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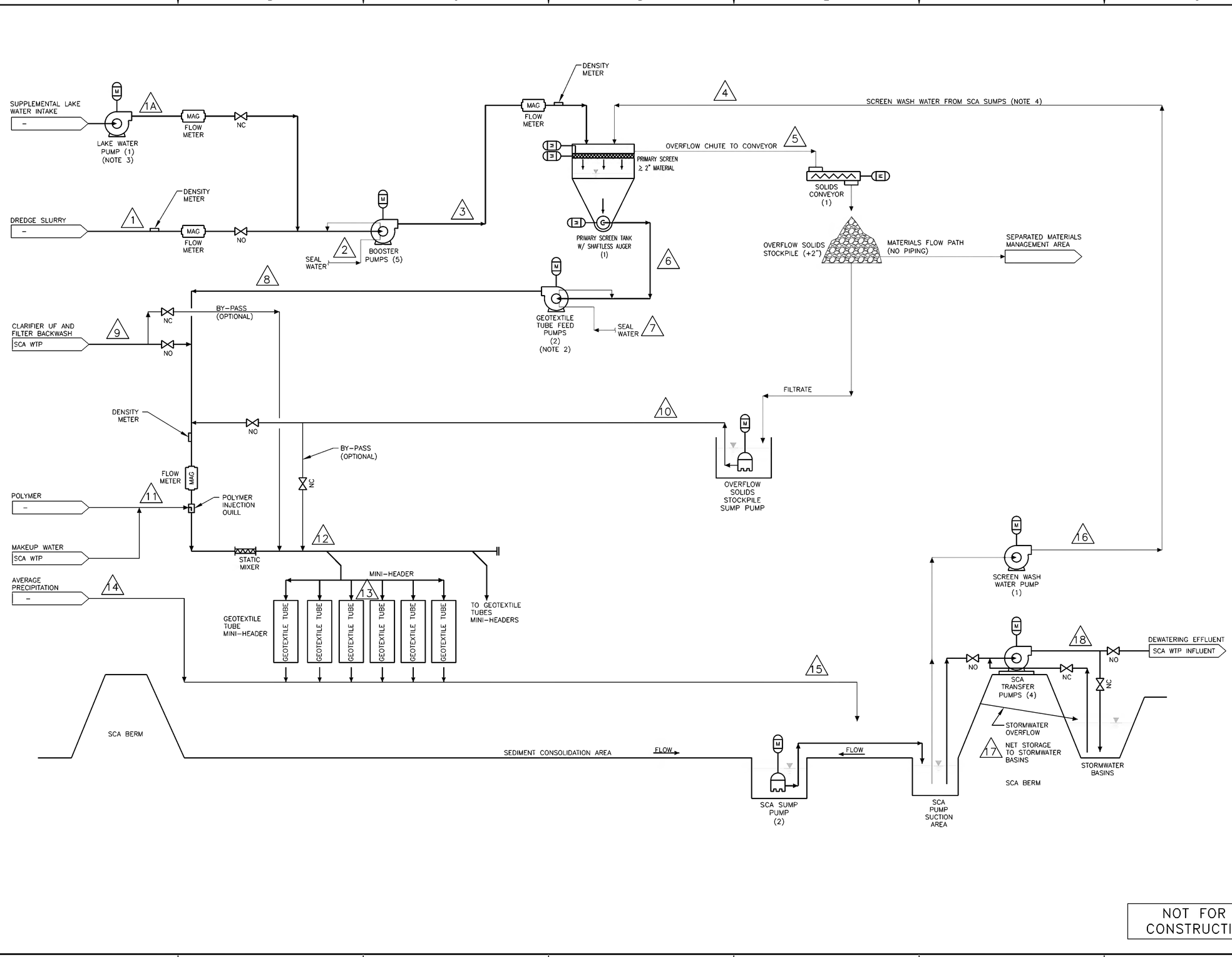

NOT FOR CONSTRUCTION

NOTES:

1. SEE DRAWING 444853-200-D-002 FOR MASS BALANCE PROCESS FLOW DIAGRAM TABLES.
2. TWO PUMPS INSTALLED, ONE DUTY AND ONE BACKUP.
3. LAKE WATER PUMP IS ONLY USED TO CLEAR SLURRY PIPELINE IF/WHEN DREDGE PUMP IS INOPERABLE.
4. ALTERNATE SOURCE OF WATER FOR SCREEN RINSING WILL BE UTILIZED IF/WHEN THE REQUIRED FLOW IS NOT AVAILABLE FROM THE SCA SUMPS (E.G. STARTUP). WATER SOURCE TO BE FINALIZED AS PART OF FINAL DESIGN.

LEGEND:

9 INDICATES MASS BALANCE STREAM NUMBER

NO.	DESCRIPTION	DATE	DRAWN	CHK'D	APPV'D
B	ISSUED FOR INTERMEDIATE DESIGN	2/24/10	JTS	XH	TCD
A	ISSUED FOR CLIENT REVIEW	1/20/10	JTS	XH	TCD

DRAWN BY: JTS — DATE: 10/22/09
CHECKED BY — DATE
APPROVED BY — DATE
PROJECT MGR. — DATE
SEAL

PARSONS
COMMERCIAL TECHNOLOGY GROUP

OFFICE: 301 PLAINFIELD ROAD, SYRACUSE, NY 13212, (315) 451-9560
JOB: 444853
WBS: 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
MASS BALANCE
PROCESS FLOW DIAGRAM
PHASE 1

SCALE: NO SCALE

DRAWING NO. 444853-200-D-001 — REV. B

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\PFD\444853-200-D-001.DWG
PLOT DATE: 2/19/2010 4:33 PM PLOTTED BY: SAVALIA, JACK

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MASS BALANCE TABLE - PHASE 1 MAXIMUM FLOW SCENARIO 5,000 GPM

STREAM NUMBER	1	1A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DESCRIPTION	DREDGE SLURRY	SUPPLEMENTAL LAKE WATER INTAKE	BOOSTER PUMPS SEAL WATER		PRIMARY SCREEN WASH WATER FROM SCA SUMPS	OVER-SIZED REMOVED FROM PRIMARY SCREEN		GEOTEXTILE TUBE FEED PUMPS SEAL WATER		CLARIFIER UNDERFLOW AND FILTER BACKWASH FROM SCA WTP	FILTRATE FROM SCREENED MATERIAL STOCKPILE	POLYMER AND MAKEUP WATER FROM SCA WTP		GEOTEXTILE TUBE RETENTION	AVERAGE PRECIPITATION		PRIMARY SCREEN WASH WATER	NET FLOW TO STORMWATER BASIN	DEWATERING EFFLUENT TO SCA WTP INFLUENT
TOTAL (GPM)	5,000	0	250	5,250	102	(0.7)	5,351	15	5,366	1,065.9	0.1	175.0	6,607	(742.6)	141	6,006	(102)	(150)	5,754
WATER (GPM)	4,792	0	250	5,042	102	(0.3)	5,144	15	5,159	1,065.0	0.1	174.5	6,398	(534.0)	141	6,006	(102)	(150)	5,753
SOLIDS (GPM) (NOTE 2)	208.0	0.0	0.0	208.0	0.0	(0.4)	207.6	0.0	207.6	0.9	0.00001	0.5	209.0	(208.5)	0.0	0.4	0.0	(0.01)	0.4
SOLIDS (LBS/MIN) (NOTE 2)	4,443.5	0.0	0.0	4,443.5	0.0	(8.9)	4,434.6	0.0	4,434.6	19.3	0.0002	2.9	4,456.8	(4,447.4)	0.0	9.4	0.0	(0.2)	9.2

NOTES:

1. STREAM NUMBER WITHOUT DESCRIPTION INDICATES THE TOTAL FLOW AT THAT POINT.
2. THEORETICAL DRY WEIGHT BASIS.
3. NUMBERS WITHIN PARENTHESIS REPRESENT DIVERTED FLOWS.

MASS BALANCE TABLE - PHASE 1 AVERAGE FLOW SCENARIO 3,500 GPM

STREAM NUMBER	1	1A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DESCRIPTION	DREDGE SLURRY	SUPPLEMENTAL LAKE WATER INTAKE	BOOSTER PUMPS SEAL WATER		PRIMARY SCREEN WASH WATER FROM SCA SUMPS	OVER-SIZED REMOVED FROM PRIMARY SCREEN		GEOTEXTILE TUBE FEED PUMPS SEAL WATER		CLARIFIER UNDERFLOW AND FILTER BACKWASH FROM SCA WTP	FILTRATE FROM SCREENED MATERIAL STOCKPILE	POLYMER AND MAKEUP WATER FORM SCA WTP		GEOTEXTILE TUBE RETENTION	AVERAGE PRECIPITATION		PRIMARY SCREEN WASH WATER	NET FLOW TO STORMWATER BASIN	DEWATERING EFFLUENT TO SCA WTP INFLUENT
TOTAL (GPM)	3,500	0	175	3,675	71	(0.5)	3,746	11	3,756	1,065.9	0.1	122.8	4,945	(520.7)	141	4,566	(71)	0	4,494
WATER (GPM)	3,354	0	175	3,529	71	(0.2)	3,601	11	3,611	1,065.0	0.1	122.4	4,799	(374.5)	141	4,566	(71)	0	4,494
SOLIDS (GPM) (NOTE 2)	145.6	0.0	0.0	145.6	0.0	(0.3)	145.3	0.0	145.3	0.9	0.00001	0.3	146.6	(146.2)	0.0	0.3	0.0	0.0	0.3
SOLIDS (LBS/MIN) (NOTE 2)	3,110.4	0.0	0.0	3,110.4	0.0	(6.2)	3,104.2	0.0	3,104.2	19.3	0.0001	2.0	3,125.6	(3,118.5)	0.0	7.1	0.0	0.0	7.1

NOTES:

1. STREAM NUMBER WITHOUT DESCRIPTION INDICATES THE TOTAL FLOW AT THAT POINT.
2. THEORETICAL DRY WEIGHT BASIS.
3. NUMBERS WITHIN PARENTHESIS REPRESENT DIVERTED FLOWS.

NOT FOR CONSTRUCTION

NOTES:

1. SEE DRAWING 444853-200-D-001 FOR MASS BALANCE PROCESS FLOW DIAGRAM.

LEGEND:

9 INDICATES MASS BALANCE STREAM NUMBER

NO.	DESCRIPTION	DATE	DRAWN	CHK'D	APP'D
B	ISSUED FOR INTERMEDIATE DESIGN	2/24/10	JTS	XH	TCD
A	ISSUED FOR CLIENT REVIEW	1/20/10	JTS	XH	TCD

DRAWN BY JTS DATE 10/22/09
CHECKED BY DATE
APPROVED BY DATE
PROJECT MGR. DATE
SEAL

PARSONS
COMMERCIAL TECHNOLOGY GROUP

OFFICE
301 PLAINFIELD ROAD
SYRACUSE, NY 13212
(315) 451-9560

JOB 444853
WBS 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
MASS BALANCE
PROCESS FLOW DIAGRAM
PHASE 1 TABLES

SCALE NO SCALE

DRAWING NO. 444853-200-D-002 REV. B

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\PFD\444853-200-D-002.DWG
PLOT DATE: 2/22/2010 9:21 AM PLOTTED BY: SAVALIA, JACK

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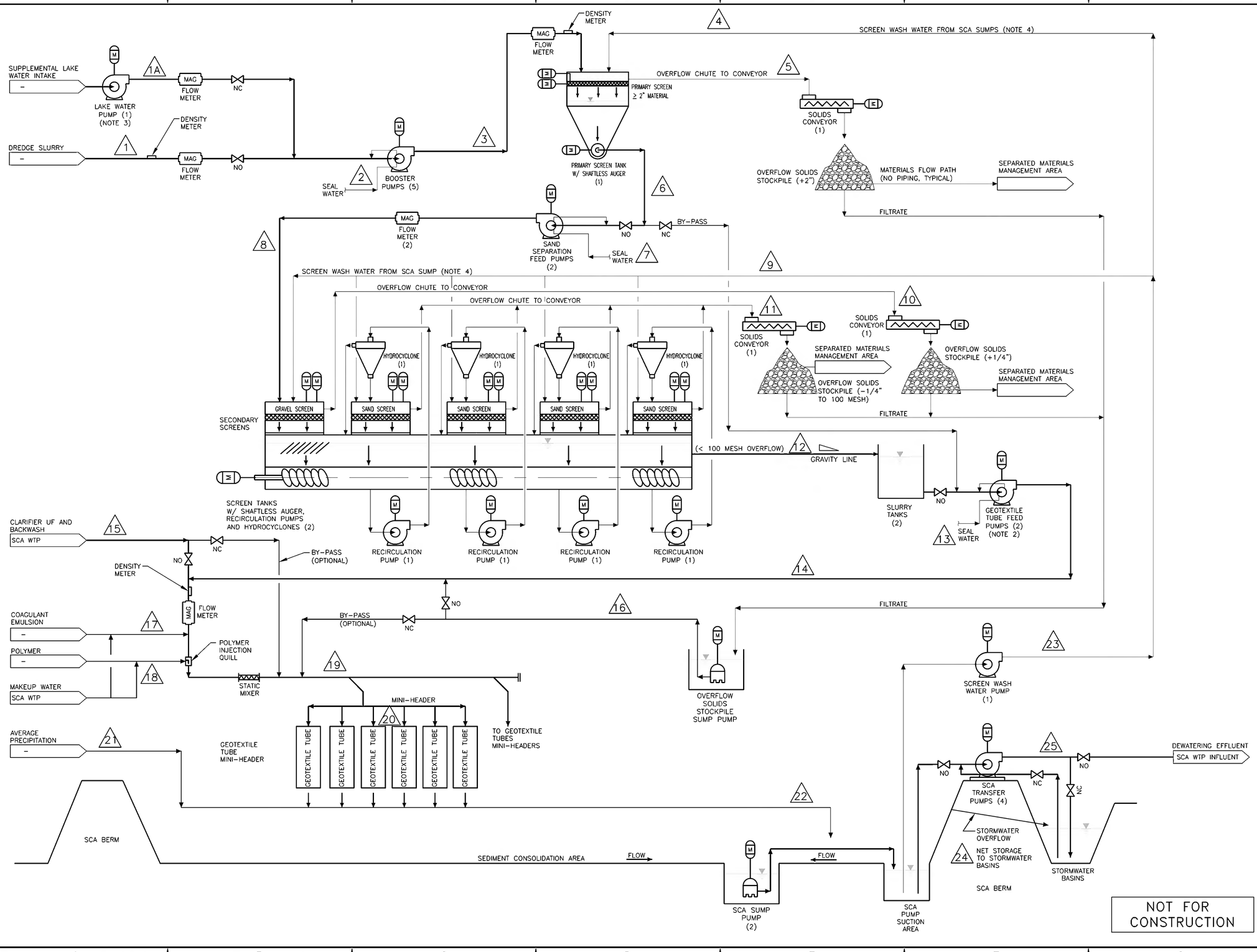

NOT FOR CONSTRUCTION

NOTES:

1. SEE DRAWING 444853-200-D-004 FOR MASS BALANCE PROCESS FLOW DIAGRAM TABLES.
2. TWO PUMPS INSTALLED, ONE DUTY AND ONE BACKUP.
3. LAKE WATER PUMP IS ONLY USED TO CLEAR SLURRY PIPELINE IF/WHEN DREDGE PUMP IS INOPERABLE.
4. ALTERNATE SOURCE OF WATER FOR SCREEN RINSING WILL BE UTILIZED IF/WHEN THE REQUIRED FLOW IS NOT AVAILABLE FROM THE SCA SUMPS (E.G. STARTUP). WATER SOURCE TO BE FINALIZED AS PART OF FINAL DESIGN.

LEGEND:

9 INDICATES MASS BALANCE STREAM NUMBER

NO.	DESCRIPTION	DATE	DRAWN	CHK'D	APPV'D
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A	ISSUED FOR CLIENT REVIEW	1/20/10	JTS	XH	TCD

DRAWN BY JTS DATE 10/22/09
CHECKED BY DATE
APPROVED BY DATE
PROJECT MGR. DATE
SEAL

PARSONS
COMMERCIAL TECHNOLOGY GROUP

OFFICE
301 PLAINFIELD ROAD
SYRACUSE, NY 13212
(315) 451-9560

JOB 444853
WBS 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
MASS BALANCE
PROCESS FLOW DIAGRAM
PHASE 2

SCALE NO SCALE

DRAWING NO. 444853-200-D-003
REV. B

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\PFD\444853-200-D-003.DWG
PLOT DATE: 2/19/2010 4:32 PM PLOTTED BY: SAVALA, JACK

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MASS BALANCE TABLE - PHASE 2 MAXIMUM FLOW SCENARIO 5,000 GPM

STREAM NUMBER	1	1A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
DESCRIPTION	DREDGE SLURRY	SUPPLEMENTAL LAKE WATER INTAKE	BOOSTER PUMPS SEAL WATER		PRIMARY SCREEN WASH WATER FROM SCA SUMPS	OVER-SIZED REMOVED FROM PRIMARY SCREEN		SAND SEPARATION FEED PUMPS SEAL WATER		SECONDARY SCREEN AND HYDROCYCLONE SCREEN WASH WATER	GRAVEL REMOVED FROM SECONDARY SCREEN	SAND REMOVED FROM HYDROCYCLONE		GEOTEXTILE TUBE FEED PUMPS SEAL WATER		CLARIFIER UNDERFLOW AND FILTER BACKWASH FROM SCA WTP	FILTRATE FROM SCREENED MATERIAL STOCKPILE	COAGULANT EMULSION AND MAKEUP WATER FROM SCA WTP	POLYMER AND MAKEUP WATER FROM SCA WTP		GEOTEXTILE TUBE RETENTION	AVERAGE PRECIPITATION		PRIMARY, SECONDARY AND HYDROCYCLONE SCREEN WASH WATER	NET FLOW TO STORMWATER BASIN	DEWATERING EFFLUENT TO SCA WTP INFLUENT
TOTAL (GPM)	5,000	0	250	5,250	102	(5.4)	5,347	30	5,377	510	(48.3)	(137.4)	5,701	15	5,716	1,065.9	30.4	66.8	92.3	6,971	(320.6)	141	6,792	(612)	(442.7)	5,737
WATER (GPM)	4,798	0	250	5,048	102	(2.1)	5,148	30	5,178	510	(19.2)	(54.6)	5,614	15	5,629	1,065.0	30.4	66.1	92.0	6,883	(232.4)	141	6,792	(612)	(442.6)	5,737
SOLIDS (GPM) (NOTE 2)	201.9	0.0	0.0	201.9	0.0	(3.2)	198.7	0.0	198.7	0.0	(29.1)	(82.8)	86.8	0.0	86.8	0.9	0.002	0.6	0.3	88.6	(88.2)	0.0	0.4	0.0	(0.03)	0.4
SOLIDS (LBS/MIN) (NOTE 2)	4,449.1	0.0	0.0	4,449.1	0.0	(71.2)	4,377.9	0.0	4,377.9	0.0	(640.7)	(1,824.1)	1,913.1	0.0	1,913.1	19.3	0.05	5.5	1.5	1,939.5	(1,929.7)	0.0	9.8	0.0	(0.6)	9.2

NOTES:

1. STREAM NUMBER WITHOUT DESCRIPTION INDICATES THE TOTAL FLOW AT THAT POINT.
2. THEORETICAL DRY WEIGHT BASIS.
3. NUMBERS WITHIN PARENTHESIS REPRESENT DIVERTED FLOWS.

MASS BALANCE TABLE - PHASE 2 AVERAGE FLOW SCENARIO 3,500 GPM

STREAM NUMBER	1	1A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
DESCRIPTION	DREDGE SLURRY	SUPPLEMENTAL LAKE WATER INTAKE	BOOSTER PUMPS SEAL WATER		PRIMARY SCREEN WASH WATER	OVER-SIZED REMOVED FROM PRIMARY SCREEN		SAND SEPARATION FEED PUMPS SEAL WATER		SECONDARY SCREEN AND HYDROCYCLONE SCREEN WASH WATER	GRAVEL REMOVED FROM SECONDARY SCREEN	SAND REMOVED FROM HYDROCYCLONE		GEOTEXTILE TUBE FEED PUMPS SEAL WATER		CLARIFIER UNDERFLOW AND FILTER BACKWASH FROM SCA WTP	FILTRATE FROM SCREENED MATERIAL STOCKPILE	COAGULANT EMULSION AND MAKEUP WATER FROM SCA WTP	POLYMER AND MAKEUP WATER FROM SCA WTP		GEOTEXTILE TUBE RETENTION	AVERAGE PRECIPITATION		PRIMARY, SECONDARY AND HYDROCYCLONE SCREEN WASH WATER	NET FLOW TO STORMWATER BASIN	DEWATERING EFFLUENT TO SCA WTP INFLUENT
TOTAL (GPM)	3,500	0	175	3,675	71	(3.8)	3,743	21	3,764	357	(33.8)	(96.2)	3,991	11	4,001	1,065.9	21.3	46.9	64.9	5,200	(225.3)	141	5,116	(428)	0	4,688
WATER (GPM)	3,359	0	175	3,534	71	(1.5)	3,604	21	3,625	357	(13.4)	(38.3)	3,930	11	3,940	1,065.0	21.3	46.5	64.7	5,138	(163.4)	141	5,116	(428)	0	4,687
SOLIDS (GPM) (NOTE 2)	141.4	0.0	0.0	141.4	0.0	(2.3)	139.1	0.0	139.1	0.0	(20.4)	(58.0)	60.8	0.0	60.8	0.9	0.002	0.5	0.2	62.3	(62.0)	0.0	0.3	0.0	0.0	0.3
SOLIDS (LBS/MIN) (NOTE 2)	3,114.4	0.0	0.0	3,114.4	0.0	(49.8)	3,064.5	0.0	3,064.5	0.0	(448.5)	(1,276.9)	1,339.2	0.0	1,339.2	19.3	0.03	3.9	1.1	1,363.5	(1,356.1)	0.0	7.4	0.0	0.0	7.4

NOTES:

1. STREAM NUMBER WITHOUT DESCRIPTION INDICATES THE TOTAL FLOW AT THAT POINT.
2. THEORETICAL DRY WEIGHT BASIS.
3. NUMBERS WITHIN PARENTHESIS REPRESENT DIVERTED FLOWS.

NOT FOR CONSTRUCTION

NOTES:

1. SEE DRAWING 444853-200-D-003 FOR MASS BALANCE PROCESS FLOW DIAGRAM.

LEGEND:

9 INDICATES MASS BALANCE STREAM NUMBER

NO.	DESCRIPTION	DATE	DRAWN	CHK'D	APPV'D
B	ISSUED FOR INTERMEDIATE DESIGN	2/24/10	JTS	XH	TCD
A	ISSUED FOR CLIENT REVIEW	1/20/10	JTS	XH	TCD

DRAWN BY JTS DATE 10/22/09
CHECKED BY DATE –
APPROVED BY DATE –
PROJECT MGR. DATE –
SEAL

PARSONS
COMMERCIAL TECHNOLOGY GROUP

OFFICE
301 PLAINFIELD ROAD
SYRACUSE, NY 13212
(315) 451-9560

JOB 444853
WBS 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
MASS BALANCE
PROCESS FLOW DIAGRAM
PHASE 2 TABLES

SCALE NO SCALE

DRAWING NO. 444853-200-D-004 REV. B

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GENERAL INSTRUMENT SYMBOLS

SINGLE FUNCTION | MULTIPLE FUNCTION

- FIELD MOUNTED INSTRUMENT OR DEVICE
- FRONT OF PANEL-MOUNTED INSTRUMENT ON LOCAL PANEL
- FRONT OF PANEL-MOUNTED INSTRUMENT ON MAIN PANEL
- REAR OF PANEL-MOUNTED INSTRUMENT ON LOCAL PANEL
- REAR OF PANEL-MOUNTED INSTRUMENT ON MAIN PANEL
- SOFTWARE-GENERATED ANALOG FUNCTION (OPERATOR ACCESSIBLE)
- SOFTWARE-GENERATED ANALOG FUNCTION (NOT OPERATOR ACCESSIBLE)
- SOFTWARE-GENERATED DIGITAL FUNCTION (OPERATOR ACCESSIBLE)
- SOFTWARE GENERATED DIGITAL FUNCTION (NOT OPERATOR ACCESSIBLE)
- PLC INPUT/OUTPUT, LOCATED IN LOCAL CONTROL PANEL (CP-1)

FIRST LETTER(S)
SUCCEEDING LETTERS
CODES AND ABBREVIATIONS
XX
XXX
XXX
ITEM DESIGNATOR USED WHEN THERE ARE IDENTICAL COMPONENTS WITH THE SAME P&ID SHEET & LOOP NUMBER
LOOP NUMBER PER P&ID SHEET
P&ID SHEET IDENTIFIER

- I — HARDWIRED INTERLOCK
- P — PURGE SYSTEM, SEE SPECIFICATIONS

FUNCTION IDENTIFICATION LETTERS

LETTER	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		PROGRAMMER		
C	CONDUCTIVITY (ELECTRICAL)			CONTROL	
D	DENSITY (MASS) OR SPECIFIC GRAVITY	DIFFERENTIAL			
E	VOLTAGE (EMF)		PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			FILTER
G	GAUGE		GLASS (VIEWING)		
H	HAND				HIGH (OPEN)
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW (CLOSED)
M	MOTOR				MIDDLE OR INTERMEDIATE
N					
O	OPERATION	OFFSET	ORIFICE (RESTRICTION)		
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY, EVENT	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD, PRINT		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION (MECHANICAL ANALYSIS)			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE, TORQUE		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	

PROCESS SYMBOLS

VALVES

- 3-WAY VALVE
- 4-WAY VALVE
- AIR RELIEF VALVE
- ANGLE VALVE (HAND OPERATED)
- BACK FLOW PREVENTER
- BACK PRESSURE REGULATING VALVE (SELF CONTAINED)
- BALL VALVE
- BUTTERFLY VALVE
- CHECK VALVE (ARROW FLOW DIRECTION)
- CONTROL VALVE
- DIAPHRAGM VALVE
- FLOAT CONTROL VALVE
- GATE VALVE
- GLOBE VALVE
- KNIFE GATE VALVE
- NEEDLE VALVE
- PLUG VALVE
- PNEUMATIC ACTUATED BALL VALVE
- PNEUMATIC DIAPHRAGM CONTROL VALVE
- PRESSURE REGULATING VALVE (SELF CONTAINED)
- QUICK OPENING VALVE
- RELIEF VALVE (PRESSURE OR VACUUM)
- SOLENOID CONTROL VALVE
- SOLENOID CONTROL VALVE (3- WAY)
- THERMOSTATIC AIR VENT VALVE

GATES

- SLIDE OR BLAST GATE
- SLUICE GATE
- STOP GATE
- WEIR GATE
- WEIR

PUMPS

- POSITIVE CENTRIFUGAL PUMP OR BLOWER
- POSITIVE DISPLACEMENT PUMP OR BLOWER
- AIR ACTUATED DIAPHRAGM PUMP
- CHEMICAL PUMP
- GEAR PUMP
- SCREW PUMP
- SUBMERSIBLE PUMP

MIXERS AND MOTORS

- MIXER/AGITATOR
- PROPELLER AERATOR
- MOTOR

FLOW AND LEVEL ELEMENTS

- FLOW METER
- ORIFICE METER
- ROTOMETER
- SIGHT GLASS
- MAGNETIC FLOW METER
- TURBIDITY METER
- VENTURI TUBE
- VORTEX FLOW METER
- ALARM BEACON (LIGHT)
- ALARM HORN
- VARIABLE FREQUENCY DRIVE

MISCELLANEOUS MECHANICAL ITEMS

- CALIBRATION CHAMBER
- CAMLOC FITTING (HOSE CONNECTION)
- CHEMICAL DIAPHRAGM SEAL
- DIAPHRAGM CHECK VALVE (FLOW DIRECTION SHOWN)
- BASKET FILTER
- END CAP
- RUPTURE DISC (PRESSURE, VACUUM)
- REDUCER (RDCR) (CONCENTRIC, ECCENTRIC)
- DESCRIP VLV# — DRAIN or SAMPLE (D= DRAIN) (S= SAMPLE)
- FLAME ARRESTOR
- PULSATION DAMPENER
- SAMPLE TAP (LOCAL, REMOTE)
- PLUGGED
- UNION
- "Y" TYPE STRAINER (FLOW DIRECTION SHOWN)

NOT FOR CONSTRUCTION

ABBREVIATIONS AND CODES

*	SUPPLIED WITH ELECTRICAL OR MECHANICAL EQUIPMENT
A/M	AUTO/MANUAL
C/L	COMPUTER/LOCAL
D/S	DUTY/STANDBY
E/S	EMERGENCY/STOP
F/S	FAST/SLOW
FOR	FORWARD/OFF/REVERSE
FOS	FAST/OFF/SLOW
FSOA	FAST/SLOW/OFF/AUTO
HOA	HAND/OFF/AUTO
HOR	HAND/OFF/REMOTE
LAR	LOWER/AUTO/RAISE
L/LLO	LEAD/LAG LOCK OUT
SL/R	STOP LOWER/RAISE
MOA	MANUAL/OFF/AUTO
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OAC	OPEN/AUTO/CLOSE
O/C	OPEN/CLOSE
O/O	ON/OFF
OOA	ON/OFF/AUTO
OOR	ON/OFF/REMOTE
ORC	OPEN/REMOTE/CLOSE
PB	PUSH BUTTON
SD	SHUTDOWN
SEL	SELECTOR
S/F	SLOWER/FASTER
S/S	START/STOP
SCA	SEDIMENT CONSOLIDATION AREA

LINE CODES

- PROCESS OR MECHANICAL LINE
- MINOR PROCESS LINE OR MECHANICAL
- CONNECTION SIGNAL LINE (ELECTRICAL, DIGITAL OR ANALOG)
- NO ELECTRICAL CONNECTION
- ELECTRICAL CONNECTIONS (INDICATED BY DOTS)
- HEAT TRACED
- TELEPHONE LINE
- SOFTWARE OR DATA
- PNEUMATIC LINE
- HYDRAULIC LINE
- CAPILLARY
- DATA HIGHWAY COMMUNICATIONS
- LINK FLEXIBLE TUBING
- FLEXIBLE HOSE
- FLOW DIRECTION
- PIPE INSULATION
- TO/FROM XXXX — PROCESS LINE OR ELECTRICAL SIGNAL CONTINUATION TO/FROM
- SHT # — SHEET NUMBER INDICATED

LINE DESIGNATION

PROCESS LINE — XX"-XX-XXX-XXX

LINE SIZE
SYSTEM CODE
SEQUENCE NUMBER (OPTIONAL)
MATERIAL CODE (OR CLASS)

SYSTEM CODE

BWW	BACK WASH WATER
CHEM	CHEMICAL
CNDS	CONDENSATE
DR	DRAIN
EFF	EFFLUENT
INF	INFLUENT
O/F	OVERFLOW
PLW	PLANT WATER (REUSE)
POL	POLYMER
PRCS	PROCESS
RTN	RETURN
SAN	SAND SEPARATION
SLU	SLURRY
SWW	SCREEN WASH WATER
SPLY	SUPPLY
ST	STEAM
U/F	UNDERFLOW
V	VENT
W	WATER (POTABLE)
WW	WASTE WATER

EQUIPMENT NOTATION

AZ	AUTOMATIC SAMPLER
B	BLOWER (AIR)
BFP	BELT FILTER PRESS
BS	BAR SCREEN
C	COMPRESSOR
CP-X	CONTROL PANEL No 'X'
EQB	EQUALIZATION BASIN
F	FAN
FP-XXX	FIELD PANEL No 'XXX'
HC	HYDROCYCLONE
M	MOTOR
MCC	MOTOR CONTROL CENTER
MX	MIXER MOTOR
OWS	OIL WATER SEPARATOR
P	PUMP
S	SUMP
SC	SCREEN
T	TANK

PIPE MATERIAL CODES

BI	BLACK IRON
CS	CARBON STEEL
CU	COPPER
DI	DUCTILE IRON
FRP	FIBER REINFORCED PLASTICS
GALV	GALVANIZED
HDPE	HIGH DENSITY POLYETHYLENE
PVC	POLYVINYL CHLORIDE
SS	STAINLESS STEEL
STL	STEEL

NO.	DESCRIPTION	DATE	DRAWN	CHK'D	APPV'D
B	ISSUED FOR INTERMEDIATE DESIGN	2/24/10	JTS	EWJ	MTO
A	ISSUED FOR CLIENT REVIEW	1/20/10	JTS	EWJ	MTO

DRAWN BY: JTS — DATE: 9/14/09
CHECKED BY — DATE
APPROVED BY — DATE
PROJECT MGR. — DATE
SEAL

PARSONS
COMMERCIAL TECHNOLOGY GROUP
OFFICE: 301 PLAINFIELD ROAD, SYRACUSE, NY 13212, (315) 451-9560
JOB: 444853
WBS: 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
P&ID LEGEND AND ABBREVIATION SHEET

SCALE: NOT TO SCALE

DRAWING NO. 444853-200-D-101 — REV. B

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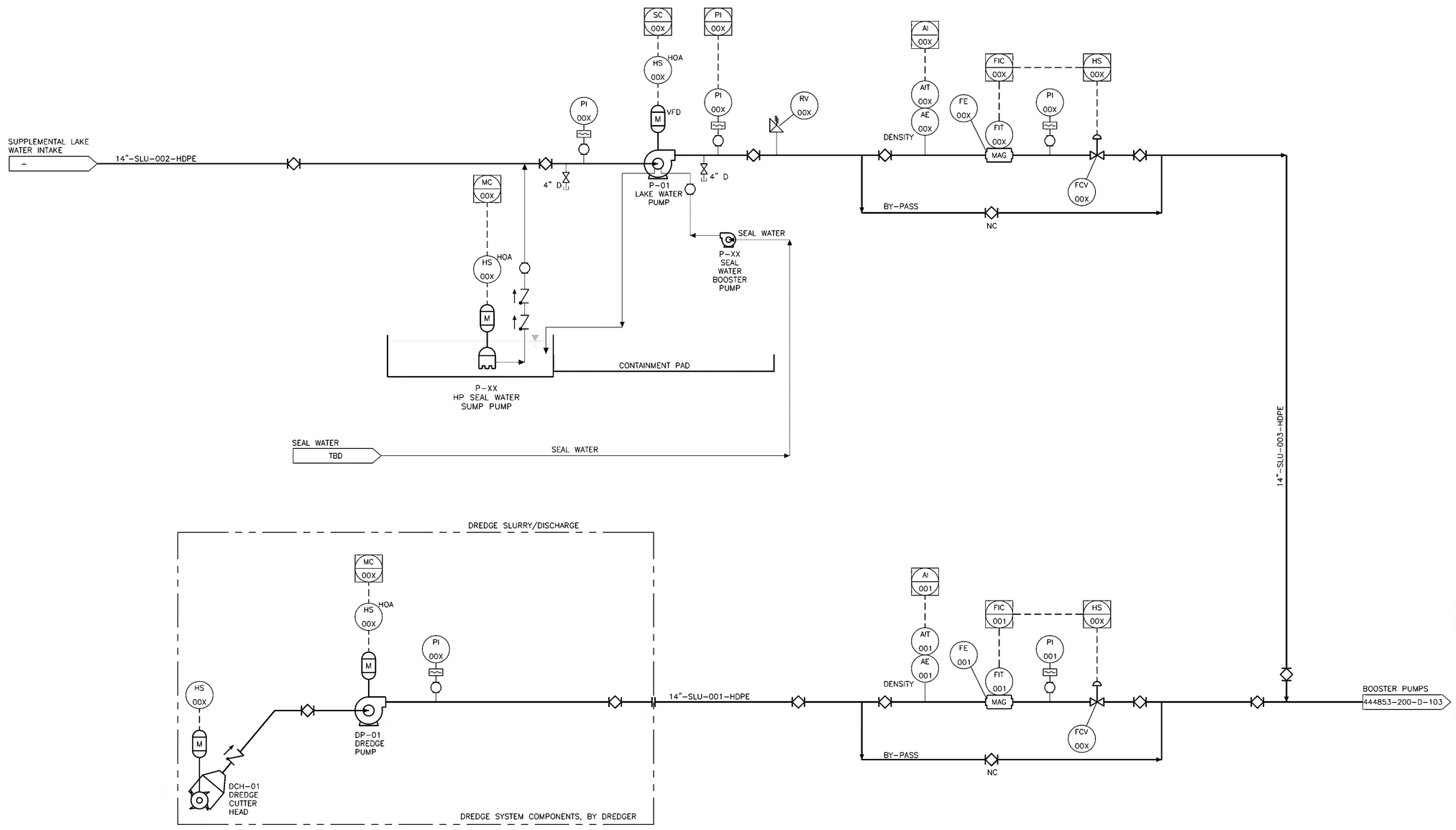

DCH-01	DP-01	P-XX	P-01
DREDGE CUTTER HEAD	DREDGE PUMP 01	SUMP PUMP XX	LAKE WATER WATER PUMP 01
MFR: XXX	MFR: XXX	MFR: XXX	MFR: XXX
MODEL: XXX	MODEL: XXX	MODEL: XXX	MODEL: XXX
CAPACITY: XXX XXHP.	CAPACITY: XXX GPM @ XX' TDH XXHP.	CAPACITY: XXX GPM @ XX' TDH XXHP, XXV	CAPACITY: XXX GPM @ XX' TDH XXHP, 460V, VFD

NOT FOR CONSTRUCTION

NO.	DESCRIPTION	DATE	DRAWN	CHK'D	APPV'D
B	ISSUED FOR INTERMEDIATE DESIGN	2/24/10	JTS	EWJ	MTO
A	ISSUED FOR CLIENT REVIEW	1/20/10	JTS	EWJ	MTO

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PROJECT MGR. — DATE
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PARSONS
COMMERCIAL TECHNOLOGY GROUP

OFFICE
301 PLAINFIELD ROAD
SYRACUSE, NY 13212
(315) 451-9560

JOB 444853
WBS 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
SLURRY TRANSPORT SYSTEM P&ID
SLURRY PIPELINE

SCALE NO SCALE

DRAWING NO. 444853-200-D-102 REV. B

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\PID\444853-200-D-102 TO D-112.DWG
PLOT DATE: 2/19/2010 12:53 PM PLOTTED BY: SMALIA, JACK

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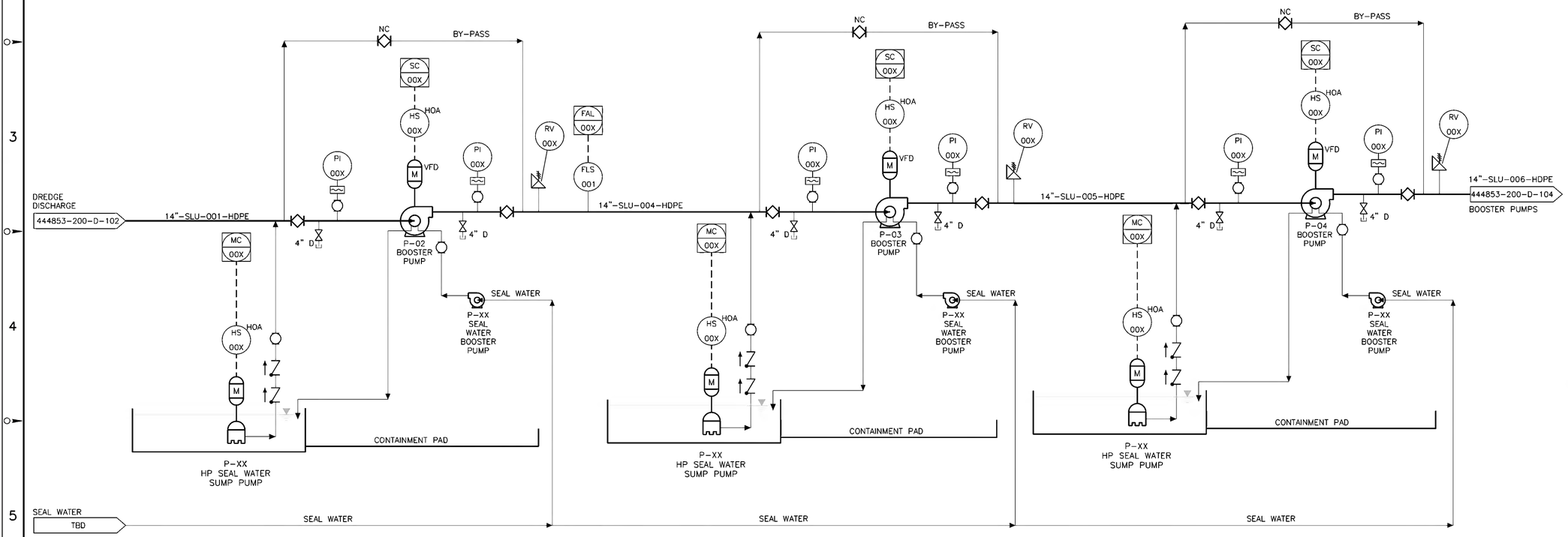

P-XX	P-02	P-XX	P-03	P-XX	P-04
SUMP PUMP XX	BOOSTER PUMP 02	SUMP PUMP XX	BOOSTER PUMP 03	SUMP PUMP XX	BOOSTER PUMP 04
MFR: XXX	MFR: XXX	MFR: XXX	MFR: XXX	MFR: XXX	MFR: XXX
MODEL: XXX	MODEL: XXX	MODEL: XXX	MODEL: XXX	MODEL: XXX	MODEL: XXX
CAPACITY: XXX GPM @ XX' TDH XXHP, XXV	CAPACITY: XXX GPM @ XX' TDH XXHP, 460V, VFD	CAPACITY: XXX GPM @ XX' TDH XXHP, XXV	CAPACITY: XXX GPM @ XX' TDH XXHP, 460V, VFD	CAPACITY: XXX GPM @ XX' TDH XXHP, XXV	CAPACITY: XXX GPM @ XX' TDH XXHP, 460V, VFD

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DRAWN BY JTS	DATE 9/14/09	SEAL
CHECKED BY	DATE	
APPROVED BY	DATE	
PROJECT MGR.	DATE	

PARSONS
COMMERCIAL TECHNOLOGY GROUP

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(315) 451-9560

JOB 444853
WBS 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
SLURRY TRANSPORT SYSTEM P&ID
SLURRY PIPELINE

SCALE NO SCALE

DRAWING NO. 444853-200-D-103
REV. B

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\PID\444853-200-D-102 TO D-112.DWG
PLOT DATE: 2/19/2010 12:55 PM PLOTTED BY: SVALIA, JACK

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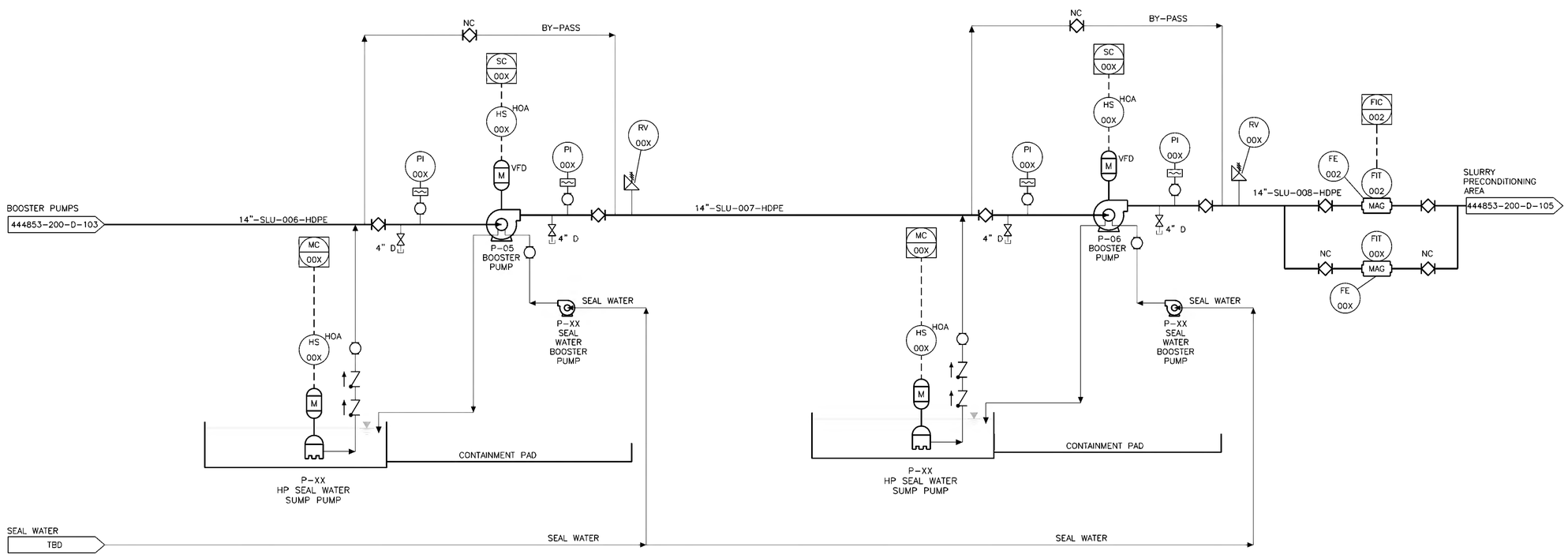

P-XX
SUMP PUMP XX
MFR: XXX
MODEL: XXX
CAPACITY: XXX GPM @ XX' TDH
XXHP, XXV

P-05
BOOSTER PUMP 05
MFR: XXX
MODEL: XXX
CAPACITY: XXX GPM @ XX' TDH
XXHP, 460V, VFD

P-XX
SUMP PUMP XX
MFR: XXX
MODEL: XXX
CAPACITY: XXX GPM @ XX' TDH
XXHP, XXV

P-06
BOOSTER PUMP 06
MFR: XXX
MODEL: XXX
CAPACITY: XXX GPM @ XX' TDH
XXHP, 460V, VFD

NOT FOR CONSTRUCTION

NO.	DESCRIPTION	DATE	DRAWN	CHK'D	APPV'D
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A	ISSUED FOR CLIENT REVIEW	1/20/10	JTS	EWJ	MTO

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PROJECT MGR. — DATE
SEAL

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COMMERCIAL TECHNOLOGY GROUP

OFFICE
301 PLAINFIELD ROAD
SYRACUSE, NY 13212
(315) 451-9560

JOB 444853
WBS 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
SLURRY TRANSPORT SYSTEM P&ID
SLURRY PIPELINE

SCALE: NO SCALE

DRAWING NO. 444853-200-D-104 — REV. B

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\PID\444853-200-D-102 TO D-112.DWG
PLOT DATE: 2/19/2010 12:55 PM PLOTTED BY: SNALIA, JACK

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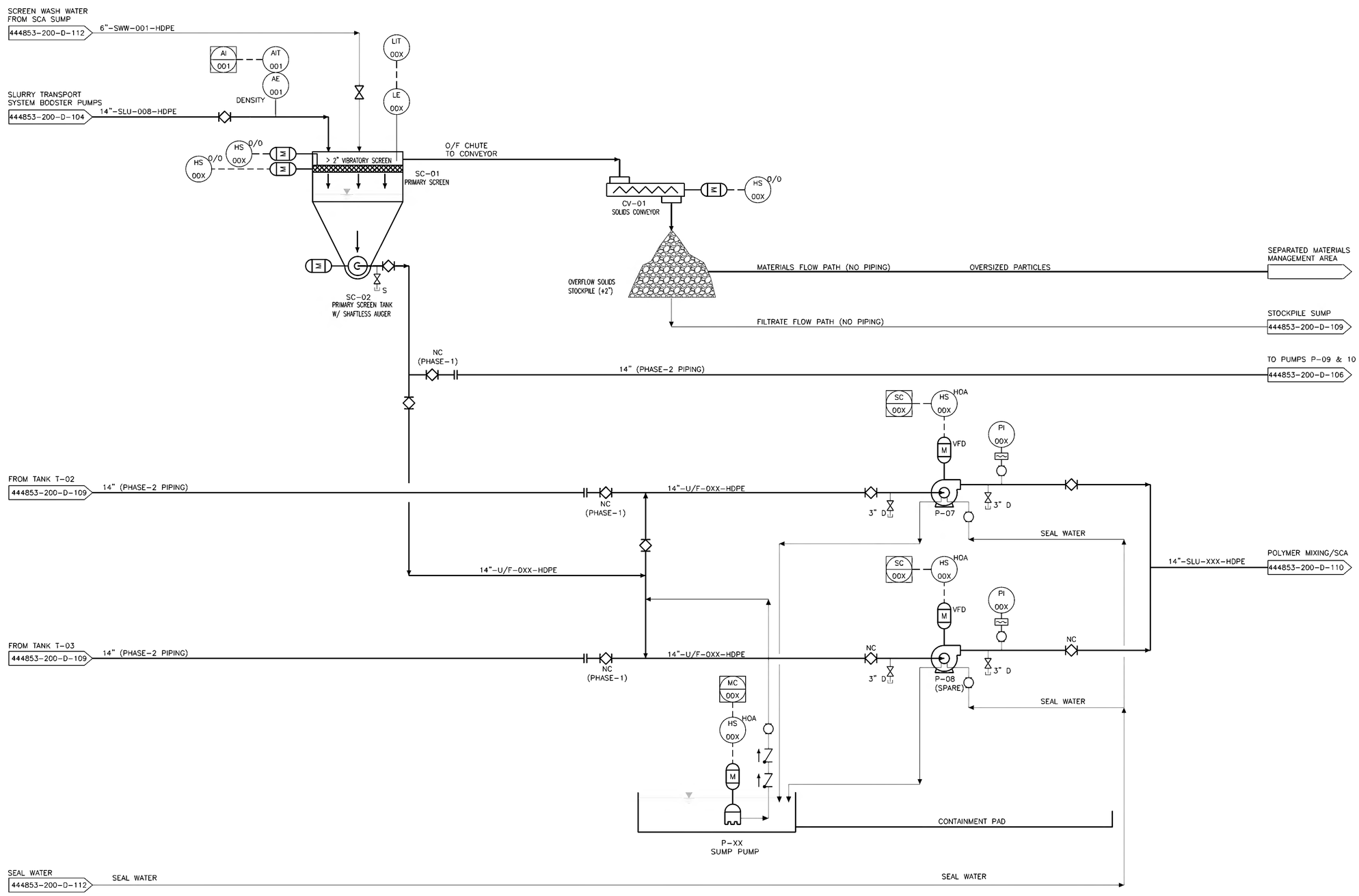

SC-01	SC-02	CV-01	P-XX	P-07, 08
PRIMARY SCREENS	PRIMARY SCREEN TANK W/ AUGER	SOLIDS CONVEYOR	SUMP PUMP XX	GEOTEXTILE TUBE FEED PUMPS 07 & 08
MFR: XXX	MFR: XXX	MFR: XXX	MFR: XXX	MFR: XXX
MODEL: XXX	MODEL: XXX	MODEL: XXX	MODEL: XXX	MODEL: XXX
CAPACITY: XXX	CAPACITY: XXX GAL	CAPACITY: XXX	CAPACITY: XXX GPM @ XX' TDH	CAPACITY: 6000 GPM @ XX' TDH
SIZE: XXX	XX' DIA x X'	XX' DIA x X'	XXHP, XXV	XXHP, 460V, VFD
5HP, 2-VIBRATORY SCREEN MOTORS	15 HP, SHAFTLESS AUGER MOTOR	10 HP, CONVEYOR MOTOR		

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JOB: 444853
WBS: 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
SLURRY TRANSPORT SYSTEM P&ID
SLURRY PRECONDITIONING

SCALE: NO SCALE

DRAWING NO. 444853-200-D-105 — REV. B

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\PID\444853-200-D-102 TO D-112.DWG
PLOT DATE: 2/19/2010 12:56 PM PLOTTED BY: SIVALIA, JACK

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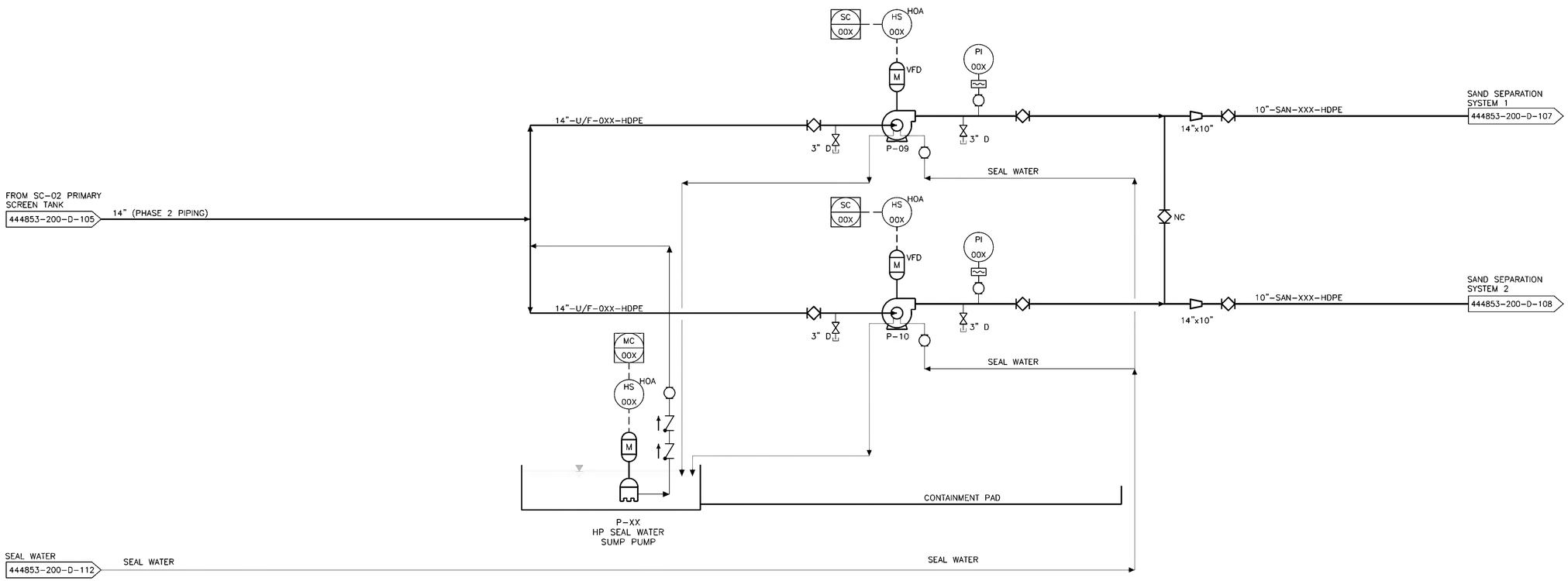

P-XX

SUMP PUMP XX
MFR: XXX
MODEL: XXX
CAPACITY: XXX GPM @ XX' TDH
XXHP, XXV

P-09 & 10

SAND SEPARATION FEED PUMPS 09 & 10
MFR: XXX
MODEL: XXX
CAPACITY: XXX GPM @ XX' TDH
75 HP, 460V, VFD

NOT FOR CONSTRUCTION

NO.	DESCRIPTION	DATE	DRAWN	CHK'D	APPV'D
B	ISSUED FOR INTERMEDIATE DESIGN	2/24/10	JTS	EWJ	MTO
A	ISSUED FOR CLIENT REVIEW	1/20/10	JTS	EWJ	MTO

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PROJECT MGR. — DATE
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JOB: 444853
WBS: 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
SLURRY TRANSPORT SYSTEM P&ID
SLURRY PRECONDITIONING
PHASE 2

SCALE: NO SCALE

DRAWING NO. 444853-200-D-106 — REV. B

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\PID\444853-200-D-102 10 D-112.DWG
PLOT DATE: 2/19/2010 12:57 PM PLOTTED BY: SVALIA, JACK

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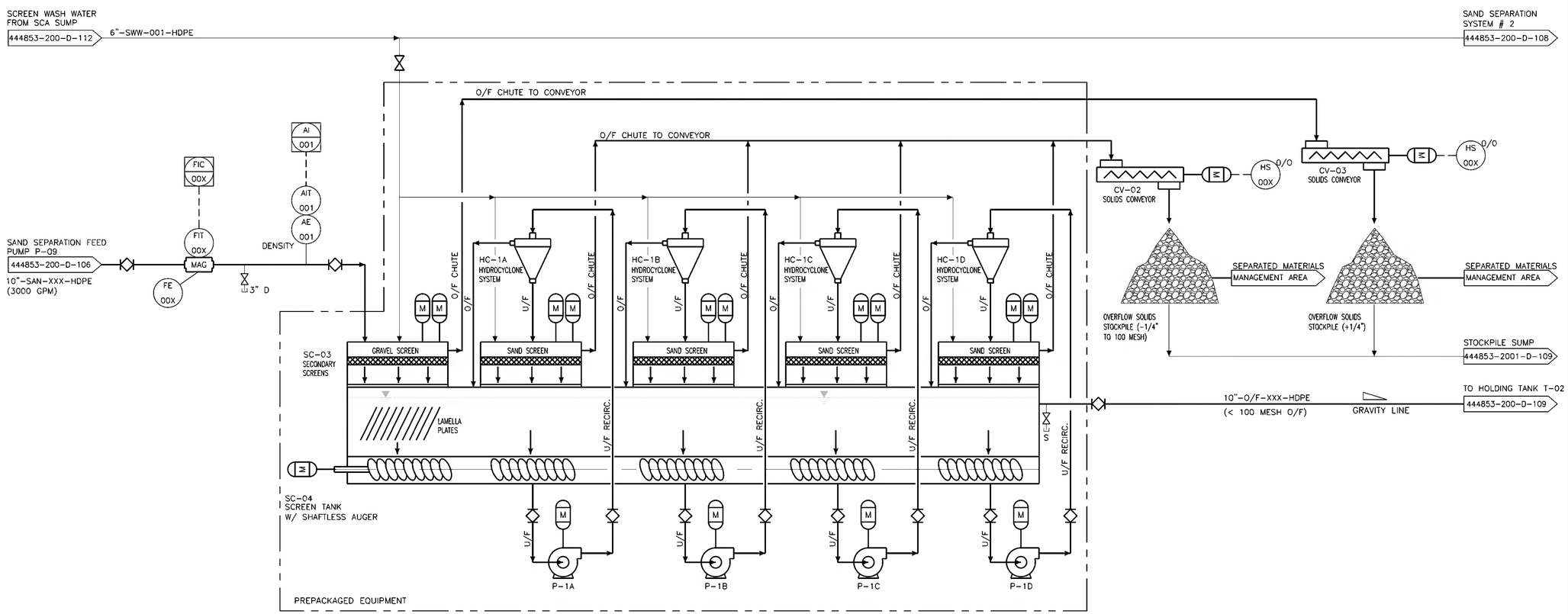

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B	ISSUED FOR INTERMEDIATE DESIGN	2/24/10	JTS	EWJ	MTO
A	ISSUED FOR CLIENT REVIEW	1/20/10	JTS	EWJ	MTO

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CHECKED BY	DATE	
APPROVED BY	DATE	
PROJECT MGR.	DATE	

PARSONS
COMMERCIAL TECHNOLOGY GROUP

OFFICE
301 PLAINFIELD ROAD
SYRACUSE, NY 13212
(315) 451-9560

JOB 444853
WBS 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
SLURRY TRANSPORT SYSTEM P&ID
SAND SEPARATION SYS. #1
PHASE 2

SCALE NO SCALE

DRAWING NO. 444853-200-D-107 REV. B

SC-03
SECONDARY SCREENS (5)
MFR: XXX
MODEL: XXX
CAPACITY: XXX
SIZE: XXX
5HP, 2-VIBRATORY SCREEN MOTORS EACH (10 MOTORS TOTAL)

SC-04
SCREEN TANK W/ AUGER
MFR: XXX
MODEL: XXX
CAPACITY: XXX GAL
XX' DIA x X'
10 HP, SHAFTLESS AUGER MOTOR

HC-1A, 1B, 1C, 1D
HYDROCYCLONE SYSTEMS 1A, 1B, 1C, 1D
MFR: XXX
MODEL: XXX
CAPACITY: XXX

P-1A, 1B, 1C & 1D
SC-04 RECIRC. PUMPS 1A, 1B, 1C, 1D
MFR: XXX
MODEL: XXX
CAPACITY: XX GPM @ XX' TDH
75 HP, 460V, VFD

CV-02 & 03
SOLIDS CONVEYORS 02, 03
MFR: XXX
MODEL: XXX
CAPACITY: XXX
XX' DIA x X'
10 HP, CONVEYOR MOTOR

NOT FOR CONSTRUCTION

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\PID\444853-200-D-102 TO D-112.DWG
PLOT DATE: 2/19/2010 12:57 PM PLOTTED BY: SIVALIA, JACK

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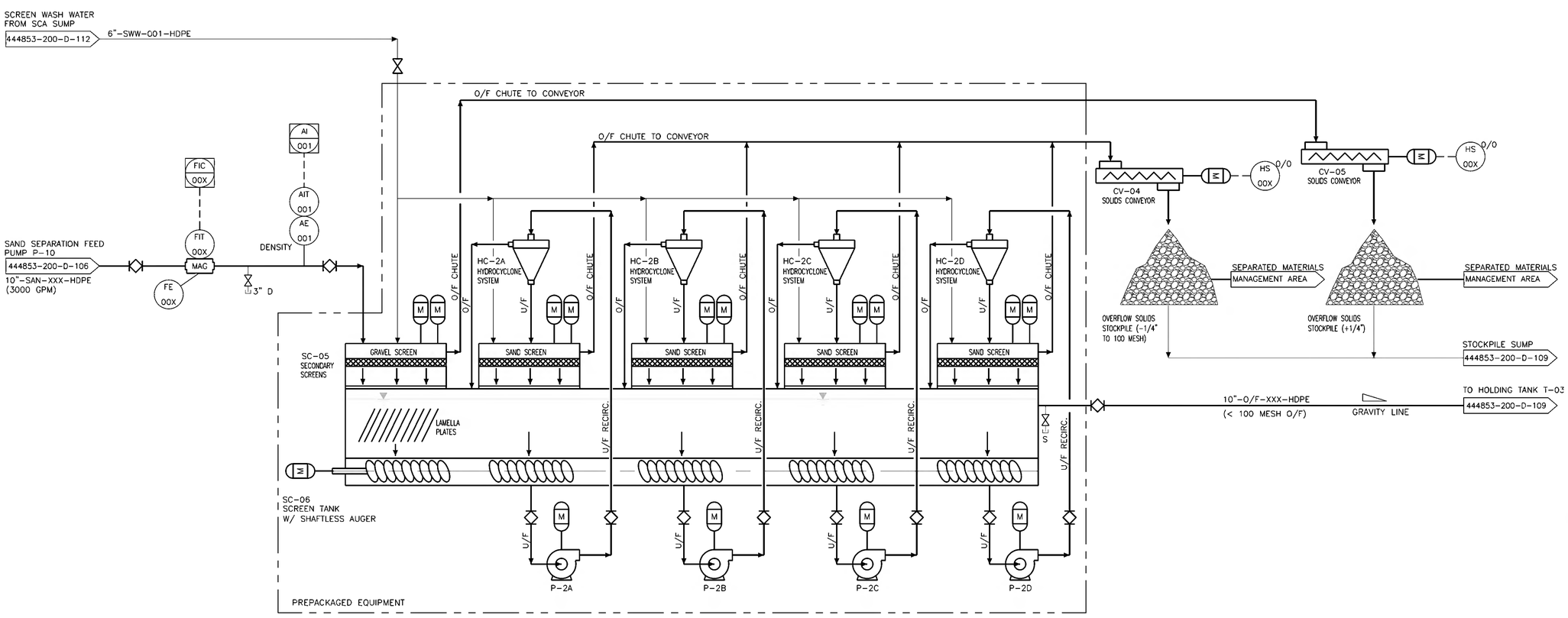

SC-05
SECONDARY SCREENS (5)
MFR: XXX
MODEL: XXX
CAPACITY: XXX
SIZE: XXX
5HP, 2-VIBRATORY SCREEN MOTORS EACH (10 MOTORS TOTAL)

SC-06
SCREEN TANK W/ AUGER
MFR: XXX
MODEL: XXX
CAPACITY: XXX GAL
XX' DIA x X'
10 HP, SHAFTLESS AUGER MOTOR

HC-2A, 2B, 2C, 2D
HYDROCYCLONE SYSTEMS 2A, 2B, 2C, 2D
MFR: XXX
MODEL: XXX
CAPACITY: XXX

P-2A, 2B, 2C & 2D
SC-06 RECIRC. PUMPS 2A, 2B, 2C, 2D
MFR: XXX
MODEL: XXX
CAPACITY: XX GPM @ XX' TDH
75 HP, 460V, VFD

CV-04 & 05
SOLIDS CONVEYORS 04, 05
MFR: XXX
MODEL: XXX
CAPACITY: XXX
XX' DIA x X'
10 HP, CONVEYOR MOTOR

NOT FOR CONSTRUCTION

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DRAWN BY: JTS — DATE: 9/14/09
CHECKED BY — DATE
APPROVED BY — DATE
PROJECT MGR. — DATE
SEAL

PARSONS
COMMERCIAL TECHNOLOGY GROUP

OFFICE: 301 PLAINFIELD ROAD, SYRACUSE, NY 13212, (315) 451-9560
JOB: 444853
WBS: 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
SLURRY TRANSPORT SYSTEM P&ID
SAND SEPARATION SYS. #2
PHASE 2

SCALE: NO SCALE

DRAWING NO.: 444853-200-D-108
REV.: B

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\PID\444853-200-D-102 TO D-112.DWG
PLOT DATE: 2/19/2010 12:58 PM PLOTTED BY: SIVALIA, JACK

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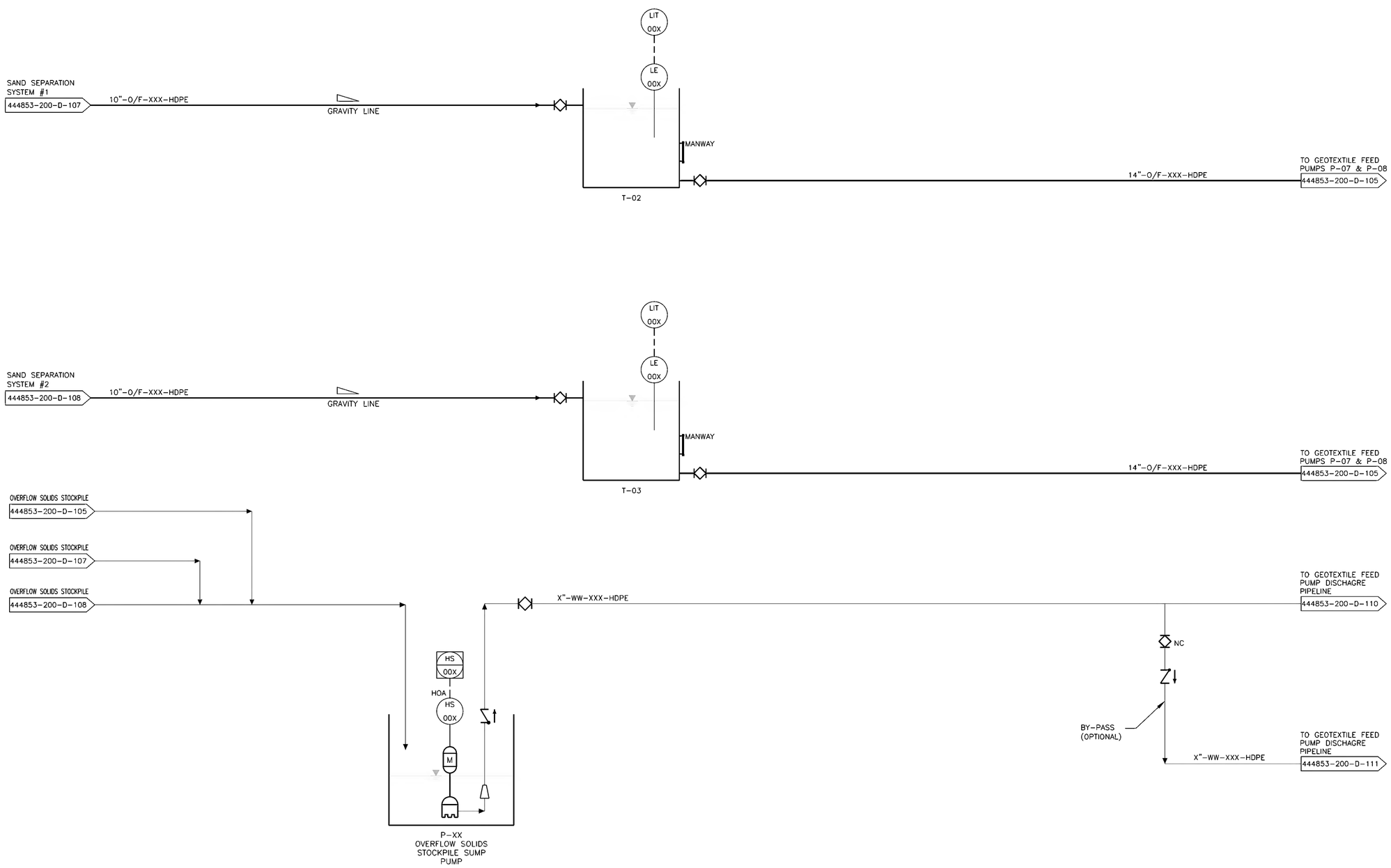

P-XX
OVERFLOW SOLIDS STOCKPILE SUMP PUMP XX
MFR: XXX
MODEL: XXX
CAPACITY: GPM @ XX' TDH
XXHP, XXV

T-02 & 03
SLURRY TANKS 02 & 03
MFR: XXX
MODEL: XXX
CAPACITY: 18,100 GAL
XX' DIA x X'

NOT FOR CONSTRUCTION

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SYRACUSE, NEW YORK

DRAWING TITLE
SLURRY TRANSPORT SYSTEM P&ID
SLURRY PRECONDITIONING
PHASE 2

SCALE: NO SCALE

DRAWING NO. 444853-200-D-109 — REV. B

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\PID\444853-200-D-102 TO D-112.DWG
PLOT DATE: 2/19/2010 12:58 PM PLOTTED BY: SNALIA, JACK

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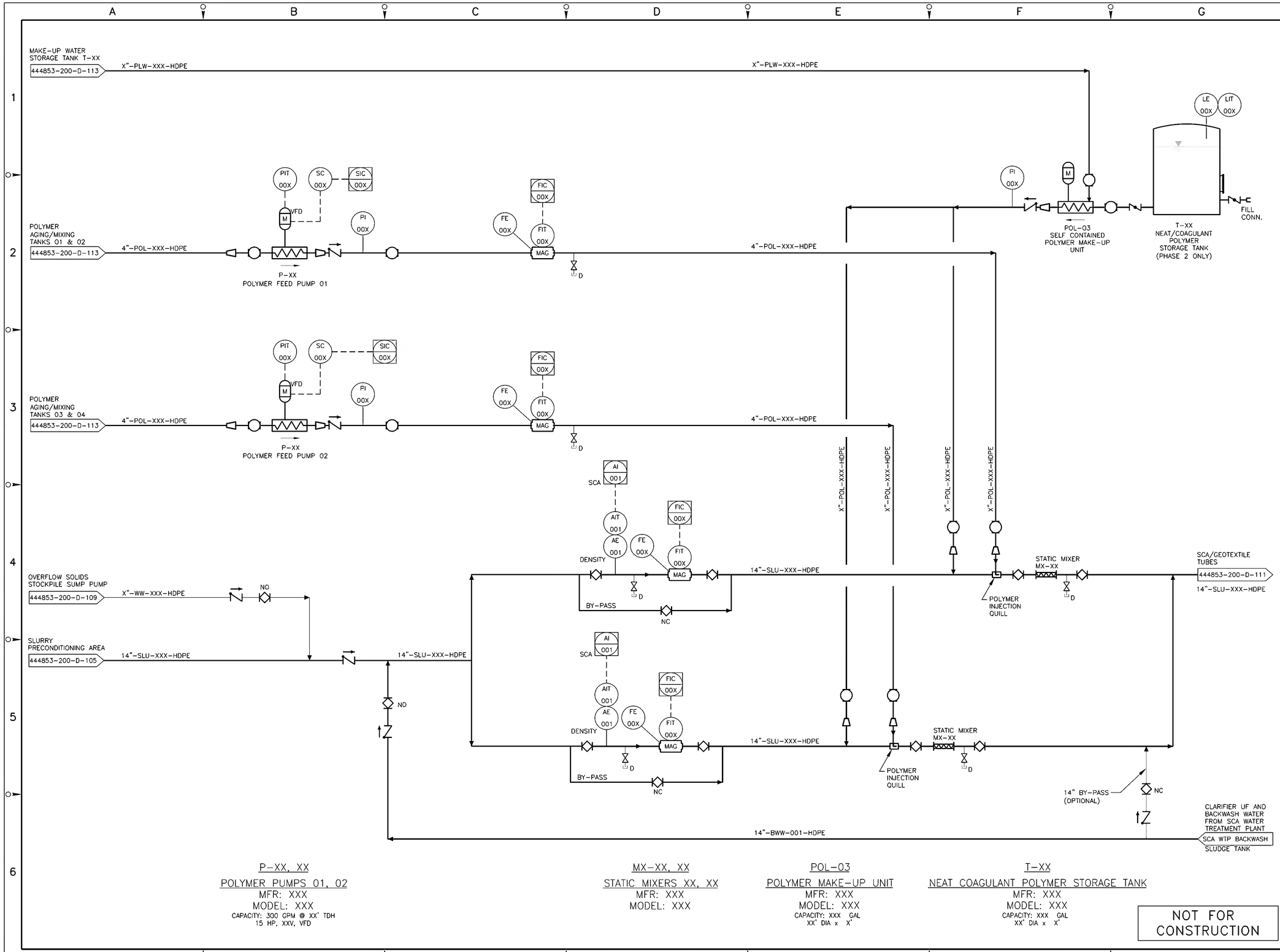

P-XX, XX
POLYMER PUMPS 01, 02
MFR: XXX
MODEL: XXX
CAPACITY: 300 GPM @ XX' TDH
15 HP, XXV, VFD

MX-XX, XX
STATIC MIXERS XX, XX
MFR: XXX
MODEL: XXX

POL-03
POLYMER MAKE-UP UNIT
MFR: XXX
MODEL: XXX
CAPACITY: XXX GAL
XX' DIA x X'

T-XX
NEAT COAGULANT POLYMER STORAGE TANK
MFR: XXX
MODEL: XXX
CAPACITY: XXX GAL
XX' DIA x X'

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NO.	DESCRIPTION	DATE	DRAWN	CHK'D	APPV'D
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A	ISSUED FOR CLIENT REVIEW	1/20/10	JTS	EWJ	MTO

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JOB: 444853
WBS: 04620

PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
SLURRY TRANSPORT SYSTEM P&ID
POLYMER FEED SYSTEM

SCALE: NO SCALE
DRAWING NO. 444853-200-D-110
REV. B

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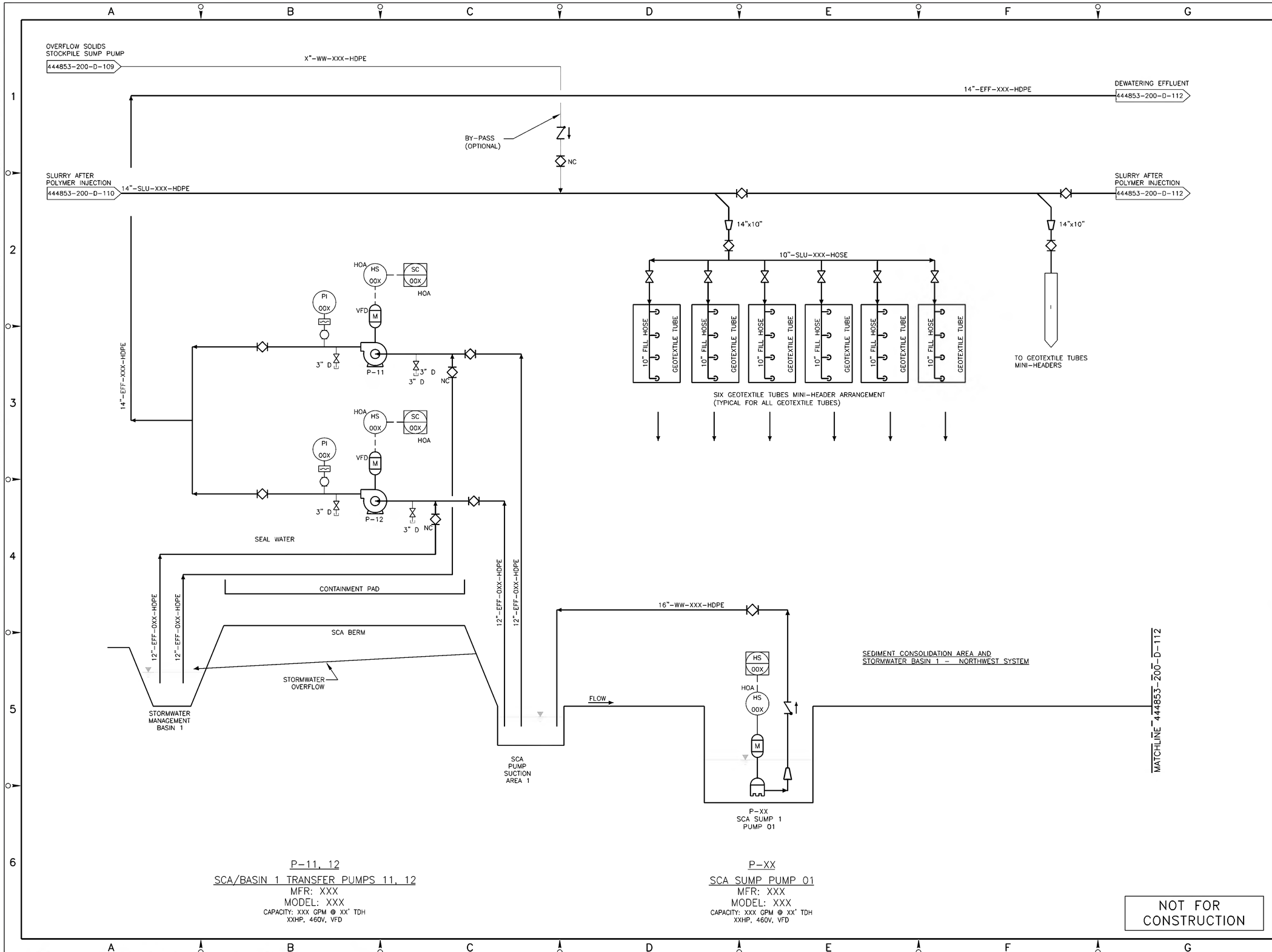

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ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
SLURRY TRANSPORT SYSTEM P&ID
SCA AND BASIN 1 - NORTHWEST

SCALE NO SCALE

DRAWING NO. 444853-200-D-111
REV. B

FILE NAME: P:\HONEYWELL -SYR\444853 - DAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\PID\444853-200-D-102 10 D-112.DWG
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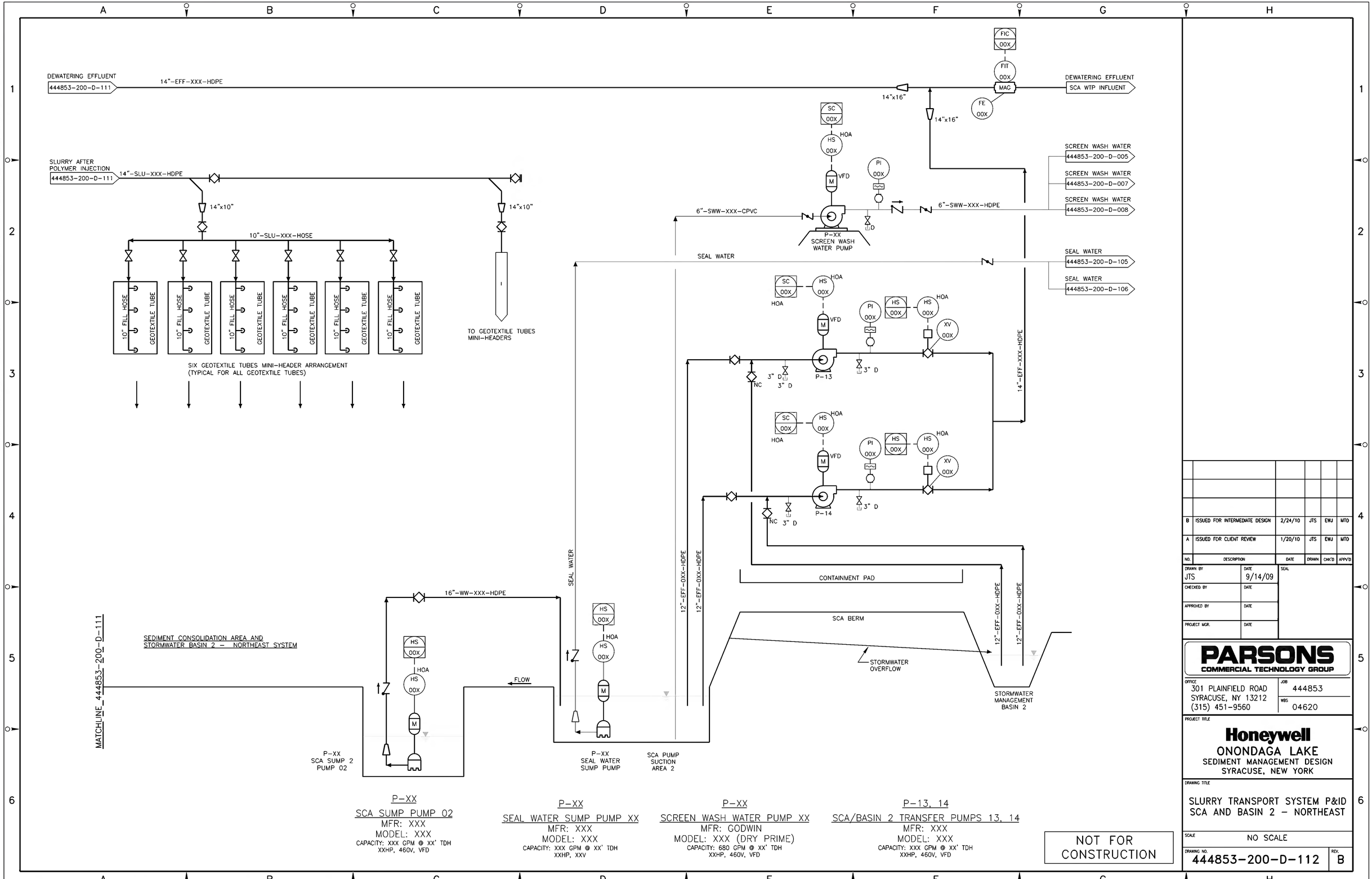

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A	ISSUED FOR CLIENT REVIEW	1/20/10	JTS	EWJ	MTO

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JOB: 444853
WBS: 04620

PROJECT TITLE: Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE: SLURRY TRANSPORT SYSTEM P&ID
SCA AND BASIN 2 - NORTHEAST

SCALE: NO SCALE

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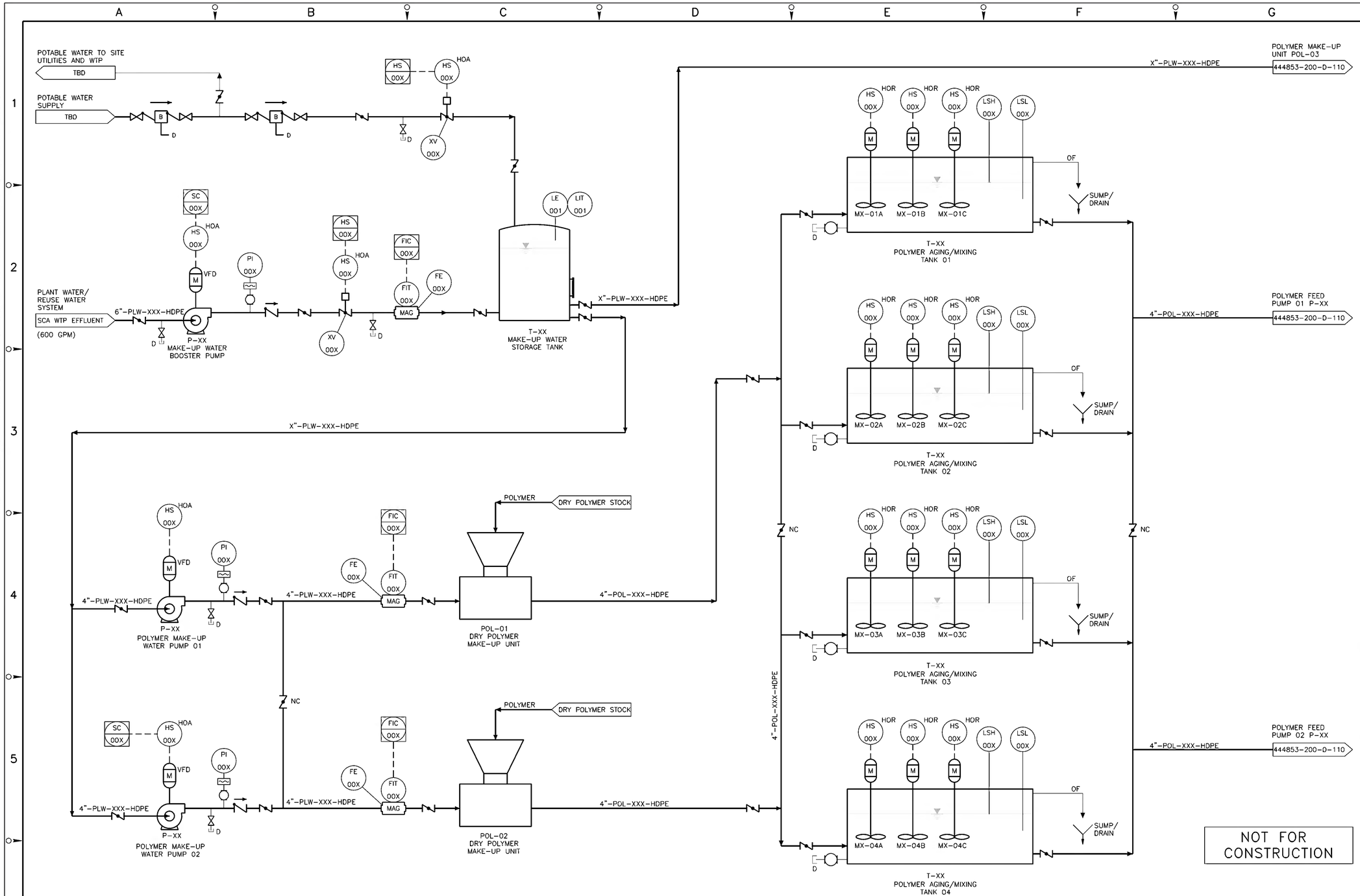

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PROJECT TITLE
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SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
SLURRY TRANSPORT SYSTEM P&ID
DRY POLYMER MIXING AND
MAKE-UP WATER

SCALE NO SCALE

DRAWING NO. 444853-200-D-113 REV. B

P-XX & XX POLYMER MAKE-UP WATER PUMPS 01 & 02	P-XX MAKE-UP WATER BOOSTER PUMP	POL-01 & 02 DRY POLYMER MAKE-UP UNIT	T-XX MAKE-UP WATER STORAGE TANK	T-XX, XX, XX & XX POLYMER AGING/MIXING TANKS 01, 02, 03 & 04	MX-01A,B,C POLYMER MIXERS	MX-02A,B,C POLYMER MIXERS	MX-03A,B,C POLYMER MIXERS	MX-04A,B,C POLYMER MIXERS
MFR: XXX	MFR: XXX	MFR: XXX	MFR: XXX	MFR: XXX	MFR: XXX	MFR: XXX	MFR: XXX	MFR: XXX
MODEL: XXX	MODEL: XXX	MODEL: XXX	MODEL: XXX	MODEL: XXX	MODEL: XXX	MODEL: XXX	MODEL: XXX	MODEL: XXX
CAPACITY: 300 GPM @ XX' TDH 15 HP, XXV, VFD	CAPACITY: 600 GPM @ XX' TDH 15 HP, XXV, VFD	CAPACITY: XXX GAL XX' DIA x X'	CAPACITY: 17,500 GAL XX' DIA x X'	CAPACITY: 17,500 GAL XX' DIA x X'	SIZE: XXX RPM XXHP, XXV,	SIZE: XXX RPM XXHP, XXV,	SIZE: XXX RPM XXHP, XXV,	SIZE: XXX RPM XXHP, XXV,

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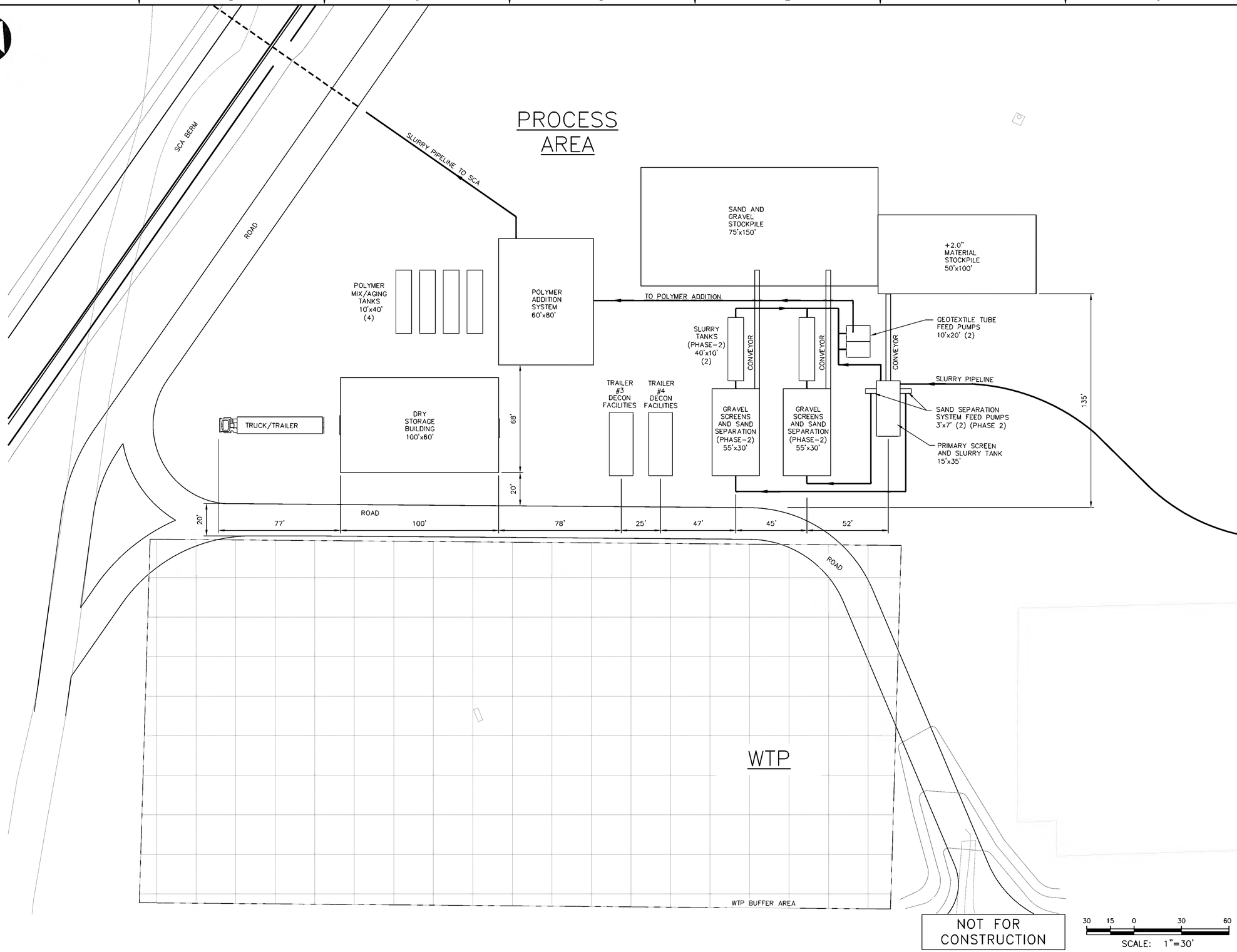

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PROJECT TITLE
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ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
PROCESS AREA PLAN

SCALE
SCALE 1"=30'
(IF PRINTED ON 22x34 SHEET)

DRAWING NO. 444853-200-M-001
REV. B

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DEFAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\MECH\444853-200-M-001.DWG
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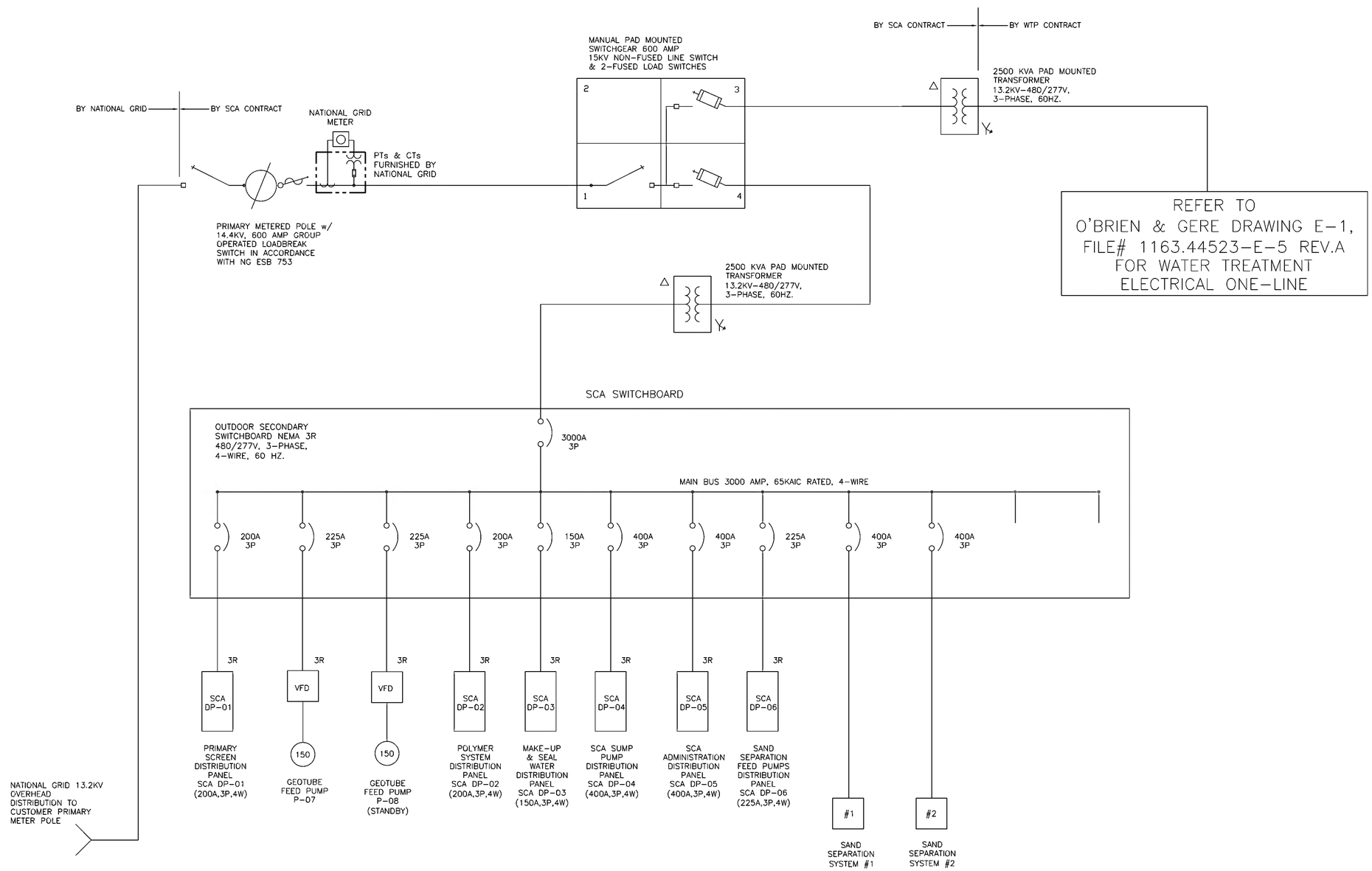

SCA ELECTRICAL ONE-LINE

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SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
POWER DISTRIBUTION ONE-LINE DIAGRAM

SCALE NO SCALE

DRAWING NO. 444853-200-E-001
REV. B

FILE NAME: P:\HONEYWELL -SYR\444853 - LAKE DETAIL DESIGN\10 TECHNICAL CATEGORIES\10.1 CAD\DESIGN_TASK 200 SED-MGMT DESIGN\ELEC\444853-200-E-001.DWG
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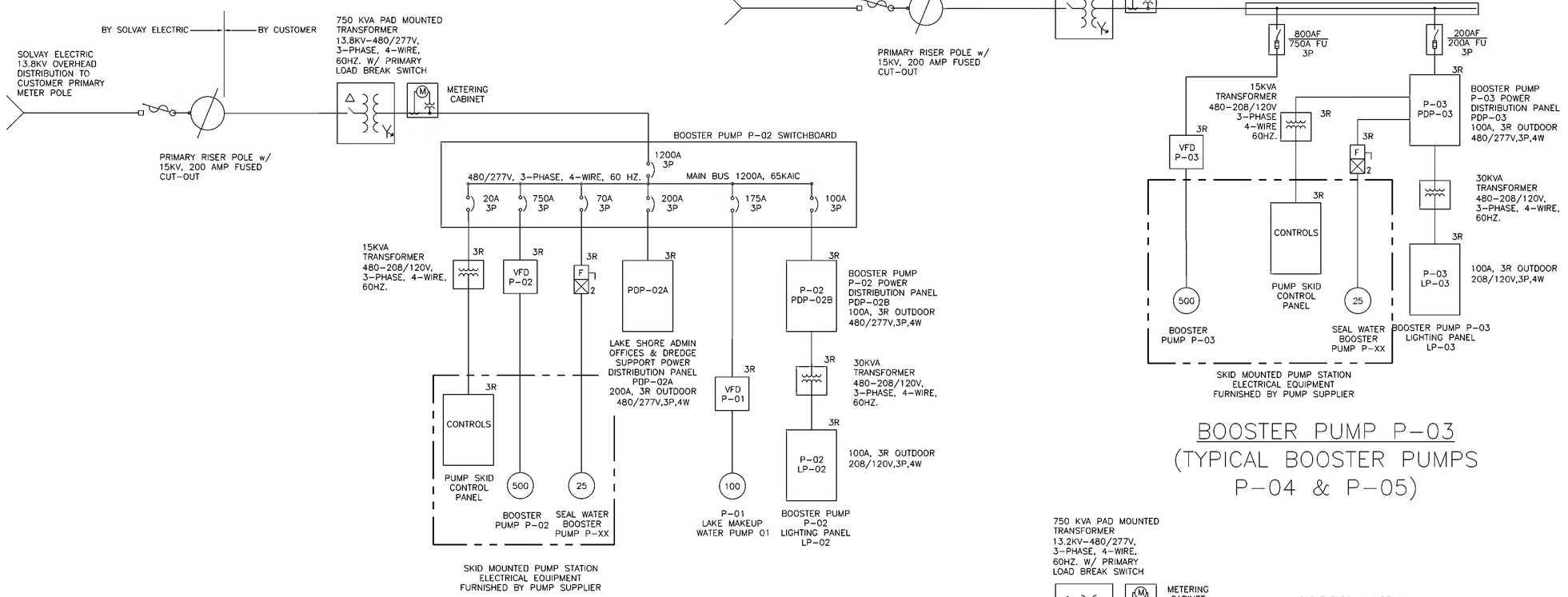
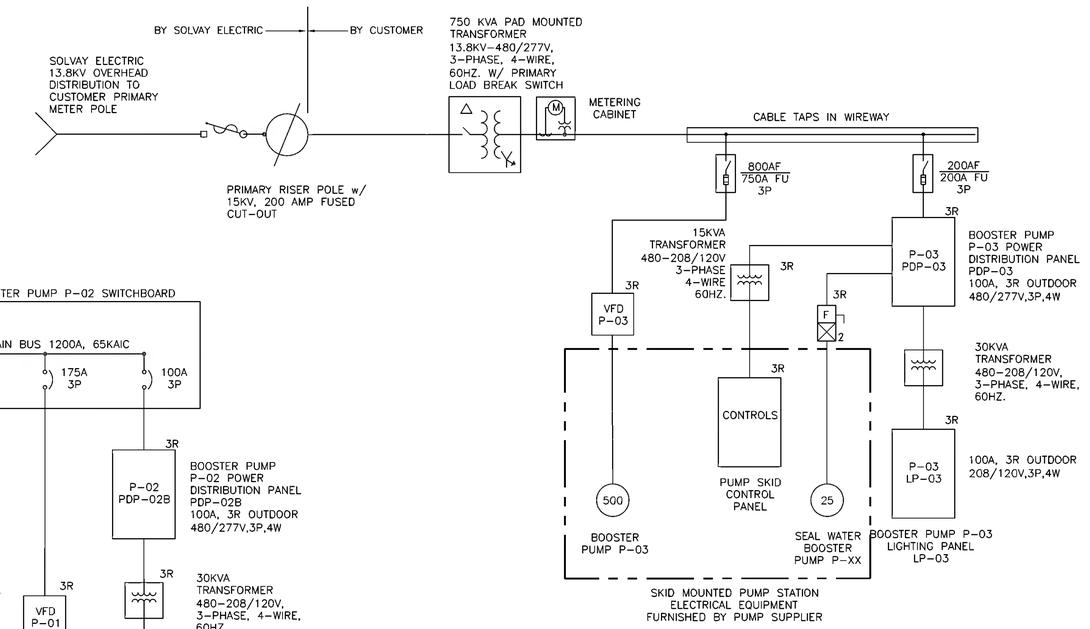
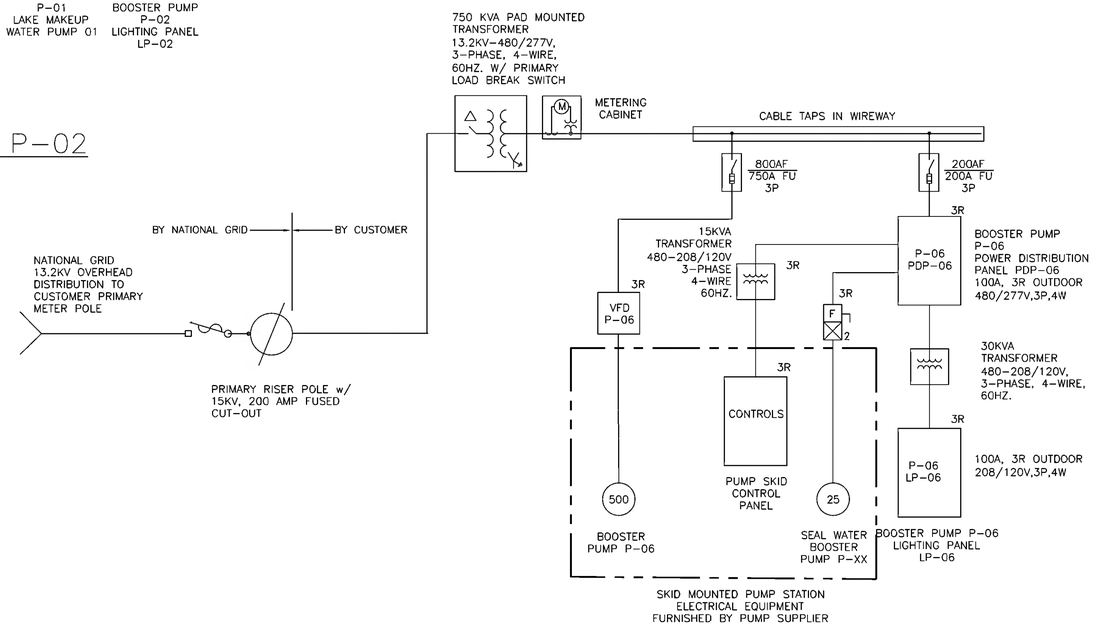


BOOSTER PUMP P-02



BOOSTER PUMP P-03
(TYPICAL BOOSTER PUMPS P-04 & P-05)



BOOSTER PUMP P-06

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PROJECT TITLE
Honeywell
ONONDAGA LAKE
SEDIMENT MANAGEMENT DESIGN
SYRACUSE, NEW YORK

DRAWING TITLE
BOOSTER PUMP STATIONS
ONE-LINE DIAGRAMS

SCALE NO SCALE

DRAWING NO. 444853-200-E-002
REV. B

APPENDIX E

SLURRY PIPELINE WETLAND DELINEATION MEMO

To:	Mr. Paul Blue - Parsons	*cc:*	Mr. Alfred J. Labuz –Honeywell
From:	Mr. Steve Mooney - O'Brien & Gere		John P. McAuliffe, P.E. – Honeywell
Re:	Slurry Pipeline Route Wetland Delineation, Onondaga Lake, Geddes and Camillus, New York – Report		Mr. Tom Drachenberg – Parsons
			Mr. Chris Calkins – O'Brien & Gere
File:	1163/43776		
Date:	December 16, 2009		

This technical memorandum was prepared to document the wetland identification and delineation activities performed by O'Brien & Gere and Parsons on behalf of Honeywell, Inc. along the proposed slurry pipeline route in the Towns of Geddes and Camillus, New York (**Figure 1**). The work was performed in association with the Onondaga Lake Bottom Subsite Project and in accordance with the Slurry Pipeline Route Wetland Delineation work plan dated September 24, 2009 and approved by the New York State Department of Environmental Conservation (NYSDEC) on October 5, 2009. Field oversight was provided by Mr. Rich Henry, a representative of the U.S. Fish and Wildlife Service (USFWS) on behalf of the U.S. Environmental Protection Agency (USEPA). Presented below are the methods and findings of the efforts performed in completion of the delineation activities.

PROJECT BACKGROUND

As part of the Onondaga Lake Bottom Subsite Project, dredged sediments from Onondaga Lake will be pumped (as a slurry mixture) through a pipeline to a sediment containment area (SCA) at Settling Basin (SB) 13 for dewatering. The route of the slurry pipeline will generally parallel the western shore of the lake and Ninemile Creek (NMC) in a southwest direction to the SCA. As depicted on **Figure 1**, existing road and utility right-of-way and settling basin access roads will be followed to the extent practical. The length of this pipeline route is approximately 21,000 feet (ft) (3.97 miles) (POA 2009).

As part of this project, a wetland identification and delineation was performed to evaluate potential crossings of wetlands by the proposed pipeline construction. The wetland delineation was performed along the proposed pipeline route between the Interbed Area located between SBs 9/10 and 11 and the SCA located at SB 13, as generally represented by points A and C (survey area) on **Figure 1**. Portions of the pipeline route east of the survey area have been previously delineated, as further discussed herein.

WETLAND IDENTIFICATION AND DELINEATION

Methodology

The wetland identification and boundary delineation for this project was performed in accordance with methods utilized at other Honeywell sites associated with Onondaga Lake and described in the revised *Onondaga Lake Wetland and Floodplain Assessment Report* submitted to the NYSDEC in June 2009 (O'Brien & Gere and Parsons 2009). O'Brien & Gere biologists performed the wetland delineation along the pipeline route in accordance with the U.S. Army Corps of Engineers (USACE) Wetlands Delineation Manual (USACE 1987). Based on the preliminary review of available NYSDEC wetland mapping, NYSDEC jurisdictional wetlands are not mapped along the survey area. However, NYSDEC delineation methods were also factored into the field work for this project.

The USACE and USEPA jointly define wetlands as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions [33 CFR 328.3(b), 40 CFR 230.3(t)]. Criteria used to identify a wetland, as defined therein, consist of the following:

- the soils present have been classified as hydric or possess reducing soil characteristics
- the prevalent vegetation is hydrophytic
- the area is either permanently or periodically at mean water depths less than or equal to 6.6 feet, or the soil is saturated to the surface at some time during the growing season.

To make a positive wetland determination, a minimum of one wetland indicator from each criterion (soil, vegetation and hydrology) must be identified. The Routine Determination Method outlined in USACE (1987) was selected for the identification and delineation of wetlands along the survey area. Routine determinations involve simple, rapidly applied methods that result in sufficient qualitative data for identifying wetland and non-wetland areas. The Routine Determination Method consists of a combination of off-site data review and on-site inspection.

Off-site activities included an evaluation of available information regarding environmental conditions at the survey area. On-site activities consisted of collecting the field data required to identify and delineate wetland boundaries. Field data were gathered at sample plots chosen in potential wetland areas, as well as in corresponding adjacent upland areas.

Off-Site Investigation
The off-site investigation procedure consisted of the review of the following documents:

- *Soil Survey of Onondaga County, New York* as prepared by the United States Department of Agriculture (USDA) Soil Conservation Service (USDA-SCS 1977) (soil survey) and the NRCS Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx) (USDA-NRCS 2009a).
- New York State Freshwater Wetland (NYSFW) maps, as presented on the NYSDEC Environmental Resource Mapper (http://www.dec.ny.gov/imsmaps/ERM/viewer.htm) (NYSDEC 2009).
- USFWS National Wetland Inventory (NWI) maps as presented on the NWI Wetland Mapper (http://www.fws.gov/wetlands/Data/Mapper.html) (USFWS 2009).

Soil Mapping
Information presented in the soil survey, the *New York Hydric Soils List* (USDA-NRCS 2009b), *New York Hydric Soils and Soils with Potential Hydric Inclusions* (USDA-NRCS 1995), and the USDA Web Soil Survey was used to evaluate the existing soil series present and the potential presence of hydric soils within the survey area. The soil series mapped along the survey area include:

- Cut and fill land (CFL)
- Made land, chemical waste (Ma)
- Fluvaquents (FL)
- Wayland silt loam (Wn)
- Palmyra gravelly loam (PgA)
- Collamer silt loam 0 to 2 percent slopes (ChA).

Cut and fill land soil, the most common soil of the survey area, is mapped on the central and eastern portions of the survey area. Fluvaquents soil is mapped in the Interbed Area at the eastern end of the survey area. Wayland silt loam, Palmyra gravelly loam, and Collamer silt loam soils are mapped on the western portion of the survey area. A soils map of the survey area is presented as **Figure 2** and soil descriptions obtained from the Web Soil Survey (USDA-NRCS 2009a) are provided as **Attachment 1**. Wayland silt loam and Fluvaquents are the only

soils considered hydric within the survey area and the mapped non-hydric soils are listed as not having potential hydric inclusions.

New York State Freshwater Wetlands

The NYSFW maps were developed by the NYSDEC pursuant to Article 24 of the NYS Environmental Conservation Law. These maps present the approximate boundaries of freshwater wetlands regulated by the NYSDEC. In most instances, the state-mapped boundaries are based on aerial photographs and soil survey interpretation and, therefore, require site-specific field verification.

Based on the mapping reviewed, no NYSFW are mapped along the survey area. However, NYSFW SYW-18 is mapped southeast of the eastern portion of the survey area. Wetland SYW-18, as mapped by the NYSDEC, consists of 35.8 acres and is hydrologically associated with NMC, a tributary of Onondaga Lake. The NYSDEC classifies SYW-18 as a Class II wetland. **Figure 3** presents the mapped location of SYW-18 in relation to the survey area.

National Wetland Inventory Wetland Habitats

The USFWS, through its NWI Project, has produced a series of topical maps to show wetlands and deep water habitats. Although these maps are helpful in the preliminary identification of wetlands, they do not represent federally regulated wetlands. The locations of NWI habitats in the vicinity of the survey area were accessed using the USFWS NWI Wetland Mapper (USFWS 2009). According to the NWI mapping, no NWI habitats are located along the survey area. The nearest NWI habitat is a palustrine, scrub-shrub, broad-leaved deciduous/emergent, common reed (*Phragmites australis)* dominant, seasonally flooded/saturated (PSS1/EM5E) habitat present just west of the western end of the survey area. A map indicating the location of NWI wetland habitats in relation to the survey area is presented as **Figure 3**.

Associated Water Bodies

A significant portion of the pipeline route is proposed along the northern bank of NMC. Also, a part of the pipeline is proposed to be submerged/floating within a portion of NMC and will eventually cross the creek as it extends to SB 13. The subject reach of NMC is classified by the NYSDEC as a Class “C” water body with “C” Standards. According to 6 NYCRR Part 701.8, these waters shall be suitable for fish propagation and survival and primary and secondary contact recreation, although other factors may limit the use for these purposes (NYCRR 2008).

The creek reach along the survey area is a wide, fairly slow-moving and generally straight channel with an average depth of approximately 18 to 42 inches. The reach contains a silt and gravel substrate with sparse areas of aquatic vegetation and defined banks rising approximately 3 to 5 feet above the water level.

Previously Delineated Wetlands

Portions of the pipeline route east of the survey area have been previously delineated by Terrestrial Environmental Specialists (TES) in October 2008 as part of the Geddes Brook/Ninemile Creek Feasibility Study. The delineation results are presented in the draft *Wetland/Floodplain Assessment Ninemile Creek and Lower Reach of Geddes Brook* (TES 2009), which is currently under review by NYSDEC. TES delineated wetlands along NMC from the mouth upstream to the Interbed Area located between SBs 9/10 and 11. This effort included an assessment and delineation of NYSDEC wetland SYW-18 and the lower reach of Geddes Brook. Boundaries for these delineated wetlands are presented on **Figure 4**.

The eastern end of the proposed pipeline route is associated with the western portion of the Wastebed B/Harbor Brook Site. O’Brien & Gere performed a wetland delineation at the Wastebed B/Harbor Brook Site in the summers of 2000 and 2003 as part of the ongoing Wastebed B/Harbor Brook Site Remedial Investigation.

Wetland delineation findings are reported in *Jurisdictional Wetland Delineation Report, Harbor Brook Site, Geddes, New York* (O'Brien & Gere 2003). Boundaries of these delineated wetlands that are in the vicinity of the eastern end of the proposed pipeline route are presented on **Figure 4**.

On-Site Investigation

O'Brien & Gere biologists trained in wetland delineation and assessment performed the field activities associated with the survey area delineation on October 13-16, 20 and 21, 2009. On-site activities included the evaluation of vegetative communities, the soil substrate, and hydrologic characteristics to identify and delineate wetland boundaries within an 80-foot corridor along the proposed pipeline route. Field data were gathered at sample plots chosen in potential wetland areas and adjacent upland areas. Wetlands were identified based on the presence of the following three parameters:

- hydric soils
- a vegetative community dominated by hydrophytes
- inundated or saturated soil conditions, and/or indicators of hydrologic patterns.

Vegetative, soil, and hydrologic conditions were recorded on Wetland Data Forms specified for the Routine Determination Method, which are included as **Attachment 2**.

Soils

Observed survey area soil characteristics were compared to the mapped soil descriptions of the soil survey to identify whether the survey area soils were consistent with the mapping, as characteristics can vary from mapped descriptions due to the scale at which the soil mapping was performed. Soil physical characteristics were evaluated using a manual auger to install a boring to 18 inches below ground surface, unless shallower refusal occurred. Soil color was evaluated using *Munsell Soil Color Charts* (Munsell 2000).

Based on this investigation, hydric soils were observed on the western portion of the survey area (Wayland) and at the Interbed Area (Fluvaquents). Hydric soil characteristics were observed in some areas mapped as Cut and fill land and Palmyra, which are listed as non-hydric soils per the Web Soil Survey (USDA-NRCS 2009a). Hydric soil characteristics observed in areas mapped as non-hydric likely developed due to prolonged saturation from surface or groundwater. Areas that exhibited hydric soil characteristics such as low chroma colors and/or evidence of reducing conditions (presence of mottles or gleying) met the hydric soil criterion per USACE (1987). Observed soil characteristics at each sample plot are summarized on Wetland Data Forms included as **Attachment 2**.

Vegetation

The criterion for wetland vegetation is a dominance of hydrophytic (water tolerant) species. A species is considered hydrophytic per USACE (1987) if it is classified either as obligate (OBL), facultative wet (FACW), or facultative (FAC), exclusive of a FAC- designation, in the *National List of Plant Species That Occur in Wetlands: Northeast (Region 1)* published by the USFWS (1988). A dominance of hydrophytes requires that more than 50% of the vegetative species in an area are classified as hydrophytic.

In accordance with USACE (1987), observations of vegetation focus on dominant vegetative species in four categories: trees (3 inch diameter at breast height), saplings/shrubs (less than 3 inch diameter and greater than 3.2 feet tall), herbs, and woody vines. Vegetation along the survey area varied from herbaceous species (*e.g*, wildflowers) to successional woody species. The dominant vegetative species observed within each of the sample plots were recorded and are presented on the Wetland Data Forms included as **Attachment 2**. Additionally, the *Draft Ecological Communities of New York State* (Edinger *et al*. 2002) was utilized to identify the ecological

community best represented by the dominant vegetative species observed in the delineated wetlands. Additional discussion regarding the observed vegetation is presented in the delineated wetland descriptions, below.

Hydrology
The survey area was examined for field indicators of wetland hydrology. According to USACE (1987), wetland hydrology consists of permanent or periodic inundation, or soil saturation to the surface during the growing season. Criteria used to indicate the existence of wetland hydrology include, but are not limited to:

- ground surface inundation or evidence of inundation
- saturated soils within 12 inches of the ground surface
- standing water in soil evaluation boreholes
- drainage patterns.

If these indicators were present within the sample plots, the hydrology criterion for wetlands was met. The primary hydrologic influence along the survey area appears to be NMC high water events and surface water runoff and drainage from steeper areas (*e.g.*, SB 11 and access roads) to depressional or low gradient areas. Ground water discharge may also be a potential hydrologic influence to some portions of the survey area. Hydrologic indicators observed within the sample plots were recorded on Wetland Data Forms included as **Attachment 2**.

Observed Wetland Areas
When all three wetland criteria (hydric soils, dominance of hydrophytes and wetland hydrology) were met, the area represented by the sample plot was identified as wetland. The delineated wetland boundaries were identified in the field with sequentially numbered (WL1-1, WL1-2, WL1-3, *etc*.) "Wetland Boundary" surveyor markers (flagging tape tied to vegetation). Wetland sample data plot locations were also identified with flagging and labeled WP1 through WP30. The wetland boundary and sample plot flagging locations were surveyed by the field biologists using a hand-held Trimble Global Positioning System (GPS) unit and subsequent post processing of the raw data.

A total of 20 wetland areas (totaling 2.78 acres) were identified and delineated within the survey area. These wetlands are listed in **Table 1** below. The location of the surveyed wetland boundaries and wetland sample plots are presented on the Delineated Wetlands maps included herein as **Figures 5A**, **5B**, and **5C**.

Table 1. Delineated Wetland Habitats

Wetland ID	Acreage	General Location	Figure
Wetland (WL)1	0.016	Eastern end of Sun Petroleum right-of-way (ROW)	5A
WL2	0.006	West of WL1 in ROW	5A
WL3	0.004	West of WL2 in ROW	5A
WL4	0.021	West of WL3 along stream/drainage ditch	5A
WL5	0.005	West of WL6 along a drainage ditch	5A
WL6	1.654	Central portion of ROW between WL4 and WL5	5A
WL7	0.025	Central portion of ROW south of WL6	5A
WL8	0.011	North bank of NMC west of Belle Isle bridge	5A
WL9	0.043	South bank of NMC west of CSX bridge	5A
WL10	0.032	South bank of NMC west of CSX bridge; east of WL9	5A
WL11	0.063	South bank of NMC west of CSX bridge	5A
WL12	0.050	South bank of NMC west of Belle Isle bridge	5A
WL12A	0.0005	East of Belle Isle bridge center of NMC	5A
WL12B	0.001	South bank of NMC east of Belle Isle bridge	5A

Table 1. Delineated Wetland Habitats

Wetland ID	Acreage	General Location	Figure
WL14	0.024	Between NMC and SB 11 access road	5C
WL15	0.236	West of WL14	5C
WL16	0.047	West of WL15	5C
WL17	0.005	West of WL16	5B
WL18	0.003	West of WL17	5B
WL19	0.530	West of WL18 and east of WL1	5B
Total Acreage	**2.7765**		

Three ecological community types described in Edinger *et al*. (2002); shallow emergent marsh, shrub swamp, and reedgrass/purple loosestrife marsh, are representative of these 20 wetland areas. Wetland-specific descriptions are presented below. A photographic log depicting some of the observed wetlands is included as **Attachment 3**.

Survey Area - West

O'Brien & Gere identified fourteen wetland habitats (WL1 through WL12B) along the western portion of the survey area, as presented on **Figure 5A**.

Wetland 1, WL2, and WL3 are small depressional wetland habitats located on the eastern portion of the ROW. Vegetation observed in these wetlands was dominated by reed canary grass (*Phalaris arundinacea*) and purple loosestrife (*Lythrum salicaria*). Hydrology was indicated by surface water drainage from higher elevations and hydric soils were indicated by the presence of low chroma colors and mottling.

Wetland 4 and WL5 are narrow wetland habitats identified along small streams discharging to NMC. Dominant species observed in these areas include reed canary grass, purple loosestrife, soft rush (*Juncus effusus*), bur reed (*Sparganium sp*.), and forget-me-not (*Myosotis scorpioides*). Hydrology was indicated by surface water drainage associated with the streams as well as soil saturation within the upper 12 inches of soil. Hydric soils were indicated by the presence of a sulfidic odor and low chroma colors and mottling within the upper 10 inches of soil. The northern boundary of WL4 is identified with a broken line on **Figure 5A** to indicate that the wetland boundary is open and continues north beyond the survey area. Based on the vegetative species observed, wetlands WL1 through WL5 are classified as shallow emergent marsh communities.

Wetland 6 is a relatively larger habitat located between WL4 and WL5 along the ROW. The eastern and central portions of WL6 are dominated by common reed. The western portion of WL6 is dominated by forget-me-not, moneywort (*Lysimachia nummularia*), and American black currant (*Ribes americanum*) with green ash (*Fraxinus pennsylvanica*) and black willow (*Salix nigra*) observed in the overstory. Snags, or standing dead trees, were also observed in this area. The western boundary of WL6 is identified with a broken line on **Figure 5A** to indicate that the wetland is open and continues west beyond the survey area. Hydrology for WL6 was indicated by surface water drainage from higher elevations and hydric soils were indicated by the presence of low chroma colors and mottling.

A portion of WL6 extends south to the edge of NMC. This area is dominated by reed canary grass. Hydrology in this area was indicated by surface water drainage patterns and potential high water flood events from NMC and sediment deposits along the stream bank creating uneven topography. Hydric soils were indicated by the presence of low chroma colors and mottling. WL6 contains a mixture of vegetative species that represent a combination of shallow emergent marsh and shrub swamp ecological communities (Edinger *et al*. 2002) surrounded by areas of mature trees.

Fringe wetlands that were identified along the banks of NMC include WL7, WL8 (north bank) and WL 9, WL10, WL11, WL12, WL12A, and WL12B (south bank). The western boundary of WL9 is identified with a broken line on **Figure 5A** to indicate that the wetland is open and continues west outside the survey area. The observed vegetation was dominated by reed canary grass and common reed. Hydrology in these areas was indicated by surface water drainage from higher topographic locations, potential flood events from NMC and sediment deposits along the stream bank creating uneven topography. Hydric soil was indicated by the presence of low chroma colors and mottling. These wetlands are best described as shallow emergent marsh communities, based on the vegetative species present and proximity to NMC.

Survey Area - Central

Three wetland habitats (WL17, WL18, and WL19) were identified along the central portion of the survey area as presented on **Figure 5B**. Wetlands 17 and 18 are shallow emergent marsh habitats located along the north bank of NMC. The observed vegetation was dominated by reed canary grass and common reed. Hydrology in these areas was indicated by surface water drainage from higher topographic locations, potential flood events from NMC and sediment deposits along the stream bank creating uneven topography. Hydric soil was indicated by the presence of low chroma colors and mottling. Wetland 19 is a reedgrass/purple loosestrife marsh community dominated by common reed with lesser densities of reed canary grass and giant goldenrod (*Solidago gigantea*). Wetland 19 receives surface water drainage via a drainage ditch and culvert located at the northwestern end of the wetland.

Survey Area - East

Three wetland habitats (WL14, WL15, and WL16) were delineated within the eastern portion of the survey area as shown on **Figure 5C**. Similar to WL19, these wetlands are located between NMC and the Setting Basin 11 access road and are dominated by common reed with lesser densities of reed canary grass and giant goldenrod. Hydric soils were indicated by the presence of low color chroma and mottling. These areas are hydrologically influenced by surface water runoff from SB 11 and seeps observed within the wetlands. These areas have likely been previously disturbed by draining, filling and/or roadside activities.

Delineated Wetland Values and Services

Data gathered during document review and wetland boundary delineation activities were used to qualitatively assess the values and services of the delineated wetlands identified within the survey area. Field observations indicate that the delineated wetlands provide suitable habitat for various species of wildlife. Amphibians, predominantly frogs and turtles, various species of songbirds, and animal sign, such as deer tracks and mammal scat, were observed throughout the survey area.

The fringe wetland habitats along NMC provide sediment/shoreline stabilization, and the wetlands identified between NCM and SB 11 likely provide sediment and toxicant retention from surface water and seep drainage directed from SB 11.

SUMMARY

O'Brien & Gere and Parsons conducted a wetland delineation for Honeywell along the proposed slurry pipeline route to evaluate potential impacts to wetlands associated with the construction of the pipeline. Field efforts were performed along the survey area on October 13-16, 20 and 21, 2009 and focused on the portion of the pipeline route located between the Interbed Area and the terminus of the pipeline at the SCA on SB 13.

For this wetland delineation task, O'Brien & Gere identified 20 wetland habitats totaling approximately 2.78 acres. Shallow emergent marsh communities were observed on the western portion of the survey area and along the riparian area of NMC. A mix of shallow emergent marsh and shrub swamp communities was observed at

WL6, the largest of the delineated areas (1.6 acres). Reedgrass/purple loosestrife marsh communities were observed on the eastern portion of the survey area between NMC and the SB 11 access road.

The information presented herein will be used by the project designers to finalize the pipeline routing and minimize potential impacts to wetlands where practicable.

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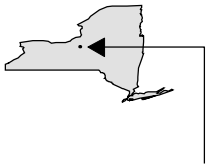
FIGURES

ADAPTED FROM: CAMILLUS AND SYRACUSE WEST USGS QUADRANGLES



MAP LOCATION

HONEYWELL
SLURRY PIPELINE
WETLAND DELINEATION
GEDDES AND CAMILLUS, NEW YORK

SITE LOCATION

LEGEND

SLURRY PIPELINE ROUTE

A, B, C SURVEY AREA BETWEEN POINTS A AND C

N

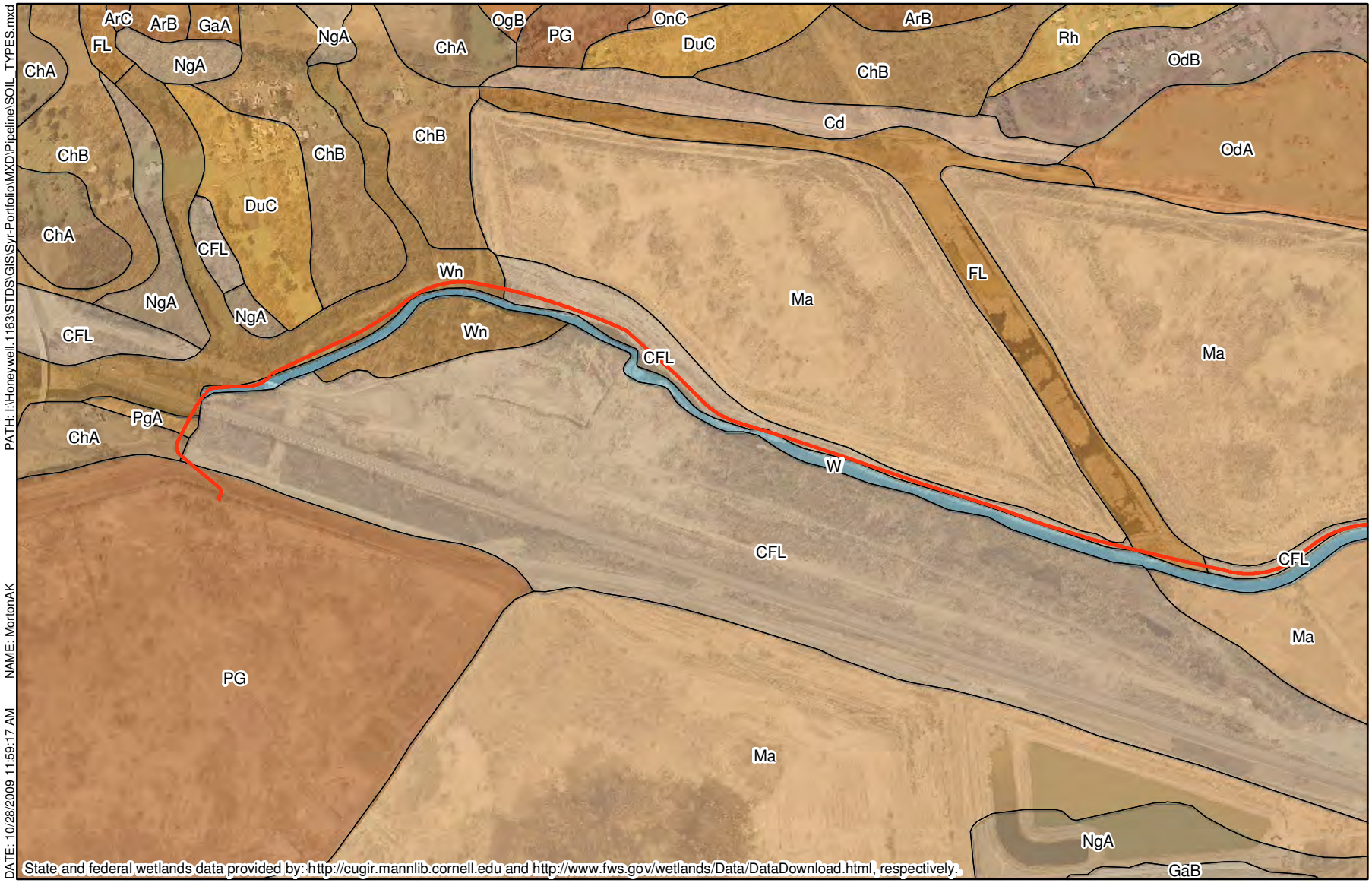
0 1,000 2,000 4,000 6,000 8,000

Feet

NOVEMBER 2009
1163/43776

1:28,000

O'BRIEN & GERE



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LEGEND

SLURRY PIPELINE ROUTE

CFL SOIL TYPE

HONEYWELL
SLURRY PIPELINE
WETLAND DELINEATION
GEDDES AND CAMILLUS, NEW YORK

SOIL TYPES

0 500 1,000 2,000
Feet

N

FIGURE 2

O'BRIEN & GERE

NOVEMBER 2009
1163/43776

PATH: I:\Honeywell.1163\STDS\GIS\Syr-Portfolio\MXD\Pipeline\ST-FED_WETLANDS.mxd

NAME: MortonAK

DATE: 10/28/2009 11:54:58 AM

HONEYWELL
SLURRY PIPELINE
WETLAND DELINEATION
GEDDES AND CAMILLUS, NEW YORK

STATE AND FEDERAL WETLANDS

0 500 1,000 2,000
Feet

N

FIGURE 3

O'BRIEN & GERE

NOVEMBER 2009
1163/43776

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NAME: MortonAK

DATE: 10/28/2009 11:56:37 AM

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LEGEND

- SLURRY PIPELINE ROUTE
- PREVIOUSLY DELINEATED WETLANDS (BY TES AND O'BRIEN & GERE)
- A, B, C SURVEY AREA BETWEEN POINTS A ND C

HONEYWELL
SLURRY PIPELINE
WETLAND DELINEATION
GEDDES AND CAMILLUS, NEW YORK

0 1,250 2,500 5,000
Feet

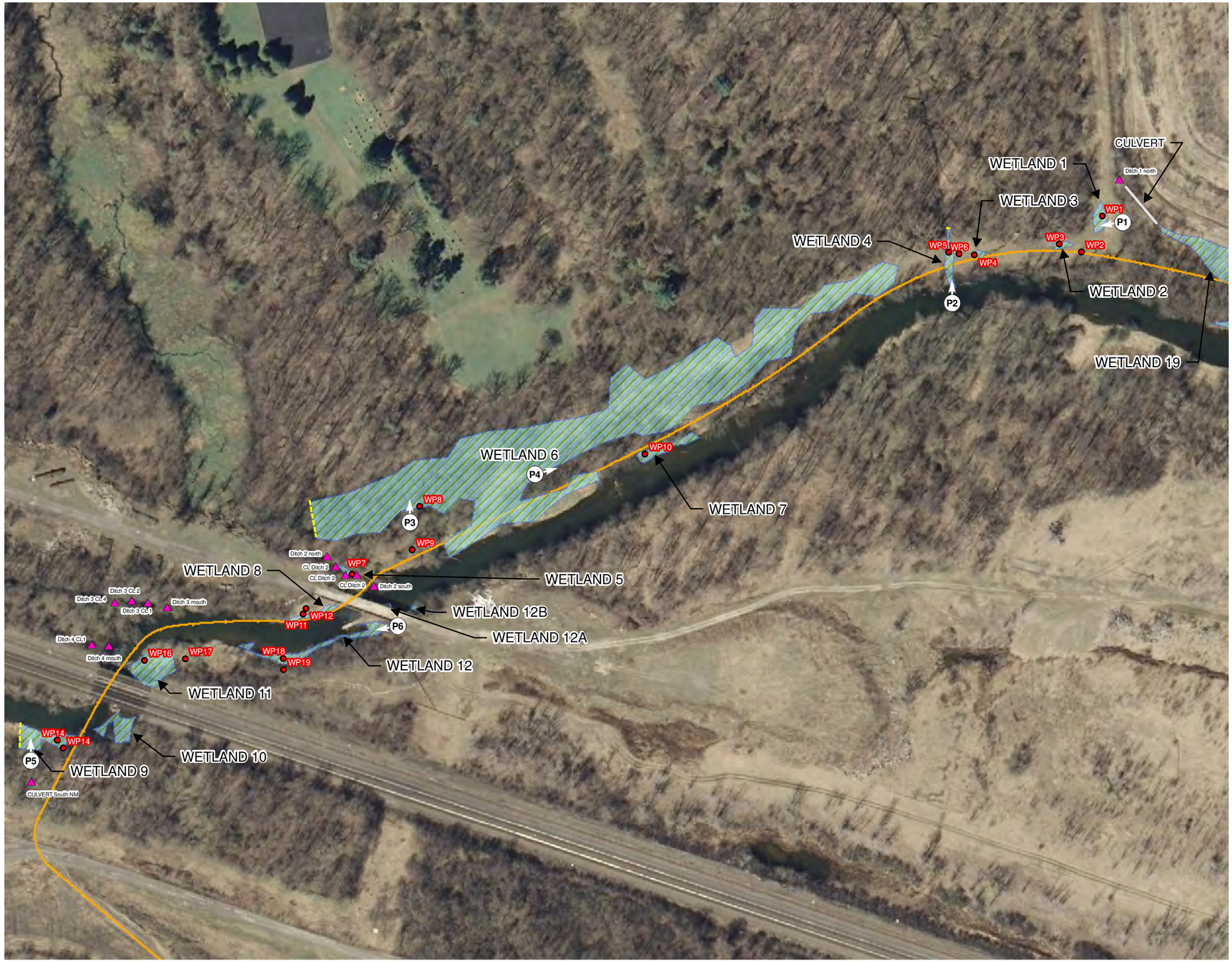
N

PREVIOUSLY DELINEATED WETLANDS

NOVEMBER 2009
1163.43776

O'BRIEN & GERE

FIGURE 5A



This document was developed in color. Reproduction in B/W may not represent the data as intended.

N

LEGEND

- DELINEATED WETLAND
- SLURRY PIPELINE ROUTE
- WETLAND PLOTS
- REFERENCE POINT
- OPEN END OF WETLAND
- PHOTO LOCATIONS

HONEYWELL
SLURRY PIPELINE
WETLAND DELINEATION
GEDDES AND CAMILLUS,
NEW YORK

DELINEATED WETLANDS (WEST)

0 75 150 300
Feet

NOVEMBER 2009
1163.43776

O'BRIEN & GERE

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NAME: NewtonJM

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FIGURE 5B

N

LEGEND

- DELINEATED WETLAND
- SLURRY PIPELINE ROUTE
- WETLAND PLOTS
- REFERENCE POINT

HONEYWELL
SLURRY PIPELINE
WETLAND DELINEATION
GEDDES AND CAMILLUS,
NEW YORK

DELINEATED WETLANDS (CENTRAL)

0 75 150 300
Feet

NOVEMBER 2009
1163.43776

O'BRIEN & GERE

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NAME: NewtonJM

DATE: 10/27/2009 4:36:11 PM

FIGURE 5C

N

LEGEND

- DELINEATED WETLAND
- SLURRY PIPELINE ROUTE
- PREVIOUSLY DELINEATED WETLANDS (TES)
- WETLAND PLOTS
- PHOTO LOCATIONS

HONEYWELL
SLURRY PIPELINE
WETLAND DELINEATION
GEDDES AND CAMILLUS,
NEW YORK

DELINEATED WETLANDS (EAST)

0 75 150 300
Feet

NOVEMBER 2009
1163.43776

O'BRIEN & GERE

This document was developed in color. Reproduction in B/W may not represent the data as intended.

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NAME: NewtonJM

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ATTACHMENT 1

Soils Information

Note: Attachment 1 is not available in this file on the DEC web site - See http://www.dec.ny.gov/chemical/66732.html
For contact and document registry information.

ATTACHMENT 2

Wetland Data Forms

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/15/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM/AES**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL1**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP1**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phalaris arundinacea *	**herb**	**FACW+**	**9**		
2 Onoclea sensibilis	**herb**	**FACW**	**10**		
3 Lythrum salicaria	**herb**	**FACW+**	**11**		
4 Eupatoriadelphus maculatus	**herb**	**FACW**	**12**		
5 Aster lateriflorus	**herb**	**FACW-**	**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**
*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	-	(in.)
Depth of Free Water in Pit:	-	(in.)
Depth to Saturated Soil:	-	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): **Wayland silt loam (Wn)**
Drainage Class **poorly drained**
Field Observations
Taxonomy (Subgroup) **Mollic Fluvaquents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-3		**10YR 3/2**	**--**	**--**	**clay loam**
3-9		**10YR 4/2**	**7.5YR 4/6**	**low/low**	**clay loam**
9-16		**10YR 5/2**	**7.5YR 5/8**	**high/moderate**	**sandy clay**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
X Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No			
Wetland Hydrology Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Hydric Soils Present?	**Yes**	No			

Remarks: **Plot located in depressional area located along the Sun Petroleum right-of-way adjacent to Ninemile Creek. (Orange flagging WL1-1 thru WL1-5)**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/15/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM/AES**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL1 and WL2**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**dry**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP2**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Artemisia vulgaris*	**herb**	**FACU-**	**9**		
2 Solidago canadensis*	**herb**	**FACU**	**10**		
***3 Rubus* sp.**	**herb**	**--**	**11**		
4 Helianthus tuberosus	**herb**	**FAC**	**12**		
5 Clematis virginiana	**herb**	**FAC**	**13**		
6 Phalaris arundinacea	**herb**	**FACW+**	**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **0%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water: **-** (in.)
Depth of Free Water in Pit: **-** (in.)
Depth to Saturated Soil: **-** (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): **Wayland silt loam (Wn)**
Drainage Class **poorly drained**
Field Observations
Taxonomy (Subgroup) **Mollic Fluvaquents**
Confirm Mapped Type? Yes **No**

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-12		**10YR 3/2**	**--**	**--**	**silty clay loam**
12-16		**10YR 5/2**	**--**	**--**	**silty clay loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
_____ Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	**No**	Is this Sampling Point Within a Wetland	Yes	**No**
Wetland Hydrology Present?	Yes	**No**			
Hydric Soils Present?	Yes	**No**			

Remarks: **WP2 is the associated dry hole for WL1 and WL2.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/15/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM/AES**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL2**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP3**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phalaris arundinacea*	**herb**	**FACW+**	**9**		
2 Lythrum salicaria	**herb**	**FACW+**	**10**		
3 Aster lanceolatus	**herb**	**FACW**	**11**		
4 Clematis virginiana	**herb**	**FAC**	**12**		
***5 Apocynum* sp.**	**herb**	**--**	**13**		
6 Verbena urticifolia	**herb**	**FACU**	**14**		
7 Chelone glabra	**herb**	**OBL**	**15**		
			16		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water: - (in.)
Depth of Free Water in Pit: - (in.)
Depth to Saturated Soil: - (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase):	**Wayland silt loam (Wn)**	Drainage Class	**poorly drained**
		Field Observations	
Taxonomy (Subgroup)	**Mollic Fluvaquents**	Confirm Mapped Type?	**Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-5		**10YR 3/2**	**--**	**--**	**silty clay loam**
5-9		**10YR 3/2**	**7.5YR 4/6**	**low/low**	**silty clay loam**
9-16		**10YR 4/2**	**7.5YR 4/6**	**moderate/moderate**	**silty clay loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
X Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Plot collected in a depressional area. Small wetland flagged WL2-1 thru WL2-4. Dry hole for WL2 is WP2.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/15/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM/AES**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL3**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP4**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phalaris arundinacea*	**herb**	**FACW+**	**9**		
2 Lythrum salicaria*	**herb**	**FACW+**	**10**		
3 Carex crinita	**herb**	**OBL**	**11**		
4 Rosa multiflora	**herb**	**FACU**	**12**		
5 Lysimachia nummularia	**herb**	**OBL**	**13**		
6 Acer saccharum	**herb**	**FACU-**	**14**		
7 Apocynum cannabinum	**herb**	**FACU**	**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: - (in.)
Depth of Free Water in Pit: - (in.)
Depth to Saturated Soil: - (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): **Wayland silt loam (Wn)**
Drainage Class Field Observations: **poorly drained**
Taxonomy (Subgroup): **Mollic Fluvaquents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-8		**10YR 4/2**	**--**	**--**	**clay loam**
8-16		**10YR 4/1**	**7.5YR 4/6**	**moderate/moderate**	**clay loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
x Reducing Conditions
x Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No			
Wetland Hydrology Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Hydric Soils Present?	**Yes**	No			

Remarks: **Plot collected in a depressional area. Flags WL3-1 thru WL3-4.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/15/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM/AES**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL4**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP5**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phalaris arundinacea *	**herb**	**FACW+**	***9 Euthamia graminifolia***	**herb**	**FAC**
2 Lythrum salicaria*	**herb**	**FACW+**	***10 Phragmites australis***	**herb**	**FACW**
3 Juncus effusus*	**herb**	**FACW+**	***11 Lycopus americanus***	**herb**	**OBL**
4 Sparganium americanum*	**herb**	**OBL**	***12 Carex lurida***	**herb**	**OBL**
5 Myosotis scorpioides	**herb**	**FACW+**	**13**		
6 Eupatorium perfoliatum	**herb**	**FACW+**	**14**		
7 Solidago canadensis	**herb**	**FACU**	**15**		
8 Aster lanceolatus	**herb**	**FACW**	**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water:	**-**	(in.)
Depth of Free Water in Pit:	**-**	(in.)
Depth to Saturated Soil:	**0**	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
X Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks: **Stream/drainage draining into Ninemile Creek.**

SOILS

Map Unit Name (Series and Phase): **Wayland silt loam (Wn)**
Drainage Class **poorly drained**
Field Observations
Taxonomy (Subgroup) **Mollic Fluvaquents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-7		**10YR 3/2**	**--**	**--**	**silty loam**
7-15		**10YR 4/1**	**--**	**--**	**silty loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
X Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **Saturated at surface. High percentage of organic material with presence of gleying, roots/leaves, sulfidic odor. from 7-15". Hard layer/refusal reached at 15".**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Flags WL4-1 thru WL4-11.**
At flags 5 and 6 the wetland continues north beyond survey area.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/15/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM/AES**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL4**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**dry**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP6**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Artemisia vulgaris*	**herb**	**FACU-**	***9 Carex* sp.****	**herb**	**--**
2 Solidago canadensis*	**herb**	**FACU**	**10**		
3 Verbena urticifolia	**herb**	**FACU**	**11**		
4 Rosa multiflora	**herb**	**FACU**	**12**		
5 Aster novae-angliae	**herb**	**FACW-**	**13**		
6 Phalaris arundinacea	**herb**	**FACW+**	**14**		
***7 Viola* sp.**	**herb**	**--**	**15**		
***8 Equisetum* sp.**	**herb**	**--**	**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **0%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water:	-	(in.)
Depth of Free Water in Pit:	-	(in.)
Depth to Saturated Soil:	-	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase):	**Wayland silt loam (Wn)**	Drainage Class	**poorly drained**
Taxonomy (Subgroup)	**Mollic Fluvaquents**	Field Observations Confirm Mapped Type?	Yes **No**

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-5		**10YR 3/3**	**--**	**--**	**clay loam**
5-14		**7.5YR 4/2**	**--**	**--**	**gravelly loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
_____ Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **Between 5-14 inches increase of gravel percentage; loose structure. Refusal at 14 inches.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	**No**	Is this Sampling Point Within a Wetland	Yes	**No**
Wetland Hydrology Present?	Yes	**No**			
Hydric Soils Present?	Yes	**No**			

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/15/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM/AES**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL5 (Ditch-BI bridge)**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP7**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phalaris arundinacea *	**herb**	**FACW+**	**9**		
2 Myosotis scorpioides*	**herb**	**FACW+**	**10**		
3 Solidago canadensis	**herb**	**FACU**	**11**		
4 Aster lanceolatus	**herb**	**FACW**	**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water:	**-**	(in.)
Depth of Free Water in Pit:	**3**	(in.)
Depth to Saturated Soil:	**0**	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
X Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): **Wayland silt loam (Wn)**
Drainage Class **poorly drained**
Field Observations
Taxonomy (Subgroup) **Mollic Fluvaquents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-10		**10YR 3/1**	**--**	**--**	**silt**
10-16		**10YR 4/1**	**--**	**--**	**silty sand**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
X Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **0-10" increase in organic material.**
10-16" displayed streaking of surface organic material.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Flags WL5-1 thru WL5-3 along western edge and center line of ditch.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/15/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM/AES**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL6**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP8**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Myosotis scorpioides*	**herb**	**FACW+**	**9**		
2 Sparganium americanum*	**herb**	**OBL**	**10**		
3 Ribes americanum*	**shrub**	**FACW**	**11**		
4 Lysimachia nummularia	**herb**	**OBL**	**12**		
5 Fraxinus pennsylvanica	**shrub**	**FACU-**	**13**		
6 Fraxinus pennsylvanica	**tree**	**FACU-**	**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**

*** = dominant species**

Remarks: **Just north of plot, *Phalaris* , *Phragmites* , and *Cornus* sp. become more dominant.**

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water:	-	(in.)
Depth of Free Water in Pit:	-	(in.)
Depth to Saturated Soil:	-	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): **Wayland silt loam (Wn)**
Drainage Class **poorly drained**
Field Observations
Taxonomy (Subgroup) **Mollic Fluvaquents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-3		**10YR 3/1**	**--**	**--**	**loam**
3-16		**10YR 3/1**	**7.5 YR 4/6**	**high/low**	**loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **Moist soil.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Flags WL6-1 thru WL6-75. Flag WL6-47 located near WP5.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/15/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM/AES**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL6**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**dry**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP9**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Rosa multiflora*	**herb**	**FACU**	**9**		
2 Aster lateriflorus*	**herb**	**FACW-**	**10**		
3 Clematis virginiana*	**herb**	**FAC**	**11**		
4 Lysimachia nummularia*	**herb**	**OBL**	**12**		
5 Solidago canadensis*	**herb**	**FACU**	**13**		
6 Solidago gigantea*	**herb**	**FACW**	**14**		
7 Viola* sp.*,*	**herb**	**--**	**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **50%**

*** = dominant species ** = species are not included as part of the percent dominance calculation.**

Remarks: **All species equally dominant.**

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water: **-** (in.)
Depth of Free Water in Pit: **-** (in.)
Depth to Saturated Soil: **-** (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): **Wayland silt loam (Wn)**
Drainage Class Field Observations: **poorly drained**
Taxonomy (Subgroup) **Mollic Fluvaquents**
Confirm Mapped Type? Yes **No**

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-14		**10YR 3/2**	**--**	**--**	**loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
_____ Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **No mottling observed.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	Yes	**No**
Wetland Hydrology Present?	Yes	**No**			
Hydric Soils Present?	Yes	**No**			

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/15/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM/AES**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL7**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP10**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phalaris arundinacea *	**herb**	**FACW+**	***9 Clematis virginiana***	**herb**	**FAC**
2 Elymus riparius*	**herb**	**FACW**	***10 Arcticum minus***	**herb**	**--**
3 Ribes americanum*	**shrub**	**FACW**	***11 Peltandra virginica***	**herb**	**OBL**
4 Lythrum salicaria	**herb**	**FACW+**	***12 Toxicodendron radicans***	**herb**	**FAC**
5 Verbena urticifolia	**herb**	**FACU**	***13 Ageratina altissima***	**herb**	**FACU-**
6 Myosotis scorpioides	**herb**	**FACW+**	***14 Fraxinus americana***	**herb**	**FACU**
7 Rosa multiflora	**herb**	**FACU**	**15**		
8 Lysimachia nummularia	**herb**	**OBL**	**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water: **--** (in.)
Depth of Free Water in Pit: **--** (in.)
Depth to Saturated Soil: **--** (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks: **Soil slightly moist at surface.**
Proximity to Ninemile Creek (at edge).

SOILS

Map Unit Name (Series and Phase): **Wayland silt loam (Wn)**
Drainage Class **poorly drained**
Field Observations
Taxonomy (Subgroup) **Mollic Fluvaquents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-10		**10YR 4/2**	**10YR 5/6**	**moderate/moderate**	**silty loam**
10-16		**10YR 4/2**	**7.5Yr 4/6**	**moderate/moderate**	**silty loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
X Reducing Conditions
_____ Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Sample plot located adjacent to flags WL6-32 to WL6-35.**
Flags WL7-1 thru WL7-7.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/16/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM/AES**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL8**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP11**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phragmites australis*	**herb**	**FACW**	***9 Cirsium discolor***	**herb**	**--**
2 Phalaris arundinacea *	**herb**	**FACW+**	***10 Lythrum salicaria***	**herb**	**FACW+**
3 Brassica nigra	**herb**	**--**	***11 Dipsacus sylvestris***	**herb**	**NI**
4 Urtica procera	**herb**	**FACU**	***12 Xanthium chinense***	**herb**	**FAC**
5 Arcticum lappa	**herb**	**--**	**13**		
6 Solidago canadensis	**herb**	**FACU**	**14**		
7 Alliaria officinalis	**herb**	**FACU-**	**15**		
8 Solanum dulcamara	**herb**	**FAC-**	**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water:	-	(in.)
Depth of Free Water in Pit:	-	(in.)
Depth to Saturated Soil:	-	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
X Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks: **Adjacent to stream and displays evidence of scour and deposition.**

SOILS

Map Unit Name (Series and Phase): **Wayland silt loam (Wn)**
Drainage Class **poorly drained**
Field Observations
Taxonomy (Subgroup) **Mollic Fluvaquents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-6		**10YR 4/2**	**--**	**--**	**silty clay**
6-16		**10YR 3/2**	**7.5YR 4/4**	**moderate/low**	**clay silt**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
X Reducing Conditions
_____ Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Flags WL-8-1 to WL8-6. Reference points taken on GPS demarcating Ninemile Creek bank edge.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/16/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM/AES**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL8**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**dry**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP12**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Solanum dulcamara*	**herb**	**FAC-**	**9**		
2 Alliaria officinalis*	**herb**	**FACU-**	**10**		
3 Cirsium discolor*, *	**herb**	**--**	**11**		
4 Fraxinus americana	**tree**	**FACU**	**12**		
5 Phragmites australis	**herb**	**FACW**	**13**		
6 Urtica procera	**herb**	**FACU**	**14**		
7 Phalaris arundinacea	**herb**	**FACW+**	**15**		
8 Brassica nigra	**herb**	**--**	**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **0%**

*** = dominant species ** = species are not included as part of the percent dominance calculation.**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water:	-	(in.)
Depth of Free Water in Pit:	-	(in.)
Depth to Saturated Soil:	-	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase):	**Wayland silt loam (Wn)**	Drainage Class	**poorly drained**
Taxonomy (Subgroup)	**Mollic Fluvaquents**	Field Observations Confirm Mapped Type?	Yes **No**

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-12		**10YR 4/2**	**--**	**--**	**silty clay**
12-16		**10YR 4/2**	**7.5YR 4/6**	**low/low**	**silty clay**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
_____ Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **Mottling not observed within the depth criteria.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	**No**	Is this Sampling Point Within a Wetland	Yes	**No**
Wetland Hydrology Present?	Yes	**No**			
Hydric Soils Present?	Yes	**No**			

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/16/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL9**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP13**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phragmites australis*	**herb**	**FACW**	**9**		
2			**10**		
3			**11**		
4			**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**
*** = dominant species**

Remarks: **Closer to creekside, *Impatiens pallida* and *Lythrum salicaria* were observed.**

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water:	**-**	(in.)
Depth of Free Water in Pit:	**-**	(in.)
Depth to Saturated Soil:	**0**	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
X Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks: **Soil saturated at surface.**

SOILS

Map Unit Name (Series and Phase):	**Palmyra gravelly loam (PgA)**	Drainage Class	**well drained**
Taxonomy (Subgroup)	**Glossoboric Hapludalfs**	Field Observations Confirm Mapped Type?	Yes **No**

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-8		**10YR 4/2**	**7.5YR 4/6**	**high/high**	**silty clay**
8-16		**Gley 1 2.5N**	**--**	**--**	**muck**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Plot collected approximately 10 feet from Ninemile Creek edge on south bank.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/16/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL9 and WL10**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**dry**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP14**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Tilia americana*	**tree**	**FACU**	**9**		
2 Prunus serotina*	**tree**	**FACU**	**10**		
3 Rhamnus cathartica	**shrub**	**FACU**	**11**		
4 Lonicera tatarica*	**shrub**	**FACU**	**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **0%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water: - (in.)
Depth of Free Water in Pit: - (in.)
Depth to Saturated Soil: - (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): **Palmyra gravelly loam (PgA)**
Drainage Class **well drained**
Field Observations
Taxonomy (Subgroup) **Glossoboric Hapludalfs**
Confirm Mapped Type? Yes **No**

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-16		**10YR 2/2**	**--**	**--**	**dry silty loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
_____ Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	**No**	Is this Sampling Point Within a Wetland	Yes	**No**
Wetland Hydrology Present?	Yes	**No**			
Hydric Soils Present?	Yes	**No**			

Remarks: **Plot collected on bank southeast of WP13.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/16/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL10**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP15**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phragmites australis*	**herb**	**FACW**	**9**		
2			**10**		
3			**11**		
4			**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: - (in.)
Depth of Free Water in Pit: - (in.)
Depth to Saturated Soil: - (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): **Palmyra gravelly loam (PgA) / Cut and Fill Land (CFL)**
Drainage Class: **well drained / somewhat excessively drained**
Field Observations
Taxonomy (Subgroup): **Glossoboric Hapludalfs / Udorthents**
Confirm Mapped Type? Yes **No**

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-10		**10YR 4/2**	**7.5YR 4/6**	**high/high**	**silty clay**
10-14		**Gley 1 3N**	**--**	**--**	**grey muck**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **Refusal at 14 inches.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Plot location on the south bank of Ninemile Creek southwest of CSX railroad bridge.**
Dry hole paired location is WP14.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/16/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL11**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP16**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phragmites australis*	**herb**	**FACW**	**9**		
2 Phalaris arundinacea*	**herb**	**FACW+**	**10**		
3 Agrostis stolonifera*	**herb**	**FACW**	**11**		
4 Apocynum cannabinum	**herb**	**FACU**	**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**
*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water: **-** (in.)
Depth of Free Water in Pit: **-** (in.)
Depth to Saturated Soil: **-** (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): **Cut and Fill Land (CFL)**
Drainage Class Field Observations: **somewhat excessively drained**
Taxonomy (Subgroup) **Udorthents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-8		**10YR 4/2**	**--**	**--**	**silt loam**
8-15		**10YR 4/2**	**5YR 5/8**	**moderate/moderate**	**silt loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Plot located on south bank of Ninemile Creek immediately east of CSX railroad bridge.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/16/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL11**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**dry**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP17**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1Solidago canadensis*	**herb**	**FACU**	**9**		
2			**10**		
3			**11**		
4			**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **0%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water: - (in.)
Depth of Free Water in Pit: - (in.)
Depth to Saturated Soil: - (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): **Cut and Fill Land (CFL)**
Drainage Class Field Observations: **somewhat excessively drained**
Taxonomy (Subgroup) **Udorthents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-11		**10YR 3/2**	**--**	**--**	**loose silty loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **Refusal at 11 inches. Gross roots in soil.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	**No**	Is this Sampling Point Within a Wetland	Yes	**No**
Wetland Hydrology Present?	Yes	**No**			
Hydric Soils Present?	Yes	**No**			

Remarks: **Plot located south of WP16 in a stand of *Solidago* sp.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/20/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL12**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP18**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phragmites australis*	**herb**	**FACW**	**9**		
2 Phalaris arundinacea*	**herb**	**FACW+**	**10**		
3 Solanum dulcamara*	**herb**	**FAC-**	**11**		
4 Brassica nigra	**herb**	**--**	**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **67%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	**-**	(in.)
Depth of Free Water in Pit:	**-**	(in.)
Depth to Saturated Soil:	**-**	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
X Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase):	**Cut and Fill Land (CFL)**	Drainage Class Field Observations	**somewhat excessively drained**
Taxonomy (Subgroup)	**Udorthents**	Confirm Mapped Type?	**Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-5		**10YR 4/2**	**--**	**--**	**silt with some clay**
5-13		**10YR 4/2**	**7.5YR 5/8**	**moderate/moderate**	**silty clay**
13-18		**2.5Y 4/1**	**--**	**--**	**silty clay**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: ***Phragmites* shoots throughout. Grey to black streaking at 18"+ with a sewage/manure odor.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Plot located on south bank of Ninemile Creek between CSX and Belle Isle bridges. Flags WL12-1 thru WL12-16.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/20/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL12**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**dry**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP19**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Rhamnus cathartica*	**shrub**	**FACU**	**9**		
2 Lonicera tatarica*	**shrub**	**FACU**	**10**		
3 Cornus racemosa*	**shrub**	**FAC-**	**11**		
4 Solidago altissima	**herb**	**FACU-**	**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **0%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water:	**-**	(in.)
Depth of Free Water in Pit:	**-**	(in.)
Depth to Saturated Soil:	**-**	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks: **none**

SOILS

Map Unit Name (Series and Phase): **Cut and Fill Land (CFL)**
Drainage Class Field Observations: **somewhat excessively drained**
Taxonomy (Subgroup) **Udorthents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-15		**2.5Y 3/1**	**--**	**--**	**dry, loose silt loam with gross roots with some gravel**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **Plot located in a suspected fill area on the south bank above Ninemile Creek. Soil meets color indicator, but does not resemble a hydric soil. Likely a fill area associated with the railroad.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	**No**	Is this Sampling Point Within a Wetland	Yes	**No**
Wetland Hydrology Present?	Yes	**No**			
Hydric Soils Present?	Yes	**No**			

Remarks: **Plot located south of WP18.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/20/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL14**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP22**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phragmites australis*	**herb**	**FACW**	**9**		
2			**10**		
3			**11**		
4			**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	**-**	(in.)
Depth of Free Water in Pit:	**9**	(in.)
Depth to Saturated Soil:	**8**	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
X Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks: **Seep drainage area with puddles of standing water.**

SOILS

Map Unit Name (Series and Phase):	**Cut and Fill Land (CFL)**	Drainage Class Field Observations	**somewhat excessively drained**
Taxonomy (Subgroup)	**Udorthents**	Confirm Mapped Type?	**Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
surface		**--**	**--**	**--**	***Phragmites* litter**
0-10		**5Y 2.5/1**	**5YR 4/6**	**moderate/moderate**	**clay silt**
10+		**Gley 2 2.5/10B**	**--**	**--**	**gravelly black, clay silt**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Plot located at base of access road slope just north of Ninemile Creek.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/21/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL14 and WL15**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**dry**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP23**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Solidago canadensis*	**herb**	**FACU**	**9**		
2 Poa pratensis*	**herb**	**FACU**	**10**		
3 Phragmites australis	**herb**	**FACW**	**11**		
4			**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **0%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water: - (in.)
Depth of Free Water in Pit: - (in.)
Depth to Saturated Soil: - (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase):	**Cut and Fill Land (CFL)**	Drainage Class Field Observations	**somewhat excessively drained**
Taxonomy (Subgroup)	**Udorthents**	Confirm Mapped Type?	**Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-12		**10YR 4/2**	**--**	**--**	**silty clay**
12-13		**10YR 5/6**	**--**	**--**	**silty clay**
13+		**10YR 5/2**	**10YR 4/6**	**low/moderate**	**silty clay**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
_____ Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **A few mottles below 13 inches. Does not meet hydric indicator depth.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	**No**	Is this Sampling Point Within a Wetland	Yes	**No**
Wetland Hydrology Present?	Yes	**No**			
Hydric Soils Present?	Yes	**No**			

Remarks: **Plot is a dry hole for WL14 and WL15.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/21/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL15**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP24**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phragmites australis*	**herb**	**FACW**	**9**		
2 Solidago gigantea*	**herb**	**FACW**	**10**		
3 Solidago canadensis*	**herb**	**FACU**	**11**		
4			**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **75%**

*** = dominant species**

Remarks: ***Phragmites* 50% dominant, *Solidago* sp. each 25% dominant.**

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water: - (in.)
Depth of Free Water in Pit: - (in.)
Depth to Saturated Soil: - (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks: **Proximity to Ninemile Creek and toe of slope of SB 11 and access road.**

SOILS

Map Unit Name (Series and Phase):	**Cut and Fill Land (CFL)**	Drainage Class Field Observations	**somewhat excessively drained**
Taxonomy (Subgroup)	**Udorthents**	Confirm Mapped Type?	**Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-3		**10YR 3/2**	**--**	**--**	**loose loam with roots**
3-14		**10YR 4/1**	**10YR 4/6**	**moderate/moderate**	**silty clay**
14-18		**2.5Y 5/3**	**10YR 5/6**	**moderate/moderate**	**sandy clay**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/21/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL16**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP25**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phragmites australis*	**herb**	**FACW**	**9**		
2			**10**		
3			**11**		
4			**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water:	**-**	(in.)
Depth of Free Water in Pit:	**2**	(in.)
Depth to Saturated Soil:	**0**	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
X Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks: **Saturated at surface.**

SOILS

Map Unit Name (Series and Phase): **Cut and Fill Land (CFL)**
Drainage Class **somewhat excessively drained**
Field Observations
Taxonomy (Subgroup) **Udorthents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-2		**--**	**--**	**--**	**Phragmites litter**
2-10		**7.5YR 5/2**	**2.5Y 3/1**	**--**	**clay with small/medium gravel**
10-15		**7.5YR 5/2**	**2.5Y 3/1**	**--**	**clay with increase in gravel size and presence**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **Rust coloring. An increase in gravel size and abundance at 10" in depth.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No			
Wetland Hydrology Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Hydric Soils Present?	**Yes**	No			

Remarks: **Plot located in a potential drainage ditch (north to south) connecting with Ninemile Creek. Ditch is approximately 3 feet wide. No apparent culvert is associated with the ditch.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/21/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL16**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**dry**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP26**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Festuca arundinacea*	**herb**	**FACU**	**9**		
2 Plantago major*	**herb**	**FACU**	**10**		
3 Solidago canadensis	**herb**	**FACU**	**11**		
4 Aster lateriflorus	**herb**	**FACW-**	**12**		
5 Daucus carota	**herb**	**--**	**13**		
6 Achillea millefolium	**herb**	**FACU**	**14**		
7 Lythrum salicaria	**herb**	**FACW+**	**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **0%**

*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water:	**-**	(in.)
Depth of Free Water in Pit:	**-**	(in.)
Depth to Saturated Soil:	**-**	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase):	**Cut and Fill Land (CFL)**	Drainage Class Field Observations	**somewhat excessively drained**
Taxonomy (Subgroup)	**Udorthents**	Confirm Mapped Type?	**Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-5		**10YR 3/2**	**--**	**--**	**silt loam**
5-7		**10YR 3/2**	**10YR 6/8**	**low/low**	**silt loam**
7-8		**10YR 3/2**	**--**	**--**	**silt loam with shale**
8-15		**10YR 5/6**	**--**	**--**	**loam with gravel**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
_____ Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **No moisture. Soil matrix colors not strong. Mottling present was faint and not consistent throughout depth interval. Refusal at 15 inches.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	**No**	Is this Sampling Point Within a Wetland	Yes	**No**
Wetland Hydrology Present?	Yes	**No**			
Hydric Soils Present?	Yes	**No**			

Remarks: **Plot located upgradient of ditch area and Ninemile Creek bank.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/21/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL17**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP27**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phragmites australis*	**herb**	**FACW**	**9**		
2 Lythrum salicaria	**herb**	**FACW+**	**10**		
3			**11**		
4			**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**
*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water:	-	(in.)
Depth of Free Water in Pit:	-	(in.)
Depth to Saturated Soil:	-	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks: **Likely seep drainage from side of slope and high water events from Ninemile Creek.**

SOILS

Map Unit Name (Series and Phase):	**Cut and Fill Land (CFL)**	Drainage Class Field Observations	**somewhat excessively drained**
Taxonomy (Subgroup)	**Udorthents**	Confirm Mapped Type?	**Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-2		**--**	**--**	**--**	**cinder material**
2-14		**7.5YR 5/2**	**10YR 5/6**	**--**	**silt loam with some clay**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **Cinder material - hard material, not natural.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Plot located on north bank of Ninemile Creek directly across from gravel deposit (island) centrally located in Ninemile Creek. Large amounts of driftwood debris have collected on this island.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/21/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL18**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP28**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phragmites australis*	**herb**	**FACW**	**9**		
2 Lythrum salicaria	**herb**	**FACW+**	**10**		
3 Solanum dulcamara	**herb**	**FAC-**	**11**		
4			**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**

*** = dominant species**

Remarks: **Line between wet and dry vegetation is a line of *Festuca arundinacea* .**

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water: - (in.)
Depth of Free Water in Pit: - (in.)
Depth to Saturated Soil: - (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks: **Fringe wetland along north bank of Ninemile Creek.**

SOILS

Map Unit Name (Series and Phase): **Cut and Fill Land (CFL)**
Drainage Class **somewhat excessively drained**
Field Observations
Taxonomy (Subgroup) **Udorthents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-14		**10YR 4/2**	**--**	**--**	**silty clay**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
_____ Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks: **Plot located on stream bank with deposition and scouring, so mottling likely does not have time to form. Refusal at 14 inches.**

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks: **Flags WL18-1 thru WL18-3. Shoreline can be demarcated by connecting flags 1 and 3.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/21/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL19**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**dry**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP29**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Festuca arundinacea*	**herb**	**FACU**	**9**		
2 Lonicera tatarica*	**shrub**	**FACU**	**10**		
3 Solidago canadensis	**herb**	**FACU**	**11**		
4			**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **0%**

*** = dominant species**

Remarks: ***Rhamnus cathartica* observed in the surrounding area.**

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water: - (in.)
Depth of Free Water in Pit: - (in.)
Depth to Saturated Soil: - (in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): **Cut and Fill Land (CFL)**
Drainage Class Field Observations: **somewhat excessively drained**
Taxonomy (Subgroup) **Udorthents**
Confirm Mapped Type? **Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-15		**10YR 3/2**	**--**	**--**	**silty clay loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
_____ Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	**No**	Is this Sampling Point Within a Wetland	Yes	**No**
Wetland Hydrology Present?	Yes	**No**			
Hydric Soils Present?	Yes	**No**			

Remarks: **Plot located approximately 20 feet south of access road.**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	**Slurry Pipeline Route**	Date:	**10/21/2009**
Applicant/Owner:	**Honeywell**	County:	**Onondaga**
Investigator:	**RPC/AKM**	State:	**NY**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	**WL19**
Is the site significantly disturbed (atypical situation?)	Yes	**No**	Transect ID:	**wet**
Is the area a potential Problem Area? (if needed, explain on reverse).	Yes	**No**	Plot ID	**WP30**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Phalaris arundinacea *	**herb**	**FACW+**	**9**		
2 Phragmites australis*	**herb**	**FACW**	**10**		
3			**11**		
4			**12**		
5			**13**		
6			**14**		
7			**15**		
8			**16**		

Percent of Dominant Species that are OBL, FACW or FAC, (excluding FAC-). **100%**
*** = dominant species**

Remarks:

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__ No Recorded Data Available

Field Observations:

Depth of Surface Water:	-	(in.)
Depth of Free Water in Pit:	-	(in.)
Depth to Saturated Soil:	-	(in.)

Wetland Hydrology Indicators:
Primary Indicators:
_____ Inundated
_____ Saturated in Upper 12 inches
_____ Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
_____ Oxidized Root Channels in Upper 12 inches
_____ Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
_____ Other (Explain in Remarks)

Remarks: **Proximity to Ninemile Creek approximately 6 feet from creek waters edge.**

SOILS

Map Unit Name (Series and Phase):	**Cut and Fill Land (CFL)**	Drainage Class Field Observations	**somewhat excessively drained**
Taxonomy (Subgroup)	**Udorthents**	Confirm Mapped Type?	**Yes** No

Profile Description:

Depth (Inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-8		**10YR 4/2**	**--**	**--**	**silty clay loam**
8-16		**10YR 4/2**	**7.5 YR 4/6**	**moderate/low**	**silty clay loam**

Hydric Soil Indicators:
_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
X Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in Surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland	**Yes**	No
Wetland Hydrology Present?	**Yes**	No			
Hydric Soils Present?	**Yes**	No			

Remarks:

ATTACHMENT 3

Photograph Log

Photo 1 (P1). Looking west at Wetland 1 (WL1) a depressed area dominated by reed canary grass.
Date: October 15, 2009

Photo 2 (P2). Looking north at Wetland 4 (WL4) along a stream/drainage way discharging to Ninemile Creek.
Date: October 15, 2009

Photo 3 (P3). Looking north at the western portion of WL6 dominated with reed canary grass and forget-me-not.
Date: October 15, 2009

Photo 4 (P4). Looking east along the southern boundary of Wetland 6 (WL6).
Date: October 15, 2009

Photo 5 (P5). Looking north at fringe Wetland 9 (WL9) along Ninemile Creek dominated by common reed and reed canary grass.
Date: October 16, 2009

Photo 6 (P6). Looking southwest from Belle Isle bridge along Ninemile Creek fringe Wetland 12 (WL12).
Date: October 20, 2009

Photo 7 (P7). Looking southwest at Wetland 15 (WL15) consisting of a typical stand of common reed.
Date: October 21, 2009

Photo 8 (P8). Looking east along the southern boundary of Wetland 16 (WL16) consisting of a stand of common reed.
Date: October 21, 2009

APPENDIX F

CONVEYANCE SYSTEM HEADLOSS CALCULATIONS

Note: "The Handbook of Dregging Engineering " and the "Advanced Water Distribution Modeling" documents are not available in this file on the DEC web site - See http://www.dec.ny.gov/chemical/66732.html for contact and document registry information.

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DRAFT

TECHNICAL MEMORANDUM

January 22, 2010

To: Onondaga Lake Sediment Management Intermediate Design Submittal

From: Jamie Fettig, Ajish Nambiar, and Adam Mickel; Parsons

Subject: Preliminary Slurry Pipeline Hydraulic Analysis

INTRODUCTION

As part of the remediation activities in and around Onondaga Lake, it has been proposed to dredge portions of the Lake bottom sediments. The dredged sediment slurry will be transported via an approximately 19,826 feet high-density polyethylene (HDPE) pipeline to a remote Sediment Consolidation Area (SCA) for dewatering and consolidation. Booster pump stations will be positioned along the pipeline approximately every 4000-6000 ft.

Design related activities associated with the slurry pipeline system will include a system hydraulic analysis and a sediment critical velocity analysis for the dredged slurry. The results from the two analyses will be used to select the optimal pipe size and rating, pump horsepower requirements, and slurry flow velocity requirements. The analysis will include the following components:

1. Preliminary headloss calculations and system curves;
2. Required pipeline slurry velocities; and
3. Pump power requirements.

SYSTEM ANALYSIS

The following analyses will be performed as part of the overall system hydraulic analysis:

1. Selection of the headloss calculation method;
2. System headloss calculations and system curves;
3. Slurry velocity calculations; and
4. Booster pump power requirements.

Headloss Calculations and System Curve

The approach, method, and development of the system curves are described in this section.

Method Approach

The slurry pipeline will be analyzed as a complete system (from the first booster pump to the SCA discharge) as well as individual reaches between booster pump stations. For the purposes of this package, only the system analysis will be considered. The total headloss through the system is the sum of three separate headloss components: (1) friction loss; (2) minor loss and; and (3) static headloss.

Friction Loss Calculation Method

Various methods have been used in computing the headloss for a slurry pipeline application. Many of these incorporate the effects of slurry solids on friction loss and have been empirically-derived. The following methods will be examined as a means to calculate the friction headloss for the proposed slurry pipeline:

1. Darcy-Weisbach
2. Durand
3. Newitt
4. Hazen-Williams

Darcy-Weisbach Method

The Darcy-Weisbach method of calculating friction losses in piping systems is derived via dimensional analysis and is given by Equation 1 (Equation 7.83, Herbich 2000)

$$h_f = SG_m \cdot f \frac{L}{D} \frac{V^2}{2g} \qquad \text{Eq}^{\underline{n}}\ 1$$

Where, h_f = headloss due to friction (ft.)
SG_m = specific gravity of the pumped slurry
L = length of pipe (ft.)
D = inner pipe diameter (ft.)
V = pipeline velocity (ft/sec)
g = Acceleration due to gravity (ft/sec^2)
f = Darcy-Weisbach friction factor, read from the Moody Diagram

Durand Method

The Durand method incorporates the physical properties of the slurry solids in its formula. This is accounted in the formula by introducing the sediment drag coefficient and is given in Equation 2 (Equation 7.86 Herbich, 2000):

$$h_{f,m} = 81 C_v h_f \left[(SG_s - 1) \frac{gD}{V^2} \left(\frac{1}{\sqrt{C_D}} \right) \right] + h_f \qquad \text{Eq}^{\underline{n}}\ 2$$

Where, $h_{f,m}$ = headloss due to friction in the slurry pipeline (ft.)
h_f = headloss due to friction in an equivalent pipe flowing with clean water (ft.)
C_v = concentration of the slurry by volume
SG_s = specific gravity of solid particles
C_D = sediment drag coefficient

Newitt Method

The Newitt method is similar to the Durand method in that it includes a term to account for the additional headloss contributed by the solids in the slurry pipeline. Specifically, the particle terminal settling velocity is factored into the Newitt calculation. The equation is given in Equation 3 (Equation 7.88, Herbich 2000):

$$h_{f,m} = h_f \left[1100 C_v (SG_s - 1) \frac{gD}{V^2} \frac{v_t}{V} + 1 \right] \qquad \text{Eq}^{\underline{n}}\ 3$$

Where, v_t = terminal particle settling velocity (ft/sec)

Hazen-Williams Method

The Hazen-Williams equation is an empirically-derived equation and is given in Equation 4:

$$h_f = \frac{4.57 L}{C^{1.853} D^{4.87}} Q^{1.852} \qquad \text{Eq}^{\underline{n}}\ 4$$

Where, C = Hazen-Williams roughness coefficient
Q = System flowrate (ft^3/sec)

The roughness coefficient is an empirical constant that describes the pipe and fluid travelling through the system. For fluids containing solids, this coefficient can be read from plots, such as from Turner, Figure 7.31, Herbich, 2000.

The headloss of an equivalent pipe flowing with clean water can be calculated via any headloss equation. For this analysis the Hazen-Williams method will be applied to calculate the clean water headloss for the slurry pipe headloss calculation.

Minor Losses

The minor losses through the system will be quantified as fractions of velocity head, according to Equation 5 (Equation 7.94, Herbich).

$$h_l = k_l \frac{V^2}{2g} \qquad \text{Eq}^{\underline{n}}\ 5$$

Where, h_l = Total minor headloss
k_l = Total minor loss coefficient through reach (sum of individual minor loss coefficients)

This approach will be used when calculating the minor losses throughout the hydraulic analysis. During this analysis, three types of minor losses were considered and were obtained from Table 2.6, Haestad Methods, 2003:

1. Wide-radius bend (k_l = 0.20)
2. Plug valve (k_l = 1.10)
3. Check valve (k_l = 4.00)

The type and quantity of minor losses assumed in this preliminary analysis of the pipeline system are as follows.

Type	Quantity
Wide-Radius Bend	17
Plug Valve	9
Check Valve	1

System Curves

System headloss curves were developed for the slurry pipeline using the headloss formulas as discussed above. The pipeline was assumed to be 19,826 feet, 16-inch nominal diameter (12.30-inch inner diameter) SDR 9 HDPE throughout the analysis. The proposed pipe routing given in drawings 444853-101-C-001 through 444853-101-C-019 and the hydraulic profile given in drawing 444853-200-C-025 were utilized when calculating the headlosses through the system. In addition, the flow characteristic calculations given in Appendix D of the Onondaga Lake Dredging, Sediment Management, & Water Treatment Initial Design Submittal (IDS) were referenced as appropriate.

Specific gravity of the slurry mixture and the slurry concentration by volume were obtained using the following equations: (Equation 7.13 & 7.15, Herbich, 2000).

$$C_w = SG_s \frac{(SG_m - SG_f)}{SG_m(SG_s - SG_f)} \qquad \text{Eq}^{\underline{n}}\ 6$$

$$C_v = \frac{SG_m}{SG_s}(C_w) \qquad \text{Eq}^{\underline{n}}\ 7$$

Where, C_w = slurry concentration by weight
C_v = slurry concentration by volume
SG_s = specific gravity of solids
SG_f = specific gravity if the carrying fluid (i.e., water)
SG_m = specific gravity of slurry

The calculations were made for a slurry concentration of 10% solids by weight. Assuming 0.2 mm sand sized particle for analysis with solids specific gravity of 2.65 the slurry concentration by volume was calculated to be about 4%. Sediment drag coefficient and terminal settling velocities were calculated for a 0.2 mm sand sized particle and are shown in the calculations sheets.

A plot comparing the results obtained via each of these methods is given in the system curve (HL comparison) sheet of this package. Friction losses calculated via the Darcy-Weisbach method resulted in the lowest estimate of headloss for the methods compared. Values for friction losses calculated via the Durand method and Newitt method were similar and were slightly greater than the Darcy-Weisbach method. Headloss calculations obtained by the Hazen-Williams formula were greater than the other methods by about 20%.

A broader particle size distribution tends to have a lower solids effect (Wilson ***et al***, 2006) and given the significant amount of percentage fines in the Onondaga Lake sediment the actual headloss may be assumed to be slightly lower than that calculated above.

For the purposes of this submittal, the Hazen-Williams formula was used to compute the potential system pump horsepower requirements which equates to a factor of safety of 1.23.

Pipeline Critical Velocity/Deposition Velocity

Critical velocity (or the deposition velocity) for a sediment grain size is the velocity at which the sediment will be removed from suspension and will settle in the pipeline or roll along the bottom of the pipeline. Slurry transport through a pipeline may be achieved by three flow regimes: 1. homogenous flow, 2. heterogeneous flow, and 3. fully stratified flow. In homogenous flow, uniform solid concentration prevails throughout the section of the pipeline. In a heterogeneous slurry flow, higher concentrations of solids are found towards the bottom section of the pipeline. The lighter solids are generally in suspension and the heavier solids may saltate (roll or bounce along the bottom of the pipeline) depending upon the flow velocity in the pipe. Fully stratified flow is achieved when all the solids are deposited on the bottom of the

pipeline and is transported as a moving bed. The most economical method of slurry transport is considered to be in the heterogeneous regime (Herbich, 2000).

Heterogeneous flow is achieved when the slurry mixture velocity is greater than the critical velocity and lower than the transitional velocity. Transitional velocity is the velocity between the homogenous and heterogeneous regime. The ratio of particle diameter to pipe diameter is also important in determining the presence of heterogeneous flow in the pipeline (Wilson ***et al***., 2006). From their experiments, Wilson ***et al***., 2006, estimated that the upper limit for particle size, for which a heterogeneous flow may occur, is 0.015D where D is the diameter of the pipe. They also estimated the flow to be stratified for particle diameter above 0.018D.

For a carrier fluid that does not differ significantly from water it may be assumed that the upper limit for homogenous flow is 150 µm (Wilson ***et al***., 2006). As was calculated during earlier hydraulic analyses, the concentration by volume that is expected during the design is approximately 4% and may be considered significantly low as compared to slurries that are usually transported in the mining industry (approximately 25-30%). Based on this data it may be assumed that all fines (< 0.075 mm) that will be pumped through the pipeline will flow as homogenous non-settling slurry for the flow velocities anticipated in the slurry pipeline.

For this analysis, 16-inch SDR 9 pipe has been considered with an inner diameter of 12.302 inches. The upper limit up to which a heterogeneous flow will occur is calculated as 0.015D which for a 12.302-inch ID pipe is calculated to be 4.7 mm. 0.075 - 4.75 mm is the size range for sand defined by USCS (Unified Sieve Classification System) and as such it may be assumed that the transport of sand and fines will be either in homogenous or a heterogeneous flow regime. Particle diameter above 4.7 mm will be transported as a moving bed along the bottom of the pipeline.

Table 1 through 3 on the sediment data sheet shows the sediment data from the pre-design investigation studies that were conducted at Onondaga Lake. Table 3 shows the weight-based percentage of the fine sand sized particles (0.075 – 0.425 mm), total sand sized particles (0.075 – 4.75 mm) and total gravel and sand sized particles (0.075 – 75mm), . Settling sediment for the sake of this analysis is considered to be all sediments that are larger than 0.075 mm. It is seen from table 3 that total weight of fine sand (0.075 – 0.425 mm) is about 55% of the total weight of all settleable solids (sand and gravel 0.075 – 75 mm). From these sediment data it is assumed that a d_{50} of 0.425 mm is a reasonable estimate for preliminary critical velocity calculations.

Critical velocities for heterogeneous flow of sediment with d_{50} of 0.425 mm flowing through SDR 9 16-inch is calculated using the Durand and Condolis equation (1952) and is shown in Equation 8 and 9 (Equation 7.79, Herbich, 2000).

$$V_{c,hor} = F_L \left[2g \left(\frac{SG_s - SG_f}{SG_f} \right) D \right]^{1/2} \qquad \text{Eq}^{\underline{n}}\ 8$$

$$V_{c,inc} = V_{c,hor} + \Delta_D \left(\sqrt{2g(SG_s - 1)D} \right) \qquad \text{Eq}^{\underline{n}}\ 9$$

Symbol	Description
$V_{c,\,hor}$	Critical velocity in the horizontal section
$V_{c,inc}$	Critical velocity in the inclined section
F_L	Coefficient that is a function of slurry concentration by volume
D	Inside diameter of of pipe in feet
g	Acceleration due to gravity in ft/sec^2
Δ_D	Factor affecting angle of inclination on durand deposition parameter (Fig 7.29, Herbich 2000)
C_w	Slurry concentration by weight (Assumed to be 10%)
C_v	Slurry concentration by volume
SG_s	Specific gravity of solids (2.65 assumed for fine sand)
SG_f	Specific gravity of the carrying fluid (i.e., water), assumed to be 1.0
SG_m	Specific gravity of slurry
V_t	Particle settling velocity in ft/sec (Fig. 7.22, Herbich 2000)

From Figure 7.27, Herbich 2000, F_L for a 4% slurry concentration by volume and for grain diameter of 0.425 is estimated to be 1.1. Assuming 8% slope for the inclined part of the pipeline and using Figure 7.29, Herbich, 2000, the Δ_D is estimated to be 0.1

Using Durand's equation the critical velocity in the horizontal section of the pipe is calculated to be 11.5 ft/sec and in the inclined section of the pipeline is calculated to be 12.5 ft/sec. Critical velocity is also determined using the nomograph by Wilson ***et al***, 1997, shown in figure 7.28 in Herbich 2000. A critical velocity of approximately 12 ft/sec is estimated from the nomograph.

Transitional flow is calculated using equation 7.82 in Herbich 2000 and is given as:

$$v_{th} = \left(1800 g D v_t\right)^{1/3} \qquad \text{Eq}^{\underline{n}}\ 10$$

Where, D is the pipe ID (in.) and;

V_t is the terminal settling velocity (ft/sec) for the 0.425 sand sized particle and is obtained from figure 7.22, Herbich, 2000.

The transitional velocity from the above equation for a sediment grain size of 0.425 mm is calculated to be 22 ft/sec.

Velocity for a 16-inch SDR 9 pipe with ID of 12.302 inches and for a flow of 5000 GPM is calculated to be 13.5 ft/sec. This flow velocity lies between the transitional velocity and the critical velocity that was calculated above.

Further review and analysis of assumptions for the sediment grain size (d_{50}) and critical velocity will be conducted as the design progresses.

HDPE Pipe Derating

HDPE pipe has been proposed to be used for the pipeline. Based on the system hydraulic analyses an appropriate SDR for the pipe meeting the system pressure requirements will be selected. The pipe diameter will also be selected so that a velocity above critical velocity can be maintained in the pipeline.

Additional de-rating for erosion/abrasion tolerance will be applied to the pipe. "Dredging applications of High Density Polyethylene Pipe" Pankow V.R, 1987, was referred to analyze the fate of HDPE pipes used in dredge slurry transport applications. The tests were conducted at the U.S Army Engineer Waterways Experiment Station (WES) Vicksburg, Mississippi. Two 20-foot-long sections of 30-inch ID, SDR-32.5, HDPE pipes were used for the experiment. The HDPE pipe sections were installed in the discharge line of the Port of Portland cutter-suction type, 30-inch hydraulic dredge. About 2.6 million cubic yards of sediment was dredged over a period of 6 months. Slurry of 15% concentration by volume and with an average velocity of 18 ft/sec (range of 13 to 25 ft/sec) was pumped through the HDPE sections. The dredge material ranged from fine sands to 2-inch diameter smooth river rock.

Test results showed that the wear on the HDPE pipes was a function of the type of the material dredged and the velocity. About 30% of wear along the bottom of the pipeline was noted during the period when heavier sediment was being dredged and minimal wear when finer material was being dredged. Wear in the pipeline ranged anywhere between 1.1% and 29.9% and was closely associated with the dredged material type.

Based on these test results and taking into consideration the type of material that is expected in the sediments from Onondaga Lake, a de-rating factor of 10% is assumed as a reasonable erosion/abrasion allowance for design purposes at this stage of the design. Table 1 shows the pressure ratings with and without a 10% derate for commercially available DR schedules of HDPE pipe.

Table 1: Commercially available HDPE pressure ratings

HDPE Spec.	Internal Pressure Rating		Internal Pressure Rating with 10% Derating	
	(psi)	(ft. H_2O)	(psi)	(ft. H_2O)
DR 7	265	612	239	551
DR 9	200	462	180	416
DR 11	160	370	144	333
DR 17	100	231	90	208

Booster Pump Power Requirements

The system headloss curves were used to generate potential booster pump power requirements. The following equation was used to calculate the power requirements:

$$P = \frac{Q \cdot \quad \cdot H_L}{550}$$

Where, P = Power input required (HP)
Q = Flowrate (ft^3/sec)
γ = Specific gravity of the fluid being pumped (lb/ft^3)
ε = Pump efficiency

The power required to pump 10% dredge slurry by weight through a 16-inch SDR 9 pipe with 70% pump efficiency and at the rate of 5000 gpm is estimated to be 1930 hp. With an accuracy of
-10/+20% for the current level of design the pump horsepower is estimated to be between 1740 – 2320 hp.

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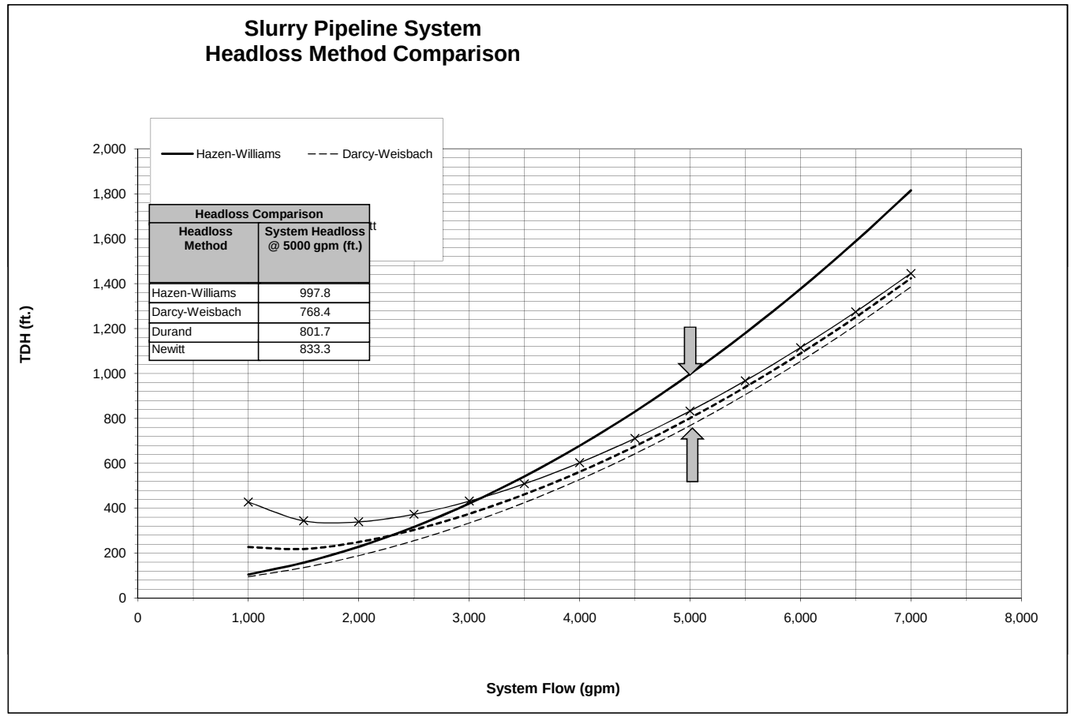
PARSONS		REV	ISSUE	BY	CHK'D	APPR'D	DATE
	Slurry Pipeline Hydraulic Analysis						
Project:	Honeywell Onondaga Lake Dredging Project						
Number:	444853	A	Preliminary Internal Draft	ADM	AN	JDF	1/8/2010

System Curve (16-in. DR 9 Pipe)				
Flow	Headloss (ft.)			
(gpm)	Hazen-Williams	Darcy-Weisbach	Durand	Newitt
0	--	--	--	--
100	--	--	--	--
500	--	--	--	--
1,000	105.6	95.2	227.3	427.7
1,500	158.6	135.6	218.6	344.4
2,000	229.4	189.2	249.5	340.0
2,500	317.3	255.6	303.6	373.6
3,000	421.8	334.3	375.1	431.9
3,500	542.3	425.2	461.8	509.3
4,000	678.7	527.9	562.2	603.0
4,500	830.6	642.4	675.7	711.4
5,000	997.8	768.4	801.7	833.3
5,500	1,180.0	905.8	939.8	968.1
6,000	1,377.0	1,054.6	1,089.8	1,115.4
6,500	1,588.6	1,214.5	1,251.3	1,274.7
7,000	1,814.8	1,385.6	1,424.4	1,445.8



Headloss Comparison	
Headloss Method	System Headloss @ 5000 gpm (ft.)
Hazen-Williams	997.8
Darcy-Weisbach	768.4
Durand	801.7
Newitt	833.3

Constants		
Parameter	Value	Units
Qpump	5,000	gpm
v_f	1.09E-05	ft2/sec
Re	1.27E+06	
ε	5.00E-06	ft.
ε/D	4.88E-06	
f	0.0111	
g	32.2	ft/sec2
SG_m	1.07	
SG_s	2.65	
$C_{HDPE, m}$	129	
$C_{HDPE, w}$	150	
C_v	4%	
d_p	0.2	mm
d_p	6.56E-04	ft.
v_o	89.0	mm/sec
V_o	0.29	ft/sec
v_t	0.08	ft/sec
Re_p	0.55	
C_D	43.9	

Minor Losses	
Type	k_l
Wide-Radius Bend	0.20
Plug Valve	1.10
Check Valve	4.0

Type	Nos.
Wide-Radius Bend	17
Plug Valve	9
Check Valve	1

Equations	
Hazen-Williams	$h_f = \frac{4.73L}{C^{1.852} \cdot D^{4.87}} \cdot Q^{1.852}$
Friction factor (Swamee and Jain)	$f = \frac{0.25}{\left[\log\left(\frac{\varepsilon}{3.7D}\right) + \frac{5.74}{Re^{0.9}}\right]^2}$
Darcy-Weisbach	$h_f = SG_m \cdot f\left(\frac{L}{D}\right)\frac{v^2}{2g}$
Hazen-Williams	$h_f = \frac{4.73L}{C^{1.852} \cdot D^{4.87}} \cdot Q^{1.852}$
Durand Equation	$h_{f,slurry} = 81\left[\frac{v^2\sqrt{C_D}}{(SG_s - 1)gD}\right]^{-3/2} C_v h_f$
Newitt Equation	$h_{f,slurry} = 1100 C_v \cdot h_f (SG_s - 1)\frac{gD}{V^2}\frac{v_t}{V}$
Minor Losses	$h_l = k_l \frac{Q^2}{2g \cdot A^2}$

PARSONS COMMERCIAL TECHNOLOGY GROUP SYRACUSE, NEW YORK	Title: Project: Number:	Slurry Pipeline Hydraulic Analysis Honeywell Onondaga Lake Dredging Project 444853	REV	ISSUE	BY	CHK'D	APPR'D	DATE
			A	Preliminary Internal Draft	ADM	AN	JDF	1/8/2009

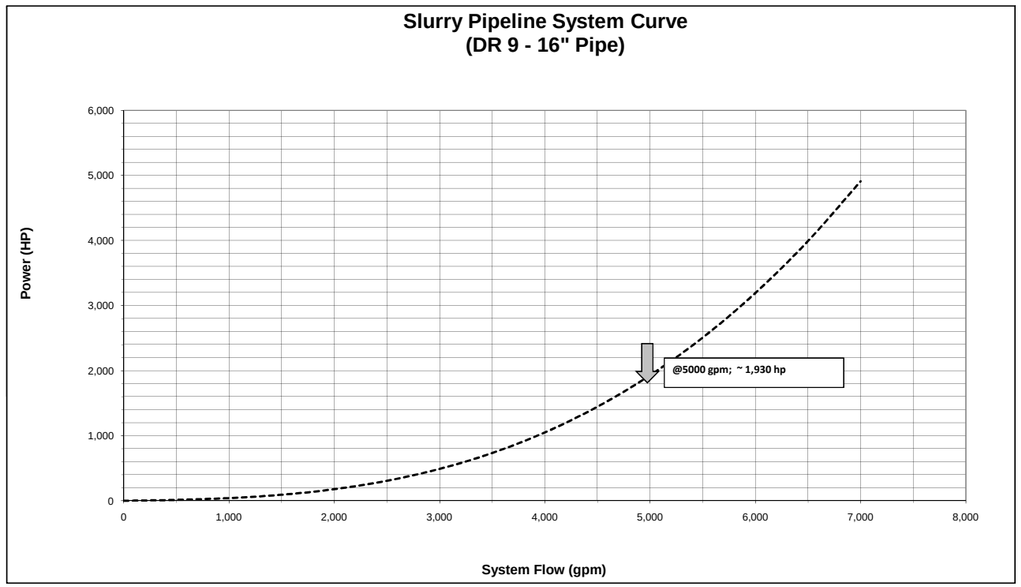
Constants		
Parameter	Value	Units
Q_{pump}	5,000	gpm
C_{HDPE}	129	
g	32.2	ft/sec^2
SG_m	1.07	
γ	66.8	lb/ft3
ε	70%	

Minor Losses	
Type	k_l
Wide-Radius	0.20
Plug Valve	1.10
Check Valve	4.0

Type	Nos.
Wide-Radius Bend	17
Plug Valve	9
Check Valve	1

1	2	3	4	5	6	7	8	9	10	11	12	13
Q (gpm)	Q (cfs)	v (ft/sec)	L (ft.)	C	D_{nom} (in.)	ID (in.)	A (ft^2)	k_l	h_f (ft.)	h_l (ft.)	h_s (ft.)	H_L (ft.)
5,000	11.1	13.5	19,826	129	16	12.302	0.825	17.30	890.4	48.9	58.4	997.8

System Curve (DR 9-16" Pipe)		
Flow (gpm)	TDH (ft)	(Power) HP
0	58.4	0
100	59.1	2
500	71.4	14
1,000	105.6	41
1,500	158.6	92
2,000	229.4	177
2,500	317.3	307
3,000	421.8	489
3,500	542.3	733
4,000	678.7	1,049
4,500	830.6	1,444
5,000	997.8	1,928
5,500	1,180.0	2,508
6,000	1,377.0	3,193
6,500	1,588.6	3,990
7,000	1,814.8	4,909



Equations	
Hazen-Williams	$h_f = \frac{4.73L}{C^{1.852} \cdot D^{4.87}} Q^{1.852}$
Minor Losses	$h_l = k_l \frac{Q^2}{2g \cdot A^2}$
Total Headloss	$H_L = h_f + h_l + h_s$

Column	Description
1	Flowrate in gallons per minute
2	Flowrate in cubic feet per second
3	Pipeline velocity in feet per second
4	Reach length in feet
5	Hazen-Williams roughness factor
6	Nominal diameter of pipe in inches
7	Actual inside diameter of pipe in inches
8	Cross-sectional area of flow in square feet
9	Total minor loss coefficient for reach (sum of individual minor loss coefficients)
10	Frictional headlosses through reach using Hazen-Williams Equation in feet
11	Minor losses through reach in feet
12	Elevation change (static head) through reach in feet
13	Total headlosses through reach (sum of friction, minor, and static losses) in feet

TABLE 1: 2.2M cy Dredging Volume (Base+Contingency)

Remediation Area	Dry Weights						
	Gravel-Sized (4.75 - 75mm) (tons)	Sand-Sized (.075 - 4.75mm) (tons)	Silt-Sized (0.005 - .075mm) (tons)	Clay-Sized (< .005 mm) (tons)	Total Coarse Grains (Gravel- and Sand-Sized) (tons)	Total Fine Grains (Silt and Clay-sized) (tons)	Total Dry Weight (tons)
D (ILWD)	7,557	77,733	346,560	107,963	85,291	454,523	539,814
C	4,266	14,733	16,708	3,792	18,999	20,500	39,500
A & B	3,242	37,341	66,758	12,727	40,583	79,485	120,069
E	132,616	253,403	186,161	50,431	386,019	236,592	622,611
TOTAL	147,681	383,210	616,187	174,913	530,892	791,101	1,321,992

Table 2 : Particle Size Distribution

Remediation Area	Average Specific Gravity	Average Percent Gravel-Sized	Average Percent Sand-Sized	Average Percent Silt-Sized	Average Percent Clay-Sized
		(%)	(%)	(%)	(%)
D (ILWD)	2.54	1.4	14.4	64.2	20.0
C	2.77	10.8	37.3	42.3	9.6
A & B	2.68	2.7	31.1	55.6	10.6
E	2.63	21.3	40.7	29.9	8.1

Table 3 : Fine Sand Content

Remediation Area	Average Percent Sand-Sized (.075 - 4.75mm)	Average Fine Sand-Sized (0.075 - 0.425mm)	Total Dry Weight	Total Coarse Grains (Gravel- and Sand-Sized)	Sand-Sized (.075 - 4.75 mm)	Fine Sand-Sized (.075 - 0.425 mm)
	(%)	(%)	(tons)	(tons)	(tons)	(tons)
D (ILWD)	14.4	7.8	539,814	85,291	77733	42105
C	37.3	18.8	39,500	18,999	14733	7426
A & B	31.1	21	120,069	40,583	37341	25214
E	40.7	34.5	622,611	386,019	253403	214801
TOTAL			1,321,992	530,892	383,210	289,546

APPENDIX G

WASTESTREAM TECHNOLOGIES PHASE IV ADDENDUM 6 SUMMARY REPORT

TREATABILITY REPORT

EVALUATION OF THE SETTLING CHARACTERISTICS OF FINE GRAIN SEDIMENT FROM ONONDAGA LAKE

Prepared For:

PARSONS

290 Elwood Davis Road, Suite 312
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Prepared By:

Waste Stream Technology, Inc.
302 Grote Street
Buffalo, New York 14207

May 2009

1.0 Scope of Work

Sediment samples were obtained from Sediment Management Units (SMUs) 1 and 6 of Onondaga Lake, located in Onondaga County, NY. Sampling was performed in accordance with *the Onondaga Lake Pre-Design Investigation: Phase IV Work Plan-Addendum 6* (Parsons, 2008). Waste Stream Technology, Inc (WST) conducted pilot and bench scale testing on SMU 1A, SMU 1B, and SMU 6 to evaluate the effectiveness of removing sand-sized particles using a hydrocyclone and gravity thickening the fine grain sediment prior to geotextile dewatering.

2.0 Initial Characterization

Sediment from various locations within SMU 1 and two locations within SMU 6 were sampled in November 2008. A total of 5 fifty five-gallon drums of site water, and one fifty five-gallon drum and 9 five-gallon buckets of sediment were shipped to WST under chain-of-custody. Chain-of-custody documents are presented in Appendix A. Upon receipt, all samples were logged in, weighed, and stored in a cooler at 4°C.

Sediment was passed through a quarter-inch screen to remove large debris. After the oversized material was removed, the buckets from SMU 1A and the buckets from SMU 6 were each composited into a 55-gallon drum. Sediment from SMU 1B did not need to be composited since the sample was contained in one drum as opposed to several buckets. After each sample was screened and composite, it was homogenized with a drill mixer. Subsamples were taken from each drum and initial analyses including percent solids (SM 2450G), specific gravity (SM 2710 F), and pH (SW-846 Method 9045 C) were performed. The results of these analyses are provided in Appendix B.

3.0 Hydrocyclone Testing

A hydrocyclone uses size and density separation to remove sand from dredged material for a variety of reasons. Sand is erosive to pump systems and can clog feed tubes. Sand sized particles tend to settle quickly and will settle in feed lines if flow is stopped or slowed. Large volumes of water are required to flush the lines and pumps when this happens. Also, sand can drop out fast when it is fed into a geotube, which

blocks additional feed from entering the tube. Testing to remove troublesome sand size particles was performed following the procedures set forth in the Standard Operating Procedure for Hydrocyclone Performance Testing and under observation and consultancy of Mike Wilkins, a technical engineer for the hydrocyclone supply company, Krebs Engineers.

A summary, of the hydrocyclone runs, is presented in Appendix C. The sediment was prescreened through a quarter inch sieve to remove the oversize material. After the sediment samples were screened they were diluted with site water to a 10% solids by weight slurry. The slurry was then pumped into the hydrocyclone. The target feed pressure was 20psi. Full feed pressure was not reached during the run of SMU 1A because of excess air caused by foaming of this sample.

The influent, overflow, and underflow material was sampled for percent solids and specific gravity analyses. Sieve analyses (Modified ASTM D-422) were also performed on the hydrocyclone overflow samples for SMU 1B and SMU 6 to confirm the removal of sand-size particles from the slurries. See Appendix C. The sieve analysis shows that 100% of the overflow sample from SMU 1B and 99% of the overflow from SMU 6 passed through a #200 sieve, demonstrating the high efficiency of the hydrocyclone to remove sand-size particles.

4.0 Jar Testing

An initial polymer screening was performed on 100 mL of the overflow slurries to evaluate the floc and water quality that various polymers produced. If a selected polymer produced a good floc that settled well, leaving fairly clear free water it underwent further testing. Polymer screening notes are listed in Appendix C.

Jar tests were performed according to procedures set forth in the Standard Operating Procedure for Jar Testing. Tests were performed on 1L slurries, using polymers that yielded good results during polymer screening. Various doses of a polymer were compared using the criteria of settling rate and water clarity, measured by turbidity, (SM 2130 B). The samples were rapidly mixed at 100rpm for two minutes after the addition of polymer. Typically samples are rapidly mixed for one minute after polymer is added. However, additional mixing improved the floc quality for the fine grain

slurries. After the rapid mix, the slurries were “slow mixed” at 20rpm for 20 minutes, and then settled for twenty minutes with no mixing. Each slurry was sampled for turbidity analysis at the end of the mixing and settling cycle. Jar testing results are presented in Appendix D.

The solids did not remain suspended during the slow mix and began to settle. This was most noticeable in the overflow slurries from SMU 1. This could be due to the high solids content and the fast settling rate of the slurries. Also, there was a significant foam layer at the top of the SMU 1A slurries that remained at the top of the slurry after settling (See Figure 1).

Figure 1:
Foam present in SMU 1A samples from Jar Test

A cationic solution coagulant, 7757 was selected for use in column testing based on jar testing results. Turbidity measurements from slurries treated with 7757 were generally lower in comparison to slurries treated with other polymers. Future dewatering applications were also taken into consideration during polymer selection. A cationic solution coagulant will interfere less and could enhance future polymer applications prior to dewatering. Also, coagulants are easier to use in field applications and have a wider acceptable dose range.

5.0 Column Testing

Column settling tests were performed, according to the Standard Operating Procedure for Column Settling Tests, on the fine grain slurries from SMU 1A, SMU 1B,

and SMU 6 using an 8'x 8" diameter plexiglass column. Using this column, the settling kinetics of each slurry can be evaluated by measuring the height of the interface between settled sediment and supernatant fluid over time. Sample ports are located every 6 inches along the column in order to extract samples of supernatant for total suspended solids. Settling tests were conducted on untreated and polymer treated slurries at various solids content.

Fifteen gallons of slurry were used for each test. Each slurry was thoroughly mixed and then poured into the column. Polymer was added and mixed in as necessary and prior to transferring the samples into the columns. Time was started as soon as the last bucket was completely emptied into the column. A sample for total suspended solids (SM 2540D) was taken through the ports at 5 feet, 2.5 feet and 0.5 feet when time was started. Every port was not sampled at the beginning of the test in order to ensure the samples were more representative of initial conditions. Sampling at every port would have consumed too much time and since the sediment settles at a fast rate, samples taken after a few minutes would not reflect the conditions at the start of the test.

The column tests were continuously monitored to observe formation of an interface. Time was noted when a noticeable interface had formed and the sediment line was recorded every 15 minutes for two hours, after the noted presence of an interface. The sediment line was also recorded at four and twenty four hours. The supernatant was sampled at one-hour, two hours and twenty-four hours after the start of the test. Column settling test results are in Appendix F.

6.0 Summary

The hydrocyclone was efficient at removing sand size particles from the 10% slurries of sediment from Onondaga Lake. Removing sand size particles will reduce the amount of sediment that goes through the dewatering process.

Polymer did not significantly enhance the settling rate of the test slurries, but were generally effective at reducing the total suspended solids, therefore making the supernatant clearer. This is most noticeable of column tests ran on SMU 6, as seen in Table 1. The TSS of the supernatant at 24 hours from SMU 6 at 3% solids was reduced 101% when treated with polymer and reduced 98% for tests ran at 6% solids.

While a cationic or anionic flocculant might have increased the settling rate, there are clear disadvantages to using these polymers. Flocculants have a lower acceptable dose range, making it easier to over treat this slurry. If the slurry is over treated, the water could become slimy and the floc can weaken. Over treatment should always be avoided by use of proper make down and feed equipment. Also, flocculants could interfere with future polymer application. The percent solids of the test slurry affected the settling rate. Slurries at lower percent solids appeared to settle faster than those at higher percent solids.

Table 1:

Total Suspended Solids from Column Settling Tests

	SMU 1A				SMU 1B							
	6%		9%		3%		6%		9%		12%	
Time (Hour)	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated
0 @ 0.5 ft	64568	62564	58748	86064	50672	15832	68476	19643	81684	26637	121,914	23636
0 @ 2.5 ft	53556	60524	85496	76068	47904	19620	87196	18672	33980	23219	111340	22051
0 @ 5.0 ft	49416	52136	92792	82180	38696	30120	77356	3113	50412	23035	69604	20568
1	196	164	357	158	174	218	231	285	115	13	674	469
2	107	543	87	157	87	153	289	51	22	39	17	94
24	22	63	151	191	24	21	84	47	27	10	29	16

	SMU 6			
	3%		6%	
Time (Hour)	Untreated	Treated	Untreated	Treated
0 @ 0.5 ft	15208	6753	53932	25356
0 @ 2.5 ft	27000	5964	36688	24971
0 @ 5.0 ft	28736	5732	44176	22944
1	97	22	116	82
2	228	108	132	11
24	446	5	752	14

APPENDIX A

Chain of Custody Document

Onondaga Lake Treatability Study
Syracuse, New York
May 2009

Note: Attachment 1 is not available in this file on the DEC web site - See http://www.dec.ny.gov/chemical/66732.html for contact and document registry information.

APPENDIX B

Initial Characterization

Onondaga Lake Treatability Study
Syracuse, New York
May 2009

Location	Sample ID	Volume Received (gallons)	% Solids	Specific Gravity	pH	Physical Description
OL-SED-SMU 1A	10114-1	5	38.46	1.33	11.79	Tan/gray liquid/ sludge and cement like solids with a chemical odor.
	10114-2	5	35.63	1.23	11.98	Tan/gray liquid/ sludge and cement like solids with a chemical odor.
	10115-1	5	35.64	1.25	11.49	Tan/gray liquid/ sludge and cement like solids with a chemical odor.
	10115-2	5	35.57	1.26	11.52	Tan/gray liquid/ sludge and cement like solids with a chemical odor.
	10116	5	38.22	1.26	11.65	Tan/gray liquid/ sludge and cement like solids with a chemical odor.
	<1/4" Composite	~20	35.56	1.22	11.89	~5 gallons of oversized material (>1/4") was removed during screening. Thick tan/ gray sludge. Significant chemical odor.
	<1/4" Composite Slurry (~10%)	~64	10.31	1.03	11.37	Tan/ gray slurry. Significant chemical odor.
OL-SED-SMU 1B	SMU B	55	36.79	1.25	12.09	Tan/gray liquid/ sludge and cement like solids with some organic matter and chemical odor.
	<1/4" Composite	~45	27.67	1.28	12.09	~10 gallons of oversized material (>1/4") was removed. Thick tan/ gray sludge. Significant chemical odor.
	<1/4" Composite Slurry (~10%)	~110	7.74	1.03	11.46	Tan/ gray slurry. Significant chemical odor.
OL-SED-SMU 6	60098-1	5	55.07	1.50	7.53	Sandy brown sludge
	60098-2	5	62.92	1.55	7.89	Sandy brown sludge
	60100-1	5	59.60	1.52	7.85	Black sandy/silty sludge.
	60100-2	5	55.81	1.34	8.10	Black sandy/silty sludge.
	<1/4" Composite	~20	58.93	1.51	7.92	Less than 1L of oversized material (>1/4") removed. Thick, black, sandy material.
	<1/4" Composite Slurry (~10%)	~110	5.17	1.00	8.30	Black sandy slurry. Settles extremely fast and is difficult to mix because of the fast settling rate.

APPENDIX C

Hydrocyclone Data

Onondaga Lake Treatability Study
Syracuse, New York
May 2009

Sieve Analysis of Overflow Material

Sample ID	Date	% Solids (w/w)	Cyclone	Vortex Finder	Cylinder	Apex	Vacuum	Feed Pressure (psi)		Influent Volume	Overflow Volume	Underflow Volume
								Target	Measured	(gal)	(gal)	(gal)
SMU 1A	4/8/2009	10.31	D6B-12	2.25"	Yes	1"	Partial	20	10*	~64	~30	<5
SMU 1B	4/7/2009	7.74	D6B-12	2.25"	Yes	1"	Partial	20	20	~110	~60	<5
			D6B-12	2.25"	Yes	1"	Full	20	20			
SMU 6	4/7/2009	5.17	D6B-12	2.25"	Yes	1"	Partial	20	20	~110	~60	~5

Sample ID	Influent		Overflow		Underflow	
	% Solids	SG	% Solids	SG	% Solids	SG
SMU 1A	11.41	1.04	10.29	1.02	28.37	1.13
SMU 1B	15.53	1.07	14.62	1.09	51.47	1.27
	15.53	1.07	14.27	1.06	48.64	1.21
SMU 6	9.85	1.02	4.66	1.01	63.59	1.56

Sample I.D. and Initial Dry Weight	Sieve #	Aperture (μm)	Tare Wt. (g)	Dry Weight (g)	Weight Retained (g)	% Weight Retained	% Weight Passed
SMU 1B Overflow 259.78 g wet/ 37.98 g dry (14.62% solids)	200	75	336.8	336.8	0.0	0.00	100.00
	325	45	339.8	339.8	0.0	0.00	100.00
	400	38	340.8	340.8	0.0	0.00	100.00
	< 400	< 38	--	--	38.0	100.00	---

Sample I.D. and Initial Dry Weight	Sieve #	Aperture (μm)	Tare Wt. (g)	Dry Weight (g)	Weight Retained (g)	% Weight Retained	% Weight Passed
SMU 6 Overflow 218.79 g wet/10.19 g dry (4.66% solids)	200	75	336.8	336.9	0.1	0.98	99.02
	325	45	339.8	340.1	0.3	2.94	96.07
	400	38	340.8	340.8	0.0	0.00	96.07
	< 400	< 38	--	--	9.8	96.07	---

APPENDIX D

Polymer Screening

Onondaga Lake Treatability Study
Syracuse, New York
May 2009

Sample ID	Polymer	Dose (ppm)	Observations
SMU 1A Overflow from the Hydrocyclone	7757	50	Slight floc with no free water
		Up to 600	No noticeable improvement
	7626	75	Floc begins to form, but is only slightly noticeable and does not settle.
		Up to 500	No noticeable improvement
	7626 + 7843	500 + 50	Floc improves and settles more.
		500 + 150	Thicker floc that settles more. Still some floating particles.
		500 + 200	Less floating particles, but water begins to get cloudy.
	7843	30	Slight floc with some free water
		40	Floc is slightly thicker and water is slightly more clear.
		50	Good floc that settles well leaving clear, free water with some floating particles.
		100	Floc starts to break apart and water begins to get cloudy.
	7824	10	Floc is very slightly noticeable.
		50	Good floc that settles well. Water is slightly cloudy.
		100	Floc is good and settles well, but is loose. Some floating particles.
	7823	Up to 500	Good floc, but is easily broken up with mixing. The water is cloudy with lots of floating particles.

Sample ID	Polymer	Dose (ppm)	Observations
SMU 1B Overflow from the Hydrocyclone	7626	Up to 600	No noticeable difference
	7843	20	Slight floc begins to form.
		40	Floc becomes thicker and settles slightly.
		100	Good floc, settles well leaving clear free water.
		200	Floc improves and there is more clear, free water.
		250	Water begins to get cloudy.
	7824	20	Slight floc begins to form.
		40	Floc becomes thicker and settles slightly.
		100	Good floc, settles well leaving clear free water.
		200	Floc is thick and settles well, but water is cloudy.

Sample ID	Polymer	Dose (ppm)	Observations
SMU 6 Overflow from the Hydrocyclone	7757	5	Good floc, settles well.
		20-100	Floc becomes larger and settles better leaving more free clear water as dose is increased.
		250	Floc appears to settle more slowly and water is slightly cloudy.
	7626	5	Noticeable floc.
		Up to 500	No noticeable improvement.
	7843	5	Slight floc that settles well leaving cloudy free water.
		10	Floc becomes larger and settles better leaving more free water that is clear.
		25	Floc becomes tighter and settles faster.
		50	Floc is thicker, but water becomes cloudy.
	7824	5	Slight floc that settles well leaving cloudy free water.
		10	Floc becomes larger and settles better leaving more free water that is clear.
		35	Floc is tighter and settles well leaving free clear water.
		75	Water starts to become cloudy.
	7823	5	Very fine floc, some free water.
		25	Floc improves and settles better leaving more free water.
		100	Water starts to become cloudy.

APPENDIX E

Jar Testing Data

Onondaga Lake Treatability Study
Syracuse, New York
May 2009

Sample ID	Jar #	Sample Volume (mL)	Polymer ID	Dosage (ppm)	Flash Mix (1 min. @ 100 rpm)	Slow Mix @ 20 rpm (observations)				Observations after settling	Settled NTU
						5 min	10 min	15 min	20 min	20 min	
SMU 1A	1	1000	--	--	No floc	Cloudy and very little free water.	~50mL of cloudy free water.	~75mL of cloudy free water.	~75mL of cloudy free water.	~150mL of cloudy free water.	423
	2		7824	10	Fine floc	Some clear free water.	~125mL of free water.	~150mL of free water.	~150mL of free water.	~250mL of free water.	223
	3			20	Fine floc	Some clear free water.	Loose floc, ~100mL of free water.	Loose floc, ~150mL of free water.	Loose floc, ~150mL of free water.	Loose floc, ~225mL of free water.	292
	4			30	Fine floc	Some clear free water.	Loose floc, ~100mL of free water.	Loose floc, ~150mL of free water.	Loose floc, ~200mL of free water.	Loose floc, ~250mL of free water.	294
	5			40	Good floc	~100mL of clear free water	Loose floc, ~300mL of free water.	Loose floc, ~350mL of free water some suspended particles.	Loose floc, ~400mL of free water some suspended particles.	Loose floc, ~450mL of free water some suspended particles.	161
	6			50	Fine floc	Some clear free water.	Loose floc, ~100mL of free water.	Loose floc, ~175mL of free water.	Loose floc, ~225mL of free water.	Loose floc, ~300mL of free water.	198
	7	1000	7843	15	Fine floc	~150mL clear, free water	~250mL clear, free water	~150mL clear, free water	~150mL clear, free water	~150mL clear, free water	43
	8			30	Fair floc	~175mL clear, free water	~275mL clear, free water	~350mL clear, free water	~400mL clear, free water	~475mL clear, free water	27.1
	9			40	Good floc	~225mL clear, free water	~350mL clear, free water	~4000mL clear, free water	~450mL clear, free water	~525mL clear, free water	54.6
	10			50	Good floc	~300mL free water, some suspended solids	~400mL free water, some suspended solids	~475mL free water, some suspended solids	~475mL free water, some suspended solids	~550mL free water, some suspended solids	33.3
	11			60	Good, fine floc	~425mL free water, some suspended solids	~500mL free water, some suspended solids	~525mL free water, some suspended solids	~550mL free water, some suspended solids	~600mL free water, some suspended solids	43.4
	12			70	Good, fine floc	~475mL free water, some suspended solids	~525mL free water, some suspended solids	~550mL free water, some suspended solids	~550mL free water, some suspended solids	~600mL free water, some suspended solids	65.3
	13	1000	7757	10	Very fine floc	~100mL of clear free water	~150mL of clear free water	~200mL of clear free water	~275mL of clear free water	~350mL of clear free water	19.2
	14			25	Very fine floc	~75mL of clear free water	~125mL of clear free water	~200mL of clear free water	~250mL of clear free water	~325mL of clear free water	18.8
	15			75	Very fine floc	~50mL of clear free water	~125mL of clear free water	~200mL of clear free water	~275mL of clear free water	~375mL of clear free water	6.3
	16			150	Very fine floc	~50mL of clear free water	~125mL of clear free water	~200mL of clear free water	~250mL of clear free water	~350mL of clear free water	28.3
	17			250	Very fine floc	~75mL of clear free water	~125mL of clear free water	~200mL of clear free water	~250mL of clear free water	~350mL of clear free water	20.3
	18			500	Very fine floc	~100mL of clear free water	~850mL of clear free water	~200mL of clear free water	~250mL of clear free water	~350mL of clear free water	11.3

Sample ID	Jar #	Sample Volume (mL)	Polymer ID	Dosage (ppm)	Flash Mix (1 min. @ 100 rpm)	Slow Mix @ 20 rpm (observations)				Observations after settling	Settled NTU
						5 min	10 min	15 min	20 min	20 min	
SMU 1B	1	1000	--	--	No floc	Slight layer of free water.	~50mL of cloudy free water.	~100mL of cloudy free water.	~125mL of cloudy free water.	~200mL of cloudy free water.	388
	2		7824	10	Fine floc	Slight layer of free water.	~150mL of free water with some floating particles.	~200mL of free water with some floating particles.	~225mL of free water with some floating particles.	~300mL of free water with some floating particles.	310
	3			20	Fair floc	Some clear free water.	~175mL of free water with some floating particles.	~225mL of free water with some floating particles.	~275mL of free water with some floating particles.	~325mL of free water with some floating particles.	79.8
	4			30	Fair floc	Some clear free water.	~100mL of free water with some floating particles.	~200mL of free water with some floating particles.	~250mL of free water with some floating particles.	~350mL of free water with some floating particles.	159
	5			40	Good floc	~150mL of clear free water with some floating particles	~225mL of clear free water with some floating particles	~300mL of clear free water with some floating particles	~325mL of clear free water with some floating particles	~375mL of clear free water with some floating particles	205
	6			50	Good floc	~200mL of clear free water with some floating particles	~275mL of clear free water with some floating particles	~350mL of clear free water with some floating particles	~375mL of clear free water with some floating particles	~450mL of clear free water with some floating particles	42.1
	7	1000	7843	15	No noticeable floc	Very fine floc, ~25mL free water.	~50mL free water	~100mL free water	~125mL free water	~175mL free water	143
	8			30	No noticeable floc	Very fine floc, ~50mL free water.	~100mL free water	~150mL free water	~175mL free water	~250mL free water	108
	9			40	No noticeable floc	Very fine floc, ~50mL free water.	~100mL free water	~150mL free water	~175mL free water	~250mL free water	75
	10			50	No noticeable floc	Very fine floc, ~50mL free water.	~100mL free water	~150mL free water	~200mL free water	~250mL free water	39.3
	11			60	No noticeable floc	Fine floc, ~100mL free water with some suspended particles.	~150mL free water with some suspended particles.	~200mL free water with some suspended particles.	~250mL free water with some suspended particles.	~325mL free water with some suspended particles.	43.3
	12			70	No noticeable floc	Fine floc, ~150mL free water with some suspended particles.	~200mL free water with some suspended particles.	~250mL free water with some suspended particles.	~300mL free water with some suspended particles.	~350mL free water with some suspended particles.	49.4
	13	1000	7757	10	Very slight floc. No free water.	Floc is slightly more noticeable, no free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	~200mL of clear free water	288
	14			25	Very fine floc. No free water.	Floc is slightly more noticeable, no free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	~150mL of clear free water	25.2
	15			75	Very fine floc. No free water.	Floc is slightly more noticeable, no free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	~275mL of clear free water	22.6
	16			150	Very fine floc. No free water.	Floc is slightly more noticeable, no free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	~150mL of clear free water	14.2
	17			250	Very fine floc. No free water.	Floc is slightly more noticeable, no free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	~175mL of clear free water	16.9
	18			500	Very fine floc. No free water.	Floc is slightly more noticeable, no free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	~200mL of clear free water	22.7

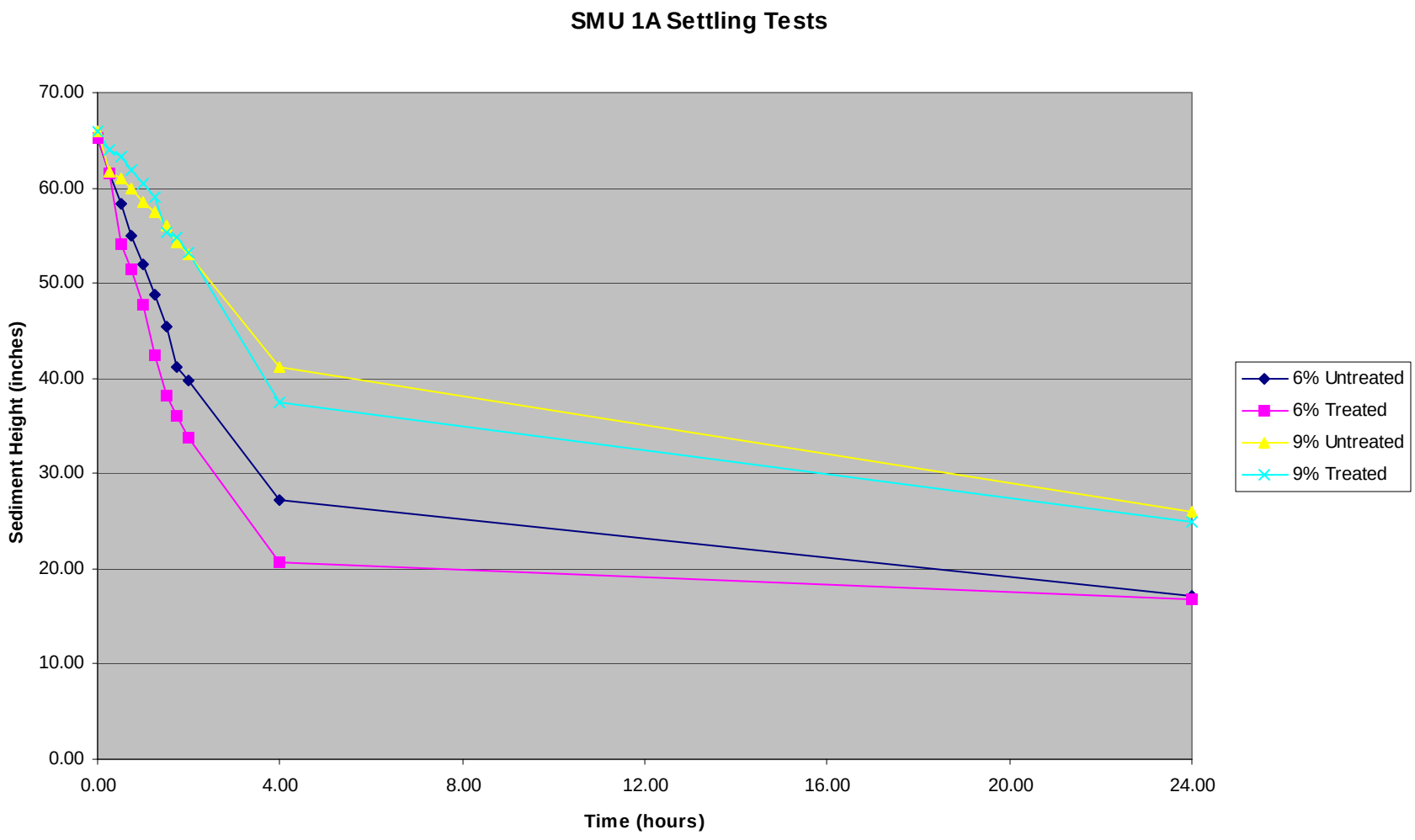
Sample ID	Jar #	Sample Volume (mL)	Polymer ID	Dosage (ppm)	Flash Mix (1 min. @ 100 rpm)	Slow Mix @ 20 rpm (observations)				Observations after settling	Settled NTU
						5 min	10 min	15 min	20 min	20 min	
SMU 6	1	1000	--	--	No floc	No noticeable difference	No noticeable difference.	~500mL of dark, cloudy water	~500mL of dark, cloudy water	~750mL of dark, cloudy, free water.	423
	2		7824	5	Good floc	~800mL of cloudy free water with some floating particles.	~850mL of cloudy free water with some floating particles.	~850mL of cloudy free water with some floating particles.	~850mL of cloudy free water with some floating particles.	~850mL of clear free water	116
	3			15	Good floc	~750mL of clear, free water, some floating particles.	~750mL of clear, free water, some floating particles.	~800mL of clear, free water, some floating particles.	~800mL of clear, free water, some floating particles.	~800mL of clear, free water, some floating particles.	21.5
	4			30	Good floc	~750mL of clear, free water, some floating particles.	~750mL of clear, free water, some floating particles.	~750mL of clear, free water, some floating particles.	~750mL of clear, free water, some floating particles.	~750mL of clear, free water, some floating particles.	12.4
	5			50	Good floc	~725mL of clear free water	~725mL of clear free water	~750mL of clear free water	~750mL of clear free water	~750mL of clear free water	17.3
	6			75	Good floc	~700mL of clear free water	~700mL of clear free water	~700mL of clear free water	~700mL of clear free water	~750mL of clear free water	7.87
	7	1000	7843	5	Fine floc	~800mL cloudy, free water	~800mL cloudy, free water	~800mL cloudy, free water	~800mL cloudy, free water	~850mL cloudy, free water	42.9
	8			10	Fine floc	~750mL cloudy, free water	~750mL cloudy, free water	~750mL cloudy, free water	~750mL cloudy, free water	~800mL cloudy, free water	51.2
	9			15	Fair floc	~700mL cloudy, free water	~750mL cloudy, free water	~750mL cloudy, free water	~750mL less cloudy, free water	~800mL clear, free water	48.3
	10			20	Fair floc	~750mL cloudy, free water	~800mL cloudy, free water	~800mL cloudy, free water	~800mL less cloudy, free water	~800mL clear, free water	42.3
	11			30	Good floc	~775mL cloudy, free water	~800mL cloudy, free water	~800mL cloudy, free water	~800mL less cloudy, free water	~900mL clear, free water	31.3
	12			50	Good floc	~850mL cloudy, free water	~850mL cloudy, free water	~850mL cloudy, free water	~850mL less cloudy, free water	~800mL clear, free water	34.2
	13	1000	7757	5	Fair floc	~450mL cloudy, free water	~600mL cloudy, free water	~675mL cloudy, free water	~325mL cloudy, free water	~325mL cloudy, free water	47.7
	14			10	Fair floc	~500mL cloudy, free water	~650mL cloudy, free water	~700mL cloudy, free water	~750mL cloudy, free water	~750mL cloudy, free water	41.5
	15			20	Good floc	~625mL of clear free water	~700mL of clear free water	~725mL of clear free water	~725mL of clear free water	~350mL of clear free water	13.7
	16			50	Good floc	~650mL of clear free water	~700mL of clear free water	~700mL of clear free water	~700mL of clear free water	~750mL of clear free water	7.29
	17			100	Very good floc	~700mL of clear free water	~725mL of clear free water	~750mL of clear free water	~750mL of clear free water	~775mL of clear free water	54.7
	18			200	Good floc	~700mL of clear free water	~725mL of clear free water	~750mL of clear free water	~750mL of clear free water	~775mL of clear free water	17.4

APPENDIX F

Column Settling Test Data

Onondaga Lake Treatability Study
Syracuse, New York
May 2009

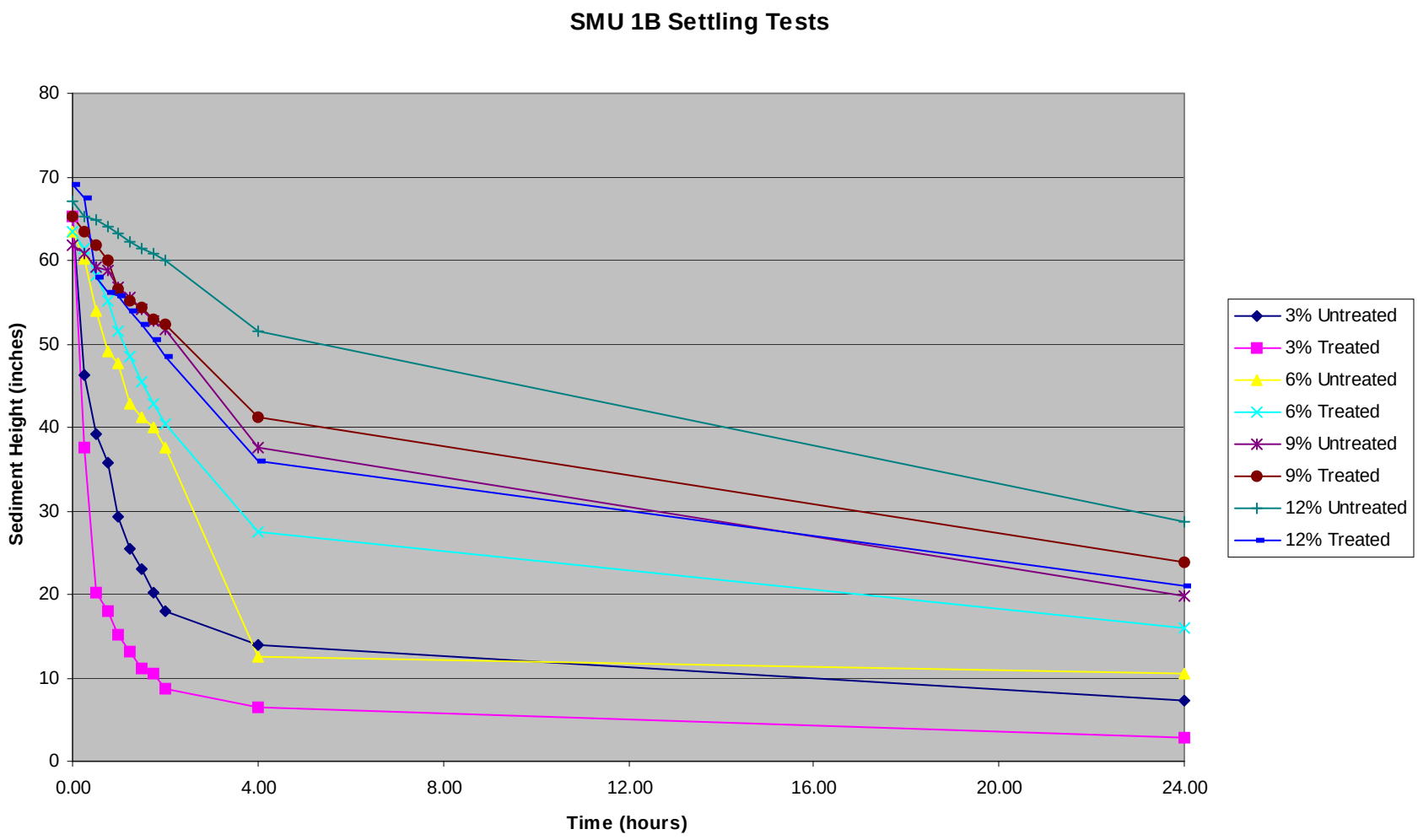
SMU 1A											
6% Solids						9% Solids					
Untreated			Treated with 250ppm 7757			Untreated			Treated with 250ppm 7757		
Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations
0:00	65.25		0:00	65.25		0:00	66.00		0:00	66.00	
0:02	--	Noticeable Interface	0:01	--	Noticeable Interface	0:05	--	Noticeable Interface	0:01	--	Noticeable Interface
0:17	61.50	Supernatant is slightly cloudy.	0:16	61.50	Good floc, settles well. Supernatant appears clear.	0:20	61.75	Supernatant is slightly cloudy.	0:16	64.00	Good floc, settles well. Supernatant appears clear.
0:32	58.25		0:31	54.13		0:35	61.00		0:31	63.25	
0:47	55.00		0:46	51.50		0:50	59.90		0:46	61.88	
1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled
1:02	52.00		1:01	47.75		1:05	58.50		1:01	60.50	
1:17	48.75		1:16	42.50		1:20	57.50		1:16	59.13	
1:32	45.50		1:31	38.25		1:35	56.00		1:31	55.25	
1:47	41.25		1:46	36.00		1:50	54.25		1:46	54.88	
2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled
2:02	39.75	Significant top layer of foam.	2:01	33.75	Significant top layer of foam.	2:05	53.00	Significant top layer of foam.	2:01	53.25	Significant top layer of foam.
4:00	27.25		4:00	20.75		4:00	41.25		4:00	37.50	
24:00	17.20	Supernatant sampled	24:00	16.75	Supernatant sampled	24:00	26.00	Supernatant sampled	24:00	25.00	Supernatant sampled


SMU 1A Settling Tests
Sediment Height (inches)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
Time (hours)
6% Untreated
6% Treated
9% Untreated
9% Treated

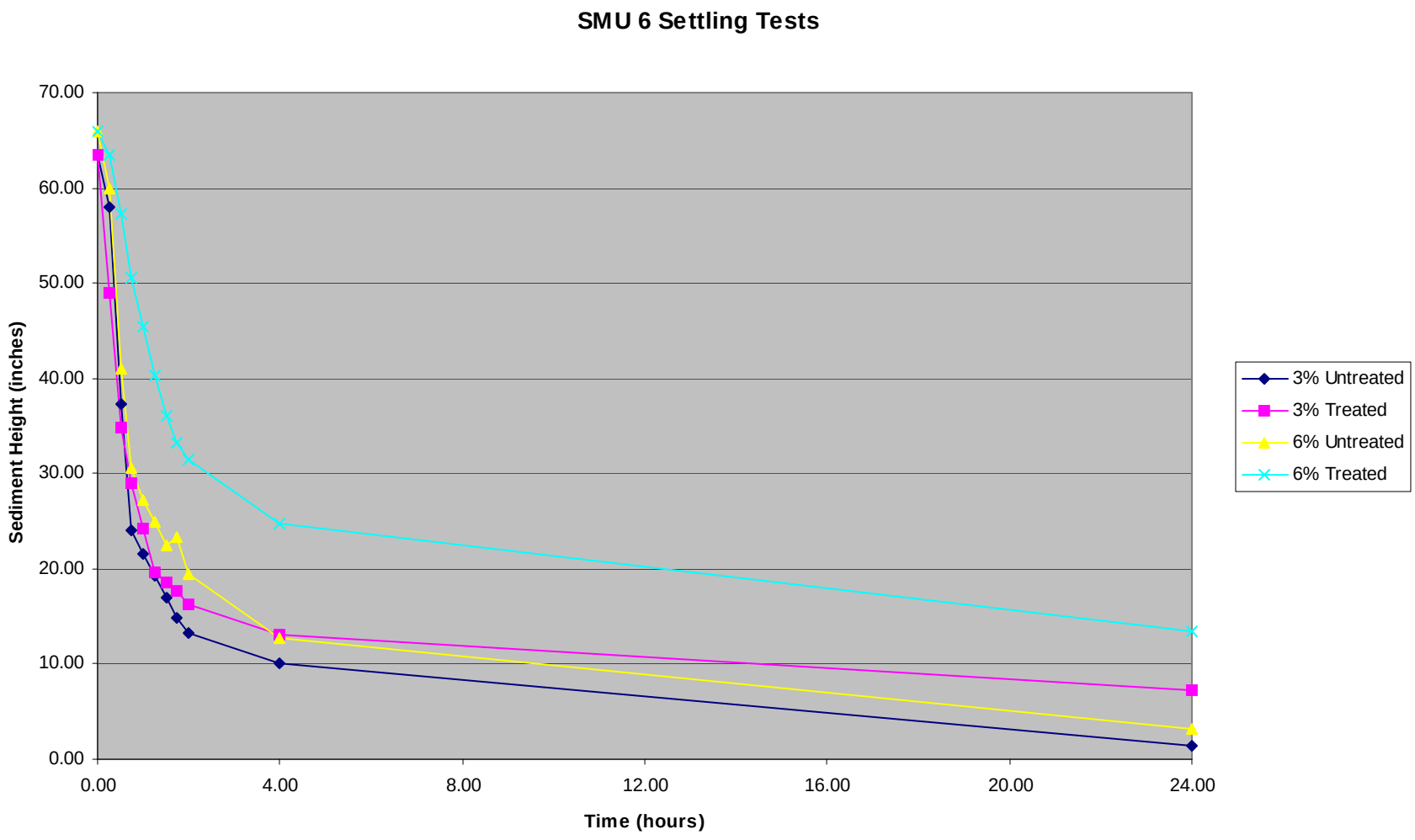
SMU 1B

3% Solids						6% Solids					
Untreated			Treated with 250ppm 7757			Untreated			Treated with 250ppm 7757		
Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations
0:00	65.25		0:00	65.25		0:00	63.50		0:00	63.50	
0:01	--	Noticeable Interface	0:01	--	Noticeable Interface	0:08	--	Noticeable Interface	0:01	--	Noticeable Interface
0:16	46.25	Supernatant is slightly cloudy.	0:16	37.50	Good floc, settles well. Supernatant appears clear.	0:23	60.13	Supernatant is slightly cloudy.	0:16	61.50	Good floc, settles well. Supernatant appears clear.
0:31	39.25		0:31	20.13		0:38	54.00		0:31	58.13	
0:46	35.75		0:46	18.00		0:53	49.00		0:46	55.13	
1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled
1:01	29.25		1:01	15.25		1:08	47.75		1:01	51.50	
1:16	25.50		1:16	13.13		1:23	42.88		1:16	48.50	
1:31	23.00		1:31	11.13		1:38	41.25		1:31	45.50	
1:46	20.25		1:46	10.50		1:53	40.00		1:46	42.75	
2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled
2:01	18.00		2:01	8.75		2:08	37.50		2:01	40.50	
4:00	14.00		4:00	6.50		4:00	12.50		4:00	27.50	
24:00	7.25	Supernatant sampled	24:00	2.75	Supernatant sampled	24:00	10.50	Supernatant sampled	24:00	16.00	Supernatant sampled

9% Solids						12% Solids					
Untreated			Treated with 250ppm 7757			Untreated			Treated with 250ppm 7757		
Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations
0:00	61.83		0:00	65.25		0:00	67.00		0:00	69.00	
0:14	--	Noticeable Interface	0:01	--	Noticeable Interface	0:07	--	Noticeable Interface	0:01	--	Noticeable Interface
0:29	60.75	Supernatant is slightly cloudy.	0:16	63.50	Good floc, settles well. Supernatant appears clear.	0:22	65.25	Supernatant is slightly cloudy.	0:16	67.50	Good floc, settles well. Supernatant appears clear.
0:44	59.25		0:31	61.75		0:37	64.75		0:31	57.94	
0:59	58.75		0:46	60.00		0:52	64.00		0:46	56.13	
1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled
1:14	56.75		1:01	56.50		1:07	63.20		1:01	55.75	
1:29	55.50		1:16	55.13		1:22	62.28		1:16	53.88	
1:44	54.13		1:31	54.25		1:37	61.50		1:31	52.25	
1:59	52.75		1:46	53.00		1:52	60.75		1:46	50.50	
2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled
2:14	51.75		2:01	52.25		2:07	60.00		2:01	48.50	
4:00	37.50		4:00	41.25		4:00	51.50		4:00	36.00	
24:00	19.75	Supernatant sampled	24:00	23.75	Supernatant sampled	24:00	28.63	Supernatant sampled	24:00	21.00	Supernatant sampled


SMU 1B Settling Tests
Sediment Height (inches)
80
70
60
50
40
30
20
10
0
0.00
4.00
8.00
12.00
16.00
20.00
24.00
Time (hours)
3% Untreated
3% Treated
6% Untreated
6% Treated
9% Untreated
9% Treated
12% Untreated
12% Treated

SMU 6											
3% Solids						6% Solids					
Untreated			Treated with 250ppm 7757			Untreated			Treated with 250ppm 7757		
Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations
0:00	63.50		0:00	63.50		0:00	66.00		0:00	66.00	
0:05	--	Noticeable Interface	0:01	--	Noticeable Interface	0:01	--	Noticeable Interface	0:00	--	Noticeable Interface at 5 seconds
0:20	58.00	Supernatant is extremely cloudy, difficult to see sediment line	0:16	49.00	Good floc, settles fast. Supernatant is clear.	0:16	60.00	Supernatant is extremely cloudy, difficult to see sediment line	0:15	63.50	Good floc, settles fast. Supernatant is clear.
0:35	37.25		0:31	34.75		0:31	41.00		0:30	57.25	
0:50	24.00		0:46	29.00		0:46	30.50		0:45	50.50	
1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	45.50	Supernatant sampled
1:05	21.50		1:01	24.25		1:01	27.25				
1:20	19.25		1:16	19.67		1:16	25.00		1:15	40.25	
1:35	17.00		1:31	18.50		1:31	22.50		1:30	36.13	
1:50	14.88		1:46	17.75		1:46	23.25		1:45	33.25	
2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	31.50	Supernatant sampled
2:05	13.25		2:01	16.25		2:01	19.50				
4:00	10.00		4:00	13.00		4:00	12.75		4:00	24.75	
24:00	1.50	Supernatant sampled	24:00	7.25	Supernatant sampled	24:00	3.25	Supernatant sampled	24:00	13.50	Supernatant sampled


SMU 6 Settling Tests
Sediment Height (inches)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
Time (hours)
3% Untreated
3% Treated
6% Untreated
6% Treated

APPENDIX H

MINERAL PROCESSING SERVICES PHASE IV ADDENDUM 6 SUMMARY REPORT

MINERAL PROCESSING SERVICES, LLC

Onondaga Lake Pre-Design Investigation Geotextile Dewatering Structure Geotube®

Bench Scale Testing Summary Report

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1/22/2010

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Executive Summary

Mineral Processing Services, LLC conducted application testing of TenCate™ Geotube® dewatering structures and chemical program evaluations to ascertain best dewatering performance combinations of fabric design and polymers for sediments from Onondaga Lake Sediment Management Units (SMUs) 1a, 1b and 6.

The results of the tests indicated that TenCate™ GT 500 filter cloth design combined with a dry polymer program provided by Ashland Chemical and Kemira Chemical offers the best performance for dewaterability. The processing programs are compatible with sediments from SMU 1a, 1b and 6 using a similar range of polymer dosage rates. SMU 6 required post addition of a coagulant to achieve similar filtrate capture rates within the Geotube® dewatering structure as SMU 1a and SMU 1b.

The characteristics of the SMU 1a and 1b sediments, and corresponding dredge slurry, are similar to mining slurry applications, where the filter cloth selection has been used successfully in many applications.

The SMU 6 slurry characteristic is similar to marine sediments with high biological content, in which the fabric selection has extensive applications.

Overall, the testing demonstrated soundness of the processing program and its application on sediment samples provided. Specific recommendations pertaining to the fabric design of the Geotube® containers, and the type and dosage of the polymer, can be incorporated into the Remedial Design.

Geotube® Geotextile Dewatering Structure Bench-Scale Testing Report

1.0 Introduction

The Rapid Dewatering Test (RDT) and the Pressure-Gravity Dewatering Test (P-GDT) were developed by TenCate and Mineral Processing Services LLC, respectively. RDT evaluates proper chemical agents and dosage for sediment conditioning. P-GDT validates full-scale application of the chemical program, sediment dewatering rate, filter cake dryness and filtrate parameters. RDT testing has been TenCate's standard for chemical program evaluation since 2005. P-GDT testing was developed in 2006 to augment RDT results. MPS has used RDT and P-GDT test results to support more than 20 projects, including mining, sediment dredging, water and wastewater treatment sludge. A detailed description of RDT and P-GDT, including descriptions of the process steps, are provided in Appendices B and C.

Application of the RDT and P-GDT testing to Onondaga Lake samples was described in the New York State Department of Environmental Conservation (NYSDEC) approved Onondaga Lake Pre-Design investigation Phase IV–Addendum 6 Workplan (Parsons, 2009). The purpose of this report is to provide results of bench scale evaluation for application of geotextile dewatering structures using a polymer conditioning program. This report details the chemical program selection process, geotextile fabric evaluation process and process mass balance for geotextile dewatering structures design.

2.0 Objectives

The specific objectives for the bench scale testing completed as part of this investigation includes testing and identifying best-performing chemical agents and filtration fabrics associated with a full-scale Geotube® dewatering operation. More specifically, the testing described in this report was designed to accomplish the following:

- Evaluate commercially available polymer programs using RDT (Rapid Dewatering Test) on sediment samples from SMUs 1 and 6.
- Evaluate Geotube® fabric design for compatibility with sediment samples from Onondaga Lake, and with polymer programs identified as best performing.
- Filtration evaluation of polymer programs and filter fabric design for thickened and non-thickened slurry, and screened (removing particle sizes greater than 100 US Mesh) and unscreened (removing particle sizes greater than 20 US Mesh) to allow samples to pass through P-GDT test stand meters.
- Provide estimate of Geotube® filtration area based on test results for project anticipated dredge yd^3 screened and non-screened options.

3.0 Sample Handling

Slurry preparation and bench-scale testing were performed by Mineral Processing Services, LLC (MPS) at its facility in South Portland, ME for RDT chemical program evaluation, and at Honeywell's Ground Water Treatment plant (WTP) on Willis Avenue in Syracuse, NY for bench scale filtration evaluation testing via P-GDT.

RDT Testing Sample Handling

Conducted at MPS Facility Location

Samples were shipped by Parson to MPS's South Portland, ME facility for an evaluation of commercially available polymer programs. SMU sediment samples were received in 5-gallon buckets from SMU 1b (location OL-STA-10118), SMU 1a (location OL-STA-10114); and SMU 6 (locations OL-STA-60098 and 60100). Additionally, water from Onondaga Lake was received to prepare slurries to the estimated dredge percent solids. Lake water was shipped in 55-gallon drums from Lake Onondaga, marked as "background water."

Samples from SMU 1a and 1b were a grayish-white color that exhibited slight hydrocarbon naphthalene odor characterization during mixing. Samples were mixed with blender with a tip speed of 600 rpm for duration of 15 minutes. As footnote on Table 1 indicates, samples averaged 41.5 percent dry solids pre-screening and 36.1 percent dry solids after screening with a 100 US Mesh screen. A 100 US Mesh screen was determined to be the most efficient screen size for this type of slurry. The SMU 1 samples had a wet weight reduction of 28.6 percent after screening at 100 US Mesh and exhibited light grey color with hydrocarbon smell.

The sample from SMU 6 was brown in color and exhibited slight organic septic odor during mixing. Sample was mixed with blender with a tip speed of 600 rpm for duration of 15 minutes. Sample measured 55.1 percent dry solids pre-screening and 35.1 percent dry solids after 100 US Mesh screening. Screening of the SMU 6 sample resulted in a 34 percent reduction in the wet weight.

Table 1 Volume Relationship Screened Particles RDT Test

P-GDT Testing Sample Handling

Conducted at Honeywell Ground Water Treatment Facility

SMU 1 and SMU 6 samples were delivered to Honeywell's Willis Avenue WTP location for P-GDT evaluation. Samples were received in 55-gallon drums and/or 5-gallon pails. Samples were mixed using a twin-prop shear mixer that extended the full length of the drum. Sample drums from SMU 1b required mechanical excavation using steel bar and shovel to create a 6-inch-diamenter hole through the settled solids, under the water cap, allowing installation of mixer shaft.

Sample drum was mixed until settled solids were able to be resuspended after 40 minutes of mix time.

SMU 1a and 1b particles are possible agglomeration of calcium carbonate fines that withstood shear mixing resulting in particle sizes that resembled course gravel and sand. SMU 6 particles are possible natural sediments with high organic content.

Sample odors were evident at the highest concentration of solids being the insitu raw slurry state having a naphthalene characterization during the resuspension process. The threshold of odor was reduced once lake dilution water was introduced to create a dredged slurry characterization.

Foam was evident during the raw insitu mixing state but dissipated quickly after completion of mixing. The foam volume increased and became more stable when mixing at the stage of dilution using lake water to replicate dredged slurry. Assessment of the mineralogy or chemical and physical characteristics of the foam was not completed. For pragmatic reasons, its existence needs to be considered should screening or clarification options be utilized. Foam may result in the carryover of particles in clarifications resulting in higher total suspended solids, and in the fluid mechanics of particle separation using hydrocyclone or screening.

Table 2 Volume Relationship of Screen Particles P-GDT Test

Screening Method of Samples

Samples received in 55-gallon drums for P-GDT testing were mixed for 40 minutes with a twin prop mixer operating at 1,800 rpm. The slurry percent dry solids of the drums for SMU 1b averaged 38-48 percent dry solids after mixing. The slurry preparation for the pressurized test tube pumps and meters used two or three different stages: first stage (applied to all tests), oversized 4-inch diameter to ¼-inch; second stage (applied to all tests), slurry passing 20 US Mesh (tests herein referred to as “unscreened”); and third stage, passing a 100 US Mesh (herein referred to as “screened”). The NYSDEC approved workplan specified that the material for the “screened” P-GDT tests would be completed on fine-grained slurry effluent from the hydrocyclone tests completed as a separate part of the workplan. Due to logistical difficulties and the locations of the various testing, use of this material was not possible. To ensure sufficient representation of the sand removal anticipated from the hydrocyclone, screening was done in a manner intended to replicate the hydrocyclone.

As noted above and in Section 2, all test samples were screened to at least the 20 US mesh size. Although the NYSDEC-approved workplan specified that P-GDT testing would also be completed on unscreened samples, the large-sized particles present in the sediment samples intended for testing was problematic for the meters and components of the P-GDT test stand. For this reason, all samples were screened to the 20 US Mesh level.

A vibratory separator operating at 4,000 Gs provided the best separation rates. The screening operation required wetting the screen prior to slurry addition, then pouring the slurry from a container at a rate of 2.6 gpm per square foot on a 20 US Mesh screen area and 1.8 gpm on a 100 US Mesh per square-foot screen area. Pouring was done by hand; pour rates were determined by best screen performance, time versus volume.

Overflow or coarse product was collected and held in a 55-gallon drum marked “screened material.” The underflow slurry was collected and added to the dilution mix tank marked “dredge slurry.” This tank was the staging mix tank, where lake water was added to create dredge slurry ranging from 8-12 percent dry solids. The screening operation was reliable and results repeatable throughout the test.

Odor was evident at the screening stage but not as strong as the raw slurry mixing stage. Foam was not evident during screening of the raw slurry, which had not received dilution with lake water. Screening of diluted dredge slurry was not tested.

4.0 Sample Testing Matrix

Appendix A provides a testing matrix that shows the interaction of test methods submitted prior to commencement of testing. Tables are provided with the results of each test method listed in the testing matrix.

Testing Goals

The use of geotextile structures requires application testing, which determines limits of structure design, fabric filtration rates "units required", dewatered "solid phase" and filtrate "water phase" characteristics. This data will support the design team in its evaluation of technology performance and its design relationship with dredging, slurry processing, geotextile structures selection and water treatment.

Methods

Testing methods of the activities included in this investigation are designed to analyze the effect of several contributing factors in a geotextile dewatering structure application. In preparation of bench testing, slurry samples are prepared to simulate the slurry feed from dredge operations. Chemical conditioning is required to facilitate water and solids destabilization and flocculation to facilitate dewatering. Chemical program testing examines the flocculation particle best suited for geotextile applications in regard to shear and consolidation.

Geotextile fabric evaluation is based on filtration rate, retention of colloidal solids and geotextile fabric characteristic for tube structure design. Full-scale simulation applies hydraulic shear forces to chemical program, examining colloid stability and solids capture rate evaluated by total suspended solids (TSS) values of the filtrate released through the fabric under full-scale design operating pressure. The results provide data on solids consolidation rates within a known filtration area to determine estimated geotextile dewatering structure consumption per dry ton of solids processed.

Evaluation

The objectives for evaluation will employ the following means:

- Sample preparation for non-thicken dredging will use dilution of sample to 12 percent dry solids with no screening or thickening conducted in P-GDT tests 1 through 6.
- Sample preparation for thickening will utilized vibratory screens removing greater than 100 US Mesh and thickening to 26 percent dry solids with chemical conditioning with in-cone thickener.
- Chemical conditioning program will utilize Rapid Dewatering Test (RDT) methods for evaluation. See Appendix B for method details.
- Geotextile filter cloth application will utilize RDT methods where the chemical conditioning program is a constant and filter cloth selection is a variable.
- Full-scale simulation testing of chemical program and filter cloth selection will utilize Pressure-Gravity Dewatering Test (P-GDT) methods for evaluation.
- Test report will submit raw data with discussions for each test method with a statistical conclusion on technology design parameters.

5.0 RDT Rapid Drainage Test

The Rapid Dewatering Test (RDT), outlined in Appendix B, was developed to evaluate chemical program requirements for water-solids separation. The test allows evaluation of 250 ml samples with various conditioning programs.

The evaluation uses gravity drainage of a known quantity of sediment, over 180 seconds. The drainage rate is evaluated using volume over time, monitored every 3 seconds using RDT software that plots results for comparisons. The drainage graph comparisons provide rates of drainage and total volume of filtrate.

Additional data produced from the RDT test includes filtrate quality (TSS) and turbidity (NTUs). Filter-cake compaction is also measured using a penetrometer recorded as kg/in², referred to as "consolidation" in the P-GDT test log. These tests provide the starting point for chemical program comparisons.

RDT Test Results

The test program utilized slurry created with sediment samples from SMU 1 and SMU 6, screened to 100 US Mesh prior to testing. For this phase of testing, samples from SMU 1a and 2b were mixted together, and tests were conducted on the mixed SMU 1 sample. Several chemical manufactures products were evaluated, usingtest kits that are provided by manufacturers. A list of manufactures and test kits used during testing is provided on Table 39. Several evaluation factors were considered when assessing the results of the various chemical products. Desirable performance characteristics of the chemical program include:

- Production of flocculants described as a "BB" or "small sphere," 6-4 mm in diameter. Flocculants with these characteristics typically result in the best dewatering performance, as it typically provides optimum free-water transport (drainage) with lowest moisture absorption (retention) in the filter cake.
- Resistance to shear resulting from hydraulic transport in piping and valves is evaluated using a mixer station speed setting and duration based on 6-7 velocity feet per second at 15 seconds.
- Ability to maintain drainage and capture rate with exposure to pH range of 8.2 – 10.8.
- Ability to retain sufficient surface charge potential to maintain flocculation characterization in salinity application of 1.7-4.3 ppt (parts per thousand).
- Comparable performance for sediments from SMUs 1 and 6.
- Chemical program dosage range has a "window of dewaterability" if operating 20 percent out of its target dosage rate.

MPS screened the manufacturers' products to evaluate what chemical program best meets the described goals of the RDT test method. Polymer manufactures were invited to participate in the evaluations of their respective products. Several of the vendors came to MPS's facility to participate in the optimization of their products. Tables 4 through 8 detail the results of RDT testing.

The subsections below outline the steps taken during the RDT testing, and key observations from the testing conducted.

Chemical Program Screening

- Sample aliquots of 250 ml slurry using lake water and insitu samples were created to 8-12 percent dry solids, representing the anticipated dredge slurry.
- Anionic and cationic emulsions were made down to 0.5 percent dilutions.

- Anionic and cationic dries were made down to 0.2 percent dilutions.
- Dilutions were aged after preparation for one hour before testing.
- Polymers were selected based on their background for treating carbonate mine slurry applications with high pH, and sediment dewatering for marine applications due to the salinity levels.
- Polymers were jar tested using a Kost and Sons paddle mixer to generate slurry velocity of 6-7 fps to establish desired flocculation structure at 15 seconds on dries and 10 seconds on emulsions.
- Products and dose rates were evaluated first by the ability to create flocculation characterization of a "BB"-size sphere with clear filtrate.
- Products meeting the first criteria were then applied to the RDT for drainage and capture-rate testing.
- Products were then ranked using RDT software that correlated drainage rates.
- One of the two dry-chemical programs selected was then tested on four filter fabric designs manufactured by TenCate™. The test results shown in Table 38 indicate that fabrics 02B and 02F had higher drainage rates than GT 500, with similar capture rates when gravity drainage tested.

Observations

- Cationic and anionic polymers show the slurry could be flocculated prior to RDT testing.
- Emulsion polymers tested showed that the flocculated sphere broke down when exposed to the higher pH and salinity slurry during shear mixing phase of testing.
- An emulsion polymer with a cationic charge provided the best overall results for the cationic emulsion products tested at 2.98 lbs/dry ton.
- Dry polymers with anionic charge provided the best overall results for dry products tested at .99 lbs/dry ton dosage.
- Best performing polymer programs were anionic dries, being low-charge, high-molecular-weight polyacrylamide formulations.
- Shear benchmarked at 6-7 fps for 15 seconds showed anionic dries ranked 1 and 2 as having the highest shear resistance.
- Products with the highest resistance to flocculated sphere deterioration resulting from high pH and salinity was anionic dries ranked 1 and 2, found in Table 3.
- Sample testing of SMU 1and SMU 6 showed similar drainage rate, with capture rates slightly lower for SMU 6 sample, indicating a coagulant program in addition to the flocculent may be required should results from P-GDT testing prove poorer capture rates on SMU 6 sample.
- RDT samples with same percent dry solids showed variability in drainage rates based on the relationship of pH, salinity and conductivity. This was most interesting as with large sediment projects, flow and percent dry solids have the largest upper and lower limits of values. But with the SMU slurries, it is expected that pH, salinity and conductivity will share these large ranges of values.
- RDT drainage rates trends have a benchmark, at X axis 60 seconds and Y axis 100 ml, to assist in evaluation comparisons.

RDT Testing and Screening Summary

The RDT test method is the first step in selection of chemical program and fabric design.

Results showed SMUs 1and 6 are successful applications for Geotube® containment dewatering structures when using the selected anionic dries polymer chemical programs.

The drainage characteristics of sediment from SMU 1 is much like mining ore slurries, having moderate but consistent water release due to the high percentage of particle fines of equal size. The drainage characteristics of sediment from SMU 6 was similar to marine sediment, having organic matter resulting in higher drainage rate than sediment from SMU 1.

The RDT testing program resulted in three out of six chemical manufacturers having products that would advance to the P-GDT testing program. These products are ranked in Table 3, showing anionic dry products as best selected chemical program with a dosage rate of .99 lbs/dry ton with filtrate total suspended solids (TSS) < 20 mg/l and filter cake compaction of .8 kg/in^2.

Screening requirements for the evaluation was to remove oversized particles down to 20 US Mesh and 100 US Mesh to generate comparable slurries from hydrocyclone operation. Screening preparation of the samples was not intended to be an evaluation of particle classification technologies. The vibratory screen method used in sample preparation was efficient in removing oversized particle with repeatable results. A volumetric mass balance estimate of values retained on 100 US Mesh of the SMU 1 and 6 samples received for testing is shown in Tables 1 and 2.

6.0 Pressure-Gravity Dewatering Test (P-GDT)

The Pressure-Gravity Dewatering Test (P-GDT) outlined in Appendix C was developed to evaluate the following criteria:

- Replicate the largest tube design for the project estimated at 90-foot circumference, having a hydraulic internal fill pressure of 3.67 psi.
- To evaluate chemical program resistance to design pressure and extrusion through fabric tested.
- To create a fill-pipe shear velocity of 6-7 fps for evaluating a chemical program's resistance to shear prior to entering the tube.
- To evaluate chemical program and filter cloth selection for processing the highest amount of solids based on wet and dry mass contained in a test tube having 1 ft^3 void filtration area.

The P-GDT test uses three methods (M_1, M_2 and M_3) for mass of sediment processed by the test:

M_1: Total mass recorded by Coriolis meter (WP_1) less the mass of filtrate released (F_1) weighed by filtrate weigh scale.

$$WP_1\ [lb] - F_1\ [lb] = TM_1\ [lb]$$

M_2: Total Processed Volume of slurry ("V_1" -gallons) determined by Coriolis meter multiplied by density determined by Humbolt density meter ("D_2" -lb_{wet}/gal) multiplied by dry solids determined by lab dry solids meter (DS_1 -%). V_1 measured by the Coriolis accounts for instantaneous changes in density during the fill. D_2 (via Humboldt) is representative of the mix tank slurry average density prior to fill. Use of V_1 x D_2 rather than a direct mass flow measurement by the Coriolis eliminates the effects of instantaneous changes in density. This allows the use of one lab test of solids (DS_1) rather than three individual tests.

$$V_1\ [gal] \times D_2\ [lb_{wet}/gal] \times DS_1\ [\%\ solids] \div 100 = DP_{M2}\ (lbdry)$$

M_3: Perform dry-solids analysis of the sediments within the tube after dewatering for 24 hours (DS_2 -% solids). Multiply by the tube's total wet weight (TT_{w2}) to establish pounds of dry solids processed for filter area. TTW_2 already accounts for the tare weight of the empty tube.

$$TT_{w2}\ [lb] \times DS_2\ [\%\ solids] \div 100 = DP_{M3}\ (lbdry)$$

M_1 and M_2 are used for performance evaluations of chemical program and fabric. M_3 is used for estimating void area of tube required to process estimated dry pounds of SMU slurries.

Assumptions

The calculation presented in the P-GDT log for wet and dry mass determination methods:

- Volume of slurry determined by Coriolis Meter V_1
- Density of slurry determined by Coriolis meter D_1
- Density of slurry determined by Humbolt mud balance D_2
- M_1 Wet pounds determination using batch volume method WP_{m1}
- M_2 Dry pounds determination using volume removed from slurry tank method DP_{m2}
- M_3 Dry pounds value calculated based on test tube % dry solids multiplied by 24/hr dewatered wet mass of tube method DP_{m3}
- Wet pounds determination using Coriolis meter WP_1
- Dry solids value using lab meter of aliquot sample of slurry tank DS_1
- Dry solids value using lab meter of aliquot sample of test tube DS_2
- Pounds of filtrate F_1
- Unit weight of water in 1ft³ of test tube Y_wT_v = 62.4 pcf
- Wet mass of test tube completion of test TT_{w1}
- Wet mass of test tube after 24hr dewatering TT_{w2}
- Methods of determining dry and wet mass M_1, M_2 and M_3

P-GDT Log Mass Calculations Methods

M_1, wet bulk density retained / ft³ (by volume): $WP_1 = V_1 * D_1$

M_2, dry solids retained / ft³ (by mass): $DPm2 = V_1 * D_2 * DS_1$

M_3, dry solids retained / ft³ (by mass after 24 hours of dewatering): $DP_{m3} = TT_{w2} * DS_2$

P-GDT Testing

The goal of the P-GDT test is to evaluate dewaterability and consolidation rate from representative samples of a full-scale dredge operation for slurry represented by sediment samples from SMU 1a, 1b and 6.

Sediment samples were screened and/or thickened as described in Section 3, and all slurry dilutions utilized Onondaga Lake background water collected as part of the Pre-Design Investigation. A range of 8-12 percent dry solids for non-thickened testing was used and 20 percent dry solids for thickened clarified application testing was created. A screening mass-balance is provided in Table 1 for RDT testing and Table 2 for P-GDT testing.

A total of 13 P-GDT tests were completed as part of this investigation. All tests except Tests 7 and 8 were conducted on unscreened material. Tests 7 and 8 were conducted on screened material that was also thickened. Tests conducted include:

P-GDT Test 1. SMU 1b Unscreened Ashland 2520 Dry Polymer Filtered by TenCate™ GT 500

P-GDT Test 2. SMU 1b Unscreened Ashland 2520 Dry Polymer Filtered by TenCate™ O2B

P-GDT Test 3. SMU 1b Unscreened Ashland 2520 Dry Polymer Filtered by TenCate™ O2F

P-GDT Test 4. SMU 1b Unscreened Kemira A-100 Dry Polymer Filtered by TenCate™ GT 500

P-GDT Test 5. SMU 1b Unscreened Nalco 7766 Emulsion Polymer Filtered by TenCate™ GT 500

P-GDT Test 6. SMU 1a Unscreened Kemira A-100 Dry Polymer Filtered by TenCate™ GT 500

P-GDT Test 7. SMU 1b Screened Thickened Ashland 2520 Dry Polymer Filtered by Ten Cate™ GT 500

P-GDT Test 8. SMU 1b Screened Thickened Kemira A-100 Dry Polymer Filtered by TenCate™ GT 500

P-GDT Test 9. SMU1b Unscreened Kemira A-100 Dry Polymer Filtered by Ten Cate™ GT 500 (repeat of Test 4)

P-GDT Test 10. SMU 1b Unscreened Ashland 2520 Dry Polymer Filtered by TenCate™ GT 500 (repeat of Test 1)

P-GDT Test 11. SMU 1b Unscreened Ashland 2520 Dry Polymer Filtered by TenCate™ GT 500 (dosage at RDT evaluation .99 / lbs dry ton)

P-GDT Test 12. SMU 6 Unscreened Brown (60098) Ashland 2520 Dry Polymer & Coagulant 492 Filtered by Ten Cate™ GT 500 (2520 @ 1.59 / lbs dry ton; 492 coag @ 5.71/lbs dry ton)

P-GDT Test 13. SMU 6 Unscreened Black (60100) Ashland 2520 Dry Polymer & Coagulant 492 Filtered by TenCate™ GT 500 (2520@ 1.59/lbs dry ton; 492 coag @ 5.71/lbs dry ton)

The subsections below outline key observations and summaries from the testing conducted.

P-GDT Test Results

Chemical program testing in the RDT phase shown in Table 3 provided optimal programs cited as anionic dry polymers with a dosage rate of 0.99 lbs / dry ton for SMU slurries, evaluated under gravity drainage conditions. During the P-GDT, and at the RDT dosage of 0.99 lbs / dry ton, a breaking down of the flocculated spheres was observed during the 20 minute (and greater) duration in the mixing tank, likely due to exposure to high pH and salinity. To counter this effect, the dosage rate was increased. Following iterative testing, a dosage rate of 1.59 lbs / dry ton was found to be successful in retaining floc formation for extended duration. P-GDT dosage rates0 .99 lbs / dry ton compared to 1.59 lbs / dry ton shows much higher losses of solids in filtrate (703 TSS) during Test 11 (Table 31) as compared to (26 TSS) Test 1 (Table 11). The higher solids losses at the lower dose could result in blinding of filter cloth openings, resulting in larger clarifier design.

The filter fabric design evaluation using TenCate™ fabric design drainage rates were: GT 500, 20 gpm / ft^2; O2B, 30 gpm / ft^2; 02F, 70 gpm / ft^2, which demonstrated greater drainage rates during RDT testing and would have beneficial application. But the slightly lower capture rates shown as higher total suspended solids (TSS) would need evaluation under pressure in the P-GDT test program. The P-GDT test fabric selection results showed higher filtration rates with fabric O2B (Table 13) and O2F (Table 15), but experienced greater than a 5:1 increase in solids loss with pressures 1.5 psi and higher during the P-GDT testing compared to GT 500 (Table 11). The results of the filter fabric evaluation showed GT 500 had the highest retention of solids under design pressure of 3.67 psi; coupled with variability of performance due to pH, salinity and conductivity changes, GT 500 would have highest recovery rate of TSS during these change conditions.

Mass-balance evaluations for performance of chemical programs combined with filter cloth selection are shown in P-GDT logs (Tables 11-36) as M1 (Method 1) and M2 (Method 2). The trend of each method individually compared with the various P-GDT tests are used in evaluations. The best performance (BP) of chemical program and filter fabric is based on the highest yield of dry and wet lbs per 1ft³ resulting from evaluations in M1 for wet lbs / 1ft³ and in M2 for dry lbs / 1ft³. The filtration area of a Geotube® containment structure required to process a dry ton of slurry solids is based on 24 hours' dewatering period of the tube after pressure filling and is expressed in dry lbs / 1ft³. The results of test provided in Table 11 shows that 2.11 yd³ of tube volume is required for 1 dry ton of SMU 1a and 1b. Table 35 shows that 2.84 yd³ of tube volume is required for 1 dry ton of SMU 6 Black (OL-STA-60100). Table 33 shows that 2.97 yd³ of tube volume is required for 1 dry ton of SMU 6 Brown (OL-STA-60098).

P-GDT Testing Summary

The P-GDT testing supports that Geotube® containment structures combined with best performing (BP) chemical programs can effectively dewater sediments from SMU 1a and 1b using similar design filter fabric TenCate™ Geotube® GT 500. The process flexibility of chemical programs ranked 1 and 2 in Table 3 (Ashland 2520 and Kemira A-100, respectively) appears to have the ability to tolerate variability in the slurries' pH, salinity, conductivity, percent dry solids and flow, and resulting filter fabric solids retention. Based on testing performed in this investigation, sediments from SMU 6 (Brown & Black) would also effectively dewater with chemical program selected for SMU 1a & 1b. Followed with a coagulant to aid in filtrate solids capture rates of the biological fines, a chemical treatment using a coagulant to restabilize floc fragments was used (as shown in Test 12, SMU 6 Black with coagulant, and Test 13, SMU 6 Brown with coagulant).

There exist multiple combinations of these variables, which the chemical conditioning system will need to monitor and react to in real time. The broad operational window which the best-performing chemical programs have, in combination with the filter-fabric design for solids retention and dewaterability, will provide a successful combination for dewatering methods.

7.0 Polymer Make Up Using Filtrate Testing

Objective

The purpose of this test is to evaluate the use of filtrate water from the Geotube® dewatering process. In most applications, potable water is needed for a chemical program using dry polymer creating an emulsion of 0.2 percent dilution for the dewatering process. Due to the absence of an existing potable water source in the immediate area the anticipated SCA, additional tests were conceived to assess whether filtrate from the dewatering operation (P-GDT filtrate), or effluent from the water treatment plant which will be constructed for the project (WTP effluent), could be utilized in the polymer "make-down" process. This test evaluated the use of filtrate from the Geotube® P-GDT test during on-site testing, and water produced by treatability testing completed by O'Brien & Gere as part of a separate portion of the investigation.

In the following section, Phase 1 refers to testing conducted at Honeywell Ground Water Treatment Plant and Phase 2 refers to testing conducted at MPS Filtration Lab.

Test Method

Phase 1 Performed At On-site Ground Water Facility

- 0.400 g dry polymer was introduced to 200 ml of tap water creating 0.2 percent dilution.
- 0.400 g dry polymer was introduced to 200 ml P-GDT filtrate creating 0.2 percent dilution.

- Polymer was aged for 6 hours, reflecting a hold time duration for temporary shut down as normal process aging is 1-2 hours.
- Polymer was added to 250 ml raw sample of SMU 1b anticipated from a dredging operation at 1.50 lbs / dry ton.
- Samples flocculated were run on the Rapid Dewatering Test (RDT).
- Drainage and capture rates were monitored and recorded as provided in Table 9.

Phase 2 Performed At MPS Facility

- 0.400 g dry polymer was introduced to 200 ml of tap water creating 0.2 percent dilution.
- 0.400 g dry polymer was introduced to 200 ml P-GDT filtrate creating 0.2 percent dilution.
- 0.400 g dry polymer was introduced to 200 ml WTP effluent rate creating 0.2 percent dilution.
- Polymer was aged for 6 hours, reflecting a hold time duration for temporary shut down as normal hold time aging is 1-2 hours.
- Polymer make up water variables were used to flocculate the three samples.
- Sample drainage and capture rates were monitored and recorded on Table 10.

Observations

Phase1, 6 hours aging time

- Test utilizing P-GDT filtrate failed drainage test and had TSS 4 times higher than potable water.
- TSS for tap water was 20 TSS and 86 TSS for P-GDT filtrate.
- Flocculation of slurry using P-GDT filtrate did not result in sphere characterization as did the tap water.
- Filter cake from untreated filtrate did not register compaction.

Phase 2, 6 hours aging time

- Test utilizing P-GDT filtrate had required sphere characterization.
- Test utilizing WTP effluent had required sphere characterization.
- Test utilizing tap water had required sphere characterization.
- Dewatering rates were similar for all three samples tested.
- RDT cake compaction was similar for all three samples tested.

Phase 2, Characterization of Water Used For Polymer Make Down (Table 10)

Filtrate Sample	TSS mg/l	pH	Salinity PPT	Conductivity mS/cm
Tap Water	0	8.8	0	70.45
WTP Effluent	0	7.5	1.7	3.82
P-GDT Filtrate	0	10.2	4.7	9.35

Phase 2. RDT Testing Results Comparisons (Table 10)

Filtrate Sample	Sphere Characterization	Floc Shear Resistance	Drainage Rate ml After 180 Sec	Compaction Rate kg/in²	Filtrate TSS mg/l
Tap Water	Similar BB	Similar 15 Sec	174	0.8	4
WTP Effluent	Similar BB	Similar 15 Sec	174	0.6	12
P-GDT Filtrate	Similar BB	Similar 15 Sec	181	0.2	21

Summary

Bench scale testing used RDT evaluation of water and P-GDT filtrate for polymer make down and was conducted in two phases. The first phase was an RDT test at the end of the P-GDT trials (Table 9) which resulted in poor drainage and capture rates of filtrate water sample. During this first phase of testing, the pH of the P-GDT filtrate was adjusted using SO^4 to similar pH values of tap water. This pH adjustment was made to simulate anticipated processes associated with the treatment of filtrate in the onsite Water Treatment Plant. The second phase (Table 10) used no chemical pretreatment of water prior to make down with dry polymer. The results showed only minimal difference between tap water, P-GDT filtrate and WTP effluent.

The largest variable in parameters between test phases was filtrate used in Phase 1 was the pH adjustment. This possibly precipitated calcium forming $CaSO^4$ that consumed much of the activity of the polymer. In Phase 2, no pH adjustment was conducted on samples prior to use for polymer make down.

Based on RDT evaluation, the WTP effluent is a candidate for supplementing the use of potable water for polymer make down operations. Although the bench tests described above did not identify major discrepancies between the effectiveness of polymer made up of the different water sources, previous project experience attempts has demonstrated that the use filtrate as polymer makeup water can be challenging. Furthermore, based on this bench testing, further evaluation would be necessary to determine whether pH adjustment completed as part of the water treatment process would have the same impact on the effectiveness of the polymer as was noted during this bench testing. Further evaluation and/or full-scale field validation on the use of filtrate water, or WTP effluent, as polymer makeup water, could be completed during the initial startup phases of the dredging operation. As a contingency, it would likely be necessary to have a potable water feed line rated for 300 gpm @ 60 psi installed to the chemical treatment pad in the event poor dewatering performance results are experienced from untreated filtrate, or the WTP effluent.

Parson

Table 39

SMU 1A - 1B - SMU 6 Brown

RDT Geotube® Evaluation Polymer Vendor Product Code

Testing Conducted At MPS Filtration Lab

Ashland	BETZ	CIBA	Kemira	SNF	Nalco
2520 DRY A	AP 1100	FC2106D	1154	913SH	7766 PLUS
K105L	AE 1700	FC 2044	3140	4190	7533 PLUS
3010	AP1110	371	3603	913VHM	7539
3025	AS1002	368	7221	4140SH	8158
3010	AP1120	156	7223	4107SH	71307
K1481	MP2402	336	3455	923	7736EZ
K132L	AS1001	10	1146	4800	7194 PLUS
K122L	AP1138	455	1162	4650	71325
K128	AE 1702	338	3135	455D	8172 PULV
K275FLX	AE1700	351	4814RS	4240VHM	8682-SC
N3100LTR	CE2694	7692	7225	4550SSH	7190 PLUS
490	AE1147	919	3620	905	7196 PLUS
12	AE1703	8844FS	7426	4650SH	7769
K136L	AP1142	333	7251	4498SH	8172 PULV
7			3638	945SH	7199
K290Fl			3456	910VHM	71303
K280FL			3155	905VHM	71306
K111L			3196	956SH	71305
485			3192	934VHM	71300
133L			3188	C-6227	71303
K110L			7257	240CT	61733
K144L			3640	EM140CT	7191 PLUS
482			3440	EM154CT	7181
K133L			3644	4290SH	71302
5320			3610	4290 SH	71301
K290FLX			1144	4115SH	7593
36			7222	956	9602
K260FL			3135	912	9601
K279FLX			3630	4190VHM	2706
A3040LA			A-100	934	7766
851BC			1849	A-6321	9602 PULV
K148L			3601	A-6341	1689
K292FLX			1849	EM1540CT	
K274FLX				EM240CT	
K120L				4290SH	
K295FL				EM 532	

APPENDIX I

MASS BALANCE CALCULATIONS

APPENDIX I

MASS BALANCE CALCULATIONS

I.1 CALCULATION ASSUMPTIONS

The mass balance presented in this Appendix has been prepared to provide a basis for the sizing and design of the equipment, pumps, and pipelines that will be utilized in the various sediment management activities that are described in this Intermediate Design Report. Mass balance diagrams have been developed for dredging Phases 1 and 2. As presented in this Appendix, two scenarios have been evaluated for each dredging Phase, the maximum flow produced by the dredge, and the average flow. The maximum flow represents the mass balance of flows while dredging operations are ongoing. The average flow incorporates the dredging "up-time" (assumed to be 70%) to produce calculated average flows over the course of a one-day period.

As described in this design report, selection of a dredging contractor has not been finalized at the time of the preparation of this report. As such, assumptions must be made regarding the flowrate and slurry percent solids that are produced by the equipment utilized to execute the dredging portion of the remedy. As described in Section 2.1.2, a dredge flowrate of 5,000 gpm, and a 10% solids by weight slurry, are assumed to be maintained by the dredging operation. Following selection of the dredging contractor, these assumptions will be reevaluated. If necessary, the mass balance will be updated as part of the Final Design to reflect any changes in these assumptions.

Due to the nature of dredging operations, the achieved percent solids produced will vary significantly over short periods of time, which will result in significant short-term variation in the proportion of water versus solids entering the system at a given time. The impact of these changes on pre-processing equipment is expected to be minimal. Due to the time required for geotextile tube filtrate to flow through the gravel and/or drainage channels, water within the SCA will effectively have some residence time before reaching the sumps. This residence time will attenuate fluctuating solids content, limiting any potential impacts to the SCA WTP.

Slurry Transport Mass Balance Calculation

1.0 Introduction

This package provides the mass balance calculation of the slurry transport, pre-processing, and geotextile tube dewatering. The hydraulically dredged Onondaga Lake sediment will be transported as a slurry to the SCA located on Wastebed 13 via a pipeline. Upon reaching the SCA, the slurry will go through several steps of pre-processing and then the final geotextile tube dewatering. The geotextile tube filtrate, along with water from screened material stockpiles and surface contact water with the active SCA, will be treated in the water treatment plant located on Wastebeds 12 and 13. The clarifier underflow and backwash water generated from the WTP will be sent back to the SCA and dewatered by geotextile tubes.

Following this introduction, Section 2 presents the definition of terms used in this calculation. Section 3 provides the assumptions. Section 4 contains a step-by-step mass balance calculation of the maximum flow scenario (5000 gpm). Section 5 assembles the results in a table format. The calculation of the average flow scenario (70% of the maximum flow or 3500 gpm) uses the same set of equations and steps. The spreadsheets contained in this appendix present calculations for both the maximum and average flow scenarios. Mass balance calculation associated with the water treatment process is provided in a separate submittal.

2.0 Definitions

Primary screening: The process of removing over-sized particles (> 2-inch) by passing the slurry through 2-inch screens.

Secondary screening: The process of removing gravel-sized particles by passing the slurry through 1/4-inch screens.

Hydrocyclone sand-sized particle removal: The process of removing sand-sized particles by passing the slurry through a hydrocyclone system.

Geotextile tube initial dewatering: The first 24 hours after the geotextile tube is filled.

Geotextile tube consolidation dewatering: The duration of 60 days after the initial dewatering. It is assumed that the primary consolidation within the geotextile tubes will complete during this period of time. Longer term consolidation or dewatering (secondary consolidation) is not considered in this calculation.

Filtrate: Including water and total suspended solids.

Geotextile tube filtrate: The summation of filtrate from the geotextile tube initial and consolidation dewatering.

Stockpile filtrate: The filtrate generated by change in water content of screened material stockpile (over-sized, gravel, and sand).

Total filtrate: The summation of geotextile tube filtrate and stockpile filtrate. The total filtrate will be sent to the SCA water treatment plant for treatment.

Phase I: For slurry from Remediation Areas C and D, the dewatering process includes primary screening for over-sized particle removal, polymer injection, and geotextile tube dewatering.

Phase II: For slurry from Remediation Areas A, B, E, and F, the dewatering process includes primary screening for over-sized particle removal, secondary screening for gravel-sized particle removal, hydrocyclone for sand-sized particle removal, polymer and coagulant injection, and geotextile tube dewatering.

3.0 Assumptions

- Geotextile tube consolidation dewatering is assumed to complete in 60 days after the initial dewatering. This calculation considers consolidation dewatering peak flow scenario , which starts from 61 days after the first tube is filled and ends at one day after the last tube is filled for the season.

- Polymer and coagulant particles injected to the slurry will be captured in the geotextile tube during the initial dewatering.

- Water density: $\rho_w := 1\frac{gm}{cm^3}$ $\rho_w = 62.4279606\frac{lb}{ft^3}$

- Maximum slurry flow rate: $q := 5000gpm$, where gpm is gallons per minute.

- Average slurry flow rate: $q_a := q \cdot 70\%$ $q_a = 3500\,gpm$

- Slurry solids content by weight: $P_s := 10\%$

- Specific gravity of lake sediment **(Table 1)**:

  Phase I: $Gs_I := 2.56$

  Phase II: $Gs_{II} := 2.64$

- The specific gravity of total suspended solids is assumed to be the same as lake sediment of each phase.

- Initial water content of screened material stockpile: $WC_{istock} := 25\%$, based on vendor's estimate.

- Final water content of screened material stockpile: $WC_{fstock} := 15\%$, assumed value.

- Total suspended solids (TSS) in geotextile tube filtrate, based on O'Brien & Gere's estimate:

  $TSS_{tube\_filtrate} := 195.2\frac{mg}{L}$

- Assumed TSS in stockpile filtrate (filtrate generated by change in stockpile water content) :

  $TSS_{stock\_filtrate} := 195.2\frac{mg}{L}$

- Maximum booster pump seal water (each): $q_{booster} := 50gpm$, based on vendor's estimate.

- Average booster pump seal water (each): $q_{booster\_a} := q_{booster} \cdot 70\%$ $q_{booster\_a} = 35\,gpm$

- Number of booster pumps: $N_{booster} := 5$

- Maximum hydrocyclone feed pump seal water (each): $q_{cyclone\_pump} := 15gpm$

- Average hydrocyclone feed pump seal water (each): $q_{cyclone\_pump\_a} := q_{cyclone\_pump} \cdot 70\%$ $q_{cyclone\_pump\_a} = 10.5\,gpm$

- Number of hydrocyclone feed pumps: $N_{cyclone\_pump} := 2.$

- Maximum geotextile tube feed pump seal water (each): $q_{tube\_pump} := 15gpm$

- Average geotextile tube feed pump seal water (each): $q_{tube\_pump\_a} := q_{tube\_pump} \cdot 70\%$ $q_{tube\_pump\_a} = 10.5\,gpm$

- Number of active geotextile tube feed pumps: $N_{tube\_pump} := 1$

- Maximum primary screen wash water: $q_{primary} := 102gpm$, based on vendor's estimate.
- Average primary screen wash water: $q_{primary\_a} := q_{primary} \cdot 70\%$ $q_{primary\_a} = 71.4\,gpm$
- Maximum secondary screen and hydrocyclone screen wash water:

  $q_{second\_cyclone} := 510gpm$, based on vendor's estimate.
- Average secondary screen and hydrocyclone screen wash water:

  $q_{second\_cyclone\_a} := q_{second\_cyclone} \cdot 70\%$ $q_{second\_cyclone\_a} = 357\,gpm$
- Clarifier underflow from the SCA water treatment plant , based on O'Brien & Gere's estimate.:

  $q_{clarifier} := 735gpm$ $TSS_{clarifier} := 3017.9\frac{mg}{L}$, where TSS is total suspended solids.
- Spent MMF backwash from the SCA water treatment plant, based on O'Brien & Gere's estimate:

  $q_{MMF} := 166.3gpm$ $TSS_{MMF} := 483.3\frac{mg}{L}$
- Spent GAC backwash from the SCA water treatment plant, based on O'Brien & Gere's estimate:

  $q_{GAC} := 164.6gpm$ $TSS_{GAC} := 95.8\frac{mg}{L}$
- Average percentage of over-sized particle (removed by primary screen), assuming 10% of the gravel-sized particle is over-sized **(Table 1)**:

  Phase I: $P_{oversized\_I} := 0.2\%$

  Phase II: $P_{oversized\_II} := 1.6\%$
- Average percentage of gravel-sized particle (removed by secondary screen) of Remediation Areas A, B, E, and F **(Table 1)**:

  $P_{gravel} := 14.4\%$

  Note: Table 1 shows approximately 16% is gravel. Based on the assumption that 10% of the gravel is over-sized and removed by the primary screen, the gravel removed by the secondary screen is 14.4% (i.e., 90% of 16%).
- Average percentage of sand-sized particle (removed by hydrocyclone) of Remediation Areas A, B, E, and F **(Table 1)**:

  $P_{sand} := 41\%$
- Average percentage of fines (silt and clay-sized particles) **(Table 1)**:

  Phase I: $P_{fine\_I} := 82\%$

  Phase II: $P_{fine\_II} := 43\%$

  Note: The polymer and coagulant dosage is based on dry weight of fines, rather than the total dry solids weight.
- Solids content by weight after initial dewatering in geotextile tubes (i.e., after the first 24 hrs):

  $P_{s2} := 38\%$,based on **P-GDT results**.

- Consolidation dewatering in the geotextile tube will take 60 days to complete, with equal daily filtrate volume. Total days of consolidation dewatering:

$$t_c := 60\text{day}$$

- Solids content by weight after consolidation dewatering in geotextile tubes (i.e., 60 days after the first 24 hrs):

$$P_{s3} := 50\%$$

- Maximum discharge to Metro WTP from SCA WTP:

$$MAX_{discharge} := 6.5 \cdot 10^6 \frac{gal}{day} \qquad MAX_{discharge} = 4513.9\,gpm$$

$$TSS_{discharge} := 4.5 \frac{mg}{L}$$

4.0 Calculations

4.1 Incoming Slurry

Slurry water content: $WC := \frac{1 - P_s}{P_s}$ $\qquad WC = 900\%$

Water in slurry:

Phase I:

Volume $q_{w\_I} := \frac{q \cdot (1 - P_s) \cdot Gs_I}{P_s + (1 - P_s) \cdot Gs_I}$ $\qquad q_{w\_I} = 6900499 \frac{gal}{day}$

Weight $W_{w\_I} := q_{w\_I} \cdot \rho_w$ $\qquad W_{w\_I} = 57587459.3 \frac{lb}{day}$

Phase II:

Volume $q_{w\_II} := \frac{q \cdot (1 - P_s) \cdot Gs_{II}}{P_s + (1 - P_s) \cdot Gs_{II}}$ $\qquad q_{w\_II} = 6909208 \frac{gal}{day}$

Weight $W_{w\_II} := q_{w\_II} \cdot \rho_w$ $\qquad W_{w\_II} = 57660141.3 \frac{lb}{day}$

Solids in slurry:

Phase I:

Volume (zero void ratio) $q_{s\_I} := \frac{q \cdot P_s}{P_s + (1 - P_s) \cdot Gs_I}$ $\qquad q_{s\_I} = 299500.8 \frac{gal}{day}$

Weight $W_{s\_I} := q_{s\_I} \cdot Gs_I \cdot \rho_w$ $\qquad W_{s\_I} = 6398607 \frac{lb}{day}$

Phase II:

Volume (zero void ratio) $q_{s\_II} := \frac{q \cdot P_s}{P_s + (1 - P_s) \cdot Gs_{II}}$ $\qquad q_{s\_II} = 290792 \frac{gal}{day}$

Weight $W_{s\_II} := q_{s\_II} \cdot Gs_{II} \cdot \rho_w$ $\qquad W_{s\_II} = 6406682 \frac{lb}{day}$

4.2 Primary Screening for Over-Sized Particle Removal

Weight of removed over-sized particles:

Phase I:

$W_{oversized\_I} := W_{s\_I} \cdot P_{oversized\_I}$ $\qquad W_{oversized\_I} = 12797.2 \frac{lb}{day}$

Phase II:

$W_{oversized\_II} := W_{s\_II} \cdot P_{oversized\_II}$ $\qquad W_{oversized\_II} = 102506.9 \frac{lb}{day}$

Volume of removed over-sized particles (zero void ratio):

Phase I:

$q_{oversized\_I} := q_{s\_I} \cdot P_{oversized\_I}$ $\qquad q_{oversized\_I} = 599 \frac{gal}{day}$

Phase II:

$q_{oversized\_II} := q_{s\_II} \cdot P_{oversized\_II}$ $\qquad q_{oversized\_II} = 4652.7 \frac{gal}{day}$

Weight of water removed with over-sized particles:

Phase I:

$W_{w\_oversized\_I} := W_{oversized\_I} \cdot WC_{istock}$ $\qquad W_{w\_oversized\_I} = 3199.3 \frac{lb}{day}$

Phase II:

$W_{w\_oversized\_II} := W_{oversized\_II} \cdot WC_{istock}$ $\qquad W_{w\_oversized\_II} = 25626.7 \frac{lb}{day}$

Volume of water removed with over-sized particles:

Phase I:

$q_{w\_oversized\_I} := \frac{W_{w\_oversized\_I}}{\rho_w}$ $\qquad q_{w\_oversized\_I} = 383.4 \frac{gal}{day}$

Phase II:

$q_{w\_oversized\_II} := \frac{W_{w\_oversized\_II}}{\rho_w}$ $\qquad q_{w\_oversized\_II} = 3070.8 \frac{gal}{day}$

Remaining dry solids weight in the slurry:

Phase I:

$W_{sr1\_I} := W_{s\_I} - W_{oversized\_I}$ $\qquad W_{sr1\_I} = 6385809.4 \frac{lb}{day}$

Phase II:

$W_{sr1\_II} := W_{s\_II} - W_{oversized\_II}$ $\qquad W_{sr1\_II} = 6304175.5 \frac{lb}{day}$

Remaining solids volume in the slurry (zero void ratio):

Phase I:

$q_{sr1\_I} := q_{s\_I} - q_{oversized\_I}$ $\qquad q_{sr1\_I} = 298901.8 \frac{gal}{day}$

Phase II:

$q_{sr1\_II} := q_{s\_II} - q_{oversized\_II}$ $\qquad q_{sr1\_II} = 286138.9 \frac{gal}{day}$

Remaining water weight in the slurry:

Phase I:

$W_{wr1\_I} := W_{w\_I} - W_{w\_oversized\_I}$ $\qquad W_{wr1\_I} = 57584260 \frac{lb}{day}$

Phase II:

$W_{wr1\_II} := W_{w\_II} - W_{w\_oversized\_II}$ $\qquad W_{wr1\_II} = 57634514.6 \frac{lb}{day}$

Remaining water volume in the slurry:

Phase I:

$q_{wr1\_I} := q_{w\_I} - q_{w\_oversized\_I}$ $\qquad q_{wr1\_I} = 6900115.8 \frac{gal}{day}$

Phase II:

$q_{wr1\_II} := q_{w\_II} - q_{w\_oversized\_II}$ $\qquad q_{wr1\_II} = 6906137.6 \frac{gal}{day}$

4.3 Secondary Screening for Gravel-Sized Particle Removal (Remediation Areas A, B, E, and F only)

Weight of removed gravel-sized particles:

$W_{gravel\_II} := W_{s\_II} \cdot P_{gravel}$ $\qquad W_{gravel\_II} = 922562.3 \frac{lb}{day}$

Volume of removed gravel-sized particles (zero void ratio):

$q_{gravel\_II} := q_{s\_II} \cdot P_{gravel}$ $\qquad q_{gravel\_II} = 41874 \frac{gal}{day}$

Weight of water removed with gravel-sized particles:

$W_{w\_gravel\_II} := W_{gravel\_II} \cdot WC_{istock}$ $\qquad W_{w\_gravel\_II} = 230640.6 \frac{lb}{day}$

Volume of water removed with gravel-sized particles:

$q_{w\_gravel\_II} := \frac{W_{w\_gravel\_II}}{\rho_w}$ $\qquad q_{w\_gravel\_II} = 27636.8 \frac{gal}{day}$

Remaining dry solids weight in the slurry:

$W_{sr2\_II} := W_{sr1\_II} - W_{gravel\_II}$ $\qquad W_{sr2\_II} = 5381613.2 \frac{lb}{day}$

Remaining solids volume in the slurry (zero void ratio):

$q_{sr2\_II} := q_{sr1\_II} - q_{gravel\_II}$ $\qquad q_{sr2\_II} = 244264.9 \frac{gal}{day}$

Remaining water weight in the slurry:

$W_{wr2\_II} := W_{wr1\_II} - W_{w\_gravel\_II}$ $\qquad W_{wr2\_II} = 57403874.1 \frac{lb}{day}$

Remaining water volume in the slurry:

$q_{wr2\_II} := q_{wr1\_II} - q_{w\_gravel\_II}$ $\qquad q_{wr2\_II} = 6878500.8 \frac{gal}{day}$

4.4 Hydrocyclone for Sand-Sized Particle Removal (Remediation Areas A, B, E, and F only)

Weight of removed sand-sized particles:

$W_{sand\_II} := W_{s\_II} \cdot P_{sand}$ $\qquad W_{sand\_II} = 2626739.8 \frac{lb}{day}$

Volume of removed sand-sized particles (zero void ratio):

$q_{sand\_II} := q_{s\_II} \cdot P_{sand}$ $\qquad q_{sand\_II} = 119224.6 \frac{gal}{day}$

Weight of water removed with sand-sized particles:

$W_{w\_sand\_II} := W_{sand\_II} \cdot WC_{istock}$ $\qquad W_{w\_sand\_II} = 656684.9 \frac{lb}{day}$

Volume of water removed with sand-sized particles:

$q_{w\_sand\_II} := \frac{W_{w\_sand\_II}}{\rho_w}$ $\qquad q_{w\_sand\_II} = 78688.2 \frac{gal}{day}$

Remaining dry solids weight in the slurry:

$W_{sr3\_II} := W_{sr2\_II} - W_{sand\_II}$ $\qquad W_{sr3\_II} = 2754873.4 \frac{lb}{day}$

Remaining solids volume in the slurry (zero void ratio):

$q_{sr3\_II} := q_{sr2\_II} - q_{sand\_II}$ $\qquad q_{sr3\_II} = 125040.4 \frac{gal}{day}$

Remaining water weight in the slurry:

$W_{wr3\_II} := W_{wr2\_II} - W_{w\_sand\_II}$ $\qquad W_{wr3\_II} = 56747189.1 \frac{lb}{day}$

Remaining water volume in the slurry:

$q_{wr3\_II} := q_{wr2\_II} - q_{w\_sand\_II}$ $\qquad q_{wr3\_II} = 6799812.6 \frac{gal}{day}$

4.5 Total Flow from SCA WTP (Clarifier Underflow and MMF and GAC Backwash Water)

Total flow from WTP:

$q_{WTP} := q_{clarifier} + q_{MMF} + q_{GAC}$ $\qquad q_{WTP} = 1065.9\,gpm$ $\qquad q_{WTP} = 1534896 \frac{gal}{day}$

Weight of total suspended solids (TSS) from SCA WTP:

All Remediation Areas:

$W_{WTP\_TSS} := q_{clarifier} \cdot TSS_{clarifier} + q_{MMF} \cdot TSS_{MMF} + q_{GAC} \cdot TSS_{GAC}$

$W_{WTP\_TSS} = 19.3 \frac{lb}{min}$ $\qquad W_{WTP\_TSS} = 27811.8050701 \frac{lb}{day}$

Volume of total suspended solids (TSS) from SCA WTP (zero void ratio):

Phase I:

$q_{WTP\_TSS\_I} := \frac{W_{WTP\_TSS}}{Gs_I \cdot \rho_w}$ $\qquad q_{WTP\_TSS\_I} = 0.904\,gpm$

$q_{WTP\_TSS\_I} = 1301.8 \frac{gal}{day}$

Phase II:

$q_{WTP\_TSS\_II} := \frac{W_{WTP\_TSS}}{Gs_{II} \cdot \rho_w}$ $\qquad q_{WTP\_TSS\_II} = 0.877\,gpm$

$q_{WTP\_TSS\_II} = 1262.3 \frac{gal}{day}$

Volume of water from SCA WTP:

Phase I:

$$q_{W\_WTP\_I} := q_{clarifier} \cdot \left(1 - \frac{TSS_{clarifier}}{Gs_I \cdot \rho_w}\right) + q_{MMF} \cdot \left(1 - \frac{TSS_{MMF}}{Gs_I \cdot \rho_w}\right) + q_{GAC} \cdot \left(1 - \frac{TSS_{GAC}}{Gs_I \cdot \rho_w}\right)$$

$q_{W\_WTP\_I} = 1065.0\,gpm$

Phase II:

$$q_{W\_WTP\_II} := q_{clarifier} \cdot \left(1 - \frac{TSS_{clarifier}}{Gs_{II} \cdot \rho_w}\right) + q_{MMF} \cdot \left(1 - \frac{TSS_{MMF}}{Gs_{II} \cdot \rho_w}\right) + q_{GAC} \cdot \left(1 - \frac{TSS_{GAC}}{Gs_{II} \cdot \rho_w}\right)$$

$q_{W\_WTP\_II} = 1065.0\,gpm$

Weight of water from SCA WTP:

Phase I:

$W_{W\_WTP\_I} := q_{W\_WTP\_I} \cdot \rho_w$

$W_{W\_WTP\_I} = 8887.8 \frac{lb}{min}$ $\quad W_{W\_WTP\_I} = 12798464.5 \frac{lb}{day}$

Phase II:

$W_{W\_WTP\_II} := q_{W\_WTP\_II} \cdot \rho_w$

$W_{W\_WTP\_II} = 8888.1 \frac{lb}{min}$ $\quad W_{W\_WTP\_II} = 12798793.8 \frac{lb}{day}$

4.6 Screened Material Stockpile Filtrate

Weight of water in filtrate from screened material stockpile:

Phase I:

$W_{w\_stock\_filtrate\_I} := (WC_{istock} - WC_{fstock}) \cdot W_{oversized\_I}$

$W_{w\_stock\_filtrate\_I} = 1279.7 \frac{lb}{day}$

Phase II:

$W_{w\_stock\_filtrate\_II} := (WC_{istock} - WC_{fstock}) \cdot (W_{oversized\_II} + W_{gravel\_II} + W_{sand\_II})$

$W_{w\_stock\_filtrate\_II} = 365180.9 \frac{lb}{day}$

Volume of water in filtrate from screened material stockpile:

Phase I:

$q_{w\_stock\_filtrate\_I} := \frac{W_{w\_stock\_filtrate\_I}}{\rho_w}$ $\quad q_{w\_stock\_filtrate\_I} = 153.3 \frac{gal}{day}$

Phase II:

$q_{w\_stock\_filtrate\_II} := \frac{W_{w\_stock\_filtrate\_II}}{\rho_w}$ $\quad q_{w\_stock\_filtrate\_II} = 43758.3 \frac{gal}{day}$

Weight of total suspended solids in stockpile filtrate:

Phase I:

$$W_{TSS\_stock\_filtrate\_I} := \frac{q_{w\_stock\_filtrate\_I} \cdot TSS_{stock\_filtrate} \cdot Gs_I \cdot \rho_w}{Gs_I \cdot \rho_w - TSS_{stock\_filtrate}}$$

$W_{TSS\_stock\_filtrate\_I} = 0.25 \frac{lb}{day}$ $\quad W_{TSS\_stock\_filtrate\_I} = 0.000079 \frac{kg}{min}$

Phase II:

$$W_{TSS\_stock\_filtrate\_II} := \frac{q_{w\_stock\_filtrate\_II} \cdot TSS_{stock\_filtrate} \cdot Gs_{II} \cdot \rho_w}{Gs_{II} \cdot \rho_w - TSS_{stock\_filtrate}}$$

$W_{TSS\_stock\_filtrate\_II} = 71.29 \frac{lb}{day}$ $\quad W_{TSS\_stock\_filtrate\_II} = 0.0225 \frac{kg}{min}$

Volume of total suspended solids in stockpile filtrate (zero void ratio):

Phase I:

$$q_{TSS\_stock\_filtrate\_I} := \frac{W_{TSS\_stock\_filtrate\_I}}{Gs_I \cdot \rho_w}$$

$q_{TSS\_stock\_filtrate\_I} = 0.012 \frac{gal}{day}$ $\quad$ $q_{TSS\_stock\_filtrate\_I} = 8.12042 \times 10^{-6}\ gpm$

Phase II:

$$q_{TSS\_stock\_filtrate\_II} := \frac{W_{TSS\_stock\_filtrate\_II}}{Gs_{II} \cdot \rho_w}$$

$q_{TSS\_stock\_filtrate\_II} = 3.236 \frac{gal}{day}$ $\quad$ $q_{TSS\_stock\_filtrate\_II} = 2.247 \times 10^{-3}\ gpm$

Weight of stockpile filtrate:

Phase I:

$W_{stock\_filtrate\_I} := W_{w\_stock\_filtrate\_I} + W_{TSS\_stock\_filtrate\_I}$ $\quad$ $W_{stock\_filtrate\_I} = 1280 \frac{lb}{day}$

Phase II:

$W_{stock\_filtrate\_II} := W_{w\_stock\_filtrate\_II} + W_{TSS\_stock\_filtrate\_II}$ $\quad$ $W_{stock\_filtrate\_II} = 365252.2 \frac{lb}{day}$

Volume of stockpile filtrate:

Phase I:

$q_{stock\_filtrate\_I} := q_{w\_stock\_filtrate\_I} + q_{TSS\_stock\_filtrate\_I}$ $\quad$ $q_{stock\_filtrate\_I} = 153.4 \frac{gal}{day}$

Phase II:

$q_{stock\_filtrate\_II} := q_{w\_stock\_filtrate\_II} + q_{TSS\_stock\_filtrate\_II}$ $\quad$ $q_{stock\_filtrate\_II} = 43761.6 \frac{gal}{day}$

Weight of final dry solids in stockpile (total minus TSS):

Phase I:

$W_{s\_stock\_I} := W_{oversized\_I} - W_{TSS\_stock\_filtrate\_I}$ $\quad$ $W_{s\_stock\_I} = 12797 \frac{lb}{day}$

Phase II:

$W_{s\_stock\_II} := W_{oversized\_II} + W_{gravel\_II} + W_{sand\_II} - W_{TSS\_stock\_filtrate\_II}$ $\quad$ $W_{s\_stock\_II} = 3651737.7 \frac{lb}{day}$

Volume of final solids in stockpile (zero void ratio, total minus TSS):

Phase I:

$q_{s\_stock\_I} := \frac{W_{s\_stock\_I}}{Gs_I \cdot \rho_w}$ $\quad$ $q_{s\_stock\_I} = 599 \frac{gal}{day}$

Phase II:

$q_{s\_stock\_II} := \frac{W_{s\_stock\_II}}{Gs_{II} \cdot \rho_w}$ $\quad$ $q_{s\_stock\_II} = 165748 \frac{gal}{day}$

4.7 Polymer Injection

Dry polymer density:

$DEN_{polymer} := 0.7 \frac{gm}{cm^3}$, based on **Ashland 2520 MSDS.**

Dry polymer dosage rate:

$DOS_{polymer} := 1.59 \frac{lb}{ton}$, based on **P-GDT report.**

Weight and volume of dry polymer:

Phase I:

$W_{drypolymer\_I} := DOS_{polymer}(W_{s\_I} \cdot P_{fine\_I} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_I})$

$W_{drypolymer\_I} = 2.912 \frac{lb}{min}$ $W_{drypolymer\_I} = 4193.36 \frac{lb}{day}$

$q_{drypolymer\_I} := \frac{W_{drypolymer\_I}}{DEN_{polymer}}$ $q_{drypolymer\_I} = 0.4985\,gpm$ $q_{drypolymer\_I} = 717.8 \frac{gal}{day}$

Phase II:

$W_{drypolymer\_II} := DOS_{polymer}(W_{s\_II} \cdot P_{fine\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II})$

$W_{drypolymer\_II} = 1.5 \frac{lb}{min}$ $W_{drypolymer\_II} = 2212.3 \frac{lb}{day}$

$q_{drypolymer\_II} := \frac{W_{drypolymer\_II}}{DEN_{polymer}}$ $q_{drypolymer\_II} = 0.3\,gpm$ $q_{drypolymer\_II} = 379 \frac{gal}{day}$

Weight and volume of polymer makeup water:

Phase I:

$q_{polymerwater\_I} := \frac{W_{drypolymer\_I} \cdot 200mL}{0.4gm}$ $q_{polymerwater\_I} = 174.5\,gpm$

$W_{polymerwater\_I} := q_{polymerwater\_I} \cdot \rho_w$ $W_{polymerwater\_I} = 2096681.1 \frac{lb}{day}$

Phase II:

$q_{polymerwater\_II} := \frac{W_{drypolymer\_II} \cdot 200mL}{0.4gm}$ $q_{polymerwater\_II} = 92\,gpm$

$W_{polymerwater\_II} := q_{polymerwater\_II} \cdot \rho_w$ $W_{polymerwater\_II} = 1106145.7 \frac{lb}{day}$

Note: Assume polymer dissolves in makeup water. Makeup water volume is the polymer emulsion volume.

4.8 Coagulant Injection (emulsion, Remediation Areas A, B, E, and F only)

Coagulant emulsion dosage rate:

$DOS_{coag} := 5.71 \frac{lb}{ton}$, based on **P-GDT report.**

Coagulant emulsion density:

$DEN_{coag} := 1.03 \frac{gm}{cm^3}$, based on **Ashland 492 MSDS.**

Coagulant emulsion weight:

$$W_{coag} := DOS_{coag} \cdot \left(W_{s\_II} \cdot P_{fine\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II}\right)$$

$W_{coag} = 7944.8 \frac{lb}{day}$ $\quad W_{coag} = 5.5 \frac{lb}{min}$

Coagulant emulsion volume:

$$q_{coag} := \frac{DOS_{coag} \cdot \left(W_{s\_II} \cdot P_{fine\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II}\right)}{DEN_{coag}}$$

$q_{coag} = 924.265 \frac{gal}{day}$ $\quad q_{coag} = 0.64\,gpm$

Coagulant emulsion makeup water (make down to 1% dilution):

$q_{coagwater} := \frac{W_{coag} \cdot 100mL}{1gm}$ $\quad q_{coagwater} = 66.1\,gpm$ $\quad q_{coagwater} = 95199.3 \frac{gal}{day}$

$W_{coagwater} := q_{coagwater} \cdot \rho_w$ $\quad W_{coagwater} = 794477 \frac{lb}{day}$ $\quad W_{coagwater} = 551.7201 \frac{lb}{min}$

4.9 Geotextile Tube Dewatering

4.9.1 Initial dewatering (the first 24 hrs)

Assume all dry polymer and/or coagulant are retained in the geotextile tubes during the initial dewatering.

Weight of dry solids retained in tubes after initial dewatering:

Phase I:

$W_{s\_ret2\_I} := W_{sr1\_I} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_I} + W_{drypolymer\_I}$ $\quad W_{s\_ret2\_I} = 6417814.79 \frac{lb}{day}$

Phase II:

$W_{s\_ret2\_II} := W_{sr3\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II} + W_{drypolymer\_II} + W_{coag}$ $\quad W_{s\_ret2\_II} = 2792914 \frac{lb}{day}$

Weight of water retained in tubes after initial dewatering:

Phase I:

$$W_{w\_ret2\_I} := \frac{\left(1 - P_{s2}\right) \cdot \left(W_{sr1\_I} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_I} + W_{drypolymer\_I}\right)}{P_{s2}}$$

$W_{w\_ret2\_I} = 10471171 \frac{lb}{day}$

Phase II:

$$W_{w\_ret2\_II} := \frac{\left(1 - P_{s2}\right)\cdot\left(W_{sr3\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II} + W_{drypolymer\_II} + W_{coag}\right)}{P_{s2}} \qquad W_{w\_ret2\_II} = 4556859\,\frac{lb}{day}$$

Volume of water retained in tubes after initial dewatering:

Phase I:

$$q_{w\_ret2\_I} := \frac{W_{w\_ret2\_I}}{\rho_w} \qquad q_{w\_ret2\_I} = 1254723\,\frac{gal}{day}$$

Phase II:

$$q_{w\_ret2\_II} := \frac{W_{w\_ret2\_II}}{\rho_w} \qquad q_{w\_ret2\_II} = 546032\,\frac{gal}{day}$$

Weight of Water in initial filtrate:

Phase I:

$$W_{w\_if\_I} := W_{wr1\_I} + W_{W\_WTP\_I} + W_{w\_stock\_filtrate\_I} + W_{polymerwater\_I} \cdots + \left(q_{booster}\cdot N_{booster} + q_{tube\_pump}\cdot N_{tube\_pump}\right)\cdot\rho_w - W_{w\_ret2\_I}$$

$$W_{w\_if\_I} = 65194120\,\frac{lb}{day}$$

Phase II:

$$W_{w\_if\_II} := W_{wr3\_II} + W_{W\_WTP\_II} + W_{w\_stock\_filtrate\_II} + W_{polymerwater\_II} + W_{coagwater} \cdots + \left(q_{booster}\cdot N_{booster} + q_{cyclone\_pump}\cdot N_{cyclone\_pump} + q_{tube\_pump}\cdot N_{tube\_pump}\right)\cdot\rho_w - W_{w\_ret2\_II}$$

$$W_{w\_if\_II} = 70800055\,\frac{lb}{day}$$

Volume of water in initial filtrate:

Phase I:

$$q_{w\_if\_I} := q_{wr1\_I} + q_{W\_WTP\_I} + q_{w\_stock\_filtrate\_I} + q_{polymerwater\_I} + q_{booster}\cdot N_{booster} + q_{tube\_pump}\cdot N_{tube\_pump} - q_{w\_ret2\_I}$$

$$q_{w\_if\_I} = 7811978\,\frac{gal}{day}$$

Phase II:

$$q_{w\_if\_II} := q_{wr3\_II} + q_{W\_WTP\_II} + q_{w\_stock\_filtrate\_II} + q_{polymerwater\_II} + q_{coagwater} \cdots + q_{booster}\cdot N_{booster} + q_{cyclone\_pump}\cdot N_{cyclone\_pump} + q_{tube\_pump}\cdot N_{tube\_pump} - q_{w\_ret2\_II}$$

$$q_{w\_if\_II} = 8483717\,\frac{gal}{day}$$

4.9.2 Consolidation dewatering (during 60 days after initial dewatering)

Weight of water retained in tubes after consolidation dewatering:

Phase I:

$$W_{w\_ret3\_I} := \frac{\left(1 - P_{s3}\right)\cdot\left(W_{sr1\_I} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_I} + W_{drypolymer\_I}\right)}{P_{s3}}$$

$$W_{w\_ret3\_I} = 6417815\,\frac{lb}{day}$$

Phase II:

$$W_{w\_ret3\_II} := \frac{\left(1 - P_{s3}\right)\cdot\left(W_{sr3\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II} + W_{drypolymer\_II} + W_{coag}\right)}{P_{s3}}$$

$$W_{w\_ret3\_II} = 2792914\,\frac{lb}{day}$$

Volume of water retained in tubes after consolidation dewatering:

Phase I:

$$q_{w\_ret3\_I} := \frac{W_{w\_ret3\_I}}{\rho_w} \qquad q_{w\_ret3\_I} = 769024\,\frac{gal}{day}$$

Phase II:

$$q_{w\_ret3\_II} := \frac{W_{w\_ret3\_II}}{\rho_w} \qquad q_{w\_ret3\_II} = 334665\,\frac{gal}{day}$$

Peak weight of water in consolidation dewatering filtrate:

Phase I:

$$W_{w\_cf\_I} := W_{w\_ret2\_I} - W_{w\_ret3\_I} \qquad W_{w\_cf\_I} = 4053357\,\frac{lb}{day}$$

Phase II:

$$W_{w\_cf\_II} := W_{w\_ret2\_II} - W_{w\_ret3\_II} \qquad W_{w\_cf\_II} = 1763945\,\frac{lb}{day}$$

Peak volume of water in consolidation dewatering filtrate:

Phase I:

$$q_{w\_cf\_I} := \frac{W_{w\_cf\_I}}{\rho_w} \qquad q_{w\_cf\_I} = 485699\,\frac{gal}{day}$$

Phase II:

$$q_{w\_cf\_II} := \frac{W_{w\_cf\_II}}{\rho_w} \qquad q_{w\_cf\_II} = 211367\,\frac{gal}{day}$$

Note: Peak consolidation dewatering is assumed to start from 61 days after the first tube in filled and ends at 1 day after the last tube is filled for the season.

4.9.3 Geotextile tube filtrate

Volume of water in geotextile tube filtrate:

Phase I:

$$q_{w\_tube\_filtrate\_I} := q_{w\_if\_I} + q_{w\_cf\_I}$$

$$q_{w\_tube\_filtrate\_I} = 8297677 \frac{gal}{day}$$

Phase II:

$$q_{w\_tube\_filtrate\_II} := q_{w\_if\_II} + q_{w\_cf\_II}$$

$$q_{w\_tube\_filtrate\_II} = 8695085 \frac{gal}{day}$$

Weight of total suspended solids in geotextile tube filtrate:

Phase I:

$$W_{TSS\_tube\_filtrate\_I} := \frac{\left(q_{w\_if\_I} + q_{w\_cf\_I}\right) \cdot TSS_{tube\_filtrate} \cdot Gs_I \cdot \rho_w}{Gs_I \cdot \rho_w - TSS_{tube\_filtrate}}$$

$$W_{TSS\_tube\_filtrate\_I} = 13518.1 \frac{lb}{day} \qquad W_{TSS\_tube\_filtrate\_I} = 4.26 \frac{kg}{min}$$

Phase II:

$$W_{TSS\_tube\_filtrate\_II} := \frac{\left(q_{w\_if\_II} + q_{w\_cf\_II}\right) \cdot TSS_{tube\_filtrate} \cdot Gs_{II} \cdot \rho_w}{Gs_{II} \cdot \rho_w - TSS_{tube\_filtrate}}$$

$$W_{TSS\_tube\_filtrate\_II} = 14166 \frac{lb}{day} \qquad W_{TSS\_tube\_filtrate\_II} = 4.46 \frac{kg}{min}$$

Volume of total suspended solids in geotextile tube filtrate (zero void ratio):

Phase I:

$$q_{TSS\_tube\_filtrate\_I} := \frac{W_{TSS\_tube\_filtrate\_I}}{Gs_I \cdot \rho_w} \qquad q_{TSS\_tube\_filtrate\_I} = 0.439\,gpm \qquad q_{TSS\_tube\_filtrate\_I} = 633 \frac{gal}{day}$$

Phase II:

$$q_{TSS\_tube\_filtrate\_II} := \frac{W_{TSS\_tube\_filtrate\_II}}{Gs_{II} \cdot \rho_w} \qquad q_{TSS\_tube\_filtrate\_II} = 0.446\,gpm \qquad q_{TSS\_tube\_filtrate\_II} = 643 \frac{gal}{day}$$

Weight of geotextile tube filtrate (water and TSS):

Phase I:

$$W_{tube\_filtrate\_I} := W_{w\_if\_I} + W_{w\_cf\_I} + W_{TSS\_tube\_filtrate\_I} \qquad W_{tube\_filtrate\_I} = 69260995.2 \frac{lb}{day}$$

Phase II:

$$W_{tube\_filtrate\_II} := W_{w\_if\_II} + W_{w\_cf\_II} + W_{TSS\_tube\_filtrate\_II} \qquad W_{tube\_filtrate\_II} = 72578166.4 \frac{lb}{day}$$

Volume of geotextile tube filtrate (water and TSS):

Phase I :

$q_{tube\_filtrate\_I} := q_{w\_if\_I} + q_{w\_cf\_I} + q_{TSS\_tube\_filtrate\_I}$ $\quad q_{tube\_filtrate\_I} = 8298310 \frac{gal}{day}$

Phase II:

$q_{tube\_filtrate\_II} := q_{w\_if\_II} + q_{w\_cf\_II} + q_{TSS\_tube\_filtrate\_II}$ $\quad q_{tube\_filtrate\_II} = 8695728 \frac{gal}{day}$

Weight of final dry solids retained in geotextile tubes (total minus TSS):

Phase I:

$W_{s\_ret\_I} := W_{sr1\_I} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_I} + W_{drypolymer\_I} - W_{TSS\_tube\_filtrate\_I}$

$W_{s\_ret\_I} = 6404296.7 \frac{lb}{day}$

Phase II:

$W_{s\_ret\_II} := W_{sr3\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II} + W_{drypolymer\_II} + W_{coag} - W_{TSS\_tube\_filtrate\_II}$

$W_{s\_ret\_II} = 2778748 \frac{lb}{day}$

Volume of final solids retained in geotextile tubes (zero void ratio, total minus TSS):

Phase I:

$$q_{s\_ret\_I} := \left(\frac{W_{sr1\_I} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_I} - W_{TSS\_tube\_filtrate\_I}}{Gs_I \cdot \rho_w} \right) + q_{drypolymer\_I}$$

$q_{s\_ret\_I} = 300288.7 \frac{gal}{day}$ $\quad q_{s\_ret\_I} = 208.53\,gpm$

Phase II:

$$q_{s\_ret\_II} := \left(\frac{W_{sr3\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II} - W_{TSS\_tube\_filtrate\_II}}{Gs_{II} \cdot \rho_w} \right) + q_{drypolymer\_II} + q_{coag}$$

$q_{s\_ret\_II} = 126966 \frac{gal}{day}$ $\quad q_{s\_ret\_II} = 88.2\,gpm$

4.10 Precipitation

Daily average precipitation, based on on-site meteorological tower data:

$PRE_{daily} := 0.15 \frac{in}{day}$

SCA open area: $A_{SCA} := 50acre$

Precipitation flow: $q_{PRE} := PRE_{daily} \cdot A_{SCA}$ $\quad q_{PRE} = 141.4\,gpm$ $\quad q_{PRE} = 203657.1 \frac{gal}{day}$

4.11 Discharge from SCA WTP to Metro

Weight of TSS in discharge:

$W_{TSS\_dis} := MAX_{discharge} \cdot TSS_{discharge}$ $\qquad W_{TSS\_dis} = 244.1 \frac{lb}{day}$

Volume of TSS in discharge:

Phase I:

$q_{TSS\_dis\_I} := \frac{W_{TSS\_dis}}{Gs_I \cdot \rho_w}$ $\qquad q_{TSS\_dis\_I} = 0.00793\,gpm$

Phase II:

$q_{TSS\_dis\_II} := \frac{W_{TSS\_dis}}{Gs_{II} \cdot \rho_w}$ $\qquad q_{TSS\_dis\_II} = 0.008\,gpm$

Weight of water in discharge:

Phase I:

$W_{w\_dis\_I} := \left(MAX_{discharge} - q_{TSS\_dis\_I}\right) \cdot \rho_w$ $\qquad W_{w\_dis\_I} = 54245036.2 \frac{lb}{day}$

Phase II:

$W_{w\_dis\_II} := \left(MAX_{discharge} - q_{TSS\_dis\_II}\right) \cdot \rho_w$ $\qquad W_{w\_dis\_II} = 54245039.1 \frac{lb}{day}$

Volume of water in discharge:

Phase I:

$q_{w\_dis\_I} := MAX_{discharge} - q_{TSS\_dis\_I}$ $\qquad q_{w\_dis\_I} = 4513.9\,gpm$

Phase II:

$q_{w\_dis\_II} := MAX_{discharge} - q_{TSS\_dis\_II}$ $\qquad q_{w\_dis\_II} = 4513.9\,gpm$

5.0 Mass Balance Tables

This section provides the mass balance calculations of the maximum flow rate (5000 gpm) shown on **Drawings D-002 and 004**. The stream numbers are defined on **Drawings D-001 and 003**, respectively. Some of the stream numbers represent individual components, including the pre-processing steps, geotextile tube dewatering, and precipitation. The flow associated with these stream numbers is shown as positive if the component add flow to the slurry (e.g., polymer injection); whereas, the flow is shown as negative if the component subtracts flow from the slurry (e.g., over-sized particle removal). The other stream numbers represents the subtotal flow at a given location along the flow streamline.

The flow at each Stream Number is shown as an array in the following format:
(total flow rate, water flow rate, solids flow rate).

Phase I:

Stream Number 1:Incoming slurry

$S1_I := (q \;\; q_{w\_I} \;\; q_{s\_I})$ $\qquad S1_I = (5000 \;\; 4792 \;\; 208)\,gpm$

Stream number 1A: Supplemental lake water intake (normally zero)

$S1A_I := (0 \;\; 0 \;\; 0)\,gpm$

Stream Number 2: booster pump seal water

$S2_I := (N_{booster} \cdot q_{booster} \;\; N_{booster} \cdot q_{booster} \;\; 0gpm)$ $\qquad S2_I = (250 \;\; 250 \;\; 0)\,gpm$

Stream Number 3: Subtotal

$S3_I := S1_I + S1A_I + S2_I$ $\qquad S3_I = (5250 \;\; 5042 \;\; 208)\,gpm$

Stream Number 4: Primary Screen Wash Water

$S4_I := (q_{primary} \;\; q_{primary} \;\; 0gpm)$ $\qquad S4_I = (102 \;\; 102 \;\; 0)\,gpm$

Stream Number 5: Over-sized Particle Removal

$S5_I := \left[-(q_{w\_oversized\_I} + q_{oversized\_I}) \;\; -q_{w\_oversized\_I} \;\; -q_{oversized\_I}\right]$

$S5_I = (-0.7 \;\; -0.3 \;\; -0.4)\,gpm$

Stream Number 6: Subtotal

$S6_I := S3_I + S4_I + S5_I$ $\qquad S6_I = (5351.3 \;\; 5143.7 \;\; 207.6)\,gpm$

Stream Number 7: Geotextile tube feed pump seal water

$S7_I := (N_{tube\_pump} \cdot q_{tube\_pump} \;\; N_{tube\_pump} \cdot q_{tube\_pump} \;\; 0gpm)$

$S7_I = (15 \;\; 15 \;\; 0)\,gpm$

Stream Number 8: Subtotal

$S8_I := S6_I + S7_I$ $\qquad S8_I = (5366.3 \;\; 5158.7 \;\; 207.6)\,gpm$

Stream Number 9: SCA WTP clarifier underflow and filter backwash

$S9_I := (q_{WTP} \;\; q_{W\_WTP\_I} \;\; q_{WTP\_TSS\_I})$

$S9_I = (1065.9 \;\; 1064.996 \;\; 0.904)\,gpm$

Stream Number 10: Stockpile filtrate

$S10_I := \left(q_{stock\_filtrate\_I} \;\; q_{w\_stock\_filtrate\_I} \;\; q_{TSS\_stock\_filtrate\_I}\right)$

$S10_I = \left(0.1065 \;\; 0.10649 \;\; 0.00001\right) gpm$

Stream Number 11: Polymer and makeup water

$S11_I := \left(q_{polymerwater\_I} + q_{drypolymer\_I} \;\; q_{polymerwater\_I} \;\; q_{drypolymer\_I}\right)$

$S11_I = \left(174.9692 \;\; 174.4707 \;\; 0.4985\right) gpm$

Stream Number 12: Subtotal

$S12_I := S8_I + S9_I + S10_I + S11_I$ $\qquad S12_I = \left(6607.3 \;\; 6398.3 \;\; 209\right) gpm$

Stream Number 13: Geotextile tube retention

$S13_I := \left[-\left(q_{w\_ret3\_I} + q_{s\_ret\_I}\right) \;\; -q_{w\_ret3\_I} \;\; -q_{s\_ret\_I}\right]$

$S13_I = \left(-742.578119 \;\; -534.044292 \;\; -208.533827\right) gpm$

Stream Number 14: Average precipitation

$S14_I := \left(q_{PRE} \;\; q_{PRE} \;\; 0gpm\right)$ $\qquad S14_I = \left(141.4 \;\; 141.4 \;\; 0\right) gpm$

Stream Number 15: Subtotal

$S15_I := S12_I + S13_I + S14_I$

$S15_I = \left(6006.144 \;\; 6005.705 \;\; 0.439\right) gpm$

Stream Number 16: Primary screen wash water

$S16_I := \left(-q_{primary} \;\; -q_{primary} \;\; 0gpm\right)$ $\qquad S16_I = \left(-102 \;\; -102 \;\; 0\right) gpm$

Stream Number 17: Net flow to stormwater basins

$S17_{water} := -\left[S15_{I_{0,1}} - q_{primary} - \left(q_{w\_dis\_I} + q_{polymerwater\_I} + q_{W\_WTP\_I}\right)\right]$

$S17_{TSS} := \dfrac{S17_{water} \cdot S15_{I_{0,2}}}{S15_{I_{0,1}}}$

$S17_{total} := S17_{water} + S17_{TSS}$

$S17_I := \left(S17_{total} \;\; S17_{water} \;\; S17_{TSS}\right)$ $\qquad S17_I = \left(-150.368 \;\; -150.357 \;\; -0.011\right) gpm$

Note: If the volume at Stream Number 17 is positive, it indicates no net flow to stormwater basins. Input zero for volume at Stream Number 17
in this case.

Stream Number 18: Effluent to SCA WTP

$S18_I := S15_I + S16_I + S17_I$ $\qquad S18_I = \left(5753.8 \;\; 5753.3 \;\; 0.4\right) gpm$

$$Title_I := \begin{pmatrix} \text{"Description"} \\ \text{"1. Incoming Slurry"} \\ \text{"2. Booster Pump Seal Water"} \\ \text{"3. Subtotal"} \\ \text{"4. Primary Screen Wash Water"} \\ \text{"5. Oversized Particle Removal"} \\ \text{"6. Subtotal"} \\ \text{"7. Geotextile tube Feed Pump Seal Water"} \\ \text{"8. Subtotal"} \\ \text{"9. SCA WTP Underflow and Backwash"} \\ \text{"10. Stockpile Filtrate"} \\ \text{"11. Polymer and Makeup Water"} \\ \text{"12. Subtotal"} \\ \text{"13. Geotextile tube Retention"} \\ \text{"14. Average Precipitation"} \\ \text{"15. Subtotal"} \\ \text{"16. Primary Screen Wash Water"} \\ \text{"17. Net Flow to Stormwater Basins"} \\ \text{"18. Effluent to SCA WTP"} \end{pmatrix}$$

Flow rate

$$S0 := \left(\text{"Total (gpm)"} \quad \text{"Water (gpm)"} \quad \text{"Solids (gpm)"}\right)$$

$$FR_{volume\_I} := stack\left(S0, S1_I, S2_I, S3_I, S4_I, S5_I, S6_I, S7_I, S8_I, S9_I, S10_I, S11_I, S12_I, S13_I, S14_I, S15_I, S16_I, S17_I, S18_I\right)$$

Solids mass flow rate

$$FR_{solids\_I} := \begin{bmatrix} \text{"Solids (lbs/min)"} \\ S1_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S2_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S3_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S4_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S5_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S6_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S7_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S8_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S9_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S10_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S11_{I_{0,2}} \cdot DEN_{polymer} \\ \left(S8_{I_{0,2}} + S9_{I_{0,2}} + S10_{I_{0,2}}\right) \cdot Gs_I \cdot \rho_w + S11_{I_{0,2}} \cdot DEN_{polymer} \\ -\left[\left(S8_{I_{0,2}} + S9_{I_{0,2}} + S10_{I_{0,2}}\right) \cdot Gs_I \cdot \rho_w + S11_{I_{0,2}} \cdot DEN_{polymer} - W_{TSS\_tube\_filtrate\_I}\right] \\ S14_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ W_{TSS\_tube\_filtrate\_I} + S14_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S16_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S17_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S18_{I_{0,2}} \cdot Gs_I \cdot \rho_w \end{bmatrix}$$

Concentration

$$CON_I := \text{stack}\left(\text{"Concentration"}, \overrightarrow{\left(\frac{\text{submatrix}\left(FR_{solids\_I}, 1, 18, 0, 0\right)}{\text{submatrix}\left(FR_{volume\_I}, 1, 18, 0, 0\right)}\right)}\right)$$

Mass balance tables

$Title_I =$

	0
0	"Description"
1	"1. Incoming Slurry"
2	"2. Booster Pump Seal Water"
3	"3. Subtotal"
4	"4. Primary Screen Wash Water"
5	"5. Oversized Particle Removal"
6	"6. Subtotal"
7	"7. Geotextile tube Feed Pump Seal Water"
8	"8. Subtotal"
9	"9. SCA WTP Underflow and Backwash"
10	"10. Stockpile Filtrate"
11	"11. Polymer and Makeup Water"
12	"12. Subtotal"
13	"13. Geotextile tube Retention"
14	"14. Average Precipitation"
15	"15. Subtotal"
16	"16. Primary Screen Wash Water"
17	"17. Net Flow to Stormwater Basins"
18	"18. Effluent to SCA WTP"

$FR_{volume\_I} =$

	0	1	2
0	"Total (gpm)"	"Water (gpm)"	"Solids (gpm)"
1	5000	4792	208
2	250	250	0
3	5250	5042	208
4	102	102	0
5	-0.7	-0.3	-0.4
6	5351.3	5143.7	207.6
7	15	15	0
8	5366.3	5158.7	207.6
9	1065.9	1065	0.9
10	0.1	0.1	0
11	175	174.5	0.5
12	6607.3	6398.3	209
13	-742.6	-534	-208.5
14	141.4	141.4	0
15	6006.1	6005.7	0.4
16	-102	-102	0
17	-150.4	-150.4	-0
18	5753.8	5753.3	0.4

gpm $FR_{solids\_I} =$

	0
0	"Solids (lbs/min)"
1	4443.5
2	0
3	4443.5
4	0
5	-8.9
6	4434.6
7	0
8	4434.6
9	19.3
10	0
11	2.9
12	4456.8
13	-4447.4
14	0
15	9.4
16	0
17	-0.2
18	9.2

$\frac{lb}{min}$ $CON_I =$

	0
0	"Concentration"
1	106489.2
2	0
3	101418.3
4	0
5	1560975.6
6	99299.1
7	0
8	99021.5
9	2171.2
10	195.2
11	1994.3
12	80826.5
13	717661.1
14	0
15	187.3
16	0
17	187.3
18	190.6

$\frac{mg}{L}$

Note: Stream Number 1A: Supplemental Lake Water Intake is not shown on these tables.

Phase II:

Stream Number 1:Incoming slurry

$S1_{II} := (q \;\; q_{w\_II} \;\; q_{s\_II})$ $\qquad S1_{II} = (5000 \;\; 4798.1 \;\; 201.9)\,gpm$

Stream number 1A: Supplemental lake water intake (normally zero)

$S1A_{II} := (0 \;\; 0 \;\; 0)\,gpm$

Stream Number 2: booster pump seal water

$S2_{II} := (N_{booster} \cdot q_{booster} \;\; N_{booster} \cdot q_{booster} \;\; 0gpm)$ $\qquad S2_{II} = (250 \;\; 250 \;\; 0)\,gpm$

Stream Number 3: Subtotal

$S3_{II} := S1_{II} + S1A_{II} + S2_{II}$ $\qquad S3_{II} = (5250 \;\; 5048.1 \;\; 201.9)\,gpm$

Stream Number 4: Primary Screen Wash Water

$S4_{II} := (q_{primary} \;\; q_{primary} \;\; 0gpm)$ $\qquad S4_{II} = (102 \;\; 102 \;\; 0)\,gpm$

Stream Number 5: Over-sized Particle Removal

$S5_{II} := \left[-(q_{w\_oversized\_II} + q_{oversized\_II}) \;\; -q_{w\_oversized\_II} \;\; -q_{oversized\_II}\right]$

$S5_{II} = (-5.4 \;\; -2.1 \;\; -3.2)\,gpm$

Stream Number 6: Subtotal

$S6_{II} := S3_{II} + S4_{II} + S5_{II}$ $\qquad S6_{II} = (5346.6 \;\; 5147.9 \;\; 198.7)\,gpm$

Stream Number 7: Hydrocyclone feed pump seal water

$S7_{II} := (N_{cyclone\_pump} \cdot q_{cyclone\_pump} \;\; N_{cyclone\_pump} \cdot q_{cyclone\_pump} \;\; 0gpm)$

$S7_{II} = (30 \;\; 30 \;\; 0)\,gpm$

Stream Number 8: Subtotal

$S8_{II} := S6_{II} + S7_{II}$ $\qquad S8_{II} = (5376.6 \;\; 5177.9 \;\; 198.7)\,gpm$

Stream Number 9: Secondary screen and hydrocyclone screen wash water

$S9_{II} := (q_{second\_cyclone} \;\; q_{second\_cyclone} \;\; 0gpm)$ $\qquad S9_{II} = (510 \;\; 510 \;\; 0)\,gpm$

Stream Number 10: Gravel removal by secondary screens

$S10_{II} := \left[-(q_{w\_gravel\_II} + q_{gravel\_II}) \;\; -q_{w\_gravel\_II} \;\; -q_{gravel\_II}\right]$

$S10_{II} = (-48.3 \;\; -19.2 \;\; -29.1)\,gpm$

Stream Number 11: Sand removal by hydrocyclones

$S11_{II} := \left[-(q_{w\_sand\_II} + q_{sand\_II}) \;\; -q_{w\_sand\_II} \;\; -q_{sand\_II}\right]$

$S11_{II} = (-137.4 \;\; -54.6 \;\; -82.8)\,gpm$

Stream number 12: Subtotal

$S12_{II} := S8_{II} + S9_{II} + S10_{II} + S11_{II}$ $\qquad S12_{II} = (5700.9 \;\; 5614.1 \;\; 86.8)\,gpm$

Stream Number 13: Geotextile tube feed pump seal water

$S13_{II} := \left(N_{tube\_pump} \cdot q_{tube\_pump} \quad N_{tube\_pump} \cdot q_{tube\_pump} \quad 0gpm\right)$ $\qquad S13_{II} = \left(15 \quad 15 \quad 0\right) gpm$

Stream Number 14: Subtotal

$S14_{II} := S12_{II} + S13_{II}$ $\qquad S14_{II} = \left(5715.9 \quad 5629.1 \quad 86.8\right) gpm$

Stream Number 15: SCA WTP clarifier underflow and filter backwash

$S15_{II} := \left(q_{WTP} \quad q_{W\_WTP\_II} \quad q_{WTP\_TSS\_II}\right)$ $\qquad S15_{II} = \left(1065.9 \quad 1065 \quad 0.9\right) gpm$

Stream Number 16: Stockpile filtrate

$S16_{II} := \left(q_{stock\_filtrate\_II} \quad q_{w\_stock\_filtrate\_II} \quad q_{TSS\_stock\_filtrate\_II}\right)$ $\qquad S16_{II} = \left(30.38997 \quad 30.38772 \quad 0.00225\right) gpm$

Stream Number 17: Coagulant and makeup water

$S17_{II} := \left(q_{coagwater} + q_{coag} \quad q_{coagwater} \quad q_{coag}\right)$ $\qquad S17_{II} = \left(66.752 \quad 66.111 \quad 0.642\right) gpm$

Stream Number 18: Polymer and makeup water

$S18_{II} := \left(q_{polymerwater\_II} + q_{drypolymer\_II} \quad q_{polymerwater\_II} \quad q_{drypolymer\_II}\right)$ $\qquad S18_{II} = \left(92.3085 \quad 92.0455 \quad 0.263\right) gpm$

Stream Number 19: Subtotal

$S19_{II} := S14_{II} + S15_{II} + S16_{II} + S17_{II} + S18_{II}$ $\qquad S19_{II} = \left(6971.3 \quad 6882.7 \quad 88.6\right) gpm$

Stream Number 20: Geotextile tube retention

$S20_{II} := \left[-\left(q_{w\_ret3\_II} + q_{s\_ret\_II}\right) \quad -q_{w\_ret3\_II} \quad -q_{s\_ret\_II}\right]$ $\qquad S20_{II} = \left(-320.576956 \quad -232.406138 \quad -88.170818\right) gpm$

Stream Number 21: Average precipitation

$S21_{II} := \left(q_{PRE} \quad q_{PRE} \quad 0gpm\right)$ $\qquad S21_{II} = \left(141.4 \quad 141.4 \quad 0\right) gpm$

Stream Number 22: Subtotal

$S22_{II} := S19_{II} + S20_{II} + S21_{II}$ $\qquad S22_{II} = \left(6792.128 \quad 6791.682 \quad 0.446\right) gpm$

Stream Number 23: Primary, secondary and hydrocyclone screen wash water

$S23_{II} := -\left(q_{primary} + q_{second\_cyclone} \quad q_{primary} + q_{second\_cyclone} \quad 0gpm\right)$ $\qquad S23_{II} = \left(-612 \quad -612 \quad 0\right) gpm$

Stream Number 24: Net flow to
Stormwater basin

$$S24_{water} := -\left[S22_{II_{0,1}} - q_{primary} - q_{second\_cyclone} - \left(q_{w\_dis\_II} + q_{coagwater} + q_{polymerwater\_II} + q_{W\_WTP\_II}\right)\right]$$

$$S24_{TSS} := \frac{S24_{water} \cdot S22_{II_{0,2}}}{S22_{II_{0,1}}} \qquad S24_{total} := S24_{water} + S24_{TSS}$$

$S24_{II} := \left(S24_{total} \quad S24_{water} \quad S24_{TSS}\right)$ $\qquad S24_{II} = \left(-442.65 \quad -442.621 \quad -0.029\right) gpm$

Note: If the volume at Stream Number 24 is positive, it indicates no net flow to stormwater basins. Input zero for volume at Stream Number 24 in this case.

Stream Number 25: Effluent to SCA WTP

$S25_{II} := S22_{II} + S23_{II} + S24_{II}$ $\qquad S25_{II} = \left(5737.478 \quad 5737.061 \quad 0.417\right) gpm$

$$Title_{II} := \begin{pmatrix} \text{"Description"} \\ \text{"1. Incoming Slurry"} \\ \text{"2. Booster Pump Seal Water"} \\ \text{"3. Subtotal"} \\ \text{"4. Primary Screen Wash Water"} \\ \text{"5. Oversized Particle Removal"} \\ \text{"6. Subtotal"} \\ \text{"7. Hydrocyclone Feed Pump Seal Water"} \\ \text{"8. Subtotal"} \\ \text{"9. Secondary Screen and Hydrocyclone Screen Wash Water"} \\ \text{"10. Gravel Removal by Secondary Screens"} \\ \text{"11. Sand Removal by Hydrocyclones"} \\ \text{"12. Subtotal"} \\ \text{"13. Geotextile tube Feed Pump Seal Water"} \\ \text{"14. Subtotal"} \\ \text{"15. SCA WTP Underflow and Backwash"} \\ \text{"16. Stockpile Filtrate"} \\ \text{"17. Coagulant and Makeup Water"} \\ \text{"18. Polymer and Makeup Water"} \\ \text{"19. Subtotal"} \\ \text{"20. Geotextile tube Retention"} \\ \text{"21. Average Precipitation"} \\ \text{"22. Subtotal"} \\ \text{"23. Primary, Secondary and Hydrocyclone Screen Wash Water"} \\ \text{"24. Net Flow to Stormwater Basin"} \\ \text{"25. Effluent to SCA WTP"} \end{pmatrix}$$

Flow rate

$$FR_{volume\_IIa} := stack(S0, S1_{II}, S2_{II}, S3_{II}, S4_{II}, S5_{II}, S6_{II}, S7_{II}, S8_{II}, S9_{II}, S10_{II}, S11_{II}, S12_{II}) *$$

$$FR_{volume\_IIb} := stack(S13_{II}, S14_{II}, S15_{II}, S16_{II}, S17_{II}, S18_{II}, S19_{II}, S20_{II}, S21_{II}, S22_{II}, S23_{II}, S24_{II}, S25_{II}) *$$

$$FR_{volume\_II} := stack(FR_{volume\_IIa}, FR_{volume\_IIb})$$

Solids mass flow rate

$$FR_{solids\_II} := \begin{bmatrix} \text{"Solids (lbs/min)"} \\ S1II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S2II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S3II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S4II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S5II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S6II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S7II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S8II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S9II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S10II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S11II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S12II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S13II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S14II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S15II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S16II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S17II_{0,2} \cdot DEN_{coag} \\ S18II_{0,2} \cdot DEN_{polymer} \\ \left(S14II_{0,2} + S15II_{0,2} + S16II_{0,2}\right) \cdot Gs_{II} \cdot \rho_w + S17II_{0,2} \cdot DEN_{coag} + S18II_{0,2} \cdot DEN_{polymer} \\ -\left[\left(S14II_{0,2} + S15II_{0,2} + S16II_{0,2}\right) \cdot Gs_{II} \cdot \rho_w + S17II_{0,2} \cdot DEN_{coag} + S18II_{0,2} \cdot DEN_{polymer} - W_{TSS\_tube\_filtrate\_II}\right] \\ S21II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ W_{TSS\_tube\_filtrate\_II} + S21II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S23II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S24II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S25II_{0,2} \cdot Gs_{II} \cdot \rho_w \end{bmatrix}$$

Concentration

$$CON_{II} := stack\left(\text{"Concentration"}, \overrightarrow{\left(\frac{submatrix\left(FR_{solids\_II}, 1, 25, 0, 0\right)}{submatrix\left(FR_{volume\_II}, 1, 25, 0, 0\right)}\right)}\right)$$

Mass balance table

$Title_{II}$ =

	0
0	"Description"
1	"1. Incoming Slurry"
2	"2. Booster Pump Seal Water"
3	"3. Subtotal"
4	"4. Primary Screen Wash Water"
5	"5. Oversized Particle Removal"
6	"6. Subtotal"
7	"7. Hydrocyclone Feed Pump Seal Water"
8	"8. Subtotal"
9	"9. Secondary Screen and Hydrocyclone Screen Wash Water"
10	"10. Gravel Removal by Secondary Screens"
11	"11. Sand Removal by Hydrocyclones"
12	"12. Subtotal"
13	"13. Geotextile tube Feed Pump Seal Water"
14	"14. Subtotal"
15	"15. SCA WTP Underflow and Backwash"
16	"16. Stockpile Filtrate"
17	"17. Coagulant and Makeup Water"
18	"18. Polymer and Makeup Water"
19	"19. Subtotal"
20	"20. Geotextile tube Retention"
21	"21. Average Precipitation"
22	"22. Subtotal"
23	"23. Primary, Secondary and Hydrocyclone Screen Wash Water"
24	"24. Net Flow to Stormwater Basin"
25	"25. Effluent to SCA WTP"

FR_{volume_II} =

	0	1	2
0	"Total (gpm)"	"Water (gpm)"	"Solids (gpm)"
1	5000	4798.1	201.9
2	250	250	0
3	5250	5048.1	201.9
4	102	102	0
5	-5.4	-2.1	-3.2
6	5346.6	5147.9	198.7
7	30	30	0
8	5376.6	5177.9	198.7
9	510	510	0
10	-48.3	-19.2	-29.1
11	-137.4	-54.6	-82.8
12	5700.9	5614.1	86.8
13	15	15	0
14	5715.9	5629.1	86.8
15	1065.9	1065	0.9
16	30.4	30.4	0
17	66.8	66.1	0.6
18	92.3	92	0.3
19	6971.3	6882.7	88.6
20	-320.6	-232.4	-88.2
21	141.4	141.4	0
22	6792.1	6791.7	0.4
23	-612	-612	0
24	-442.7	-442.6	-0
25	5737.5	5737.1	0.4

gpm

FR_{solids_II} =

	0
0	"Solids (lbs/min)"
1	4449.1
2	0
3	4449.1
4	0
5	-71.2
6	4377.9
7	0
8	4377.9
9	0
10	-640.7
11	-1824.1
12	1913.1
13	0
14	1913.1
15	19.3
16	0
17	5.5
18	1.5
19	1939.5
20	-1929.7
21	0
22	9.8
23	0
24	-0.6
25	9.2

CON_{II} =

	0
0	"Concentration"
1	106623.6
2	0
3	101546.3
4	0
5	1590361.4
6	98115.5
7	0
8	97568.1
9	0
10	1590361.4
11	1590361.4
12	40211.1
13	0
14	40105.6
15	2171.2
16	195.2
17	9903.8
18	1994.3
19	33337.7
20	721285.1
21	0
22	173.5
23	0
24	173.5
25	192.1

$\frac{mg}{L}$

Note: Stream Number 1A: Supplemental Lake Water Intake is not shown on these tables.

Table 1 Geotechnical Properties

2.2M cy Dredging Volume (Base+Contingency)

Remediation Area	Total Dry Weight	Over-Sized Grain	Gravel-Sized Grain (including Over-Sized)	Sand-Sized Grain	Fines	Percent Over-Sized	Percent Gravel (including Over-sized)	Percent Sand	Percent Fines	Weighted Average Specific Gravity
	(tons)	(tons)	(tons)	(tons)	(tons)	(%)	(%)	(%)	(%)	
A	122,063	415	4,150	43,821	74,214	0.34%	3.4%	35.9%	60.8%	
B	20,228	218	2,185	7,545	10,498	1.08%	10.8%	37.3%	51.9%	
C	39,646	428	4,282	14,788	20,576	1.08%	10.8%	37.3%	51.9%	
D	539,814	756	7,557	77,733	454,523	0.14%	1.4%	14.4%	84.2%	
E	613,208	11,528	115,283	257,547	240,377	1.88%	18.8%	42.0%	39.2%	
C/D	579,460	1,184	11,839	92,521	475,100	0.20%	2.0%	16.0%	82.0%	2.56
A/B/E	755,498	12,162	121,618	308,913	325,090	1.61%	16.1%	40.9%	43.0%	2.64

SPREADSHEET CALCULATIONS

PARSONS

Project Number: 444853	Calc.No. from index: 3	Preparer: XDH	Date:2/17/2010	Rev. No.:2	Preparer:	Date:
Project Name:Sediment Management Design	Calculation Title: Mass Balance	Reviewer: MTO	Date: 2/18/2010		Review:	Date:

RA-C/D **Maximum Flow Scenario** **5,000 GPM**
Primary Screens Only

Stream Number	1	1A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Description	Dredge Slurry	Supplemental Lake Water Intake	Booster Pumps Seal Water		Primary Screen Wash Water from SCA Sumps	Over-Sized Removed from Primary Screen		Geotextile Tube Feed Pump Seal Water		Clarifier Underflow and Filter Backwash from SCA WTP	Filtrate from Screened Material Stockpile	Polymer and Makeup Water from SCA WTP		Geotextile Tube Retention	Average Precipitation		Primary Screen Wash Water	Net Flow to Stormwater Basins	Dewatering Effluent to SCA WTP Influent
Total (gpm)	5,000	0	250	5,250	102	(0.7)	5,351	15	5,366	1,065.9	0.1	175.0	6,607	(742.6)	141	6,006	(102)	(150)	5,754
Water (gpm)	4,792	0	250	5,042	102	(0.3)	5,144	15	5,159	1,065.0	0.1	174.5	6,398	(534.0)	141	6,006	(102)	(150)	5,753
Solids (gpm) (Note 2)	208.0	0.0	0.0	208.0	0.0	(0.4)	207.6	0.0	207.6	0.9	0.00001	0.5	209.0	(208.5)	0.0	0.4	0.0	(0.01)	0.4
Solids (lbs/min) (Note 2)	4,443.5	0.0	0.0	4,443.5	0.0	(8.9)	4,434.6	0.0	4,434.6	19.3	0.0002	2.9	4,456.8	(4,447.4)	0.0	9.4	0.0	(0.2)	9.2
Concentration (mg/L)	106,489.2	NA	0.0	101,418.3	0.0	1,560,975.6	99,299.1	0.0	99,021.5	2,171.2	195.2	1,994.3	80,826.5	717,661.1	0.0	187.3	0.0	187.3	190.6

RA-C/D **Average Flow Scenario** **3,500 GPM**
Primary Screens Only

Stream Number	1	1A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Description	Dredge Slurry	Supplemental Lake Water Intake	Booster Pumps Seal Water		Primary Screen Wash Water from SCA Sumps	Over-Sized Removed from Primary Screen		Geotextile Tube Feed Pump Seal Water		Clarifier Underflow and Filter Backwash from SCA WTP	Filtrate from Screened Material Stockpile	Polymer and Makeup Water from SCA WTP		Geotextile Tube Retention	Average Precipitation		Primary Screen Wash Water	Net Flow to Stormwater Basins	Dewatering Effluent to SCA WTP Influent
Total (gpm)	3,500	0	175	3,675	71	(0.5)	3,746	11	3,756	1,065.9	0.1	122.8	4,945	(520.7)	141	4,566	(71)	0	4,494
Water (gpm)	3,354	0	175	3,529	71	(0.2)	3,601	11	3,611	1,065.0	0.1	122.4	4,799	(374.5)	141	4,566	(71)	0	4,494
Solids (gpm) (Note 2)	145.6	0.0	0.0	145.6	0.0	(0.3)	145.3	0.0	145.3	0.9	0.00001	0.3	146.6	(146.2)	0.0	0.3	0.0	0.0	0.3
Solids (lbs/min) (Note 2)	3,110.4	0.0	0.0	3,110.4	0.0	(6.2)	3,104.2	0.0	3,104.2	19.3	0.0001	2.0	3,125.6	(3,118.5)	0.0	7.1	0.0	0.0	7.1
Concentration (mg/L)	106,489.2	NA	0.0	101,418.3	0.0	1,560,975.6	99,299.1	0.0	99,021.5	2,171.2	195.2	1,994.3	75,736.0	717,576.9	0.0	186.1	0.0	NA	189.1

RA-A/B/E/F **Maximum Flow Scenario** **5,000 GPM**
Primary Screens, Secondary Screens, Hydrocyclones

Stream Number	1	1A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Description	Dredge Slurry	Supplemental Lake Water Intake	Booster Pumps Seal Water		Primary Screen Wash Water from SCA Sump	Over-Sized Removed from Primary Screen		Sand Separation Feed Pumps Seal Water		Secondary Screen and Hydrocyclone Screen Wash Water from SCA Sump	Gravel Removed from Secondary Screen	Sand Removed from Hydrocyclone		Geotextile Tube Feed Pump Seal Water		Clarifier Underflow and Filter Backwash from SCA WTP	Filtrate from Screened Material Stockpile	Coagulant Emulsion and Makeup Water from SCA WTP	Polymer and Makeup Water from SCA WTP		Geotextile Tube Retention	Average Precipitation		Primary, Secondary and Hydrocyclone Screen Wash Water	Net Flow to Stormwater Basins	Dewatering Effluent to SCA WTP Influent
Total (gpm)	5000	0	250	5,250	102	(5.4)	5,347	30	5,377	510	(48.3)	(137.4)	5,701	15	5,716	1,065.9	30.4	66.8	92.3	6,971	(320.6)	141	6,792	(612)	(442.7)	5,737
Water (gpm)	4798	0	250	5,048	102	(2.1)	5,148	30	5,178	510	(19.2)	(54.6)	5,614	15	5,629	1,065.0	30.4	66.1	92.0	6,883	(232.4)	141	6,792	(612)	(442.6)	5,737
Solids (gpm) (Note 2)	201.9	0.0	0.0	201.9	0.0	(3.2)	198.7	0.0	198.7	0.0	(29.1)	(82.8)	86.8	0.0	86.8	0.9	0.002	0.6	0.3	88.6	(88.2)	0.0	0.4	0.0	(0.03)	0.4
Solids (lbs/min) (Note 2)	4,449.1	0.0	0.0	4,449.1	0.0	(71.2)	4,377.9	0.0	4,377.9	0.0	(640.7)	(1,824.1)	1,913.1	0.0	1,913.1	19.3	0.05	5.5	1.5	1,939.5	(1,929.7)	0.0	9.8	0.0	(0.6)	9.2
Concentration (mg/L)	106,623.6	NA	0.0	101,546.3	0.0	1,590,361.5	98,115.5	0.0	97,568.1	0.0	1,590,361.5	1,590,361.5	40,211.1	0.0	40,105.6	2,171.2	195.2	9,903.8	1,994.3	33,337.7	721,285.1	0.0	173.5	0.0	173.5	192.1

RA-A/B/E/F **Average Flow Scenario** **3,500 GPM**
Primary Screens, Secondary Screens, Hydrocyclones

Stream Number	1	1A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Description	Dredge Slurry	Supplemental Lake Water Intake	Booster Pumps Seal Water		Primary Screen Wash Water from SCA Sump	Over-Sized Removed from Primary Screen		Sand Separation Feed Pumps Seal Water		Secondary Screen and Hydrocyclone Screen Wash Water from SCA Sump	Gravel Removed from Secondary Screen	Sand Removed from Hydrocyclone		Geotextile Tube Feed Pump Seal Water		Clarifier Underflow and Filter Backwash from SCA WTP	Filtrate from Screened Material Stockpile	Coagulant Emulsion and Makeup Water from SCA WTP	Polymer and Makeup Water from SCA WTP		Geotextile Tube Retention	Average Precipitation		Primary, Secondary and Hydrocyclone Screen Wash Water	Net Flow to Stormwater Basins	Dewatering Effluent to SCA WTP Influent
Total (gpm)	3500	0	175	3,675	71	(3.8)	3,743	21	3,764	357	(33.8)	(96.2)	3,991	11	4,001	1,065.9	21.3	46.9	64.9	5,200	(225.3)	141	5,116	(428)	0	4,688
Water (gpm)	3359	0	175	3,534	71	(1.5)	3,604	21	3,625	357	(13.4)	(38.3)	3,930	11	3,940	1,065.0	21.3	46.5	64.7	5,138	(163.4)	141	5,116	(428)	0	4,687
Solids (gpm) (Note 2)	141.4	0.0	0.0	141.4	0.0	(2.3)	139.1	0.0	139.1	0.0	(20.4)	(58.0)	60.8	0.0	60.8	0.9	0.002	0.5	0.2	62.3	(62.0)	0.0	0.3	0.0	0.0	0.3
Solids (lbs/min) (Note 2)	3,114.4	0.0	0.0	3,114.4	0.0	(49.8)	3,064.5	0.0	3,064.5	0.0	(448.5)	(1,276.9)	1,339.2	0.0	1,339.2	19.3	0.03	3.9	1.1	1,363.5	(1,356.1)	0.0	7.4	0.0	0.0	7.4
Concentration (mg/L)	106,623.6	NA	0.0	101,546.3	0.0	1,590,361.5	98,115.5	0.0	97,568.1	0.0	1,590,361.5	1,590,361.5	40,211.1	0.0	40,105.6	2,171.2	195.2	9,903.8	1,994.3	31,418.6	721,095.5	0.0	173.5	0.0	NA	189.3

Notes:
(1). Stream number without description indicates the total flow at that point.
(2). Theoretical dry weight basis.
(3). Numbers within parenthesis represent diverted flows.
(4). NA indicates not applicable.

PARSONS

Project Number: 444853 Calc.No. from index: 3 Preparer: XDH Date:2/17/2010 Rev. No.:2 Preparer: Date:

Project Name:Sediment Management Design Calculation Title: Mass Balance Reviewer:MTO Date:2/18/2010 Review: Date:

	A	B	C	D	Notes
6	**Incoming Slurry**				
7	Slurry Flow Rate, q_s	5,000	gpm		Maximum flow
8	Working Hours, t	24	hr/day		
9	Daily Slurry Volume, q_T	7,200,000	gallons/day	962,500 ft^3/day	
10	Solids Content by Weight of Incoming Slurry, P_s	10%			
11	Specific Gravity of Solids, G_s	2.56			Tab "Weight&Volume"
12	Unit Weight of Water, γ_w	62.4279606	pcf		
13	Slurry Water Content, WC	900%			
14	Water Flow Rate, q_w	4792	gpm		
15	Dry Solids Flow Rate, q_s	208	gpm		
16	Daily Water Volume, q_w	6,900,499	gallons/day	922,463 ft^3/day	
17	Daily Water Weight, W_w	57,587,459	lbs/day		
18	Daily Dry Solids Volume, q_s	299,501	gallons/day	40,037 ft^3/day	
19	Daily Dry Solids Weight, W_s	6,398,607	lbs/day		
20	Slurry Concentration, C_{s1}	0.89	lbs/gallon	6.6 lb/ft^3	
21	% Water in Slurry (by Volume)	96%			
22					
23					
24	**Booster Pump Seal Water**				
25	Booster Pump Seal Water (each), $q_{booster}$	50	gpm		
26	Number of Booster Pumps, $N_{booster}$	5			
27	Daily Volume of Booster Pump Seal Water	360,000	gallons/day	48,125 ft^3/day	
28	Daily Weight of Booster Seal Water	3,004,346	lbs/day		
29					
30	**Primary Screens (Over-Sized Particle Removal, >2-inch)**				
31	Average Percentage of Over-Sized Particles, $P_{over-sized}$	0.2%			Tab "Weight&Volume"
32	Daily Dry Weight of Removed Over-Sized Particle, $W_{over-sized}$	12,797	lbs/day		
33	Daily Volume of Removed Over-Sized Particle, $q_{over-sized}$	599	gallons/day	80 ft^3/day	
34	Initial Water Content of Removed Over-Sized Particles in Stockpile, WC_{istock}	25%			
35	Daily Weight f Water Removed with Over-Sized Particles, $W_{w-over-sized}$	3,199	lbs/day		
36	Daily Volume of Water Removed with Over-Sized Particles, $q_{w-over-sized}$	383	gallons/day	51 ft^3/day	
37	Remaining Daily Dry Solids Weight in Slurry, W_{sr1}	6,385,809	lbs/day		
38	Remaining Daily Water Weight Slurry, W_{wr1}	57,584,260	lbs/day		
39	Remaining Daily Solids Volume Slurry, q_{sr1}	298,902	gallons/day	39,957 ft^3/day	
40	Remaining Daily Water Volume Slurry, q_{wr1}	6,900,116	gallons/day	922,411 ft^3/day	
41					
42	**Geotextile Tube Feed Pump Seal Water**				
43	Geotextile Tube Feed Pump Seal Water (each), $q_{tube-pump}$	15	gpm		
44	Number of Geotextile Tube Feed Pumps, $N_{tube-pump}$	1			
45	Daily Volume of Tube Feed Pump Seal Water	21,600	gallons/day	2,888 ft^3/day	
46	Daily Weight of Tube Feed Pump Seal Water	180,261	lbs/day		
47					
48	**Secondary Screens (Gravel Removal for RA-A/B/E/F)**				
49	Average Percentage of Gravel in RA-A/B/E/F, P_{gravel}	No Applicable			
50	Daily Dry Weight of Removed Gravel, W_{gravel}				
51	Daily Volume of Removed Gravel, q_{gravel}				
52	**Initial Water Content of Removed Gravel in Stockpile, WC_{gravel}**				
53	Daily Weight of Water Removed with Gravel, $W_{w-gravel}$				
54	Daily Volume of Water Removed with Gravel, $q_{w-gravel}$				
55	Remaining Daily Dry Solids Weight in Slurry, W_{sr2}				
56	Remaining Daily Water Weight in Slurry, W_{wr2}				
57	Remaining Daily Dry Solids Volume in Slurry, q_{sr2}				
58	Remaining Daily Water Volume in Slurry, q_{wr2}				
59					
60	**Hydrocyclone (Sand Removal for RA-A/B/E/F)**				
61	Average Percentage of Sand in RA-A/B/E/F, P_{sand}	No Applicable			
62	Daily Dry Weight of Removed Sand, W_{sand}				
63	Daily Volume of Removed Sand, q_{sand}				
64	Initial Water Content of Removed Sand in Stockpile, WC_{sand}				
65	Daily Weight of Water Removed with Sand, W_{w-sand}				
66	Daily Water Removed with Sand Volume, q_{w-sand}				
67	Remaining Daily Dry Solids Weight in Slurry, W_{sr3}				
68	Remaining Daily Water Weight in Slurry, W_{wr3}				
69	Remaining Daily Dry Solids Volume in Slurry, q_{sr3}				
70	Remaining Daily Water Volume in Slurry, q_{wr3}				
71					
72					
73	**SCA WTP**				**Notes**
74	I.P Clarifier Sludge (OBG line number 16)				OBG's estimate.
75	Total Suspended Solids, $TSS_{clarifier}$	3017.9 mg/L	11424.0 mg/gallon	0.001 gallon/gallon	
76	Clarifier Sludge Flow Rate, $q_{clarifier}$	735 gpm			
77	Flow Rate of Solids in Clarifier Sludge, $q_{TSS-clarifier}$	0.87 gpm			
78	Flow Rate of Water in Clarifier Sludge, $q_{w-clarifier}$	734.1 gpm			
79	Weight of Dry Solids in Clarifier Sludge, $W_{TSS-clarifier}$	8.40 kg/min	1110.7 lbs/hr	26,656 lbs/day	
80	Spent MMF Backwash (OBG line number 21)				
81	Total Suspended Solids, TSS_{MMF}	483.3 mg/L	1829.5 mg/gallon	0.0002 gallon/gallon	
82	MMF Backwash Flow Rate, q_{MMF}	166.3 gpm			
83	Flow Rate of Solids in MMF Backwash, $q_{TSS-MMF}$	0.03 gpm			
84	Flow Rate of Water in MMF Backwash, q_{w-MMF}	166.3 gpm			
85	Weight of Dry Solids in MMF Backwash, $W_{TSS-MMF}$	0.30 kg/min	40.2 lbs/hr	966 lbs/day	
86	Spent GAC Backwash (OBG line number 22)				
87	Total Suspended Solids, TSS_{GAC}	95.8 mg/L	362.6 mg/gallon	0.00004 gallon/gallon	
88	GAC Backwash Flow Rate, q_{GAC}	164.6 gpm			
89	Flow Rate of Solids in GAC Backwash, $q_{TSS-GAC}$	0.006 gpm			
90	Flow Rate of Water in GAC Backwash, q_{w-GAC}	164.6 gpm			
91	Weight of Dry Solids in GAC Backwash, $W_{TSS-GAC}$	0.06 kg/min	7.9 lbs/hr	189 lbs/day	
92	**SCA WTP Total**				
93	Total Flow Rate, q_{WTP}	1065.9 gpm	1,534,896 gallons/day	205,186 ft^3/day	
94	Solid Flow Rate, $q_{WTP-TSS}$	0.9 gpm	1,302 gallons/day	174 ft^3/day	
95	Water Flow Rate, q_{w-WTP}	1065.0 gpm	1,533,594 gallons/day	205,012 ft^3/day	
96	Water Weight, W_{w-WTP}	12,798,465 lbs/day			
97	Solids Weight, $W_{WTP-TSS}$	27,812 lbs/day			
98					
99	**Water from Removed Material (Over-sized) Stockpile**				
100	Typical Solids Content of Sand from Hydrocyclone Shaker (TotalClean) (75-85%)	80%			DelTank TCW-3000
101	Sand Water Content	25%			
102	Assumed Initial Water Content of Screened Material Stockpile, WC_{istock}	25%			
103	**Assumed Final Water Content of Screened Material Stockpile, WC_{fstock}**	**15%**			
104					
105	Weight of Water Removed from Stockpile (Water Content from 25% to 15%), $W_{w-stock}$	1,280 lbs/day			
106	Volume of Water Removed from Stockpile (Water Content from 25% to 15%), $q_{w-stock}$	153 gallons/day	20 ft^3/day		
107	Weight of Water Remained in Stockpile, $W_{wf-stock}$	1,920 lbs/day			
108	Volume of Water Remained in Stockpile, $q_{wf-stock}$	230 gallons/day	31 ft^3/day		
109					
110	**Total Suspended Solids in Stockpile Filtrate**				
111	Total Suspended Solids, $TSS_{stock-filtrate}$	195.2 mg/L	738.9 mg/gallon	0.0001 gallon/gallon	
112	Total Stockpile Filtrate Flow Rate, $q_{stock-filtrate}$	0.1 gpm	153 gallons/day		
113	Flow Rate of Solids in Stockpile Filtrate, $q_{s-stock-filtrate}$	8.12042E-06 gpm	0.01 gallons/day		
114	Flow Rate of Water in Stockpile Filtrate, $q_{w-stock-filtrate}$	0.11 gpm	153.34 gallons/day		
115	Weight of Dry Solids in Stockpile Filtrate, $W_{TSS-stock-filtrate}$	7.86889E-05 kg/min	0.25 lbs/day		
116	Weight of Water in Stockpile Filtrate, $W_{w-stock-filtrate}$	1,280 lbs/day			
117					
118	**Polymer and Makeup Water**				
119	Percent Fines in Slurry Solids, P_{fins}	82%			
120	Fine Solids Weight (Fines in Slurry, SCA WTP TSS, Stockpile Filtrate TSS)	5274669.47 lbs/day			
121	Polymer Dosage Rate (lbs of dry polymer per dry ton of solids), $DOS_{polymer}$	1.59 lbs/ton			Based on P-GDT draft report.
122	Dry Polymer Density, $DEN_{polymer}$	0.70 g/cm^3			Ashland 2520 MSDS
123	Daily Dry Polymer Needed, $W_{drypolymer}$	4193.36 lbs/day	2.912 lbs/min		
124	Dry Polymer Volume, $q_{drypolymer}$	0.4985 gpm	718 gallons/day	96 ft^3/day	
125	Polymer Makeup Water Volume, $q_{makeupwater}$	174.47 gpm	251,238 gallons/day	33,586 ft^3/day	Based on P-GDT draft report 0.2% dilution
126	Polymer Makeup water Weight, $W_{makeupwater}$	2,096,681 lbs/day			
127					
128					
129	**Coagulant (Emulsion) for RA-A/B/E/F**				
130	Coagulant Dosage Rate lbs of emulsion per dry ton of solids, DOS_{coag}	Not Applicable			
131	Coagulant Density, DEN_{coag}				
132	Coagulant Flow Rate, q_{coag}				
133	Coagulant Weight, W_{coag}				
134					
135					
136	**RA-C/D Primary Screens and Polymer Injection**				**Notes**
137	**Initial Dewatering in Geotextile Tubes (i.e., the first 24 hrs in the tubes)**				
138	Solids Content by Weight after Initial Dewatering in Tubes, P_{sr2}	38%			Based on P-GDT draft report.
139	Daily Weight of Dry Solids Retained in Tubes, W_{s-ret2}	6,417,815 lbs/day			
140	Daily Volume of Solids Retained in Tubes,q_{s-ret2}	300,921 gallons/day	40,227 ft^3/day		
141	Daily Weight of Water Retained in Tubes after Initial Dewatering, W_{ret2}	10,471,172 lbs/day			
142	Daily Volume of Water Retained in Tubes after Initial Dewatering,q_{ret2}	1,254,723 gallons/day	167732.0775 ft^3/day		
143	Daily Weight of Water in Initial Filtrate Weight, W_{if}	65,194,121 lbs/day			
144	Daily Volume of Water in Initial Filtrate, q_{if}	7,811,978 gallons/day	1044309.632 ft^3/day		
145	**Consolidation Dewatering in Geotextile Tubes**				
146	Solids Content by Weight after Consolidation Dewatering, P_{s3}	50%			Assumed value
147	Peak Daily Weight of Retained Water in Tubes after Consolidation Dewatering, W_{ret3}	6,417,815 lbs/day			
148	Peak Daily Volume of Retained Water in Tubes after Consolidation Dewatering, q_{ret3}	769,024 gallons/day	102,804 ft^3/day		
149	Peak Daily Weight of Water in Consolidation Dewatering Filtrate, W_{cf}	4,053,357 lbs/day			
150	Peak Daily Volume of Water in Consolidation Dewatering Filtrate, q_{cf}	485,699 gallons/day	64,929 ft^3/day		
151	Consolidation Dewatering Duration, t_c	60 days			
152	Average Water Volume from Consolidation Dewatering of One Day Filling, q_{acf}	8,095 gallons/day	1,082 ft^3/day		
153					
154	Peak Volume of Water in Geotextile Tube Filtrate, $q_{tube-filtrate}$	8,297,677 gallons/day	1,109,238 ft^3/day		
155	Daily Water Retained in Geotextile Tube, $q_{w-retained}$	769,024 gallons/day	102,804 ft^3/day		
156					
157					
158					
159	**Total Suspended Solids in Geotextile Tube Filtrate**				**Notes**
160	Total Suspended Solids, $TSS_{tube-filtrate}$	195.2 mg/L	738.9 mg/gallon	0.0001 gallon/gallon	OBG's estimate.
161	Total Geotextile Tube Filtrate Flow Rate, $q_{tube-filtrate}$	5762.7 gpm	8,298,310 gallons/day		
162	Flow Rate of Solids in Geotextile Tube Filtrate, $q_{s-tube-filtrate}$	0.44 gpm	633 gallons/day		
163	Flow Rate of Water in Geotextile Tube Filtrate, $q_{w-tube-filtrate}$	5762.3 gpm	8,297,677 gallons/day		
164	Weight of Dry Solids in Geotextile Tube Filtrate, $W_{TSS-tube-filtrate}$	4.26 kg/min	13,518 lbs/day		
165					
166	**Precipitation**				

167	Daily Precipitation, PRE_{daily} (inch)	Open Area, A_{SCA} (acres)	Flow Rate, q_{PRE} (gpd)	Flow Rate, q_{PRE} (gpm)	
168	0.15	50	203,657	141.4	On-site met data.

169					
170	**Effluent Tank Discharge (OBG line number 23)**				
171	Total Suspended Solids, $TSS_{discharge}$	4.5 mg/L	17.03 mg/gallon	1.75781E-06 gallon/gallon	OBG's estimate.
172	Total Flow Rate , $MAX_{discharge}$	4,514 gpm	6,500,000 gallons/day		
173	Flow Rate of Solids in Discharge, $q_{TSS-dis}$	0.008 gpm	11 gallons/day		
174	Flow Rate of Water in Discharge, q_{w-dis}	4513.88 gpm	6,499,989 gallons/day		
175	Weight of Dry Solids in Discharge, $W_{TSS-dis}$	0.08 kg/min	10.2 lbs/hr	244.1 lbs/day	
176					
177					
178					
179					

Mass Balance Tables

RA-C/D

Primary Screens and Polymer Injection

180		Incremental					Accumulative					Notes
181		Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	
182	Dredge Slurry	5000	4792	208	4443.5	1	5,000	4,792	208	4443.5		
183	Booster Pumps Seal Water	250	250	0	0.0	2	5,250	5,042	208	4443.5	3	
184	Primary Screen Wash Water from SCA Sumps	102	102	0	0.0	4	5,352	5,144	208	4443.5		Vendor's estimate.
185	Over-Sized Removed from Primary Screen	(0.7)	(0.3)	(0.4)	(8.9)	5	5,351	5,144	208	4434.6	6	
186	Geotextile Tube Feed Pump Seal Water	15	15	0	0.0	7	5,366	5,159	208	4434.6	8	
187	Secondary Screen and Hydrocyclone Screen Wash Water from SCA Sump	0	0	0	0.0							
188	Gravel Removed from Secondary Screen	0.0	0.0	0.0	0.0		5,366	5,159	208	4434.6		
189	Sand Removed from Hydrocyclone	0.0	0.0	0.0	0.0		5,366	5,159	208	4434.6		
190	Geotextile Tube Feed Pump Seal Water	0	0	0	0.0		5,366	5,159	208	4434.6		
191	Clarifier Underflow and Filter Backwash from SCA WTP	1066	1065	0.9	19.3	9	6,432	6,224	208	4453.9		
192	Filtrate from Screened Material Stockpile	0.1	0.1	0.00001	0.0	10						
193	Coagulant Emulsion and Makeup Water from SCA WTP	0	0	0.000	0.0							
194	Polymer and Makeup Water from SCA WTP	175	174	0.5	2.9	11	6,607	6,398	209	4456.8	12	
195	Geotextile Tube Retention	(742.6)	(534.0)	(208.5)	(4447.4)	13	5864.7	5864.3	0.4	9.4		
196	Average Precipitation	141	141	0	0.0	14	6006.1	6005.7	0.4	9.4	15	
197	Primary Screen Wash Water	(102)	(102)	0	0.0	16	5904.1	5903.7	0.4	9.4		
198	Net Flow to Stormwater Basins	(150.4)	(150.4)	(0.01)	(0.2)	17	5753.8	5753.3	0.4	9.2	18	Maximum Flow from EQ Basin to WTP
199	Clarifier Underflow and Filter Backwash	(1066)	(1065)	(0.9)	(19.3)		5,754.26	5,753.35	0.912			
200	Polymer Makeup Water	(174)	(174)	0			4,688.36	4,688.35	0.008			Flow from WTP
201	Net Flow to Holding Basin (Downstream Storage)	0	0	0								
202	Maximum Discharge to Metro						4,513.89	4,513.88	0.008			Maximum Discharge to Metro (6.5 MGD)

PARSONS

Project Number: 444853 Calc.No. from index: 3 Preparer: XDH Date:2/17/2010 Rev. No.:2 Preparer: Date:

Project Name:Sediment Management Design Calculation Title: Mass Balance Reviewer:MTO Date:2/18/2010 Review: Date:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
6	**Incoming Slurry**													
7	Slurry Flow Rate, q_s	3,500	gpm											
8	Working Hours, t	24	hr/day											
9	Daily Slurry Volume, q_T	5,040,000	gallons/day	673,750	ft^3/day									
10	Solids Content by Weight of Incoming Slurry, P_s	10%												
11	Specific Gravity of Solids, G_s	2.56												
12	Unit Weight of Water, γ_w	62.4279606	pcf											
13	Slurry Water Content, WC	900%												
14	Water Flow Rate, q_w	3354	gpm											
15	Dry Solids Flow Rate, q_s	146	gpm											
16	Daily Water Volume, q_w	4,830,349	gallons/day	645,724	ft^3/day									
17	Daily Water Weight, W_w	40,311,222	lbs/day											
18	Daily Dry Solids Volume, q_s	209,651	gallons/day	28,026	ft^3/day									
19	Daily Dry Solids Weight, W_s	4,479,025	lbs/day											
20	Slurry Concentration, C_{s1}	0.89	lbs/gallon	6.6	lb/ft^3									
21	% Water in Slurry (by Volume)	96%												
22														
23														
24	**Booster Pump Seal Water**													
25	Booster Pump Seal Water (each), $q_{booster}$	35	gpm											
26	Number of Booster Pumps, $N_{booster}$	5												
27	Daily Volume of Booster Pump Seal Water	252,000	gallons/day	33,688	ft^3/day									
28	Daily Weight of Booster Seal Water	2,103,042	lbs/day											
29														
30	**Primary Screens (Over-Sized Particle Removal, >2-inch)**													
31	Average Percentage of Over-Sized Particles, $P_{over-sized}$	0.2%												
32	Daily Dry Weight of Removed Over-Sized Particle, $W_{over-sized}$	8,958	lbs/day											
33	Daily Volume of Removed Over-Sized Particle, $q_{over-sized}$	419	gallons/day	56	ft^3/day									
34	Initial Water Content of Removed Over-Sized Particles in Stockpile, WC_{istock}	25%												
35	Daily Weight f Water Removed with Over-Sized Particles, $W_{w-over-sized}$	2,240	lbs/day											
36	Daily Volume of Water Removed with Over-Sized Particles, $q_{w-over-sized}$	268	gallons/day	36	ft^3/day									
37	Remaining Daily Dry Solids Weight in Slurry, W_{sr1}	4,470,067	lbs/day											
38	Remaining Daily Water Weight Slurry, W_{wr1}	40,308,982	lbs/day											
39	Remaining Daily Solids Volume Slurry, q_{sr1}	209,231	gallons/day	27,970	ft^3/day									
40	Remaining Daily Water Volume Slurry, q_{wr1}	4,830,081	gallons/day	645,688	ft^3/day									
41														
42	**Geotextile Tube Feed Pump Seal Water**													
43	Geotextile Tube Feed Pump Seal Water (each), $q_{tube-pump}$	10.5	gpm											
44	Number of Geotextile Tube Feed Pumps, $N_{tube-pump}$	1												
45	Daily Volume of Tube Feed Pump Seal Water	15,120	gallons/day	2,021	ft^3/day									
46	Daily Weight of Tube Feed Pump Seal Water	126,183	lbs/day											
47														
48	**Secondary Screens (Gravel Removal for RA-A/B/E/F)**													
49	Average Percentage of Gravel in RA-A/B/E/F, P_{gravel}													
50	Daily Dry Weight of Removed Gravel, W_{gravel}													
51	Daily Volume of Removed Gravel, q_{gravel}													
52	**Initial Water Content of Removed Gravel in Stockpile, WC_{gravel}**													
53	Daily Weight of Water Removed with Gravel, $W_{w-gravel}$						No Applicable							
54	Daily Volume of Water Removed with Gravel, $q_{w-gravel}$													
55	Remaining Daily Dry Solids Weight in Slurry, W_{sr2}													
56	Remaining Daily Water Weight in Slurry, W_{wr2}													
57	Remaining Daily Dry Solids Volume in Slurry, q_{sr2}													
58	Remaining Daily Water Volume in Slurry, q_{wr2}													
59														
60	**Hydrocyclone (Sand Removal for RA-A/B/E/F)**													
61	Average Percentage of Sand in RA-A/B/E/F, P_{sand}													
62	Daily Dry Weight of Removed Sand, W_{sand}													
63	Daily Volume of Removed Sand, q_{sand}													
64	Initial Water Content of Removed Sand in Stockpile, WC_{sand}													
65	Daily Weight of Water Removed with Sand, W_{w-sand}						No Applicable							
66	Daily Water Removed with Sand Volume, q_{w-sand}													
67	Remaining Daily Dry Solids Weight in Slurry, W_{sr3}													
68	Remaining Daily Water Weight in Slurry, W_{wr3}													
69	Remaining Daily Dry Solids Volume in Slurry, q_{sr3}													
70	Remaining Daily Water Volume in Slurry, q_{wr3}													
71														
72														
73	**SCA WTP**													
74	I.P Clarifier Sludge (OBG line number 16)													
75	Total Suspended Solids, $TSS_{clarifier}$	3017.9	mg/L	11424.0	mg/gallon	0.001	gallon/gallon							
76	Clarifier Sludge Flow Rate, $q_{clarifier}$	735	gpm											
77	Flow Rate of Solids in Clarifier Sludge, $q_{TSS-clarifier}$	0.87	gpm											
78	Flow Rate of Water in Clarifier Sludge, $q_{w-clarifier}$	734.1	gpm											
79	Weight of Dry Solids in Clarifier Sludge, $W_{TSS-clarifier}$	8.40	kg/min	1110.7	lbs/hr	26,656	lbs/day							
80	Spent MMF Backwash (OBG line number 21)													
81	Total Suspended Solids, TSS_{MMF}	483.3	mg/L	1829.5	mg/gallon	0.0002	gallon/gallon							
82	MMF Backwash Flow Rate, q_{MMF}	166.3	gpm											
83	Flow Rate of Solids in MMF Backwash, $q_{TSS-MMF}$	0.03	gpm											
84	Flow Rate of Water in MMF Backwash, q_{w-MMF}	166.3	gpm											
85	Weight of Dry Solids in MMF Backwash, $W_{TSS-MMF}$	0.30	kg/min	40.2	lbs/hr	966	lbs/day							
86	Spent GAC Backwash (OBG line number 22)													
87	Total Suspended Solids, TSS_{GAC}	95.8	mg/L	362.6	mg/gallon	0.00004	gallon/gallon							
88	GAC Backwash Flow Rate, q_{GAC}	164.6	gpm											
89	Flow Rate of Solids in GAC Backwash, $q_{TSS-GAC}$	0.006	gpm											
90	Flow Rate of Water in GAC Backwash, q_{w-GAC}	164.6	gpm											
91	Weight of Dry Solids in GAC Backwash, $W_{TSS-GAC}$	0.06	kg/min	7.9	lbs/hr	189	lbs/day							
92	**SCA WTP Total**													
93	Total Flow Rate, q_{WTP}	1065.9	gpm	1,534,896	gallons/day	205,186	ft^3/day							
94	Solid Flow Rate, $q_{WTP-TSS}$	0.9	gpm	1,302	gallons/day	174	ft^3/day							
95	Water Flow Rate, q_{w-WTP}	1065.0	gpm	1,533,594	gallons/day	205,012	ft^3/day							
96	Water Weight, W_{w-WTP}	12,798,465	lbs/day											
97	Solids Weight, $W_{WTP-TSS}$	27,812	lbs/day											
98														
99	**Water from Removed Material (Over-sized) Stockpile**													
100	Typical Solids Content of Sand from Hydrocyclone Shaker (TotalClean) (75-85%)	80%												
101	Sand Water Content	25%												
102	Assumed Initial Water Content of Screened Material Stockpile, WC_{istock}	25%												
103	**Assumed Final Water Content of Screened Material Stockpile, WC_{fstock}**	15%												
104														
105	Weight of Water Removed from Stockpile (Water Content from 25% to 15%), $W_{w-stock}$	896	lbs/day											
106	Volume of Water Removed from Stockpile (Water Content from 25% to 15%), $q_{w-stock}$	107	gallons/day	14	ft^3/day									
107	Weight of Water Remained in Stockpile, $W_{wf-stock}$	1,344	lbs/day											
108	Volume of Water Remained in Stockpile, $q_{wf-stock}$	161	gallons/day	22	ft^3/day									
109														
110	**Total Suspended Solids in Stockpile Filtrate**													
111	Total Suspended Solids, $TSS_{stock-filtrate}$	195.2	mg/L	738.9	mg/gallon	0.0001	gallon/gallon							
112	Total Stockpile Filtrate Flow Rate, $q_{stock-filtrate}$	0.1	gpm	107	gallons/day									
113	Flow Rate of Solids in Stockpile Filtrate, $q_{s-stock-filtrate}$	5.68429E-06	gpm	0.01	gallons/day									
114	Flow Rate of Water in Stockpile Filtrate, $q_{w-stock-filtrate}$	0.07	gpm	107.34	gallons/day									
115	Weight of Dry Solids in Stockpile Filtrate, $W_{TSS-stock-filtrate}$	5.50822E-05	kg/min	0.17	lbs/day									
116	Weight of Water in Stockpile Filtrate, $W_{w-stock-filtrate}$	896	lbs/day											
117														
118	**Polymer and Makeup Water**													
119	Percent Fines in Slurry Solids, P_{fins}	82%												
120	Fine Solids Weight (Fines in Slurry, SCA WTP TSS, Stockpile Filtrate TSS)	3700612.17	lbs/day											
121	Polymer Dosage Rate (lbs of dry polymer per dry ton of solids), $DOS_{polymer}$	1.59	lbs/ton											
122	Dry Polymer Density, $DEN_{polymer}$	0.70	g/cm^3											
123	Daily Dry Polymer Needed, $W_{drypolymer}$	2941.99	lbs/day	2.043	lbs/min									
124	Dry Polymer Volume, $q_{drypolymer}$	0.3497	gpm	504	gallons/day	67	ft^3/day							
125	Polymer Makeup Water Volume, $q_{makeupwater}$	122.41	gpm	176,264	gallons/day	23,563	ft^3/day							
126	Polymer Makeup water Weight, $W_{makeupwater}$	1,470,993	lbs/day											
127														
128														
129	**Coagulant (Emulsion) for RA-A/B/E/F**													
130	Coagulant Dosage Rate lbs of emulsion per dry ton of solids, DOS_{coag}													
131	Coagulant Density, DEN_{coag}						Not Applicable							
132	Coagulant Flow Rate, q_{coag}													
133	Coagulant Weight, W_{coag}													
134														
135														
136	**RA-C/D Primary Screens and Polymer Injection**													
137	**Initial Dewatering in Geotextile Tubes (i.e., the first 24 hrs in the tubes)**													
138	Solids Content by Weight after Initial Dewatering in Tubes, P_{s2}	38%												
139	Daily Weight of Dry Solids Retained in Tubes, W_{s-ret2}	4,500,821	lbs/day											
140	Daily Volume of Solids Retained in Tubes,q_{s-ret2}	211,037	gallons/day	28,212	ft^3/day									
141	Daily Weight of Water Retained in Tubes after Initial Dewatering, W_{ret2}	7,343,444	lbs/day											
142	Daily Volume of Water Retained in Tubes after Initial Dewatering,q_{ret2}	879,939	gallons/day	117630.6893	ft^3/day									
143	Daily Weight of Water in Initial Filtrate Weight, W_{if}	49,465,116	lbs/day											
144	Daily Volume of Water in Initial Filtrate, q_{if}	5,927,228	gallons/day	792355.1544	ft^3/day									
145	**Consolidation Dewatering in Geotextile Tubes**													
146	Solids Content by Weight after Consolidation Dewatering, P_{s3}	50%												
147	Peak Daily Weight of Retained Water in Tubes after Consolidation Dewatering, W_{ret3}	4,500,821	lbs/day											
148	Peak Daily Volume of Retained Water in Tubes after Consolidation Dewatering, q_{ret3}	539,317	gallons/day	72,096	ft^3/day									
149	Peak Daily Weight of Water in Consolidation Dewatering Filtrate, W_{cf}	2,842,623	lbs/day											
150	Peak Daily Volume of Water in Consolidation Dewatering Filtrate, q_{cf}	340,621	gallons/day	45,534	ft^3/day									
151	Consolidation Dewatering Duration, t_c	60	days											
152	Average Water Volume from Consolidation Dewatering of One Day Filling, q_{acf}	5,677	gallons/day	759	ft^3/day									
153														
154	Peak Volume of Water in Geotextile Tube Filtrate, $q_{tube-filtrate}$	6,267,849	gallons/day	837,890	ft^3/day									
155	Daily Water Retained in Geotextile Tube, $q_{w-retained}$	539,317	gallons/day	72,096	ft^3/day									
156														
157														
158														
159	**Total Suspended Solids in Geotextile Tube Filtrate**													
160	Total Suspended Solids, $TSS_{tube-filtrate}$	195.2	mg/L	738.9	mg/gallon	0.0001	gallon/gallon							
161	Total Geotextile Tube Filtrate Flow Rate, $q_{tube-filtrate}$	4353.0	gpm	6,268,327	gallons/day									
162	Flow Rate of Solids in Geotextile Tube Filtrate, $q_{s-tube-filtrate}$	0.33	gpm	478	gallons/day									
163	Flow Rate of Water in Geotextile Tube Filtrate, $q_{w-tube-filtrate}$	4352.7	gpm	6,267,849	gallons/day									
164	Weight of Dry Solids in Geotextile Tube Filtrate, $W_{TSS-tube-filtrate}$	3.22	kg/min	10,211	lbs/day									
165														
166	**Precipitation**													
167	Daily Precipitation, PRE_{daily} (inch)	Open Area, A_{SCA} (acres)	Flow Rate, q_{PRE} (gpd)	Flow Rate, q_{PRE} (gpm)										
168	0.15	50	203,657	141.4										
169														
170	**Effluent Tank Discharge (OBG line number 23)**													
171	Total Suspended Solids, $TSS_{discharge}$	4.5	mg/L	17.03	mg/gallon	1.75781E-06	gallon/gallon							
172	Total Flow Rate , $MAX_{discharge}$	3,306	gpm	4,760,824	gallons/day									
173	Flow Rate of Solids in Discharge, $q_{TSS-dis}$	0.006	gpm	8	gallons/day									
174	Flow Rate of Water in Discharge, q_{w-dis}	3306.12	gpm	4,760,816	gallons/day									
175	Weight of Dry Solids in Discharge, $W_{TSS-dis}$	0.06	kg/min	7.4	lbs/hr	178.8	lbs/day							
176														
177	**Mass Balance Tables**													
178	**RA-C/D**													
179	**Primary Screens and Polymer Injection**													

180		Incremental					Accumulative					Notes
181		Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	
182	Dredge Slurry	3500	3354	146	3110.4	1	3,500	3,354	146	3110.4		
183	Booster Pumps Seal Water	175	175	0	0.0	2	3,675	3,529	146	3110.4	3	
184	Primary Screen Wash Water from SCA Sumps	71	71	0	0.0	4	3,746	3,601	146	3110.4		Vendor's estimate.
185	Over-Sized Removed from Primary Screen	(0.5)	(0.2)	(0.3)	(6.2)	5	3,746	3,601	145	3104.2	6	
186	Geotextile Tube Feed Pump Seal Water	11	11	0	0.0	7	3,756	3,611	145	3104.2	8	
187	Secondary Screen and Hydrocyclone Screen Wash Water from SCA Sump	0	0	0	0.0							
188	Gravel Removed from Secondary Screen	0.0	0.0	0.0	0.0		3,756	3,611	145	3104.2		
189	Sand Removed from Hydrocyclone	0.0	0.0	0.0	0.0		3,756	3,611	145	3104.2		
190	Geotextile Tube Feed Pump Seal Water	0	0	0	0.0		3,756	3,611	145	3104.2		
191	Clarifier Underflow and Filter Backwash from SCA WTP	1066	1065	0.9	19.3	9	4,822	4,676	146	3123.5		
192	Filtrate from Screened Material Stockpile	0.1	0.1	0.00001	0.0	10						
193	Coagulant Emulsion and Makeup Water from SCA WTP	0	0	0.000	0.0							
194	Polymer and Makeup Water from SCA WTP	123	122	0.3	2.0	11	4,945	4,799	147	3125.6	12	
195	Geotextile Tube Retention	(520.7)	(374.5)	(146.2)	(3118.5)	13	4424.4	4424.1	0.3	7.1		
196	Average Precipitation	141	141	0	0.0	14	4565.8	4565.5	0.3	7.1	15	
197	Primary Screen Wash Water	(71)	(71)	0	0.0	16	4494.4	4494.1	0.3	7.1		
198	Net Flow to Stormwater Basins	0.0	0.0	0.00	0.0	17	4494.4	4494.1	0.3	7.1	18	Maximum Flow from EQ Basin to WTP
199	Clarifier Underflow and Filter Backwash	(1066)	(1065)	(0.9)	(19.3)							
200	Polymer Makeup Water	(122)	(122)	0								Flow from WTP
201	Net Flow to Holding Basin (Downstream Storage)	0	0	0								
202	Maximum Discharge to Metro						3,306	3,306	0.006			Maximum Discharge to Metro (6.5 MGD)

PARSONS

Project Number: 444853 Calc.No. from index: 3 Preparer: XDH Date:2/17/2010 Rev. No.:2 Preparer: Date:

Project Name:Sediment Management Design Calculation Title: Mass Balance Reviewer:MTO Date:2/18/2010 Review: Date:

	A	B	C	D	E	F	G	H
6	**Incoming Slurry**						**Notes**	
7	Slurry Flow Rate, q	5,000	gpm				Maximum flow	
8	Working Hours, t	24	hr/day					
9	Daily Slurry Volume, q_T	7,200,000	gallons/day	962,500	ft^3/day			
10	Solids Content by Weight of Incoming Slurry, P_s	10%						
11	Specific Gravity of Solids, G_s	2.64					Tab "Weight&Volume"	
12	Unit Weight of Water, γ_w	62.4279606	pcf					
13	Slurry Water Content, WC	900%						
14	Water Flow Rate, q_w	4798	gpm					
15	Dry Solids Flow Rate, q_s	202	gpm					
16	Daily Water Volume, q_w	6,909,208	gallons/day	923,627	ft^3/day			
17	Daily Water Weight, W_w	57,660,142	lbs/day					
18	Daily Dry Solids Volume, q_s	290,792	gallons/day	38,873	ft^3/day			
19	Daily Dry Solids Weight, W_s	6,406,682	lbs/day					
20	Slurry Concentration, C_{s1}	0.89	lbs/gallon	6.7	lb/ft^3			
21	% Water in Slurry (by Volume)	96%						
22								
23								
24	**Booster Pump Seal Water**							
25	Booster Pump Seal Water (each), $q_{booster}$	50	gpm					
26	Number of Booster Pumps, $N_{booster}$	5						
27	Daily Volume of Booster Pump Seal Water	360,000	gallons/day	48,125	ft^3/day			
28	Daily Weight of Booster Seal Water	3,004,346	lbs/day					
29								
30	**Primary Screens (Over-Sized Grain Removal, >2-inch)**							
31	Average Percentage of Over-Sized Particles, $P_{over-sized}$	1.6%					Tab "Weight&Volume"	
32	Daily Dry Weight of Removed Over-Sized Particle, $W_{over-sized}$	102,507	lbs/day					
33	Daily Volume of Removed Over-Sized Particle, $q_{over-sized}$	4,653	gallons/day	622	ft^3/day			
34	Initial Water Content of Removed Over-Sized Particles in Stockpile, WC_{istock}	25%						
35	Daily Weight f Water Removed with Over-Sized Particles, $W_{w-over-sized}$	25,627	lbs/day					
36	Daily Volume of Water Removed with Over-Sized Particles, $q_{w-over-sized}$	3,071	gallons/day	411	ft^3/day			
37	Remaining Daily Dry Solids Weight in Slurry, W_{sr1}	6,304,175	lbs/day					
38	Remaining Daily Water Weight Slurry, W_{wr1}	57,634,515	lbs/day					
39	Remaining Daily Solids Volume Slurry, q_{sr1}	286,139	gallons/day	38,251	ft^3/day			
40	Remaining Daily Water Volume Slurry, q_{wr1}	6,906,138	gallons/day	923,216	ft^3/day			
41								
42	**Hydrocyclone Feed Pump Seal Water**							
43	Hydrocyclone Feed Pump Seal Water (each), $q_{cyclone-pump}$	15	gpm					
44	Number of Hydrocyclone Feed Pumps, $N_{cyclone-pump}$	2						
45	Daily Volume of Booster Pump Seal Water	43,200	gallons/day	5,775	ft^3/day			
46	Daily Weight of Booster Seal Water	360,521	lbs/day					
47								
48	**Secondary Screens (Gravel Removal for RA-A/B/E/F)**						Tab "Weight&Volume"	
49	Average Percentage of Gravel in RA-A/B/E/F, P_{gravel}	14.4%						
50	Daily Dry Weight of Removed Gravel, W_{gravel}	922,562	lbs/day					
51	Daily Volume of Removed Gravel, q_{gravel}	41,874	gallons/day	5,598	ft^3/day			
52	Initial Water Content of Removed Gravel in Stockpile, WC_{gravel}	25%						
53	**Daily Weight of Water Removed with Gravel, $W_{w-gravel}$**	**230,641**	**lbs/day**					
54	Daily Volume of Water Removed with Gravel, $q_{w-gravel}$	27,637	gallons/day	3,695	ft^3/day			
55	Remaining Daily Dry Solids Weight in Slurry, W_{sr2}	5,381,613	lbs/day					
56	Remaining Daily Water Weight in Slurry, W_{wr2}	57,403,874	lbs/day					
57	Remaining Daily Dry Solids Volume in Slurry, q_{sr2}	244,265	gallons/day	32,653	ft^3/day			
58	Remaining Daily Water Volume in Slurry, q_{wr2}	6,878,501	gallons/day	919,522	ft^3/day			
59								
60	**Hydrocyclone (Sand Removal for RA-A/B/E/F)**						Tab "Weight&Volume"	
61	Average Percentage of Sand in RA-A/B/E/F, P_{sand}	41%						
62	Daily Dry Weight of Removed Sand, W_{sand}	2,626,740	lbs/day					
63	Daily Volume of Removed Sand, q_{Sand}	119,225	gallons/day	15,938	ft^3/day			
64	Initial Water Content of Removed Sand in Stockpile, WC_{sand}	25%						
65	Daily Weight of Water Removed with Sand, W_{w-sand}	656,685	lbs/day					
66	Daily Water Removed with Sand Volume, q_{w-sand}	78,688	gallons/day	10,519	ft^3/day			
67	Remaining Daily Dry Solids Weight in Slurry, W_{sr3}	2,754,873	lbs/day					
68	Remaining Daily Water Weight in Slurry, W_{wr3}	56,747,189	lbs/day					
69	Remaining Daily Dry Solids Volume in Slurry, q_{sr3}	125,040	gallons/day	16,715	ft^3/day			
70	Remaining Daily Water Volume in Slurry, q_{wr3}	6,799,813	gallons/day	909,003	ft^3/day			
71								
72	**Geotextile Tube Feed Pump Seal Water**							
73	Geotextile Tube Feed Pump Seal Water (each), $q_{tube-pump}$	15	gpm					
74	Number of Geotextile Tube Feed Pumps, $N_{tube-pump}$	1						
75	Daily Volume of Tube Feed Pump Seal Water	21,600	gallons/day	2,888	ft^3/day			
76	Daily Weight of Tube Feed Pump Seal Water	180,261	lbs/day					

	A	B	C	D	E	F	G
77							
78	**SCA WTP**						**Notes**
79	I.P Clarifier Sludge (OBG line number 16)						OBG's estimate.
80	Total Suspended Solids, $TSS_{clarifier}$	3017.9	mg/L	11424.0	mg/gallon	0.001	gallon/gallon
81	Clarifier Sludge Flow Rate, $q_{clarifier}$	735	gpm				
82	Flow Rate of Solids in Clarifier Sludge, $q_{TSS-clarifier}$	0.84	gpm				
83	Flow Rate of Water in Clarifier Sludge, $q_{w-clarifier}$	734.2	gpm	734.2	gpm		
84	Weight of Dry Solids in Clarifier Sludge, $W_{TSS-clarifier}$	8.40	kg/min	1110.7	lbs/hr	26,656	lbs/day
85	Spent MMF Backwash (OBG line number 21)						
86	Total Suspended Solids, TSS_{MMF}	483.3	mg/L	1829.5	mg/gallon	0.0002	gallon/gallon
87	MMF Backwash Flow Rate, q_{MMF}	166.3	gpm				
88	Flow Rate of Solids in MMF Backwash, $q_{TSS-MMF}$	0.03	gpm				
89	Flow Rate of Water in MMF Backwash, q_{w-MMF}	166.3	gpm	166.3	gpm		
90	Weight of Dry Solids in MMF Backwash, $W_{TSS-MMF}$	0.30	kg/min	40.2	lbs/hr	966	lbs/day
91	Spent GAC Backwash (OBG line number 22)						
92	Total Suspended Solids, TSS_{GAC}	95.8	mg/L	362.6	mg/gallon	0.00004	gallon/gallon
93	GAC Backwash Flow Rate, q_{GAC}	164.6	gpm				
94	Flow Rate of Solids in GAC Backwash, $q_{TSS-GAC}$	0.006	gpm				
95	Flow Rate of Water in GAC Backwash, q_{w-GAC}	164.6	gpm	164.6	gpm		
96	Weight of Dry Solids in GAC Backwash, $W_{TSS-GAC}$	0.06	kg/min	7.9	lbs/hr	189	lbs/day
97	**SCA WTP Total**						
98	Total Flow Rate, q_{WTP}	1065.9	gpm	1,534,896	gallons/day	205,186	ft^3/day
99	Solid Flow Rate, $q_{WTP-TSS}$	0.88	gpm	1,262	gallons/day	169	ft^3/day
100	Water Flow Rate, q_{w-WTP}	1065.0	gpm	1,533,634	gallons/day	205,017	ft^3/day
101	Water Weight, W_{w-WTP}	12,798,794	lbs/day				
102	Solids Weight, $W_{WTP-TSS}$	27812	lbs/day				
103							
104	**Water from Removed Material (Over-sized, Gravel, and Sand) Stockpile**						
105	Typical Solids Content of Sand from Hydrocyclone Shaker (TotalClean) (75-85%)	80%					DelTank TCW-3000
106	Sand Water Content	25%					
107	Assumed Initial Water Content of Screened Material Stockpile, WC_{istock}	25%					
108	Assumed Final Water Content of Screened Material Stockpile, WC_{fstock}	15%					
109							
110	Weight of Water Removed from Stockpile (Water Content from 25% to 15%), $W_{w-stock}$	365,181	lbs/day				
111	Volume of Water Removed from Stockpile (Water Content from 25% to 15%), $q_{w-stock}$	43,758	gallons/day	5,850	ft^3		
112	Weight of Water Remained in Stockpile, $W_{wf-stock}$	15,376	lbs/day				
113	Volume of Water Remained in Stockpile, $q_{wf-stock}$	1,842	gallons/day	246	ft^3		
114							
115	**Total Suspended Solids in Stockpile Filtrate**						
116	Total Suspended Solids, $TSS_{stock-filtrate}$	195.2	mg/L	738.9	mg/gallon	0.0001	gallon/gallon
117	Total Stockpile Filtrate Flow Rate, $q_{stock-filtrate}$	30.4	gpm	43,762	gallons/day		
118	Flow Rate of Solids in Stockpile Filtrate, $q_{s-stock-filtrate}$	0.002	gpm	3	gallons/day	0	ft^3/day
119	Flow Rate of Water in Stockpile Filtrate, $q_{w-stock-filtrate}$	30.4	gpm	43,758	gallons/day	5,850	ft^3/day
120	Weight of Dry Solids in Stockpile Filtrate, $W_{TSS-stock-filtrate}$	0.02	kg/min	71	lbs/day		
121	Weight of Water in Stockpile Filtrate, $W_{w-stock-filtrate}$	365,181	lbs/day				
122							
123	**Polymer and Makeup Water**						
124	Percent Fines in Slurry Solids, P_{fine}	43%					
125	Fine Solids Weight (Fines in Slurry, SCA WTP TSS, Stockpile Filtrate TSS)	2782756.52	lbs/day				
126	Polymer Dosage Rate (lbs of dry polymer per dry ton of solids), $DOS_{polymer}$	1.59	lbs/ton				Based on P-GDT draft report.
127	Dry Polymer Density, $DEN_{polymer}$	0.70	g/cm^3				Ashland 2520 MSDS
128	Daily Dry Polymer Needed, $W_{drypolymer}$	1.536	lbs/min	2212.29	lbs/day		
129	Dry Polymer Volume, $q_{drypolymer}$	0.2630	gpm	379	gallons/day	51	ft^3/day
130	Polymer Makeup Water Volume, $q_{makeupwater}$	92.05	gpm	132,545	gallons/day	17,719	ft^3/day
131	Polymer Makeup water Weight, $W_{makeupwater}$	1,106,146	lbs/day				
132							
133	**Coagulant (Emulsion) for RA-A/B/E/F**						
134	Coagulant Dosage Rate (lbs of emulsion per dry ton of solids), DOS_{coag}	5.71	lbs/ton				Based on P-GDT draft report.
135	Coagulant Emulsion Density, DEN_{coag}	1.03	g/cm^3	64.300799	pcf		Based on Ashland 492 MSDS
136	Coagulant Emulsion Flow Rate, q_{Coag}	0.64	gpm	924	gallons/day	124	ft^3/day
137	Coagulant Emulsion Weight, W_{Coag}	5.5	lbs/min	7,945	lbs/day		
138	Weight of Coagulant Makeup Water, $W_{coagwater}$	551.7	lbs/min	794,477	lbs/day		
139	Volume of Coagulant Makeup Water, $q_{coagwater}$	66.1	gpm	95199	gallons/day		
140							
141							
142	**RA-A/B/E/F Primary Screens, Secondary Screens, Hydrocyclones, Polymer Injection, and Coagulant Injection**						**Notes**
143	**Initial Dewatering in Geotextile Tubes (i.e., the first 24 hrs in the tubes)**						
144	Solids Content by Weight after Initial Dewatering in Tubes, P_{s2}	38%					Based on P-GDT draft report.
145	Daily Weight of Dry Solids Retained in Tubes, W_{s-ret2}	2,792,914	lbs/day				
146	Daily Volume of Solids Retained in Tubes,q_{s-ret2}	127,609	gallons/day	17,059	ft^3/day		
147	Daily Weight of Water Retained in Tubes after Initial Dewatering, W_{ret2}	4,556,859	lbs/day				
148	Daily Volume of Water Retained in Tubes after Initial Dewatering, q_{ret2}	546,032	gallons/day	72993.87901	ft^3/day		
149	Daily Weight of Water in Initial Filtrate Weight, W_{if}	70,800,056	lbs/day				
150	Daily Volume of Water in Initial Filtrate, q_{if}	8,483,717	gallons/day	1134108.098	ft^3/day		
151	**Consolidation Dewatering**						
152	Solids Content by Weight after Consolidation Dewatering, P_{s3}	50%					Assumed value
153	**Peak Daily Weight of Retained Water in Tubes after Consolidation Dewatering, W_{ret3}**	**2,792,914**	**lbs/day**				
154	Peak Daily Volume of Retained Water in Tubes after Consolidation Dewatering, q_{ret3}	334,665	gallons/day	44,738	ft^3/day		
155	Peak Daily Weight of Water in Consolidation Dewatering Filtrate, W_{cf}	1,763,945	lbs/day				
156	Peak Daily Volume of Water in Consolidation Dewatering Filtrate, q_{cf}	211,367	gallons/day	28,256	ft^3/day		
157	Consolidation Dewatering Duration, t_c	60	days				
158	Average Water Volume from Consolidation Dewatering of One Day Filling, q_{acf}	3,523	gallons/day	471	ft^3/day		
159							
160	Peak Volume of Water in Geotextile Tube Filtrate, $q_{tube-filtrate}$	8,695,085	gallons/day	1,162,364	ft^3/day		
161	Daily Water Retained in Geotube, $q_{w-retained}$	334,665	gallons/day	44,738	ft^3/day		
162							
163							
164							
165	**Total Suspended Solids in Geotextile Tube Filtrate**						**Notes**
166	Total Suspended Solids, $TSS_{tube-filtrate}$	195.2	mg/L	738.9	mg/gallon	0.0001	gallon/gallon
167	Total Geotextile Tube Filtrate Flow Rate, $q_{tube-filtrate}$	6038.7	gpm	8,695,728	gallons/day		
168	Flow Rate of Solids in Geotextile Tube Filtrate, $q_{s-tube-filtrate}$	0.446	gpm	643	gallons/day		
169	Flow Rate of Water in Geotextile Tube Filtrate, $q_{w-tube-filtrate}$	6038.3	gpm	8,695,085	gallons/day		
170	Weight of Dry Solids in Geotextile Tube Filtrate, $W_{TSS-tube-filtrate}$	4.46	kg/min	14,166	lbs/day		
171							
172	**Precipitation**						

	A	Open Area, A_{SCA} (acres)	Flow Rate, q_{PRE} (gpd)	Flow Rate, q_{PRE} (gpm)	G
173	Daily Precipitation, PRE_{daily} (inch)				
174	0.15	50	203,657	141.4	On-site met data.

	A	B	C	D	E	F
175						
176	**Effluent Tank Discharge (OBG line number 23)**					
177	Total Suspended Solids, $TSS_{discharge}$	4.5	mg/L	17.03	mg/gallon	1.7045E-06 gallon/gallon
178	Total Flow Rate , $MAX_{discharge}$	4,514	gpm	6,500,000	gallons/day	
179	Flow Rate of Solids in Discharge, $q_{TSS-dis}$	0.008	gpm	11	gallons/day	
180	Flow Rate of Water in Discharge, q_{w-dis}	4513.9	gpm	6,499,989	gallons/day	
181	Weight of Dry Solids in Discharge, $W_{TSS-dis}$	0.08	kg/min	10.2	lbs/hr	244.1 lbs/day
182						

183 **Mass Balance Tables**

184 **RA-A/B/E/F**

185 **Primary Screens, Secondary Screens, Hydrocyclones, Polymer Injection, and Coagulant Injection**

186		Incremental					Accumulative					
187		Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	**Notes**
188	Dredge Slurry	5000	4798	201.9	4449.1	1	5,000	4,798	202	4449.1		
189	Booster Pumps Seal Water	250	250	0	0.0	2	5,250	5,048	202	4449.1	3	
190	Primary Screen Wash Water from SCA Sump	102	102	0	0.0	4	5,352	5,150	202	4449.1		Vendor's estimate.
191	Over-Sized Removed from Primary Screen	(5.4)	(2.1)	(3.2)	(71.2)	5	5,347	5,148	199	4377.9	6	
192	Sand Separation Feed Pumps Seal Water	30	30	0	0.0	7	5,377	5,178	199	4377.9	8	
193	Secondary Screen and Hydrocyclone Screen Wash Water from SCA Sump	510	510	0	0.0	9						
194	Gravel Removed from Secondary Screen	(48)	(19)	(29)	(640.7)	10	5,838	5,669	170	3737.2		
195	Sand Removed from Hydrocyclone	(137)	(55)	(83)	(1824.1)	11	5,701	5,614	87	1913.1	12	
196	Geotextile Tube Feed Pump Seal Water	15	15	0	0.0	13	5,716	5,629	87	1913.1	14	
197	Clarifier Underflow and Filter Backwash from SCA WTP	1066	1065	0.9	19.3	15	6,782	6,694	88	1932.4		
198	Filtrate from Screened Material Stockpile	30.4	30.4	0.002	0.0	16						
199	Coagulant Emulsion and Makeup Water from SCA WTP	66.75	66.11	0.64	5.5	17						
200	Polymer and Makeup Water from SCA WTP	92.3	92.0	0.3	1.5	18	6,971	6,883	89	1939.5	19	
201	Geotextile Tube Retention	(320.6)	(232.4)	(88.2)	(1929.7)	20						
202	Average Precipitation	141	141	0.00	0.0	21	6,792	6,792	0.4	9.8	22	
203	Primary, Secondary and Hydrocyclone Screen Wash Water	(612)	(612)	0	0.0	23	6180.1	6179.7	0.4	9.8		
204	Net Flow to Stormwater Basins	(442.7)	(442.6)	(0.03)	(0.641)	24	5737.5	5737.1	0.4	9.2	25	Maximum Flow from EQ Basin to WTP
205	Clarifier Underflow and Filter Backwash	(1066)	(1065)	(0.9)	(19.3)		5,738	5,737	0.9			
206	Coagulant and Polymer Makeup Water	(158)	(158)	0			4,672	4,672	0.008			Flow from WTP
207	**Net Flow to Holding Basin (Downstream Storage)**	**0**	**0**	**0**								
208	Maximum Discharge to Metro						4,514	4,514	0.008			Maximum Discharge to Metro (6.5 MGD)

PARSONS

Project Number: 444853 Calc.No. from index: 3 Preparer: XDH Date:2/17/2010 Rev. No.:2 Preparer: Date:

Project Name:Sediment Management Design Calculation Title: Mass Balance Reviewer:MTO Date:2/18/2010 Review: Date:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
6	**Incoming Slurry**						**Notes**							
7	Slurry Flow Rate, q	3,500	gpm				Maximum flow							
8	Working Hours, t	24	hr/day											
9	Daily Slurry Volume, q_T	5,040,000	gallons/day	673,750	ft^3/day									
10	Solids Content by Weight of Incoming Slurry, P_s	10%												
11	Specific Gravity of Solids, G_s	2.64					Tab "Weight&Volume"							
12	Unit Weight of Water, γ_w	62.4279606	pcf											
13	Slurry Water Content, WC	900%												
14	Water Flow Rate, q_w	3359	gpm											
15	Dry Solids Flow Rate, q_s	141	gpm											
16	Daily Water Volume, q_w	4,836,446	gallons/day	646,539	ft^3/day									
17	Daily Water Weight, W_w	40,362,099	lbs/day											
18	Daily Dry Solids Volume, q_s	203,554	gallons/day	27,211	ft^3/day									
19	Daily Dry Solids Weight, W_s	4,484,678	lbs/day											
20	Slurry Concentration, C_{s1}	0.89	lbs/gallon	6.7	lb/ft^3									
21	% Water in Slurry (by Volume)	96%												
22														
23														
24	**Booster Pump Seal Water**													
25	Booster Pump Seal Water (each), $q_{booster}$	35	gpm											
26	Number of Booster Pumps, $N_{booster}$	5												
27	Daily Volume of Booster Pump Seal Water	252,000	gallons/day	33,688	ft^3/day									
28	Daily Weight of Booster Seal Water	2,103,042	lbs/day											
29														
30	**Primary Screens (Over-Sized Grain Removal, >2-inch)**													
31	Average Percentage of Over-Sized Particles, $P_{over-sized}$	1.6%					Tab "Weight&Volume"							
32	Daily Dry Weight of Removed Over-Sized Particle, $W_{over-sized}$	71,755	lbs/day											
33	Daily Volume of Removed Over-Sized Particle, $q_{over-sized}$	3,257	gallons/day	435	ft^3/day									
34	Initial Water Content of Removed Over-Sized Particles in Stockpile, WC_{istock}	25%												
35	Daily Weight f Water Removed with Over-Sized Particles, $W_{w-over-sized}$	17,939	lbs/day											
36	Daily Volume of Water Removed with Over-Sized Particles, $q_{w-over-sized}$	2,150	gallons/day	287	ft^3/day									
37	Remaining Daily Dry Solids Weight in Slurry, W_{sr1}	4,412,923	lbs/day											
38	Remaining Daily Water Weight Slurry, W_{wr1}	40,344,160	lbs/day											
39	Remaining Daily Solids Volume Slurry, q_{sr1}	200,297	gallons/day	26,776	ft^3/day									
40	Remaining Daily Water Volume Slurry, q_{wr1}	4,834,296	gallons/day	646,251	ft^3/day									
41														
42	**Hydrocyclone Feed Pump Seal Water**													
43	Hydrocyclone Feed Pump Seal Water (each), $q_{cyclone-pump}$	10.5	gpm											
44	Number of Hydrocyclone Feed Pumps, $N_{cyclone-pump}$	2												
45	Daily Volume of Booster Pump Seal Water	30,240	gallons/day	4,043	ft^3/day									
46	Daily Weight of Booster Seal Water	252,365	lbs/day											
47														
48	**Secondary Screens (Gravel Removal for RA-A/B/E/F)**						Tab "Weight&Volume"							
49	Average Percentage of Gravel in RA-A/B/E/F, P_{gravel}	14.4%												
50	Daily Dry Weight of Removed Gravel, W_{gravel}	645,794	lbs/day											
51	Daily Volume of Removed Gravel, q_{gravel}	29,312	gallons/day	3,918	ft^3/day									
52	Initial Water Content of Removed Gravel in Stockpile, WC_{gravel}	25%												
53	**Daily Weight of Water Removed with Gravel, $W_{w-gravel}$**	**161,448**	**lbs/day**											
54	Daily Volume of Water Removed with Gravel, $q_{w-gravel}$	19,346	gallons/day	2,586	ft^3/day									
55	Remaining Daily Dry Solids Weight in Slurry, W_{sr2}	3,767,129	lbs/day											
56	Remaining Daily Water Weight in Slurry, W_{wr2}	40,182,712	lbs/day											
57	Remaining Daily Dry Solids Volume in Slurry, q_{sr2}	170,985	gallons/day	22,857	ft^3/day									
58	Remaining Daily Water Volume in Slurry, q_{wr2}	4,814,951	gallons/day	643,665	ft^3/day									
59														
60	**Hydrocyclone (Sand Removal for RA-A/B/E/F)**						Tab "Weight&Volume"							
61	Average Percentage of Sand in RA-A/B/E/F, P_{sand}	41%												
62	Daily Dry Weight of Removed Sand, W_{sand}	1,838,718	lbs/day											
63	Daily Volume of Removed Sand, q_{sand}	83,457	gallons/day	11,157	ft^3/day									
64	Initial Water Content of Removed Sand in Stockpile, WC_{sand}	25%												
65	Daily Weight of Water Removed with Sand, W_{w-sand}	459,679	lbs/day											
66	Daily Water Removed with Sand Volume, q_{w-sand}	55,082	gallons/day	7,363	ft^3/day									
67	Remaining Daily Dry Solids Weight in Slurry, W_{sr3}	1,928,411	lbs/day											
68	Remaining Daily Water Weight in Slurry, W_{wr3}	39,723,032	lbs/day											
69	Remaining Daily Dry Solids Volume in Slurry, q_{sr3}	87,528	gallons/day	11,701	ft^3/day									
70	Remaining Daily Water Volume in Slurry, q_{wr3}	4,759,869	gallons/day	636,302	ft^3/day									
71														
72	**Geotextile Tube Feed Pump Seal Water**													
73	Geotextile Tube Feed Pump Seal Water (each), $q_{tube-pump}$	10.5	gpm											
74	Number of Geotextile Tube Feed Pumps, $N_{tube-pump}$	1												
75	Daily Volume of Tube Feed Pump Seal Water	15,120	gallons/day	2,021	ft^3/day									
76	Daily Weight of Tube Feed Pump Seal Water	126,183	lbs/day											
77														
78	**SCA WTP**						**Notes**							
79	I.P Clarifier Sludge (OBG line number 16)						OBG's estimate.							
80	Total Suspended Solids, $TSS_{clarifier}$	3017.9	mg/L	11424.0	mg/gallon	0.001	gallon/gallon							
81	Clarifier Sludge Flow Rate, $q_{clarifier}$	735	gpm											
82	Flow Rate of Solids in Clarifier Sludge, $q_{TSS-clarifier}$	0.84	gpm											
83	Flow Rate of Water in Clarifier Sludge, $q_{w-clarifier}$	734.2	gpm	734.2	gpm									
84	Weight of Dry Solids in Clarifier Sludge, $W_{TSS-clarifier}$	8.40	kg/min	1110.7	lbs/hr	26,656	lbs/day							
85	Spent MMF Backwash (OBG line number 21)													
86	Total Suspended Solids, TSS_{MMF}	483.3	mg/L	1829.5	mg/gallon	0.0002	gallon/gallon							
87	MMF Backwash Flow Rate, q_{MMF}	166.3	gpm											
88	Flow Rate of Solids in MMF Backwash, $q_{TSS-MMF}$	0.03	gpm											
89	Flow Rate of Water in MMF Backwash, q_{w-MMF}	166.3	gpm	166.3	gpm									
90	Weight of Dry Solids in MMF Backwash, $W_{TSS-MMF}$	0.30	kg/min	40.2	lbs/hr	966	lbs/day							
91	Spent GAC Backwash (OBG line number 22)													
92	Total Suspended Solids, TSS_{GAC}	95.8	mg/L	362.6	mg/gallon	0.00004	gallon/gallon							
93	GAC Backwash Flow Rate, q_{GAC}	164.6	gpm											
94	Flow Rate of Solids in GAC Backwash, $q_{TSS-GAC}$	0.006	gpm											
95	Flow Rate of Water in GAC Backwash, q_{w-GAC}	164.6	gpm	164.6	gpm									
96	Weight of Dry Solids in GAC Backwash, $W_{TSS-GAC}$	0.06	kg/min	7.9	lbs/hr	189	lbs/day							
97	**SCA WTP Total**													
98	Total Flow Rate, q_{WTP}	1065.9	gpm	1,534,896	gallons/day	205,186	ft^3/day							
99	Solid Flow Rate, $q_{WTP-TSS}$	0.88	gpm	1,262	gallons/day	169	ft^3/day							
100	Water Flow Rate, q_{w-WTP}	1065.0	gpm	1,533,634	gallons/day	205,017	ft^3/day							
101	Water Weight, W_{w-WTP}	12,798,794	lbs/day											
102	Solids Weight, $W_{WTP-TSS}$	27812	lbs/day											
103														
104	**Water from Removed Material (Over-sized, Gravel, and Sand) Stockpile**													
105	Typical Solids Content of Sand from Hydrocyclone Shaker (TotalClean) (75-85%)	80%					DelTank TCW-3000							
106	Sand Water Content	25%												
107	Assumed Initial Water Content of Screened Material Stockpile, WC_{istock}	25%												
108	Assumed Final Water Content of Screened Material Stockpile, WC_{fstock}	15%												
109														
110	Weight of Water Removed from Stockpile (Water Content from 25% to 15%), $W_{w-stock}$	255,627	lbs/day											
111	Volume of Water Removed from Stockpile (Water Content from 25% to 15%), $q_{w-stock}$	30,631	gallons/day	4,095	ft^3									
112	Weight of Water Remained in Stockpile, $W_{wf-stock}$	10,763	lbs/day											
113	Volume of Water Remained in Stockpile, $q_{wf-stock}$	1,290	gallons/day	172	ft^3									
114														
115	**Total Suspended Solids in Stockpile Filtrate**													
116	Total Suspended Solids, $TSS_{stock-filtrate}$	195.2	mg/L	738.9	mg/gallon	0.0001	gallon/gallon							
117	Total Stockpile Filtrate Flow Rate, $q_{stock-filtrate}$	21.3	gpm	30,633	gallons/day									
118	Flow Rate of Solids in Stockpile Filtrate, $q_{s-stock-filtrate}$	0.002	gpm	2	gallons/day	0	ft^3/day							
119	Flow Rate of Water in Stockpile Filtrate, $q_{w-stock-filtrate}$	21.3	gpm	30,631	gallons/day	4,095	ft^3/day							
120	Weight of Dry Solids in Stockpile Filtrate, $W_{TSS-stock-filtrate}$	0.02	kg/min	50	lbs/day									
121	Weight of Water in Stockpile Filtrate, $W_{w-stock-filtrate}$	255,627	lbs/day											
122														
123	**Polymer and Makeup Water**													
124	Percent Fines in Slurry Solids, P_{fine}	43%												
125	Fine Solids Weight (Fines in Slurry, SCA WTP TSS, Stockpile Filtrate TSS)	1956273.11	lbs/day											
126	Polymer Dosage Rate (lbs of dry polymer per dry ton of solids), $DOS_{polymer}$	1.59	lbs/ton				Based on P-GDT draft report.							
127	Dry Polymer Density, $DEN_{polymer}$	0.70	g/cm^3				Ashland 2520 MSDS							
128	Daily Dry Polymer Needed, $W_{drypolymer}$	1.080	lbs/min	1555.24	lbs/day									
129	Dry Polymer Volume, $q_{drypolymer}$	0.1849	gpm	266	gallons/day	36	ft^3/day							
130	Polymer Makeup Water Volume, $q_{makeupwater}$	64.71	gpm	93,179	gallons/day	12,456	ft^3/day							
131	Polymer Makeup water Weight, $W_{makeupwater}$	777,619	lbs/day											
132														
133	**Coagulant (Emulsion) for RA-A/B/E/F**													
134	Coagulant Dosage Rate (lbs of emulsion per dry ton of solids), DOS_{coag}	5.71	lbs/ton				Based on P-GDT draft report.							
135	Coagulant Emulsion Density, DEN_{coag}	1.03	g/cm^3	64.300799	pcf		Based on Ashland 492 MSDS							
136	Coagulant Emulsion Flow Rate, q_{Coag}	0.45	gpm	650	gallons/day	87	ft^3/day							
137	Coagulant Emulsion Weight, W_{Coag}	3.9	lbs/min	5,585	lbs/day									
138	Weight of Coagulant Makeup Water, $W_{coagwater}$	387.9	lbs/min	558,516	lbs/day									
139	Volume of Coagulant Makeup Water, $q_{coagwater}$	46.5	gpm	66925	gallons/day									
140														
141														
142	**RA-A/B/E/F Primary Screens, Secondary Screens, Hydrocyclones, Polymer Injection, and Coagulant Injection**						**Notes**							
143	**Initial Dewatering in Geotextile Tubes (i.e., the first 24 hrs in the tubes)**													
144	Solids Content by Weight after Initial Dewatering in Tubes, P_{s2}	38%					Based on P-GDT draft report.							
145	Daily Weight of Dry Solids Retained in Tubes, W_{s-ret2}	1,963,414	lbs/day											
146	Daily Volume of Solids Retained in Tubes,q_{s-ret2}	89,709	gallons/day	11,992	ft^3/day									
147	Daily Weight of Water Retained in Tubes after Initial Dewatering, W_{ret2}	3,203,464	lbs/day											
148	Daily Volume of Water Retained in Tubes after Initial Dewatering, q_{ret2}	383,860	gallons/day	51314.57292	ft^3/day									
149	Daily Weight of Water in Initial Filtrate Weight, W_{if}	53,391,713	lbs/day											
150	Daily Volume of Water in Initial Filtrate, q_{if}	6,397,738	gallons/day	855253.1977	ft^3/day									
151	**Consolidation Dewatering**													
152	Solids Content by Weight after Consolidation Dewatering, P_{s3}	50%					Assumed value							
153	**Peak Daily Weight of Retained Water in Tubes after Consolidation Dewatering, W_{ret3}**	**1,963,414**	**lbs/day**											
154	Peak Daily Volume of Retained Water in Tubes after Consolidation Dewatering, q_{ret3}	235,269	gallons/day	31,451	ft^3/day									
155	Peak Daily Weight of Water in Consolidation Dewatering Filtrate, W_{cf}	1,240,051	lbs/day											
156	Peak Daily Volume of Water in Consolidation Dewatering Filtrate, q_{cf}	148,591	gallons/day	19,864	ft^3/day									
157	Consolidation Dewatering Duration, t_c	60	days											
158	Average Water Volume from Consolidation Dewatering of One Day Filling, q_{def}	2,477	gallons/day	331	ft^3/day									
159														
160	Peak Volume of Water in Geotextile Tube Filtrate, $q_{tube-filtrate}$	6,546,329	gallons/day	875,117	ft^3/day									
161	Daily Water Retained in Geotube, $q_{w-retained}$	235,269	gallons/day	31,451	ft^3/day									
162														
163														
164														
165	**Total Suspended Solids in Geotextile Tube Filtrate**						**Notes**							
166	Total Suspended Solids, $TSS_{tube-filtrate}$	195.2	mg/L	738.9	mg/gallon	0.0001	gallon/gallon							
167	Total Geotextile Tube Filtrate Flow Rate, $q_{tube-filtrate}$	4546.4	gpm	6,546,813	gallons/day		OBG's estimate.							
168	Flow Rate of Solids in Geotextile Tube Filtrate, $q_{s-tube-filtrate}$	0.336	gpm	484	gallons/day									
169	Flow Rate of Water in Geotextile Tube Filtrate, $q_{w-tube-filtrate}$	4546.1	gpm	6,546,329	gallons/day									
170	Weight of Dry Solids in Geotextile Tube Filtrate, $W_{TSS-tube-filtrate}$	3.36	kg/min	10,665	lbs/day									
171														
172	**Precipitation**													
173	Daily Precipitation, PRE_{daily} (inch)	Open Area, A_{SCA} (acres)	Flow Rate, q_{PRE} (gpd)	Flow Rate, q_{PRE} (gpm)										
174	0.15	50	203,657	141.4			On-site met data.							
175														
176	**Effluent Tank Discharge (OBG line number 23)**													
177	Total Suspended Solids, $TSS_{discharge}$	4.5	mg/L	17.03	mg/gallon	1.7045E-06	gallon/gallon							
178	Total Flow Rate , $MAX_{discharge}$	3,511	gpm	5,055,470	gallons/day		OBG's estimate.							
179	Flow Rate of Solids in Discharge, $q_{TSS-dis}$	0.006	gpm	9	gallons/day									
180	Flow Rate of Water in Discharge, q_{w-dis}	3510.7	gpm	5,055,461	gallons/day									
181	Weight of Dry Solids in Discharge, $W_{TSS-dis}$	0.06	kg/min	7.9	lbs/hr	189.9	lbs/day							
182														

Mass Balance Tables

RA-A/B/E/F

Primary Screens, Secondary Screens, Hydrocyclones, Polymer Injection, and Coagulant Injection

186		Incremental					Accumulative					Notes
187		Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	
188	Dredge Slurry	3500	3359	141.4	3114.4	1	3,500	3,359	141	3114.4		
189	Booster Pumps Seal Water	175	175	0	0.0	2	3,675	3,534	141	3114.4	3	
190	Primary Screen Wash Water from SCA Sump	71	71	0	0.0	4	3,746	3,605	141	3114.4		Vendor's estimate.
191	Over-Sized Removed from Primary Screen	(3.8)	(1.5)	(2.3)	(49.8)	5	3,743	3,604	139	3064.5	6	
192	Sand Separation Feed Pumps Seal Water	21	21	0	0.0	7	3,764	3,625	139	3064.5	8	
193	Secondary Screen and Hydrocyclone Screen Wash Water from SCA Sump	357	357	0	0.0	9						
194	Gravel Removed from Secondary Screen	(34)	(13)	(20)	(448.5)	10	4,087	3,968	119	2616.1		
195	Sand Removed from Hydrocyclone	(96)	(38)	(58)	(1276.9)	11	3,991	3,930	61	1339.2	12	
196	Geotextile Tube Feed Pump Seal Water	11	11	0	0.0	13	4,001	3,940	61	1339.2	14	
197	Clarifier Underflow and Filter Backwash from SCA WTP	1066	1065	0.9	19.3	15	5,067	5,005	62	1358.5		
198	Filtrate from Screened Material Stockpile	21.3	21.3	0.002	0.0	16						
199	Coagulant Emulsion and Makeup Water from SCA WTP	46.93	46.48	0.45	3.9	17						
200	Polymer and Makeup Water from SCA WTP	64.9	64.7	0.2	1.1	18	5,200	5,138	62	1363.5	19	
201	Geotextile Tube Retention	(225.3)	(163.4)	(62.0)	(1356.1)	20						
202	Average Precipitation	141	141	0.00	0.0	21	5,116	5,116	0	7.4	22	
203	Primary, Secondary and Hydrocyclone Screen Wash Water	(428)	(428)	0	0.0	23	4687.8	4687.5	0.3	7.4		
204	Net Flow to Stormwater Basins	0.0	0.0	0.00	0.000	24	4687.8	4687.5	0.3	7.4	25	Maximum Flow from EQ Basin to WTP
205	Clarifier Underflow and Filter Backwash	(1066)	(1065)	(0.9)	(19.3)							
206	Coagulant and Polymer Makeup Water	(111)	(111)	0								Flow from WTP
207	**Net Flow to Holding Basin (Downstream Storage)**	**0**	**0**	**0**								
208	Maximum Discharge to Metro						3,511	3,511	0.006			Maximum Discharge to Metro (6.5 MGD)

PARSONS

Project Number: 444853	Calc.No. from index: 3	Preparer: XDH	Date:2/17/2010	Rev. No.:2	Preparer: Date:
Project Name:Sediment Management Design	Calculation Title: Mass Balance	Reviewer:MTO	Date:2/18/2010	Review:	Date:

	Average sediment properties in dredge zone							Calculated properties							
										2.2M cy Dredging Volume (Base+Contingency)			2M cy Dredging Volume (Base)		
Remediation Area	Average Water Content	Average Specific Gravity	Pore Water Density	Average Percent Gravel-Sized	Average Percent Sand-Sized	Average Percent Silt-Sized	Average Percent Clay-Sized	Solids by Weight	Dry Density	Dredge Volume	Total Dredge Dry Weight	Dry Solids Volume	Dredge Volume	Total Dredge Dry Weight	Dry Solids Volume
	(%)		(pcf)	(%)	(%)	(%)	(%)	(%)	(pcf)	(cy)	(tons)	(cy)	(cy)	(tons)	(cy)
A	80.7	2.68	62.4	3.4%	35.9%	51.5%	9.3%	55.3%	52.9	171,000	122,063	54,067	133,000	94,938	42,052
B	68.4	2.80	62.4	10.8%	37.3%	42.3%	9.6%	59.4%	59.9	25,000	20,228	8,576	20,000	16,182	6,861
C	68.4	2.80	62.4	10.8%	37.3%	42.3%	9.6%	59.4%	59.9	49,000	39,646	16,808	38,000	30,746	13,035
D	148.5	2.54	62.4	1.4%	14.4%	64.1%	20.1%	40.2%	33.2	1,204,000	539,814	252,389	1,147,000	514,258	240,440
E	61.3	2.63	62.4	18.8%	42.0%	30.8%	8.4%	62.0%	62.8	723,000	613,208	276,779	588,000	498,708	225,098
TOTAL										2,172,000	1,334,958	608,619	1,926,000	1,154,832	527,486

2.2M cy Dredging Volume (Base+Contingency)

Remediation Area	Total Dry Weight	Over-Sized Grain	Gravel-Sized Grain (including Over-Sized)	Sand-Sized Grain	Fines	Percent Over-Sized	Percent Gravel (including Over-sized)	Percent Sand	Percent Fines	Weighted Average Specific Gravity
	(tons)	(tons)	(tons)	(tons)	(tons)	(%)	(%)	(%)	(%)	
A	122,063	415	4,150	43,821	74,214	0.34%	3.4%	35.9%	60.8%	
B	20,228	218	2,185	7,545	10,498	1.08%	10.8%	37.3%	51.9%	
C	39,646	428	4,282	14,788	20,576	1.08%	10.8%	37.3%	51.9%	
D	539,814	756	7,557	77,733	454,523	0.14%	1.4%	14.4%	84.2%	
E	613,208	11,528	115,283	257,547	240,377	1.88%	18.8%	42.0%	39.2%	
C/D	579,460	1,184	11,839	92,521	475,100	0.20%	2.0%	16.0%	82.0%	2.56
A/B/E	755,498	12,162	121,618	308,913	325,090	1.61%	16.1%	40.9%	43.0%	2.64

2M cy Dredging Volume (Base)

Remediation Area	Total Dry Weight	Over-Sized Grain	Gravel-Sized Grain (including Over-Sized)	Sand-Sized Grain	Fines	Percent Over-Sized	Percent Gravel (including Over-sized)	Percent Sand	Percent Fines	Weighted Average Specific Gravity
	(tons)	(tons)	(tons)	(tons)	(tons)	(%)	(%)	(%)	(%)	
A	94,938	323	3,228	34,083	57,722	0.34%	3.4%	35.9%	60.8%	
B	16,182	175	1,748	6,036	8,399	1.08%	10.8%	37.3%	51.9%	
C	30,746	332	3,321	11,468	15,957	1.08%	10.8%	37.3%	51.9%	
D	514,258	720	7,200	74,053	433,005	0.14%	1.4%	14.4%	84.2%	
E	498,708	9,376	93,757	209,458	195,494	1.88%	18.8%	42.0%	39.2%	
C/D	545,004	1,052	10,520	85,521	448,962	0.19%	1.9%	15.7%	82.4%	2.55
A/B/E	609,828	9,873	98,733	249,576	261,614	1.62%	16.2%	40.9%	42.9%	2.64