APPENDIX F – GROUNDWATER MONITORING PLAN

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GROUNDWATER MONITORING PLAN
BIVENS INDUSTRIAL PARK MONOFILL EXPANSION
CAMDEN, TENNESSEE

TriAD Project No. 01-TRA03-01

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1.0 INTRODUCTION

This Groundwater Monitoring Plan (GWMP) presents the details of the groundwater monitoring program for the Bivens Industrial Park Monofill Expansion (Site), located in Camden, Benton County, Tennessee. The existing monofill is located at N36°02'15" Latitude and W88°04'30" Longitude. Access to the Site is from Bivens-Cypress Creek Road. A Vicinity Map is presented as Figure 1. The existing facility includes approximately 38.3 acres permitted for the beneficial use of coal ash from the Tennessee Valley Authority's Johnsonville Fossil Plant. The proposed expansion will increase the monofill by approximately 20.6 acres and is adjacent to the eastern boundary of the existing facility. This GWMP has been prepared to satisfy the requirements of Tennessee Rule 1200-1-7-.04, and will serve as guidance for personnel performing groundwater monitoring during the active life of the Site and during the closure/post-closure period.

Groundwater monitoring involves the effective use of monitoring parameters (or "indicator" parameters) and sampling locations to provide the earliest possible detection of a potential release from a facility. The objective is to select proper sample locations and parameters, identify an appropriate "background" (i.e., sampling medium that has not been affected by the facility and that represents the media at the relevant point(s) of compliance), and evaluate potential changes in water quality using an effective statistical methodology. The statistical methodology must be environmentally sensitive while balancing the false positive error rate.

This GWMP describes the monitoring frequencies for each monitoring point; analytical parameters; a sampling and analysis plan; and an appropriate site-specific statistical methodology. All elements of this program are in compliance with Tennessee Rule 1200-1-7-04, with the exception that a variance from the full Appendix 1 sampling list is requested. Instead, Trans-Ash will continue to sample for the list of parameters detailed in Section 2.4 which have been chosen based on the chemical characteristics of the ash and the parameters most likely to provide a reliable indication of a release from the facility.

2.0 GROUNDWATER MONITORING

This section describes the Site geology and hydrogeology and presents the proposed groundwater monitoring network, analytical parameters, and sampling schedule for the Site.

2.1 Site Geology and Hydrogeology

Based on the Geologic Map of the Camden Quadrangle (Tennessee Division of Geology, 1969), the entire Site lies within the outcrop zone of the Devonian-age Camden Formation. This formation consists of gray, bedded to blocky chert with some light gray tripolitic clay, locally stained yellow to brown. The Camden Formation is mapped as being over 100 feet thick in the area, and is underlain by the Harriman Formation, another chert that is difficult to distinguish from the Camden. Beneath the Harriman Formation, at a depth of about 150 feet, are limestones of the Ross and Decatur Formations.

Groundwater in the area is generally under unconfined (water-table) conditions, although the low permeability of the chert formation results in some localized confined conditions. Overall groundwater flow is to the north-northeast, into the valley of Cypress Creek, based on groundwater elevation data collected by TriAD as part of the existing monofill groundwater monitoring.

2.2 Groundwater Monitoring System

There are four existing groundwater monitoring wells located at the facility. MW-1 is an upgradient well located on the southern boundary of the existing facility. MW-2 is located just west of the northernmost corner of the existing facility. MW-3 and MW-4 are located along the northeast side of the existing facility. MW-4 will be relocated to the far northeast side of the Site to allow construction of the proposed 20.6-acre expansion. Figure 2 shows the existing and proposed locations of the monitoring wells. Well locations were chosen based on the groundwater flow direction to provide one upgradient and three downgradient monitoring wells.

The proposed groundwater monitoring well MW-4R will be installed in compliance with the United States Environmental Protection Agency (USEPA) Science and Ecosystem Support Division guidance *Design and Installation of Monitoring Wells*, dated February 2008. The site boundary will be considered the compliance boundary for the groundwater monitoring system. The well will be constructed of 2-inch diameter PVC with factory-slotted screen of appropriate length for the hydrogeologic conditions. A typical Well Construction Schematic is presented in Figure 3 and construction information regarding the existing wells is provided in Table 2-1. It is anticipated that MW-4R will be installed to a similar subsurface elevation as the existing well MW-4.

TABLE 2-1
EXISTING GROUNDWATER MONITORING NETWORK

Well	Top of Casing Elevation (ft MSL)	Well Depth (ft)
MW-1	505.60	90.4
MW-2	435.39	27.5
MW-3	416.39	21.7
MW-4	426.83	20.5

Prior to landfill construction, the outer well security casing and PVC stick-up of existing well MW-4 will be removed and the well will be backfilled with a bentonite grout by the tremie method from the bottom of the well to the ground surface.

2.3 Groundwater Sampling Schedule

For the first year, groundwater monitoring will be performed at MW-4R on a quarterly basis, while monitoring of MW-1, MW-2, and MW-3 will continue to be conducted semi-annually. Thereafter, groundwater monitoring at MW-4R will be performed on a semi-annual basis, in conjunction with monitoring at MW-1, MW-2, and MW-3. The first quarterly sampling event at MW-4R will be conducted prior to initiation of ash disposal activities in the expansion.

The monitoring parameters for the Site are listed in Table 4-1. Each sampling event will include the collection and analysis of one sample at each of the monitoring points included in the detection program. The monitoring requirement continues throughout the active life of the landfill and the post-closure care period unless a modified sampling frequency is approved in writing by the Tennessee Division of Solid Waste Management (TDWSM). If assessment monitoring is required, a schedule will be developed (see Section 4).

2.4 Groundwater Sampling Parameters

In addition to the field parameters which will be monitored in accordance with Section 5.1.2, the constituents listed in Table 2-2 will be monitored on a semi-annual basis. Associated analytical methods for each constituent are also provided in Table 2-2.

The monitoring parameters and their respective EPA analytical methods are listed below in Table 2-2.

TABLE 2-2
MONITORING PARAMETERS
(EPA ANALYTICAL METHOD)

Appendix I Inorganics	Additional Parameters
Antimony (6010)	Boron (6010)
Arsenic (6010)	Iron (6010)
Barium (6010)	Lithium (6010)
Beryllium (6010)	Strontium (6010)
Cadmium (6010)	Sulfate (9056)
Chromium (6010)	Total Dissolved Solids (2540)
Cobalt (6010)	
Copper (6010)	
Fluoride (340.2)	
Lead (6010)	
Mercury (7471)	
Nickel (6010)	
Selenium (6010)	
Silver (6010)	
Thallium (6010)	
Vanadium (6010)	
Zinc (6010)	

3.0 STATISTICAL EVALUATION

The statistical evaluation will be based on the requirements of Tennessee Rule 1200-1-7-.04(7)(a)4.(v)(II) and in general accordance with applicable portions of the USEPA, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance,* dated April 1989, and the USEPA, *Addendum to Interim Final Guidance*, dated July 1992.

Before determination of data distribution type, the non-detects will be assigned the value of one-half the appropriate detection limit for each constituent. After replacement, the coefficient of skewness will be calculated for the data to determine if the data has a normal distribution. If the coefficient of the skewness is between -1 and 1, then the data can be assumed to have a normal distribution. If the data is not normally distributed, the data will be transformed using a logarithm transformation and the coefficient of skewness will be recalculated. If the data distribution is determined to be normal with less than or equal to 15 percent non-detects, a one-way parametric analysis of variance (ANOVA) of the data will be performed. The one-way parametric ANOVA procedure will be used to compare the means of different groups of observations to determine whether there are any statistically significant differences among the groups. The two groups used in this statistical comparison will be the compliance wells (MW-2, MW-3, and MW-4R) and the background well (MW-1). In the event that a statistically significant increase is observed during the comparison, an individual well comparison will be performed using the residuals between the observation and the mean for each compliance well and the Bonferroni t-statistic critical value. If the residual exceeds the Bonferroni t-statistic critical value, there exists statistically significant evidence of contamination.

For normally distributed data with non-detect values accounting for greater than 15 to 50 percent of the data and non-normally distributed data with less than or equal to 50 percent non-detect values, the Kruskal-Wallis Test will be used to perform the statistical

comparison. The Kruskal-Wallis Test is a one-way non-parametric ANOVA procedure that compares the median concentration of a constituent in two groups instead of the mean concentration to determine whether there are any statistically significant differences among the groups. In the event that a statistically significant increase is observed, the critical difference will be calculated to compare the difference between the average rank of each compliance well and the background well. If the difference between the average rank of each compliance well and the background well exceeds the critical difference, there exists statistically significant evidence that the compliance well has been contaminated.

For normally and non-normally distributed data with greater than 50 percent non-detect values, the Test of Proportions will be used to perform the statistical comparison. The Test of Proportions is a method used to determine whether a difference in the proportion of detected values in the background well observations and the compliance well observations provides statistically significant evidence of contamination. The Test of Proportions procedure will be performed by comparing the absolute Z statistic based on the difference between the proportion of detects in the compliance wells and background well with the 97.5^{th} percentile of the standard normal distribution. If the absolute Z statistic exceeds the 97.5^{th} percentile, there is statistically significant evidence, at the five percent significance level, that the proportion of compliance well samples exceed the proportion of background samples.

Statistics will not be completed for field parameters.

4.0 ASSESSMENT MONITORING

Assessment monitoring will be conducted if, during detection monitoring, a statistically significant increase (SSI) over background is detected and verified for one or more constituents listed on Table 2-2. The TDSWM will be notified within 14 days of an SSI, in accordance with Tennessee Rule 1200-1-7-.04(7)(a)5.(iii)(I).

Upon commencement of assessment monitoring, a groundwater sample will be collected from all detection monitoring locations, unless otherwise approved by the TDSWM. This sampling will occur within a period of 90 days from the verified exceedance (inclusive of verification re-sampling activities). Samples collected for assessment monitoring will be analyzed for the constituents listed in Table 2-2.

Alternate source demonstrations (ASDs), if initiated, will be completed within 90 days of verification of the SSI (Tennessee Rule 1200-1-7-.04(7)(a)5.(iii)). Assessment monitoring must be initiated within 90 days of an unsuccessful completion of an ASD or within 90 days of the SSI if an ASD is not initiated.

Should assessment monitoring reveal a verified detection(s) of a monitoring parameter(s), the TDSWM will be notified within 14 days of this finding. Concurrently, a groundwater quality assessment plan will be developed for the Site and submitted to the TDSWM in a timely manner. The groundwater quality assessment will meet all the requirements specified in Tennessee Rule 1200-1-7-.04(7(a)6.(iv)(I). Quarterly sampling and analysis for those parameters with an SSI will be conducted while the corrective action plan is being developed and implemented, or until the TDSWM gives notice to cease. A letter addendum to this Plan will be developed if an assessment monitoring plan is ever required.

5.0 SAMPLING PLAN

Proper sampling procedures are a fundamental aspect in an effective monitoring program. All environmental sampling at the Site will be performed by personnel trained in proper sampling protocol, and in accordance with the methods presented in this plan. As Site conditions change, all activities related to monitoring at the Site will be continually reviewed and scrutinized for completeness and integrity.

The following subsections describe the field activities required to accomplish the groundwater sampling at the Site. All field activities will be recorded in a dedicated field notebook or on a field form. Entries will be made in ink and will contain, at a minimum:

(1) Facility name

(2) Date and time of the sampling event

(3) Names of sample personnel

(4) Weather and other pertinent field notes

(5) Sample locations

(6) Field measurements (e.g. pH, temperature, specific conductance)

(7) Description of sampling procedures

(8) Description of any deviations from the sampling plan

(9) Description of extraordinary events or conditions

5.1 Sample Collection Procedures

5.1.1 Monitoring Well Sampling Methodology

5.1.1.1 Monitoring Well Elevation Data

Prior to sampling, each monitor well will be gauged from the top-of-casing with an electronic resistivity probe, which measures the groundwater level. Measurements of groundwater elevation will be made to a precision of ±0.01 ft. The measuring device will be cleaned prior to use in each well.

The volume of water in a well volume will be calculated as follows:

- Subtract the depth to the top of the water column from the total depth of the well to determine the length of the water column.
- The water column length will then be multiplied by 0.163 for 2-inch wells and 0.65 for 4-inch wells.

5.1.2 Monitoring Well Evacuation Prior to Sampling

After the water level measurement, each monitoring well will be purged using a dedicated, clean polyethylene bailer or dedicated submersible pump. New nylon string will be used to lower the bailers into the wells. Purging will be considered complete

when a minimum of three well volumes are removed and field parameters have stabilized, or when the well is dry. Field parameters will be considered stabilized when pH, specific conductance, and temperature have stabilized. Stabilization will be achieved when, for at least three consecutive measurements, pH remains constant within 0.1 standard units, and specific conductance and temperature vary no more than approximately 10 percent.

If after three well volumes have been purged the chemical parameters have not stabilized, additional well volumes (up to five volumes) should be purged. If the parameters have not stabilized within five volumes, the field personnel will determine whether or not to collect a sample or continue purging.

During purging, measurements of groundwater turbidity will also be made and recorded.

5.1.3 Sample Collection from Monitoring Wells

Groundwater samples will be obtained using either clean, dedicated polyethylene bailers or dedicated pumping systems. New nylon string will be used to lower the bailer to the top of the water column for sample collection in a manner to minimize agitation within the well. The bailer will be retrieved from the well and the contents poured into laboratory-supplied containers.

Upon completion of the field measurements, additional samples, as needed, will be collected from the well for laboratory analyses and placed in laboratory-supplied containers.

5.2 Sample Preservation, Shipment, and Chain-of-Custody Control

5.2.1 Sample Preservation

All samples that are collected will be poured into laboratory-supplied containers that have been pretreated with the appropriate preservative for the parameter being tested.

5.2.2 Sample Shipment

All samples will be packaged securely in an ice-filled cooler (kept at or below 4□C) and transported to the analytical laboratory following the chain-of-custody procedures outlined below.

5.2.3 Chain-of-Custody

Each sample container will be individually identified as to sample number, date and time taken, and source of sample. A chain-of-custody record will be prepared for all samples which will include:

(1) Name of the person collecting the samples
(2) Identity of each sample
(3) Source of each sample
(4) Preservation provisions for each sample
(5) Analytical requirement
(6) Name of person accepting sample

Custody transfers of samples will be recorded on the chain-of-custody form by signatures of the relinquisher and the receiver. This procedure will be repeated, as necessary, until final delivery is made to the analytical laboratory.

6.0 DATA QUALITY REVIEW, REPORTING, AND RECORDKEEPING

The following sections describe the evaluation, reporting, and recordkeeping procedures that will be followed upon receipt of the analytical report.

6.1 Data Quality Review

Each analytical report received from the laboratory will undergo quality assessment. Before the results are subjected to statistical analysis, it will be evaluated by examining the quality control information that accompanies the analytical results. Relevant quality control data include measures of accuracy (percent recovery), precision (relative

percent difference), and sample contamination (blank determinations). Data that fail any of these checks will be flagged for closer evaluation and a Data Quality Review (DQR) by the laboratory. Results of the DQR will be submitted with the analytical data in the monitoring report.

6.2 Data Reporting Requirements

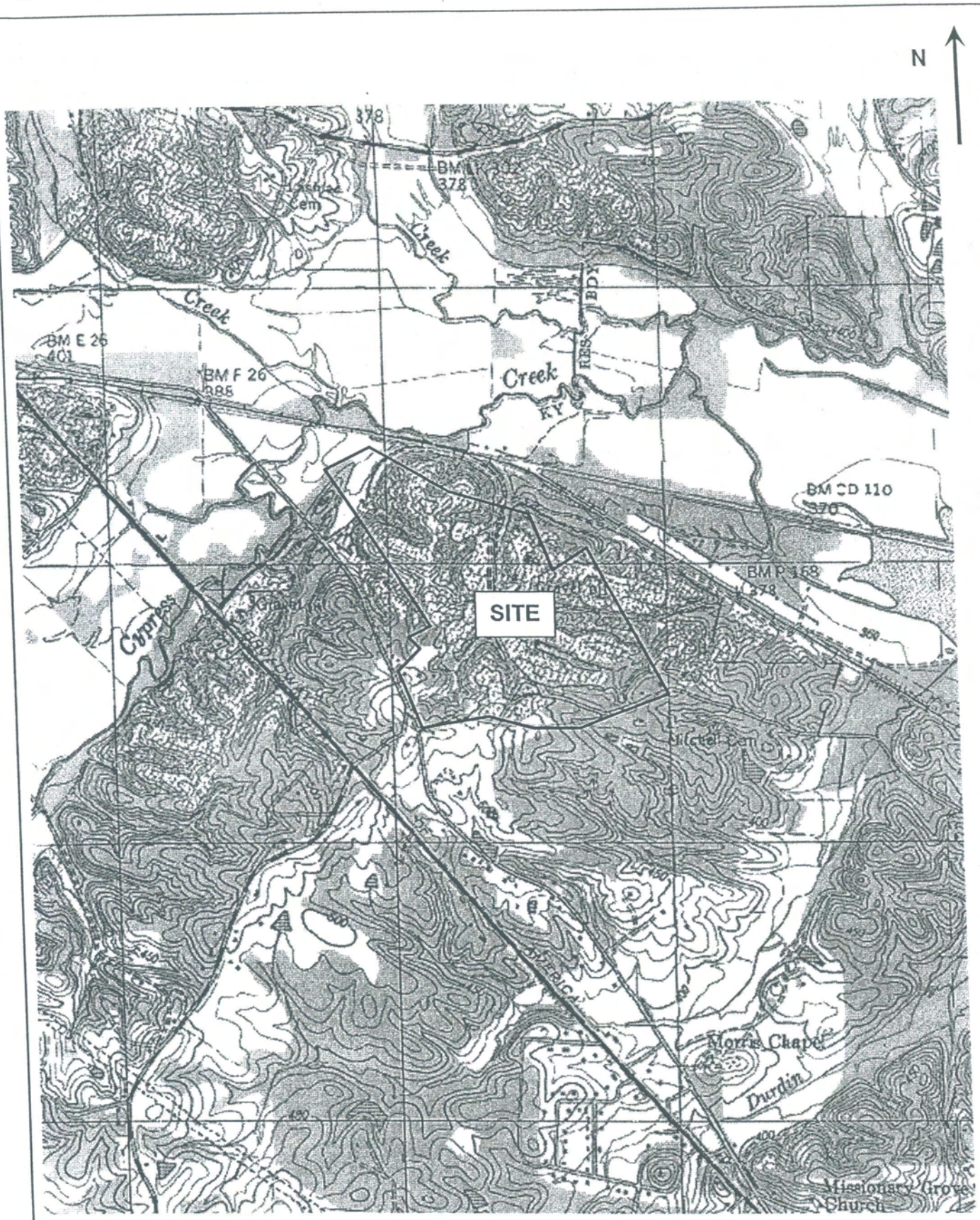
As per Tennessee Rule 1200-1-7, reports of groundwater monitoring activities will be prepared and transmitted to the TDSWM within 60 days of sampling completion. These reports will include the following, at a minimum:

- Description of sampling activities and a summary of analytical results
- Site vicinity and sampling location map
- Statistical analysis of the results
- Copies of field data sheets and records
- Copies of the laboratory data reports
- Copies of the laboratory chain of custody forms
- Flow direction and rate information
- Documentation of statistical analyses

6.3 Recordkeeping

The Site will maintain records of all groundwater sampling reports performed at the Site throughout the post-closure period. The reports will be kept at the facility or at some other location in Tennessee as approved by the TDSWM.

FIGURE 1
Vicinity Map



Source: USGS Topographic Map of the Camden, TN Quadrangle

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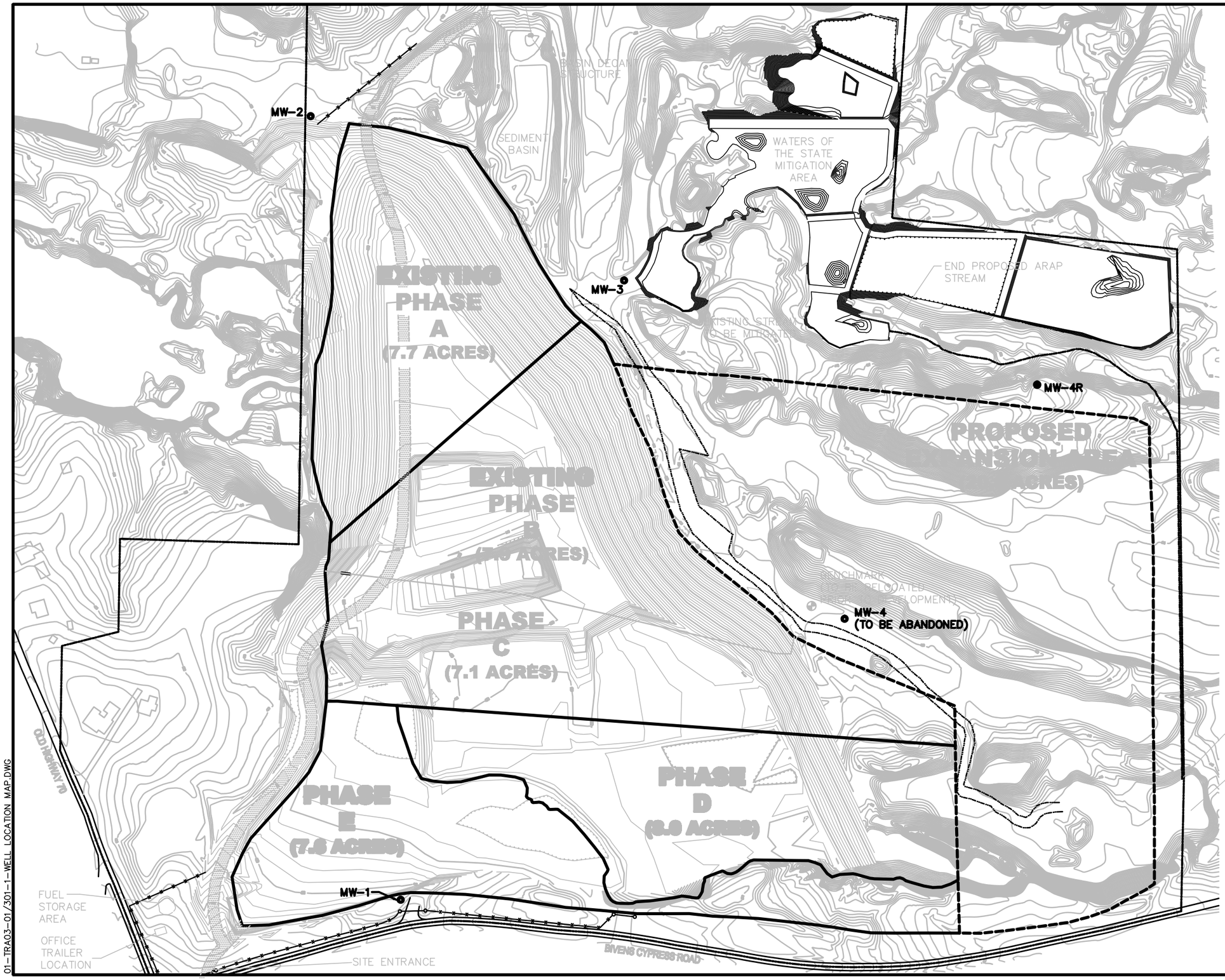
FIGURE 1
VICINITY MAP
Bivens Industrial Park
Benton County, Camden, Tennessee

DWG DATE: 3/21/08 | SCALE: 1:50,000

FIGURE 2
Groundwater Monitoring Locations



BENCHMARK – IRON ROD MARKER IN CONCRETE
N627596.36
E135629.65
ELEV.=424.80

NOTES

1. BASE MAP DEVELOPED FROM MARCH 27, 2003, AERIAL SURVEY PROVIDED BY KUCERNA INTERNATIONAL, INC.
2. BASE MAP MODIFIED BASED ON JANUARY 11, 2007, SURVEY BY TRANS-ASH, INC.
3. ACCORDING TO FIRM MAP NO. 47005C0162D, DATED DECEMBER 16, 2005, THIS PROPERTY IS NOT LOCATED IN A 100-YEAR FLOOD PLAIN.
4. PROPOSED ARAP STREAM LOCATION IS APPROXIMATE. ACTUAL STREAM SHALL BE FIELD LOCATED.
5. EXISTING WETLAND LOCATIONS SHOWN ARE APPROXIMATE. EXISTING WETLANDS WILL BE MITIGATED IN ACCORDANCE WITH THE APPROVED SITE ARAP.

LEGEND

- EXISTING FENCE
- EXISTING ENTRANCE GATE
- EXISTING CONTOUR
- EXISTING ROAD
- MW-1 EXISTING GROUNDWATER MONITORING WELL
- MW-4R PROPOSED GROUNDWATER MONITORING WELL
- PHASE BOUNDARY
- BLUELINE STREAM
- PROPERTY BOUNDARY
- PROPOSED EXPANSION AREA

0 200 400
SCALE IN FEET

WELL LOCATION MAP

BIVENS INDUSTRIAL PARK MONOFILL
CAMDEN, TENNESSEE

SCALE: 1"=400'	DR ALW	CHK	REV DWF

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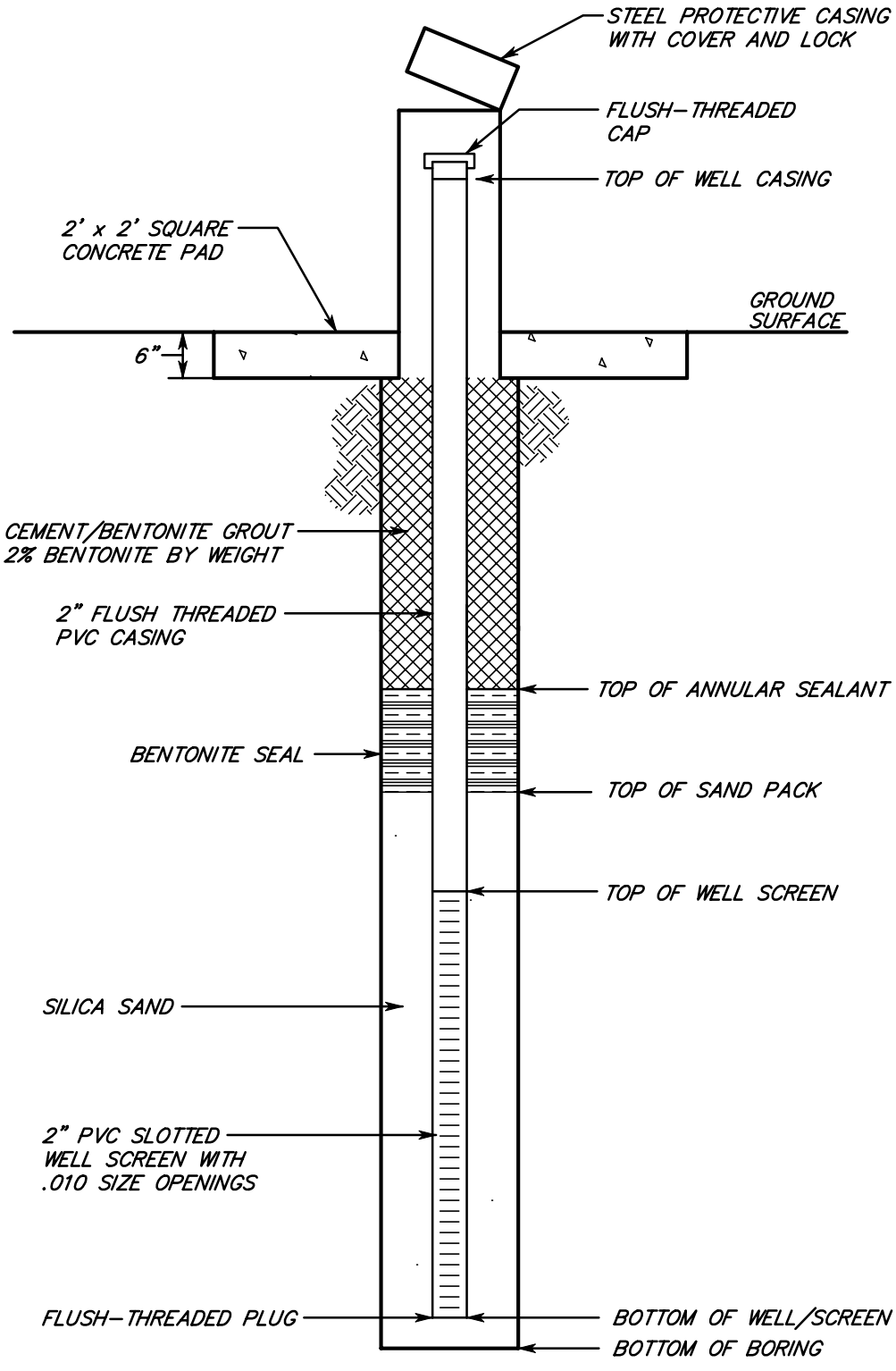
01-TRA03-01/301-1-WELL LOCATION MAP.DWG

FIGURE 3
Typical Well Construction



DEPTH	ELEVATION

NOT TO SCALE

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TYPICAL WELL CONSTRUCTION

DWG. DATE: 08/27/08	PROJECT NO.:
FILE NAME:	SHEET 1 OF 1

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