418096

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From: Robert Workman <rworkman@crbgeo.net>
Sent: Friday, May 18, 2018 4:18 PM
To: Crawford, Bruce
Cc: Trent, Janice; Emilee Payne
Subject: UIC Permit Application Woven Electronics - BLWM File 418096

Good Afternoon Mr. Crawford,

Attached is the electronic copy of the signed UIC Permit application that was sent in today's mail for the Woven Electronics facility in Simpsonville, SC.

Please don't hesitate to let me know if you have any questions,

Thank you

Robert Workman, PG, CIH
CRB Geological & Environmental Services, Inc.
5000 Old Buncombe Road, Suite 21
Greenville, SC 29609
Office (864) 283-2000 ext. 101 Mobile (305) 542-5455
rworkman@crbgeo.net **LinkedIn**



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418096

CRB
GEOLOGICAL & ENVIRONMENTAL SERVICES, INC.

Email Scanned PM Copy

RECEIVED
MAY 23 2018
SITE ASSESSMENT, REMEDIATION & REVITALIZATION

May 18, 2018

Mr. Bruce Crawford
South Carolina Department of Health and Environmental Control
Bureau of Water – Underground Injection Control
2600 Bull Street
Columbia, South Carolina 29201

Re: Class V.A. Underground Injection Control Permit Application
Pilot Study Workplan for Woven Electronics Corporation
1001 Old Stage Road, Simpsonville, South Carolina 29681

Dear Mr. Crawford:

Enclosed please find a permit application prepared by CRB Geological & Environmental Services, Inc. (CRB), to install three (3) bioremediation injection wells and one (1) air sparging well at the above referenced site (the "Site"). Groundwater at the Site is currently monitored through a Voluntary Cleanup Contract with the South Carolina Department of Health and Environmental Control (SCDHEC).

This UIC permit is requested as part of a remediation pilot study and Feasibility Study. If you have any questions or comments, please don't hesitate to contact one of us at (864) 283-2000.

Sincerely,
CRB Geological & Environmental Services, Inc.

Frederick R. Baddour, PG
Senior Project Manager

Robert Workman, PG
Project Manager

cc: Jan Trent, SCDHEC BLWM

Attachments
UIC Permit Form DHEC2502
UIC Permit Application

Form I UIC	D H E C Underground Injection Control Permit Application Ground-Water Protection Division (Collected under the Authority of Title 48 Chapter I of the 1976 South Carolina Code of Laws)	I. EPA ID NUMBER	T/A	C
		U SCD980838015		

Read attached instructions before starting.

For OfficialUse Only

Application Approved month day year	Date Received month day year	Permit Well Number

Comments

II. Facility Name and Address	III. Owner/Operator and Address
Facility Name: Woven Electronics Corporation	Owner/OperatorName: Woven Electronics Corporation
Street Address: 1001 Old Stage Road	Street Address: 1001 Old Stage Road
City: Simpsonville; State: South Carolina; Zip Code: 29681	City: Simpsonville; State: South Carolina; Zip Code: 29681

IV. Ownership Status (Select One)

☐ A. Federal ☐ B. State ☒ C. Private ☐ D. Public ☐ E. Other (Explain)

V. SIC Codes

2221 2241

VI. Well Status (Select A, B or C)

☐ A. Operating Date Started *(MM/DD/YYYY)* ☐ B. Modification/Conversion ☒ C. Proposed

VII. Type of Permit Requested - Class and Type of Well (see reverse)

A. Class(es) enter code(s)	B. Type(s) enter code(s)	C. If class is "other" or type is code 'Y', explain	D. Number of Wells per type
V.A	V.A		3 Bioremed./ 2 Air Sparging

VIII. Location of Wells or Approximate Center of field or Project

C	A. Latitude				B. Longitude			
1		Deg 34	Min 45	Sec 9.7		Deg 82	Min 16	Sec 16.0

IX. Attachments

Complete the following questions on a separate sheet(s) and number accordingly; see instructions for Classes II, III, and V, complete and submit on a separate sheet(s) attachments A-U as appropriate. Attach maps where required. List attachments by letter which are applicable and include with your application.

X. Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment.

A. Name (Type or Print)	Title	B. Phone No.
Robert Workman	as Agent	864-283-2000 x 101
C. Signature		D. Date Signed (MM/DD/YYYY) 5/18/17

DHEC2502(08/1997)

GEOLOGICAL & ENVIRONMENTAL SERVICES, INC.

SOUTH CAROLINA CLASS V.A. UNDERGROUND INJECTION CONTROL PERMIT APPLICATION FOR WOVEN ELECTRONICS CORPORATION 1001 OLD STAGE ROAD SIMPSONVILLE, SOUTH CAROLINA 29681

BLWM TECHNICAL FILE #418096

PREPARED FOR:

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL BUREAU OF LAND AND WASTE MANAGEMENT 2600 BULL STREET COLUMBIA, SOUTH CAROLINA 29201

PREPARED BY:

CRB GEOLOGICAL & ENVIRONMENTAL SERVICES, INC. 5000 OLD BUNCOMBE ROAD, SUITE 21 GREENVILLE, SOUTH CAROLINA 29617

MAY 18, 2018

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ATTACHMENT A - ACTIVITY FOR REVIEW

CRB submits this application to obtain a Class V.A. Underground Injection Control (UIC) permit to install and operate three (3) bioremediation injection wells and two (2) air sparging wells at the Woven Electronics Corporation, located at 1001 Old Stage Road, in Simpsonville, South Carolina. The injections will be performed as part of a pilot-sale remediation required for a Feasibility Study.

Operational details, bioremediation fluid information and equipment specifications are described in the Pilot Study Workplan, dated April 24, 2018 and submitted to SCDHEC BLWM.

BIOREMEDIATION INJECTIONS FOR GROUNDWATER REMEDIATION

To achieve favorable geochemical conditions for reductive dechlorination at the Site, a food-grade vegetable oil electron donor substrate available commercially as NewmanZone™ will be injected in a limited area near MW-05A. A total mass of 2,231 pounds (280 gallons) of substrate will be mixed with water for the one-time injection. The calculations take into account the hydrogen demand concentration of dissolved oxygen, sulfate and contaminant mass.

The objective of bioremediation injections is to distribute a target concentration of 100-mg/L of the electron donor substrate in the contaminated zone which then is fermented and degraded by native microbial populations to yield hydrogen and free electrons. After the bioremediation substrate has been injected, the progress of bioremediation is then evaluated based on groundwater analytical and geochemical parameters.

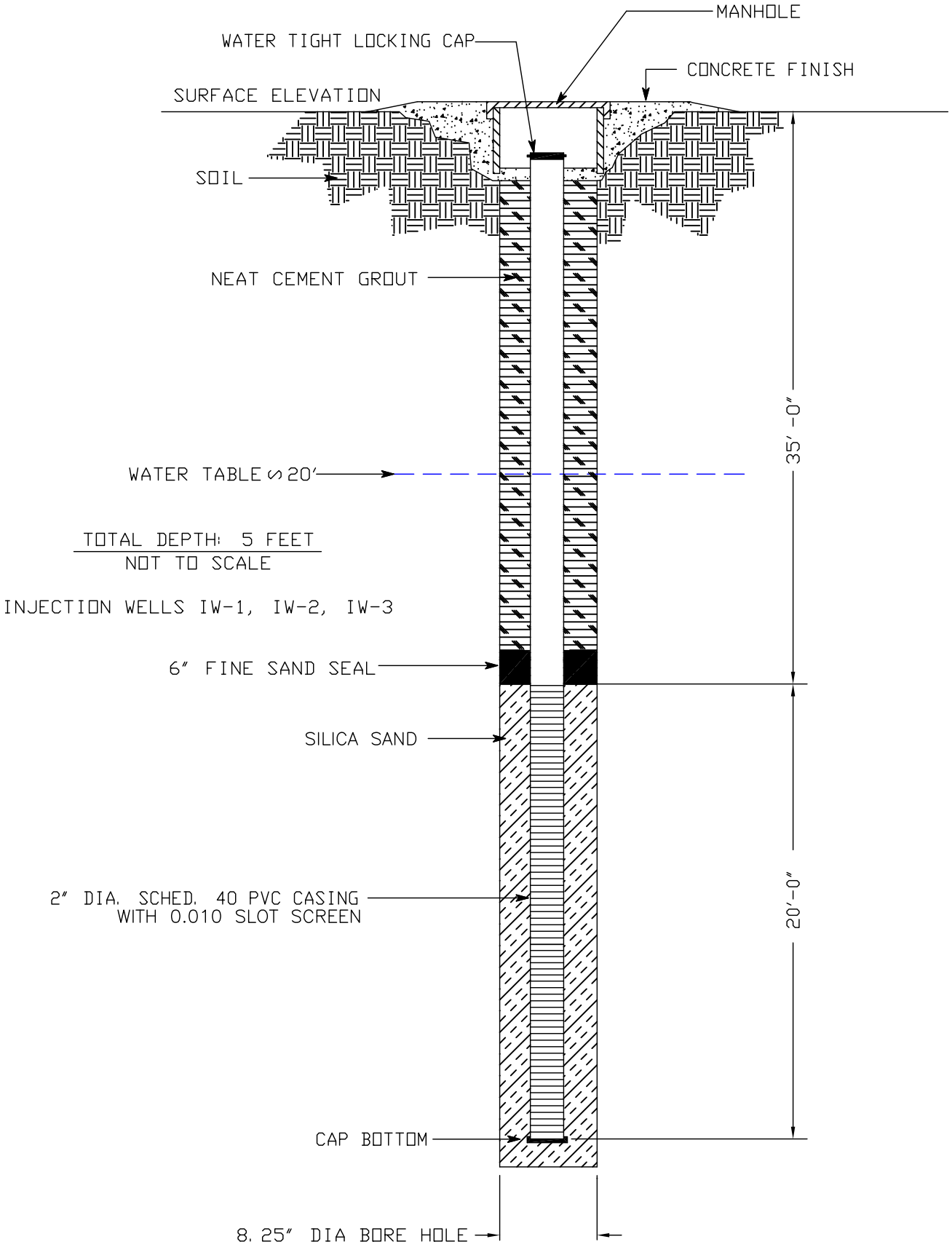
AIR SPARGING AND SOIL VAPOR EXTRACTION

The use of Air Sparging (AS) and Soil Vapor Extraction (SVE) is proposed to evaluate vapor phase removal of chlorinated volatile organic compounds (CVOCs) from groundwater in the limited area near the monitoring well MW-6 cluster at the Site. The UIC permit is requested for injection of atmospheric air into two (2) air sparging wells.

ATTACHMENT B – WELL CONSTRUCTION DETAILS

Figure 1 – In-Situ Bioremediation Injection Point Construction Diagram

Figure 2 – Air Sparging Well Construction Diagram

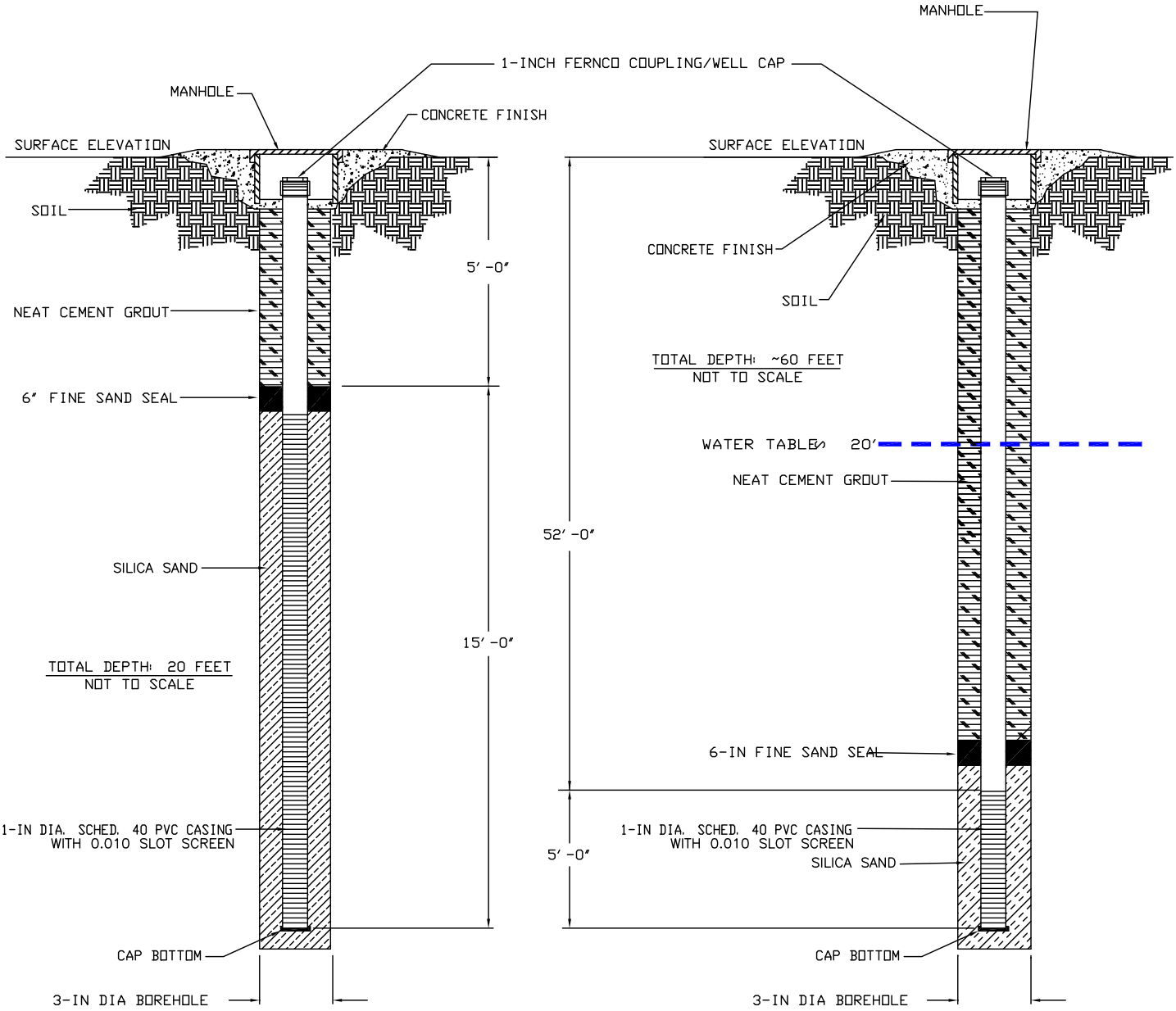


CRB
Geological & Environmental Services, Inc.
8744 SW 133rd Street
Miami, Florida 33176
Tel: (305) 447-9777
Fax: (305) 567-2853

TITLE:
INJECTION WELL ASSEMBLY WITH MANHOLE
WOVEN ELECTRONICS
1001 OLD STAGE ROAD
SIMPSONVILLE, SOUTH CAROLINA

REV'D DATE: APR 15, 2018	PROJECT NO. RCI 414-26	FIGURE 1
DRAWN DATE: APR 15, 2018	SCALE: AS NOTED	
DRAWN BY: LA	APPROVED BY: RW	

RCI 414...\26...\Report\2018UIC\CAD\TYPE 2 INJ WELL



CRB
Geological & Environmental Services, Inc.
8744 SW 133rd Street
Miami, Florida 33176
Tel: (305) 447-9777
Fax: (305) 567-2853

TITLE:
SVE & INJECTION WELL CONSTRUCTION DIAGRAM
WOVEN ELECTRONICS CORP.
1001 OLD STAGE ROAD, SIMPSONVILLE, SC

REV'D DATE:	MAR 20, 2018	PROJECT NO. RCI 414-26	FIGURE 2
DRAWN DATE:	MAR 20, 2018	SCALE: AS NOTE	
DRAWN BY:	LAA	APPROVED BY: RCW	

ATTACHMENT C – OPERATING DATA

The following section provides operating data for the bioremediation injections and air sparging pursuant to the permit application requirements. Details of the construction and equipment is included in the attached April 24, 2018 Pilot-Scale Remediation Workplan.

1. IN-SITU BIOREMEDIATION INJECTION

The injection of the bioremediation products will be conducted using three (3) injection wells (IW-1, IW-2, IW-3) shown in Figure 5A of Attachment H. The wells will be installed in a grid upgradient from MW-04.

Bioremediation Injection Rate, Volume, Pressure & Schedule

Schedule: The bioremediation injections will be a one-time event over a one-week injection event followed by groundwater monitoring.

Rate: Injection will be controlled at a maximum of ten (10) gallons per minute (GPM).

Total Volume: A total injection volume of up to 280-gallons of NewmanZone diluted with 1,400 gallons of groundwater; total volume of 1,680 gallons distributed evenly to three (3) injection wells with a total volume of 349 to 560 gallons per well.

Pressure: A minimum entry pressure of 20-psi is required for injection at depth limited to a maximum injection pressure of 40-psi to prevent soil fracturing and uneven substrate distribution.

Injected Fluid Contaminant Concentrations

The proposed injected fluid is a food-grade bioremediation substrate (NewmanZone) that contains no expected contaminants of concern.

Bioremediation Well Construction

Three (3) bioremediation injection wells will be installed using rotary drilling methods and constructed using two (2)-inch diameter, schedule 40 polyvinyl chloride (PVC) pipe with twenty (20) feet of screen from thirty-five to fifty-five (35-55) feet, followed by a solid riser to the surface. The wells will be completed with standard flush mounted, waterproof locking caps and manholes at the surface.

2. AIR SPARGING INJECTION

The air sparging will be conducted using two (2) injection wells (AS-1, AS-2) shown in Figure 5B of Attachment H. The wells will be installed in a grid upgradient from MW-06.

Air Sparging Rate, Volume, Pressure & Schedule

Schedule: Air sparging will be performed over a 90-day pilot-study period followed by groundwater monitoring.

Rate: Air sparging will be performed up to thirty (30) cubic feet per minute (CFM).

Total Volume: Net injected volume is zero. Injected air will be captured and released to the atmosphere.

Pressure: A minimum entry pressure of 16-psi is required for injection at depth limited to a maximum injection pressure of 35-psi to prevent soil fracturing.

Injected Fluid Contaminant Concentrations

The proposed injected fluid is atmospheric air that contains no expected contaminants of concern.

Air sparging will be performed for 90-days using an electric blower to introduce compressed air into the base of the groundwater plume through two (2) air sparging wells. Soil vapors generated as off-gas from the air sparging will be captured from two (2) SVE vent wells using a regenerative blower operating as a soil vacuum. The AS/SVE system and estimated performance characteristics are described below.

Air Sparging Well Construction

Two (2) air sparging wells and two (2) vent wells will be used for AS/SVE. The sparging well locations were selected based on coverage of the plume near MW-06. The air sparging wells will be installed using rotary drilling methods and constructed using one (1)-inch diameter, schedule 40 polyvinyl chloride (PVC) pipe with five (5) feet of screen to a total depth of sixty (60) feet bls, followed by a solid riser to the surface.

ATTACHMENT D - MONITORING PROGRAM

Monitoring results from the following schedule will be presented in a pilot-study completion report to be submitted for review by the SCDHEC BLWM.

1. IN-SITU BIOREMEDIATION INJECTIONS

The following tasks will be completed as part of the monitoring program. Monitoring required for the in-situ the Pilot Study bioremediation treatment at the monitoring well cluster MW-4 includes periodic groundwater sampling and analysis.

Monitoring required for the pilot-scale remediation bioremediation treatment at the MW-4 cluster includes periodic groundwater sampling and analysis. In order to measure the duration of the NewmanZone, field measurements of Total Dissolved Solids (TDS) will be collected from the MW-4 cluster wells prior to injection and following injections in order to track the return to baseline geochemical conditions.

Monitoring Frequency

- Baseline
- Monthly post-injection (Day 30, 60, 90)

Monitoring Parameters

- Depth to Water in MW-2, MW-4 cluster, MW-5
- Geochemical parameters in MW-4 and MW-4T: pH, ORP, dissolved oxygen, TDS,
- Analytical parameters in MW-4 and MW-4T: ferrous iron, TOC, CVOCs by EPA 8260

2. AIR SPARGING AND SOIL VAPOR EXTRACTION

Monitoring of the AS/SVE system at the MW-6 cluster will involve at periodic site visits and data collection to evaluate the treatment system performance. The monitoring schedule and list of parameters is presented below. A low-level organic vapor analyzer/photoionization meter (OVA/PID) will be used to measure soil gas concentrations from the AS/SVE system in the field.

Monitoring Frequency

- Startup (Day 1, 2, 3)
- Weekly (Day 7, 14, 21, 30)
- Monthly (Day 30, 45, 60, 75, 90)

Monitoring Parameters

- AS Pressure
- AS Flow Rate
- AS Air Inlet Filter / Differential Pressure

- AS Motor Function / Current
- SVE Knockout Tank Water Level
- SVE Manifold Vacuum
- SVE Flow Rate
- SVE Motor Function / Current
- SVE Exhaust OVA/PID Measurement
- Depth to Water in MW-6 cluster (monthly)
- Dissolved Oxygen in MW-6 cluster (monthly)

AS/SVE Evaluation

Periodic operation of individual AS and SVE wells will be performed to measure maximum flow, pressure, vacuum conditions, and ROI. The nearby monitoring wells will be used to evaluate responses to changes in flow and pressure.

Laboratory samples will be collected from the SVE well with the highest OVA/PID reading or as determined by the field manager on Day 1 and Day 90 of operation. The laboratory samples will be submitted for analysis of VOCs by EPA method TO-15. For laboratory sampling, an in-line three-way tee valve will be installed in the gas pump inlet line with one (1) connection to a six (6) liter pre-cleaned Suma® canister. The Suma canister will be equipped with a 0.2-LPM flow regulator that will be opened when the three-way valve is closed to the atmosphere. Once the canister vacuum is exhausted the sampling valve will be closed and resealed.

After sampling, the Suma canisters will be delivered to an SCDHEC certified analytical laboratory for laboratory analysis of VOCs by EPA method TO-15. The samples will be delivered under chain of custody for reporting. The results of the sampling will be included for baseline comparison and evaluation.

ATTACHMENT E – EXISTING PERMITS

CRB is not aware of any existing state or federal environmental remediation permits for the Woven Electronics Corporation facility.

ATTACHMENT F – BUSINESS DESCRIPTION

The Site is located in an industrial area northwest of Simpsonville, South Carolina and consists of one parcel 16.4-acre parcel identified by the Greenville County Property Assessor as Parcel Number 0303000100300. The Site was developed from vacant land in 1961, and has been used for weaving and electronics manufacturing processes since that time. The area surrounding the facility is characterized by industrial or manufacturing facilities and vacant, undeveloped land adjoining to the west, north and south.

In the areas of proposed UIC work, no occupied buildings or regular activity were performed. Air sparging is proposed in a wooded area more than 300-feet from any building. Bioremediation injections are proposed in a field area more than 100-feet and downgradient from the main building.

The main development of the site is an approximately 100,000-square foot brick and slab manufacturing building with administrative offices, and work areas for assembly, machining, weaving, and testing. Two (2) unoccupied storage buildings were present in the rear of the property. Paved employee parking areas are present on the north and south sides of the building, and the entire facility is fenced with controlled access points from Old Stage Road. An outdoor gravel security testing area is present in the rear of the Site in the area of the proposed injections.

The building is served with public water, sewer, natural gas, and electricity. Electrical, municipal water, public sewer and gas connections are maintained from Old Stage Road. The municipal sewer connection operates from a sump grinder and lift station near the western end of the building with a pipe connecting the lift station to the sewer main along Old Stage Road. The property boundary includes a narrow strip to the southwest which was formerly used as an easement for the wastewater discharge pipe for the original wastewater drainage system.

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ATTACHMENT G – AREA OF REVIEW

The area reviewed for this UIC permit application extends in a ¼-mile radius from MW-4 and MW-6. The area of review is shown in Figure 3A, 3B and 3C.

ATTACHMENT H – MAPS

The following maps and monitoring well construction summary tables are attached:

Figure 3A – Topographic Map

Figure 3B – Topographic Map – 1-Mile Radius

Figure 3C – Topographic Map – ¼-Mile Radius

Figure 4 – Site Map with Monitoring Wells & Water Bodies

Figure 5A – ERD Injection Well Location Map

Figure 5B – Air Sparging and Extraction Well Location Map

Figure 6 – Groundwater Plume Map

Table 1 – Monitoring Well Construction Summary

Source: USGS 7.5-Minute
Mauldin, SC Quadrangle 1983
Simpsonville, SC Quadrangle 1983

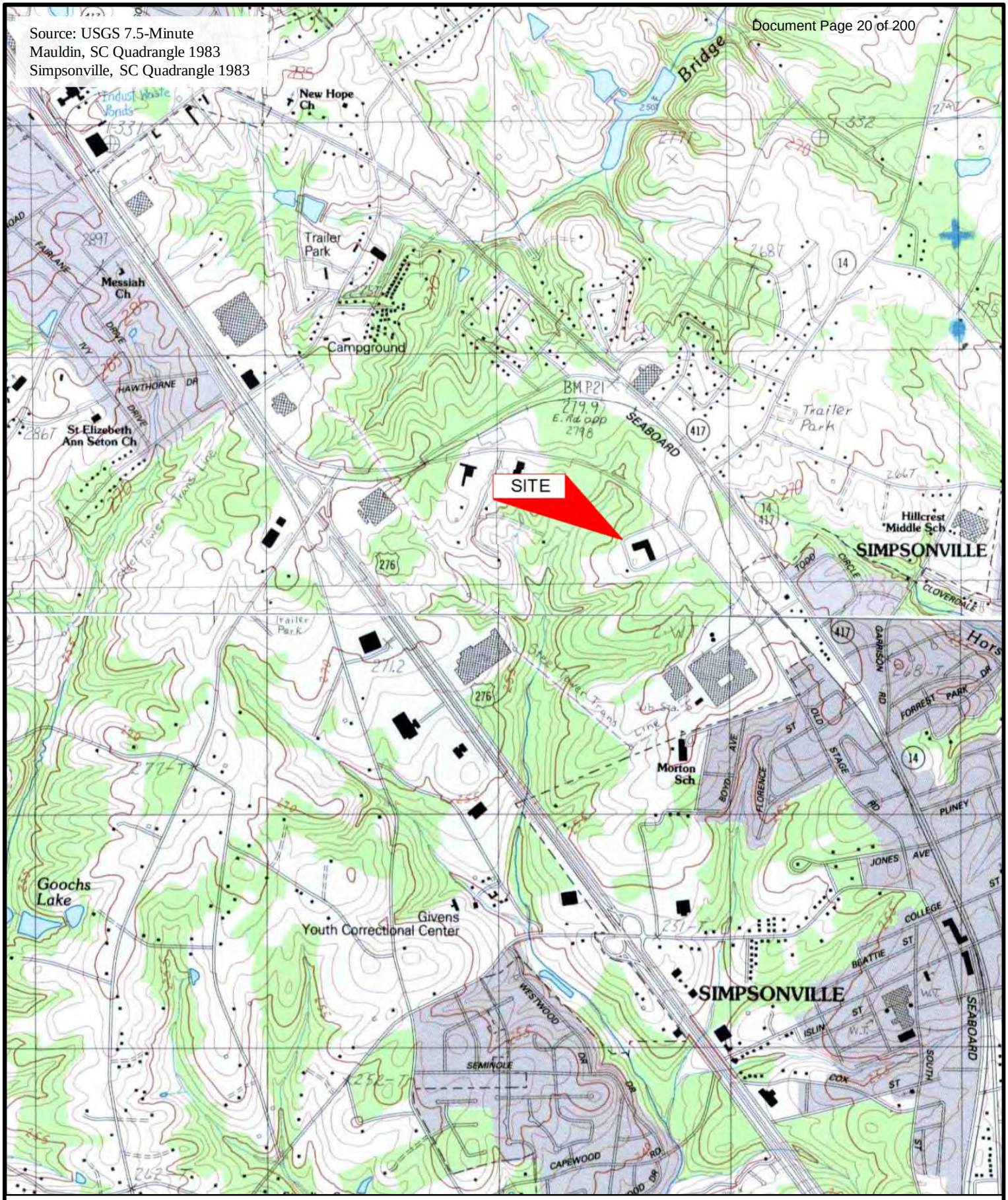


Figure 3A

Site Location Map
Woven Electronics, LLC
1001 Old Stage Road, Simpsonville, South Carolina

CRB

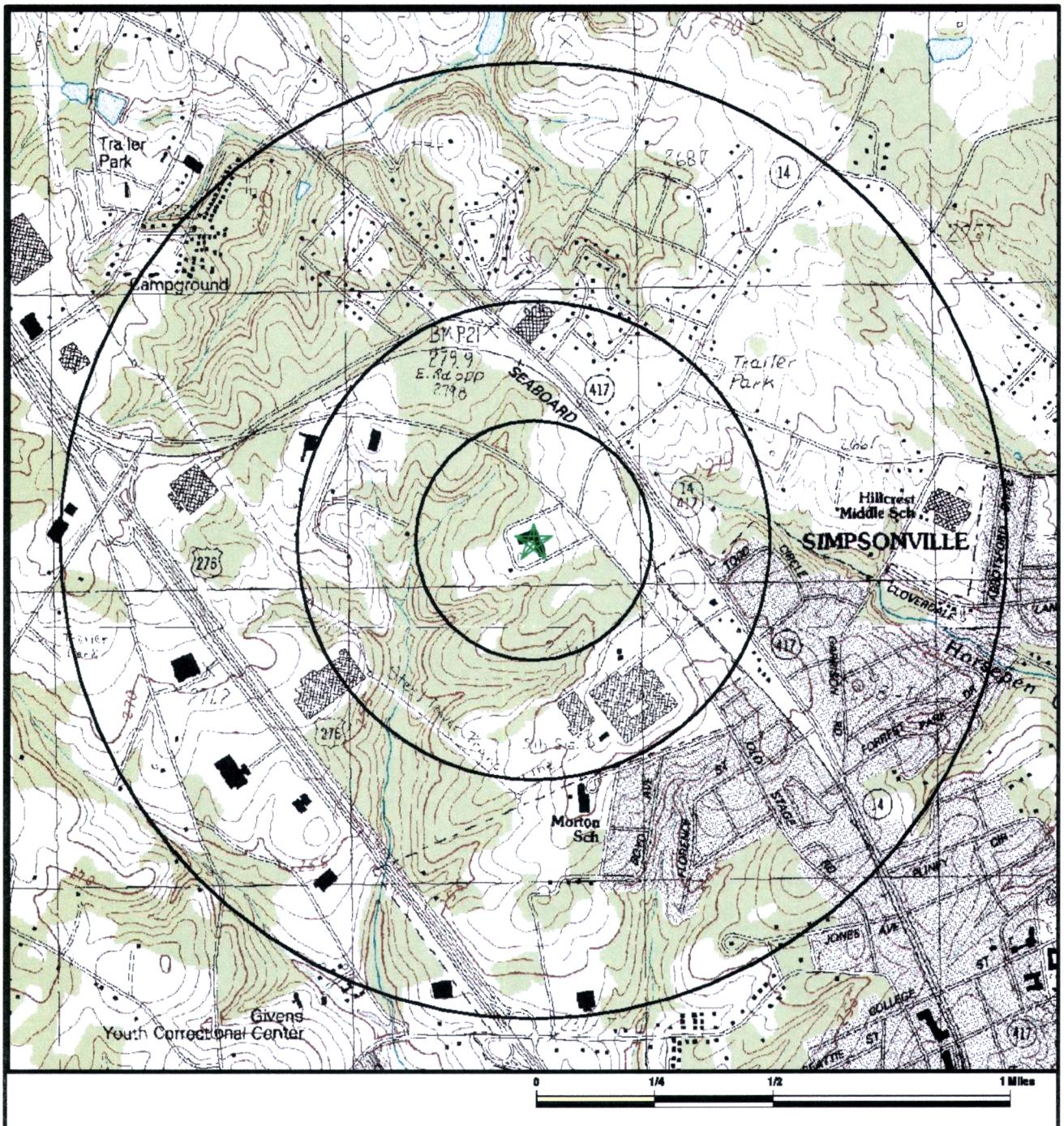


Figure 3B

Site Location Map – 1 Mile Radius
Woven Electronics Corporation
1001 Old Stage Road, Simpsonville, South Carolina

CRB

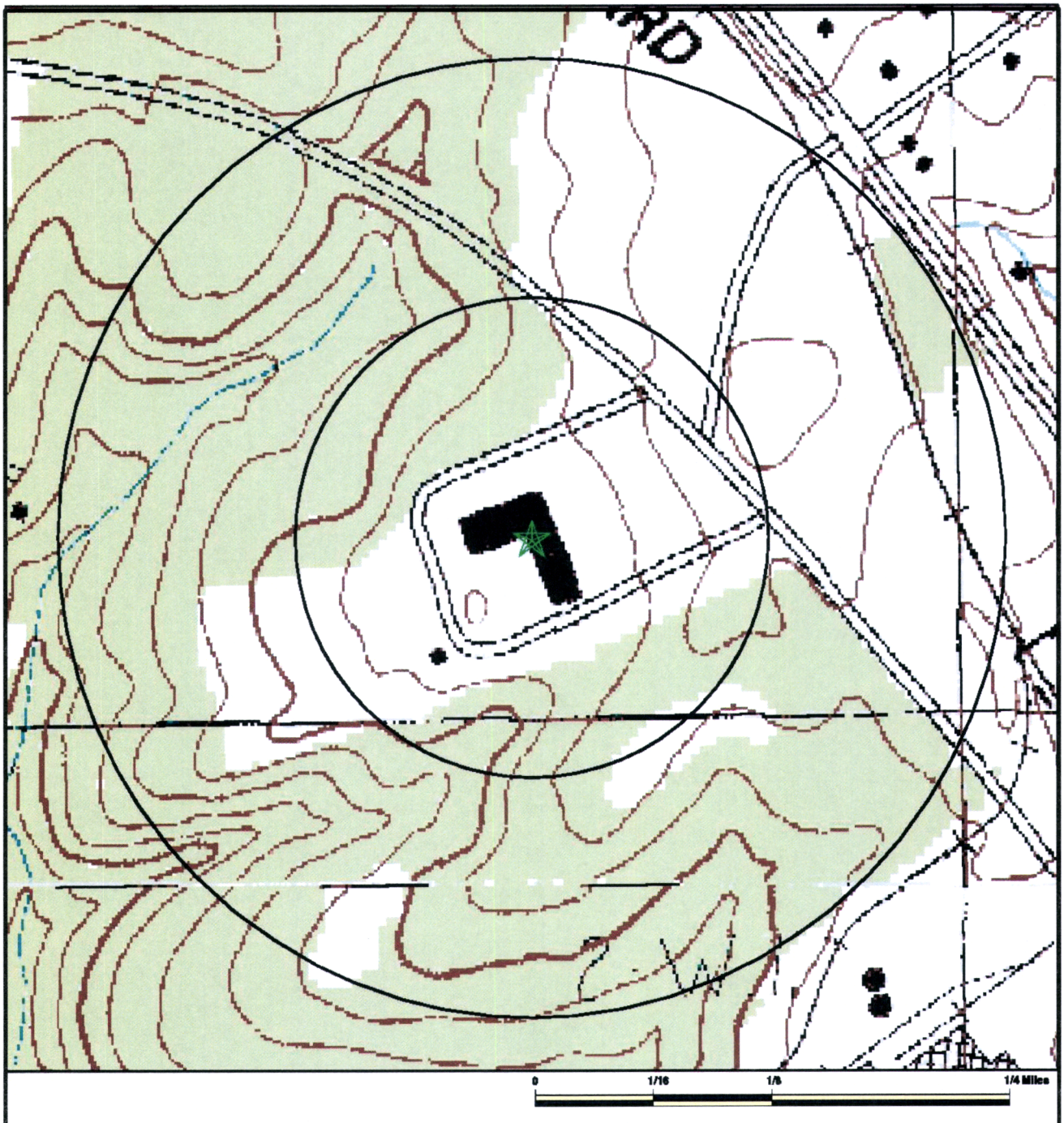


Figure 3C

Site Location Map – 1/4 Mile Radius
Woven Electronics Corporation
1001 Old Stage Road, Simpsonville, South Carolina

CRB



Figure 4

Site Map with Monitoring Well Locations
Woven Electronics Corporation
1001 Old Stage Road, Simpsonville, South Carolina

CRB



Figure 5A

ERD Injection Wells Layout
Woven Electronics Corporation
1001 Old Stage Road, Simpsonville, South Carolina

CRB



Figure 5B

AS / SVE Layout
Woven Electronics Corporation
1001 Old Stage Road, Simpsonville, South Carolina

CRB

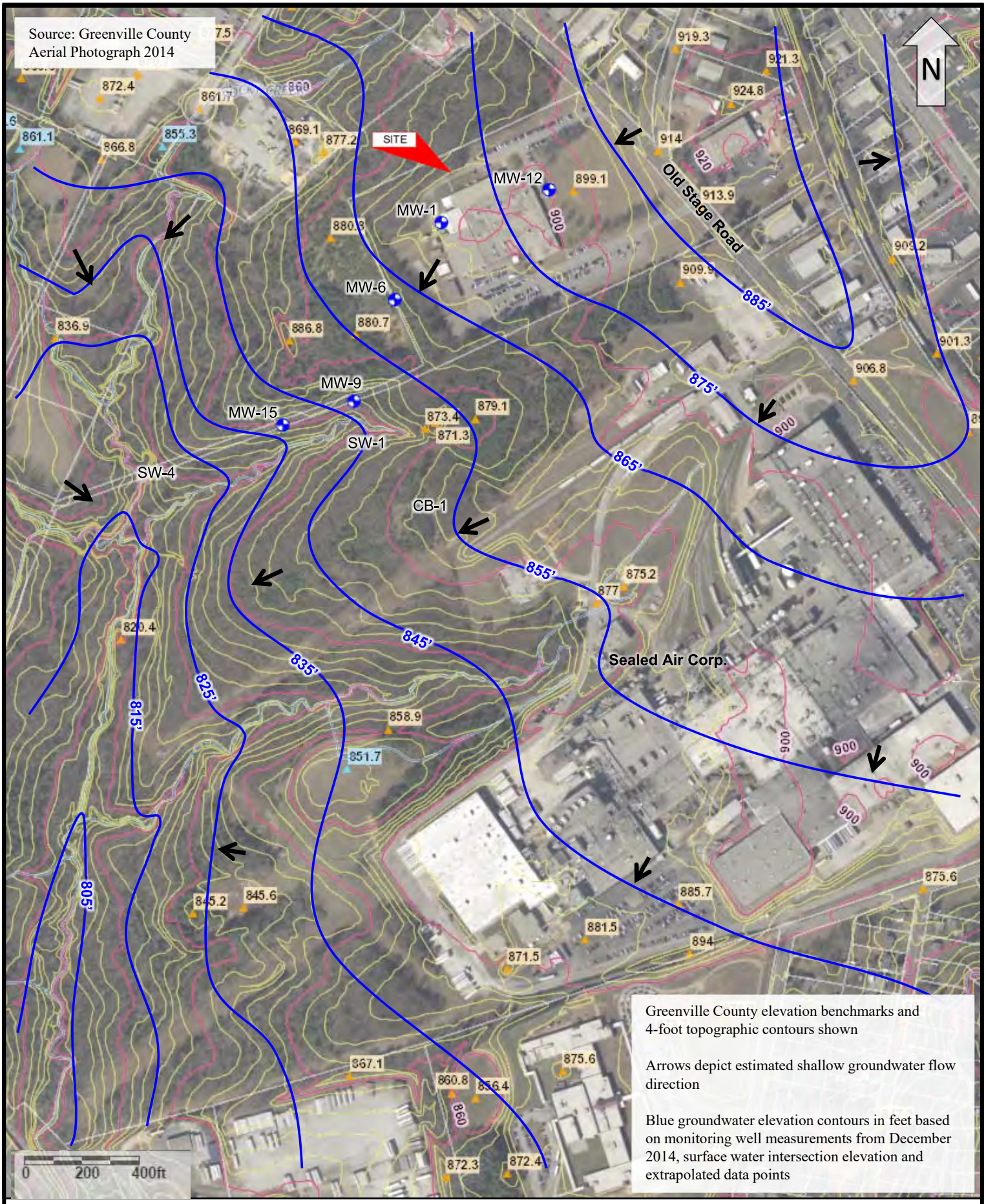


Figure 6

Watershed Groundwater Flow Diagram – February 2017
Woven Electronics Corporation
1001 Old Stage Road, Simpsonville, South Carolina

CRB

Table 1 - Monitoring Well Construction Summary
Woven Electronics Corporation
1001 Old Stage Road, Simpsonville SC

Well ID	Total Depth	TIC Elevation[1]	Screened Interval	Screen Top Depth	Screen Base Depth	Screen Top Elevation	Screen Base Elevation	Well Diameter (inches)	Screened Formation
MW-1S	29.98	895.82	20-30	19.98	29.98	875.84	865.84	2.0	Saprolite
MW-1T [2]	69.71	895.74	60-70	59.71	69.71	836.03	826.03	2.0	Transition
MW-2	58.61	894.91	19-59	18.61	58.61	876.30	836.30	2.0	Saprolite
MW-3	60.28	892.99	20-60	20.28	60.28	872.71	832.71	2.0	Saprolite
MW-4	45.58	889.78	16-46	15.58	45.58	874.20	844.20	1.0	Saprolite
MW-4T	54.65	889.87	50-55	49.65	54.65	840.22	835.22	2.0	Transition
MW-4D [3]	73.22	889.85	68-73	68.22	73.22	821.63	816.63	2.0	Bedrock
MW-5	41.83	891.83	12-42	11.83	41.83	880.00	850.00	1.0	Saprolite
MW-6S[4]	30.50	889.97	21-31	21.00	30.50	868.97	859.47	1.0	Saprolite
MW-6I	46.96	890.49	35-45	36.96	46.96	853.53	843.53	2.0	Saprolite
MW-6T	56.70	890.63	52-57	51.70	56.70	838.93	833.93	2.0	Transition
MW-6D	69.50	890.19	64-69	64.50	69.50	825.69	820.69	2.0	Bedrock
MW-7	39.71	889.92	9-39	9.71	39.71	880.21	850.21	1.0	Saprolite
MW-8	36.04	889.51	14-34	16.04	36.04	873.47	853.47	1.0	Saprolite
MW-9S[5]	20.80	865.36	11-21	11.00	20.80	854.36	844.56	1.0	Saprolite
MW-9T	37.97	864.46	25-35	27.97	37.97	836.49	826.49	2.0	Transition
MW-9D	56.90	862.04	51-56	51.90	56.90	810.14	805.14	2.0	Bedrock
MW-10S[6]	23.60	899.70	10-23	10.00	23.60	889.70	876.10	1.0	Saprolite
MW-10I	34.65	899.70	25-35	24.65	34.65	875.05	865.05	2.0	Saprolite
MW-10T	58.45	899.70	53-58	53.45	58.45	846.25	841.25	2.0	Transition
MW-12	40.97	899.71	31-41	30.97	40.97	868.74	858.74	1.0	Saprolite
MW-13	42.97	891.27	33-43	32.97	42.97	858.30	848.30	1.0	Saprolite
MW-14	45.55	891.14	36-46	35.55	45.55	855.59	845.59	1.0	Saprolite
MW-15	32.74	854.13	23-33	22.74	32.74	831.39	821.39	1.0	Saprolite
MW-16	45.20	883.68	30-45	30.20	45.20	853.48	838.48	2.0	Saprolite
MW-17	29.57	899.70	20-30	19.57	29.57	880.13	870.13	1.0	Saprolite
TMW-18	8.90	853.45	0-9	4.90	8.90	848.55	844.55	1.0	Transition
MW-20S	20.26	899.58	15-20	15.26	20.26	884.32	879.32	2.0	Saprolite
MW-20T	56.51	899.59	46-56	46.51	56.51	853.08	843.08	2.0	Transition
MW-21S	27.35	881.52	17-27	17.35	27.35	864.17	854.17	2.0	Saprolite
MW-21T	36.95	881.59	31-36	31.95	36.95	849.64	844.64	2.0	Transition
MW-23S	24.97	899.00	15-25	14.97	24.97	884.03	874.03	2.0	Saprolite

Notes

Depth in feet below land surface; elevation in feet above sea level NGVD 83
DTW - Depth to Water
TIC - Top of Inner Casing

[1] - Top of Inner Casing elevation in feet relative to building slab elevation of 900 feet.

[2] - MW-1 was renamed MW-1T as part of the MW-1 cluster

[3] - MW-11D was renamed MW-4D as part of the MW-4 cluster

[4] - MW-6 was plugged to a depth of 31.0 feet and renamed MW-6S as part of the MW-6 cluster

[5] - MW-9 was plugged to a depth of 21.0 feet and renamed MW-9S as part of the MW-9 cluster

[6] - MW-10 was plugged to a depth of 23.6 feet and renamed MW-10S as part of the MW-10 cluster

Monitoring Well Cluster Screen Designations

S - Shallow Zone water table or uppermost water-bearing depth
I - Intermediate Zone water-bearing depth above Transition Zone
T - Transition Zone water-bearing depth at the saprolite / bedrock boundary
D - Deep Zone, bedrock water-bearing depth

ATTACHMENT I – CROSS SECTION DIAGRAMS

The following cross-section diagrams are attached:

Figure 7 – Geologic Cross-Section Locator Map

Figure 8 – Geologic Cross-Section A-A' (Parallel to Groundwater Flow)

Figure 9 – Geologic Cross-Section B-B' (Perpendicular to Groundwater Flow)

Figure 10 – ERD Injection Well Cross Section Diagram

Figure 11 – Air Sparging and SVE Well Cross Section Diagram

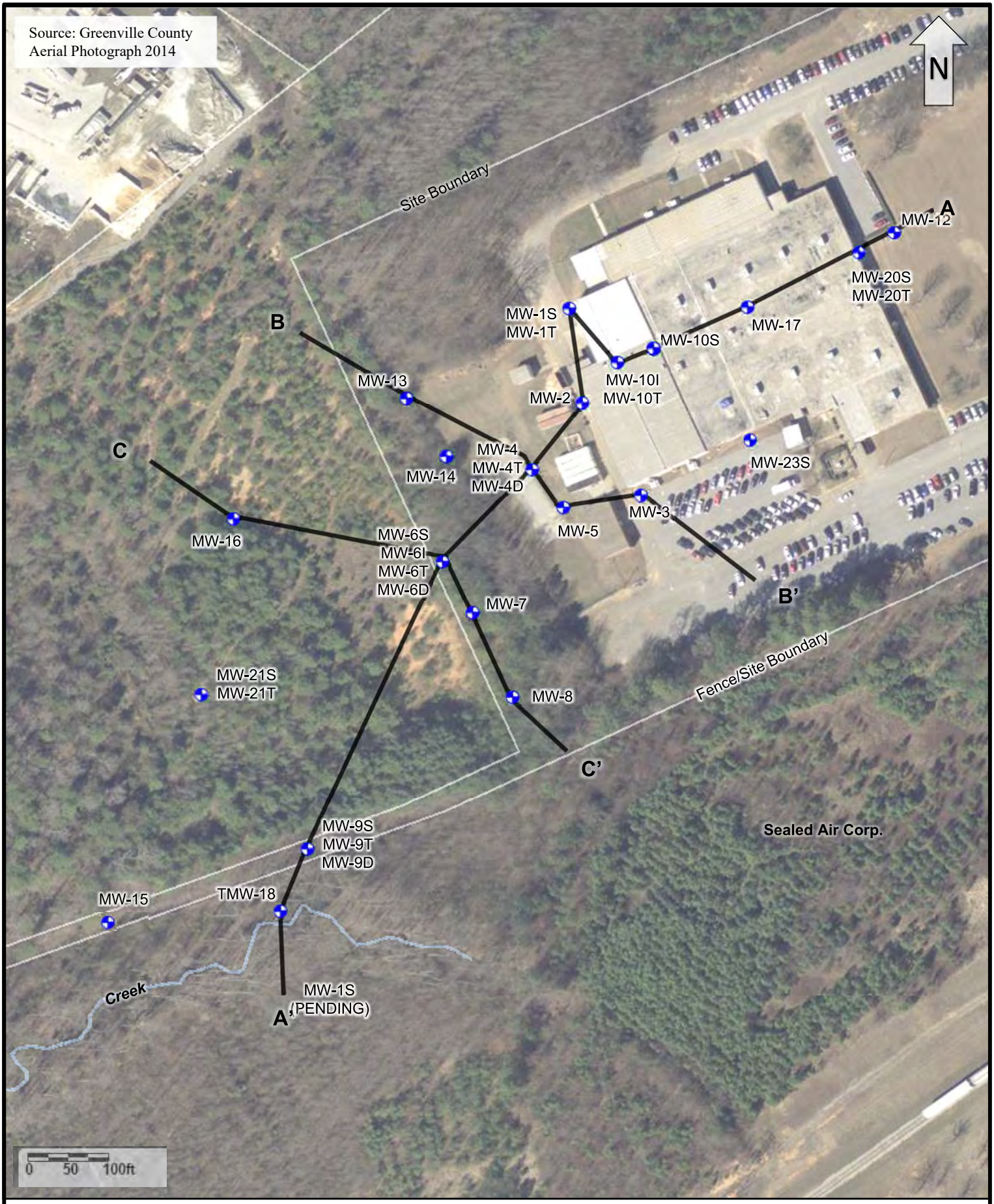


Figure 7

Geological Cross Section Locator Diagram
Woven Electronics Corporation
1001 Old Stage Road, Simpsonville, South Carolina

CRB

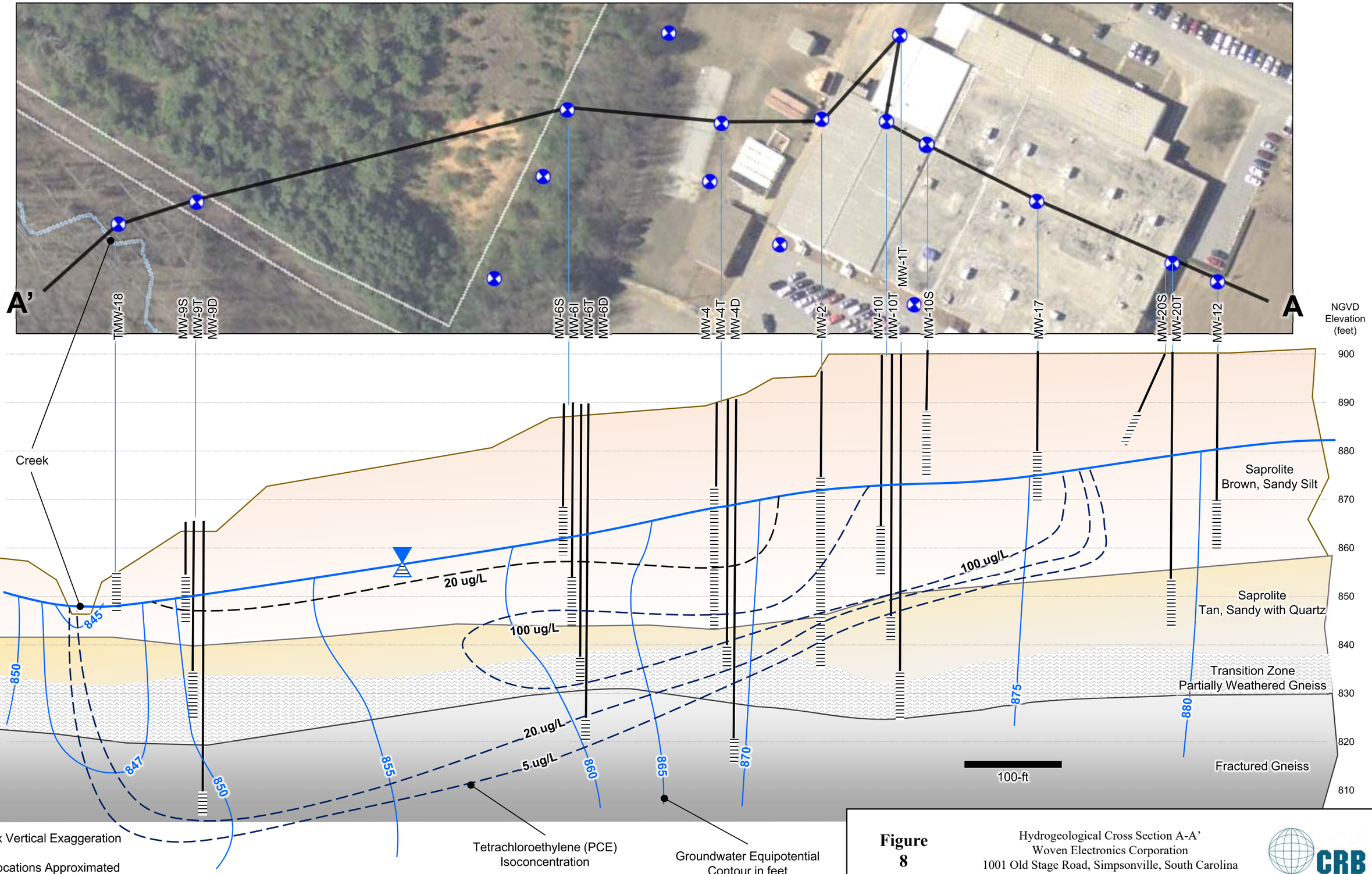
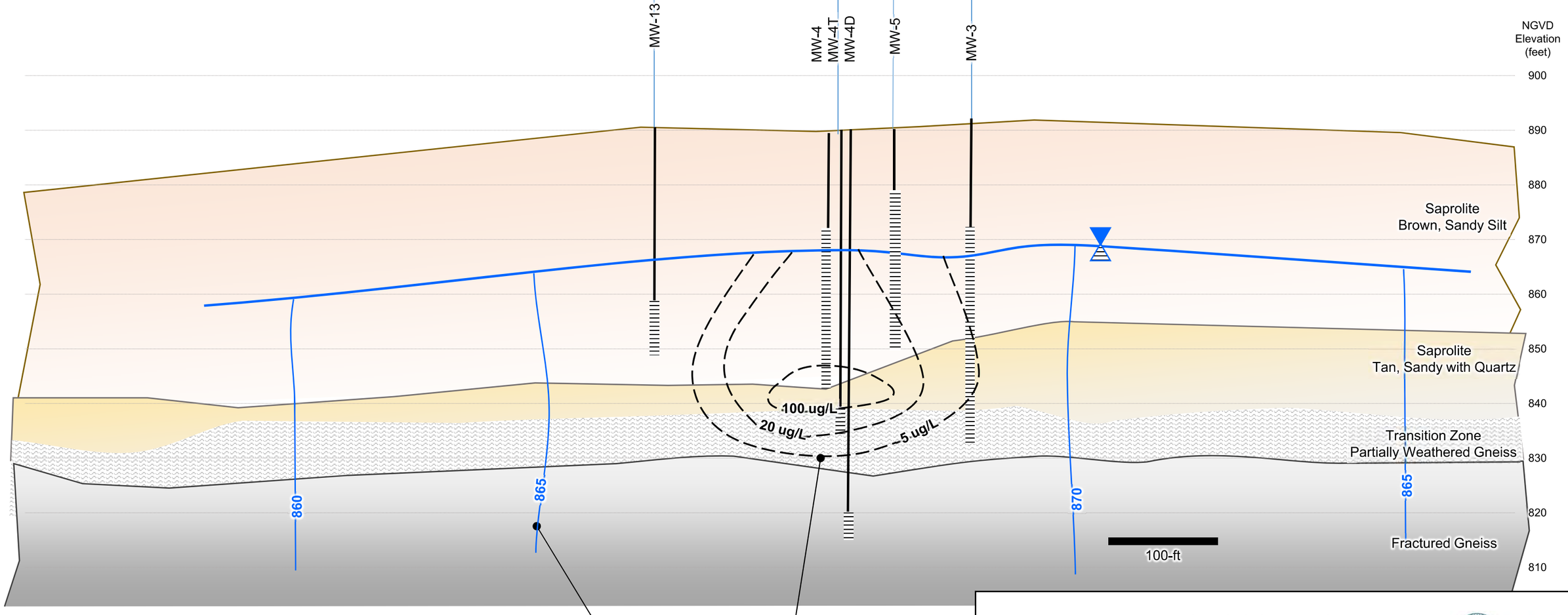


Figure 8

Hydrogeological Cross Section A-A'
Woven Electronics Corporation
1001 Old Stage Road, Simpsonville, South Carolina

CRB





5x Vertical Exaggeration

Locations Approximated

Groundwater Equipotential Contour in feet

Tetrachloroethylene (PCE) Isoconcentration

Figure 9

Hydrogeological Cross Section B-B'
Woven Electronics Corporation
1001 Old Stage Road, Simpsonville, South Carolina

CRB

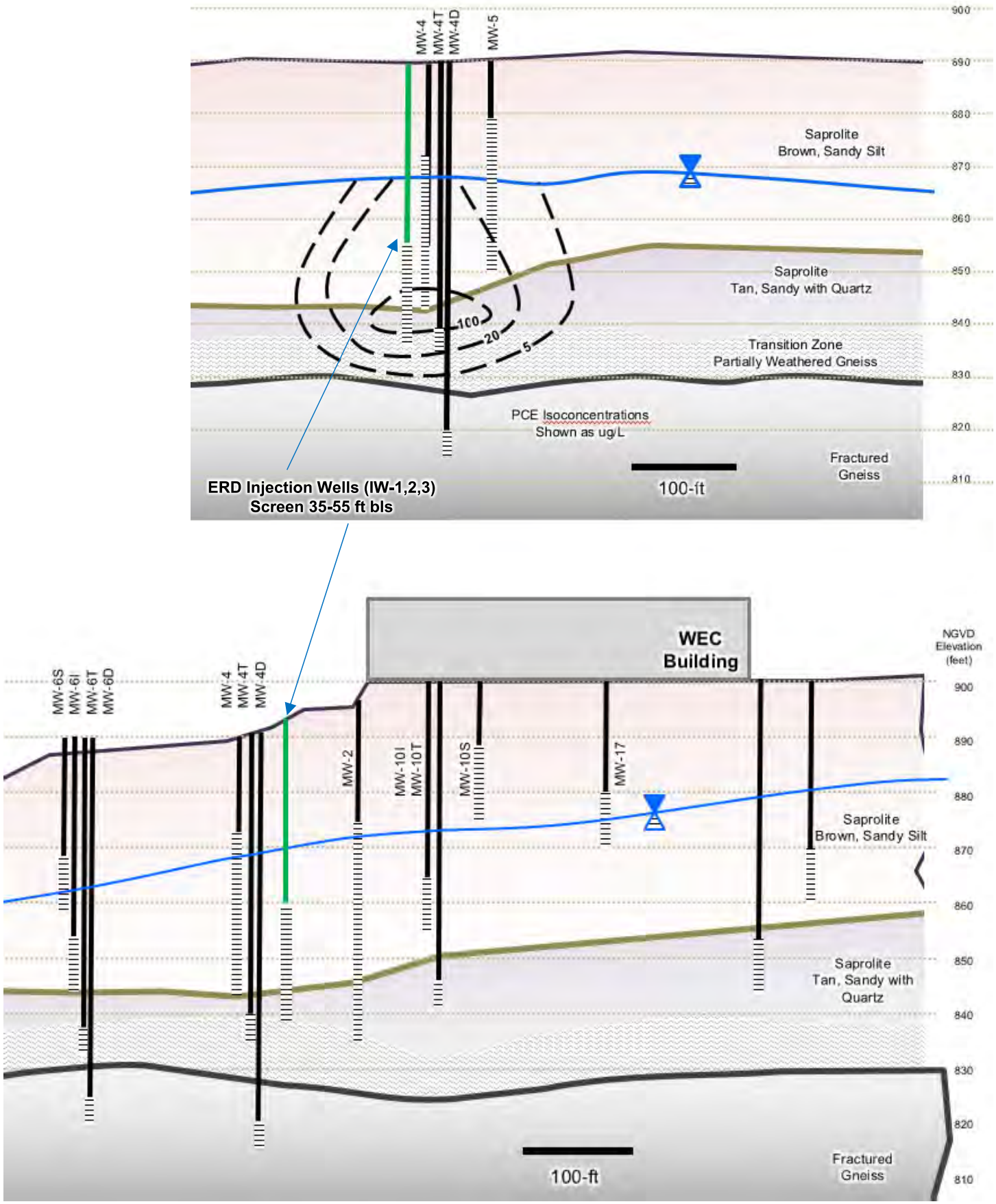
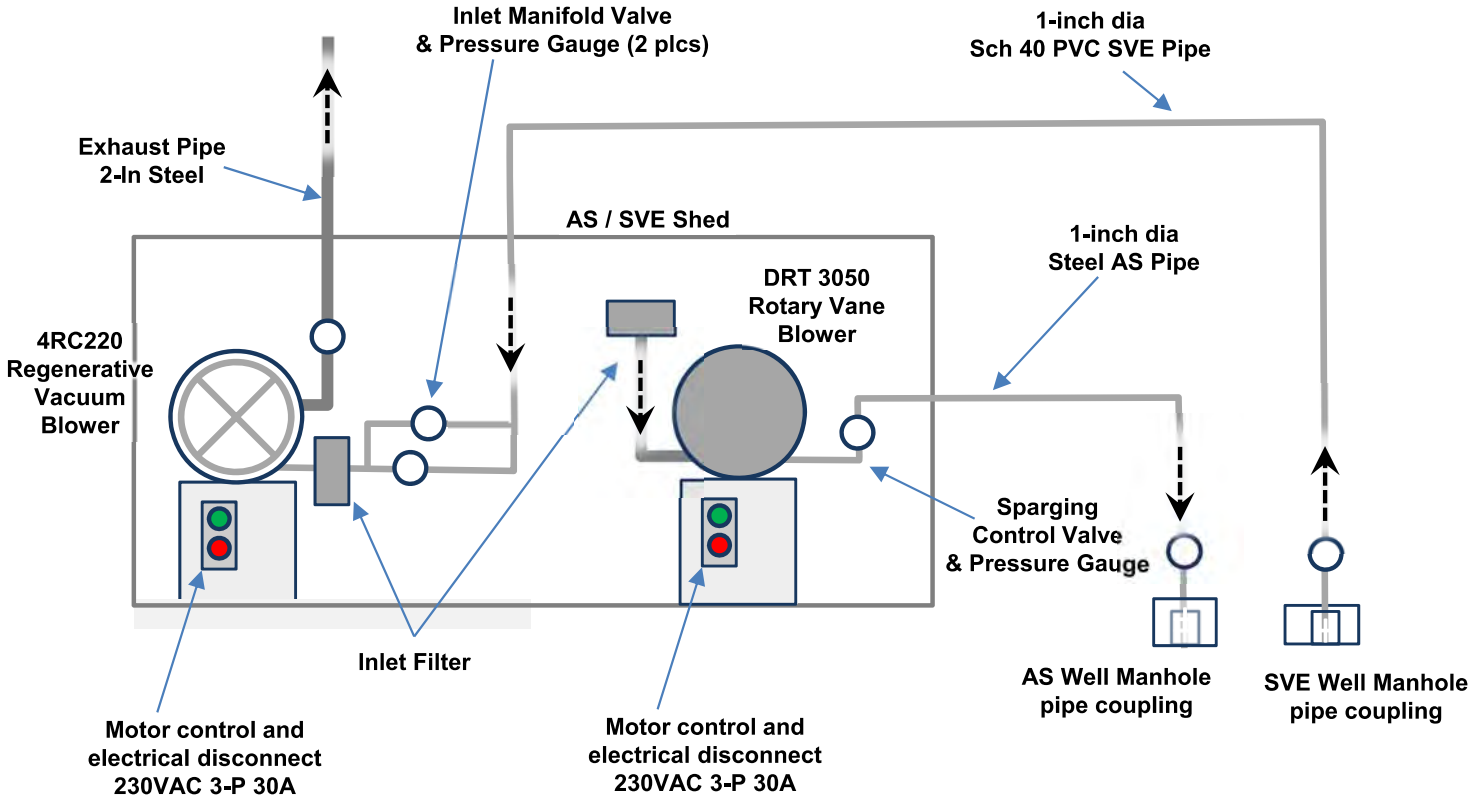


Figure 10

ERD Cross-Section
Woven Electronics Corporation
1001 Old Stage Road, Simpsonville, South Carolina

CRB



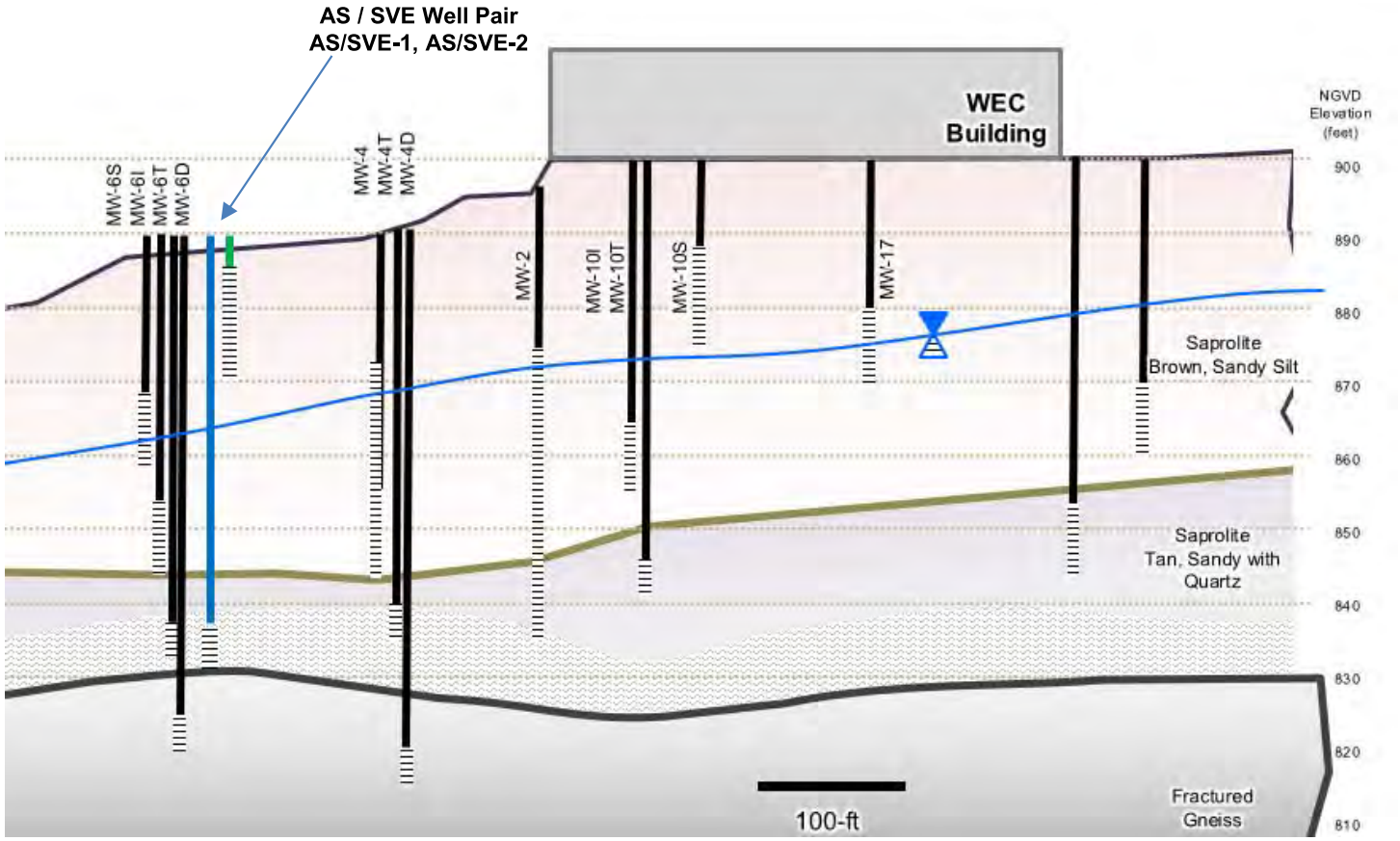


Figure 11

AS / SVE Cross-Section and Equipment Diagram
Woven Electronics Corporation
1001 Old Stage Road, Simpsonville, South Carolina

CRB

ATTACHMENT J – UNDERGROUND SOURCES OF DRINKING WATER

Based on groundwater measurements, groundwater at the Site was present at a depth of 20-feet and flows generally to the southwest towards a branch of Rocky Fork Creek. Potable water at neighboring properties is provided by municipal surface water impoundments more than 10-miles from the Site, and no drinking water or industrial water extraction is currently used at the Site. The USGS Map from 1968 depicts an agricultural well beyond ¼-mile to the northwest and across a stream watershed boundary. The proposed injections are not anticipated to influence any off-site water wells.

The objective of implementing the treatment system is to restore groundwater at the site to acceptable concentrations of target compounds. No active sources of drinking water will be affected by the in-situ bioremediation injections or air sparging wells.

ATTACHMENT K – HYDRAULIC CONTROL

IN-SITU BIOREMEDIATION INJECTION AREA

The bioremediation injections performed at the site is a short-term periodic process that does not measurably alter groundwater flow during injections after several hours. No clay lenses or formation layering was reported during past well drilling. Due to relatively homogenous formation characteristics, injections of electron donor substrate is not expected to result in plume migration. The influence of the injections on groundwater flow will be continued to be monitored through groundwater elevation measurements.

AIR SPARGING

Air sparging introduces localized groundwater mounds, which may affect groundwater movement. The short-term air sparging is not expected to result in any lasting groundwater mounding or natural flow modification. No clay extensive lenses or formation layering were reported during past well drilling. Due to relatively homogenous formation characteristics, air sparging is not expected promote uneven migration of the plume.

MEASURED HYDRAULIC GRADIENTS AND FLOW

Groundwater flowed southwest towards a branch of Rocky Fork Creek. Hydraulic conductivity at the Site was measured at 4.8 to 5.2 ft/day in the lower saprolite intersected by MW-2 and MW-3. Lower conductivity was estimated in the upper saprolite based on purging and recharge observations. Based on typical heterogeneity, it is expected that hydraulic conductivity in the saprolite ranges from 0.1 to 10 ft/day.

From the upgradient well MW-12 southwest over a distance of 1,035 feet to the creek discharge well MW-9, observed gradient ranged from 0.027 and 0.020. Using a hydraulic conductivity of 5 ft/day, the calculated linear groundwater flow velocity across the Site ranged from 126 to 150 feet per year. Vertical gradients from the bedrock layer at 60-feet below grade were upward near the building, and downward near MW-6. Discrete areas of lower and higher groundwater flow are expected based on variability in the saprolite permeability.