GEOTECHNICAL PRE-DESIGN INVESTIGATION WORK PLAN BUFFALO COLOR AREA A

BUFFALO, NEW YORK

Prepared for:

SOUTH BUFFALO DEVELOPMENT LLC

Buffalo, New York

Prepared by:

MACTEC Engineering and Consulting, Inc.

Portland, Maine

October 2009

MACTEC Project No. 3410090701

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Mark Stelmack, P.E.
Principal Engineer

Lyle Tracy
Principal Engineer

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LIST OF ACRONYMS AND ABBREVIATIONS

AAR	Alternative Analysis Report
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
bgs	below the ground surface
CB	cement-bentonite slurry wall
FS	Feasibility Study
GPR	ground penetrating radar
HSA	hollow stem augers
ID	inside diameter
IDW	investigation derived waste
Honeywell	Honeywell International Inc.
HSA	Hollow Stem Auger
MACTEC	MACTEC Engineering and Consulting, Inc.
PDI	Pre-design Investigation
SB	soil-bentonite slurry wall
SPT	Standard Penetration Test
Site	former Buffalo Color Area ABCE facility

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1.0 INTRODUCTION

On behalf of South Buffalo Development LLC (SBD), MACTEC Engineering and Consulting, Inc. (MACTEC) has prepared this Work Plan for geotechnical pre-design work at the former Buffalo Color Area ABCE facility (Site) in Buffalo, New York (Figure 1). MACTEC previously prepared an Alternatives Analysis Report (AAR) that presented and recommended remedial action alternatives for the Site (MACTEC, February 2009). The recommended remedial activities described in the AAR include the installation of a hydraulic barrier wall at Area A. The barrier wall is proposed to run from the along South Park Avenue to the Buffalo River, then extend along the river (southeast side of the Site), and extend along the southwest border of the site along an abandoned rail line. Figure 2 shows the locations of the proposed geotechnical borings spaced along the conceptual alignment of the barrier wall, as proposed in the AAR. The barrier wall would be keyed into a glaciolacustrine clay stratum to prevent the offsite flow of groundwater toward the Buffalo River. The barrier wall would have an added benefit of preventing the extraction of river water by the existing groundwater extraction wells, thus reducing the volume of water extracted and treated on-site.

Three options for the barrier wall were discussed in the FS. The options include a grouted steel sheet pile wall, a cement-bentonite (CB) slurry wall, and a soil-bentonite (SB) slurry wall. This pre-design investigation (PDI) work plan was developed to gather data and site information that will be used to select the barrier wall type and design the wall. As part of the pre-design investigation, site soil and groundwater samples will be collected for compatibility testing with potential slurry wall materials. The purpose of the compatibility testing is to ensure that the hydraulic containment characteristics of the wall will not be adversely affected by the site soil and/or groundwater chemistry over time.

2.0 SCOPE OF WORK

The objective of the pre-design investigation is to gather data for the design and construction of a hydraulic barrier wall. The hydraulic barrier wall will be keyed into a glaciolacustrine clay stratum that is present across the Site and acts as a horizontal hydraulic barrier preventing the downward flow of contaminated groundwater. The scope of the geotechnical investigation includes drilling 17 geotechnical borings along the proposed alignment of the barrier wall. Shallow tests pits will be excavated along the proposed wall alignment and a limited geophysical investigation will be conducted to determine the location and extent of foundations and other obstructions along the wall alignment. Soil and groundwater samples, along with samples of potential barrier wall construction materials, will be collected and tested to determine long-term compatibility between the completed wall and the surrounding groundwater. An existing river water in-take structure that appears to cross the wall alignment will be evaluated via review of available record drawings and, if necessary, an underwater investigation will be conducted by a diver to gather information on the extent of that structure. If necessary based on the outcome of the drawing review and diver investigation, coring of the in-take structure's concrete side walls will also be conducted to determine depth and condition of the walls. The pre-design investigation will also include a soil borrow search to locate local sources for borrow that could be used for construction of an SB wall.

The objectives of the pre-design investigation are to:

- evaluate the subsurface conditions including subsurface utilities, foundations, and other obstructions along the proposed alignment of the hydraulic barrier wall
- confirm presence, depth, and characteristics of the confining clay layer to establish the elevation of the bottom of the barrier wall
- gather information on the details and extent of the intake structure
- perform test pits and geophysical investigation to determine the extent and locations of foundations
- retrieve soil samples for geotechnical laboratory testing
- investigate and collect local borrow source material that may be utilized in construction of the barrier wall (for SB backfill, and possibly the CB backfill)
- perform compatibility testing with the proposed SB or CB backfills and site groundwater

The following subsections describe the major activities of the pre-design investigation.

2.1 GEOTECHNICAL INVESTIGATION

2.1.1 Geotechnical Drilling

A truck or track mounted drill rig will advance geotechnical borings using rotary drilling techniques using 4.25-inch inside diameter (ID) hollow stem augers (HSA). A total of 17 geotechnical soil borings (SB-A1 through SB-A17), spaced approximately 120 feet apart, will be advanced along the proposed alignment of the barrier wall (see Figure 2). The odd numbered borings will be advanced at least 10 feet into the glaciolacustrine clay stratum, while the even numbered borings will be advanced at least 5 feet into the clay. Borings may be extended deeper at any location if sand seams are present within the clay stratum samples to identify the depth necessary to provide containment at the base of the wall. Borings will be extended a minimum of 3 feet below the deepest sand seam. The MACTEC geologist or geotechnical engineer overseeing the drilling activities will determine the depth to terminate each boring. Based on existing data, the top of the clay stratum at Area A varies from approximately 20 feet below ground surface (bgs) to 33 feet bgs, with the clay becoming shallower near the northern edge of the site.

Borings may be relocated in the field as necessary to avoid surface or subsurface utilities and other obstructions. The actual boring locations will be shown on a figure provided in the PDI report.

The purpose of the geotechnical borings will be to collect soil samples, determine the stratigraphy at each location, and determine depth to the glaciolacustrine clay stratum. Standard Penetration Test (SPT) sampling will be conducted at 5-foot intervals above the clay stratum. SPTs will be conducted continuously within the clay stratum. At the discretion of the MACTEC field engineer, continuous sampling may be performed at select boring or depths. Within the clay unit, 3-inch diameter, undisturbed, thin-walled, Shelby tube sampling will also be conducted at selected intervals. Soil samples obtained from the SPT sampling will be retained in 16-ounce glass jars. Shelby tubes will be sealed with wax and stored on-site until they are transported to a geotechnical laboratory for analysis. The SPT sampling will be conducted in accordance with American Society for Testing and Materials (ASTM) D1586 and the Shelby tube sampling will be conducted in

accordance with ASTM D1587 and/or ASTM D6519 (piston sampler). Field vane shear testing, including an undrained strength test and a remolded strength test, will be conducted in accordance with ASTM D2573 within the clay stratum at selected borings. After each vane test is conducted, a sample of the material tested shall be collected via a 3-inch split spoon sampler and retained for index testing.

After completion of each boring, the drilling equipment (i.e. drilling rods, augers, split spoons, etc.) will be brought to a decontamination pad and power washed. Investigation derived waste (IDW) consisting of soil cuttings, used personal protective equipment, and used disposable sampling equipment will be containerized in 55-gallon drums. The drums will be stored in a containment area designated by SBD until proper disposal can be arranged. Drill cuttings will be managed in accordance with the current version of the Soil Fill Management Plan.

Final geotechnical boring locations and elevations will be surveyed by a New York state licensed surveyor. Data from the survey will be included in the exploration location plan as part of the PDI report.

2.1.2 Test Pits

It is anticipated that foundations, floor slabs, abandoned vaults and utilities may be encountered during the drilling investigations. Test pits will be excavated with a rubber-tired backhoe or small track-mounted excavator, and will be excavated to depths on the order of 10 feet bgs. A MACTEC geotechnical engineer or geologist will oversee and document the encountered conditions at each test pit with photographical and written logs. Grab soil samples may be collected within the test pits for geotechnical laboratory analysis. The test pits will be backfilled with soil removed during the excavation and compacted by tamping with the excavator bucket. Dewatering of the test pits is not anticipated. The test pit locations and elevations will be surveyed by a NY-licensed land surveyor and the locations will be shown on a figure provided in the PDI report.

2.1.3 Geophysical Investigation

MACTEC will complete ground-penetrating radar (GPR) surveying along the northeast, southeast and southeast borders of Area A along the transect of the proposed hydraulic barrier wall. The purpose of GPR profiling is to identify potential subsurface obstructions to the extent practical prior to or concurrent with the drilling and in advance of design and construction activities.

A Geophysical Survey Systems Subsurface Interface Radar Model 3000 (or equivalent) GPR unit equipped with 100 megahertz (mHz) and 400 mHz transducers will be used to collect subsurface data. The 100 mHz transducer will be used for deeper profiling (in excess of 10 feet) while the 400 mHz will be used for shallow imaging (less than 10 feet). Subsurface GPR anomalies interpreted to represent former building foundations or buried utilities will be marked in the field with pin flags or wooden stakes. Locations of subsurface anomalies will be established using a hand-held GPS unit. The GPS coordinates of subsurface anomalies will be imported onto site drawings.

Light brush cutting may be completed to properly conduct geophysical profiling. Findings from the survey, including maps showing the interpreted location of subsurface anomalies and their relation to proposed construction activities, will be included PDI report.

2.1.4 In-take Structure Investigation

A structure believed to be a water in-take structure for the former power plant has been observed that penetrates the existing concrete retaining wall along the Buffalo River. The structure, which was integrated into the retaining wall, is approximately 40 feet long along the river bank. This structure may be a former aqueduct and may contain a hidden intake bulkhead and intake pipes; water appears to flow perpendicular to the river below an exterior bulkhead through a 2-foot high (minimum) slot (observed above water level). The upstream and downstream ends of this intake/outlet (along the river bank) consist of 2 to 3-foot wide/thick concrete retaining walls that extend perpendicular to the river toward the former plant. The extent or termination point of this apparent intake is unknown, but appears to cross the proposed alignment of the barrier wall. The condition and extent of this intake structure will be investigated to determine its impact on the design of the barrier wall. MACTEC will attempt to locate and review drawings that reportedly exist in the Buffalo Color files retained by SBD for information on the construction of the intake

structure. If drawings with sufficient record information cannot be located, MACTEC will retain a certified commercial diver to investigate the intake structure, take measurements and video record the structure. In addition, three vertical concrete cores may be drilled through the structure's retaining walls to determine the depth and condition of the walls. The cores will be conducted using an NQ-sized (1-7/8-inch diameter), 5-foot long double-tube core barrel equipped with a diamond impregnated drill bit. Each core is estimated to be 25 feet in depth. Water used during the coring may be taken from the Buffalo River.

2.2 GEOTECHNICAL LABORATORY ANALYSIS

2.2.1 Testing of Encountered Soils

Soil samples collected during the pre-design investigation will be shipped to a qualified laboratory for geotechnical testing. Index tests will be conducted on selected soil samples, and include:

- Moisture content - ASTM D2216
- Grain size analysis (with and without hydrometer) - ASTM D422
- Atterberg limits - ASTM D4318

The intent of the index testing is to develop engineering properties for the site soils that will be in contact with, and potentially impact the design of, the barrier wall. In addition to index testing, permeability and laboratory vane shear testing will be conducted on cohesive material from the glaciolacustrine clay stratum collected via Shelby tubes. Permeability testing will be performed in general accordance with ASTM D5084 and will be used to verify that the clay stratum acts as a hydraulic barrier to vertical groundwater flow. Laboratory vane shear testing (ASTM D2573) will be conducted to supplement and validate data obtained from the field vane shear tests.

Table 2.1 presents a summary of the proposed geotechnical testing program, corresponding ASTM standards, and anticipated number of tests. However, the need for and frequency of testing will be determined by the project geotechnical engineer or geologist based on field conditions.

2.2.2 Testing of Potential Backfill Mixes

The pre-design studies will include assessment of potential hydraulic barrier wall backfill mixes. For budgeting purposes MACTEC has assumed this assessment will include performance of a two-phased laboratory testing program for a CB or SB slurry wall. Phase 1 will consist of laboratory index and permeability testing of SB and/or CB backfill materials for use with the slurry wall alternatives. The testing will establish potential SB and/or CB backfill mix designs. This testing would include preparation and index testing of bentonite slurry mixes, and preparation and testing of SB and/or CB backfill mixes using borrow soils/materials collected as discussed in Section 2.4.

Table 2.2 presents a summary of the proposed geotechnical barrier backfill testing program, corresponding ASTM or American Petroleum Institute (API) standards, and anticipated number of tests. The need for and frequency of testing will be determined by the project geotechnical engineer or geologist based on the actual field conditions and borrow materials recovered.

2.3 COMPATIBILITY TESTING

The pre-design studies will include assessment of potential hydraulic barrier wall materials. For budgeting purposes MACTEC has assumed this assessment will include performance of a two-phased laboratory testing program for a CB or SB slurry wall. As stated in Section 2.2.2, Phase 1 will consist of laboratory index and permeability testing of SB and/or CB backfill materials for use with the slurry wall alternatives. The testing will establish potential SB and/or CB backfill mix designs. Upon completion of the Phase 1 laboratory program, a Phase 2 laboratory program will be performed by a qualified laboratory to assess the long-term compatibility of the backfill with the contaminated site groundwater. This testing program will include laboratory permeability testing of selected backfill (SB or CB) specimens by permeating them with the site groundwater (up to three samples) to determine the affect of the groundwater chemistry on the permeability of the proposed barrier. In addition, one sample will be permeated with deionized water for control purposes. The testing will simulate the performance of the backfill over the intended design life of the barrier (to be established during design). Table 2.3 presents a summary of the Phase 2 laboratory testing program. The results of the compatibility testing will be used to confirm selection of the wall materials during the design phase.

2.4 BORROW SOURCE SEARCH

MACTEC will work with SBD to identify potential local soil and/or flyash (for CB) borrow sources to gather material for testing for the possible use as backfill material for the SB or CB walls. Borrow material will be collected in 5-gallon buckets and retained for geotechnical index testing (grain size analysis and Atterberg limits), backfill mixing, permeability testing, and compatibility testing.

2.5 HEALTH AND SAFETY

MACTEC personnel will perform work associated with the field activities in accordance with the approved MACTEC Site Health and Safety Plan. Work performed by subcontractors working at the Site will be completed in accordance with their respective companies' health and safety procedures and plans. MACTEC will conduct health and safety meetings with the subcontractors or field crews at the beginning of each day.

2.6 SCHEDULE

The anticipated investigation schedule is summarized below. Geotechnical drilling and test pit activities are anticipated to occur concurrently with oversight provided for each activity.

- Geotechnical soil borings – 14 days.
- Diver investigation (if necessary) - one day.
- Coring of intake concrete walls (if necessary) – two days.
- Test pitting - two days.
- Geotechnical laboratory testing – six weeks.
- Compatibility testing – 28 weeks.
- Prepare pre-design investigation report – four weeks after receipt of Phase 2 laboratory results (see Section 3.0).

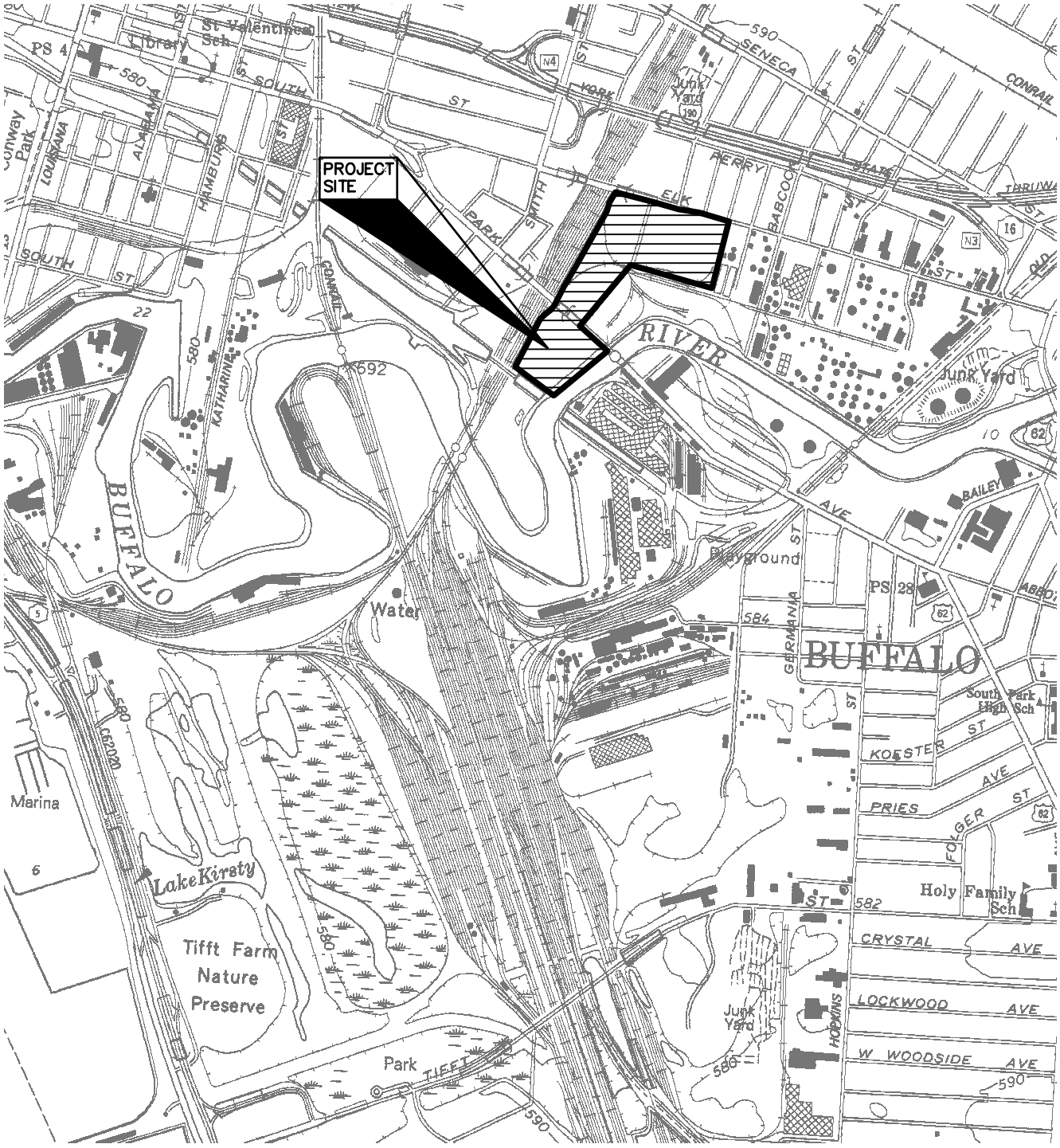
3.0 REPORTING

The pre-design investigation report will include the results of the Area A geotechnical investigation. The report will be assembled after the field investigation and laboratory analysis is complete. The report will consist of a description of the field work performed, soils encountered, geotechnical laboratory and compatibility testing results, and recommendations for the type of barrier wall (i.e. sheet pile, CB, SB, etc.), wall alignment, and construction technologies required to construct the wall.

4.0 REFERENCES

MACTEC Engineering and Consulting, February 2009, "Alternatives Analysis Report, Buffalo Color Corporation, Buffalo, New York".

FIGURES



NEW YORK

QUADRANGLE LOCATION

N

MAP SOURCE: USGS QUADRANGLE/NYS DOT – BUFFALO SE SCANNED 1990

0 250 500 1000

SCALE IN FEET

PROJECT SITE:
BUFFALO COLOR CORPORATION
100 LEE STREET, BUFFALO, NY

Prepared/Date: MRS 09/01/09
Checked/Date: RSE 09/01/09

Geotechnical Pre-design Investigation
Buffalo Color Corp. Area A
Buffalo, New York
Honeywell Site ID# 37745

MACTEC

SITE LOCATION MAP
Project 3410-09-0701
Figure 1

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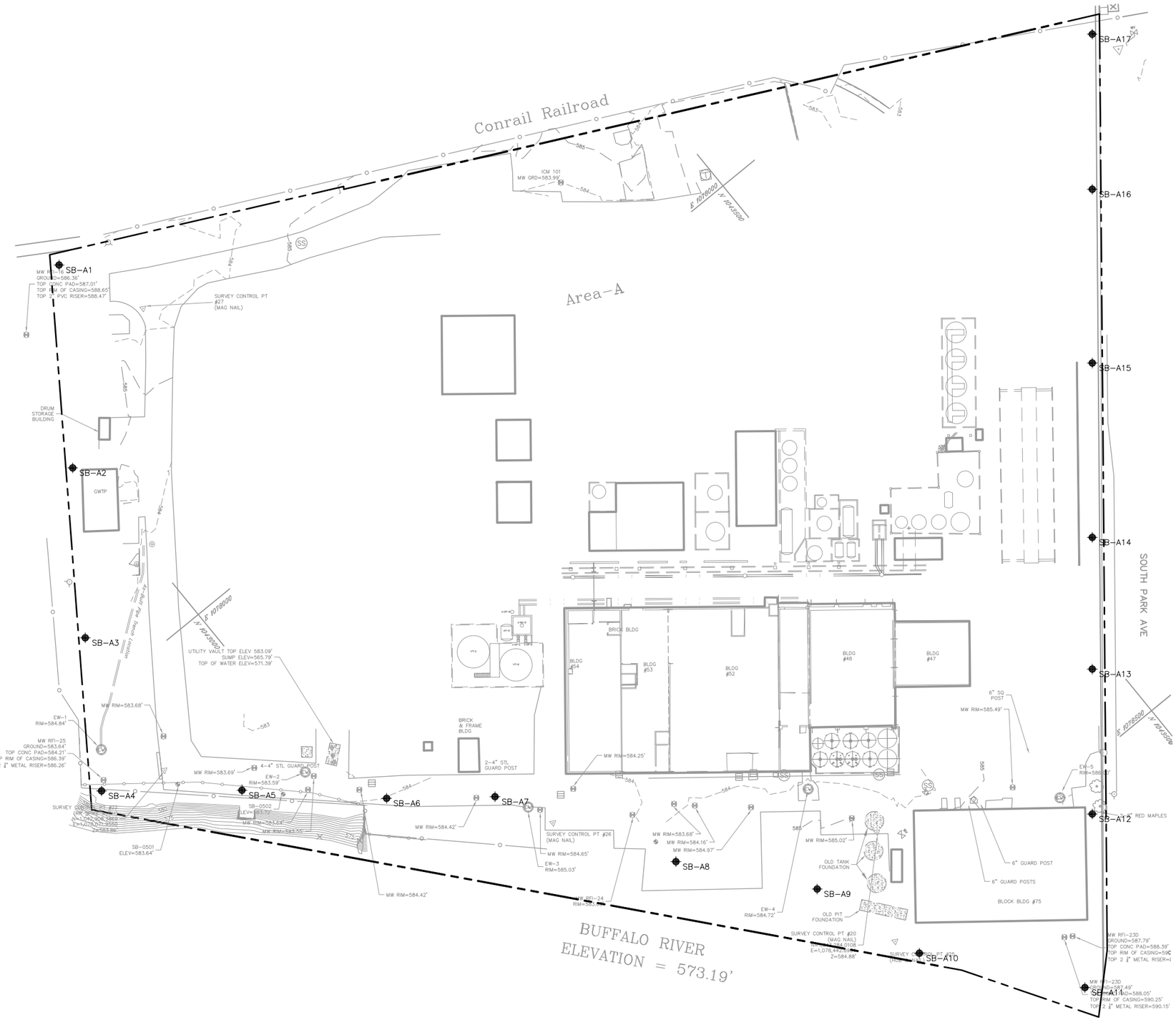

LEGEND

EW — EXISTING ICM GROUNDWATER EXTRACTION WELL

SB-A2 — APPROX LOCATION OF PRE-DESIGN SOIL BORING

0 20 40 80

SCALE IN FEET

Prepared/Date: MRS 08/31/09
Checked/Date: RSE 08/31/09

Geotechnical Pre-design Investigation
Buffalo Color Corp. Area A
Buffalo, New York
Honeywell Site ID# 37745

MACTEC

Proposed Boring Location Plan
Project 3410-09-0701
Figure 2

J:\Projects\CADD-PORT\Projects\HONEYWELL\BUFFALO COLOR\AREA A DRAWGPR - Figure 2.dwg Tue, 01 Sep 2009 - 1:32pm mrstacey

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MACTEC Engineering and Consulting, Inc.
P.O. Box 7050, 511 Congress Street
Portland, Maine 04112-7050
(207) 775-5401

TEST PIT LOCATION PLAN

GEOTECHNICAL PRE-DESIGN INVESTIGATION
FORMER BUFFALO COLOR CORP SITE
BUFFALO, NY

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
R. Egan	R. Holman		

DATE 12-04-09
PROJ 341009701
DWG C-102
SHEET 1 OF 1

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DURING REMOVAL OF STORM DRAIN (SD) TO ALLOW INSTALLATION OF GROUND WATER EXTRACTION PIPING (GW), EXCAVATE UP TO 12' DEPTH AT LOCATION SHOWN TO INVESTIGATE PRESENCE OF INTAKE PIPES BELOW THE STORM DRAIN LINE IN THE PRESENCE OF MACTEC'S ENGINEER.

SCALE IN FEET
0 15 30 60

NO.	DATE	DSGN	DR	CHK	APVD	BY	APVD
		R. Egan	R. Holman				

REVISION

GEOTECHNICAL PRE-DESIGN
INVESTIGATION
FORMER BUFFALO COLOR CORP SITE
BUFFALO, NY

MACTEC Engineering and Consulting, Inc.
P.O. Box 7050, 511 Congress Street
Portland, Maine 04112-7050
(207) 775-5401

MACTEC

INTAKE INVESTIGATION
TEST PIT PLAN

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	02-02-10
PROJ	3410090701
DWG	
SHEET	OF 1

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1" HDPE GW

10" WATER PIPE GOES INTO GROUND

PIPE RACK COLUMN

BRICK & FRAME BLDG

18" LW 10"W OH

18" LW RISER

PIPE RACK COLUMNS

1" HDPE GW

UG ELEC

UNDERGROUND VAULT

10"

6"

6"

12"

18" VT

5+00

4+00

3+00

584

ASPHALT PAVEMENT

INV EL 572.3

15"

TEST PIT

GROUND WATER EXTRACTION PIPING (GW)

4"

4"

BLDG #46

INTAKE STRUCTURE #45

EW-3

RIM=585.03'

BLDG #44

BLDG #43

ASPHALT PAVEMENT

EW

RIM=584.

DURING REMOVAL OF STORM DRAIN (SD) TO ALLOW INSTALLATION OF GROUND WATER EXTRACTION PIPING (GW), EXCAVATE UP TO 12' DEPTH AT LOCATION SHOWN TO INVESTIGATE PRESENCE OF INTAKE PIPES BELOW THE STORM DRAIN LINE IN THE PRESENCE OF MACTEC'S ENGINEER.

EDGE OF RETAINING WALL

BUFFALO RIVER

0 5 10 20
SCALE IN FEET

NO.	DSGN	DATE	DR	CHK	REVISION	BY	APVD
			R. Egan	R. Holman			

GEOTECHNICAL PRE-DESIGN INVESTIGATION
FORMER BUFFALO COLOR CORP SITE
BUFFALO, NY

MACTEC Engineering and Consulting, Inc.
P.O. Box 7050, 511 Congress Street
Portland, Maine 04112-7050
(207) 775-5401

MACTEC

INTAKE INVESTIGATION
TEST PIT PLAN
EXPANDED VIEW

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	02-02-10
PROJ	3410090701
DWG	
SHEET	OF 1

TABLES

Table 2.1

Geotechnical Laboratory Testing of Encountered Soils

Area A Hydraulic Barrier Wall

Test	Method	Number of Tests
Grain Size Analysis	ASTM D422	22
Atterberg Limits	ASTM D4318	8
Moisture Content	ASTM D2216	40
Permeability Test	ASTM D5084	5
Laboratory Vane Shear	ASTM D2573	8

Table 2.2

Geotechnical Laboratory Testing of Potential Backfill Mixes

Area A Hydraulic Barrier Wall

Test	Method	Number of Tests
Bentonite Slurry Filter Press	API 13B	5
Bentonite Slurry Mud Balance	API 13B	5
Bentonite Slurry Marsh Funnel	API 13B	5
SB Backfill Component Soil Grain Size Analysis	ASTM D422	15
SB Backfill Grain Size Analysis	ASTM D422	5
SB Backfill and Component Soil Atterberg Limits	ASTM D4318	10
SB Backfill Moisture Content	ASTM D2216	25
SB Backfill Slump	ASTM C172	25
SB Backfill Permeability Test	ASTM D5084	10
CB Slurry Filter Press	API 13B	5
CB Slurry Mud Balance	API 13B	5
CB Slurry Flow Cone	ASTM C939	5
CB Slurry Unconfined Compressive Strength	ASTM D1633	10
CB Backfill Permeability Test	ASTM D5084	10

Table 2.3

Phase 2 Geotechnical Laboratory Testing of Potential Backfill Mixes

Area A Hydraulic Barrier Wall

Test	Method	Number of Tests
SB or CB Backfill Test with Contaminated Site Water	ASTM D5084	3
SB or CB Backfill Permeability Test with Deionized water	ASTM D5084	1