TURNER PIT EVALUATION PLAN

BBSS Site
Crofton, Maryland

Submitted to:

Constellation Power Source Generation

Submitted by:

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1.0 Introduction

This report addresses item 35 of the October 1, 2007 Consent Decree issued by the Maryland Department of the Environment (MDE) to BBSS, Inc. and Constellation Power Source Generation, Inc. (CPSG) for the ash reclamation site located in Crofton, Maryland. The BBSS site is located in central Anne Arundel County as shown on Figure 1. As shown on Figure 2, there are two coal ash fills at the site, the Waugh Chapel Pit and the Turner Pit. Item 35 of the Consent Decree requires preparation of a plan to evaluate remedial options for the Turner Pit to address existing groundwater impacts and prevent further offsite migration of contaminants. The plan must include: a) a description of a quarterly assessment program for the pump and treat system to demonstrate the effectiveness of hydraulic control; b) a schedule for engineering, permit modifications and construction to increase groundwater collection and treatment capacity; c) investigation into the potential use of improved source controls at Turner Pit to enhance long term protection of groundwater; and d) a proposed schedule for all tasks culminating in a Turner Proposed remediation Report.

Remedial activities currently under way at the Turner Pit include a five-well pump and treat system that was installed downgradient of the Turner Pit and began pumping in May 2004. The five recovery wells, designated RW-1 through RW-5, are located along the eastern boundary of the Turner pit site adjacent to Maryland Route 3 (see Figure 2). Sample results from monitoring wells installed along this boundary suggest that capture of constituents by the remedial system is not complete along the southeastern corner of the site in the area of RW-1. As a result, additional studies are being performed to evaluate options to improve the recovery system.

An assessment of the remedial system and proposed interim and future long-term remedial system improvements are presented in this report, which is comprised of the following five sections:

- Section 1 – Introduction
- Section 2 – Quarterly Assessment Program
- Section 3 – Interim Remedial System Improvements
- Section 4 – Long-term Remedial System Improvements
- Section 5 – Schedule

2.0 Quarterly Assessment Program

This section discusses the quarterly program implemented to assess the capture zone for the Turner Pit recovery system. The program is comprised of several parts:

- Measuring water levels
- Measuring recovery well flow rates

- Constructing groundwater contour maps
- Assessing the capture of the Turner Pit recovery system

The first step in the capture zone assessment process is the collection of reliable water level measurements. By monitoring the rise and fall of water levels over time and at multiple locations, representative potentiometric maps can be prepared. Line graphs (hydrographs) prepa red to track water levels at multiple well locations also provide valuable information. Groups of wells may track with similar patterns showing long-term regional increasing or decreasing water level trends in response to periods of heavy rain or droughts. The second step is to monitor the flow rate for each of the pumping wells. Target pumping rates are established for each of the recovery wells based on groundwater modeling results (see Section 3.3). Maintaining pumping rates at target levels ensures comparability with groundwater modeling results and that capture is maintained.

2.1 Water Level Measurements

Water levels are measured monthly at monitoring wells and surface water locations at the BBSS site. The procedures described in this section apply to the following activities:

- Monthly water level measurements
- Annual well depth measurements

The water level measurements are recorded monthly in a bound notebook and are entered into a spreadsheet to calculate the elevation of the water at the observation point. Water levels are charted on line graphs and are included in the quarterly reports to MDE. The collection of accurate water level measurements relies on several factors:

- Accurate survey data for set measurement point
- Consistently using the same measurement reference point
- Accurately recording the data in a bound notebook
- Use of a high quality measurement device which is periodically checked against a known standard

The procedures for collecting water level data at the Turner Pit are detailed below:

- Locate the well and verify its position on the site map. Record whether positive identification was obtained, including the well number and any identifying marks or codes contained on the well casing or protective casing. Gain access to the top of the well casing.
- Locate the permanent reference mark (well datum) at the top of the casing. This reference point will be scribed, notched or otherwise noted on the top of the casing. If no such marks are present, measure to the top of the highest point of the well casing and note this fact in the field logbook. Identify the well datum elevation from the previous sampling event and record it in the notebook.

- Record any observations and remarks regarding the completion characteristics and well condition (such as evidence of cracked casing or surface seals), security of the well (locked cap), and evidence of tampering.
- Remove cap. Allow well to vent for 60 to 90 seconds to allow the water level to equilibrate to atmospheric conditions.

- Open the water level probe housing, turn the probe on, and test the alarm. Slowly lower the probe and cable into the well, allowing the cable reel to unwind. Continue lowering until the meter buzzes. Very slowly, raise and lower the probe until the point is reached where the meter just buzzes. Mark the spot by grasping the cable with the thumb and forefingers at the top of the casing. If a mark is present on the casing, use the mark as the reference point. If no mark is present, use the highest point on the casing as the reference point. Withdraw the cable sufficiently to record the depth.
- Raise the probe several feet above the previous reading and stop. Lower the probe a second time to confirm the water level. Record both water levels in the bound notebook.
- If a well depth measurement is required, lower the probe to the bottom of the well and record the depth to the known reference point.

Water levels in the following wells are measured on a monthly basis:

MW-1	MW-14	MW-26
MW-2	MW-15	PZ-3d
MW-3	MW-16	PZ-3s
MW-6	MW-17	PZ-4d
MW-7	MW-18	PZ-4s
MW-8	MW-19	RW-1
MW-9	MW-20	RW-2
MW-10	MW-21	RW-3
MW-11	MW-22	RW-4
MW-12	MW-24	RW-5
MW-13	MW-25	

Additional water level measurements are proposed for the following wells for future monitoring:

RW-6	*MW-30*	*PZ-7d*
RW-7	*MW-31*	*PZ-7s*
MW-23	*MW-32*	*PZ-8d*
MW-27	*MW-33*	*PZ-8s*
MW-28	*PZ-5s*	
MW-29	*PZ-6d*	

2.2 Flow Rates

Individual recovery well flow rates are measured on a monthly basis. The flow meters are located in the treatment shed at the northeast corner of the Turner Pit site (see Figure 2). Each recovery well has a dedicated flow meter. The flow from the recovery wells is combined into one pipe and is metered through a final flow meter. The cumulative gallons of water pumped are displayed on flow meters using an odometer-style counter which displays in units of tens of gallons pumped. The instantaneous flow for each well is displayed on a rotating dial. One rotation of the dial is equal to 10 gallons pumped. Flow rates are determined by timing one rotation of the dial (10 gallons) with a stopwatch. *Example: 30 seconds for one rotation (30/60 seconds = 0.5 minutes), therefore, 10 gallons/0.5 minutes = 20 gallons per minute.*

2.3 Data Management

Consistent, accurate water level measurements are important to understanding groundwater movement. Water level data are entered into a spreadsheet and water elevations are calculated from the datum elevation. Data-entries are independently checked for possible outliers or errors prior to data use. Data values in question will be brought to the attention of the data collector, and the data value assessed to determine if the data value is accurate and a reflection of a change to the groundwater system, or if there is a possible error (measurement, transcription or calculation). If the data point is determined to be in error, it will be corrected as possible (i.e., transcription error fixed), or the data point will not be used in analysis. The use of outlier values will be assessed on an individual basis, and noted as to their resolution.

A similar process is performed for reported flow rate data. Once checked, water level measurement and flow data values are available for use in analyses.

2.4 Contouring Procedures

Water level measurements from known reference points are entered into a spreadsheet and water elevations are calculated. The location identifications (e.g. MW-monitoring well, PZ-piezometer, RW-recovery well, SW-surface water) are paired with their X, Y coordinates. The data set for the quarterly water-level measurements is imported into Surfer 8.0® for contouring. The following procedures are followed:

- Data is gridded using a 50-foot by 50-foot grid.
- The grid is sized as follows:

Direction	Minimum (ft)	Maximum (ft)	Distance (ft)	# of Lines
X	1,398,300	1,402,550	4,250	86
Y	496,450	502,700	6,250	126

- Data is gridded using the Kriging method.

- A defined boundary file is used to eliminate grid points on the margins of the data set and to limit the contour extrapolation beyond the available data set. For example, one side of the boundary is formed by Towsers Branch.

- The piezometric surface developed by Surfer® is placed over a site map to correlate the measurements with site features and the remediation system.

- The completed piezometric map is used in the capture zone assessment and in the identification of changes to the groundwater flow system.

2.5 Capture Zone Assessment

Multiple data measures are used to evaluate the capture zone developed by the pumping wells. First, the potentiometric surface map described above is used to identify the limits of the capture zone developed by the pumping wells. Inflection points in the water table indicate where the groundwater flow direction changes from its natural flow path (controlled by the local hydraulic gradient) to that influenced by the drawdown of the remediation wells. Once the inflection points are located visually, the capture zone is traced on the map. With the use of a computer contouring program such as Surfer®, a flow vector field also can be added to the map, to assist in locating inflection points.

The pumping flow rates are then tabulated to provide information about the robustness of the pumping program. Steady pumping with little down-time aids in the consistent maintenance of a capture zone. A report is generated showing average flow rates and minimum/maximum values during the monitoring period. Any pump downtimes are noted, as well as their potential influence on the capture zone.

3.0 Interim Remedial System Improvements

3.1 RW-1 Modeling Results

Groundwater flow modeling was performed to identify possible modifications to the existing five-well remediation system in the form of alternate pumping rates or the addition of pumping wells to increase the capture zone and prevent the offsite migration of contaminants. The modeling refined a previous steady-state groundwater flow model that was developed in 2002 to simulate the groundwater remedial effect of the five groundwater extraction wells installed downgradient of the ash fill. The wells were installed in early 2004 and have been operated nearly continuously since May 2004. The previous steady-state model was re-calibrated to pre- and post-pumping scenarios and then simulations were performed to examine potential extraction schemes.

The U.S Geological Survey's (USGS) MODFLOW groundwater modeling program was used to simulate the groundwater flow system. The groundwater flow model was developed as a steady-state model and the model parameters included the vertical and horizontal boundary conditions, hydraulic conductivity (i.e., permeability), and recharge. The model was first calibrated to non-pumping conditions, and the model

was then subjected to the steady-state stresses of pumping from the five extraction wells (RW-1 through RW-5).

The USGS particle tracking computer program MODPATH was used to simulate groundwater particle tracking to assess and delineate potential groundwater capture zones. Hypothetical releases from beneath the landfill were simulated as particles traveling with groundwater flow. For the capture zone analysis, extraction wells were spaced along the property line to capture contaminants extending northeast of monitoring well MW-7 and southwest of well MW-13. The well pumping rates for each well were adjusted to optimize the capture zones for each well and to simulate groundwater removal from the existing extraction wells, which are fully screened within the target contaminant zone.

Two particle tracking scenarios were evaluated that simulated the actual operation of the pumping system: one scenario simulated operation from 2004 to early 2007 with steady-state pumping from the five wells at rates of 16-25 gallons per minute (gpm) and the other scenario simulated the upsizing of the pump in RW-1 that occurred in September 2007. A third particle tracking scenario was simulated that included the addition of a sixth pumping well placed between wells MW-8 and MW-13. The modeled particle tracking scenarios and results are summarized in the table below.

Particle Tracking Scenario	Pumping Details	Results
105 gpm System (simulated system operating from 2004-2007)	Five wells pumped at rates of 16-25 gpm each for combined rate of 105 gpm	Insufficient capture - particles escape along area between MW-13 and MW-8
108 gpm System (simulated system operating September 2007)	Five wells with upsized pump in RW-1 pumped at 26 gpm; other four wells pumped at rates of 18.5-24 gpm each for combined rate (five wells) of 108 gpm	Insufficient capture - particles escape along area between MW-13 and MW-8
134 gpm System (simulated addition of sixth well)	Sixth well pumped at 26 gpm added to 108 gpm system for combined rate of 134 gpm	Adequate capture - no particles escape

The results suggest that that although the treatment system as currently configured provides a hydraulic barrier to the area initially targeted (between MW-7 and MW-13), there are potential locations beneath the ash-fill in the area between MW-8 and MW-13 where the groundwater could escape the current network, even at increased pumping rates. Therefore, an additional well located between wells MW-8 and MW-13 is proposed to enhance the zone of capture. The modeled scenario indicates the well should be pumped at 26 gpm; however, future monitoring data should be evaluated and adjustments to the pumping scheme made, if needed, to balance the capture zone network.

3.2 Landfill Cap Performance

This section evaluates the effect of cap performance at the Turner Pit on groundwater quality and recovery efforts. Two modeling runs were used to identify possible impacts to groundwater associated with cap performance. The first model run

simulated hypothetical worst-case scenario conditions associated with decreased cap performance. This simulation yielded higher rates of recharge through the landfill. The second model run simulated the designed cap performance conditions, which are expected to be met in the post-construction phase after redevelopment is completed. In actuality, the long-term effects of the redevelopment may exceed this cap design as a result of decreased infiltration and reduced permeability associated with asphalt parking lots and structures. Because of this, the second modeling run may be considered a conservative case. While the model is a simplified version of the complex natural system, it provides insight into the controlling physical properties of the interaction between recharge through the cap and the pumping well performance. Simplifying assumptions included:

- steady state operation of the pumping wells
- consistent and uniform recharge over the entire cap area under the simulated scenarios

The two modeling runs are described below:

- Degraded Performance Scenario: 10 inches of infiltration per year (based on cap performance of 10^{-6} centimeter per second [cm/sec])

- Design Cap/Post-Development: 2 inches of infiltration per year (based on cap performance of 10^{-7} cm/sec)

The results of the modeling and the possible effects on the required pumping rates to maintain capture of constituents along Maryland Route 3 are as follows:

The current pumping scheme of 108 gpm was applied to each scenario. Identical particle release areas also were used in each model run, to isolate the impact of the increased recharge through the landfill. In both scenarios, particle migration reached MW-13. Under the Degraded Performance scenario, increased infiltration through the cap caused particle migration towards MW-8.

Next, an additional well was placed between MW-8 and MW-13. This proposed well was operated at a constant rate of 26 gpm. The distribution of pumping over the model layers matched the operation of the existing well network. This well operated in such a manner to capture the particles simulated to be released from the landfill under both the Degraded Performance and Design Cap/Post-Development scenarios.

Based on the modeling results presented in Sections 3.1 and 3.2, and the current understanding of the extent of impacted groundwater, URS recommends that one new recovery well be installed at the Turner Pit. Plume capture of the simulated particles released from the landfill indicates that an additional well will promote the creation of a larger capture zone towards the southwest (near MW-8). This will aid in reducing contaminant migration. The rational, locations and proposed flow rates are discussed in Section 3.3 along with need for additional piezometers to evaluate the capture zone.

3.3 Additional Recovery Well(s) and Piezometers

This section describes how additional recovery well(s) will be added to the existing five-well system to provide improved collection between MW-13 and MW-8. The additional groundwater collection for this phase of improvements will be limited to keep the total treatment quantity within the 160 gpm capability of the treatment system. Total flow from the five-well system is currently about 108 gpm. Therefore, approximately 40 to 50 gpm of additional capacity is available for interim system improvements. At current pumping rates, this would allow up to two additional recovery wells to be added without requiring significant changes to the treatment system.

Preliminary assessment of the remediation system performance suggests that only one well will be necessary to meet the current remediation requirements. This well would be located between monitoring wells MW-13 and MW-8. This assessment is based on the sulfate concentrations identified in down-gradient monitoring wells. Wells located along the south-western edge of the landfill (along Evergreen Road) appear to have background concentrations, while MW-8 and MW-13 appear to have increasing concentrations.

It is important to balance the pumping rate and well location with the observed sulfate concentrations in the groundwater. Excessive pumping or locating pumping wells in areas not affected by elevated sulfate concentrations could promote groundwater plume migration into previously un-impacted areas.

3.4 Water Appropriation Permit

The BBSS remedial system operates under MDE Water Appropriation Permit # AA2003G005 (01) with effective and expiration dates of September 1, 2003 and September 1, 2015, respectively. An application will be submitted to the MDE Water Management Administration–Water Rights Division requesting a change to the existing permit conditions. The requested changes are summarized below and correspond to the maximum capacity of the current treatment system:

Daily Average Gallons Pumped

Scenario	Current	Requested	Difference
On a yearly basis	157,000	209,000	52,000
For the month of maximum use	182,000	230,000	48,000

3.5 NPDES Permit

A request to revise the facility's National Pollutant Discharge Elimination System (NPDES) permit (permit # MD0068993) was included in the permit renewal application submitted to the MDE in March 2007. The permit renewal application described CPSG's intent to increase flow to the treatment ponds by up to 30 gpm. This additional flow was originally intended for the North Turner Pit leachate recovery system, but the system is no longer under consideration. CPSG will request approval from MDE to instead

discharge the additional flow (> 30 gpm) anticipated from the proposed Turner Pit remedial system improvements. The total flow from the improved remedial system would be up to 160 gpm, which is the capacity of the treatment ponds.

4.0 Long-term Remedial System Improvements

This section describes the modeling effort that will be used to determine if barrier walls are technically feasible to control off-site migration of constituents. URS will model barrier wall and pumping alternatives to identify options for preventing down-gradient transport of contaminants from the Turner Pit. URS will model hydraulic control scenarios (e.g., barrier wall, pumping wells, and/or a combination of the two) to examine the capture of groundwater flowing beneath the Turner Pit ash areas. The modeling will assume that the current cap performance is impaired and that the planned commercial development will significantly reduce infiltration by providing long term performance of 10^{-7} cm/sec infiltration rate or better (see Section 3.3).

The previously developed model for the BBSS site will be modified to incorporate and demonstrate the effect of low permeability barrier walls. Typical barrier wall permeability values will be taken from literature, professional experience and contacts with vendors. No testing of wall permeability or subsurface testing is associated with this task. However, site review and reconnaissance may be necessary to identify surface (existing and proposed roads, buildings, power, communication infrastructure, etc) and subsurface (sewer, water, power, communications) restrictions prior to modeling.

Modeling variables will include wall alignment, wall length, and wall depth. Important factors which need to be addressed include:

- The wall length needed to prevent off-site contaminant migration
- The wall depth needed to prevent underflow contaminant transport
- The wall and pumping well alignment that are necessary to prevent off-site contaminant migration and prevent groundwater mounding behind the wall
- The effect of having no confining unit to key into
- If the presence of the barrier wall will allow for reducing the flow rates in wells RW-1 through RW-5
- If site limitations (e.g., future development plans and high tension power lines along Route 3) impact wall alignment

URS envisions that up to three barrier wall configurations will be evaluated. These configurations could include:

- Entire downgradient extent of landfill
- Partial wall along the southwest edge of the landfill
- Partial wall along the southeast edge of the landfill.

URS will work closely with BBSS to identify wall configuration limitations prior to modeling the effects of the wall. The results of the modeling will provide information that can be used to assess the feasibility of a barrier wall system at the BBSS site. Limited sensitivity analysis is recommended to examine the impacts of the infiltration variations and the wall permeability.

5.0 Schedule

The following schedule is proposed for completing the actions described in this report:

a) The description of the quarterly assessment program for the pump and treat system to demonstrate the effectiveness of hydraulic control is included in this report. The first quarterly assessment report is due on January 31, 2008.

b) The schedule for engineering, permit modifications and construction to increase groundwater collection and treatment capacity is based on obtaining MDE approval of the proposed additional well, approval for modifications to the Water Appropriations Permit authorizing additional groundwater withdrawal and approval to discharge the additional treated groundwater under the existing NPDES (National Pollutant Discharge Elimination Permit) discharge permit.
   - Requests for permit modifications for the Water Appropriations and NPDES Permits will be submitted by the end of January, 2008.
   - Engineering will be complete within 2 months of obtaining all MDE approvals.
   - Installation of the well and associated equipment will be completed within 4 months of obtaining all MDE approvals.

c) The investigation into the potential use of improved source controls at Turner Pit to enhance long term protection of groundwater is underway as described in Section 4. A draft report describing the modeled effectiveness of proposed remedial alternatives for CPSG's and BBSS's review and selection of a remedy is anticipated in February.

d) The Turner Proposed Remediation Report will be the culmination of the Turner Pit remedial options evaluation. It will include a status report on the proposed interim remedial system improvements (installation of the proposed additional groundwater recovery well) in addition to a description of the remedial alternatives considered and the recommended alternative with supporting conclusions. This report will be submitted to MDE by April 30, 2008.

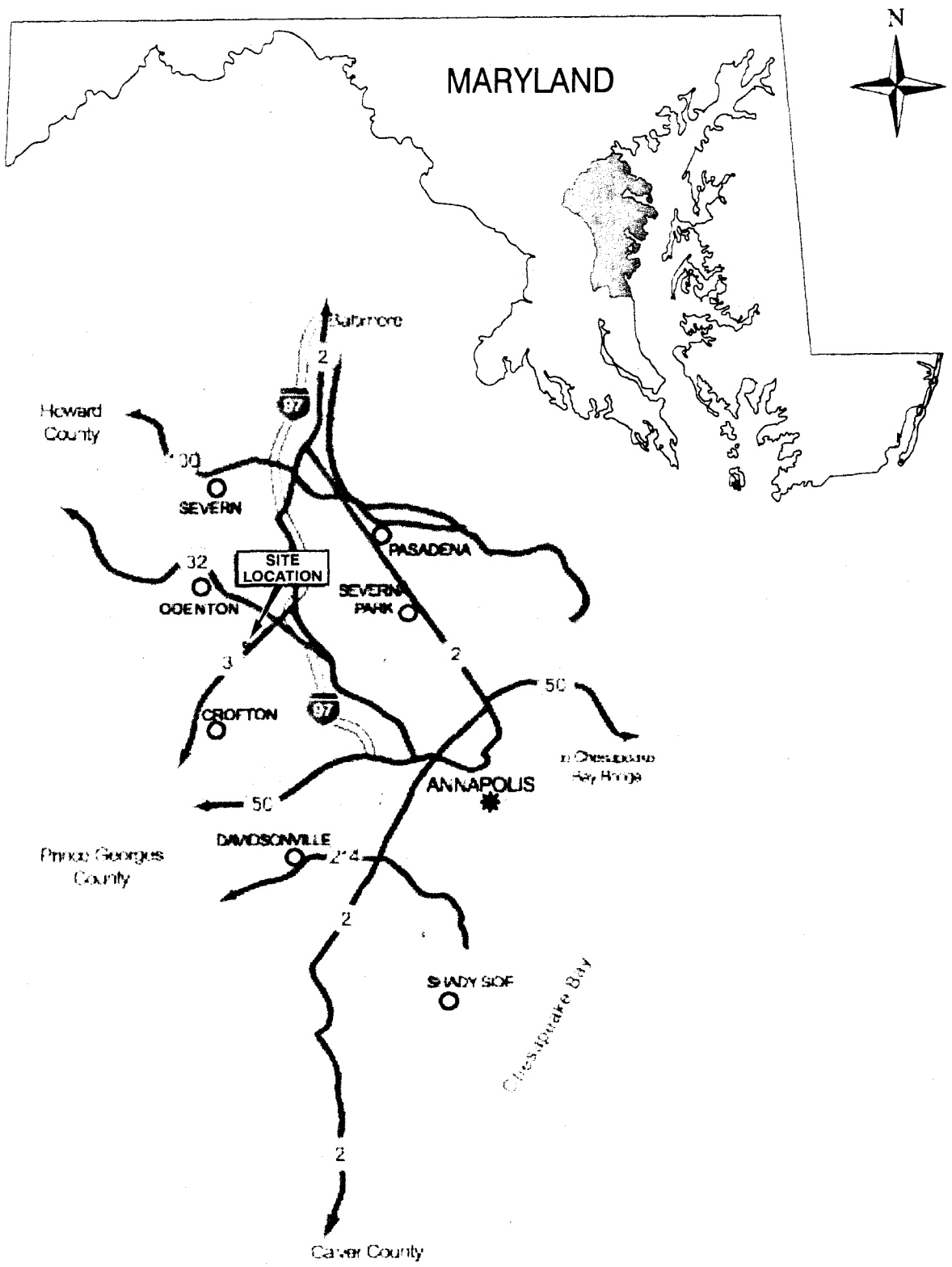
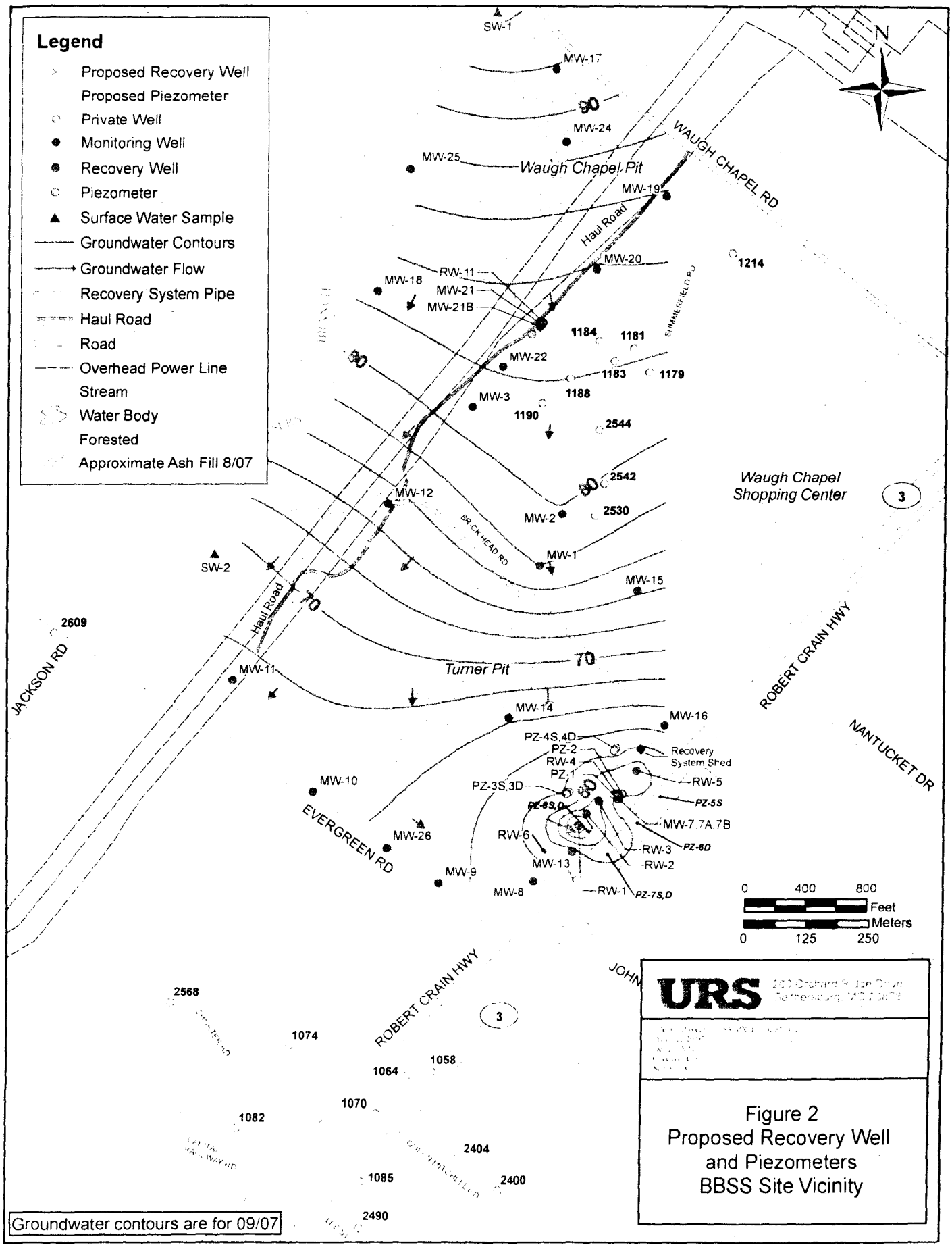


FIGURE 1
REGIONAL MAP
BBSS SITE
CROFTON, MD

P:\Gaithersburg\15300792.00003-BBSS\BBSS 1.cdr (11/28/07) SS

URS


Legend
Proposed Recovery Well
Proposed Piezometer
Private Well
Monitoring Well
Recovery Well
Piezometer
Surface Water Sample
Groundwater Contours
Groundwater Flow
Recovery System Pipe
Haul Road
Road
Overhead Power Line
Stream
Water Body
Forested
Approximate Ash Fill 8/07
N
SW-1
MW-17
MW-24
MW-25
Waugh Chapel Pit
MW-19
WAUGH CHAPEL RD
Haul Road
MW-20
1214
MW-18
RW-11
MW-21
MW-21B
1184
1181
SUMMERFIELD PL
MW-22
1183
1179
MW-3
1188
1190
2544
2542
MW-12
MW-2
2530
Waugh Chapel Shopping Center
3
BRICKHEAD RD
SW-2
MW-1
MW-15
Haul Road
2609
JACKSON RD
Turner Pit
MW-11
ROBERT CRAIN HWY
MW-14
MW-16
PZ-4S,4D
PZ-2
Recovery System Shed
RW-4
PZ-1
RW-5
MW-10
PZ-3S,3D
PZ-5S
PZ-8S,D
MW-7,7A,7B
EVERGREEN RD
MW-26
RW-6
RW-3
PZ-6D
RW-2
MW-13
MW-9
MW-8
RW-1
PZ-7S,D
NANTUCKET DR
0
400
800
Feet
Meters
0
125
250
JOHN
ROBERT CRAIN HWY
3
2568
1074
1058
1064
1070
1082
2404
1085
2400
2490
URS
Figure 2
Proposed Recovery Well
and Piezometers
BBSS Site Vicinity
Groundwater contours are for 09/07