December 9, 2011

Ms. Jaclynne Drummond
NCDENR Environmental Compliance
Solid Waste Section
1646 Mail Service Center
Raleigh, NC 27699-1646

Re: Assessment Monitoring Work Plan for MW-2R
Winston-Salem Construction and Demolition (C&D) Landfill (No. 34-12)
Forsyth County, North Carolina
HDR Project No. 00162-13625-018

Dear Ms. Drummond:

HDR Engineering, Inc. of the Carolinas (HDR), on behalf of the Winston-Salem City/County Utility Commission (the City), is hereby submitting this assessment monitoring work plan for monitoring well MW-2R at the Old Salisbury Road (OSR) C&D Landfill located in Forsyth County, North Carolina. Monitoring well MW-2R is located downgradient of closed Phases I, II, and III of the landfill.

PURPOSE

During the Spring 2011 semiannual groundwater monitoring event in May, benzene and tetrachloroethene (PCE) were detected in a sample from one monitoring well (MW-2R) at a level slightly above their 2L standard. (Table 1). These results were subsequently confirmed in a resample event. Wells further downgradient of MW-2R (including MW-10 through MW-13) and downstream surface water sampling did not indicate the presence of these compounds. The only well indicating the presence of compounds above 2L standards is MW-2R. These were the only compounds detected above 2L standards and neither of these compounds has been detected at the site during previous routine semiannual testing. This letter presents background information and a work plan detailing the approach to assessment of potential ground water impacts.

BACKGROUND

The OSR C&D Landfill is operated by the City under NCDENR Permit No. 34-12. Phases I, II and III were permitted prior to January 1, 2007 and stopped receiving waste prior to June 30, 2008 which, under Rule 15A NCAC 13B .0531(c)(1), requires the City to comply with the Conditions of the Solid Waste Permit and Rule .0510. The letter of intent to close was submitted to NCDENR on April 23, 2008; a copy is attached for reference. Hand augers were performed on a 100 x 100 foot grid to confirm

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that there was a minimum of two feet of suitable compacted earth as required in 15A NCAC 13B .0505(3)(c). The closure certification dated on November 5, 2008 is included for reference. On November 6, 2008 HDR and City staff met with NCDENR on site to review the closure and hand deliver the certification. In February 2009, HDR submitted a request to enhance the existing cap by permanently adding excess excavated soil on top of the closed Phase I, II, and III landfill. The request was subsequently approved by NCDENR on March 18, 2009 with no additional waste being placed in the closed landfill phases.

Well MW-2R is utilized to monitor the groundwater for the closed Phases I, II and III which stopped receiving waste prior to June 30, 2008 and were capped properly under 15A NCAC 13B .0510.

ASSESSMENT MONITORING PLAN

Introduction

The Spring 2011 groundwater sample collected from monitoring well MW-2R detected benzene and PCE at 1.3 and 1.4 µg/L respectively. The 2L standard is 1.0 µg/L and 0.7 µg/L respectively and the NCDENR Solid Waste Section Limits (SWSL) standard is 1.0 µg/L. Monitoring well MW-2R is located adjacent to the closed Phase III. MW-2R was subsequently resampled on June 9th. As described in the July 11, 2011 water quality report, the retest results confirmed the presence of benzene and PCE. Each compound was detected at 1.6 µg/L, during the retest.

The following work plan has been developed to assess the cause, significance and extent of the groundwater impacts around MW-2R in accordance with 15A NCAC 13B .0545.

Site Conditions

The site is situated within an approximate 140-acre tract north of Friedberg Church Road and west of Old Salisbury Road in Forsyth County, North Carolina. The Davidson County line borders the site to the south. Land use in the site vicinity is mixed with residential, light commercial and undeveloped (agricultural) properties.

Routine semiannual monitoring has been conducted at the site since 1996. The current monitoring network at OSR consists of one background well (MW-1R) and twelve detection wells (MW-2R through MW-5R, and MW-7 through MW-14) which are sampled semiannually and analyzed for permit required parameters. Two surface water monitoring stations located along the South Fork Muddy Creek to the east (SW-1) and northeast (SW-2) of the landfill are also sampled semiannually. OSR also routinely monitors for methane gas at twelve methane monitoring wells which surround the site. The monitoring network is shown in Figure 1.

Figure 1 indicates that MW-2R is located in close proximity to the waste. The boring log indicates that MW-2R was installed through soil fill material. This well is surrounded by waste on the west, south and southeast sides.

Based on the results of previously conducted drilling and lithologic sampling programs at the site, three primary geologic units have been identified. They consist of the following layers.

- Residuum, the uppermost stratum (saprolite), consists predominantly of tan reddish-brown and gray silty sand (SM) with lesser amounts of a sandy silt (ML) formed in-situ by the physical and chemical weathering of bedrock. This unit has been reported to be up to 65 feet thick at the site, although it is generally much less.
- The bedrock transition unit consists of a variably decomposed and highly fractured bedrock zone lying beneath the residuum. The transition zone is sampled as a reddish-brown to tan silty sand (SM), with lesser amounts of a silty sandy gravel.
- A bedrock zone consisting of relatively unweathered, slightly fractured granodiorite is present at variable depths, but generally greater than 35 feet below ground surface along the older portion of the landfill. Fracture occurrence in the bedrock is reported to be variable and diminishes with depth.

Monitoring well MW-2R is located at the eastern edge of the Phase III area of the landfill. Groundwater flows north northeast from MW-2R along a drainage feature associated with the tributary of the South Fork of Muddy Creek. MW-2R was a replacement well installed to monitor the groundwater downgradient of the closed landfill (Phase I to III). MW-2R was completed to a depth of 20 feet below ground surface (bgs) with a screened interval of 15 feet. The well was installed through fill materials and residuum/saprolite to the top of partially weathered rock located at 20 feet bgs.

Surface drainage along the MW-2R area is to the east towards a small stream located approximately 30 feet east of MW-2R. MW-2R is also within 50 feet of two stormwater features located upgradient. Sedimentation Basin No.1 was installed in 1995 to collect stormwater runoff from Phase I and a drop inlet with a culvert directing drainage into the basin was installed in late 2009. The drop inlet collects runoff from the landfill access road on top of the landfill.

Shallow groundwater discharges to this stream, although at times the stream reportedly does not contain flowing water. This stream flows northward through a 250-foot length of 30-inch diameter pipe beneath the road to the scale house where it discharges into a northward flowing drainage feature which is a tributary of the South Fork of Muddy Creek.

As is typical for the Piedmont Physiographic Province, groundwater flows laterally and downward through the saprolite and bedrock toward streams, and other surface water bodies (discharge areas), to and along streams in the adjacent valleys. The water table surface is generally a subdued reflection of the surface topography. Groundwater at the site flows generally northward. Figure 1 includes a potentiometric surface map depicting groundwater elevations measured in May 2011.

As reported in the 1994 Groundwater Monitoring Plan, based on site hydraulic conductivities and gradients (assuming effective porosity of 20%) of the partially weathered rock, the groundwater flow rate at the site ranges from 0.10 to 1.1 feet per day (37 to 390 feet per year) at the site.

Site Investigation

In accordance with 15A NCAC 13B .0545, this assessment work plan is proposed to establish the nature and extent of the low level VOC concentrations downgradient and side gradient from MW-2R. The plan shall be capable of determining the following parameters.

- Lithology of the aquifer and unsaturated zone;
- Hydraulic Conductivity of the aquifer and unsaturated zone;
- Ground-water flow rates;
- Minimum distance of travel;
- Resource value of the aquifer; and
- Nature, fate, and transport of any detected constituents.

Procedural details of the proposed sampling and analysis program to determine the source and distribution of these low level VOC impacts are presented below.

Sampling

Groundwater and surface water sampling locations are described below and depicted on Figure 2 (attached).

- Groundwater samples will be collected from select monitoring wells and temporary investigative borings (e.g. Geoprobe®) at several locations, including:
  - Sampling point A*, on Figure 2, near the north boundary of the access road approximately 100 feet from the waste boundary downgradient of MW-2R.
  - Sampling point B*, on Figure 2, located approximately 200 ft east from the MW-2R and west of the scale house.
  - Additional borings may be installed based on conditions encountered.
  - Monitoring wells associated with only the closed Phases I, II, and III will be sampled. These include MW- 1, MW-2R, MW-3, MW-4, MW-5, MW-6, MW-7 and MW-8.

- Borings will be advanced using a direct push sampler or a small diameter hollow-stem auger into the water table. Upon reaching the water table, a groundwater sample will be collected approximately 3 to 5 feet below the water table. In select borings, the soil boring may be further advanced (if conditions allow), and an additional groundwater sample will be collected approximately 20 to 25 ft below the groundwater surface in the bedrock transition zone.

Samples will either be collected with an expendable drive point attached to a Geoprobe/HydroPunch tool or via a small diameter temporary PVC well screen inserted into the borehole to facilitate the collection of an adequate groundwater sample volume and assist in minimizing sample turbidity. Upon completion of groundwater sampling, these borings will be backfilled and sealed at ground surface with granular bentonite and abandoned. The location will be field measured off known landmarks such as existing wells and located horizontally with a hand held GPS unit. All drilling tools and sampling equipment will be decontaminated upon arrival to the site and between borings to minimize the possibility of cross contamination between borings.

- The on-site stream frequently contains flowing water with shallow groundwater in the vicinity of MW-2R discharging to the stream. Surface water samples will be collected from areas downstream of MW-2R including:

  - The small stream approximately 30 feet east of MW-2R (SW-3) prior to the pipe inlet.
  - At the pipe discharge point located approximately 300 feet downstream of MW-2R where the pipe discharges from beneath the road.

Permanent Well Installation

Per Rule 15A NCAC 13B .0545 (a) (1) a new groundwater monitoring well (MW-15) is proposed to be installed approximately 250 feet northeast of MW-2R at the compliance boundary to monitor shallow groundwater. This well will provide groundwater quality data. The following describes construction of this proposed well.

MW-15 will be constructed with a hollow stem auger rig in a manner comparable to other existing wells at the site. A hollow stem auger boring will be extended approximately 15 feet below the water table. Two-inch inside diameter (ID), Schedule 40 polyvinyl chloride (PVC) riser pipe will be flush-mounted to 15-foot section of 0.01-inch slotted PVC well screen thread connected to a PVC riser pipe. Washed #2 silica sand will be emplaced between the borehole wall and the well screen. In general, the sand pack will extend from the bottom of the boring to approximately 2 feet above the top of the well screen. A 2-foot thick bentonite seal will then be installed above the filter pack. The remaining borehole annulus from the top of the bentonite seal will be sealed using a Portland Type I cement with three percent bentonite mixture. The top of the new well will be fitted with a watertight locking well cap. A small vent hole in the PVC well pipe just below the cap will allow the water level in the piezometer to adjust to changes in atmospheric conditions. A concrete pad and protective riser casing will be installed. Upon completion, the well will be surveyed by a licensed surveyor and a slug test will be conducted to determine the hydraulic conductivity of this replacement well. A construction documentation report including soil boring and well construction log will be developed.

Analysis

Analytical testing will include constituents on the Appendix II of 40 CFR Part 258 as directed by the Division. Testing will occur at select monitoring wells, temporary groundwater borings, and surface water locations. To assist in evaluating the source of the impacts, select indicator compounds will also be tested. Analytical testing is further described below.

- Surface water samples, groundwater samples from the Geoprobe® borings, MW- 1, MW-2R, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8 and MW-15 will be analyzed for Appendix II as directed by the Division. Field measurements will include turbidity, dissolved oxygen, conductivity, oxygen reduction potential (ORP) and pH.
- To assist in source determination and to verify if the potential presence of landfill gas exist beyond the waste footprint, the well headspace in MW-2R and select other nearby wells and investigation borings will be monitored for methane gas using a GEM 2000 (or equivalent).
- To further assist in source identification, select leachate indicator compounds (including sodium, chloride and sulfate) will also be analyzed from select groundwater samples.

If any new constituent is detected in the downgradient wells during this sampling event a minimum of four independent samples from each well (background and downgradient) will be collected and analyzed to establish a new background. If the constituents are at or below background values for two consecutive events, the plume is not migrating horizontally or vertically, and the plume has not exceeded the compliance boundary the Owner shall request that the Division allow a return to detection monitoring.

Upon NCDENR approval of this assessment monitoring work plan, field activities (including water quality sampling and analysis) will be initiated and the owner shall place the approved program in the operation record. Upon the completion of field activities, a report will be prepared summarizing the initial findings, assessing the cause (source), extent, and significance of the water quality impacts, and providing recommendations for future actions. Based on the results of the initial sampling, additional sampling may be conducted to determine the extents of the plume. The summary report will be submitted to the NCDENR within four months after receipt of NCDENR work plan approval.

If you have any questions or comments concerning the information presented in this letter, or in the attached documents, please do not hesitate to contact me at (704) 338-6843.

Sincerely,

HDR Engineering, Inc. of the Carolinas

NORTH CAROLINA PROFESSIONAL SEAL 025495 ENGINEER MICHAEL D. PLUMMER
12/9/11

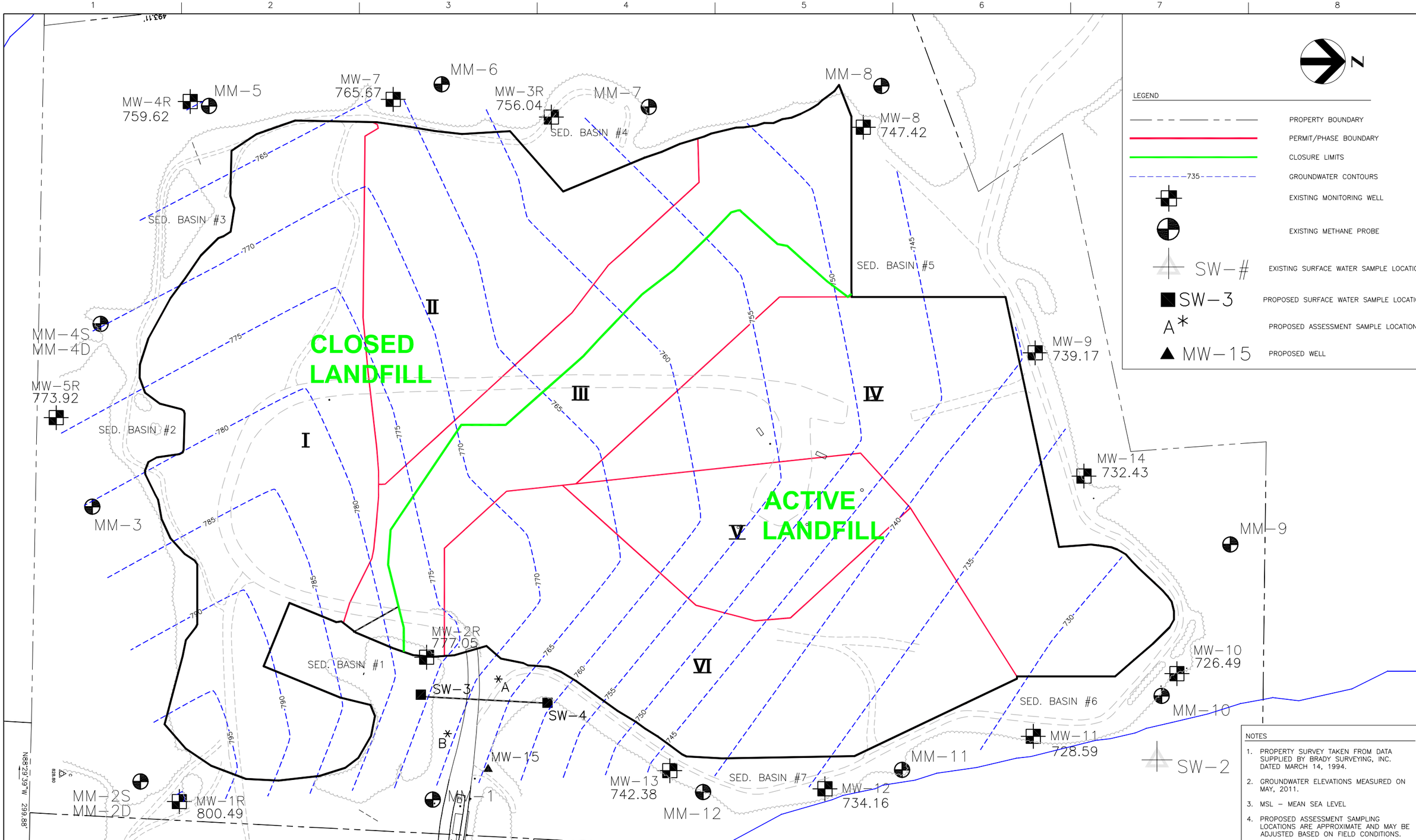
Michael D. Plummer, P.E.
Project Engineer

MDP/apb

Enclosures:

Figure 1, GW Contours and Monitoring Locations
Figure 2, Proposed Sampling Locations for Site Assessment
Event Summary Table, May-June 2011

cc: Jan McHargue, PE Winston-Salem City/County Utility Commission
Edward Gibson, PE, Winston-Salem City/County Utility Commission
File



NOTES

1. PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC. DATED MARCH 14, 1994.
2. GROUNDWATER ELEVATIONS MEASURED ON MAY, 2011.
3. MSL – MEAN SEA LEVEL
4. PROPOSED ASSESSMENT SAMPLING LOCATIONS ARE APPROXIMATE AND MAY BE ADJUSTED BASED ON FIELD CONDITIONS.

HDR
HDR Engineering, Inc.

ISSUE	DATE	DESCRIPTION
A	12/9/11	SUBMITTED TO NCDENR

CLIENT MANAGER	M.D. PLUMMER, P.E.
PROJECT MANAGER	
CAD	G.M. WILLIAMS, P.E.
PROJECT NUMBER	

OLD SALISBURY ROAD
C & D LANDFILL

WINSTON-SALEM **NORTH CAROLINA**

FIGURE 1
OSR GROUNDWATER
SITE ASSESMENT

0 1" 2"

FILENAME	FIG 1 – OSR GW
SCALE	1"=100'

SHEET
FIG 1

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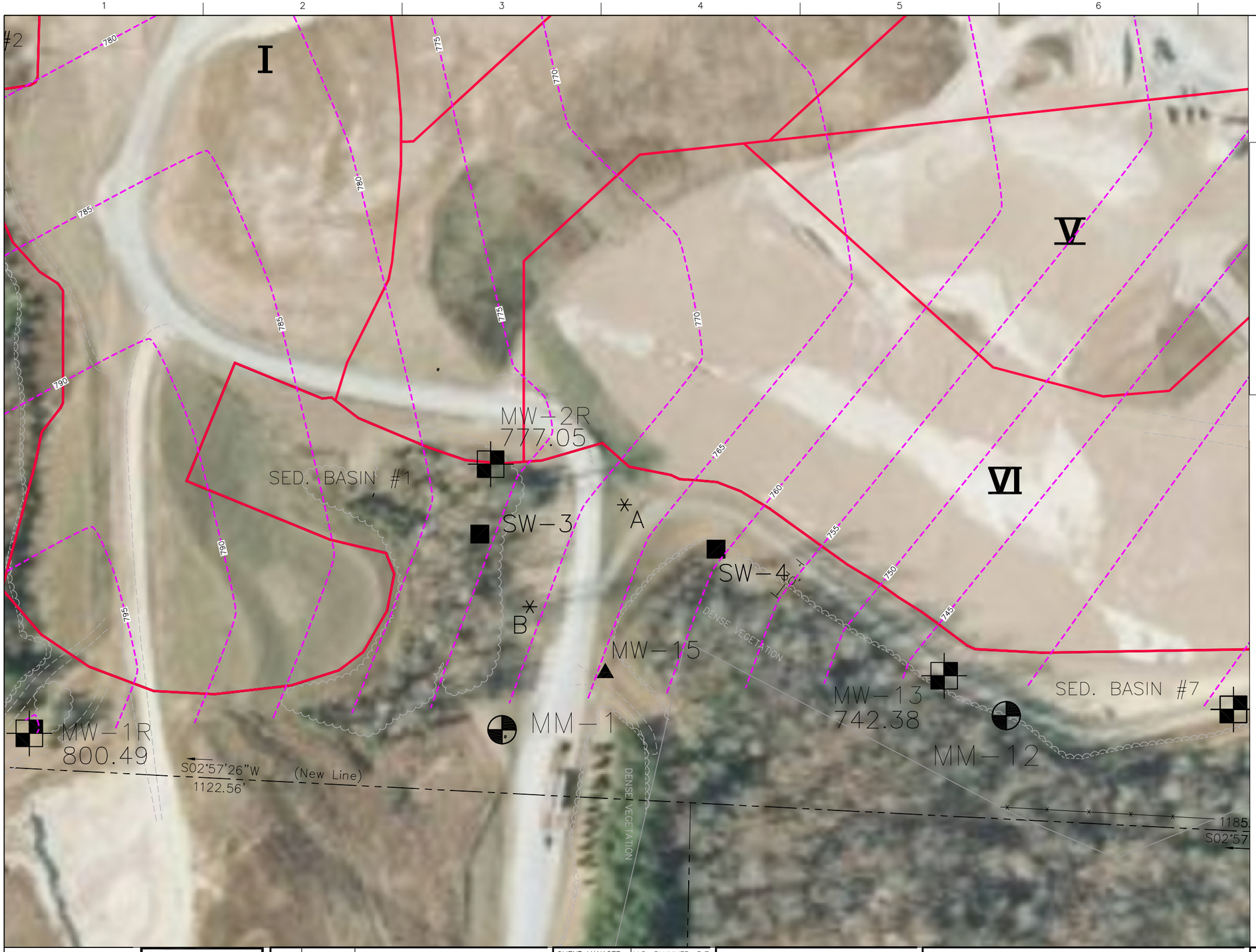

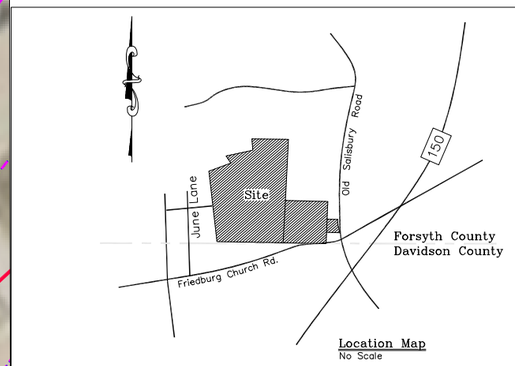

Location Map
No Scale

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LEGEND

	PROPERTY BOUNDARY
	PERMIT/PHASE BOUNDARY
735	GROUNDWATER CONTOURS
	EXISTING MONITORING WELL
	EXISTING METHANE PROBE
SW-#	EXISTING SURFACE WATER SAMPLE LOCATION
SW-3	PROPOSED SURFACE WATER SAMPLE LOCATION
A*	PROPOSED ASSESSMENT SAMPLE LOCATION
MW-15	PROPOSED WELL

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CAD	
PROJECT NUMBER	–

OLD SALISBURY ROAD
C & D LANDFILL

WINSTON-SALEM NORTH CAROLINA

FIGURE 2
PROPOSED SAMPLING LOCATION
FOR SITE ASSESSMENT

0 1" 2"

FILENAME	FIG 2 SAMPLE
SCALE	1"=60'

SHEET
FIG 2

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Event Summary Table

Facility Permit 34-12

Old Salisbury Road Landfill (C&D)

To distinguish non detections (ND) from not sampled (NS), refer to complete laboratory analysis. This table represents both ND and NS as blanks.

Standard		Value		Jun-11		May-11																
SWSL	2L	units		MW-2R	Trip Blank	MW-1R	MW-2R	MW-3R	MW-4R	MW-5R	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12	MW-13	MW-14	SW-1	SW-2	Equipment Blank	Trip Blank
			°C																			
			Field Temperature	19.1		17	16	14.6	14.3	15.5	16.2	16.6	18.7	16.6	15.6	15	15	17.1	19.7	18.6		
			µg/L																			
5	NE	µg/L	1,1,1,2-Tetrachloroethane																			
1	200	µg/L	1,1,1-Trichloroethane								0.82											
3	0	µg/L	1,1,2,2-Tetrachloroethane																			
1	NE	µg/L	1,1,2-Trichloroethane																			
5	6.00	µg/L	1,1-Dichloroethane				1.1				3.8											
1	0	µg/L	1,2,3-Trichloropropane																			
13	0	µg/L	1,2-Dibromo-3-chloropropane																			
1	0.02	µg/L	1,2-Dibromoethane (EDB)																			
5	20	µg/L	1,2-Dichlorobenzene																			
1	0	µg/L	1,2-Dichloroethane																			
1	1	µg/L	1,2-Dichloropropane																			
1	6	µg/L	1,4-Dichlorobenzene																			
100	4000	µg/L	2-Butanone (MEK)																			
50	NE	µg/L	2-Hexanone																			
100	NE	µg/L	4-Methyl-2-pentanone (MIBK)																			
100	6000	µg/L	Acetone									3.8										
200	NE	µg/L	Acrylonitrile																			
10	10	µg/L	Arsenic																			
100	700	µg/L	Barium			84.7	273	301	126	63.7	104	27.3	153	80.7	56.2	39.1	164	125	69.9	49.2		
1	1	µg/L	Benzene	1.6			1.3															
3	NE	µg/L	Bromochloromethane																			
1	1	µg/L	Bromodichloromethane																			
3	4	µg/L	Bromoform																			
10	NE	µg/L	Bromomethane																			
1	2.00	µg/L	Cadmium																			
100	700	µg/L	Carbon disulfide																			
1	0	µg/L	Carbon tetrachloride																			
3	50	µg/L	Chlorobenzene																			
10	3000	µg/L	Chloroethane																			
5	70	µg/L	Chloroform				0.36															
1	3	µg/L	Chloromethane						0.15							0.21		0.24				
10	10.0	µg/L	Chromium			1.4	5.4		1.3	7.6		0.96		0.63		2.6	3.9	1.8				
5	70.0	µg/L	cis-1,2-Dichloroethene				0.26				0.71											
1	0	µg/L	cis-1,3-Dichloropropene																			
3	0	µg/L	Dibromochloromethane																			
10	NE	µg/L	Dibromomethane																			
1	600	µg/L	Ethylbenzene																			
10	NE	µg/L	Iodomethane																			
10	15	µg/L	Lead																			
5	500	µg/L	m&p-Xylene				0.74				1.4											
0	1	µg/L	Mercury																			
10	20	µg/L	Silver			0.51	2.5	0.6	0.88	0.57	0.84	0.1	0.43	0.12	1.2	0.7	0.72	0.74	0.4	0.2		
5	7	µg/L	1,1-Dichloroethene																			
1	5	µg/L	Methylene Chloride				4.1															
NE	NE	µg/L	o-Xylene				0.84				0.39											
1	2000	µg/L	Trichlorofluoromethane				31.6				0.48		0.26	0.52								
10	20	µg/L	Selenium																			
1	70	µg/L	Styrene																			
1	1	µg/L	Tetrachloroethene	1.6			1.4															
1	600	µg/L	Toluene																			
5	100	µg/L	trans-1,2-Dichloroethene																			
1	0	µg/L	trans-1,3-Dichloropropene																			
100	NE	µg/L	trans-1,4-Dichloro-2-butene																			
1	3.00	µg/L	Trichloroethene				0.65															
50	NE	µg/L	Vinyl acetate																			
1	0	µg/L	Vinyl chloride																			
NE	NE	µg/L	Sodium	27200																		
NS	NS	µg/L	Methane	1280																		
NE	NE	µg/L	Ethane																			
NE	NE	µg/L	Ethene																			
NS	NS	µg/L	Nitrogen, Ammonia	0.12																		
NS	NS	µg/L	Tetrahydrofuran	274			226								12.1		18.6					
			µmhos/cm																			
			Field Specific Conductance	698		110	687	409	174	208	193	10	153	55	321	179	171	140	295	129		
			feet																			
			Static Water Level	8.31		35.93	8.17	20.6	8.34	10.44	38	15.1	51.1	11.7	4	4.91	8.85	51.5				
			Total Well Depth	21		60	21	27	20	19.56	48	27	60	21	20	15.6	20	60				
			mg/L																			
NS	NS	mg/L	Chloride	39.9																		
			Oxygen, Dissolved	4.2		6.3	3.9	6.3	5.3	9	3.2	8.7	7.3	7.1	4.3	7.4	5.2	7.8	6.6	9.1		
			Alkalinity, Total as CaCO3	165																		
			mV																			
			REDOX	88		263	71	-43	271	141	245	272	265	279	-36	188	245	272	-15	23		
			NTU																			
			Turbidity	3		55	57	70	96	85	40	18	1	4	23	25	177	39	50	52		
			Std. Units																			
			Field pH	5.8		5.8	5.9	6.2	5.7	6.1	5.6	5.1	5.6	5.5	6.2	6	5.6	5.5	6.4	6.5		