical Identification. All identification letters and numbers shall be typed.

L. Wire pulled prior to the equipment setting, or completion of conduit termination, shall be protected from the environment and shall be neatly coiled and protected from damage.

M. Terminations:

1. All cable terminations shall be completed only after the cable checks and tests have been performed and found acceptable by ENGINEER.

2. Conducting surfaces of the cable terminating ends shall be thoroughly cleaned before applying connectors.

3. No more than two wires shall be terminated at any terminal. Wire twisting around the terminal will not be allowed.

N. Checkouts and Tests:

1. Prove all interconnecting cable and wire continuity and freedom from grounds and short circuit.

2. Ensure the equipment proper polarity and phasing, and that all conductors have been terminated at the correct terminals.

3. All power, control, and instrumentation wiring shall be tested. Cable, which fails the test, shall be promptly replaced at CONTRACTOR'S expense.

4. All underground cables shall be tested twice prior to and after backfill of the trenches.

5. All test results shall be documented and submitted to ENGINEER for review and comments, and shall later become a part of the as-built documents.

6. The high voltage cable shall be given manufacturer's recommended high voltage test.

7. The low voltage cable tests shall be performed with a digital insulation and continuity tester (AVO INTERNATIONAL Megger BM80 or approved equal) as follows:

   a. All 480V power and motor feeders shall be 1000 VDC megger tested. Record lowest readings. Reference insulation resistance numbers shall be obtained from the cable manufacturer.

   b. Instrumentation cable shall be checked for continuity only (disconnect all associated surge protective devices during the test).

O. Phasing:

1. The entire electrical system shall be properly phased-out by CONTRACTOR, so that all three-phase transformers, motor control center, distribution panels, disconnects, power outlets, etc., are identical in phase relationship.

2. The phasing shall be of A-B-C sequence, left to right, top to bottom, front to back.

3.03 DEBRIS

A. During cable installation, at the end of each day, CONTRACTOR shall ensure that cable cuttings and other cable waste are deposited into a trash container to avoid any debris left in the work area, and in the equipment enclosures.

3.04 DAILY RUNNING RECORD

A. CONTRACTOR shall keep a daily running record of cables pulled and terminated, and it should be available for ENGINEER'S periodic inspection.

3.05 FIELD QUALITY CONTROL

A. On completion, CONTRACTOR shall demonstrate to ENGINEER that all project wire and cable has been installed as specified.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.01 SCOPE

A. This Section covers minimum requirements for miscellaneous wiring devices furnished by the CONTRACTOR.

B. The miscellaneous wiring devices shall include, but not be limited to: convenience receptacles, GFCI convenience receptacles, locking receptacles, and plugs.

C. All receptacles shall be supplied and installed complete with all necessary accessories such as boxes (enclosures), cover plates, and supports.

D. Refer to the Contract Drawings for additional requirements.

1.01 SUBMITTAL

A. For Approval

1. Submit Manufacturer's data (i.e., catalog cut sheets) for each type of device supplied.

PART 2 - PRODUCT

2.01 GENERAL

A. Each device shall be UL listed and bear a label or imprinted mark stating so.

B. Furnish devices as manufactured by: Hubbell; Leviton; Pass & Seymour/Legrand; or equal.

2.01 CONVENIENCE RECEPTACLES

A. Straight Blade Duplex Receptacle

1. 125VAC rating.

2. 15 Ampere.

3. 2 pole, 3 wire, U ground slot.

4. Industrial Specification Grade.

5. Side wired.

6. Ivory color (except where wall finish is wood or dark in color, then use brown).

7. Leviton Model #5242-I or equal.

2.01 GFCI CONVENIENCE RECEPTACLES

A. Straight Blade GFCI Duplex Receptacle

1. 125VAC rating.

2. 15 Ampere.

3. 2 pole, 3 wire, U ground slot.

4. Commercial Specification Grade.

5. Side wired.

6. Test and Reset buttons.

7. Device operation to automatically lockout if ground continuity is absent.

8. Leviton Model #8599-I or equal.

2.01 LOCKING RECEPTACLES

A. When indicated on the Contract Drawings, a locking plug and receptacle shall be utilized as a means of isolating small building service loads (i.e. electric unit heaters, high bay light fixtures, etc.) or small pieces of process equipment (i.e. metering pumps, chlorinators, etc.).

B. Receptacle

1. Unless noted otherwise, utilize single (as opposed to duplex) receptacle devices.

2. Each device to include one (1) grounding contact.

3. Standard NEMA rating and configuration.

4. Industrial Specification Grade.

5. Leviton or equal.

2.01 PLUGS

A. Locking Plugs

1. Each device to include one (1) grounding pin.

2. Standard NEMA rating and configuration.

3. Industrial Specification Grade.

4. Device supplier to include a length, minimum 1'-6" ± (18" nominal) and maximum 4'-0" ± (48" nominal), of extra flexible cable to interconnect the device and the piece of equipment.

5. Leviton or equal.

2.01 COVER PLATES

A. Recessed Box(es)

1. Commercial grade molded nylon wall plates to match color of receptacle.

B. Surface Mounted Box(es)

1. Commercial grade stamped Type 430 stainless steel complete with rounded or beveled edges.

C. Weatherproof Surface Mounted Box(es)

1. Commercial specification grade self-closing clear plastic cover which maintains the rain tight status even when the receptacle is in use.

2. Covers utilized in exterior applications shall also be padlockable.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Unless noted otherwise on the Contract Drawings:

1. Mount convenience receptacles 1’-6”± (18” nominal) above the finished floor (A.F.F.).

2. Mount locking receptacles, utilized as equipment disconnects, at:

a. 2’-0” ± (24” nominal) above the finished floor for floor mounted equipment.

b. 6’-0” ± (72” nominal) above the finished floor for ceiling mounted equipment.

3. Mount devices vertically with the ground pole on the bottom.

END OF SECTION

SECTION 16160

DISTRIBUTION/LIGHTING PANELBOARD

PART 1 - GENERAL

1.01 SCOPE

A. This Section covers minimum requirements for distribution panelboards and/or lighting panelboards furnished either by Vendors, as part of pre-packaged equipment, or by installation CONTRACTORS.

B. All panelboards for this Work shall be from one manufacturer.

1.02 SUBMITTAL

A. For Approval

1. Manufacturer's data (i.e., catalog cut sheets) for each type of unit utilized for this Work.

2. Include drawings and data to indicate:

a. General layout of each unit (i.e., front face view) including overall dimensions and nameplate designations.

b. Conduit entry/exit locations and allowable cable terminal size information.

c. Assembly ratings such as short circuit, voltage, and continuous current.

PART 2 - PRODUCTS

2.01 PANELBOARD

A. Copper buses throughout.

B. Indoor, surface mount, galvanized steel enclosure (minimum 20 inches wide and 5 3/4 inches deep) complete with gray enamel painted front face. Unless indicated otherwise on the Contract Drawings, enclosure(s) shall be NEMA 1.

C. Front face trim, complete with a hinged door which shall cover all circuit breaker handles, shall be included. Opening of the door shall not uncover any energized parts and the door shall be capable of being locked.

D. UL listed and bear a label stating so.

E. Include a ground bus.

F. If used for 480/277Y service, include a 100% rated neutral bus.

G. Plug-in type bus such that individual breakers can be added or replaced without disturbing adjacent breakers or without removing main bus or branch circuit connections. The panelboard shall not be required to be completely shutdown to add additional breakers.

H. 480VAC units (distribution) braced for 65kA minimum. 480/277VAC units (lighting) braced for 42kA minimum.

I. Ampacity rating as indicated on the Contract Drawings.

J. Provide, at a minimum, the spare breaker mounting space indicated on the Contract Drawings.

2.02 CIRCUIT BREAKERS

A. Molded case plug-in type circuit breakers with integral thermal and instantaneous magnetic trip on each pole.

B. Single handle for multi-pole units. Do not use tandem breakers.

C. UL listed and labeled.

D. Sizes as indicated on the Contract Drawings.

E. Use type HACR for heating, ventilation and air conditioning loads.

F. Use type HID for lighting loads.

G. Breakers to include: on, off, and visual trip indication.

2.03 MANUFACTURERS

A. Provide unit(s) as manufactured by:

1. Cutler-Hammer.

2. General Electric.

3. Square D.

4. Or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Support panelboard independently of the connecting conduit.

B. Do not mount directly to wall surface. Provide galvanized steel channel.

C. Ground the enclosure per NEC requirements.

D. Install panelboard to provide minimum working space clearance per NEC Article 110.

E. Highest circuit breaker shall be no more than six feet (6'-0") above finished floor.

F. Provide blank filler plates for unused spaces.

G. Provide a typed circuit directory in each panel board.

H. The supplier of the unit shall be responsible for the power, control, and grounding interconnection.

I. Wires to be trained inside panel board to allow easy access to spare and/or unused spaces.

J. Limit the amount of cable jacket, where applicable, within the panelboard.

3.02 BALANCE LOAD

A. It is the intent of the design that the installation provide a balanced load on each phase. The CONTRACTOR shall reconnect loads if an imbalance exists.

END OF SECTION

SECTION 16265

480VAC VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 SCOPE

A. This Section covers minimum requirements for low voltage (600V or less) Variable Frequency Drives (VFDs) furnished by the CONTRACTOR. Unit(s) shall be utilized to power AC electric motors for sewage pumps.

B. The drive manufacturer shall have a minimum of ten (10) continuous years of experience in the production and application of this type of equipment in the specified process field.

C. All necessary equipment, whether specified or not, shall be furnished and properly coordinated in accordance with the intent of this Specification. The vertical pump supplier shall be responsible for the proper function of all components. Any item, material, or detail not specified or indicated on the Contract Drawings shall be determined by the vertical pump manufacturer and shall be subject to approval.

1.02 QUALITY ASSURANCE

A. The drive manufacturing facility shall be ISO 9001 certified.

1.03 SUBMITTAL

A. For Approval

1. Submit manufacturer's standard data (i.e., catalog cut sheets) for each type of unit supplied.

2. A minimum of one (1) job specific layout drawing per unit type or rating complete with dimensions, total weight, shipping splits (if required), and material list.

3. Unit front face (operator interface) layout complete with devices.

4. Elementary diagrams complete with internal and external (field) wiring information.

5. Engineering data to prove compliance with IEEE Standard 519 Guide for Harmonic Control and Reactive Compensation for Static Power Converters. Include project specific analysis indicating total harmonic voltage distortion.

6. The name, address, and telephone number of a local (within 150 miles or less) factory authorized service organization.

   a. Include a signed statement indicating the maximum time required to have a factory trained service technician on-Site after telephone notification of an equipment malfunction.

   b. Include a signed statement indicating that standard replacement parts can be obtained, shipped, and delivered to the OWNER within 24-hours of a written request.

1.04 GUARANTEE

A. Each VFD unit shall be guaranteed to be free from defects in materials and workmanship for a minimum period of twelve (12) months from the date of certified start-up and acceptance by the OWNER. The guarantee shall include all parts, field and shop labor, travel time, and expenses.

B. The above general guarantee shall not act as a waiver of any original equipment manufacturers (OEM) warranty of greater length in time.

PART 2 PRODUCT

2.01 GENERAL

A. Each unit shall be:

1. UL listed and bear a label stating so.

2. Manufacturer's standard rating.

3. Permanently labeled with a Model number and a unique Serial number.

4. Manufactured and installed in accordance with the latest issue of ANSI, NEMA, IEEE, and NEC standards.

B. Site Conditions

1. Continuously operating (24-hours per day, 7-days per week) municipal wastewater facilities.

2. Non-hazardous industrial environment (damp, humid, dust, and dirt).

3. Indoor temperature range of 0-degree C (32-degrees F) to 40-degrees C (104-degrees F) and relative humidity 0 percent to 95 percent.

4. Elevation below 1,000 meters (3,300 feet) above sea level.

5. System Voltage

a. 480/277 VAC -10% +5% (432 to 504 volts AC).

b. 3 Phase.

c. 4 Wire.

d. 60 Hertz +/- 1 Hertz.

C. Motor Data

1. Unless noted otherwise or required by the process, each VFD shall be fully capable of operating any standard 460VAC three phase NEMA B squirrel cage induction motor.

2. The motor shall be energy efficient (premium).

2.02 FABRICATION

A. Enclosure

1. Each drive shall be open chassis for field mounting within an existing enclosure.

2. Each unit shall be vibration resistant.

3. Each unit shall be electro-magnetic interference (EMI) resistant.

B. Electrical

1. In multiple drive applications, each unit shall be fed incoming AC power from a common bus. Power distribution shall be supplied via a distribution panelboard.

2. Each drive shall include an incoming power disconnect device. The device shall provide unit overload protection and unit short circuit protection. The device shall be fused.

3. Each drive shall have a symmetrical short circuit current rating equal to or greater than the rating of the feeder circuit breaker and distribution switchboard.

4. A separately mounted incoming power isolation transformers shall be furnished; if required because of power quality

5. Units shall not be affected by (insensitive to) incoming AC power phase rotation.

6. Each drive shall utilize a full wave rectifier, DC bus filter, and, unless noted otherwise, a pulse width modulating (PWM) inverter.

7. Each unit shall be the manufacturers commonly produced solid state, microprocessor based, fully digital system utilizing surface mounted devices and modular construction. All control components shall be physically and electrically isolated from the power circuits.

8. No external sources of internal control power will be provided. Each drive shall include a 120 VAC control power transformer (CPT) with both primaries fused, one secondary fused, and one secondary grounded. Also, if necessary, a +24VDC power supply shall be included.

9. Internal wiring shall be 600V copper MTW. Minimum #14 AWG for power and #16 AWG for 120 VAC control. Provide plastic sleeve wire labels on both ends of each conductor. All ground conductor insulation shall be green and all external source interlocks shall be yellow.

10. Drive supplier shall guarantee that each unit, as measured at the drive incoming power terminals, shall not contribute more than 5 percent total harmonic distortion (THD) and 3 percent single harmonic distortion per IEEE 519 to the existing power distribution system. If the drive supplier determines that an AC input line reactor and/or filter is required, the reactor shall be furnished by the drive supplier and shall be mounted within the drive enclosure.

11. Internal Drive Protection:

    a. Incoming power over voltage.

    b. Incoming power under voltage.

    c. Incoming power phase loss.

    d. Instantaneous overcurrent.

e. Inverse time current.

f. Over temperature.

g. Over frequency.

h. Under frequency.

12. Drive supplier shall note the distance (or motor lead length) between the VFD and the motor. If deemed necessary by the drive supplier to avoid nuisance trips due to capacitive current flow to ground, furnish an output line reactor and/or output line filter for each VFD.

C. Performance

1. A 97 percent or better efficiency at base speed and 100 percent load. The efficiency at 50 percent of base speed shall be 95 percent or better.

2. A 0.95 lagging or better power factor at all operating speeds. Unless noted otherwise, the unit shall not exceed a unity power factor.

3. Maintain speed control, regardless of load, within ±1.0 percent of motor base speed.

D. Capabilities

1. Unit shall be able to start, without tripping, into a rotating (forward or reverse) load.

2. Constant (high) torque starting mode with automatic adjustment to variable (running) torque.

3. Each unit shall be an AC/DC/AC converter utilizing isolated gate bipolar transistor (IGBT) technology. Drives shall have an optional mode for scalar or Volts/Hertz operation. In the V/H operating mode, each drive shall be capable of maintaining a constant volts-to-hertz ratio throughout the speed range.

4. Drive output current (Io) overload capacity shall be 150 percent of the normal rated current for one minute out of every ten minutes and 200 percent for two seconds out of every fifteen (15) seconds. Unit(s) shall include instantaneous overcurrent trip at 350 percent of normal rated current. All values shall be easily field adjustable.

5. Output frequency shall be easily field adjustable between zero and three hundred Hertz.

6. Starting and running slip compensation shall be available.

7. Unit shall be capable of no-load operation during maintenance.

8. Unit shall be capable of continuous operation at full rated current and load within the Site Conditions stated in this Technical Specification Section. Each drive shall be self-adjusting to incoming AC power fluctuations. Fluctuations within this range shall cause no interruption of drive operation.

9. Provide motor protection:

a. Solid state field adjustment thermal overload.

b. Critical speed lockout.

c. Phase-to-phase short-circuit.

d. Phase-to-ground short-circuit.

10. Perform an orderly and non-component damaging shutdown upon internal fault or loss of incoming power.

11. Ability to ride through a 30-cycle (or 0.5 second) local electric utility company power outage. Include a power loss ride through feature that will allow the drive to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

12. Unit(s) shall have an automatic energy optimization option to adjust the volts-to-hertz ratio for minimum energy consumption while maintaining the load requirements.

2.03 INTERFACE

A. Local Operator Interface

1. Each unit shall include a lamacoid nameplate (black lettering on a white background) identifying OWNER'S designation (i.e., Pump No. 1 VFD). Anchoring method shall not void the integrity (NEMA rating) of the enclosure. Minimum size shall be 3 inch by 6 inch.

2. Unless noted otherwise, each VFD shall include a front mounted Operator Control Panel (OCP) consisting of a four line by twenty-character backlit alphanumeric display and a keypad with Run/Stop, Local/Remote, Increase/Decrease, menu navigation, and parameter Select/Save pushbuttons. This keypad and display shall be able to perform all programming and configuration functions for each individual drive unit.

a. All parameter names, fault messages, warnings, and all other information shall be displayed in simple complete plain English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table (coded messages are not acceptable).

b. Each OCP shall be capable of uploading drive parameter settings to non-volatile OCP memory and downloading drive parameter settings from non-volatile OCP memory to the same drive or to another similar drive OCP.

c. The display capabilities shall include, but not be limited to:

1) Output voltage, current, frequency, or torque.

2) Output speed in RPMs, % of total, or other engineered units.

3) Input voltage, power (kW), or energy (kWh).

4) Internal drive heatsink temperature (in % of unit trip).

5) Status of discrete inputs and outputs.

6) Values of analog input and output signals.

7) Values of PID controller references, feedback loops, and error signals.

d. During normal drive operation, one line of the OCP display shall indicate the speed reference, the run/stop status, and the local/remote status. The remaining three lines

shall display the values of any three (3) OWNER selected parameters. Include detailed trip and/or fault indication.

e. Provide lockout capabilities to prevent unwanted programming. Lockout must not inhibit Local/Remote selection or manual operation.

f. Loss of incoming AC power or drive internal control power shall not necessitate a reloading of any drive parameters and/or configuration. The local operator interface as well as the entire drive shall automatically reset and be ready for continued operation upon return of power.

g. Each OCP shall include capabilities to increase/decrease the motor speed when the VFD is in local or "HAND" mode.

3. Include a non-resettable elapsed running time meter (ETM).

B. External Interface

1. Hardwired Inputs

a. Include three (3) independently programmable analog inputs with easily field selectable functions. One (1) shall be 0 – 10 VAC and two (2) shall be 4 – 20 mA DC. Provide input isolation for each. Processing functions shall include scaling adjustment, adjustable filtering, and signal inversion. One input will typically be utilized for speed reference from a central control system.

b. If the speed input reference is lost, the drive shall be field adjustable to stop and alarm a fault locally and to the central control system or to continue operating at a predetermined field adjustable speed and alarm a fault locally and to the central control system.

c. Include six (6) independently programmable discrete inputs with easily field selectable functions. Each input is intended for use as a dry contact with either an internal or external control power source. One input may typically be utilized as a Run/stop signal (115 VAC) and another may be utilized as an External Stop (115 VAC; normally closed safety device).

2. Hardwired Outputs

a. Include two (2) analog outputs that shall provide 4 – 20 mA DC signals. Outputs shall be independently programmable to provide proportional signals to easily field selectable functions such as drive output speed, frequency, current, or power.

b. Include three (3) form C independently programmable relay contact outputs with easily field selectable functions. Relay contacts shall be rated 8 amps at 250 VDC. General and specific warning and fault indications shall be available. One output may typically be utilized as a Drive Fault (115 VAC) signal and another may be used as a Drive Running (115 VAC) signal to a central control system.

3. All inputs and outputs shall be wired to terminal blocks for connection to field wiring.

4. Network Communication

a. A RS485 serial port connection shall be provided for network communication purposes. Each unit shall communicate with the proposed local control panel (LCP).

b. A remote input/output interface board shall be furnished to allow connection to other equipment. All drive parameters, operation programming, monitoring, and diagnostic functions shall be available via the serial link.

c. Unless specified otherwise or required for the application, MODBUS protocol shall be provided to allow direct communication with other drives and programmable logic controllers (PLCs). Each individual drive shall be addressable for serial network communication purposes.

C. Operate Selected Parameters

1. The following easily field adjustable operator selected parameters shall be included, at a minimum.

a. Preset output speed selection (if reference signal is lost).

b. Minimum output speed (20 to 60 percent of nominal rated speed).

c. Maximum output speed (100 to 110 percent of nominal rated speed).

d. Linear acceleration and declaration rates (1.0 to 90 seconds).

e. Output torque boost.

f. Running output current limit (up to 110% of full load current).

g. Frequency avoidance band (at least one).

h. Automatically attempt to restart after an internal fault or an external incoming power failure (on or off option).

i. Number of auto restart attempts (at least three).

j. Time delay between auto restart attempts (1-30 seconds).

2.04 MANUFACTURERS

A. Provide unit(s) as manufactured by:

1. Allen-Bradley, A Division of Rockwell Automation, Powerflex 40 Series.

2. Or equal.

PART 3 EXECUTION

3.01 SHIPPING

A. Unit(s) shall be handled and stored in accordance with the manufacturers written instructions.

3.02 FIELD INSTALLATION

A. Each unit shall be securely fastened to the existing enclosure utilizing appropriate anchors, nuts, and bolts. Unit enclosures shall not be field welded in any fashion.

B. The unit shall be mounted with the highest operator device no more than 5 feet 6inches above the finished floor.

C. Each unit shall be properly grounded per the NEC.

D. Close, using proper seals, all unused openings and/or penetrations to maintain the enclosure NEMA rating.

3.03 COMMISSIONING

A. The CONTRACTOR who supplied the unit shall be responsible for proving correct operation, under all possible conditions, to the OWNER.

B. Upon completion of the commissioning, the supplier shall furnish, within the O & M Manual, a complete set of “As-Installed” schematics and wiring diagrams for each type of unit.

3.04 TRAINING

A. The drive supplier shall provide a factory trained technician to conduct a one (1) normal 8-hour workday training session for up to six (6) of the OWNER'S representatives. The session will be conducted at the OWNER'S designated site and shall consist of instruction on the proper operation and maintenance of the equipment.

B. The drive supplier shall furnish all instruction material (one per OWNER representative plus two spares) to conduct the session. Upon completion of the training, all instructional material shall become the property of the OWNER.

3.05 FINAL PAYMENT

A. The CONTRACTOR shall not receive final payment under this Contract until:

1. The complete O & M Manual, including As-Builts, is received, reviewed, and accepted by the OWNER.

2. All training is complete.

END OF SECTION

SECTION 16405

ELECTRIC UTILITY SERVICE

PART 1 - GENERAL

1.01 SCOPE

A. The CONTRACTOR shall provide all coordination, labor, materials, equipment, services, and incidentals necessary and/or required to furnish and install a new electric service.

B. The CONTRACTOR shall furnish all equipment and perform all work in accordance with requirements and specifications of the local electric utility company.

C. The CONTRACTOR, as part of the Bid Price, shall pay all local electric utility company one time fees associated with the new service.

D. The CONTRACTOR shall be responsible for furnishing all information required by the local electric utility company. This shall include, but not be limited to, all easement application information, service application information, work order information, and inspection documentation.

E. The ENGINEER, for information purposes only, shall be copied on all correspondence between the CONTRACTOR and the local electric utility company.

1.02 WORK BY OTHERS

A. The Local Electric Utility Company shall:

1. Furnish, to the CONTRACTOR, all required applications associated with the execution of the Work.

2. Provide the electric service to the site.

3. Designate the point-of-attachment.

4. Provide the revenue meter and, if required, metering transformers complete with interconnecting wiring.

PART 2 - PRODUCTS

2.01 SPECIFIED IN OTHER SECTIONS

PART 3 - EXECUTION

3.01 CONTRACTOR

A. Furnish underground conduit(s), wide sweep elbows, and risers from the local utility company designated point-of-attachment to the service entrance disconnect. Refer to the Contract Drawings for quantity of conduits, routing, conduit material, bedding or encasement information, etc.

B. Temporarily cap both ends of each service conduit until ready for use.

C. Cap both ends of spare service conduits with appropriate covers designated for this function (not duct tape). Furnish a heavy- duty nylon pull string in each spare service conduit.

D. Supply and install the new service conductors between the local electric utility company designated point-of-attachment and the service entrance disconnect. (The local electric utility company shall terminate the CONTRACTOR furnished service conductors at the designated point-of-attachment.) The CONTRACTOR shall properly terminate all service conductors at the service entrance disconnect.

E. Shall supply, install, and properly ground RGS conduit between the service entrance metering transformers and the local utility company revenue meter as indicated on the Contract Drawings.

END OF SECTION

SECTION 16500

LIGHTING

PART 1 - GENERAL

1.01 SCOPE

A. This Section covers minimum requirements for lighting furnished either by Vendors, as part of pre-packaged equipment, or by installation CONTRACTORS.

B. Unless noted otherwise, the supplier shall furnish and assemble all fixtures, lamps, ballasts, control devices, materials, and interconnection necessary and required to provide a complete and functional lighting system.

1.02 SUBMITTAL

A. For Approval

1. Submit Manufacturer's data (i.e., catalog cut sheets) for each type of fixture and/or device.

PART 2 - PRODUCT

2.01 GENERAL

A. Unless noted otherwise, each fixture shall be brand new and shall be UL listed and bear a label stating so.

B. All fixtures shall be formed from material of required thickness to prevent twisting and/or warping.

C. Identical fixtures shall be provided with identical diffusers and identical lamps.

D. Refer to the Contract Drawings and/or other sections of this Specification for additional lighting information.

E. Unless noted otherwise on the Contract Drawings or other sections of this Specification, only 120VAC or 480VAC shall be utilized for lighting applications.

2.02 FLUORESCENT FIXTURES

A. Open Industrial Channel:

1. Two (2) lamp or four (4) lamp. Refer to the Contract Drawings.

2. Solid Top (no uplight).

2. Phosphate treated, white painted, die-formed steel.

4. Specular reflector.

5. Lithonia AFST –2 –32 (for 2 lamp applications) or AFST –4 –32 (for 4 lamp applications, or Equal.

B. Four Foot Enclosed

1. Two (2) lamps.
2. Reinforced molded polyester fiberglass housing.
3. One piece molded acrylic diffuser.
4. Retained non-metallic latches.
5. Neoprene gasket between housing and diffuser.
6. UL listed for wet locations.
7. Lithonia DMW-2-32, USI Columbia LUN240-WL, or Equal.

C. Compact

1. Coated aluminum housing.
2. Acrylic refractor.
3. Enclosed and gasketed. Suitable for wet locations.
4. Refractor guards.
5. Stainless steel exterior hardware.
6. O-Z Gedney CM; GE Mini●Gard MGA; or Equal.

2.03 HIGH INTESITY DISCHARGE FIXTURES

A. Wall-Pak

1. Borosilicate primatic glass refractor/diffuser.
2. Sealed and gasketed.
3. Wire guard.
4. Suitable for wet location.
5. Lithonia TWH Wall-Pak, GE Walmount, or Equal.

B. Low Bay

1. General Electric Minimite, Holophane Petrolux II, or Equal.
2. Industrial grade.
3. Borosilicate prismatic glass refractor/diffuser.
4. Aluminum housing with corrosion resistant paint.
5. Suitable for damp locations.

6. Include pre-wired auto-regulating integral ballasts.

C. Floodlights

1. Corrosion-resistant fiberglass reinforced polyester housing.
2. Suitable for exterior (wet) service.
3. General Electric HLU/VLU Powerflood, or Equal.

D. High Bay

1. Include pre-wired auto-regulating integral ballast and housing.
2. Suitable for damp locations.
3. Enclosed reflector.
4. Certain fixtures, indicated on Contract Drawings, to include time delayed.
5. Automatically switched quartz lamp (instant-on lamp).
6. General Electric Filterglow or Equal.

2.04 BALLASTS

A. General

1. Rated for voltage required by application.
2. Minimum temperature rating for interior locations: +25ºF.
3. Minimum temperature rating for exterior locations: - 15ºF.
4. Identical fixtures shall be provided with identical ballasts.

B. Fluorescent

1. Rapid start.
2. Solid state electronic.
3. 0.90 power factor minimum.
4. Class A sound rating or better.
5. THD less than 10 percent.
6. Automatic reset.
7. Thermal protection.
8. Utilize two-lamp ballasts in open industrial type fixtures; three lamp and four lamp ballasts shall not be used.

C. High Intensity Discharge

1. Capable of operation with an open or short circuit condition without significant loss of life.
2. Entirely encapsulated.
3. THD less than 20 percent.
4. Auto-regulating type for metal halide lamps.

D. Emergency

1. High temperature maintenance free battery type.
2. Battery charger.
3. Electronic control circuitry.
4. One (1) compact metal housing.
5. Visible status indication light.
6. Test switch.
7. Capable of operating two 48-inch 32W T-8 fluorescent lamps.
8. Capable of 90 minutes of continuous illumination.

2.05 LAMPS

A. Fluorescent (F)

1. 48 inch, 32 watt, T-8 Octran.
2. Compact (CF) wattage as indicated on the Contract Drawings.
3. Rapid start.
4. Triphosphor.
5. Operate at 4100º Kelvin.

B. Metal Halide (MH) or High Pressure Sodium (HPS)

1. 70, 100, 175, 400, or 1000 watt as indicated on the Contract Drawings.
2. Coated.
3. Base and bulb to suit fixture.

2.05 EMERGENCY LIGHTING

A. Provided either by emergency ballasts in certain fluorescent fixtures or by self-contained emergency battery units.

2.05 EXIT SIGNS

A. Light emitting diode type.

B. Outage of one LED will not affect the integrity of the total sign.

C. Normal operation from the building power supply.

D. Emergency operation for 90 minutes from a self-contained battery.

E. When indicated, include a NEMA 4X Corrosion resistant enclosure.

F. Lithonia Signature LED, Chloride Infinity LED, or equal.

2.05 PHOTOELECTRIC SENSORS

A. Shall be used to turn individual exterior lights on at dusk.

B. Shall have an adjustment for the amount of foot-candles that turn the unit on and off.

C. Lights to remain on if the photocell fails.

D. Typically included with wall-packs and/or floodlights used on the exterior of buildings.

2.05 WALL SWITCHES

A. 120/277VAC

B. Toggle handle, totally enclosed case.

C. 20 Ampere.

D. Industrial specification grade.

E. Side wired.

F. Provide a ground screw.

G. Ivory color (except where wall finish is wood or dark color, then use brown color).

H. Providing matching 2-pole 3-way and/or 2-pole 4-way switches as indicated on the Contract Drawings or as required for the application.

I. Leviton or Equal.

2.05 EMERGENCY BATTERY UNITS (EBU)

A. Self-contained emergency lighting units.

B. Maintenance free 6V nickel-cadmium battery with 90 minutes of full capacity.

C. Battery charger with sufficient capacity to recharge a fully discharged battery back to full charge within 12 hours.

D. Two (2) sealed beam lamps. Combined lamp output of 25 watts minimum.

E. NEMA 4X fiberglass reinforced polyester enclosure.

F. Indication of AC power on, unit recharging, and fault condition.

G. Include a test button (transfer unit from external AC power to integral battery supply).

H. Lithonia, Hubbell, Chloride, or equal.

2.05 COVER PLATES

A. Recessed boxes: plastic wallplate to match color of switch.

B. Surface mounted boxes: beveled stamped sheet steel.

C. Weatherproof surface mounted boxes: beveled cast iron (similar to box material) cover with gasket.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Minimum average foot-candle illumination levels, as measured at 3 feet above floor level with a 0.70 maintenance factor, shall be:

Emergency egress	5 foot-candles
walkways	20 foot-candles
Main process areas	40 foot-candles
Electrical rooms	50 foot-candles
Exterior process areas	10 foot-candles
Exterior non-process areas	2 foot-candles

B. Light fixtures, lamps, ballasts, and exit signs shall meet the standards, if applicable, to qualify for local electric utility company rebates.

C. If applicable, the CONTRACTOR shall file necessary forms for a local electric utility company rebate program. The refund check shall be sent by the local electric utility company directly to the OWNER.

D. Furnish and install all supports, hardware, wiring, and accessories necessary and required.

E. All conduit for exterior fixtures shall be run on the interior of the building.

F. Fixtures shall be ceiling mounted wherever possible. Wall mounted lighting fixtures shall be allowed only where mechanical interference prevents ceiling mounted units or where indicated on the Contract Drawings.

G. Fixtures shall be supported independently of HVAC ductwork, ductwork supports, or other mechanical equipment.

H. Fixture mounting heights and locations indicated on the Contract Drawings are approximate and are subject to revision in the field when necessary to clear conflicts and/or obstructions.

I. The Contract Drawings indicate an approximate arrangement to provide uniform light distribution. If interference causes the arrangement to change, the fixture installer shall be responsible for a uniform light distribution.

J. Immediately prior to acceptance by the OWNER, the fixture installer shall clean all fixtures, reflectors, and diffusers by the manufacturer's recommended practice.

K. Four-foot fluorescent fixtures shall be supported by at least two fixed support points. Chain shall not be used to support fixtures.

L. Light fixtures shall be supported independently of the cable and/or conduit entering the fixture.

M. Install ballasts for all fixtures that require ballasts.

N. Replace any ballast that exceeds the normal sound level.

O. Four-lamp fluorescent fixtures shall utilize two ballasts.

P. Install new lamps in all fixtures.

Q. Install all controls for lighting system per the equipment manufacturer's recommendations.

END OF SECTION

SECTION 16680

SURGE PROTECTION

PART 1 - GENERAL

1.01 SCOPE

A. This Section covers minimum requirements for transient voltage surge suppressors (TVSS) furnished either by Vendors, as part of pre-packaged equipment, or by installation CONTRACTORS.

B. All surge protection units for this Work shall be from a single manufacturer. All surge protection devices for this Work shall be from a single manufacturer. Units and devices need not be from the same manufacturer.

C. For electrical power systems that include multiple application points of surge protection units, the unit supplier shall be responsible for overall surge protection coordination.

1.02 SUBMITTAL

A. For Approval

1. Submit Manufacturer's data (i.e., catalog cut sheets) for each type of unit or device to be supplied.

PART 2 - PRODUCT

2.01 GENERAL

A. Each unit or device shall be UL listed and bear a label stating so.

B. Each unit or device shall include, at a minimum:

1. Surge arrestor.

2. EMI/RFI filter.

3. Voltage clamp.

4. Single point grounding.

5. Normal mode protection (L-N).

6. Common mode protection (L-G & N-G).

7. Industrial grade.

8. LED indication of phase protection functioning.

9. Push-to-test function to verify unit is operating properly.

10. Capability to handle 110% of the nominal system operating voltage.

2.02 SECONDARY POWER SURGE SUPPRESSORS

A. Unit enclosure shall be as indicated on the Contract Drawings or in other sections of this Specification. In general, units mounted within a control panel or within a panelboard shall be NEMA 1; units that service panelboards but are mounted externally shall match the panelboard enclosure NEMA rating; and units mounted outdoors shall be NEMA 3R.

B. Each unit shall be manufactured to UL Standard 1449 Second Edition.

C. Each unit shall contain:

1. At least one (1) non-linear component.

2. Easily field replaceable components (modular design).

3. Surge current diversion paths for all modes of protection.

4. Easily field replaceable surge rated fuses for each mode.

D. Provide unit(s) as manufactured by:

1. Advanced Protection Technologies, Inc. TE Series.

2. MCG Surge Protection XT or M Series.

3. Or equal.

2.03 TVSS RECEPTACLES

A. Individual 120VAC, 60HZ, 20A duplex receptacle complete with integral suppressor.

B. Provide device(s) as manufactured by:

1. Leviton Model 5380.

2. Or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Each unit or device shall be interconnected to a dedicated multi-pole circuit breaker.

B. Where indicated, furnish surge protection at motor control centers (MCC), at distribution switchboards (DSB), and at distribution (DP), lighting (LP), and/or power (PP) panelboards. For new equipment applications, surge protection unit may be internally mounted (integral to the equipment enclosure). Where new surge protection is being added to existing equipment (retrofit applications), unit shall typically be separately mounted.

C. Where indicated, furnish surge protection within control panels containing solid state electronic equipment such as programmable logic controllers (PLCs) and SCADA remote terminal units (RTUs).

D. Where indicated, furnish surge protected duplex receptacles for portable electronic equipment such as personal computers (PCs).

E. Install all units per the manufacturer's recommendations (i.e. suppression device feeder breaker sizing, etc.). For externally mounted units, minimize the distance between the circuit breaker and the unit.

F. Properly ground all surge protection devices.

G. The supplier of the unit or device shall be responsible for power, control, and grounding interconnection.

END OF SECTION

SECTION 17420

INSTRUMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Control Valve w/ Electric Actuator.

B. Ultrasonic level transmitter.

C. Float level switch.

D. Magnetic water flow transmitter.

E. Float level control.

1.2 REFERENCES

A. Section 01400 – References: Requirements for references.

B. National Electrical Manufacturers Association (NEMA).

C. National Fire Protection Association, Inc. (NFPA): 70 – National Electrical Code.

D. Underwriters Laboratories Inc. (UL).

1.3 ALLOWANCES

A. Allowances shall be made for the number of days of commissioning or supervision required for installation and startup at the time of bid with no additional payment for startup or commissioning.

1.4 REGULATORY REQUIREMENTS

A. Conform to NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

1.5 PROGRESS SUBMITTALS

A. Shop Drawings: Indicate operating data, system drawings, wiring diagrams, and written detailed description of operation.

B. Product Data: Include manufacturer's product and engineering data for each instrument. Include ranges, materials, and dimensions.

C. Test Reports: Include calibration reports.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use. Include instructions for storage, handling, preparation, installation, and setup of product.

E. Instrumentation Specification: The project instrumentation requirements are listed on Attachment 1, Instrument List. The following project instrumentation requirements, shall be completed by the CONTRACTOR.

1. Complete review and update of all project instrumentation as specified in Section 17420.

2. Determine and submit for approval, final manufacture's instrument part number to satisfy all installation, specification and functional requirements.

3. Before procurement, submit all required instrument documentation to ENGINEER for review and approval. As a minimum, this shall include specific manufactures equipment part number, equipment cut sheets, equipment manufacturer's drawings, installation and operation manuals, equipment and installation test reports and the like.

1.6 CLOSEOUT SUBMITTALS

A. Section 01700 Execution Requirements:

B. Record Documents: Indicate actual locations of instruments. Include actual setpoints, analog signal spans, and programming setpoints data.

C. Operation and Maintenance Data: Include bound copies of operating and programming instructions, adjustments, and preventative maintenance procedures and materials. Provide manufacturer's technical operation and maintenance manuals. Provide six complete copies of the operating and maintenance instructions, including parts lists for all of the equipment. One copy to be single sided for production of additional operation and maintenance manuals. Bind material in sections in hard backed binders.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this Section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept instruments on the Site in factory containers. Inspect for damage.

B. Store products in clean and dry area.

1.9 SYSTEM STARTUP AND COMMISSIONING

A. Section 01700 - Closeout Procedures: Requirements for commissioning.

B. Provide instrumentation calibration, field configuration, documentation, startup and commissioning support for all instrumentation testing and integration.

C. Provide technical support for staff training for a minimum of one day after equipment commissioning.

1.10 MAINTENANCE MATERIALS

A. Section 01700 – Closeout Procedures: Requirements for maintenance materials.

B. Furnish 1 set of calibration accessories for the humidity transmitters.

PART 2 PRODUCTS

2.1 INSTRUMENT LIST

A. Appended to this Section is Attachment 1, Instrument List, which tabulates the instruments that form part of the work. Use this list in conjunction with Drawings.

2.2 CONTROL VALVE w/ ELECTRIC ACTUATOR

A. Part of Mechanical Design.

B. Gate Valve 10" line size.

C. Electric actuator (Open/Close).

D. Power Supply: 120 VAC.

E. Limit Switches: 2 SPDT for Open/Close Indication.

F. Position Indicator.

2.3 ULTRASONIC LEVEL TRANSMITTER

A. Non-contact ultrasonic level transmitter as manufactured by Endress & Hauser (Prosonic M FMU41 series) or approved equal.

B. Power Supply: 120 VAC.

C. Output: 4-20 mA.

D. Enclosure: Local LCD display. NEMA 4X.

E. Mountings: NPT 2" thread process connection.

2.4 FLOAT LEVEL SWITCH

A. Polypropylene float with cord and mechanical switch as manufactured by SJE-Rhombus (Milliamp Master Control Switch) or approved equal.

B. Output: 1 NC switch, wired as per schematics.

C. Mounting: Externally weighted.

2.5 MAGNETIC WATER FLOWMETERS

A. Pulsed magnetic flowmeter, flanged, Hastelloy electrodes, Polyurethane liner with transmitter and display; as manufactured by Endress & Hauser (Promag 50W) or approved equal.

B. Model: As per Instrument List, with integral indicator and transmitter.

C. Power: 120 VAC.

D. Output: 4-20 mA, configurable totalizer pulse.

E. Enclosure: NEMA 4X.

F. Accessories: Grounding rings, Stainless Steel.

2.6 FLOAT LEVEL CONTROL

A. Polypropylene float with cord and mechanical switch as manufactured by SJE-Rhombus (Milliamp Master Control Switch) or approved equal.

B. Output: 1 NO switch, wired as per schematics.

C. Mounting: Externally weighted.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 – Execution Requirements: Verification of existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Sequence works to ensure installation of components is complimentary to installation of similar components in other systems.

D. Coordinate installation of system components with installation of mechanical systems equipment.

3.2 INSTALLATION

A. Install equipment in accordance with manufacturer's written instructions, final Shop Drawings, Drawings, applicable standards, and with manufacturer or Supplier supervision as required.

B. Install instruments and their associated sensors to ensure easy access for maintenance, calibration, withdrawal, and replacement.

C. Calibrate, program, and setup all instruments as directed by the ENGINEER.

3.3 MANUFACTURER'S FIELD SERVICES

A. Section 01400 – Quality Requirements: Requirements for preparing and starting systems.

B. Provide manufacturer's representative to inspect magnetic water flow transmitters and ultrasonic level transmitters after installation, and submit report prior to startup, verifying installation and operation is in accordance with specifications and manufacturer's written instructions.

3.4 ADJUSTING

A. Section 01700 – Execution Requirements: Requirements for adjusting installed work.

B. Adjust instrument setpoints as directed by ENGINEER.

3.5 DEMONSTRATION

A. Section 01800 – Facility Operation: Requirements for demonstrating installed work.

B. Demonstrate operation of installed instrumentation.

END OF SECTION

SECTION 17431

CONTROL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Control panels.

B. Automatic telephone dialer.

C. Uninterruptible power supply.

D. Enclosures.

E. Power Supply.

F. Ethernet network components.

1.2 REFERENCES

A. Section 01400 – Quality Requirements: Requirements for references.

B. National Electrical Manufacturers Association (NEMA):

1. ICS 1 - General Standards for Industrial Control Systems.

2. ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.

3. ICS 6 - Enclosures for Industrial Controls and Systems.

4. Standards Publication 250.

C. National Fire Protection Association, Inc. (NFPA): 70 - National Electrical Code.

D. Underwriters Laboratories Inc. (UL).

1.3 ALLOWANCES

A Allowances shall be made for the number of days of commissioning or supervision required for control panel and system installation and startup at the time of bid with no additional payment for startup or commissioning.

1.4 DRAWINGS AND DESIGN

A. Drawings, specifications, and tabulations do not purport to be complete in listing or indicating exact detail. Drawings are intended to show the intention of layout and operation.

B. Final placement of all internal and external panel components is CONTRACTOR's responsibility based on the guidelines provided by the equipment manufacturer.

1.5 REGULATORY REQUIREMENTS

A. Conform to NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

1.6 PROGRESS SUBMITTALS

A. Shop Drawings: Submit in accordance with NEMA ICS 1. Include:

1. Prepare as-constructed control panel wiring diagrams to include any changes made during field installation and startup.

B. Product Data: Include for each component showing electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Operation and Maintenance Data: Include bound copies of operating and programming instructions, adjustments, and preventative maintenance procedures and materials. Provide six complete copies of the operating and maintenance instructions, including parts lists for all of the equipment. One copy to be single sided for production of additional operation and maintenance manuals. Bind material in sections in hard backed binders.

1.7 CLOSEOUT SUBMITTALS

A. Section 01700 – Execution Requirements: Requirements for closeout submittals

B. Record Documents: Indicate actual control panel layouts, wiring connections, and wire numbers.

C. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer. Provide manufacturer's standard warranty.

1.8 QUALIFICATIONS

A. Fabricator: Company specializing in fabrication of control panels with minimum three years documented experience.

PART 2 PRODUCTS

2.1 CONTROL PANEL SCHEDULE

A.

Description	*Drawing #*
PLC Control Panel-002	EL-08

B. Fabrication: Shop-fabricate control panels to NEMA ICS 1.

C. Panel dimensions given are the minimum required. Ensure items shown on the general layouts can be mounted within given panel dimensions.

D. Install products in accordance with manufacturer's written instructions.

E. Use minimum control wire sizes as per schematics.

F. Run wires for door mounted items in "expando" type flexible covering. Spiral type wrapping shall not be used. Ground door to enclosure using manufacturer supplied braids and hardware.

G. Run wires in wireway and exit the wireway at the point nearest to the device to which it is wired.

H. Do not splice wires within a wireway.

I. Identify each wire at each termination point using markers bearing the complete wire number in accordance with Section 16075.

J. Neatly harness wires within wireways using tyrap fasteners or approved manufactured wiring organization harnesses.

K. Route AC wiring separately from DC wiring. Make allowance for this in the manufacture of the panel.

L. Verify that the number of terminal blocks is sufficient to make the identified connections. Furnish 20 percent spare terminal blocks.

M. Any steel fasteners shall be hot dip galvanized. Under no circumstances shall interior fasteners penetrate the panel skin.

N. Install programmable controllers furnished in accordance with Section 17451.

O. Provide cabling required to connect the PLC equipment mounted in the panel and as shown on Drawings.

P. Provide service and component identification in accordance with Section 16075.

Q. Wire I/O points and other panel devices point-to-point, if applicable.

R. Wire spare I/O points to terminal blocks and be identified with I/O address, if applicable.

S. Color code wires as per notes on layouts and schematics.

T. Provide all fusing for rail mounted terminal blocks, sized as per schematics.

U. Provide all pre-manufactured programming, control, and communication cables for panel mounted equipment.

V. Provide a 120 VAC duplex outlet mounted inside all panels for local computer programming use. Label outlet "FOR COMPUTER USE ONLY."

2.2 UNINTERRUPTIBLE POWER SUPPLY

A. Supply uninterruptible power supplies for each PLC based control panel; PLC Control Panel-001 as shown on drawings, manufactured by APC (BR1500 Series) or approved equal.

B. Description: UPS shall be true on-line, reverse transfer type, UPS components, controls and backup battery shall be housed in one NEMA 1 enclosure. UPS shall be provided with monitoring means for local PLC to monitor UPS capacity in use and to indicate UPS alarm conditions.

C. UPS shall be of robust construction, suitable for industrial applications and provide clean, regulated AC power (120 V, 60 Hz) to the load.

D. UPS shall provide at least 30 minutes of backup power at full UPS nominal load. Size the UPS to meet the anticipated load demand of all control devices plus 25 percent.

2.3 ENCLOSURES

A. Control Enclosure: NEMA ICS 6 Type 4X for outdoor locations and Type 12 for indoor locations as manufactured by Hoffman or approved equal.

2.4 POWER SUPPLY

A. Provide and mount two industrially rated Power Supplies inside the Main Control Enclosure. Power Supplies shall be SDN Series, as manufactured by Sola, or approved equal. DIN Rail mount, 115 VAC nominal input voltage, 24 VDC nominal output voltage with 2.5 A nominal output current.

2.5 ETHERNET NETWORK

A. Provide and mount industrially rated managed Ethernet switch for the Main Control Enclosure. Switches shall be DRL-380 Series, as manufactured by Brad Communications, or approved equal. Full duplex, 10/100Mbps connection speed, 24 VDC power.

B. Switches shall be supplied with proper copper/fiber ports as necessary for local connections to PC, PLC, variable speed drives, and I/O modules.

C. Supply and terminate all CAT5 Ethernet cables and patch cords as required to interconnect the drives, PLC, PC, and I/O modules to Ethernet switches.

D. Program and configure all devices with IP addresses and subnet masks as supplied by ENGINEER.

2.6 SOURCE QUALITY CONTROL

A. Section 01400 – Quality Requirements.

B. Arrange for inspection of control panel at location of manufacture prior to shipment. Advise ENGINEER at least five working days in advance of inspection.

2.7 SPARE PARTS

A. Provide spare parts as follows:

1. Two fluorescent bulbs for panel lighting.

2. 25% by quantity of each fuse in panel (at least one).

3. One DC power supply.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Do not install products until major construction is complete and building interior is enclosed.

3.2 FIELD QUALITY CONTROL

A. Section 01400 – Quality Requirements: Field inspection and testing. Perform operational testing on control systems to verify proper operation and field connections.

END OF SECTION

SECTION 17451

PROGRAMMABLE CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Programmable controllers.

B. Programming software.

C. Cables and accessories.

D. Local operation terminal.

1.2 REFERENCES

A. Section 01400 – Quality Requirements: Requirements for references.

B. National Electrical Manufacturers Association (NEMA):

1. ICS 1 - General Standards for Industrial Control and Systems.

2. ICS 3 - Industrial Systems.

C. National Fire Protection Association, Inc. (NFPA): 70 - National Electrical Code.

D. Underwriters Laboratories Inc. (UL).

1.3 ALLOWANCES

A. Allowances shall be made for the number of days of commissioning or supervision required for installation, startup, and software debug at the time of bid with no additional payment for startup or commissioning.

1.4 REGULATORY REQUIREMENTS

A. Conform to NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

1.5 PROGRESS SUBMITTALS

A. Shop Drawings: Indicate electrical characteristics and connection requirements, including layout of completed assemblies, interconnecting cabling, dimensions, weights, and external power requirements.

B. Product Data: Include for each component specified showing electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. CONTRACTOR shall submit to the ENGINEER layouts of all Operator screens, alarm summaries, databases, and reports along with all PLC software for review and approval at 30% completion, 60% completion, and prior to debug and startup of the system.

1.6 CLOSEOUT SUBMITTALS

A. Section 01700 – Execution Requirements: Requirements for closeout submittals.

B. Record Documents: Indicate actual locations of controller cabinets and input and output devices connected to system; include interconnection wiring and cabling information, and terminal block layouts in controller cabinets.

C. Operation and Maintenance Data: Include bound copies of operating and programming instructions, card replacement, adjustments, and preventative maintenance procedures and materials. Provide six complete copies of the operating and maintenance instructions, including parts lists for all of the equipment. One copy to be single sided for production of additional operation and maintenance manuals. Bind material in sections in hard backed binders.

D. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.7 QUALIFICATIONS

A. Programmer: System Integrator specializing in control system programming with minimum 5 years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept products on Site in factory containers. Inspect for damage.

B. Store products in clean and dry area; maintain temperature in accordance with NEMA ICS 1.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature above 32 degrees F and below 104 degrees F during and after installation of products.

B. Maintain area free of dirt and dust during and after installation of products.

1.10 WARRANTY

A. Provide manufacturer's standard warranty.

B. Fill out original warranty forms in OWNER's name and register with manufacturer.

C. Provide one year warranty on PLC and SCADA system custom software functionality.

1.11 SYSTEM STARTUP AND COMMISSIONING

A. Software commissioning and startup shall include, but not be limited to the following:

1. Process control system verification.

2. Operator interface device verification down to final control devices.

3. Systems power fail/restart testing to verify proper operation.

4. Verification of alarms and interlocks.

5. Loop Tuning.

1.12 SOFTWARE PROGRAMMING

A. The drawings define the basic functional requirements of the control system. CONTRACTOR shall augment these functions as necessary to achieve a complete functional system. The CONTRACTOR shall provide fully operational and documented software for the PLC and SCADA Workstation. The software shall include all necessary logic, timing, filtering, deadbands, debouncing, mathematical, data handling, alarms and communication functions required to give smooth, reliable, safe control of the equipment.

B. General PLC Requirements:

1. Develop application software using Rockwell Software RSLogix 5000 programming software.

2. The overall PLC control program shall be divided into different tasks, utilizing subroutine files to segment a section of code that is particular to a specific function/device in the process.

3. For optimal system communications, all PLC data of the same type shall be assigned (mapped) to contiguous memory locations in a single data type arrays for the Panelview Plus and SCADA interface.

4. Develop Autodialer functionality logic to map alarms to the shared database as required. Configure the Autodialer for proper operation with the PLC.

C. General SCADA Interface Requirements:

1. Operator station software shall provide functionality as per drawings and 30% / 60%/ 90% review comments. This includes, but is not limited to the following:

a. Graphical viewing and control of processes.

b. Manual override where indicated and/or appropriate.

c. Historical and dynamic trending.

d. Alarm reporting and management.

e. Report generation.

f. Definition and construction of dynamic color graphic displays.

2. Provide a graphic user interface such that users shall be able to start and stop equipment or change setpoints from graphic displays through the use of a mouse and "point and click" operation.

3. Develop the SCADA application using Allen-Bradley RSView Studio software.

4. Design an efficient operator interface by making the following screen considerations: function key layout, alarm status line, time and date field, screen title, and menu selections.

D. SCADA Collection and Analysis of Historical Data:

1. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or changes of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting.

2. Trend graphic displays shall be provided to allow the user to view all trended point data. Displays shall be actual plots of both static and/or real-time dynamic point data and may be customized to include individual points or predefined groups of at least four points. Provide additional functionality/configuration to allow any trended data to be transferred easily to Microsoft Excel. This shall allow the user to perform custom calculations such as energy usage, equipment efficiency chemical costs, and shall allow for generation of these reports on high quality plots, graphs, and charts.

3. CONTRACTOR shall, collectively with ENGINEER, determine the interval at which all trended data shall be stored on the SCADA computer hard drive.

E. SCADA Dynamic Color Graphic Displays:

1. Provide a complete set of color graphic displays based on flow sheets. All points on Attachment 1 - PLC I/O List and associated variables and parameters shall be dynamically displayed. However, no graphic display shall contain an excessive quantity of information so as to create unnecessary confusion for the operator. CONTRACTOR shall allow in his work a block of time for cooperatively defining OWNER's specific preferences for graphic display layout and organization.

2. Color conventions for graphic displays, pushbutton function, and device state or operating conditions shall be provided.

3. Provide an operator interface with a consistent look and feel. All displays should adhere to a common screen format and generally be organized in a consistent screen hierarchy that follows the flow of the process.

4. Provide an operator interface that allows users to access the various system schematics by graphical penetration or menu selection scheme. The graphical penetration scheme shall present a schematic overview as the top-level screen, then process unit schematics, then individual point, equipment, or control parameter details. A consistent screen navigation methodology shall be applied.

5. Dynamic values and equipment status shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention.

6. Graphic development software shall be provided to allow the user to add, modify, or delete system graphic displays.

1.13 SPARES

A. Provide one of each type of PLC I/O module and power supply for spares inventory.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Allen-Bradley. No other acceptable manufacturers.

2.2 PROGRAMMABLE CONTROLLERS

A. Controller Requirements: The PLCs shall be Allen-Bradley CompactLogix with 1769 Series I/O as per control panel drawings and schematics. The PLC equipment is to be supplied and installed in control panels as shown on Drawings.

B. Appropriate terminal block housings and wiring harnesses is to be supplied with I/O cards and modules as appropriate for the type of card as per manufacturer's instructions.

C. Input/Output Schedule: Specific points are indicated on the Drawings and summarized in Attachment 1, PLC I/O List, appended to this Section.

D. System Configuration:

1. General Configuration: Main Control Panel:

Allen-Bradley Cat. No.	*Description*	*Quantity*
1769-L32E	CompactLogix Processor	1
1769-PA4	Power Supply	as required
1784-CF64	Compact Flash Memory	1
1769-IF8	4-20 mA, 8 pt. analog input	as required
1769-OF4CI	4-20 mA, 4 pt. analog output	as required
1769-IQ16	24 VDC, 16 point input	as required
1769-OW8I	Relay Contact, 8 point output	as required
Assorted	Cables, Interface Modules, Endcaps	as required

2.3 PROGRAMMING ACCESSORIES

A. PLC Programming Software: Provide RSLogix 5000, RSLinx Classic programming licenses.

B. SCADA Programming Software: Provide RSView Studio Screen Development and RSView Machine Edition Runtime Software, and RSLinx Enterprise licenses.

C. Provide all pre-manufactured programming, control, and communication cables for interconnecting all panel-mounted, field, and SCADA equipment.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Do not install products until major construction is complete and building interior is enclosed.

C. Connect input and output devices in accordance with Section 17431.

3.2 FIELD QUALITY CONTROL

A. Section 01400 – Quality Requirements: Field inspection and testing. Perform operational testing on control systems to verify proper operation and field wiring connections.

3.3 ADJUSTING

A. Section 01700 - Execution Requirements: Requirements for adjusting installed work.

A. Adjust process setpoints, alarm setpoints, timers, and durations as directed by ENGINEER.

B. Tune all control loops as directed by ENGINEER.

3.4 DEMONSTRATION

A. Section 01800 – Facility Operation: Requirements for demonstrating installed work.

B. Requirements for demonstrating installed work.

C. Demonstrate the operation and programming of PLC controllers, including Ethernet communications. A PLC and SCADA software functionality testing and signoff sheet shall be developed by the CONTRACTOR, subject to approval by the ENGINEER. All aspects of system operation, display, communications, and SCADA operation shall be demonstrated in the presence of the ENGINEER in accordance with the testing and signoff sheet. Any modifications made to the system software due to insufficient testing and demonstration may nullify any previous system tests at the discretion of the ENGINEER.

D. Provide 16 hours of instruction each for 2 persons, to be conducted at Site with programmer.

END OF SECTION

ATTACHMENT 1 - PLC I/O LIST

CARD/POINT	TAG NUMBER	DESCRIPTION	CALIBRATED RANGE	PART NUMBER	INFORMATION
CONTROL PANEL IP-001; CompactLogix					
		Power Supply		**1769-PA4**	**(4.0A @ 5V dc / 2.0A @ 24V dc); Input voltage: 124/240V ac**
		Right End Cap		**1769-ECR**	**(5mA @ 5V dc / 0A @ 24V dc)**
Slot 0 Controller		**Processor / Communication**		**1769-L32E**	**(90mA @ 24V dc; 4.74 W @ 24V dc); 1 Ethernet 10/100 Mbps**
		Compact Flash Card		**1784-CF64**	**(Nonvolatile Memory)**
		Interface Module w/ Cable		**IFM: 1492-AIFM8-3**	**CABLE: 1492-ACAB005ED69 (1.64ft)**
Slot 1		**Analog Inputs (8 pt)**		**1769-IF8**	**(120mA @ 5V dc / 70mA @ 24V dc)**
Local:1:I.Ch0Data	LIT-200	Discharge Supply Tank Level	0-100 % Filled		
Local:1:I.Ch1Data	FIT-200	Discharge Supply Tank Effluent Water Flow	0-2000 gpm		
Local:1:I.Ch2Data		SPARE			
Local:1:I.Ch3Data		SPARE			
Local:1:I.Ch4Data		SPARE			
Local:1:I.Ch5Data		SPARE			
Local:1:I.Ch6Data		SPARE			
Local:1:I.Ch7Data		SPARE			
		Interface Module w/ Cable		**IFM: 1492-AIFM4-3**	**CABLE: 1492-ACAB005BD69 (1.64ft)**
Slot 2		**Analog Outputs (4 pt Isolated Current)**		**1769-OF4CI**	**(145mA @ 5V dc / 140mA @ 24V dc)**
Local:2:O.Ch0Data		SPARE			
Local:2:O.Ch1Data		SPARE			
Local:2:O.Ch2Data		SPARE			
Local:2:O.Ch3Data		SPARE			

ATTACHMENT 1 - PLC I/O LIST

CARD/POINT	TAG NUMBER	DESCRIPTION	CALIBRATED RANGE	PART NUMBER	INFORMATION
		Interface Module w/ Cable		**IFM: 1492-IFM20F-F24A-2**	**CABLE: 1492-CAB010B69 (3.28ft)**
Slot 3		**Digital Inputs (16 pt Current Sinking/Sourcing 24 Vdc)**		**1769-IQ16**	**(115mA @ 5V dc / 0mA @ 24V dc)**
Local:3:I.Data.0	ZSL-100	Air Stripper Valve Closed	Normally Open		
Local:3:I.Data.1	ZSH-100	Air Stripper Valve Opened	Normally Open		
Local:3:I.Data.2	ZSL-101	Air Stripper Bypass Valve Closed	Normally Open		
Local:3:I.Data.3	ZSH-101	Air Stripper Bypass Valve Opened	Normally Open		
Local:3:I.Data.4	YS-100	Air Stripper Blower Running	Normally Open		
Local:3:I.Data.5	PDSH-100	Air Stripper Pressure Differential High	Normally Closed		
Local:3:I.Data.6	LSHH-100	Air Stripper Level High High	Normally Closed		
Local:3:I.Data.7	LSC-101	Building Sump Pump Level Control Switch	Normally Open		
Local:3:I.Data.8	YS-101	Building Sump Pump Running	Normally Open		
Local:3:I.Data.9	LSHH-101	Building Sump Level High High	Normally Closed		
Local:3:I.Data.10	LSHH-201	Discharge Supply Tank Level High High	Normally Closed		
Local:3:I.Data.11	FIQ-200	Discharge Supply Tank Effluent Water Flow Totalizing Pulse	N.O.; 1 pulse per 500 gallons		
Local:3:I.Data.12	UA-112	PLC Control Panel-002 Power Status	Normally Closed		
Local:3:I.Data.13		SPARE			
Local:3:I.Data.14		SPARE			
Local:3:I.Data.15		SPARE			

		Interface Module w/ Cable		**IFM: 1492-IFM20F-F24A-2**	**CABLE: 1492-CAB010B69 (3.28ft)**
Slot 4		**Digital Inputs (16 pt Current Sinking/Sourcing 24 Vdc)**		**1769-IQ16**	**(115mA @ 5V dc / 0mA @ 24V dc)**
Local:4:I.Data.0		SPARE			
Local:4:I.Data.1		SPARE			
Local:4:I.Data.2		SPARE			
Local:4:I.Data.3		SPARE			
Local:4:I.Data.4		SPARE			
Local:4:I.Data.5		SPARE			
Local:4:I.Data.6		SPARE			
Local:4:I.Data.7		SPARE			
Local:4:I.Data.8		SPARE			
Local:4:I.Data.9		SPARE			
Local:4:I.Data.10		SPARE			
Local:4:I.Data.11		SPARE			
Local:4:I.Data.12		SPARE			
Local:4:I.Data.13		SPARE			
Local:4:I.Data.14		SPARE			
Local:4:I.Data.15		SPARE			

ATTACHMENT 1 - PLC I/O LIST

CARD/POINT	TAG NUMBER	DESCRIPTION	CALIBRATED RANGE	PART NUMBER	INFORMATION
		Interface Module w/ Cable		**IFM: 1492-IFM20F-FS120-2**	**CABLE: 1492-CAB005D69 (1.64ft)**
Slot 5		**Digital Outputs (8 pt Isolated AC/DC Relay Output)**		**1769-OW8I**	**(125mA @ 5V dc / 100mA @ 24V dc)**
Local:5:O.Data.0	YV-100	Open Air Stripper Valve	Normally Open		
Local:5:O.Data.1	YV-101	Open Air Stripper Bypass Valve	Normally Open		
Local:5:O.Data.2	YC-100	Start Air Stripper Blower	Normally Open		
Local:5:O.Data.3	YC-101	Start Building Sump Pump	Normally Open		
Local:5:O.Data.4		SPARE			
Local:5:O.Data.5		SPARE			
Local:5:O.Data.6		SPARE			
Local:5:O.Data.7	UAC-201	Interlock-1 Signal Remote Transceiver	Normally Closed		

		Interface Module w/ Cable		**IFM: 1492-IFM20F-FS120-2**	**CABLE: 1492-CAB005D69 (1.64ft)**
Slot 6		**Digital Outputs (8 pt Isolated AC/DC Relay Output)**		**1769-OW8I**	**(125mA @ 5V dc / 100mA @ 24V dc)**
Local:6:O.Data.0		SPARE			
Local:6:O.Data.1		SPARE			
Local:6:O.Data.2		SPARE			
Local:6:O.Data.3		SPARE			
Local:6:O.Data.4		SPARE			
Local:6:O.Data.5		SPARE			
Local:6:O.Data.6		SPARE			
Local:6:O.Data.7		SPARE			