

APPROVED

DIVISION OF WASTE MANAGEMENT

SOLID WASTE SECTION

DATE 1/14/05 BY JF

central office

18-09

Duke Power

Marshall Steam Station

Catawba County, N.C.



Flue Gas Desulfurization (FGD) Residue

Landfill Permit Application

Site Suitability Information

November 12, 2004

Volume 1

Addendum 1

15A NCAC 13B

.0503(1) and .0504(1) Requirements and Responses

Carmen Johnson

Fac/Perm/Co ID #	Date	Doc ID#
18-09	1/25/12	DIN

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Duke Energy
Marshall Steam Station
Catawba County, N.C.
Landfill Permit Application – Site Suitability Report – Addendum 1
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Addendum 1

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.0503(1) and .0504(1) Requirements and Responses

Volume 1

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Description of Addendum 1

The original Site Suitability Information report for the Marshall FGD Residue Landfill, Volumes 1 and 2, dated August 29, 2003, was based on a landfill footprint of 22 acres. The landfill footprint has been revised to 33 acres. Addendum 1 is prepared to address changes to the information submitted on August 29, 2003.

Only portions of Volumes 1 and 2 requiring changes were revised. These revised sections are marked with a vertical bar in the right margin of the text or by noting "Revision 1" on the drawing or figure.

The property where the landfill is located is comprised of several tracts that were purchased at the time the Marshall project began. These tracts were recombined into a single tract, described by a single property deed. This revised property information is shown on Figure 5 and Figure 6.

Attachments 1 – 7, which were provided in the original report are unchanged, therefore, no copies of those attachments are contained in this report.

The Catawba County Planning Department has approved a Duke Power request that would allow the landfill at Marshall Steam Station to receive FGD residue generated by other Duke Power facilities. A copy of the letter from the Catawba County Planning Department is included in Attachment 8.

Attachment 9 is the Proposed Groundwater Sampling and Analysis Plan. A revised version of Attachment 9 is included in this report.

1.0 INTRODUCTION

The Clean Smokestacks Act passed in 2002 requires significant reductions in emissions from coal-fired power plants operating in North Carolina. NC utilities must reduce the actual emissions of nitrous oxides (NO_x) by 77% by the year 2009 and must reduce actual sulfur dioxide (SO₂) emissions by 49% by the year 2009 and by 73% by 2013. As part of Duke Power's effort to meet the SO₂ reduction requirements, a Flue Gas Desulfurization (FGD) system will be installed at the Marshall Steam Station. Duke will also install similar FGD systems at other power plants located in NC. Duke's intent is that a large portion of the residue from this process will be utilized in beneficial products and the remainder will be placed in the proposed FGD residue landfill.

2.0 DESCRIPTION OF PLANT AND LANDFILL SITE

Marshall Steam Station is located in Catawba County, on Highway NC 150, just west of Lake Norman. The Marshall plant generates 2090 MW of electric power by combustion of coal. Marshall is the second largest coal facility owned by Duke Power. The Marshall station generates enough electricity to power over half a million homes.

The plant is located in the Piedmont physiographic region. Figure 1 shows the location of the plant and the location of the proposed FGD landfill. The footprint for the landfill contains an area of approximately 33 acres.

The FGD landfill will be located on Duke Power property, northwest of the Marshall plant and to the west of the Marshall Ash Basin. The landfill is located to the east of a railroad line, running north-to-south. Located to the west of this railroad line is Sherrill's Ford Road, which runs north-south along a surface water divide. Located within landfill footprint and the railroad line is a surface water drainage feature. This feature drains to the south, to an intermittent stream that drains to Beaverdam Creek, which drains to Lake Norman. There is a topographic divide running NNW through the landfill footprint, along Steam Plant Road. Surface drainage to the west of Steam Plant Road drains to the surface drainage feature and surface drainage to the east of Steam Plant Road drains to the Marshall Ash Basin.

As described in the site hydrogeological study (Hydrogeological Study FGD Scrubber Landfill, Duke Power – Marshall Steam Station, Terrell, North Carolina, S&ME Project No: 1264-02-578, May 30, 2003)¹, the subsurface conditions in the landfill area consist of residual soils and partially weathered rock which have been formed by the in-place weathering of the parent rock. As is typical in the groundwater systems located in the Piedmont region, groundwater at the landfill site occurs within the residuum and saprolite under unconfined aquifer conditions. The predominant groundwater discharge areas are expected to be the drainage feature and the ash basins located to the east of the landfill.

¹ An addendum to the hydrogeologic report dated October 29, 2004, was prepared to reflect changes in the landfill footprint and to provide an updated evaluation of the estimated seasonal high groundwater levels.

3.0 DESCRIPTION OF FGD SYSTEM

The FGD system contracted for installation at Marshall is a Wet Scrubber system. In a Wet Scrubber system the SO₂ component of the flue gas produced from the coal combustion process is removed by reaction with a limestone-water slurry.

The particular system to be used at Marshall will collect the flue gas after it passes through the electrostatic precipitator and route the gas into the lower end of a vertical tank. As the gas rises through the tank to the outlet at the top, the gas passes through a spray header. An atomized slurry of water and limestone droplets is continually sprayed through this header into the stream of flue gas. The SO₂ in the flue gas reacts with the calcium in the limestone and produces SO₃. The SO₃ slurry falls to the bottom of the tank where a stream of air is injected to oxidize the slurry to form gypsum (CaSO₄·H₂O). The gypsum slurry is then drawn off to a hydroclone and subsequently routed to a vacuum belt filter. The liquid waste from this process will be treated as wastewater.

Duke is presently investigating beneficial uses for the FGD residue (gypsum). If these options are determined to be viable, the FGD residue meeting the material requirements for the beneficial uses will not be disposed in the landfill.

The typical parameters for this material produced by the system to be used at Marshall are:

Typical FGD Residue Parameters

Gypsum	93% to 95%
Sulfite	0.35%
CO ₃	1.3%
CaF ₂	0.2%
Inerts	2.5% to 3.5%
Fly ash Content	0.5% to 0.8%
pH	6.0 to 8.3
Unit Weight	76 lb/ft ³ to 97 lb/ft ³
Specific Gravity	2.35
Moisture	10% to 12%

FGD residue material that is not suitable for beneficial use will be placed in the landfill. In addition to this material, material will periodically be removed from the clarifier stage of the waste-water treatment system and placed in the landfill.²

Synthetic Precipitation Leaching Procedure (SPLP EPA Method 1312) leaching has been performed on samples of FGD residue material provided by the equipment vendor. These results will be presented in subsequent submittals to NCDENR. Duke will also provide results of geotechnical tests performed on the FGD residue in subsequent submittals.

² An evaluation of the physical, chemical, and leaching characteristics of this material will be performed and submitted to NCDENR, once the waste-water treatment system is operational.

4.0 DESCRIPTION OF FGD RESIDUE LANDFILL

The FGD landfill will be located on Duke Power property, northwest of the Marshall plant and to the west of the Marshall Ash Basin. The landfill footprint contains an area of approximately 33 acres. The FGD residue will be conveyed to the landfill site by truck, where the material will be spread and compacted. The landfill will begin receiving FGD residue in the summer of 2006. The volumetric capacity of the landfill is 2.19 million yd³.

The FGD residue landfill at Marshall will receive FGD residue generated at Marshall and at other Duke plants located within NC. The residue placed in the landfill will be:

1. FGD residue material that is not needed to meet the production needs of any beneficial use options.
2. FGD residue material that does not meet the specifications required for beneficial use.
3. FGD residue material that is removed from settling or clarifier stages of the associated waste water treatment facility.

Since the plan is to use as much FGD residue as possible for a beneficial use, the period of time that will be required to fill the capacity of the landfill cannot be determined at this time.

Duke plans to construct the landfill in two cells. The first cell (Cell 1) will be located along the eastern side of the landfill and will extend north-to south. The second cell, Cell 2 of the landfill will utilize the remainder of the landfill footprint. The estimated gross volume of Cell 1 is 751,200 yd³. The estimated gross volume of Cell 2 is 1,436,600 yd³. The Construction Plan Application shows the specific areas for Cell 1 and Cell 2.

5.0 .0503 SITING AND DESIGN REQUIREMENTS FOR DISPOSAL SITES

Disposal sites shall comply with the following requirements in order for a permit to be issued:
(1) A site shall meet the following siting requirements:

Response:

The specific requirements of .0503 (1) are addressed on the following pages.

Requirement .0503(1)(a)

A site located in a floodplain shall not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain or result in washout of solid waste so as to pose a hazard to human life, wildlife or land or water resources.

Response

The proposed landfill site for the Marshall Steam Station FGD Residue Landfill is not located in the 100-year floodplain. Therefore, the proposed landfill will not restrict the flow of a 100-year flood, nor will the proposed landfill reduce the temporary water storage capacity of the floodplain or result in washout of solid waste so as to pose a hazard to human life, wildlife or land or water resources.

Figure 2 is the National Flood Insurance Program Flood Insurance Rate Map, prepared by FEMA, for the area adjacent to Marshall Steam Station.

The location of the revised footprint for the proposed landfill relative to the 100-year floodplain is shown on Figure 2.

Requirement .0503(1)(b) (i) and (ii)

A site shall be located in consideration of the following:

- (i) a site shall not cause or contribute to the taking of any endangered or threatened species of plants, fish or wildlife;
- (ii) a site shall not result in the destruction or adverse modification of the critical habitat of endangered or threatened species as identified in 50 C.F.R. Part 17 which is hereby incorporated by reference including any subsequent amendments and editions. This information is available for inspection at the Department of Environment, Health, and Natural Resources, Division of Solid Waste Management, 401 Oberlin Road, Raleigh, North Carolina 27605 where copies can be obtained at no cost;

Response

A site survey was performed to investigate the presence of endangered or threatened species of plants, fish or wildlife or critical habitat of endangered or threatened species. The Duke letter to the United States Fish and Wildlife Service (USFWS) providing the results of the site survey is dated April 30, 2003 and is included in Attachment 1.

The USFWS response is found in a letter dated July 11, 2003. The USFWS response states:

According to our records and a review of the information you provided, no listed species or their habitats occur on the site. We concur with your determination that the proposed project will not affect endangered or threatened species and their habitats.

The response from the USFWS is included as Attachment 2.

The area included in the revised footprint was included in the site survey described above.

Requirement .0503(1)(b)(iii)

A site shall not damage or destroy an archaeological or historical site.

Response

The North Carolina Department of Cultural Resources, State Historic Preservation Office (SHPO) was consulted to determine if an archaeological or historic site was listed at the proposed site. The response provided by the SHPO is dated May 5, 2003. The response stated that:

“We have conducted a review of the proposed undertaking and are aware of no historic resources which would be affected by the project.”

The letter to the SHPO providing the location of the landfill is included in Attachment 3. The revised footprint is depicted in the letter to the SHPO.

The response from the SHPO is found in Attachment 4.

Requirement .0503(1)(b)(iv)

A site shall not cause an adverse impact on a state park, recreation or scenic area, or any other lands included in the state nature and historic preserve.

Response

The proposed landfill will not adversely impact a state park, recreation or scenic area or nature or historic preserves. There are no state parks, recreation or scenic areas, or any other lands included in the state nature and historic preserve within ten (10) kilometers (6.2 miles) of the proposed landfill site.

Several boating access areas are located within ten (10) kilometers (6.2 miles) of the proposed landfill site including Hager Creek, McCrary Creek, and Pinnacle access areas. The Marshall bank fishing area is also located approximately one-half mile from the proposed landfill site. All of these access areas are owned by Duke Power. As operation of the current facility adjacent to the proposed landfill has not adversely impacted the access areas, there will be no impact resulting from the proposed landfill.

The evaluation above is valid for the revised footprint.

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Requirement .0503(1)(c)

A new site disposing of putrescible wastes shall not be located within 10,000 feet of an airport runway used by turbojet aircraft or within 5,000 feet of an airport runway used by piston-type aircraft;

Response

The proposed landfill will not receive putrescible wastes.

Requirement .0503(1)(d)

A site shall have available adequate suitable soils for cover either on-site or from off-site.

Response

The proposed landfill site has adequate suitable soils available on-site. The excavated contours for Cell 1 and Cell 2 are shown on drawings M-6024-02.00 and M-6024-05.00.³

As described in Section 4.0 of the Construction Plan Application, the volume of excavation within the proposed landfill footprint is 669,400 cubic yards. The soil volume required for construction of the landfill, including roads, operational cover soil and the final cover system is about 525,800 cubic yards. Therefore, there are adequate suitable soils on site.

³ These drawings are included in the Construction Plan Application, dated March 2004, Document No. MM6451.00-0000.001 and the Construction Plan Application Addendum, dated November 2004.

6.0 .0504 APPLICATION REQUIREMENTS FOR SANITARY LANDFILLS

A permit for a sanitary landfill shall be based upon a particular stream of identified waste, as set forth in Rule .0504 (g)(i) and (ii) of this Section. Any substantial change in the population or area to be served, or in the type, quantity or source of waste shall require a new permit and operation plan, including waste determination procedures where appropriate. Five sets of plans shall be required with each application.

(1) The following information shall be required for reviewing a site application for a proposed sanitary landfill:

Requirement .0504(1)(a)

An aerial photograph on a scale of at least 1 inch equals 400 feet and a blueprint of the photograph accurately showing the area within one-fourth mile of the proposed site's boundaries with the following specifically identified:

- (i) Entire property owned or leased by the person proposing the disposal site;
- (ii) Land use and zoning;
- (iii) Location of all homes, industrial buildings, public or private utilities, and roads;
- (iv) Location of wells, watercourses, dry runs, and other applicable details regarding the general topography; and
- (v) Floodplains.

Response

The information listed above is identified on Figure 3. An electronic version of an aerial photograph of the site is used as the background for Figure 3. The revised footprint is shown on Figure 3.

Requirement .0504(1)(b)

A map on a scale of at least 1 inch equals 1000 feet showing the area within two miles of the proposed site's boundaries with the following specifically identified:

- (i) Significant ground-water users;
- (ii) Potential or existing sources of ground-water and surface water pollution;
- (iii) Water intakes;
- (iv) Airport and runways; and
- (v) Subdivisions.

Response

The information listed above is identified on Figure 4. The revised footprint is shown on Figure 4.

The Environmental Data Resources report, dated June 25, 2003 (Report TC0961975.2s) provides information on significant groundwater users and was used as a source for of information for items (i). A copy of this report is found in Attachment 5.⁴

The Environmental Data Resources report, dated June 25, 2003 (Report TC0961975.1s) provides information on potential or existing sources of groundwater contamination and was used as a source for of information for items (ii). A copy of this report is found in Attachment 6.

As shown on Figure 4, there are no significant ground-water users, water intakes, airports and runways, or subdivisions within two miles of the proposed site's boundaries.

⁴ Note that in the EDR report there are a large number of wells (users) that are attributed to being located within 2 miles of the site. A large number of these wells are owned by Mid-South Water Systems, located in Sherrills Ford. Since EDR search is based on zip codes, all of the drinking water systems owned by Mid-South Water Systems appear in the report as being located within 2 miles of this site, when in fact they may be located as far away as Shelby, Charlotte, or Gastonia.

Requirement .0504(1)(c)

A geological and hydrological study of the site which provides:

- (i) Soil borings for which the numbers and depths have been confirmed by the Division and lab testing of selected soil samples that provide:
 - (A) standard penetration - resistance;
 - (B) particle size analysis;
 - (C) soil classification - USCS;
 - (D) geologic considerations (slopes, solution features, etc.);
 - (E) undisturbed representative geologic samples of the unconfined or confined or semiconfined hydrological units within a depth of 50 feet that provide the following information for each major lithologic units:
 - (I) saturated hydraulic conductivity (or by in-situ);
 - (II) volume percent water; and
 - (III) porosity;
 - (F) remolded sample of cover soils that provide:
 - (I) saturated hydraulic conductivity,
 - (II) total porosity,
 - (III) atterberg limits;
 - (G) stratigraphic cross-sections identifying hydrogeological units including lithology;
 - (H) tabulation of water table elevations at time of boring, 24 hours, and seven days (The number of cased borings to provide this information shall be confirmed by the Division.); and
 - (I) boring logs;
- (ii) A boundary plat locating soil borings with accurate horizontal and vertical control which are tied to a permanent onsite bench mark;
- (iii) A potentiometric map of the surficial aquifer based on stabilized water table elevations; and
- (iv) A report summarizing the geological and hydrological evaluation.

Response

A geological and hydrological study of the site is submitted. Prior to the start of the site investigation, a meeting was conducted with the Division to discuss the numbers, the locations, and the depths of the soil borings. The title of this report is:

**Hydrogeological Study
FGD Scrubber Landfill
Duke Power – Marshall Steam Station
Terrell, North Carolina
S&ME Project No: 1264-02-578
May 30, 2003⁵**

⁵ An addendum to the hydrogeologic report dated October 29, 2004, was prepared to reflect changes in the landfill footprint and to provide an updated evaluation of the estimated seasonal high groundwater levels.

Response to Requirement .0504(1)(c) (continued)

This report is included as Volume 2. Information on the depths of the borings and wells is found in the hydrogeologic study.

A map showing the location of the horizontal and vertical location of the monitoring wells is included as Figure 5. A map of the property boundary for the tract containing the landfill is included as Figure 6. Figures 5 and 6 show the revised footprint.

Requirement .0504(1)(d)

A conceptual design plan presenting special engineering features or considerations which must be included or maintained in site construction, operation, maintenance and closure.

Response

The design drawings for the proposed FGD Residue landfill were submitted in the Construction Plan Application.⁶

There are four special engineering features or considerations which must be included or maintained in site construction, operation, maintenance and closure. These engineering features or considerations are:

1. Construction of Phase 1 and Phase 2 of the landfill.
2. Landfill Design Considerations and Mitigation of Intermittent Stream and Potential Wetland Area.
3. Relocation of Energy United Electric Power Distribution Line.
4. Placement of an Engineered Cover to Minimize Infiltration.

These engineering features or considerations are discussed below.

Construction of Cell 1 and Cell 2 of the Landfill

Duke plans to construct the landfill in two cells. The first cell (Cell 1) will be located along the eastern side of the landfill and will extend north-to south. The second cell, Cell 2 of the landfill will utilize the remainder of the landfill footprint. The estimated gross volume of Cell 1 is 751,200 yd³. The estimated gross volume of Cell 2 is 1,436,600 yd³. The Construction Plan Application shows the specific areas for Cell 1 and Cell 2.

Landfill Design Considerations and Mitigation of Intermittent Stream and Potential Wetland Area

As noted in the Description of Plant and Landfill Site, an intermittent stream and potential wetland area are located within the footprint. The intermittent stream receives flow from surface water runoff from upgradient areas and from within the landfill footprint and supplies water to the wetland area, before draining out of the landfill footprint. The wetland area has developed from a spoil berm constructed across the drainage path of the stream. This spoil material is believed to have originated from soil excavations made during the construction of the railroad line that runs along the west side of the landfill footprint. An undersize corrugated metal culvert is located at the downstream end of the wetland and routes flow through the spoil berm. Soil deposition upstream of the culvert is believed to have impeded the flow of the intermittent stream, creating the potential for wetland conditions.

The stream and wetland area were investigated by a qualified wetlands specialist. The preliminary determination from this investigation is that the stream is classified as an unimportant intermittent stream and therefore does not require mitigation for disturbance. The preliminary determination for the wetland area was that the area did not meet all of the criteria

⁶ Construction Plan Application, dated March 2004, Document No. MM6451.00-0000.001 and Construction Plan Application Addendum, dated November 2004.

Landfill Permit Application – Site Suitability Report – Addendum 1

to classify the area as a jurisdictional wetland. Representatives from the US Army Corps of Engineers (USACOE) and from NCDENR Water Quality Section have visited the site to view and discuss the stream and potential wetland area. The determination that this is not a jurisdictional wetland area is subject to regulatory confirmation by the USACOE with consultation by the NCDENR Water Quality Section.

A copy of the stream and wetland investigation report and the letter transmitting this information to the USACOE and to the NCDENR Water Quality Section are included as Attachment 7.

As described previously, Duke plans to construct the landfill in two cells. The first cell, Cell 1, will be located along the eastern side of the landfill and will extend north-to south. Construction of Cell 1 will not disturb this intermittent stream.

If this USACOE determination differs from the preliminary determination for the intermittent stream and wetland area, Duke will consult with the appropriate agency to perform the required mitigation, prior to construction of Cell 2 of the landfill.

The engineering features required to accommodate the surface drainage associated with this intermittent stream is provided in the Construction Plan Application.

Relocation of Energy United Electric Power Distribution Line

An electric power distribution line transmission line, owned by Energy United is located to the west of Steam Plant Road. This line will be relocated to be outside of the proposed landfill footprint prior to construction.

Placement of an Engineered Cover to Minimize Infiltration

The proposed landfill will be a monofill composed of FGD residue from the wet scrubbers installed at Marshall and other Duke power plants located in NC. Laboratory analysis of the FGD residue leachate has been performed. This leachate was generated by subjecting the residue to SPLP testing (EPA Method 1312). The residue tested was provided by the FGD equipment vendor and is similar in type to the residue that will be produced at the Marshall Plant (similar processes)

This analytical information and infiltration modeling, developed by using the HELP model, was used in a groundwater fate and transport model (MYGRT) to determine compliance with T15A NCAC 2L Groundwater Standards. The results of this modeling show that a landfill design, utilizing an engineered cap system to minimize infiltration into the landfill, will allow the landfill to meet 2L standards. This demonstration will be submitted in a separate submittal.

The engineered cap will consist of a 40 mil textured linear low density polyethylene (LLDPE) geomembrane beneath a geocomposite drainage net. The cap will be topped with two feet of soil for vegetative growth. The geomembrane is a barrier layer that prevents rainwater from entering the waste cell of the landfill. The geocomposite drainage net allows water that percolates through the vegetative layer to drain laterally to a collection system.

The vegetative layer protects the geomembrane and geocomposite from ultraviolet degradation, desiccation, freeze-thaw, wind, and vectors. The vegetative layer shall be

Landfill Permit Application – Site Suitability Report – Addendum 1

stabilized and seeded appropriately to prevent erosion. Native material cut from open areas within the landfill will be used for the vegetative layer. Debris will be removed, and the soil will be amended as needed.

Other Engineering Features or Considerations

Other than the engineered cap described above, there are no special engineering features or considerations that must be included or maintained in site construction, operation, maintenance and closure.

Requirement .0504(1)(e)

Local government approvals:

(i) If the site is located within an incorporated city or town, or within the extra-territorial jurisdiction of an incorporated city or town, the approval of the governing board of the city or town shall be required. Otherwise, the approval of the Board of Commissioners of the county in which the site is located shall be required. Approval may be in the form of either a resolution or a vote on a motion. A copy of the resolution, or the minutes of the meeting where the vote was taken, shall be forwarded to the Division.

(ii) A letter from the unit of government having zoning jurisdiction over the site which states that the proposal meets all of the requirements of the local zoning ordinance, or that the site is not zoned.

Response

Requirement .0504(1)(e)(i) is not applicable.

A zoning approval letter from Catawba County, as stipulated by .0504(1)(e)(ii), is included as Attachment 8.

The Catawba County Planning Department has approved a Duke Power request that would allow the landfill at Marshall Steam Station to receive FGD residue generated by other Duke Power facilities. A copy of the letter from the Catawba County Planning Department is included in Attachment 8.

Requirement .0504(1)(f)

A discussion of compliance with siting standards in Rule .0503(1) of this Subchapter.

Response:

The .0503 (1) requirements and the Duke response are included with this site suitability package. The proposed design will ensure that the siting requirements specified in Rule .0503 (1) are met.

Requirement .0504(1)(g)

A report indicating the following:

- (i) population and area to be served;
- (ii) type, quantity and source of waste;
- (iii) the equipment that will be used for operating the site;
- (iv) a proposed groundwater monitoring plan including well location and schematics showing proposed screened interval, depth and construction.

Response

- (i) The FGD residue landfill at Marshall will receive FGD residue generated at Marshall and at other Duke plants located within NC.
- (ii) The FGD residue will primarily be gypsum. The quantity of waste placed in the landfill will not exceed 2.19 million yd³. Source of the waste will be FGD equipment located at Marshall and other Duke plants located in NC.
- (iii) The equipment used to operate the landfill includes but is not limited to: backhoes, bulldozers, front end loaders, trucks to haul the material, excavators, watering and maintenance trucks.
- (iv) Attachment 9 contains the proposed groundwater monitoring plan including well locations, screened intervals, depths, and construction details. Attachment 9 is revised to depict the revised footprint.

Requirement .0504(1)(h)

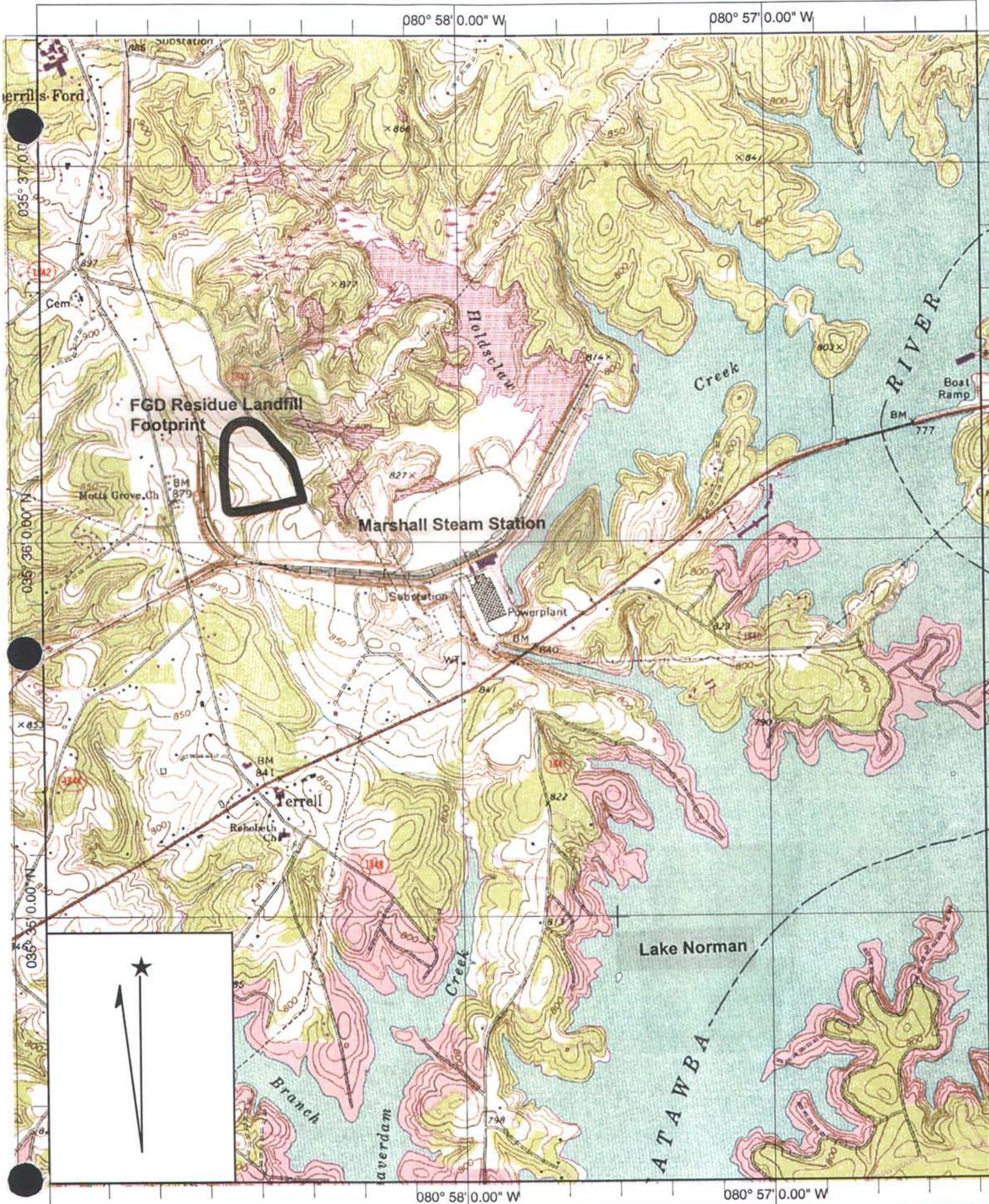
Any other information pertinent to the suitability of the proposed site.

Response

The review performed by Duke and by its consultants has not identified any concerns with the suitability of the proposed site.

Duke is not aware of additional information pertinent to the suitability of the proposed site.

Figures



Name: LAKE NORMAN NORTH
 Date: 11/9/2004
 Scale: 1 inch equals 2000 feet

Location: 035° 35' 49.2" N 080° 57' 50.0" W
 Caption: Figure 1- Revision 1
 Marshall Steam Station
 FGD Residue Landfill
 Footprint

Attachments

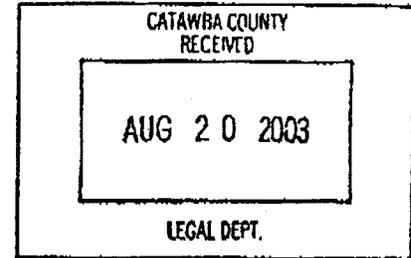
8



CATAWBA COUNTY

P.O. Box 389 • 100-A South West Boulevard • Newton, North Carolina 28658-0389 • Telephone (828) 465-8390
http://www.co.catawba.nc.us FAX (828) 465-8484

August 20, 2003



Duke Energy
Attention Allen Stowe
Mail Code: EC11E
Charlotte, NC 28201-1006

RE: Parcel ID. 4616-03-14-9641
E NC 150 Highway

Dear Mr. Stowe:

This letter is in response to your request for a zoning determination for a Gypsum Landfill unit at the above referenced property. This parcel of land is zoned E-2 Industrial. A Gypsum Landfill is allowed as a permitted accessory use in this district as long as the gypsum is generated from the industrial use on the above referenced property. This expansion will meet the requirements of the Catawba County Zoning Ordinance.

If you have questions concerning this matter, you may call my office at 828-465-8382.

Sincerely,

A handwritten signature in cursive script that reads "Jacky Eubanks".

Jacky Eubanks
Catawba County
Planning Department

dj



CATAWBA COUNTY

P.O. Box 389 100-A South West Boulevard Newton, North Carolina 28658-0389 Telephone (828) 465-8381
http://www.co.catawba.nc.us FAX (828) 465-8484

November 9, 2004

Mr. Allen Stowe
Duke Power Company
526 South Church Street
Charlotte, NC 28202

RE: Parcel ID #4616-03-14-9641 and
Parcel ID #4618-03-20-4565

Dear Mr. Stowe:

This letter is in response to your request for a zoning determination for a Gypsum Landfill unit at the above referenced property. The landfill will receive product from the Marshall, Cliffside, and Allen sites. The subject parcels are zoned E-2 Industrial.

The Catawba County Board of Adjustment conducted a public hearing on Tuesday, October 26, 2004. At this meeting, the Board unanimously approved your request for a Special Use Permit to construct and operate a gypsum landfill with the following conditions:

1. Operating hours, for trucks bringing gypsum by-product from Allen and Cliffside into the Marshall landfill, will be from 7:00 AM to 7:00 PM, Monday through Friday.
2. The optimal location for the road, which will be built to provide access into the landfill, will intersect Sherrills Ford Road Gregory Road. The next preferred alternative will be a realignment of Steam Plant Road so that it intersects 100 feet south of the current intersection with Sherrills Ford Road. The exact location will be dependent upon NCDOT approval.

If I can be of any additional assistance, please call my office at 828-465-8381.

Sincerely,

Susan Ballbach

Susan Ballbach, AICP
County Planner

sb

9

DUKE POWER
MARSHALL STEAM STATION
CATAWBA COUNTY, NC

FLUE GAS DESULFURIZATION (FGD) RESIDUE LANDFILL

PROPOSED

GROUND WATER MONITORING PROGRAM
SAMPLING AND ANALYSIS PLAN

Revision 1

May 24, 2004

Prepared By:



William M. Miller, P.E.

Duke Power
PO Box 1006
Charlotte, NC 28201-1006

Description of Changes for Revision 1

Page(s)	Description of Revision
1	Section 1.2 <ul style="list-style-type: none"> Revised acreage for landfill footprint.
2, 3	Section 1.3 <ul style="list-style-type: none"> Changed wells to be included in the monitoring plan, due to change in landfill footprint Changed the designation (name) of the following wells: <i>new name (old name)</i> MS-12 (OW-3) MS-13 (MS-6) MS-14 (B-5) MS-15 (B-4)
3	Section 1.4 Added surface water sampling location, SW-1.
6	Section 2.3 Added discussion of procedures for surface water samples.
Figure 2	Revised Figure to show revised footprint, Monitoring Well locations, Surface Water Sample location, and Compliance Boundary.
Table 1	Revised to reflect changes in monitoring well locations.
Appendix C	Added Duke Power Procedure 3290 – Surface Water Sample Collection and Custody

1.0 PROGRAM DESCRIPTION

1.1 SCOPE OF WORK

This Ground-Water Monitoring Program is designed to monitor the effects of the Flue Gas Desulfurization (FGD) Residue Landfill at Marshall Steam Station (MSS) on the groundwater in the area. This plan has been prepared according to the guidelines set forth by the North Carolina Water Quality Guidance Document for Solid Waste Facilities (SW-1001-87), and by the EPA in "Interim Guidelines and Specifications for Preparing Quality Assurance Plans" (QAMS-500/80), and documents the methodologies of field sampling, record-keeping protocols, data quality objectives, and data validation procedures that will be used in this program.

1.2 BACKGROUND AND SITE HYDROGEOLOGICAL DESCRIPTION

Marshall Steam Station is located in Catawba County, on Highway NC 150, just west of Lake Norman. The plant is located in the Piedmont physiographic region. Figure 1 shows the location of the plant and the location of the proposed FGD landfill. The landfill footprint contains approximately 31.74 acres.

The FGD residue will be conveyed to the landfill site by truck, where the material will be spread and compacted. The landfill will begin receiving FGD residue in May of 2006. The volumetric capacity of the landfill is 1,865,000 yd³. The FGD residue landfill at Marshall will receive FGD residue generated at Marshall and at other Duke plants located within NC.

The FGD landfill will be located on Duke Power property, northwest of the Marshall plant and to the west of the Marshall Ash Basin. The landfill is located to the east of a railroad line, running north-to-south. Located to the west of this railroad line is Sherrill's Ford Road, which runs north-south along a surface water divide. Located between the landfill footprint and the railroad line is a surface water drainage feature. This feature drains to the south, to an intermittent stream that drains to Lake Norman. There is a topographic divide running NNW through the landfill footprint, along Steam Plant Road. Surface drainage to the west of Steam Plant Road drains to the surface drainage feature and surface drainage to the east of Steam Plant Road drains to the Marshall Ash basin.

As described in the site hydrogeological study (Hydrogeological Study FGD Scrubber Landfill, Duke Power – Marshall Steam Station, Terrell, North Carolina, S&ME Project No: 1264-02-578, May 30, 2003), the subsurface conditions in the landfill area consist of residual soils and partially weathered rock with have formed by the in-place weathering of the parent rock. As is typical in the groundwater systems located in the Piedmont region, groundwater at the landfill site occurs within the residuum and saprolite under unconfined aquifer conditions. The predominant groundwater discharge areas are expected to be the drainage feature and the ash basins located to the east of the landfill.

The subsurface conditions at the landfill can be described by the following conditions:

- **Residuum:** Beneath the ground surface, residual material consisting of silts, silty clays, clayey silts, and silty sands and sandy silts were found for a depths ranging from 2.5 to 14 feet below ground surface.
- **Saprolite:** Saprolite material was found from depths from 13.5 feet to 68.5 feet below ground surface. This material is a product of weathered bedrock, consisting of silts to clayey silts and sandy silts to silty sands, having a Standard Penetration Test (SPT) resistance of 50 blows or more.
- **Partially Weathered Rock:** This material is defined as material exhibiting SPT resistances in excess of 100 blows per foot. This material was found ranging from depths of 25.5 feet to 90 feet below ground surface.

- **Bedrock:** Bedrock was found at depths ranging from 25.5 feet to 79.5 feet. When sampled, this material was classified as granite, schist and gneiss. Horizontal to high-angle fractures were found in the upper ten feet. Many fractures were found to be iron stained, indicating flow of water into the fractures.

1.3 WELL LOCATIONS AND INSTALLATION

The landfill will be monitored through a series of nine monitoring wells and one surface water sampling location. Monitoring well information is detailed in Table 1. The location of these wells is shown on Figure 2. Monitoring well MS-8 will be used as the background well.

These wells will be constructed of two-inch diameter PVC well screen and casing. Each well will intercept the aquifer with section of PVC well screen with a slot size of 0.010 inch. The screen lengths are shown in Table 1.

The wells will be installed by a North Carolina registered well driller in accordance with applicable NCDENR regulations. The location of the well and the elevation of the top of the casing will be surveyed under the direction of a Professional Surveyor, licensed in North Carolina.

Figure 3 shows a typical construction diagram for the wells. All wells will be equipped with dedicated bladder type pump systems. Well construction records for the existing wells are included in Appendix B.

A brief description of the monitoring locations and their monitoring function is provided below.

Monitoring Well MS-8 – Background Well (Proposed)

Monitoring well MS-8 will be used as a background monitoring well. This well is located approximately 250 feet north-west of the landfill, on the west side of Steam Plant Road. This well will be screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-9

This existing well is located north of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-10

This existing well is located west of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-11

This existing well is located west of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-12 (Formerly designated as well OW-3)

This existing well is located south of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-13 (Formerly designated as well MS-6)

This existing well is located south of the landfill. The well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-14 (Formerly designated as well B-5)

This existing well is located to the southeast of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-15 (Formerly designated as well B-4)

This existing well is located to the east of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-16 (Proposed)

This proposed well is to be located to the northeast of the landfill. This well will be screened to monitor groundwater in the saprolite layer.

1.4 SURFACE WATER SAMPLING

A surface water sampling will be collected from location SW-1. This surface water sampling location is south of the landfill, between wells MS-12 and MS-13, as shown of Figure 2.

1.5 MONITORING FREQUENCY

The wells will be sampled semi-annually (with the actual sampling periods determined later). Sampling results will be submitted to the State within 90 days of sampling. The monitoring wells will be sampled prior to placement of waste in the landfill expansion.

1.6 PARAMETERS

Proposed parameters, units of measure, methods, and detection limits are presented in Table 2.

1.6 DATA QUALITY OBJECTIVES

The overall Quality Assurance (QA) objective is to ensure that reliable data of known and acceptable quality are provided. All measurements will be documented to yield results that are representative of the groundwater. Data will be calculated and reported in units consistent with those of other agencies and organizations to allow comparability of data.

The QA objectives for precision, accuracy, and completeness have been established by the laboratory(s) in accordance with EPA or other accepted agencies for each measurement variable (where possible). The objectives are outlined in the Duke Power Company Laboratory Services Procedures Manual, and are available upon request.

Detection limits for the water analyses presented in Table 2 are generally specified by the analytical methods. As stated above, appropriate methods have been selected to meet applicable standards for groundwater quality. Instances may occur, however, in which the condition of the sample will not allow detection of the desired limits for various parameters either because of matrix interference or high analyte concentrations requiring sample dilution. The laboratory(s) will provide sufficient documentation with each data package to notify reviewers of the data to any analytical problems.

2.0 SAMPLING PROCEDURES

2.1 SAMPLING EQUIPMENT

Development, purging and sampling equipment are selected to ensure all materials are compatible with the sample parameters and comply with state and federal regulatory requirements for sampling. Positive-gas-displacement fluorocarbon resin bladder pumps are installed in each monitoring well as dedicated purging and sampling systems.

2.1.1 Equipment Cleaning Procedures

Dedicated sampling equipment will be installed in each monitoring well. However, in the event non-dedicated equipment is used, reusable water level meters, development pumps, purging and sampling equipment are cleaned between wells in accordance with standard EPA approved cleaning procedures for field equipment. This standard is outlined in "Standard Operating Procedures and Quality Assurance Manual", Engineering Support Branch, EPA Region IV, February 1, 1991.

2.2 GROUND-WATER SAMPLING

2.2.1 Development of Wells

After installation of new wells, and prior to initial sampling, the monitoring wells are developed. Development removes silt that has settled into the bottom of the well following installation, and removes fine silt and clay particles from the well screen and sandpack surrounding the screen. Well development is necessary to eliminate potential clogging and enhance well performance. Development involves removing an estimated ten or more well volumes from the well using a positive-gas-displacement fluorocarbon resin bladder pump with an up-and-down agitation to loosen particles from the well screen. After development of a well, a true well depth is recorded.

2.2.2 Ground-Water Level and Total Depth Measurements

Water-level measurements are performed to determine the ground-water flow elevations and to calculate the volume of standing water in the well. All monitoring wells have been surveyed by a registered surveyor to determine the elevation of the top of each well casing. All depth and water-level measurements are referenced to the top of the well casing and recorded to the nearest one-hundredth of a foot.

Water level measurements are made with an electronic measuring device consisting of a spool of dual conductor wire, a probe attached to the end, and an indicator. When the probe comes in contact with water, the circuit is closed and a meter light and/or buzzer attached to the spool signal the contact. The probe is lowered further until it rests on the bottom of the well to determine the depth of the well. The depth and water level are used to determine that the well has not filled with silt and to calculate the volume of standing well water. The volume of well water (in gallons) is calculated using the following equation:

$$V = h \times \pi r^2 \times (7.48052 \text{ gal/ft}^3)$$

where V = volume of standing water (gallons)

h = height of standing water (feet) = casing depth - water level

r = radius of well casing (feet)

In dedicated sampling systems, an accurate well depth is determined, as indicated above, after development of the well and prior to installation of the dedicated bladder pump. The well depth, water level measurement, and calculated well volume are recorded on the Groundwater Monitoring Data Sheet (Figure 4).

2.2.3 Well Purging and Sampling

A Hydrolab® Multi-parameter Water Quality Monitoring Instrument is used to measure indicator parameters for establishing representative groundwater. These instruments are calibrated with

reference standards prior to and after each sampling day as described in Procedure 3210.1.¹ The pH subsystem is calibrated with two different pH standards (pH 7.0 and 4.0) which usually bracket the expected groundwater pH. The conductivity subsystem is calibrated to a standard nearest the expected groundwater conductivity. Calibration results are recorded on the Field Sampling Calibration Data Form (Figure 5).

Wells will be purged and sampled by conventional sampling methods in accordance to Procedure 3500.1.² Conventional sampling entails removing one equivalent well volume and measuring the indicator parameters temperature, pH, conductivity and turbidity. When indicator parameters have stabilized within ± 0.2 pH units and $\pm 10\%$ for temperature, conductivity and turbidity over 3 to 5 consecutive well volumes, representative groundwater has been determined and sample collection may begin. Removed well volumes, indicator parameters, and pertinent notations are documented on the Groundwater Monitoring Data Sheet.

In the case of low groundwater levels, an alternative to conventional well purging and sample collection is the use of low flow sampling technology. This technique is particularly suited for low yielding wells where conventional purging and sampling evacuate a well to dryness. This method will not normally be employed, but is a viable option for obtaining samples under low groundwater conditions.

Low flow well purging and sampling allows the well to be purged in a shorter period of time, with less purge water generated while maintaining the same level of accuracy and reproducibility. Low flow technology involves using dedicated bladder pumps, a flow through cell, and water quality monitor continually measuring pH, turbidity, specific conductance, temperature, oxidation-reduction potential, and dissolved oxygen. Water is purged from the screened interval of the well at low flow rates (≤ 100 ml/min) through a flow cell connected to a water quality instrument. The pumping rate will be maintained in an attempt to match the natural groundwater flow velocity in order to minimize drawdown in the well. Indicator parameters are electronically logged until stabilization is achieved and samples are collected.

2.2.4 Sample Collection

After representative groundwater has been determined by purging and stabilizing the indicator parameters, sampling may begin. Sampling personnel wear clean, disposable, non-powdered latex gloves during sample collection for each well. Samples are collected in the order of the volatilization sensitivity of the parameters:

- Metals
- Sulfate and chloride
- Nitrate
- TDS

If groundwater samples for metal analysis have a turbidity ≥ 10 NTU, the sample is collected and preserved. An additional sample should be collected using an in line flow through filter suitable for groundwater sampling. This filtered sample should be preserved accordingly with the analytical results used as information only.

2.2.5 Sample Containers, Volume, Preservative, and Holding Time

All sample containers supplied for the collection of groundwater samples by the laboratory are new, precleaned as approved by EPA procedures appropriate for the parameters of interest. Table 3 summarizes the sample containers, sample volume, preservation procedures and holding

¹ Procedure found in Duke Power Company Environmental Chemistry Operating Procedure For The Hydrolab Water Quality Analyzers.

² Procedure found in Groundwater Investigation, Groundwater Monitoring, Sample Collection And Aquifer Investigations At Duke Energy Corporation Locations.

times required for each type of sample and parameter. Sample containers are kept closed until used. All sample containers are provided by Duke Energy or vendor laboratories.

2.3 SURFACE WATER SAMPLING

All activities associated with surface water sampling, including collection, preservation, storage and transport, will be performed in accordance with the following procedure: DUKE POWER COMPANY ENVIRONMENTAL CHEMISTRY PROCEDURE 3290 - SURFACE WATER GRAB SAMPLE COLLECTION AND CUSTODY.

A copy of this procedure is included as Appendix C.

3.0 SAMPLE TRACKING

The chain of custody program allows for tracing the possession and handling of individual samples from the time of field collection through laboratory analysis and report preparation. Samples are pre-logged prior to sample collection. This process assigns a unique tracking number for each sample and generates corresponding labels.

3.1 SAMPLE LABELING

Sample containers are labeled and organized prior to field activities as part of the pre-sampling staging process. As samples are actually collected, the sampling personnel write the following information directly on the label: sampling date and time, and initials of sample collector. This information is also recorded on the Groundwater Monitoring Data Form and the Chain of Custody Record (Figure 6).

3.2 FIELD DOCUMENTATION

Field documentation from each sampling event is recorded on the Groundwater Monitoring Data Sheets, the Field Sampling Calibration Form, and the Chain-of-Custody Record. These loose-leaf sheets are arranged in sequential order and filed by project and date. All recorded entries are made in indelible ink. Errors are corrected by drawing a line through the error, initialing and dating the correction, and starting a new entry on the next line (if necessary). Additionally, a Groundwater Sampling Site Checklist (Figure 7) is completed indicating information of the monitoring well such as proper ID tag, condition of protective casing and pad. Field notations are made during the course of the field work to document the following information:

- Identification of well
- Well depth
- Static water level depth and measurement technique
- Presence of immiscible layers and detection method
- Well yield - high or low
- Purge volume or pumping rate
- Sample identification numbers
- Well evacuation procedure/equipment
- Sample withdrawal procedure/equipment
- Date and time of collection
- Types of sample containers used
- Identification of replicates or blind samples
- Preservative(s) used
- Parameters requested for analysis
- Field analysis data and methods
- Sample distribution and transporter
- Field observations on sampling event
- Name of collector(s)
- Climatic conditions including estimate of air temperature

3.3 CHAIN-OF-CUSTODY RECORD (COC)

The COC Record (Figure 6) accompanies the sample(s), traces sample possession from time of collection to delivery to the laboratory(s), and clearly identifies which sample containers have been designated for each requested parameter. The record includes the following types of information:

- Sample identification number
- Signature of collector
- Date and time of collection
- Sample type (e.g., groundwater, immiscible layer)
- Identification of well
- Number of containers
- Parameters requested for analysis
- Preservative used
- Signature of persons involved in the chain of possession
- Inclusive dates of possession

3.4 SAMPLE CUSTODY, SHIPMENT AND LABORATORY RECEIPT

For the purpose of these procedures, a sample is considered in custody if it is:

- In actual possession of the responsible person;
- In view, after being in physical possession;
- Locked so that no one can tamper with it, after having been in physical custody; or in a secured area, restricted to authorized personnel. All samples are maintained in the custody of the sampling crew during the sampling event. At the end of each sampling day and prior to the transfer of the samples off-site, chain-of-custody entries are completed on the COC for all samples. Upon transfer of custody, the chain-of-custody form is signed by a sampling crew member, including the date and time. If outside vendor laboratories are utilized, samples are delivered to these facilities by Duke Energy personnel or courier.

All chain-of-custody forms received by the laboratory(s) are signed and dated by the respective Supervising Scientist(s) or their designee (at the Duke Energy lab), or the laboratory sample custodian (at vendor labs) immediately following receipt by the laboratory.

The analysts at the laboratory(s) maintain a sample-tracking record that will follow each sample through all stages of laboratory processing. The sample tracking records show the date of sample extraction or preparation, and analysis. These records are used to determine compliance with holding time limits during lab audits and data validation.

Custody procedures followed by Duke Energy laboratory personnel are described in detail in the Duke Energy Laboratory Services Procedures Manual.

4.0 ANALYTICAL PROCEDURES

The main analytical laboratory used in this program is the Duke Energy Laboratory Services Laboratory: N.C. Drinking Water (NC37804) and Wastewater (#248) Certifications. The organizational structure and staff qualifications of the laboratory are discussed in its generic Quality Assurance Program (QAP). The QAP and Laboratory Services Procedures Manual are available for review upon request.

Vendor laboratories that meet EPA and North Carolina certification requirements may be used for analyses which cannot be performed in-house.

The analytical procedures used for this Groundwater Monitoring Program are listed in Table 2. Indicator parameters are measured in the field according to Duke Energy Scientific Services Section Quality Assurance Plan and Procedure 3210.1.

5.0 INTERNAL QUALITY CONTROL CHECKS

Internal laboratory control checks used by the laboratories are described in their generic QAP and procedures manual. The laboratories demonstrate the ability to produce acceptable results using the methods specified.

Internal quality control checks for sampling procedures and laboratory analyses will be conducted with each sampling event. These checks will consist of the preparation and submittal of field blanks, trip (travel) blanks, and/or field replicates for analysis of all parameters at frequencies described in the laboratory(s) procedures manuals. Equipment rinseate blanks for laboratory-cleaned equipment will be collected quarterly.

The above field QC blanks and replicates included as internal QC checks are described as follows:

- **Field Blanks:** A field blank consists of sample containers filled in the field with organic-free, deionized or distilled water prepared and preserved in the same manner as the samples. The field blank is transported to the laboratory with the samples and analyzed along with the field samples for the constituents of interest to check for contamination imparted to the samples by the sample container, preservative, or other exogenous sources.
- **Trip Blanks:** A trip (travel) blank is a sample container filled with organic-free water in the laboratory that travels unopened with the sample bottles. It is returned to the laboratory with the field samples, and analyzed along with the field samples for parameters of interest.
- **Field Replicates:** A field replicate is a duplicate sample prepared at the sampling locations from equal portions of all sample aliquots combined to make the sample. Both the field replicate and the sample are collected at the same time, in the same container type, preserved in the same way, and analyzed by the same laboratory as a measure of sampling and analytical precision.

6.0 VALIDATION OF FIELD DATA PACKAGE

The field data package includes all of the field records and measurements developed by the sampling team personnel. The field data package validation procedure consists of:

- A review of field data contained on the Groundwater Monitoring Data Sheets for completeness.
- Verification that equipment blanks, field blanks, and trip blanks were properly prepared, identified, and analyzed.
- A check of the Field Sampling Calibration Form for equipment calibration and instrument condition.
- A review of the Chain-Of-Custody Record for proper completion, signatures of field personnel and the laboratory sample custodian, and dates, and for verification that the correct analyses were specified.

7.0 REPORT SUBMITTAL

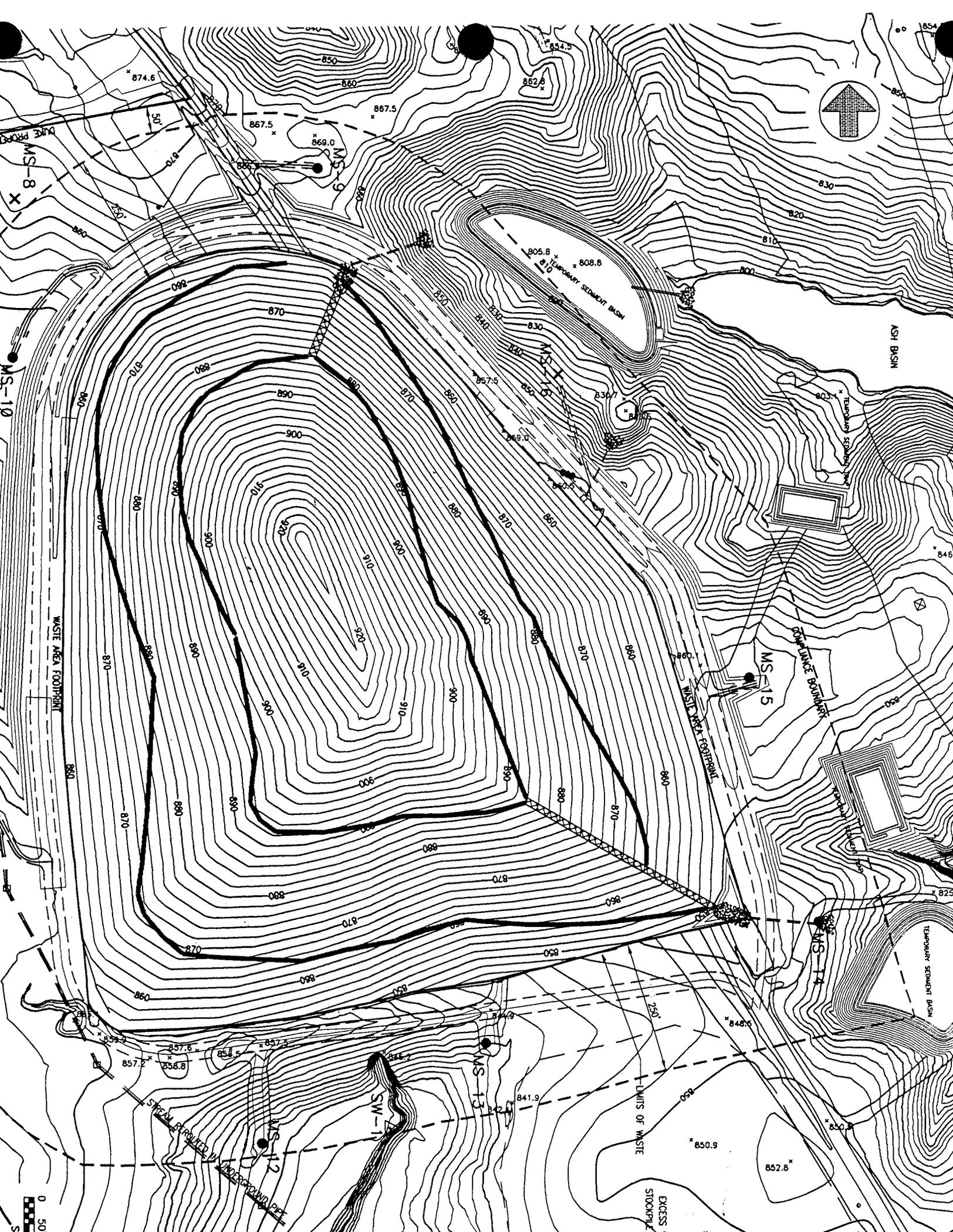
A summary table of the field and laboratory data and a cover letter describing trends will be submitted to the North Carolina Department of Environment and Natural Resources within 90 days of sampling. The State will be notified in the event that vendor lab analyses have not been completed within this time frame. All Groundwater Monitoring Data Sheets, Field Calibration Forms, Chain-of-Custody Record, Laboratory(s) QA data, and Data Validation Checklists are kept in fire-proof file cabinets or microfiche, and are available upon request.

APPENDIX A
FIGURES & TABLES



Name: LAKE NORMAN NORTH
 Date: 6/5/2003 - Revised Footprint 5/2004
 Scale: 1 inch equals 2000 feet

Location: 035° 36' 09.3" N 080° 57' 45.0" W
 Caption: Figure 1 - Site Location
 Duke Power
 Marshall Steam Station



Enclosure E

OPERATION OF A KEMMERER SAMPLER

EQUIPMENT NEEDED:

- Kemmerer Sampler
- Rope marked in depth increments, or winch with depth indicator-pulley block
- Messenger

METHOD

- ① Secure the rope or cable to the top of the Kemmerer sampler.
- ② Cock the sampler by fully raising the sample bottle while the bottom end cap remains stationary; then return the bottle to an intermediate position between the open upper and lower end caps.
- ③ If necessary, reset the pulley depth indicator to zero with the sample bottle at the water surface; then lower the sampler to the desired sampling depth.
- ④ Place the messenger on the rope and release messenger to trip the end caps.
- ⑤ Retrieve the sampler and dispense water to sample container(s) immediately after purging the delivery tubing (if any) connected to the sampler's outlet port.

Enclosure F

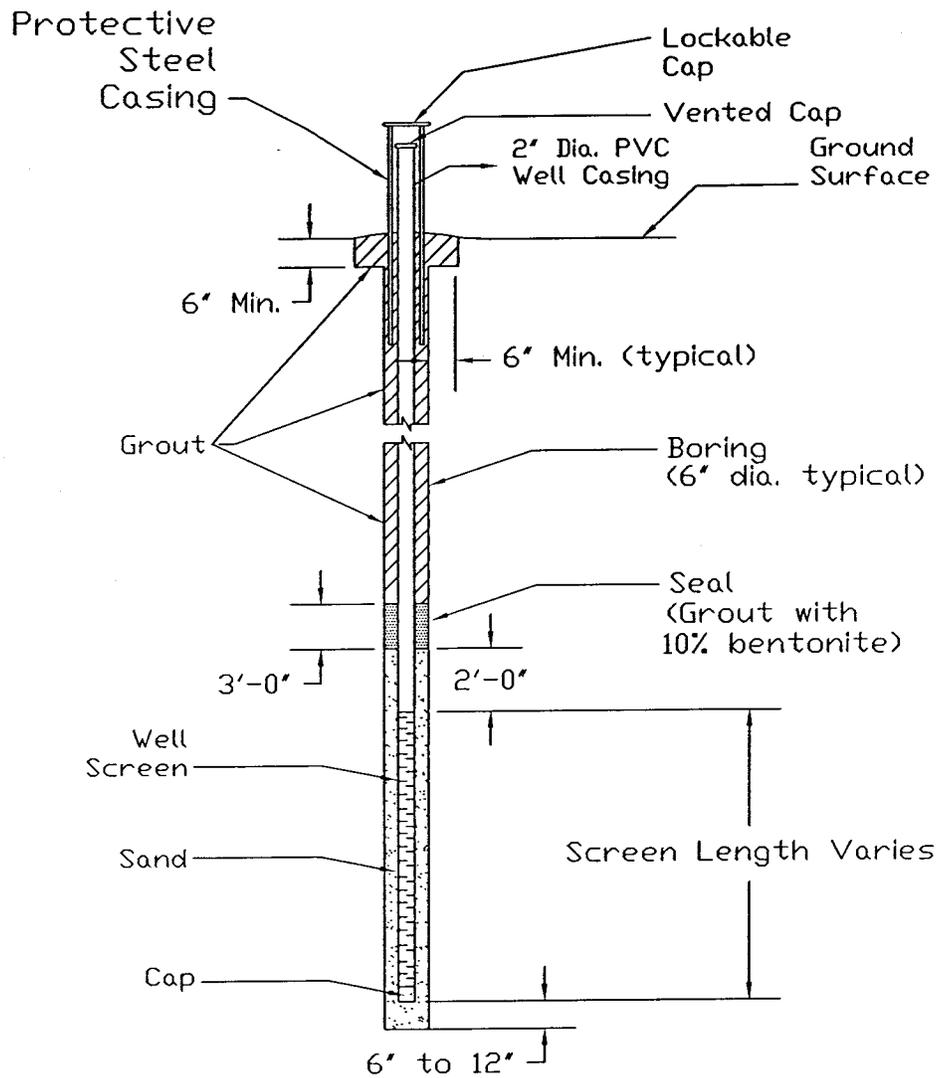
OPERATION OF A VAN DORN SAMPLER

EQUIPMENT NEEDED:

- Van Dorn Sampler
- Rope marked in depth increments
- Messenger

METHOD

- ① Secure the rope to the Van Dorn sampler through the release mechanism.
- ② Close the air vent by turning clockwise.
- ③ Turn the water outlet valve counterclockwise and "out" to the closed position.
- ④ Pull out the end caps and attach the wire loops to the pins located on the release mechanism.
- ⑤ Lower the sampler to the desired sampling depth.
- ⑥ Place the messenger on the rope and release messenger to trip the end caps.
- ⑦ Retrieve the sampler.
- ⑧ Turn the water outlet valve clockwise and "in" and open the air vent valve counterclockwise to drain water from the sampler into sample container(s).



Notes:

- All well casing material shall be Sch 40 PVC.
- Well screen material shall be Sch 40 PVC.

Duke Power Company

Typical
Groundwater Monitoring Well
Construction Details
FIGURE 3

FIELD SAMPLING CALIBRATION DATA FORM

<u>STUDY:</u> _____	<u>WEATHER CONDITIONS:</u> _____
<u>DATE:</u> _____	<u>SURFACE UNIT READER:</u> _____
<u>COLLECTORS:</u> _____	<u>COMPUTER:</u> _____
<u>HYDROLAB SERIAL #:</u> _____	<u>SURVEYOR SERIAL #:</u> _____
<u>OTHER EQUIPMENT:</u> _____	_____

Procedure Number 3210.1							
Calibration Time		Time		Time		Time	
Barometric Pressure		mmHg		mmHg		mmHg	
Parameter	Calib.	Instrument Value	Standard Value	Instrument Value	Standard Value	Instrument Value	Standard Value
Thermometer No.							
TEMP (deg C)		- / ->		- / ->		- / ->	
		- / ->		- / ->		- / ->	
DO (mg/l)	W						
	W						
	W						
	AW	---		---		---	
pH (units)	B	---	7.00	---	7.00	---	7.00
	B	---	4.00	---	4.00	---	4.00
	B	---	10.00	---	10.00	---	10.00
SP COND (uS/cm)	SS	---	0.00	---	0.00	---	0.00
	SS	---		---		---	
	SS	---		---		---	
ORP (mV)	SS	---		---		---	
	SS	---		---		---	
TURBIDITY (ntu)	SS	---	0.00	---	0.00	---	0.00
	SS	---		---		---	

KEY: B = Buffer W = Winkler NA = Not Applicable
 SS = Standard Solution AW = Average Winkler
 ---> = Adjusted To - / -> = Not Adjusted To

Figure 5

GROUNDWATER SAMPLING SITE CHECKLIST

Location _____

Site _____

Site Contact _____

Field Crew _____

Sample Date _____

Weather _____

YES NO

SITE CONDITIONS DURING GROUNDWATER SAMPLING EVENT

____ Was Access to the wells clear & adequate ? _____

____ Were wells locked ? _____

____ Do locks need replacing ? _____

Do wells have proper identification tags attached including:

NC REQUIREMENTS

- ___ Drilling contractor name & registration number
- ___ Date well completed
- ___ Total well depth
- ___ Warning that the well is not for water supply & that the groundwater may contain hazardous materials
- ___ Depth to screen

SC REQUIREMENTS

- ___ Drilling contractor name & driller certification number
- ___ Date well completed
- ___ Total well depth
- ___ Casing depth (ft) and inside diam. (in)
- ___ Screen interval(s)
- ___ Yield in gpm or specific capacity in gpm per ft of drawdown (gpm/ft-dd)
- ___ Static water level and date measured

____ Were well PVC casings in good shape ? _____

____ Were concrete pads in good shape ? _____

____ Any ants, wasps, etc. in or around the casing ? _____

____ Were well protective casings in good shape _____

FLUSH MOUNT WELLS ONLY

____ Do well caps work properly ? _____

____ Are gaskets & bolts in good shape (keep out the rain) ? _____

Note any type activity that might impact the integrity of the monitoring wells (dumping, earthmoving, construction, or the use of pesticides/herbicides) _____

ANY OTHER COMMENTS: _____

Table 1. Monitoring Well Information

	MS-8 (Proposed)	MS-9 (Existing)	MS-10 (Existing)	MS-11 (Existing)	MS-12 (Existing)	MS-13 (Existing)	MS-14 (Existing)	MS-15 (Existing)	MS-16 (Proposed)
Previous Well Name (if different)					OW-3	MS-6	B-5	B-4	
North (ft)		681,384.5	681,027.65	680,297.49	679,540.04	679,732.80	679,988.41	680,428.0	
East (ft)		1,412,181.7	1,4116,22.46	1,411,564.82	1,412,086.50	1,412,500.68	1,413,123.89	1,412,428.0	
Top Of Casing Elevation (ft)		868.04	851.29	859.78	835.66	841.90	861.47	861.47	
Well Diameter	2"	2"	2"	2"	2"	2"	2"	2"	2"
Well Stick-up (ft)		2.68	3.0	3.0	2.96	2.71	3.05	3.05	
Type of Casing	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Total Depth (ft)		50.0	20.0	39.0	27.0	38.0	41.0	59.0	
Screen Length (ft)	10.0	10.0	10.0	10.0	10.0	10.0	19.0	10.0	10.0
Screen Interval (ft below ground surface)		40.0	To 20.0	To 29.0	To 17.0	To 28.0	To 31.0	To 49.0	To 59.0
		50.0	20.0	39.0	27.0	38.0	41.0	59.0	

Coordinates: NC State Plane Grid, NAD83
Elevations: NAVD 88

Table 2. Sample Parameters, Analytical Methods and Detection Limits

PARAMETER	UNITS	ANALYTICAL METHOD	DETECTION LIMITS
<i>In situ Parameters</i>			
Field pH	pH Units	Hydrolab	NA
Specific Conductance	umhos/cm	Hydrolab	NA
Temperature	°C	Hydrolab	NA
Turbidity	NTU	HACH	NA
Water Level	ft	Water Level Meter	0.01 ft
<i>Laboratory Analyses</i>			
Nitrate	mg/l	EPA 353.2	0.05
Chloride	mg/l	EPA 300.0	0.1
Arsenic	ug/l	EPA 200.8	(Note 1) 2
Barium	mg/l	EPA 200.7	0.0050
Cadmium	ug/l	EPA 200.8	0.5
Chromium	ug/l	EPA 200.8	1
Copper	ug/l	EPA 200.8	2
Iron	mg/l	EPA 200.7	0.010
Lead	ug/l	EPA 200.8	2
Manganese	mg/l	EPA 200.7	0.0050
Mercury	ug/l	EPA 245.1	0.1
Nickel	ug/l	EPA 200.7	40
Selenium	ug/l	EPA 200.8	2
Silver	ug/l	EPA 200.8	0.5
Zinc	ug/l	EPA 200.7	0.02
Sulfate	mg/l	EPA 300.0	0.1
Fluoride	mg/l	EPA 300.0	0.10
TDS	mg/l	EPA 160.1	10

Note 1: The Division of Public Health has recommended that the Groundwater Quality Standard for Arsenic be lowered to 0.00002 mg/L. The Environmental Management Commission previously directed that NCDENR staff proceed with permanent rulemaking to change the Groundwater Quality Standard for Arsenic. The permanent rule published for hearing will propose a concentration level for Arsenic at the much lower concentration of 0.00002 milligrams per liter. Duke is evaluating methods to achieve detection at this lower concentration.

Table 3. Sample Containers, Preservatives and Holding Times.

PARAMETER	CONTAINERS	PRESERVATIVES	HOLDING TIMES
<i>In situ Parameters</i>			
Field pH	Insitu	None	Analyze Immediately
Specific Conductance	Insitu	None	Analyze Immediately
Temperature	Insitu	None	Analyze Immediately
Turbidity	Insitu	None	Analyze Immediately
ORP	Insitu	None	Analyze Immediately
<i>Laboratory Analyses</i>			
Nitrate	500 ml HDPE	Cool 4°C	48 hrs
Chloride	500 ml HDPE	Cool 4°C	28 days
Arsenic	500 ml HDPE	pH<2 HNO ₃	6 months
Barium	500 ml HDPE	pH<2 HNO ₃	6 months
Cadmium	500 ml HDPE	pH<2 HNO ₃	6 months
Chromium	500 ml HDPE	pH<2 HNO ₃	6 months
Copper	500 ml HDPE	pH<2 HNO ₃	6 months
Iron	500 ml HDPE	pH<2 HNO ₃	6 months
Lead	500 ml HDPE	pH<2 HNO ₃	6 months
Manganese	500 ml HDPE	pH<2 HNO ₃	6 months
Nickel	500 ml HDPE	pH<2 HNO ₃	6 months
Mercury	500 ml HDPE	pH<2 HNO ₃	6 months
Selenium	500 ml HDPE	pH<2 HNO ₃	6 months
Silver	500 ml HDPE	pH<2 HNO ₃	6 months
Zinc	500 ml HDPE	pH<2 HNO ₃	6 months
Sulfate	500 ml HDPE	Cool 4°C	28 days
Fluoride	500 ml HDPE	pH<2 HNO ₃	6 months
Total Dissolved Solids	500 ml HDPE	Cool 4°C	7 days

APPENDIX B

Monitoring Well Construction Records

**(Monitoring Well Construction Records will
be supplied upon construction of the wells)**

APPENDIX C

**DUKE POWER COMPANY
ENVIRONMENTAL CHEMISTRY**

PROCEDURE 3290

**SURFACE WATER GRAB SAMPLE
COLLECTION AND CUSTODY.**

DUKE POWER COMPANY
ENVIRONMENTAL CHEMISTRY
PROCEDURE 3290

SURFACE WATER GRAB SAMPLE COLLECTION AND CUSTODY

I. INTRODUCTION

A. Purpose

This procedure applies to the collection of grab samples from surface waters for various physical and chemical analyses. The procedure provides methods specific to the collection of both regulatory (e.g., NPDES compliance) and non-regulatory surface water samples. The procedure does not address requirements or recommendations for environmental sampling program designs, which, in general are provided within project-specific documents.

B. Summary of Method

Samples are collected using techniques and equipment that preserve characteristics of the water body being investigated and minimize chances of sample contamination. During all procedural steps, including collection, preservation, storage and transport, samples should be transferred and handled to the minimum extent practical.

Descriptive information is recorded on both the sample labels (Enclosure A), and the Chain of Custody Record and Analysis Request Form (Enclosure B) at the time samples are collected. The sample chain of custody begins with the collector's completion of the required sampling documentation, and is maintained by all individuals who subsequently handle or transfer the samples until they arrive in the laboratory, and are formally received by laboratory personnel.

Persons collecting samples are responsible for proper storage and transport until either custody is officially relinquished to analytical laboratory personnel, or the samples are sealed or locked prior to transit via a third party courier. Sample custody is assumed by a member of the Environmental Chemistry staff when samples are collected by that individual, or when samples are accepted from another source. Continuous custody of a group of samples, from collection, preservation, transport and/or storage, until delivery in the analytical lab must be documented by the collector and any subsequent sample custodians completing required information on the Chain of Custody Record and Analysis Request Form (Enclosure B).

Sample handling, preservation, and sample holding time requirements specified by required analytical procedures (Enclosures C and D) or the study plan must be followed. In some instances, the methods of collecting or preserving samples for

an analyte vary between regulatory and non-regulatory programs, so the sampling crew must be alert to the applicable requirements.

Iced samples stored in coolers should be covered with sufficient ice to maintain sample temperatures in the range 0 to 4 °C. Sample pre-treatments, where appropriate, including filtration and acidification, should be completed in the field whenever practical, or as soon after the time of collection as practical.

C. References:

1. American Public Health Association; American Water Works Association; Water Environment Federation. 1995. Standard Methods for the Examination of Water and Wastewater. 19th Edition. American Public Health Association, Washington DC.
2. U.S. Environmental Protection Agency (USEPA) 1996. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. May 1996. USEPA Region 4, Athens GA.
3. _____. 1983. Methods for the Chemical Analysis of Water and Wastes. Environmental Monitoring and Support Lab, Office of Research and Development. Cincinnati, OH.
4. U.S. Government Printing Office. 1998. Code of Federal Regulations. Part 136 - Guidelines Establishing Test Procedures For the Analysis of Pollutants. § 136.3 Identification of test procedures. National Archives and Records Administration, Washington, D.C.

II. MATERIALS

A. Materials

- A.1 Sample containers of a suitable material and sample volume for the anticipated analyses (Enclosure C or D)
- A.2 Adhesive, water-resistant sample container labels (Enclosure A) and marking pen with water-resistant ink (marking pen necessary for labels that are not pre-printed)

- A.3 Discrete depth water sample collection device(s), as needed
 - A.3.1 Kemmerer bottle (Enclosure E)
 - A.3.2 Van Dorn bottle (Enclosure F)
 - A.3.3 Other suitable device (e.g., peristaltic pump, APHA-type sampler, etc.) consistent with analytical requirements
- A.4 Sample filtration apparatus, as needed, including the following:
 - A.4.1 Vacuum pump and suction tubing
 - A.4.2 Power supply with AC/DC inverter
 - A.4.3 Vacuum bell with fitted base
 - A.4.4 Filtration funnel, magnetic coupling style
 - A.4.5 Glass fiber filters, 0.45 μm (i.e., 47-mm diameter. Whatman No. 934-AH, or equivalent), stored in contaminant-free closure
 - A.4.6 Forceps, stored in contaminant-free closure
- A.5 Coolers with ice
- A.6 Sample temperature blank (100 mL or larger labeled sample bottle filled with water for measuring representative sample temperatures at log-in)
- A.7 Chain of Custody Record and Analysis Request Form (Enclosure B)
- A.8 Safety equipment, as needed
 - A.8.1 Reflective vests and/or road reflectors or flashers for sampling from highway bridges
 - A.8.2 Approved floatation gear for sampling on or over water
 - A.8.3 Safety glasses and disposable gloves for handling acid preservative
- B. Reagents
 - B.1 50% HNO_3 (1.0 N HNO_3 diluted to 50% with Milli-Q water) preservative (required for field preservation per Enclosures C and D)

- B.2 50% H₂SO₄ (1.0 N H₂SO₄ diluted to 50% with Milli-Q water) preservative (required for field preservation per Enclosures C and D)
- B.3 Milli-Q water as needed, required for the preparation of field sample blanks (see Section IV)
- B.4 Detergent (e.g., Liquinox[®], or equivalent), required if decontamination of sampling gear is needed (see Section III,G)

III. METHOD

A. General Sampling Techniques

- A.1 Samples must be collected using materials and methods that are in accordance with the anticipated analytical methods, and the study plan, as applicable. Consult Enclosures B, and either C or D, as applicable, for details of sample volume, type of container, pretreatment and preservation for various surface water analytes. For analytes not listed, consult the laboratory's or an appropriate method reference.
- A.2 When sampling a site for a known or suspected contaminant, where possible, initiate sampling in an area known or expected to have the lowest concentrations of the contaminant and then proceed to areas having progressively greater contaminant concentrations. When collecting samples throughout a water column profile, start at the uppermost sampled depth, and proceed downward until the final samples are collected from the deepest sampled depth.
- A.3 When collecting water samples at locations where bottom sediment sampling is also required, complete all water sampling prior to initiating sampling of the bottom sediments.
- A.4 Except as noted below in step A.5.3, sample containers should always be thoroughly pre-rinsed with a portion of sample water (which is then discarded) prior to filling with sample water.
- A.5 When collecting surface or near-surface samples (e.g., 0.3 m), water can usually be collected directly into the sample container, with the following precautions.
 - A.5.1 When wading or navigating a stream or river, always collect the sample facing upstream so that the sample is not potentially contaminated by disturbed sediment or material leached from the boat.

A.5.2 During filling, grasp the sample container by its lower half, keeping hands and fingers away from the mouth of the container to the extent practical. With a current present, hold the container opening facing upstream; otherwise, an artificial current may be created during filling by slowly sweeping the container in a direction away from the hand holding it.

A.5.3 If collecting a sample in a bottle containing preservative (pre-preserved container), take care not to overfill or displace the preservative.

A.6 When collecting near-surface samples from a bridge (or similar structure) over a river or lake, collect sample water in a clean plastic (polyethylene, polypropylene or PVC) bucket or other suitably designed grab sample device, suspended by a clean nylon rope. Ensure that the rope, when lowered or raised, does not rub concrete or paint particles from the bridge guard rail or similar structure, potentially contaminating the sample. Pour the sample from the collection device into the sample containers (including a quick pre-rinse, unless containers are pre-preserved), immediately to avoid suspended material settling out in the sampling device.

A.7 Samples collected from boats, particularly from below-surface depths, are most often collected with a Kemmerer or Van Dorn bottle. Such water collection bottles may be constructed from acrylic or PVC resin, with polyurethane, and/or silicon end seals. Prior to filling sample containers from a Kemmerer or Van Dorn, avoid potential sample cross-contamination by running to waste enough water to completely flush any outlet tubing attached to the device.

B. In-Field Filtration of Samples

B.1 Samples requiring filtration should be filtered in the field as soon after collection as practical. However, avoid setting up filtration equipment where samples or the filtration apparatus might be exposed to conditions that might increase contamination risks (e.g., near a busy roadway, construction activity, running gasoline motors, etc.).

B.2 Assemble the pre-cleaned filtration apparatus and connect the filtration pump to the power supply.

B.3 Uncouple the filter funnel from the support, use clean forceps to center a clean 0.45- μ m glass fiber filter on the filter support, and couple the funnel back into place.

- B.4 Place a waste container under the filter funnel turn on the vacuum pump. Pre-rinse the sides of the filter funnel (and the filter) with at least 50 mL of sample water from the same location and depth. Discard this filtrate waste. (If the filter is to be used subsequently for an analysis such as chlorophyll *a*, then be sure to measure and note the volume filtered to waste in the calculations.)
- B.5 Replace the rinse waste container under the filter funnel with a labeled sample container and proceed to filter enough sample to fill the container. Remove and cap it immediately. Use forceps to remove and discard (or preserve, if desired) the filter.
- B.6 Repeat Steps B.3 through B.5 of this section each subsequent sample requiring filtration.

C. Sample Preservation

NOTE: SAFETY GLASSES AND DISPOSABLE GLOVES SHOULD BE WORN BY INDIVIDUALS WORKING WITH 50% ACID SOLUTIONS.

- C.1 For samples requiring acidification (see Enclosure C or D as applicable), use a fixed volume dispenser or a mechanical pipette to deliver 1.0 mL of acid preservative (i.e., 50% HNO₃ or 50% H₂SO₄) per 100 mL sample. Keep sample containers open only briefly, for the time it takes to add acid; then re-seal tightly. Be sure to carefully seal and store the dispenser and/or acid container during transit. Wash any spilled acid solution from containers or equipment using ample quantities of water.
- C.2 For samples requiring chilling (see Enclosure C or D), seal containers tightly and place in coolers. In general, samples should take up no more than the lower 2/3 of the cooler's storage space in order to leave room for a sufficient amount of ice. Cover the containers (including the temperature blank) under a layer of loose ice adequate to maintain temperatures within 0 to 4 °C until receipt at the lab.

D. Sampling Collection and Custody Documentation

- D.1 For routine pre-logged samples, laboratory-generated sample labels (Enclosure A) are used. Pre-logged sample labels contain all the descriptive information (and a bar code), taken from the sampling program plans, to permit the lab to link the sample to other information recorded at the pre-log-in time.
- D.2 For non-routine samples that are not pre-logged, generic sample labels are used (Enclosure A). These labels require the collector fill in the

appropriate sampling information, including the following:
project/station, sample location, depth, type of sample (e.g., grab),
collector's name or initials, date and time of collection. All sample
containers delivered to the lab must have a completed sample label.

- D.3 The Chain of Custody Record and Analysis Request Form is completed (use black ink) prior to sampling and/or in the field with the following information for each sample: project/station, location, nominal depth, type of sample (e.g., grab), preservation and/or filtration (if applicable). Later at the time of sampling, the collector's name or initials, date and time of collection are added to the respective sample lines on the sheet. For pre-logged samples that appear on the custody form but are not collected (e.g., bottom-most water samples not collected due to reservoir drawdown), the collector should strike a line through the sample on the custody sheet. Where pre-printed custody sheets supply a blank entry for bottom depth (or 1 m above bottom) samples, be sure to enter the actual depth sampled.

E. Sample Transport

- E.1 During transport, samples should remain in the physical possession or within sight of the collector, or other documented sample custodian, at all times. Otherwise, samples should be sealed, locked, or placed in a secure area to prevent possible tampering. The Chain of Custody Record and Analysis Request Form should remain with samples during all phases of transit until samples reach the analytical lab.
- E.2 If the collector relinquishes physical custody of samples and a second party (the new custodian) receives the samples, both parties must sign and provide the time and date of the custody transfer on the Chain of Custody Record and Analysis Request Form.
- E.3 If samples are to be mailed or delivered to any location by a courier who does not formally assume custody by signing Chain of Custody Record and Analysis Request Form, the samples should be sealed or locked prior to the time they are provided to the courier. The person sealing or locking the samples must sign and provide the time and date below the "Seal/Locked By" entry on the Chain of Custody Record and Analysis Request Form. Because in this case the custodian is relinquishing physical custody of the samples that will be shipped, he/she must also sign a "Relinquished By" line on the form.
- E.4 More than one transfer of custody is possible; however, transfers should be kept to the minimum necessary to avoid personnel unnecessarily handling samples. If more than two transfers of custody are necessary, attach an additional Chain of Custody Record and Analysis Request Form (or

similar) form to each original form to document the entire chain of custody for all samples.

F. Sample Log-In

F.1 Samples should be delivered, along with the completed Chain of Custody Record and Analysis Request Form, to the analytical lab log-in area as soon as practical upon return from a sampling trip.

F.2 The original Chain of Custody Record and Analysis Request Form must be signed by the collector (or current custodian) and a lab employee, indicating receipt of the samples and transfer of custody to the lab. A photocopy of the signed form shall be retained by Environmental Chemistry in a designated storage area until all reported results for the group of samples are reviewed and validated.

G. Sampling Equipment Cleaning and Maintenance

G.1 Ensure that all sampling equipment is rinsed thoroughly with either contaminant-free surface water or tap water before and after sampling trips. Collection devices must be stored dry and away from contaminants.

G.2 If sampling equipment becomes contaminated with sediment, petroleum products, or other undesirable material, follow guidance for cleaning recommended by the equipment manufacturer, or Reference I.C.2. Note that any cleaning procedure must be followed by an extremely thorough rinsing with tap and/or Milli-Q water to remove traces of all cleaning solutions.

IV. QUALITY CONTROL

A. Split Samples

Split samples may occasionally be requested by regulatory or resource agencies. Each split sample must be taken from a single discrete collection container (i.e., Kemmerer, Van Dorn, or other device) containing adequate water for both samples. Extreme care must be taken that the sample water is adequately mixed before partitioning the split samples.

B. Sample Blanks

Generally, specific project study plans will delineate instances, if any, where the following blanks, or combinations of them, are employed within environmental monitoring programs.

B.1 Trip Blanks

Trip blanks are sealed sample containers filled with Milli-Q or other suitable analyte-free water that accompany the empty sample containers to the field, and then return to the lab with the samples.

B.2 Equipment Field Blanks

Equipment field blanks may be employed as a check on potential contamination that resulting from sampling equipment. Milli-Q or other suitable analyte-free water is exposed to sampling equipment in a manner identical to actual samples, and then returned to the lab for analysis.

B.3 Preservative Blanks

Preservative blanks are sample containers of Milli-Q or other suitable analyte-free water that receive the same amount of preservative as samples. They are intended to quantify potential contamination of a given analyte from the preservative agent.

B.4 Filtration Blanks

Filtration blanks are designed to assess the potential contamination that can be attributed to the process of sample filtration. Milli-Q or other suitable analyte-free water is filtered and treated in a manner identical to samples, and then returned to the lab for analysis.

V. SAFETY

There are no specific safety guidelines for this procedure; however, as with all type of work, the guidelines outlined in the Duke Power Safe Work Practices manual should be followed. For the activities outlined in this procedure, refer to the manual's sections on:

- water safety
- hazardous chemicals

VI. ENCLOSURES

- A. Example sample labels (Top: pre-logged, printed sample label; Bottom: generic sample label)
- B. Example Chain of Custody Record and Analysis Request Form
- C. NON-REGULATORY PROGRAMS: Sample preservation and holding requirements for various analytical methods
- D. REGULATORY PROGRAMS: Sample preservation and holding requirements for various analytical methods
- E. Operation of a Kemmerer Sampler
- F. Operation of a van Dorn Sampler

VII. NOTES

None

Enclosure A. Example sample labels (Top: pre-printed sample label; Bottom: generic label)

SURFQ	DAN RIVER
710.0	0.3 M
Job #:	99-FEB-0140
Sample #:	99003500
Loc:	710.0
Depth/Type:	0.3
0:00:00	2/24/1999
	Collection Time/Date



99003500

Station Marshall Steam Station
Location Ash Basin Loc. 6 0.3m
Type of Sample Grab (Cu, Fe)
Collected by K. Finley
Date 12/2/98
Time 0955

Enclosure B. (Continued) Example Chain of Custody Record and Analysis Request Form
(reverse side)

Form 8882 (p. 87)
Previously Form 24226

Instructions For Filling Out CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST FORM

1. Duke Power's Analytical Laboratories address and phone number.
2. CLIENT: Person or group who is requesting the analysis.
3. Report to/Ph: Person(s)/phone number to directly receive analytical results.
4. Project Name: Name of station, facility, and/or project (examples - McGuire Landfill #1, Marshall NPDES).
5. Mail Code: Duke Energy assigned code to receive internal mail.
6. Business Unit: Unit identifier
7. Resp. Center To: Responsibility identifier
8. Project ID: Project identification identifier
9. Activity ID: Activity identification identifier
10. Process: Process identifier
11. Lab Use: To be completed by Analytical Lab only.
12. SAMPLE #: Lab information management system assigned number to individual samples. To be completed by Analytical Lab.
13. Lab PROFS #: Individual station sample assigned tracking number number.
14. Sample Description or ID: Brief description of sample type or origin (example - Monitoring well #2B), or sample ID series (hand Date Collector #).
15. Collection Information: Date and time of sample collection and signature (NOT INITIALS) of person who collected each sample.
16. Container Type: Specify type of container used for sample by checking appropriate box.
17. Preservative Added: Specify method of preservation by checking appropriate box(es).
18. Analysis Required: (Write sideways)
MUST include ANALYSIS REQUESTED, one column for each type of bottle
Examples - [Column 1] Metals: Ca, Mg, Na, Pb, Cu, Cd
[Column 2] Nutrients: nitrate + nitrite, chloride
[Column 3] Fecal/Coliform
19. GRAB: Check appropriate line for GRAB samples.
20. COMP: Check appropriate line for composite samples.
21. Total # of Containers: Total number of containers for a sample location.
22. Relinquished By/Accepted By: Signature (NO INITIALS) of person(s) releasing sample(s) into another person(s) care, who MUST sign accepting responsibility of sample(s). Each person(s) handling sample(s), whatever delivery method used, MUST acknowledge custody of sample(s).
23. Seal/Locked By/Seal/Lock Opened By: Signature of person sealing container for delivery of sample(s). Signature of person opening sealed container for receipt of samples.
24. Turnaround Requested: Time frame client needs analyses to be complete and date results should be received by client.
25. Sample Matrix: Matrix of sample(s) (example - soil, oil, sludge, H₂O), specific program and where samples were collected, NC or SC.
26. TEMP: Temperature of samples upon receipt.
27. Comments: Any unusual circumstances of sample collection or handling.
28. Original - Kept on file in AL Client Contact Active Files. Copy 1 - Client Contact files. Copy 2 - Client copy.

Enclosure C. NON-REGULATORY PROGRAMS: Sample preservation and holding requirements for various analytical methods

TABLE II—REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter	Container¹	Preservation^{2,3}	Maximum Holding time⁴
Alkalinity	P, G	Cool, 4°C	14 days.
Ammonia	P, G	Filter immediately, Cool, 4°C	28 days.
Biochemical oxygen demand	P, G	Cool, 4°C	48 hours.
Biochemical oxygen demand, carbonaceous	P, G	Cool, 4°C	48 hours.
Chemical oxygen demand	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days.
Chloride	P, G	None required	28 days.
Chlorine, total residual	P, G	None required	Analyze Immediately.
Color	P, G	Cool, 4°C	48 hours.
Fluoride	P	None required	28 days.
Hardness	P, G	HNO ₃ to pH<2, H ₂ SO ₄ to pH<2	6 months.
Hydrogen ion (pH)	P, G	None required	Analyze immediately.
Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days.
Metals: ⁷			
Chromium VI	P, G	Cool, 4°C	24 hours.
Mercury	P, G	HNO ₃ to pH<2	28 days.
Metals, except boron, chromium VI and mercury.	P, G	HNO ₃ to pH<2	6 months.
Nitrate	P, G	Filter immediately, Cool, 4°C	48 hours.
Nitrate-nitrite	P, G	Filter immediately, Cool, 4°C	28 days.
Nitrite	P, G	Filter immediately, Cool, 4°C	48 hours.
Oil and grease	G	Cool to 4°C, HCl or H ₂ SO ₄ to pH<2.	28 days.
Organic Carbon	P, G	Cool to 4 °C HCl or H ₂ SO ₄ or H ₃ PO ₄ , to pH<2.	28 days.
Orthophosphate	P, G	Filter immediately, Cool, 4°C	48 hours.
Oxygen, Dissolved Probe	G Bottle and top	None required	Analyze immediately.
Winkler	do	Fix on site and store in dark	8 hours.
Phosphorus (elemental)	G	Cool, 4°C	48 hours.
Phosphorus, total	P, G	Cool, 4°C	28 days.
Residue, total	P, G	Cool, 4°C	7 days.
Residue, Filterable	P, G	Cool, 4°C	7 days.
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days.
Residue, Settleable	P, G	Cool, 4°C	48 hours.
Silica	P, PFTE, or Quartz.	Cool, 4 °C	28 days.
Specific conductance	P, G	Cool, 4°C	28 days.
Sulfate	P, G	Cool, 4°C	28 days.
Sulfide	P, G	Cool, 4°C add zinc acetate plus sodium hydroxide to pH>9	7 days
Sulfite	P, G	None required	Analyze immediately.
Temperature	P, G	None required	Analyze.
Turbidity	P, G	Cool, 4°C	48 hours.

Enclosure C. (Continued) **NON_REGULATORY PROGRAMS: Sample preservation and holding requirements for various analytical methods**

Table II Notes

¹ Plastic (polyethylene or polyethylene terephthalate) (P) or glass (G).

² Sample preservation should be performed immediately upon sample collection.

³ When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO₃) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H₂SO₄) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

⁴ Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Some samples may not be stable for the maximum time period given in the table. The term "analyze immediately" usually means within 15 minutes or less of sample collection.

⁵ Should only be used in the presence of residual chlorine.

⁶ Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

⁷ Samples should be filtered immediately on-site before adding preservative for dissolved metals.

Enclosure D. REGULATORY PROGRAMS: Sample preservation and holding requirements for various analytical methods. Preservation and holding time requirements for various analytical methods (from 40 CFR Part 136, §136.3, Table II).

TABLE II—REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter	Container ¹	Preservation ^{2,3}	Maximum	
				Holding time ⁴
Alkalinity	P, G	Cool, 4°C		14 days.
Ammonia	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2		28 days.
Biochemical oxygen demand	P, G	Cool, 4°C		48 hours.
Biochemical oxygen demand, carbonaceous	P, G	Cool, 4°C		48 hours.
Chemical oxygen demand	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2		28 days.
Chloride	P, G	None required		28 days.
Chlorine, total residual	P, G	None required		Analyze immediately.
Color	P, G	Cool, 4°C		48 hours.
Fluoride	P	None required		28 days.
Hardness	P, G	HNO ₃ to pH<2, H ₂ SO ₄ to pH<2		6 months.
Hydrogen ion (pH)	P, G	None required		Analyze immediately.
Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2		28 days.
Metals: ⁷				
Chromium VI	P, G	Cool, 4°C		24 hours.
Mercury	P, G	HNO ₃ to pH<2		28 days.
Metals, except boron, chromium VI and mercury.	P, G	HNO ₃ to pH<2		6 months.
Nitrate	P, G	Cool, 4°C		48 hours.
Nitrate-nitrite	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2		28 days.
Nitrite	P, G	Cool, 4°C		48 hours.
Oil and grease	G	Cool to 4°C, HCl or H ₂ SO ₄ to pH<2.		28 days.
Organic Carbon	P, G	Cool to 4°C HCl or H ₂ SO ₄ or H ₃ PO ₄ , to pH<2.	28 days.	
Orthophosphate	P, G	Filter immediately, Cool, 4°C		48 hours.
Oxygen, Dissolved Probe	G Bottle and top	None required		Analyze immediately.
Winkler	do	Fix on site and store in dark		8 hours.
Phosphorus (elemental)	G	Cool, 4°C		48 hours.
Phosphorus, total	P, G	Cool, 4°C, H ₂ SO ₄ to pH<2		28 days.
Residue, total	P, G	Cool, 4°C		7 days.
Residue, Filterable	P, G	Cool, 4°C		7 days.
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C		7 days.
Residue, Settleable	P, G	Cool, 4°C		48 hours.
Silica	P, PFTE, or Quartz.	Cool, 4°C		28 days.
Specific conductance	P, G	Cool, 4°C		28 days.
Sulfate	P, G	Cool, 4°C		28 days.
Sulfide	P, G	Cool, 4°C add zinc acetate plus sodium hydroxide to pH>9		7 days
Sulfite	P, G	None required		Analyze immediately.
Temperature	P, G	None required		Analyze.
Turbidity	P, G	Cool, 4°C		48 hours.

Enclosure D. (Continued) **REGULATORY PROGRAMS: Sample preservation and holding requirements for various analytical methods. Preservation and holding requirements for various analytical methods (from 40 CFR Part 136, § 136.3, Table II).**

Table II Notes

¹ Plastic (polyethylene or polyethylene terephthalate) (P) or glass (G).

² Sample preservation should be performed immediately upon sample collection.

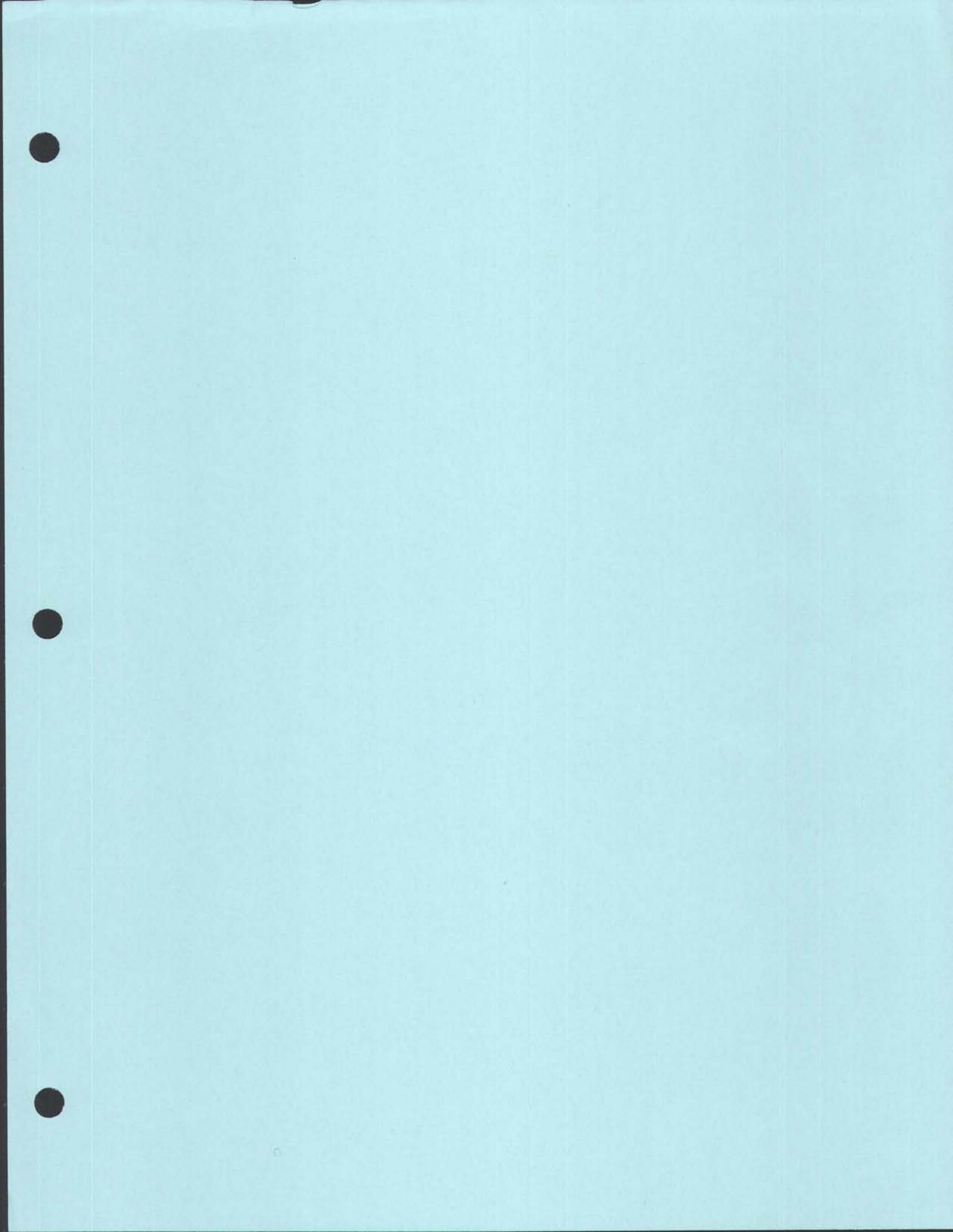
³ When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO₃) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H₂SO₄) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

⁴ Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that for the specific types of samples under study, the analytes are stable for the longer time, and has received a variance from the Regional Administrator under § 136.3(e). Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability. See § 136.3(e) for details. The term "analyze immediately" usually means within 15 minutes or less of sample collection.

⁵ Should only be used in the presence of residual chlorine.

⁶ Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

⁷ Samples should be filtered immediately on-site before adding preservative for dissolved metals.



Carmen Johnson

FSS/Permit ID #	Date	Doc ID#
18-09	1/25/12	DIN

January 6, 2005

North Carolina Department of Environment
and Natural Resources
Division of Waste Management
Solid Waste Section
401 Oberlin Road, Suite 150
Raleigh, NC 27605-1350

APPROVED
DIVISION OF WASTE MANAGEMENT
SOLID WASTE SECTION
DATE 1/14/05 BY JK
Central Office
18-09

ATTENTION: Ms. Ellen Lorscheider
Hydrogeologist
Solid Waste Permitting Branch

SUBJECT: Marshall Steam Station
FGD Industrial Landfill
Permit to Construct

After review of your December 15, 2004 letter, we have included a response to the concerns you have cited in the attached document. Also attached is an addendum regarding cover soil depth to address a concern raised by John Murray.

Please contact me at (704) 382-4309 if additional information is needed to ensure that a Permit to Construct is issued by January 15, 2005.

Sincerely,

Allen Stowe

Allen Stowe, Scientist
Environmental Support

Attachments

*Duke Power Marshall Steam Station, Catawba County,
FGD Residue Landfill Permit Application
Responses to NC DENR questions dated 12/15/2004*

Construction Plan Application

It is my understanding, regarding comment 5.4 of that letter that the Cell 2 will be handled under a separate Permit to Construct (PTC). It would be impossible to include that area in this PTC, as the paperwork from other agencies is not complete. Additionally, it will be necessary to evaluate hydrogeologic conditions before construction is started in this area of wetland mitigation

Response:

Your concern is duly noted, a PTC for Cell 2 will be managed via a separate Construction Permit Application.

Landfill Operations and Maintenance

Comment 1.6: Mention is made to "FGD residue that is removed from settling and clarifier stages". Is this a separate waste from the typical FGD waste. It seems to be because it is considered to be a finer material. When the material is tested, when the Marshall scrubber is operational, both types of material will need to be tested. At this time, the testing will not be required for the PTC.

Response:

The FGD residue collected from the settling and clarifier stages may differ somewhat from off-specification gypsum. Once the Marshall scrubber is operational, Duke Power will analyze and characterize all applicable waste produced by this process. These analytical results will be shared with the NC DENR Solid Waste Section.

Compliance Demonstration

Comment 5.1.1: Whatever the actual waste to be landfilled is, it will be need to be tested after the scrubber is in operation and the tests submitted to this Section.

Response:

Duke Power will fully analyze and characterize the FGD residue once it is produced. These analytical results will then be submitted to the NC DENR Solid Waste Section for review.

Duke Power Marshall Steam Station, Catawba County,
FGD Residue Landfill Permit Application
Responses to NC DENR questions dated 12/15/2004

Appendix B

Please replace the USGS Seismic Map with the most updated information which is from 2002. It is unacceptable to keep information which is not current in the document. The data from 1996 (in your document) and 2002 has been altered significantly by the USGS for the area, which includes North Carolina.

Response:

The document which contained the referenced map was prepared by S&ME and contained geotechnical testing results for the FGD residue material and a conceptual evaluation of slope stability of a FGD residue landfill. As part of that conceptual slope stability, S&ME was requested to evaluate the slope stability from seismic events. This review selected the most conservative probabilistic ground motion for the three FGD residue landfill sites. The most conservative probabilistic ground motion was found at the Cliffside plant. On the 1996 USGS map, the peak ground acceleration was 0.18g.

Duke requested S&ME review the 2002 USGS Seismic Map with respect to their previous analysis. This review found that the peak ground accelerations on the 1996 maps were greater than the values for the Duke plants found on the 2002 USGS seismic map. S&ME concluded that the conceptual slope stability analyses included in the February 2, 2004 FGD Scrubber Sludge Testing (Revision 1) report are conservative when considering use of the 1996 versus 2002 seismic data.

The letter providing this evaluation is included as Attachment 1.

*Duke Power Marshall Steam Station, Catawba County,
FGD Residue Landfill Permit Application
Responses to NC DENR questions dated 12/15/2004*

Other MYGRT questions

It is unclear to me how the dimensions of Width of Source and Source Length were derived. Please show on a map the dimensions shown.

Response:

As described in the demonstration modeling report, two cross sections of the site were modeled in MYGRT to evaluate compliance with 2L standards. The groundwater flow at this site is generally from the northwest of the landfill footprint towards the east and southeast in the direction of the Ash Basin arms located east of the landfill. The groundwater flow underneath the landfill footprint is generally defined by two discharge locations:

- a discharge to the southern arm of the Ash Basin, near boring MS-2. This is modeled in Cross Section 1-1.
- a discharge to the northernmost arm of the Ash Basin, near boring B-1. This is modeled in Cross Section 2-2.

In effect there are two groundwater drainage areas, discharging as described above.

In MYGRT, the source is modeled using values for width and length of the source. Since this site has two adjacent groundwater drainage areas, a separate width and length were selected for each area. The length and width for each of these areas is shown on Figure 1.

The width for each cross section was conservatively selected to be approximately the width of the landfill along the N-S (actually NNW-SSE) axis of the landfill. This width is greater than the actual width of the groundwater drainage areas.

The length selected is the length along the cross section.

*Duke Power Marshall Steam Station, Catawba County,
FGD Residue Landfill Permit Application
Responses to NC DENR questions dated 12/15/2004*

Let me restate my question about Transverse Dispersion Coefficient

$$Dy = Dx / 10.$$

Dx is Horizontal Dispersion Coefficient

$$Dx = \text{Horizontal Dispersion} * \text{Horizontal Seepage Velocity}$$

$$= 7.84 \text{ feet/year} * 24.93 \text{ ft/year}$$

$$= 195.45 \text{ ft}^2/\text{year}$$

$$\text{Therefore } Dy = 195.45 \text{ ft}^2/\text{year} / 10$$

$$= 19.5 \text{ ft}^2/\text{year}$$

This is according to the manual page 7-18. Please let me know if I am calculating something wrong. I still believe the Dy is wrong.

Response:

The calculations that you present are correct.

In the MYGRT modeling submitted in the report dated March 31, 2004, the MYGRT output for sulfate, Cross Section 1-1, contains an error in the printed value for "Dispersion along Y". The value in the printout is 1.96 ft²/yr. The correct value should be 19.6 ft²/yr.

The input file for this model run was reviewed and found to contain the correct value of (Dy =) 19.6 ft²/yr. The input file was re-run (as found) and the printed input parameter was correctly printed as 19.6ft²/yr. The results of this run were compared to the results in the March 31, 2004 report and are identical. These results and the printed input file are included in Attachment 2.

The printed input values for "Dispersion along Y" for the other MYGRT runs in the March 31, 2004 report were reviewed and found to be correctly printed as 19.6ft²/yr.

In addition, the printed input values for the MYGRT analyses contained in the Compliance Demonstration Report Addendum, dated November 12, 2004, were reviewed. The printed values for the two sulfate analyses and the analysis for fluoride for Cross Section 1-1 were found to be correct.

However, the same printing error was found in the two analyses for arsenic and for the analysis for fluoride for Cross Section 2. The input files were reviewed and found to contain the correct values. These analyses were re-run (as found). Again, the printed input parameters were correctly printed. The results of these runs were compared to the results in the November 12, 2004 report and are identical. These results and the printed input file are included in Attachment 2.

Duke has a meeting scheduled with the developer of the program MYGRT to discuss this and other printed input files issues.

*Duke Power Marshall Steam Station, Catawba County,
FGD Residue Landfill Permit Application
Responses to NC DENR questions dated 12/15/2004*

*Please let me know which specific cross-sections show the soil types
which reflect the cross-sections in the MYGRT demonstration.*

The soil types are shown on the drawing showing the MYGRT cross sections. The soil types were taken from the boring logs found in the report for the site hydro-geo investigation. This drawing is included as Figure 2.

*Duke Power Marshall Steam Station, Catawba County,
FGD Residue Landfill Permit Application
Responses to NC DENR questions dated 12/15/2004*

**Addendum No. 2
Construction Plan Application
Duke Energy Marshall Steam Station
FGD Residue Landfill
Catawba County, NC**

Construction Plan Application Report

Section 2.3, page 3- Replace “An 8-inch thick intermediate layer...” with “A 12-inch thick intermediate layer...”

Operations and Maintenance Plan

Section 1.5, page 2- Replace “FDG waste shall be covered with an 8-inch thick layer of intermediate cover soil...” with “FGD waste shall be covered with a 12-inch thick layer of intermediate cover soil...”



North Carolina Department of Environment and Natural Resources

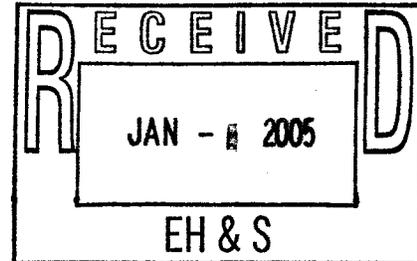
Dexter R. Matthews, Director

Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary

December 15, 2004

Mr. Allen Stowe
Duke Power
EC11E / 526 South Church Street
Charlotte, NC 28202-1802



Subject: Review of Application for Permit to Construct
Duke Energy Marshall Steam Station FGD Residue Landfill
Catawba County, North Carolina

Dear Mr. Stowe,

Thank you for the response to my September 20, 2004 comment letter, regarding the proposed Flue Gas Desulfurization (FGD) landfill in Catawba County. I reviewed the following documents from you.

- 1) FGD Residue Landfill Permit Application Site Suitability Information August 29, 2003 Volume 1 15A NCAC 13B .0503 (1) and .0504 (1) Requirements and Responses received September 3, 2003.
- 2) FGD Residue Landfill Permit Application Site Suitability Information August 29, 2003 Volume 2 Hydrogeologic Study Study S&ME Project 1264-02-578 received November 18, 2004 received September 3, 2003.
- 3) Compliance Demonstration Report dated March 31, 2004, received April 6, 2004,
- 4) Construction Plan Application for Phase 1 dated March 2004, received April 2, 2004.
- 5) FGD Residue Landfill Permit Application site Suitability Information October 29, 2004 Volume 1 Appendum 1 Hydrogeologic Study S&ME Project 1264-02-578 received November 18, 2004.
- 6) FGD Residue Landfill Permit Application site Suitability Information October 29, 2004 Volume 2 Appendum 1 Hydrogeologic Study S&ME Project 1264-02-578 received November 18, 2004
- 7) FGD Residue Landfill Permit Application .0503(2)(d)(ii)(A) Compliance Demonstration Report. Addendum November 12, 2004, received November 18, 2004.

This review is according to and is referenced to the *15A NCAC 13B Solid Waste Management Rules* Section .0503 and .0504. Following are comments regarding the application.

Construction Plan Application

- It is my understanding, regarding comment 5.4 of that letter that the Cell 2 will be handled under a separate Permit to Construct (PTC). It would be impossible to include that area in this PTC, as the paperwork from other agencies is not complete. Additionally it will be necessary to evaluate hydrogeologic conditions before construction is started in the area of wetland mitigation.

Landfill Operations and Maintenance

- Comment 1.6: Mention is made to "FGD residue that is removed from settling and clarifier stages". Is this a separate waste to the typical FGD waste. It seems to be because it is considered to be a finer material. When the material is tested, when the Marshall scrubber is operational, both types of material will need to be tested. At this time, the testing will not be required for the PTC.

Compliance Demonstration

- Comment 5.1.1: Whatever the actual waste to be landfilled is, it will be need to be tested after the scrubber is in operation and the tests submitted to this Section.

Appendix B

- Please replace the USGS Seismic Map with the most updated information, which is from 2002. It is unacceptable to keep information, which is not current in the document. The data from 1996 (in your document) and 2002 has been altered significantly by the USGS for the area, which includes North Carolina.

Other MYGRT questions

- It is unclear to me how the dimensions of *Width of Source* and *Source Length* were derived. Please show on a map the dimensions shown.

- Let me restate my question about *Transverse Dispersion Coefficient*

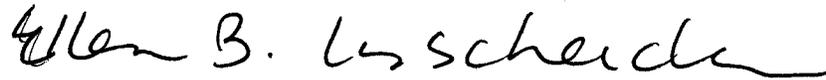
$$\begin{aligned} D_y &= D_x / 10. \text{ } D_x \text{ is Horizontal Dispersion Coefficient.} \\ D_x &= \text{Horizontal Dispersion} * \text{Horizontal Seepage Velocity} \\ &= 7.84 \text{ feet/year} * 24.93 \text{ ft/year} \\ &= 195.45 \text{ ft}^2/\text{year} \\ \text{Therefore } D_y &= 195.45 \text{ ft}^2/\text{year} / 10 \\ &= 19.5 \text{ ft}^2/\text{year} \end{aligned}$$

This is according to the MYGRT manual page 7-18. Please let me know if I am calculating something wrong. I still believe the D_y is wrong.

- Please let me know which specific cross-sections show the soil types, which reflect the cross-sections in the MYGRT demonstration.

Please contact me regarding these questions. I can be reached at 919-733-0692 extension 345 or by email at ellen.lorscheider@ncmail.net. Additional comments may be forthcoming from me, I needed to clarify the above before completing my review for a permit to construct.

Sincerely,



Ellen B. Lorscheider
Permitting Hydrogeologist

Cc: Bill Miller, Duke
John Murray, SWS
Jim Barber, SWS

Attachment 1



January 5, 2005

Mr. William (Bill) Miller, P.E
Mail Code EC11E
Duke Energy
526 South Church Street
Charlotte, North Carolina 28202

Reference: **PROBABILISTIC GROUND MOTIONS**
Duke Power Coal-Fired Steam Stations in North Carolina
S&ME Project 1264-03-057

Dear Mr. Miller:

S&ME's February 2, 2004 *FGD Scrubber Sludge Testing (Revision 1)* report included selected slope stability analyses on conceptual landfill cross-sections. The probabilistic ground motion used for the analyses was the peak ground acceleration (PGA) of 0.18g for the Cliffside Steam Station location. This value was selected as the most conservative between the Cliffside, Marshall, and Belews Creek Steam Station locations as obtained from the United States Geologic Survey *Interpolated Probabilistic Ground Motion for the Conterminous 48 States by Latitude Longitude, 1996 Data* <http://eqint.cr.usgs.gov/eq/html/lookup-interp.html>.

We understand that the North Carolina Department of Environment and Natural Resources (NCDENR) has requested that the seismic information included in the referenced document be replaced with data from *Interpolated Probabilistic Ground Motion for the Conterminous 48 States by Latitude Longitude, 2002 Data* <http://eqint.cr.usgs.gov/eq/html/lookup-2002-interp.html>. As such, we have attached the 2002 seismic information for the Cliffside, Marshall, and Belews Creek Steam Station locations for reference and record.

Review of the 2002 data reveals that the most conservative PGA is 0.16g, still for the Cliffside Steam Station location. Comparison of the 1996 and 2002 data reveals that the most conservative PGA is the 1996 PGA of 0.18g for the Cliffside Steam Station location. Therefore, the conceptual slope stability analyses included in our February 2, 2004 *FGD Scrubber Sludge Testing (Revision 1)* report are conservative when considering use of the 1996 versus 2002 seismic data.

S&ME appreciates this and every opportunity we have to be of service to you, Duke Power, and Duke Energy. We trust this information is responsive to your needs at this time. If you need additional information or assistance, please do not hesitate to contact us.

Sincerely,

S&ME, Inc.


Larry Armstrong, P.E.
Senior Engineer/Project Manager
larmstrong@smeinc.com



S:\ENVIRON\2003\Projects\6403057\Ground Motions\2002 Probabilistic Ground Motions Letter.doc



Earthquake Hazards Program

LOCATION 35.21367 Lat. -81.76253 Long.
The interpolated Probabilistic ground motion values, in %g,
at the requested point are:

	10%PE in 50 yr	2%PE in 50 yr
PGA	5.77	15.74
0.2 sec SA	12.97	32.79
1.0 sec SA	4.04	10.40

LOCATION 35.60267 Lat. -80.97572 Long.
The interpolated Probabilistic ground motion values, in %g,
at the requested point are:

	10%PE in 50 yr	2%PE in 50 yr
PGA	4.75	12.24
0.2 sec SA	11.07	27.72
1.0 sec SA	3.72	9.72

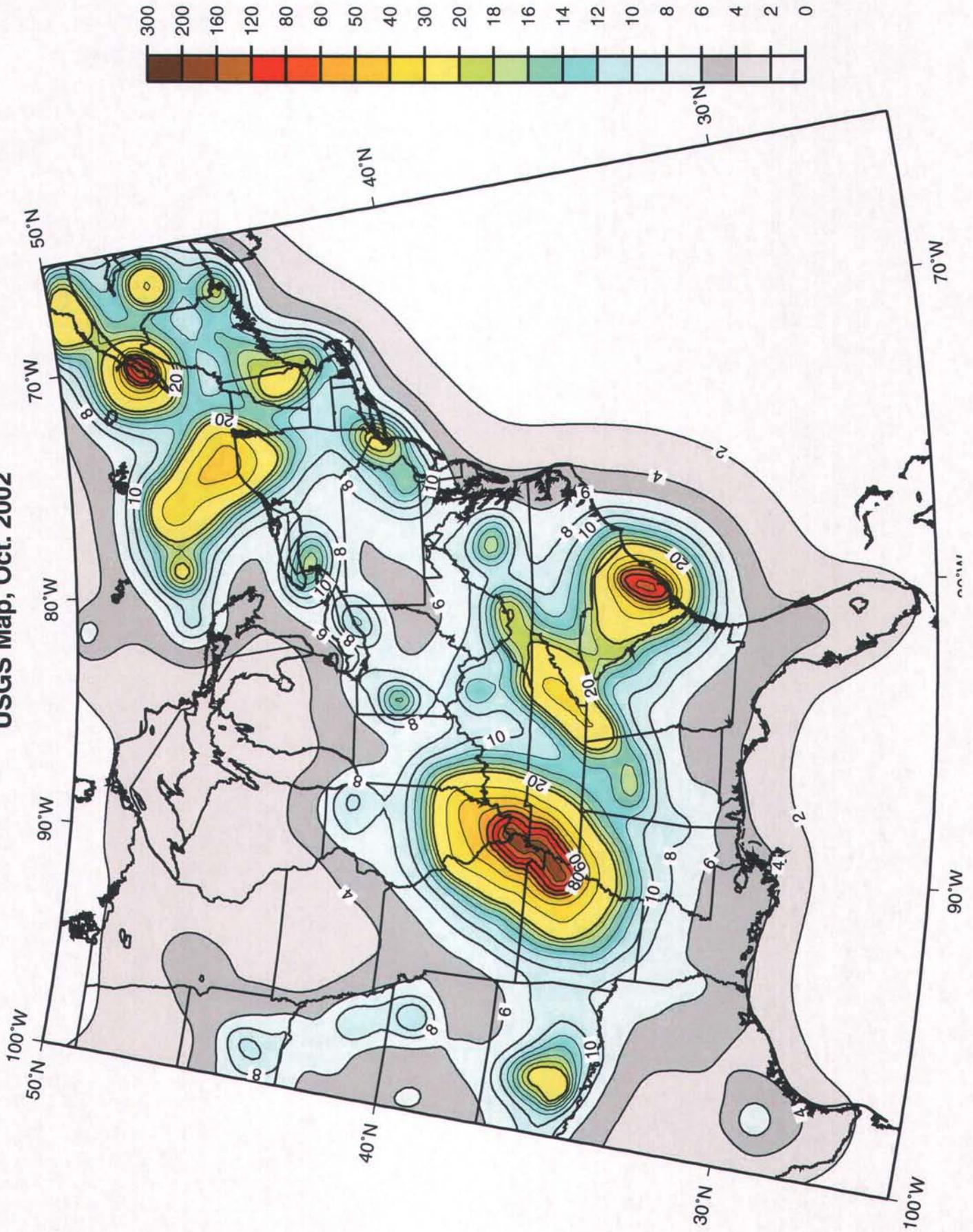
LOCATION 36.27578 Lat. -80.05647 Long.
The interpolated Probabilistic ground motion values, in %g,
at the requested point are:

	10%PE in 50 yr	2%PE in 50 yr
PGA	3.76	9.69
0.2 sec SA	8.86	22.18
1.0 sec SA	3.19	8.23

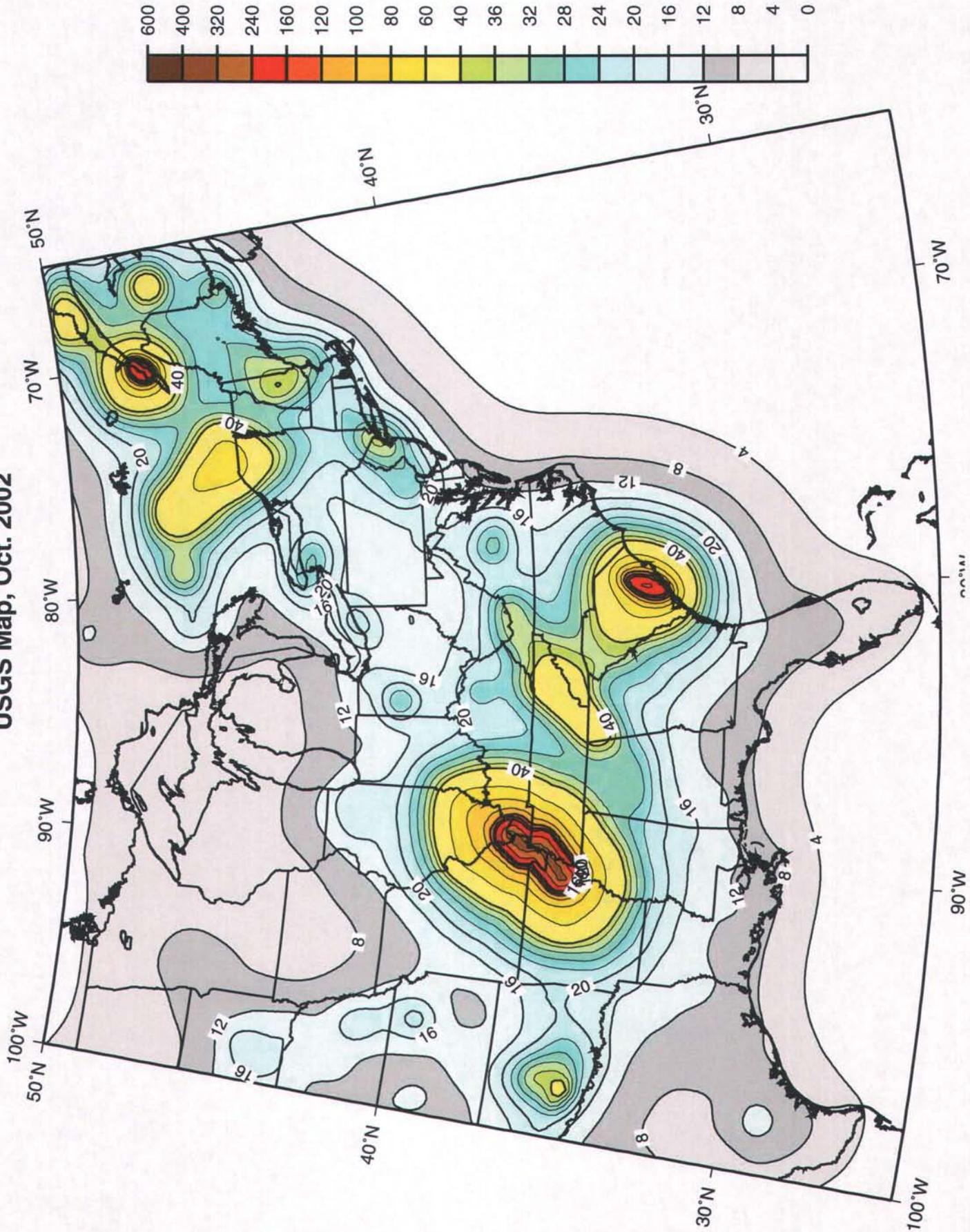
PROJECT INFO: [Home Page](#)

SEISMIC HAZARD: [Hazard by Lat/Lon, 2002](#)

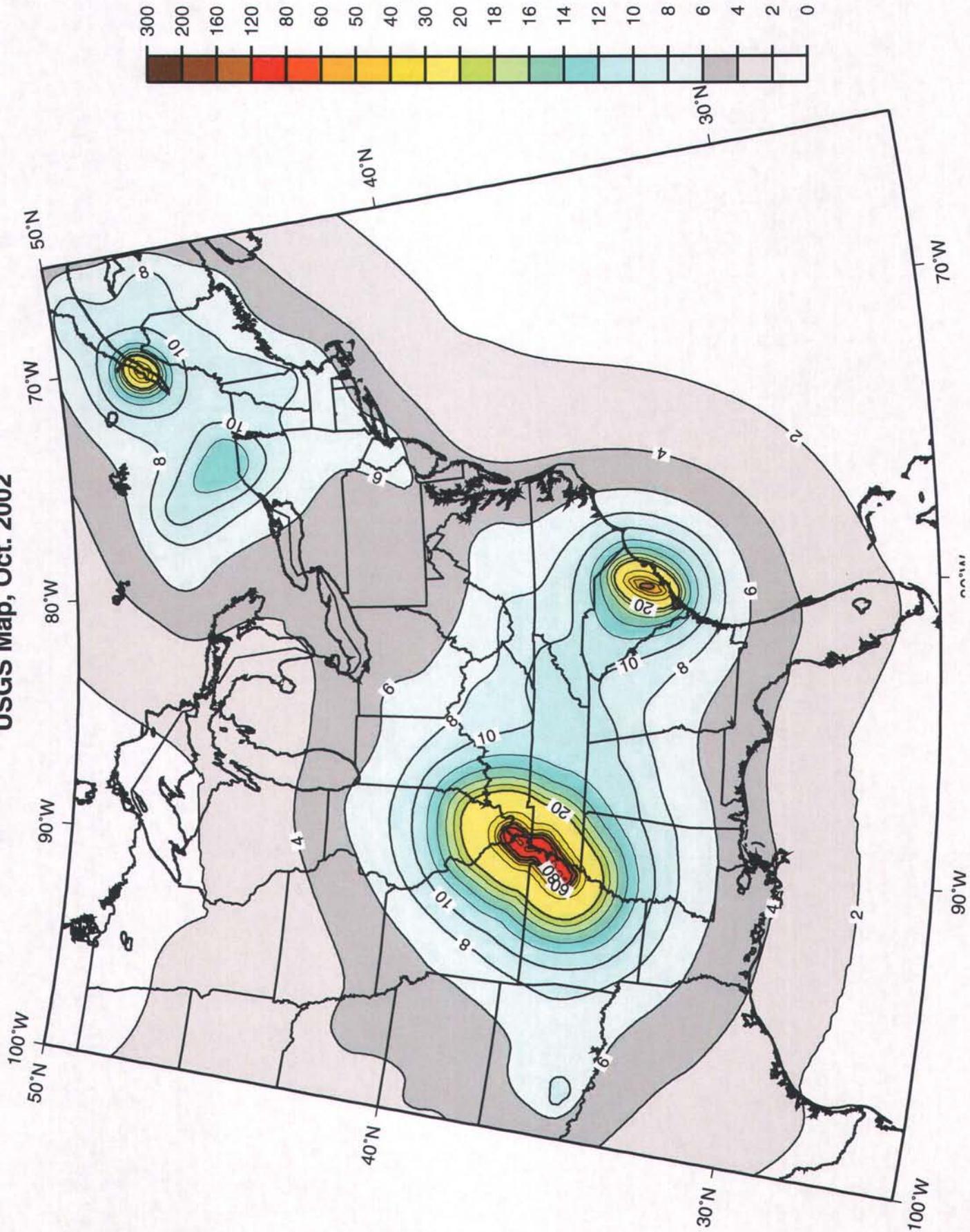
**Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002**



0.2 sec SA (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002



**1.0 sec SA (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002**



Attachment 2

**MYGRT Analysis
Input and Results**

**Cross Section 1-1
Sulfate**

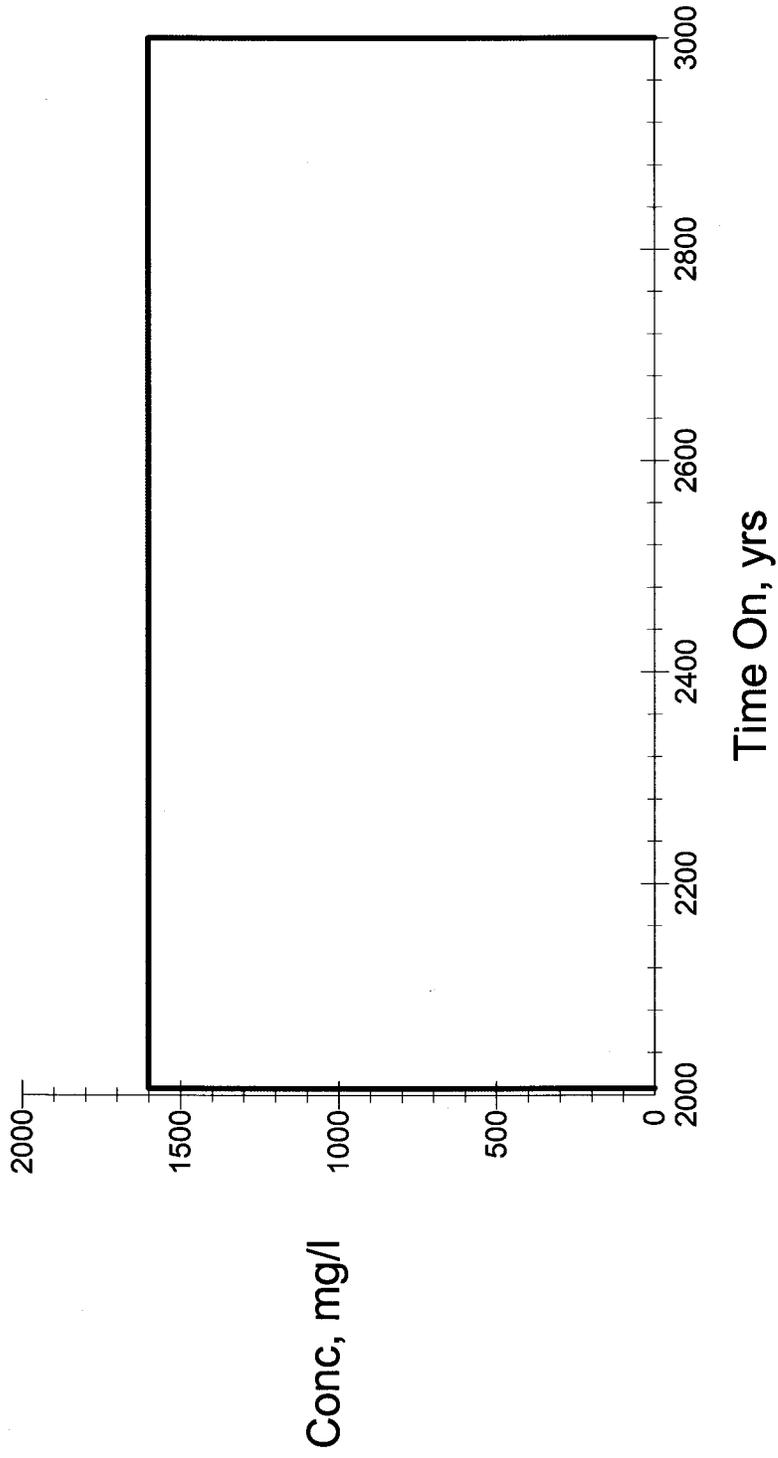
Input Parameters

Description	Units	Value	Note
General Parameters			
Site		MSS FGD Landfill - Cross Section 1-1	
Description		X Sect 1-1 Cap @End of Year	
Notes		Put your notes here.	
Solute Name		SO4	
Organic		No	
Zones Simulated		Unsat/Sat	
Source Location		Unsat	
Saturated Zone Dimension		Sat_3d	
Point or Depth Averaged		Point	
Aquifer Thickness		Finite	
Number of Sat Down Gradient Zones		One	
Unsaturated Zone Parameters			
Unsat Infiltration Rate used in Sat		Yes	
Unsat Infiltration Rate	ft/yr	0.78	
Infiltration Switching		Yes	
Time to Switch Infiltration	yr	2011	
Unsat Infiltration After Switch	ft/yr	0.0001	
Unsat Moisture Content	ft3/ft3	0.25	
Unsat Dispersion Coeff in Z	ft2/yr	1.25	Calc'd
Depth to water table	ft	4	
Unsat Retardation Coeff		1	
Dispersion Calculated		Yes	
Source Parameters			
Width of Source	ft	1440	
Source Length	ft	1300	
Saturated Zone Properties			
Zone Length	ft	32.8084	
Dispersion along X	ft2/yr	196	
Dispersion along Y	ft2/yr	19.6	
Dispersion along Z	ft2/yr	1.96	
Distance for Dispersion	ft	250	
Dispersion calculated		Yes	
Aquifer Thickness	ft	27.8	
Seepage Velocity	ft/yr	7.84	Calc'd
Sat Volumetric Porosity	ft3/ft3	0.28	
Hydraulic Gradient	ft/ft	0.01	
Hydraulic Conductivity	ft/yr	219.4	
Horozontal Velocity calculated		Yes	
Source Penetration Depth	ft	27.8	Calc'd
Source Penetration Depth After	ft	25.8	Calc'd
Mixing Depth Calculated		Yes	
Mixing Depth (2) Calculated		Yes	
Solute Plume Description			

Input Parameters

Description	Units	Value	Note
Background Concentration	mg/l	0	
Bulk Density	g/ml	1.6	
pH		7	
Rd (inorganic)		1	Calc'd
Partition Coeff, Kd	ml/g	0	
Rd calculated		Yes	
Distance to Top of Source	ft	0	
Distance to Bottom of Source	ft	16.4042	

Source Concentration



Conc, mg/l

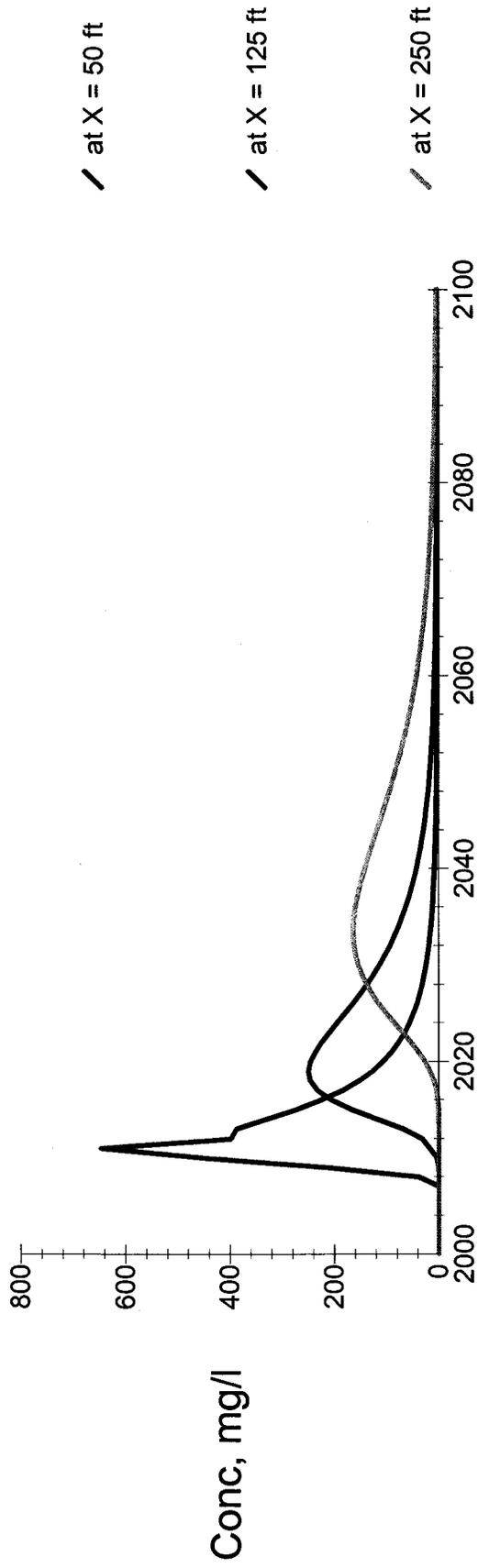
Conc, mg/l

Time On, yrs

Source Concentration

	Time On, yrs	Conc, mg/l
1	2006.000	1600.000
2	2007.000	1600.000
3	2008.000	1600.000
4	2009.000	1600.000
5	2010.000	1600.000
6	3000.000	0.000

SO4 Concentrations vs Time



Time, yrs, Saturated Zone, 3D, Y: 0 ft, Z: 27.8 ft

SO4 Concentrations vs Time

	Time, yrs	Conc, mg/l at X = 50 ft	Conc, mg/l at X = 125 ft	Conc, mg/l at X = 250 ft
1	2000	0	0	0
2	2001	0	0	0
3	2002	0	0	0
4	2003	0	0	0
5	2004	0	0	0
6	2005	0	0	0
7	2006	0	0	0
8	2007	0.102417	0	0
9	2008	38.9357	000349101	0
10	2009	214.562	0.175169	0
11	2010	443.416	3.38919	.30102E-6
12	2011	646.569	18.2632	.85453E-5
13	2012	397.84	32.4923	.00166168
14	2013	387.599	69.3706	0.021533
15	2014	331.53	117.471	0.142206
16	2015	274.028	166.337	0.598729
17	2016	224.946	206.056	1.84407
18	2017	185.057	232.534	4.52032
19	2018	153.205	246.454	9.30924
20	2019	127.602	249.965	16.6964
21	2020	106.99	245.954	26.8169
22	2021	90.2703	236.79	39.3938
23	2022	76.5824	224.304	53.8156
24	2023	65.3522	210.085	69.3396
25	2024	56.074	195.122	85.1634
26	2025	48.3268	179.973	100.503
27	2026	41.8252	165.12	114.736
28	2027	36.3846	151.048	127.526
29	2028	31.7739	137.743	138.477
30	2029	27.8547	125.324	147.429
31	2030	24.5101	113.825	154.339
32	2031	21.6453	103.248	159.267
33	2032	19.2	93.6459	162.429
34	2033	17.0896	84.8747	163.87
35	2034	15.2656	76.8979	163.774
36	2035	13.6861	69.6664	162.351
37	2036	12.3142	63.117	159.779
38	2037	11.1189	57.188	156.231
39	2038	10.0807	51.8602	151.98
40	2039	9.17187	47.0423	147.083
41	2040	8.37667	42.7009	141.726
42	2041	7.67951	38.7894	136.034

SO4 Concentrations vs Time

	Time, yrs	Conc, mg/l at X = 50 ft	Conc, mg/l at X = 125 ft	Conc, mg/l at X = 250 ft
43	2042	7.06696	35.2639	130.107
44	2043	6.52834	32.0899	124.057
45	2044	6.05333	29.228	117.942
46	2045	5.63355	26.6456	111.823
47	2046	5.26436	24.3312	105.832
48	2047	4.93701	22.2409	99.934
49	2048	4.64715	20.3582	94.1935
50	2049	4.38979	18.6592	88.6233
51	2050	4.16175	17.1309	83.2729
52	2051	3.95938	15.7551	78.1524
53	2052	3.77916	14.513	73.2509
54	2053	3.61875	13.3931	68.5865
55	2054	3.47582	12.3829	64.1592
56	2055	3.34848	11.4723	59.9746
57	2056	3.23467	10.6494	56.0157
58	2057	3.13306	9.90689	52.2881
59	2058	3.04229	9.23688	48.7868
60	2059	2.96109	8.63176	45.501
61	2060	2.88842	8.08513	42.4226
62	2061	2.8233	7.59095	39.5412
63	2062	2.76504	7.14513	36.8557
64	2063	2.71271	6.74141	34.345
65	2064	2.66577	6.37649	32.0066
66	2065	2.62361	6.04616	29.8276
67	2066	2.58565	5.74667	27.7958
68	2067	2.55164	5.47648	25.9151
69	2068	2.52112	5.23243	24.1735
70	2069	2.49359	5.01082	22.5523
71	2070	2.46882	4.81023	21.0505
72	2071	2.44651	4.62851	19.6589
73	2072	2.42641	4.46383	18.3702
74	2073	2.40829	4.31459	17.1779
75	2074	2.39194	4.17909	16.073
76	2075	2.37723	4.05666	15.0559
77	2076	2.36391	3.94523	14.1121
78	2077	2.35194	3.84457	13.2445
79	2078	2.34111	3.75304	12.4415
80	2079	2.33132	3.66999	11.7005
81	2080	2.32247	3.59461	11.0169
82	2081	2.31448	3.52619	10.3865
83	2082	2.30726	3.46409	9.80563
84	2083	2.30072	3.40767	9.27001

SO4 Concentrations vs Time

	Time, yrs	Conc, mg/l at X = 50 ft	Conc, mg/l at X = 125 ft	Conc, mg/l at X = 250 ft
85	2084	2.2948	3.35639	8.77598
86	2085	2.28943	3.30973	8.32017
87	2086	2.28459	3.26745	7.90165
88	2087	2.28021	3.22909	7.51694
89	2088	2.27623	3.19413	7.16168
90	2089	2.27263	3.16232	6.83449
91	2090	2.26936	3.13342	6.53358
92	2091	2.2664	3.10714	6.25664
93	2092	2.26372	3.08322	6.00183
94	2093	2.26128	3.06147	5.76742
95	2094	2.25907	3.04168	5.55191
96	2095	2.25706	3.02364	5.35323
97	2096	2.25525	3.00729	5.17153
98	2097	2.2536	2.99237	5.00396
99	2098	2.2521	2.97879	4.84992
100	2099	2.25074	2.96642	4.70829
101	2100	2.2495	2.95516	4.57812

**MYGRT Analysis
Input and Results**

**Cross Section 1-1
Arsenic**

Input Parameters

Description	Units	Value	Note
General Parameters			
Site		MSS FGD Landfill - Cross Section 1-1	
Description		X Sect 1-1 Cap @End of Year 5	
Notes			
Solute Name		Arsenic	
Organic		No	
Zones Simulated		Unsat/Sat	
Source Location		Unsat	
Saturated Zone Dimension		Sat_3d	
Point or Depth Averaged		Point	
Aquifer Thickness		Finite	
Number of Sat Down Gradient Zones		One	
Unsaturated Zone Parameters			
Unsat Infiltration Rate used in Sat		Yes	
Unsat Infiltration Rate	ft/yr	1.55	
Infiltration Switching		Yes	
Time to Switch Infiltration	yr	2011	
Unsat Infiltration After Switch	ft/yr	0.0001	
Unsat Moisture Content	ft3/ft3	0.25	
Unsat Dispersion Coeff in Z	ft2/yr	2.48	Calc'd
Depth to water table	ft	4	
Unsat Retardation Coeff		1	
Dispersion Calculated		Yes	
Source Parameters			
Width of Source	ft	1440	
Source Length	ft	1300	
Saturated Zone Properties			
Zone Length	ft	32.8084	
Dispersion along X	ft2/yr	196	
Dispersion along Y	ft2/yr	19.6	
Dispersion along Z	ft2/yr	1.96	
Dispersion calculated		No	
Aquifer Thickness	ft	27.8	
Seepage Velocity	ft/yr	7.84	Calc'd
Sat Volumetric Porosity	ft3/ft3	0.28	
Hydraulic Gradient	ft/ft	0.01	
Hydraulic Conductivity	ft/yr	219.4	
Horizontal Velocity calculated		Yes	
Source Penetration Depth	ft	27.8	Calc'd
Source Penetration Depth After :	ft	25.8	Calc'd
Mixing Depth Calculated		Yes	
Mixing Depth (2) Calculated		Yes	
Solute Plume Description			
Background Concentration	mg/l	0	

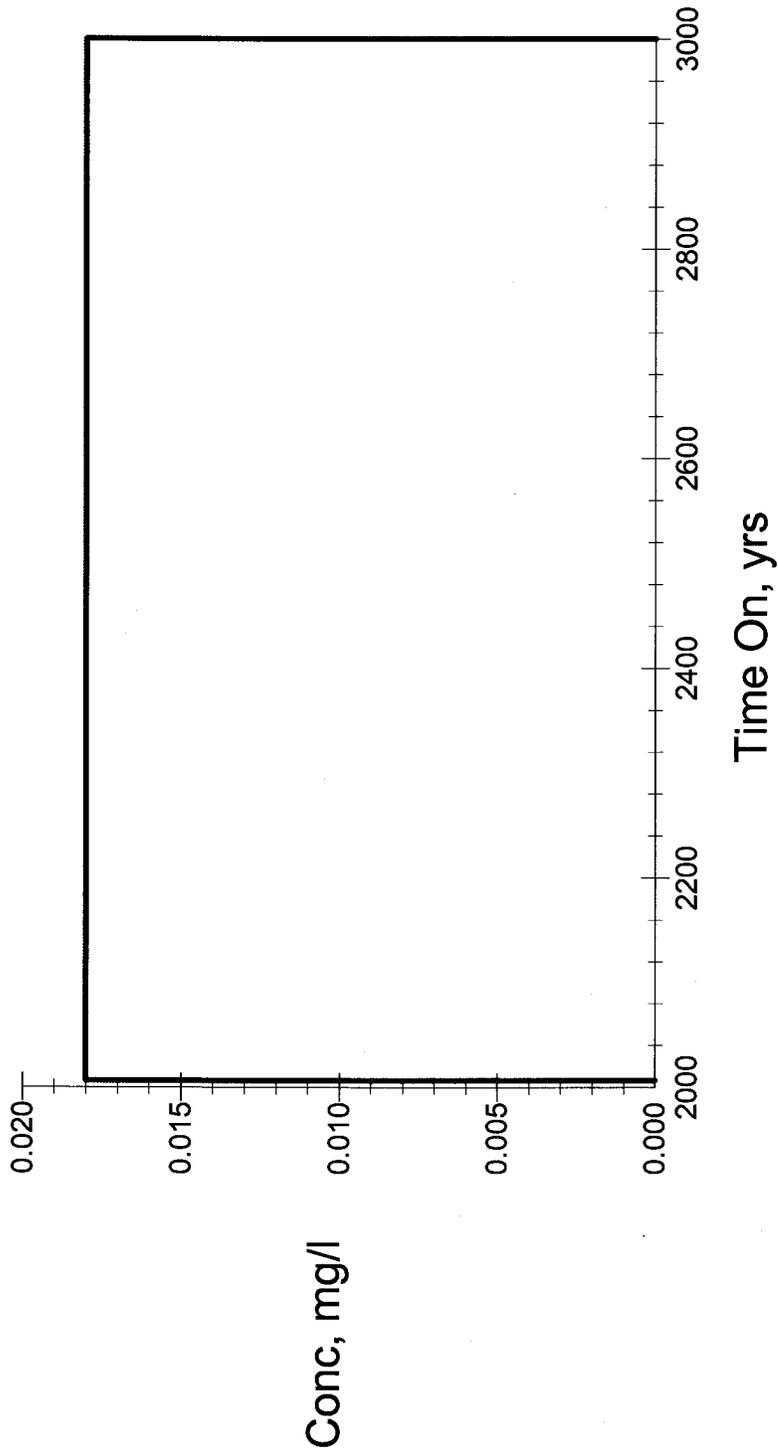
Input Parameters

Description	Units	Value	Note
Bulk Density	g/ml	1.6	
pH		7	
Rd (inorganic)		1	Calc'd
Partition Coeff, Kd	ml/g	0	
Rd calculated		Yes	
Distance to Top of Source	ft	0	
Distance to Bottom of Source	ft	16.4042	

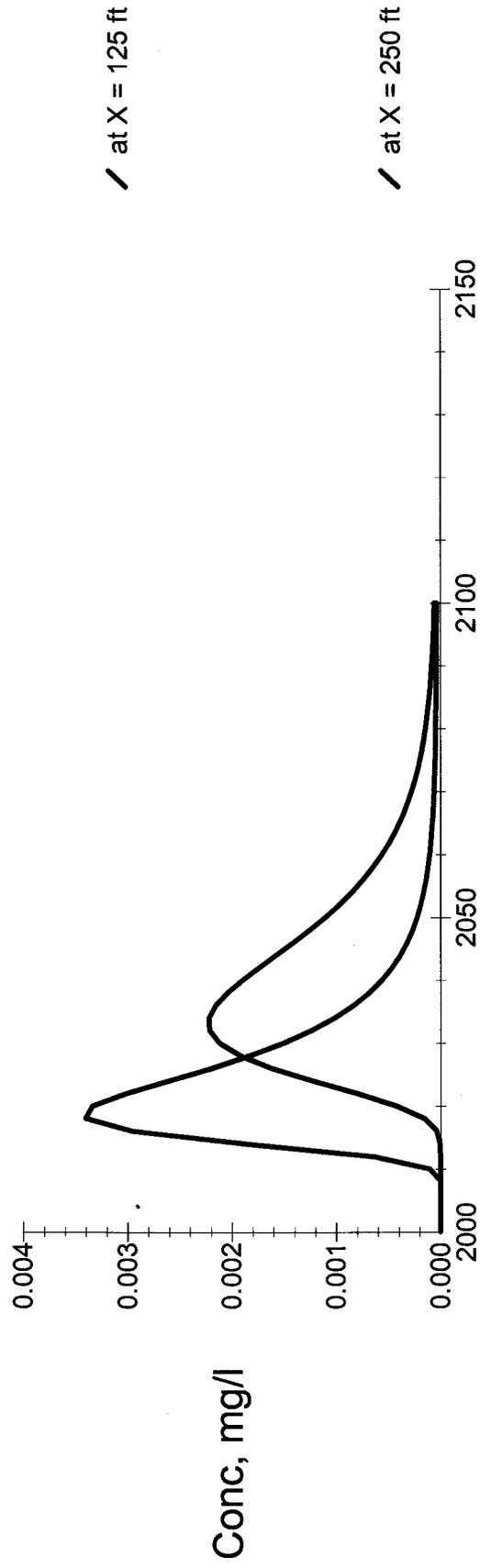
Source Concentration

	Time On, yrs	Conc, mg/l
1	2006.000	0.018
2	2007.000	0.018
3	2008.000	0.018
4	2009.000	0.018
5	2010.000	0.018
6	3000.000	0.000

Source Concentration



Arsenic Concentrations vs Time



Arsenic Concentrations vs Time

	Time, yrs	Conc, mg/l at X = 125 ft	Conc, mg/l at X = 250 ft
1	2000	0	0
2	2002	0	0
3	2004	0	0
4	2006	0	0
5	2008	6.06621E-8	0
6	2010	0.000104139	4.22817E-11
7	2012	0.000644868	7.22039E-8
8	2014	0.00185264	3.76634E-6
9	2016	0.0029599	3.70643E-5
10	2018	0.00340321	0.000159383
11	2020	0.00333785	0.000419325
12	2022	0.00301313	0.000797716
13	2024	0.00260598	0.00122282
14	2026	0.00219543	0.00161271
15	2028	0.00182643	0.00191929
16	2030	0.00150613	0.00211827
17	2032	0.00123693	0.00221333
18	2034	0.00101419	0.00221975
19	2036	0.000830971	0.00215595
20	2038	0.000681526	0.00204354
21	2040	0.000559969	0.00189973
22	2042	0.000461219	0.0017389
23	2044	0.000381743	0.00157476
24	2046	0.000316895	0.00141044
25	2048	0.000264266	0.00125302
26	2050	0.00022144	0.0011053
27	2052	0.000186901	0.000971296
28	2054	0.000158707	0.000849346
29	2056	0.00013575	0.000740183
30	2058	0.000117058	0.000643516
31	2060	0.000101807	0.000558411
32	2062	8.93309E-5	0.000483815
33	2064	7.92235E-5	0.000419652
34	2066	7.09015E-5	0.00036364
35	2068	6.40829E-5	0.00031528
36	2070	5.84922E-5	0.00027367
37	2072	5.39045E-5	0.000237971
38	2074	5.01263E-5	0.000207315
39	2076	4.70408E-5	0.000181333
40	2078	4.44955E-5	0.000159107
41	2080	4.23975E-5	0.000140161
42	2082	4.06689E-5	0.000124056

Arsenic Concentrations vs Time

	Time, yrs	Conc, mg/l at X = 125 ft	Conc, mg/l at X = 250 ft
43	2084	3.92459E-5	0.000110405
44	2086	3.80683E-5	9.87878E-5
45	2088	3.70957E-5	8.89397E-5
46	2090	3.62918E-5	8.05954E-5
47	2092	3.56257E-5	7.3518E-5
48	2094	3.50759E-5	6.7548E-5
49	2096	3.46202E-5	6.24953E-5
50	2098	3.42427E-5	5.82245E-5
51	2100	3.39296E-5	5.46146E-5

**MYGRT Analysis
Input and Results**

**Cross Section 2-2
Arsenic**

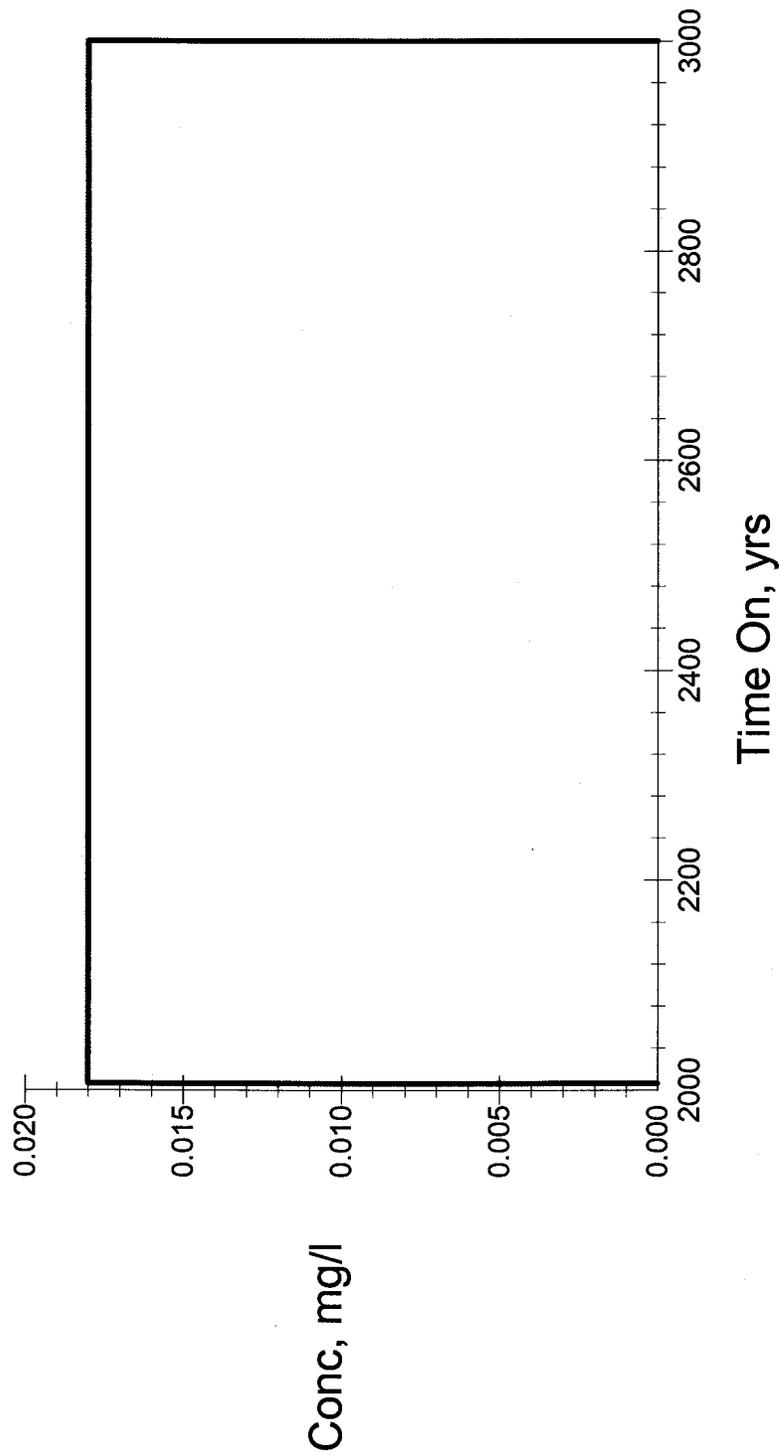
Input Parameters

Description	Units	Value	Note
General Parameters			
Site		MSS FGD Landfill - Cross Section 2-2	
Description		X Sect 2-2 Cap @End of Year 5	
Notes			
Solute Name		Arsenic	
Organic		No	
Zones Simulated		Unsat/Sat	
Source Location		Unsat	
Saturated Zone Dimension		Sat_3d	
Point or Depth Averaged		Point	
Aquifer Thickness		Finite	
Number of Sat Down Gradient Zones		One	
Unsaturated Zone Parameters			
Unsat Infiltration Rate used in Sat		Yes	
Unsat Infiltration Rate	ft/yr	1.55	
Infiltration Switching		Yes	
Time to Switch Infiltration	yr	2011	
Unsat Infiltration After Switch	ft/yr	0.0001	
Unsat Moisture Content	ft3/ft3	0.25	
Unsat Dispersion Coeff in Z	ft2/yr	8.99	Calc'd
Depth to water table	ft	14.5	
Unsat Retardation Coeff		1	
Dispersion Calculated		Yes	
Source Parameters			
Width of Source	ft	1440	
Source Length	ft	760	
Saturated Zone Properties			
Zone Length	ft	32.8084	
Dispersion along X	ft2/yr	510	
Dispersion along Y	ft2/yr	51	
Dispersion along Z	ft2/yr	5.1	
Distance for Dispersion	ft	250	
Dispersion calculated		Yes	
Aquifer Thickness	ft	24.3	
Seepage Velocity	ft/yr	20.4	Calc'd
Sat Volumetric Porosity	ft3/ft3	0.27	
Hydraulic Gradient	ft/ft	0.03	
Hydraulic Conductivity	ft/yr	183.9	
Horizontal Velocity calculated		Yes	
Source Penetration Depth	ft	24.3	Calc'd
Source Penetration Depth After	ft	19.9	Calc'd
Mixing Depth Calculated		Yes	
Mixing Depth (2) Calculated		Yes	
Solute Plume Description			

Input Parameters

Description	Units	Value	Note
Background Concentration	mg/l	0	
Bulk Density	g/ml	1.6	
pH		7	
Rd (inorganic)		1	Calc'd
Partition Coeff, Kd	ml/g	0	
Rd calculated		Yes	
Distance to Top of Source	ft	0	
Distance to Bottom of Source	ft	16.4042	

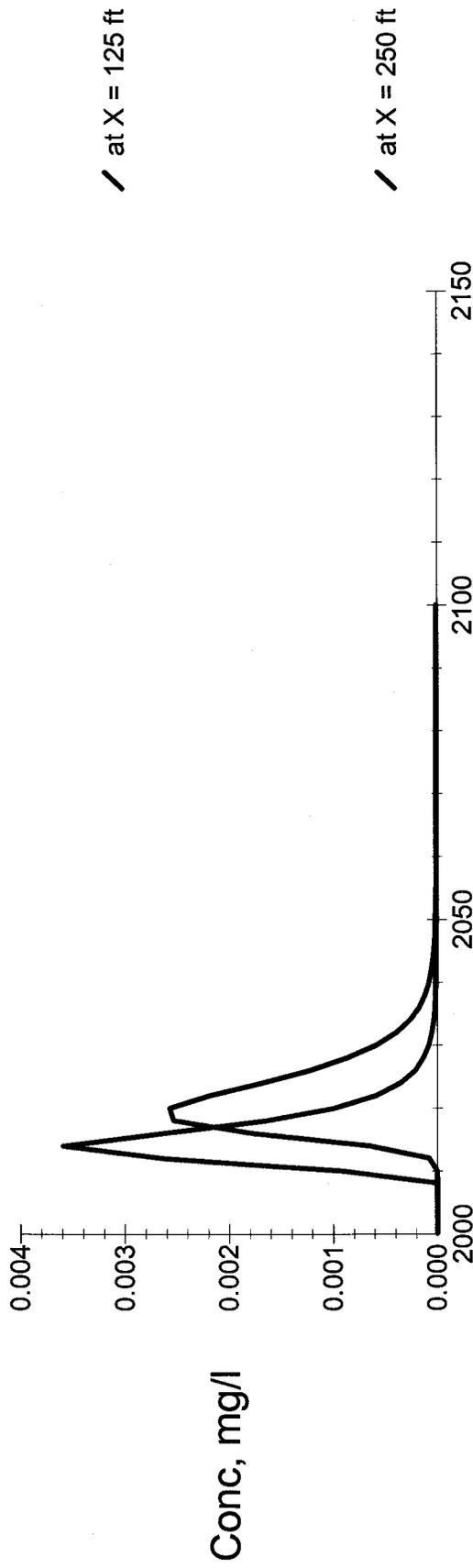
Source Concentration



Source Concentration

	Time On, yrs	Conc, mg/l
1	2006.000	0.018
2	2007.000	0.018
3	2008.000	0.018
4	2009.000	0.018
5	2010.000	0.018
6	3000.000	0.000

Arsenic Concentrations vs Time



Time, yrs, Saturated Zone, 3D, Y: 0 ft, Z: 19.9 ft

Arsenic Concentrations vs Time

	Time, yrs	Conc, mg/l at X = 125 ft	Conc, mg/l at X = 250 ft
1	2000	0	0
2	2002	0	0
3	2004	0	0
4	2006	0	0
5	2008	2.04823E-6	0
6	2010	0.000908123	1.18129E-6
7	2012	0.00261356	7.661E-5
8	2014	0.00359184	0.000654955
9	2016	0.00262352	0.00178199
10	2018	0.00164343	0.00252991
11	2020	0.000987603	0.00256777
12	2022	0.000588241	0.00218496
13	2024	0.000351767	0.00168433
14	2026	0.000212221	0.00122282
15	2028	0.000129863	0.000855458
16	2030	8.10308E-5	0.000584438
17	2032	5.19455E-5	0.000393596
18	2034	3.45099E-5	0.000262894
19	2036	2.40053E-5	0.000175122
20	2038	1.76533E-5	0.000117042
21	2040	1.37885E-5	7.88948E-5
22	2042	1.14289E-5	5.40267E-5
23	2044	9.9843E-6	3.79071E-5
24	2046	9.09682E-6	2.74944E-5
25	2048	8.54938E-6	2.07754E-5
26	2050	8.21101E-6	1.64494E-5
27	2052	8.00188E-6	1.36726E-5
28	2054	7.87233E-6	1.18894E-5
29	2056	7.79215E-6	1.07462E-5
30	2058	7.74253E-6	1.00124E-5
31	2060	7.71198E-6	9.54229E-6
32	2062	7.69327E-6	9.24132E-6
33	2064	7.68203E-6	9.04893E-6
34	2066	7.67538E-6	8.92608E-6
35	2068	7.67161E-6	8.84784E-6
36	2070	7.66961E-6	8.79814E-6
37	2072	7.66872E-6	8.76675E-6
38	2074	7.6685E-6	8.7471E-6
39	2076	7.6687E-6	8.73503E-6
40	2078	7.66914E-6	8.72773E-6
41	2080	7.66972E-6	8.7235E-6
42	2082	7.67036E-6	8.72122E-6

Arsenic Concentrations vs Time

	Time, yrs	Conc, mg/l at X = 125 ft	Conc, mg/l at X = 250 ft
43	2084	7.67104E-6	8.72018E-6
44	2086	7.67172E-6	8.71991E-6
45	2088	7.6724E-6	8.72011E-6
46	2090	7.67306E-6	8.72061E-6
47	2092	7.6737E-6	8.72129E-6
48	2094	7.67429E-6	8.72203E-6
49	2096	7.67491E-6	8.72287E-6
50	2098	7.67548E-6	8.72371E-6
51	2100	7.67602E-6	8.72454E-6

**MYGRT Analysis
Input and Results**

**Cross Section 2-2
Fluoride**

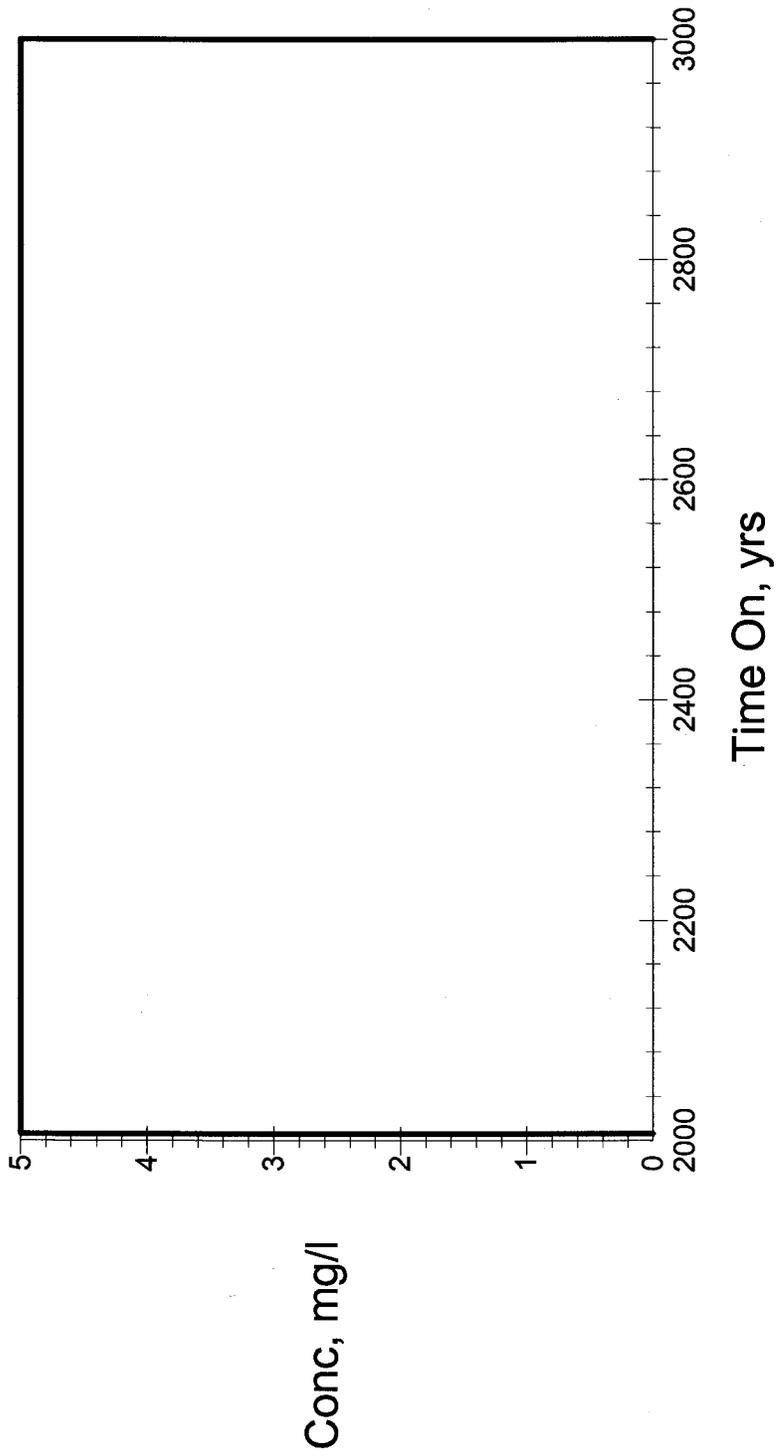
Input Parameters

Description	Units	Value	Note
General Parameters			
Site		MSS FGD Landfill - Cross Section 2-2	
Description		X Sect 2-2 Cap @End of Year 5	
Notes			
Solute Name		Flouride	
Organic		No	
Zones Simulated		Unsat/Sat	
Source Location		Unsat	
Saturated Zone Dimension		Sat_3d	
Point or Depth Averaged		Point	
Aquifer Thickness		Finite	
Number of Sat Down Gradient Zones		One	
Unsaturated Zone Parameters			
Unsat Infiltration Rate used in Sat		Yes	
Unsat Infiltration Rate	ft/yr	1.55	
Infiltration Switching		Yes	
Time to Switch Infiltration	yr	2011	
Unsat Infiltration After Switch	ft/yr	0.0001	
Unsat Moisture Content	ft3/ft3	0.25	
Unsat Dispersion Coeff in Z	ft2/yr	8.99	Calc'd
Depth to water table	ft	14.5	
Unsat Retardation Coeff		1	
Dispersion Calculated		Yes	
Source Parameters			
Width of Source	ft	1440	
Source Length	ft	760	
Saturated Zone Properties			
Zone Length	ft	32.8084	
Dispersion along X	ft2/yr	510	
Dispersion along Y	ft2/yr	51	
Dispersion along Z	ft2/yr	5.1	
Distance for Dispersion	ft	250	
Dispersion calculated		Yes	
Aquifer Thickness	ft	24.3	
Seepage Velocity	ft/yr	20.4	Calc'd
Sat Volumetric Porosity	ft3/ft3	0.27	
Hydraulic Gradient	ft/ft	0.03	
Hydraulic Conductivity	ft/yr	183.9	
Horozontal Velocity calculated		Yes	
Source Penetration Depth	ft	24.3	Calc'd
Source Penetration Depth After :	ft	19.9	Calc'd
Mixing Depth Calculated		Yes	
Mixing Depth (2) Calculated		Yes	
Solute Plume Description			

Input Parameters

Description	Units	Value	Note
Background Concentration	mg/l	0	
Bulk Density	g/ml	1.6	
pH		7	
Rd (inorganic)		1	Calc'd
Partition Coeff, Kd	ml/g	0	
Rd calculated		Yes	
Distance to Top of Source	ft	0	
Distance to Bottom of Source	ft	16.4042	

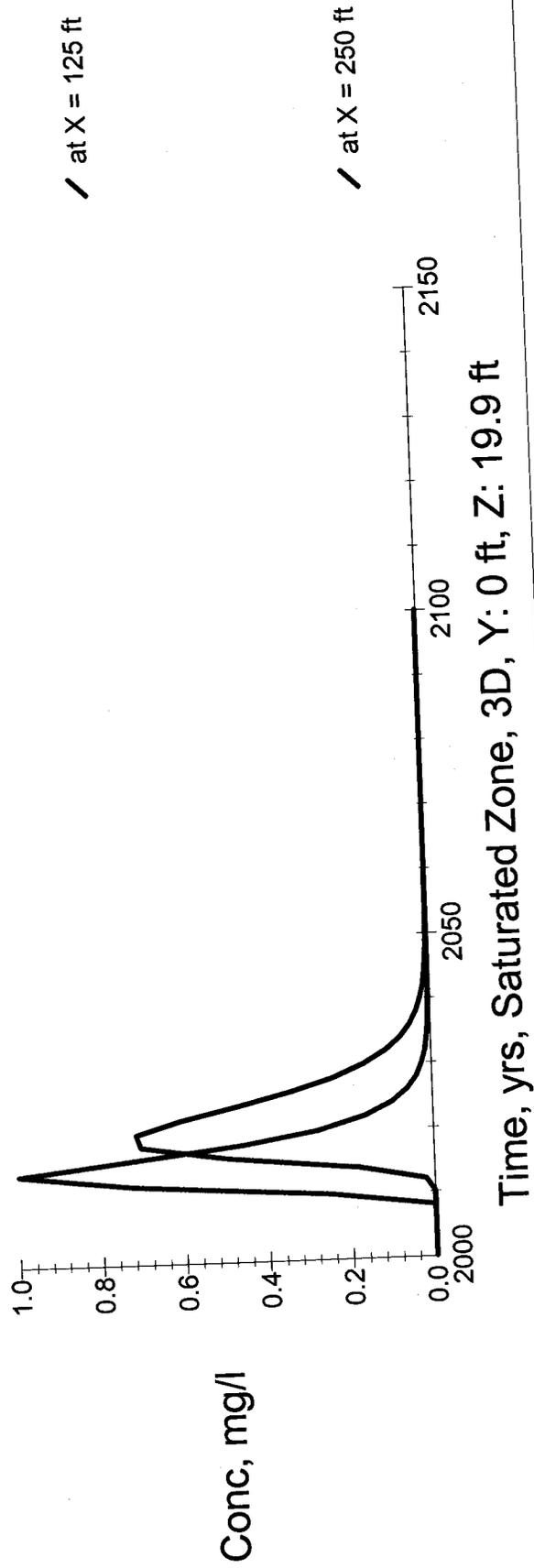
Source Concentration



Source Concentration

	Time On, yrs	Conc, mg/l
1	2006.000	5.000
2	2007.000	5.000
3	2008.000	5.000
4	2009.000	5.000
5	2010.000	5.000
6	3000.000	0.000

Flouride Concentrations vs Time



Flouride Concentrations vs Time

	Time, yrs	Conc, mg/l at X = 125 ft	Conc, mg/l at X = 250 ft
1	2000	0	0
2	2002	0	0
3	2004	0	0
4	2006	0	0
5	2008	0.000568948	0
6	2010	0.252257	0.000328136
7	2012	0.725991	0.0212806
8	2014	0.997736	0.181932
9	2016	0.728759	0.495001
10	2018	0.45651	0.702754
11	2020	0.274345	0.713297
12	2022	0.163401	0.606934
13	2024	0.097714	0.467872
14	2026	0.058951	0.339673
15	2028	0.0360739	0.237629
16	2030	0.0225095	0.162347
17	2032	0.01443	0.109334
18	2034	0.00958675	0.0730275
19	2036	0.00666859	0.048646
20	2038	0.00490427	0.0325127
21	2040	0.00383067	0.0219163
22	2042	0.00317487	0.0150078
23	2044	0.00277389	0.0105308
24	2046	0.00252734	0.00763827
25	2048	0.00237525	0.00577184
26	2050	0.00228124	0.00457015
27	2052	0.00222313	0.00379876
28	2054	0.00218712	0.0033034
29	2056	0.00216483	0.00298579
30	2058	0.00215104	0.00278193
31	2060	0.00214254	0.00265132
32	2062	0.00213725	0.00256752
33	2064	0.0021342	0.00251423
34	2066	0.00213234	0.00248008
35	2068	0.00213128	0.00245833
36	2070	0.00213072	0.0024445
37	2072	0.00213046	0.00243576
38	2074	0.00213039	0.0024303
39	2076	0.00213044	0.00242692
40	2078	0.00213056	0.00242488
41	2080	0.00213071	0.00242369
42	2082	0.00213088	0.00242304

Flouride Concentrations vs Time

	Time, yrs	Conc, mg/l at X = 125 ft	Conc, mg/l at X = 250 ft
43	2084	0.00213106	0.00242274
44	2086	0.00213125	0.00242265
45	2088	0.00213143	0.0024227
46	2090	0.00213161	0.00242283
47	2092	0.00213178	0.002423
48	2094	0.00213187	0.00242305
49	2096	0.00213211	0.00242342
50	2098	0.00213226	0.00242365
51	2100	0.00213241	0.00242387