# EDGECOMBE COUNTY LANDFILL
# CORRECTIVE ACTION PLAN
# (PERMIT #33-01)
# TARBORO, NORTH CAROLINA
# S&ME Project No. 1054-07-241

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**CORRECTIVE ACTION PLAN**
**Edgecombe County Landfill**
**(Permit #33-01)**
**Tarboro, North Carolina**
**S&ME Project No. 1054-07-241**

I hereby certify this 30th of June, 2008, that this report was prepared by me or under my direct supervision.

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# EXECUTIVE SUMMARY

Edgecombe County (County) currently operates a construction and demolition (C&D) debris landfill on top of a closed municipal solid waste (MSW) landfill in general accordance with North Carolina Department of Environment and Natural Resources (NCDENR) Solid Waste Facility Permit No. 33-01. The landfill is located off of State Road 1601 (Colonial Road), south of Tarboro, North Carolina. The C&D landfill is used for the disposal of waste generated within Edgecombe County and from surrounding counties.

The NCAC 2L Groundwater Quality Standards (2L Standard) for several target constituents in groundwater have been exceeded at the facility near the north-northeastern property boundary. The nearest receptor north-northwest of the facility is Jerry's Creek.

S&ME previously performed a Nature and Extent Study (NES) and an Assessment of Corrective Measures (ACM) to characterize the nature and extent of the release and identify several potential solutions or corrective measures which could be implemented to address the migration of groundwater contaminants beyond the compliance boundary.

NCDENR, Division of Waste Management (DWM), Solid Waste Section (SWS) Solid Waste Rules defined under 15A NCAC 13B .1636 & .1637 require that the County perform a Corrective Action Plan (CAP) for the selection of a remedy that is protective of human health and the environment, and will attain the approved groundwater protection standards.

The ACM Report has been submitted to the Solid Waste Section for approval, however, the selection process of the ACM has not yet been fully completed, pending meetings for public questions and input. Due to schedule requirements for submission of this CAP, alternatives for in-situ isolation combined with monitored natural attenuation (MNA) have been selected for completion of this plan. In-situ isolation was chosen because the site conceptual model indicates that water management issues are the primary mechanism for addressing the release and migration of the constituents of concern at the landfill. MNA has been incorporated into the facility's updated water quality monitoring plan (WQMP) to evaluate the effectiveness of the remedial measures. After completion of the ACM subsequent to the public meeting process, an addendum to this CAP will be submitted, if necessary, to reflect any changes based on public comments.

In-situ isolation and monitored natural attenuation (MNA) have been selected as the remedies at the Edgecombe County Landfill, which will involve the following:

- Installation of an upgradient groundwater barrier wall;
- Maintaining a consistent contour with pre-1998 waste area;
- Increase slope of the closed MSW area;
- Stormwater improvements on the western half of the landfill; and,
- Implementation of a MNA program to address impacted groundwater.

Because the MSW remains in place at the waste disposal unit and the MSW is covered by daily cover soils and the landfill cap, the proposed remedy is expected to continue for an extended period of time. At some future point, after the achievement of 2L Standards/GWPST, the monitoring program will be revised from MNA and into a long-term maintenance monitoring. Once the in-situ isolation program is no longer required, the effectiveness of the in-situ isolation structures (i.e. barrier walls, monitor wells, trenches) will be evaluated to determine if the structures require maintenance and can remain in-place or require removal.

# 1. INTRODUCTION

## 1.1 Site Background

The Edgecombe County Landfill is owned and operated by Edgecombe County (County). The landfill is located off of State Road 1601 (Colonial Road), south of Tarboro, North Carolina. The landfill location and site vicinity are shown on **Figure 1**. The active C&D landfill is accessed off of Colonial Road and is regulated under the North Carolina Department of Environment and Natural Resources (NCDENR) Solid Waste Facility Permit No. 33-01. The C&D landfill is used for the disposal of waste generated within Edgecombe County and from surrounding counties. The C&D landfill is located over a closed MSW landfill cell which is also regulated under Facility Permit 33-01.

The C&D landfill and closed MSW landfill are bounded by Jerry's Creek to the north and by woodlands to the west and south-southwest. The topography of the landfill facility generally slopes downward from south to north, toward Jerry's Creek. Agricultural fields are located immediately adjacent to the facility to the south and Colonial Road is immediately adjacent to the east. Across Colonial Road farther to the east is an Edgecombe County MSW convenience center, MSW transfer station, and borrow areas for landfill cover soils. Three residential single-family homes are located to the northeast.

A closed pre-Subtitle D Landfill (northern old landfill), which stopped receiving waste in 1979, is located just north of the active landfill, across Jerry's Creek. The northern old landfill is identified as Facility No. NONCD0000653 on the North Carolina Inactive Hazardous Sites Branch (IHSB) Inactive Hazardous Waste Sites Inventory and is located between Jerry's Creek and Wright's Creek off of Colonial Road. Wright's Creek is present along the northern property boundary of the old landfill and converges with Jerry's Creek to the east of the old landfill.

**Figure 2** is a site map illustrating site features. For the purposes of this report, the "landfill" or "waste disposal unit" refers to the Edgecombe County Landfill facility regulated under Facility Permit 33-01, located south of Jerry's Creek at 1601 Colonial Road, comprised of the active C&D landfill unit and the underlying closed MSW unit.

## 1.2 Purpose

The County performs landfill gas monitoring on a quarterly basis and performs semi-annual groundwater and surface water monitoring from a monitor well network consisting of seven monitor well locations surrounding the boundary of the waste disposal unit, two surface water sample locations, and eleven gas monitoring wells. The network of monitor wells was designed for compliance monitoring in the event that concentrations of contaminants originating from the landfilled waste materials were released to the environment. Groundwater and surface water compliance monitoring is performed to comply with the requirements of North Carolina Solid Waste Management Rules (Solid Waste Rules), 15A NCAC 13B § .600, §.1632 and §.1634 of the Solid Waste Rules.

Volatile organic compounds (VOCs) and inorganic constituents have been detected above North Carolina groundwater protection standards in groundwater samples collected from groundwater compliance monitoring points used to monitor the Edgecombe County Landfill. In addition, statistical evaluation of groundwater monitoring data indicates a release of VOCs and inorganic constituents from the landfill.

In accordance with NCDENR Division of Waste Management (DWM), Solid Waste Section (SWS) Solid Waste Rules defined under 15A NCAC 13B, S&ME has completed the following activities on behalf of Edgecombe County in response to the detections of these constituents:

- Statistical analyses of semi-annual water quality results of compliance well monitoring system in accordance with the facility's *Water Quality Monitoring Plan* (WQMP);
- Alternate Source Demonstration (ASD) study in accordance with Solid Waste Rules defined under 15A NCAC 13B.1633(c)(3) and .1634(g)(2);
- Nature and Extent Study (NES) prepared in accordance with Solid Waste Rules defined under 15A NCAC 13B.1634(g)(1); and,
- Assessment of Corrective Measures (ACM) in accordance with Solid Waste Rules defined under 15A NCAC 13B.1635.

These previous assessments identified five organic compounds (vinyl chloride, benzene, cis-1, 2-dichloroethene, trichloroethene, and 1,4-dichlorobenzene) and one inorganic analyte (cobalt) as constituents of concern (COCs) at the Edgecombe County Landfill. This Corrective Action Plan (CAP) has been prepared in accordance with 15A NCAC 13B.1636, for the selection of a remedy that is protective of human health and the environment, and will attain the approved groundwater protection standards.

## 1.3 Previous Studies

### *1.3.1 Water Quality Monitoring Plans*

Groundwater has been monitored at the landfill facility since 1994 in accordance with the facility's *Water Quality Monitoring Plan* (WQMP), dated September 1994. Statistical analyses of the groundwater monitoring data indicated a statistical release from the waste disposal unit.

On March 31, 1999, on behalf of Edgecombe County, S&ME submitted a *Work Plan for Groundwater Assessment – Edgecombe County Landfill* (Work Plan) to the Solid Waste Section (Section). The Section approved the Work Plan, with comments, on May 10, 1999. The Section comments were addressed in a revision to the Work Plan. Using the revised Work Plan, the County began to assess potential impacts to groundwater quality from the waste disposal unit.

As the County began these activities to implement the groundwater assessment Work Plan, several significant events occurred affecting conditions at the facility. These events

included: closure of the MSW landfill (1997-1999); Hurricane Floyd (1999); a revision to the WQMP groundwater sampling and analysis plan (1998), and revisions to the surface water locations and monitor wells included in the water quality monitoring network (1998-2002). These events so altered the water quality observed at the facility that a re-evaluation of the site-wide water quality was performed.

The results of a baseline statistical re-evaluation were reported to the Section in S&ME's report titled *January 2003 Semi-Annual Sampling/Baseline Statistical Analysis*, dated August 19, 2003. These findings indicated a release of Appendix I constituents in the area of monitor well MW-5. However, no statistical evidence of a release of any Appendix II constituents was found.

### *1.3.2 Semi-Annual Groundwater and Surface Water Sampling*

Eleven monitor wells (MW-1A, MW-3B, MW-4, MW-5, MW-5S, MW-5D, MW-6, MW-7A, MW-8A, MW-9, and MW-10) and three piezometers (P-1, P-2A, and P-3A) currently comprise the groundwater quality monitoring network for the facility. Of these eleven monitor wells and three piezometers, seven of the monitor wells are sampled on a semi-annual basis for water quality indicators and laboratory analyses. The remaining seven monitor wells/piezometers are only used to measure groundwater elevations to enhance the potentiometric mapping.

**Water Quality Monitoring Network**
**Groundwater Sampling Locations**

| Background Monitor Wells | Compliance Monitor Wells |
|---|---|
| **MW-3B** | **MW-1A** |
| **MW-4** | **MW-5** |
| **MW-9** | **MW-6** |
| | **MW-7A** |

Two surface water sampling locations (upstream and downstream) located on Jerry's Creek currently comprise the surface water monitoring system for the landfill facility.

The facility's water quality monitoring network has been sampled on a semi-annual basis since 1994. These wells and surface water locations were selected in order to monitor constituent concentrations migrating hydraulically downgradient towards Jerry's Creek. Groundwater and surface water samples collected from the water quality monitoring network have historically been analyzed for Appendix I constituents including VOCs and metals and Appendix II constituents including VOCs, semi-volatile organic compounds (SVOCs), metals, sulfide, and cyanide. In addition, groundwater and surface water samples have also been historically analyzed for several other constituents including polychlorinated biphenyls (PCBs), pesticides, and herbicides.

Several organic as well as inorganic constituents have been historically detected in some water samples above the 15A North Carolina Administrative Code (NCAC), Subchapter

2L Groundwater Standards (2L Standards), the NCDENR DWM Groundwater Protection Standard (GWPST), and NCAC, Subchapter 2B Surface Water Standards (2B Standards). The organic constituents detected above standards include the following VOCs: vinyl chloride, benzene, 1,1-dichloroethane, 1,2-dichloroethane, cis-1,2-dichloroethene, trichloroethene, 1,2-dichloropropane, tetrachloroethene, 1,4-dichlorobenzene, and methylene chloride. The SVOC 4-methylphenol has also historically detected above its respective 2L Standard/2B Standard in the samples collected from sampling locations at the waste disposal unit. The inorganic constituents detected above standards include the following metals: cadmium, beryllium, cobalt, chromium, lead, silver, nickel, vanadium, and thallium.

A statistical evaluation of the laboratory analytical data from the historical groundwater monitoring data set was last performed as part of the July 2006 Monitoring Report for the Edgecombe County Landfill prepared by S&ME. The historical data pool has been updated and included in the subsequent sampling events, however, no statistical analysis was performed due to the changes in sample analytical methods. According to the July 2006 Monitoring Report, four analytes (vinyl chloride, 1,1-dichloroethane, cis-1,2-dichlorethene, and trichloroethene) were shown to have statistical evidence of a release at the facility and were detected at both monitor wells MW-1A and MW-5. Two additional analytes (benzene and cobalt) were detected at monitor well MW-5 and were shown to have statistical evidence of a release at the facility at that location. Only one analyte (cis-1,2-dichloroethene) was detected at monitor well MW-7A and was shown to have a statistical evidence of a release at the facility. These statistically significant constituents along with additional historically detected constituents are further discussed in **Section 2.1**.

### *1.3.3 Alternate Source Demonstration*

On behalf of Edgecombe County, S&ME previously performed an Alternate Source Demonstration (ASD) in response to the detection of inorganic constituents at concentrations exceeding their respective 2L Standards/GWPST in several monitoring wells. (*Alternate Source Demonstration*, dated June 10, 2008)

During the January 2008 groundwater monitoring event, lead was detected in the groundwater sample from monitor well MW-7A at a reported concentration exceeding its respective 2L Standard. Additionally, three metals for which there is no corresponding 2L Standard (cobalt, thallium, and, vanadium) were detected above their GWPST during the four most recent groundwater monitoring events (July 2006, January 2007, June 2007, and January 2008). In order to examine whether naturally occurring metals concentrations within the in-situ native soils on-site could be influencing groundwater quality, an ASD for metals was undertaken.

The concentrations of several naturally occurring metals within the in-situ soil at the facility were found to be sufficient to influence the concentrations of these metals in groundwater samples from the downgradient compliance monitoring wells. Other metals were found to not represent a statistically significant increase (SSI) above background

values. Therefore, the concentrations of some constituents could be attributed to naturally occurring background values of these metals within the hydrogeologic regime.

The results of the ASD analyses did not support influence to groundwater quality from the natural occurrence of the metal cobalt because, while cobalt was detected in the in-situ soils at the facility, the levels of cobalt detected in the groundwater samples from monitoring well MW-5 could not be attributed solely to its natural occurrence in the overlying soils. Therefore, cobalt remains an inorganic constituent of concern at the facility.

### *1.3.4 Nature and Extent Study*

Due to the detection of VOCs and inorganic constituents in excess of the 2L Standards/GWPST in groundwater samples from the landfill facility compliance wells and the determination that those findings indicated significant increases of some of the constituents, S&ME has performed a Nature and Extent Study (NES) in compliance with the Solid Waste Rules. (*Nature and Extent Study*, dated June 25, 2008)

As a part of the NES, S&ME reviewed the recent and historical groundwater and surface water analytical data at the landfill facility to identify the constituents of concern (COCs) and trends in their concentration and distribution. The extent of the contaminant plume in the area of groundwater compliance monitor wells was characterized and delineated. In addition, S&ME evaluated the limits of waste placed at the former MSW landfill site. The contaminant distribution in the groundwater within the waste disposal unit was also evaluated for the potential of contaminant migration to and beyond the waste boundary. S&ME personnel also identified possible receptors within 1,500 feet of the landfill facility.

The NES identified five organic compounds and one inorganic analyte as the COCs at the Edgecombe County Landfill. These constituents include the VOCs: vinyl chloride, benzene, cis-1,2-dichloroethene, trichloroethene, and 1,4-dichlorobenzene, as well as the metal cobalt.

The results of this NES indicated that the area impacted by these constituents of concern is limited to areas within the Edgecombe County Landfill facility boundary. The COC concentrations do not appear to have adversely impacted surface water quality. The concentrations of the organic and inorganic COCs detected within the plume are relatively low. In addition, there are no identified drinking water wells located downgradient of the landfill facility. Therefore, the NES determined that the level of risk to human health from the identified release is expected to be low.

### *1.3.5 Assessment of Corrective Measures*

On behalf of Edgecombe County, S&ME previously prepared an Assessment of Corrective Measures (ACM) to identify the options for potential corrective measures, to consider the advantages and disadvantages, including costs, for these methods and to

recommend, with public input, measures that are appropriate to address the constituents and conditions at the Edgecombe County Landfill. (*Assessment of Corrective Measures*, dated June 26, 2008)

The ACM evaluated the performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination; the time required to begin and complete the remedy; the costs of remedy implementation; and the institutional requirements such as State and Local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s), in accordance with 15A NCAC 13.B1635.

The following techniques were considered as possible effective corrective measures:

- Institutional Controls – Monitored Natural Attenuation (MNA), Access Restrictions, and Deed Restrictions
- Groundwater Collection –Pumping Wells/Hydraulic Barrier and Interceptor Trenches
- Gas Extraction – Volatilization
- On-Site Treatment – Physical: Air Stripping, Carbon Adsorption, Filtration, Ion Exchange, Reverse Osmosis

  Chemical: Neutralization, Physical/Chemical Separation

  Biological: Constructed Wetlands
- In Situ Isolation – Surface Cap / Grade and Barrier / Containment Wall
- Off-Site Disposal – POTW Discharge
- On-Site Disposal – Discharge to Surface Water

Of these potential measures, the facility will choose the most feasible method which will achieve the combined goals of protection of human health and the environment with a reasonable allocation of County resources. The ACM report was submitted to the Solid Waste Section (SWS) of NCDENR, Division of Waste Management (DWM), however the selection process of the ACM has not yet been fully completed, pending meetings for public questions and input. Due to schedule requirements for submission of this Corrective Action Plan, alternatives for in-situ isolation combined with monitored natural attenuation (MNA) have been selected for completion of this plan. In-situ isolation was chosen because the site conceptual model indicates that water management issues are the primary mechanism for addressing the release and migration of the constituents of concern at the waste disposal unit. MNA will be incorporated into the facility's water quality monitoring plan (WQMP) to evaluate the effectiveness of the remedial measures. After completion of the ACM subsequent to the public meeting process, an addendum to

this CAP will be submitted, if necessary, to reflect any changes based on public comments.

## 1.4 Regional Geology

Edgecombe County lies within the Coastal Plain Physiographic Province of North Carolina. In general, geologic units in the Coastal Plain Region consist of deep, unconsolidated clastic deposits overlying crystalline basement rocks. The Coastal Plain sedimentary formations in this region include, from youngest to oldest (top to bottom):

- The Surficial Deposits (Quaternary)
- The Yorktown Formation (Tertiary)
- The Upper Cape Fear Formation (Cretaceous)

In the site vicinity, the Quaternary surficial sediments are comprised of the Penholoway, Wicomico, and Sunderland Formations. These formations are generally less than 50 feet in total thickness, with an average of 20 to 30 feet and consist of yellow silty sand and sandy clays. The Yorktown Formation lies beneath these surficial sediments. The Yorktown consists of 30 to 60 feet of blue gray fossiliferous silty clay with sandy clay, shell beds and fine sands. The Yorktown is extensive throughout the county forming an almost continuous layer. Beneath the Yorktown are Cretaceous-aged Cape Fear Formation sediments of reddish brown to brown clay, sand and sandy clay with some gravel resting on the irregular bedrock surface. These sediments range in thickness from 30 in the west to 400 feet or more in thickness in the eastern area of the county.

The Cretaceous sediments are underlain by crystalline igneous and metamorphic rocks, with an irregular surface that dips gently to the east. The depth to the bedrock is approximately 300 feet below National Geodetic Vertical Datum (NGVD) (approximately 240 to 400 feet below land surface).

## 1.5 Site Geology

S&ME personnel have previously performed several test pits, soil borings, and the installation of temporary piezometers throughout the site to identify the soil conditions at the landfill facility. Sand and silty sand were identified from the ground surface to typical depths of 4 to 6 feet below ground surface (ft bgs). The soil underlying the sand and silty sand surface layer generally consisted of the following: sandy silty clay; sandy clayey silt; silty sandy gravel; and sandy clayey silt. The subsurface exploration identified a marine clay (Yorktown Formation) underlying the near surface soils at the landfill site at depths ranging from 3 to 20 ft bgs. The full thickness of the Yorktown clay has not been determined. However, two deep borings (MW-5D and CPT-1) have been performed at the site which indicate the Yorktown formation is at least 25 feet thick. On the north side of the landfill at MW-5D the clayey soils associated with the Yorktown formation were encountered from approximately 10 ft bgs to the termination of the boring at 40 ft bgs (40 ft AMSL to 10 ft AMSL). On the south southeast corner of the landfill at CPT-1, the clayey soils associated with the Yorktown formation were

encountered from approximately 10 ft bgs to the termination of the boring at approximately 35 ft bgs (55 ft AMSL to 30 ft AMSL).

The MSW landfill is constructed largely within and above the surficial Quaternary deposits, with embankment and cover soils derived largely from these sandy and silty sand soils. The Yorktown clays form a hydraulic base for the landfill.

## 1.6 Hydrologic Setting

### *1.6.1 Surface Water*

The local surface water features in the immediate vicinity of the landfill include: Jerry's Creek; Wright's Creek; the drainage features in the waste disposal unit including a former sediment basin; and the farm pond located in the southeast corner of the site. The undisturbed natural topography in the areas surrounding the waste management units at the facility is characterized as gradual to moderate slopes toward these local surface water features. The surface of the landfill facility generally mimics these natural slope gradients and also discharges to these surface water features. Jerry's Creek is the primary receptor of surface water runoff from the landfill. Some areas of the landfill drain surface water directly to Jerry's Creek, while much of the central portion of the waste disposal unit drains to a topographic "horseshoe" feature in the northern boundary of the landfill. A sedimentation pond which is a remnant of former MSW operations collects the surface drainage in this area. Infiltration and percolation into the upper soil horizon is expected to be moderate due to the sandy loam content within this stratum. The uppermost aquifer underlying the landfill is expected to discharge to the local surface water features. During periods of rainfall with high surface water runoff, Jerry's Creek, Wright's Creek, the sediment pond, the southwest perimeter trench, and the farm pond may recharge the aquifer. Surface water features are shown on **Figure 2**.

### *1.6.2 Groundwater Hydrogeology*

The Coastal Plain Physiographic Region of North Carolina is located between the uplands of the Piedmont and the Atlantic Ocean. Investigations of the Coastal Plain Region have identified as many as 10 aquifers separated by 9 confining units. However, these aquifers can basically be divided into three major deep aquifer systems in North Carolina: the Quaternary Aquifer System, the Tertiary Aquifer System, and the Cretaceous Aquifer System. Each of these three major aquifer systems are separated from each other by units of lower permeability composed of clays and silts. The Quaternary Aquifer is composed of surficial deposits of sandy silt and clay. The Tertiary Aquifer is composed of glauconitic sands, clayey sands, and limestone. The Cretaceous Aquifer is composed of sand, silty and clayey sand, and clay separated by confining units of clay and silt.

The uppermost aquifer at the site is unconfined and is found in the silty sands of the Quaternary-age Sunderland formation. This aquifer is recharged by inflow from upgradient areas and by infiltration of precipitation. The Tertiary-age Yorktown clay layer appears to act as a confining layer below the landfill. In some areas, this water may

be "perched" over the Yorktown clays beneath the Quaternary sands, rather than forming a true unconfined aquifer.

Groundwater within and below the landfill appears to result partially from lateral flow recharge through the sandy surficial soils from upland areas to the south flowing downgradient through the waste disposal unit toward Jerry's Creek. Surface water from the waste disposal unit surface also infiltrates through the sandy cap and cover soils and buried wastes to further recharge groundwater within and beneath the landfill. Just north of the waste disposal unit, groundwater levels are very near the ground surface and the water surface in the old sediment pond, which is likely further recharging groundwater in this area.

## 1.7 Site Conceptual Model

The Edgecombe County landfill is unlined and was constructed in the sandy soils of the geologically recent Quaternary deposits which overlie the Yorktown Formation in this area. The Quaternary deposits typically extend for a few feet below the base of the landfill, where they rest on a medium gray marine clay of the Yorktown. This Yorktown clay appears to form an aquitard beneath the sandy Quaternary deposits.

The topography of the area around the landfill slopes naturally from the south toward Jerry's Creek to the north. The unconfined aquifer is contained within the Quaternary sands and may be "perched" in some locations on the Yorktown clay. The groundwater in this unconfined aquifer generally follows the topography and flows from south to north over the basal Yorktown clay toward Jerry's Creek. In the area of Jerry's Creek, the groundwater is thought to converge with groundwater flowing south toward Jerry's Creek from the old landfill to the north. Thus, the Jerry's Creek topographic depression is thought to form a hydraulic barrier to groundwater flow from the active landfill. The mingled groundwaters from the active landfill and the northern old landfill apparently flow along the trace of the creek topographic depression, in a more easterly direction.

The detected groundwater contamination consists of mostly VOCs, one SVOC, and several metals, appearing at the compliance wells to the north, just downgradient of the limits of the landfill. The contaminants are limited to the shallow unconfined aquifer and no contaminants have been detected in the deeper aquifer beneath the Yorktown clay layer. The VOC concentrations at compliance wells MW-1A, MW-6, and MW-7 have a decreasing trend in recent years. The VOC levels at MW-5 have remained relatively consistent with some increase in the degradation "daughter" products of the detected VOCs, indicating that degradation of the primary VOCs is occurring.

The mechanism for the release of contaminants from the MSW landfill appears to be largely due to surface water from precipitation infiltrating through the waste disposal unit cap, percolating through the buried MSW, and impinging as leachate on the groundwater flowing beneath the waste disposal unit. The geochemical indicator parameters support the interpretation that the generation of leachate in the MSW landfill is the primary contaminant mechanism. Analysis of collected landfill gas samples for non-methane

organic compounds indicate that some portion of the contamination reaching the underlying groundwater may also be attributed to landfill gas. Once the leachate reaches the groundwater, the contaminants are then carried by groundwater flow beyond the limits of the waste disposal unit toward Jerry's Creek.

Contributing factors to the release of contaminants from the waste disposal unit include:

- The western half of the MSW landfill cap is very flat with some soil berms that create ponding on the waste disposal unit surface.

- The closed MSW unit was capped with sandy soils because more clayey soils were not available. To achieve an effective permeability of approximately $1 \times 10^{-5}$ cm/sec, an extra vegetative layer was added.

- On the eastern half of the landfill an active C&D unit overlies the closed MSW unit. Although the C&D materials may add additional components to the leachate percolating through the waste disposal unit, the combination of additional daily cover soils and the increased surface slope enhances the drainage of precipitation surface water from this portion of the waste disposal unit, reducing the total volume of water available for the generation of leachate.

- Until recently, the waste disposal unit cap supported very little vegetation. Vegetation protects the integrity of the cap and reduces the volume of surface water percolating through the cap by evapotranspiration.

- Due to the shallow water table aquifer and the elevation of the land surface to the south of the waste disposal unit, infiltrated surface water and/or shallow groundwater appears to enter the south side of the waste disposal unit into the wastes. This is providing another source of water for the generation of leachate.

- The waste disposal unit was constructed in what was previously a swampy area, indicating that the unconfined groundwater was at or very close to the ground surface. Ditches and drainage channels may have actually extended into the water table aquifer during wet seasons. A combination of possible filling of such ditches and channels and a rise in groundwater levels due to settlement of the waste disposal unit base from the weight of the waste may mean that some buried waste may be in direct contact with the groundwater.

- The old sedimentation pond located on the north side of the landfill in the "horseshoe" provides a collection point for shallow leachate seeps along the north face during wet seasons. The increased surface water directed to the center of the "horseshoe" from three sides also provides an infiltration source recharging and likely mounding the groundwater at the toe of the waste disposal unit.

# 2. CONTAMINANT CHARACTERIZATION

## 2.1 Constituents of Concern

Historical groundwater monitoring results have been compiled since the facility initiated groundwater monitoring in September of 1994. Several organic and inorganic constituents have been both historically detected exceeding 2L Standards/GWPST and *consistently* detected at compliance monitor well locations at the landfill facility. *Consistently* detected constituents are defined as those constituents that have been detected exceeding their respective groundwater quality standard during at least two separate semi-annual sampling events and also have been detected at least one time within the last three semi-annual sampling events at the landfill facility. S&ME reviewed historical monitoring results and previous statistical data for Edgecombe County Landfill to identify which organic and inorganic constituents are constituents of concern. Five organic compounds and one inorganic constituent have been identified as the COCs at the Edgecombe County Landfill. These organic compounds include the VOCs: vinyl chloride, benzene, cis-1,2-dichloroethene, trichloroethene, and 1,4-dichlorobenzene. The inorganic constituent is the metal cobalt.

## 2.2 Background Concentrations

Three upgradient (background) monitor wells (MW-3B, MW-4, and MW-9) are currently sampled for water quality indicators and laboratory analyses as part of the semi-annual groundwater monitoring at the landfill facility. Review of historical groundwater monitoring data indicate that no VOCs or SVOCs have been detected exceeding 2L Standards/GWPST in the groundwater samples collected from upgradient monitor wells MW-3B, MW-4, and MW-9. Therefore, vinyl chloride, benzene, cis-1,2-dichloroethene, trichloroethene, and 1,4-dichlorobenzene remain organic COCs at the landfill facility.

Several inorganic constituents have been historically detected exceeding their respective groundwater quality standards in the groundwater samples collected from the upgradient wells. Four of these historically detected inorganics (cobalt, lead, thallium, and vanadium) have also been *consistently* detected at background and compliance monitor well locations. As discussed in **Section 1.3.3**, S&ME performed an ASD for metals in response to these inorganic constituent exceedances. The ASD found that concentrations of the naturally occurring lead and vanadium within the in-situ soil at the facility were sufficient to influence the concentrations of these metals in groundwater samples from the monitoring wells. Thallium was found to not represent a statistically significant increase above background values. Therefore, the concentrations of these constituents could be attributed to naturally occurring background values of these metals within the hydrogeologic regime. However, the results of the ASD analyses did not support influence to groundwater quality from the natural occurrence of the metal cobalt. Cobalt remains an inorganic COC at the facility.

## 2.3 Source Area Determination

The Nature and Extent Study indicates that the source area(s) for the contaminant plume are located within the landfilled MSW. The contaminant plume appears to be migrating outside of the waste boundary, north-northeast toward Jerry's Creek, but remaining on the landfill property. Historical surface water and temporary piezometer data indicate that the topographically low area located along Jerry's Creek is acting as a hydraulic barrier. The downgradient extent of the contaminant plume has been delineated along the northern property boundary and the contaminant plume is contained within the facility boundaries. In addition, the contaminant plume located within the waste disposal unit is confined to the surficial, uppermost aquifer.

Concentrations of the COCs at compliance monitor wells MW-1A, MW-6, and MW-7, located along the northern property boundary, have a decreasing trend or no trend, due to lack of detections, in recent years. The VOC levels at MW-5, located along the north-northeast property boundary, have remained relatively consistent with some increase in the degradation "daughter" products of the detected VOCs, indicating that degradation of the primary VOCs is occurring. Elevated concentrations of the chlorinated compound tetrachloroethene and its daughter products have been historically detected at monitor well MW-5. Chlorinated COC trends in concentration over time are further discussed in **Section 5.1**. It appears that the source area(s) for the chlorinated COCs are located within the landfilled MSW hydraulically upgradient of monitor well MW-5.

The concentration of benzene in groundwater samples from monitor well MW-5 has strong evidence of a decreasing trend in recent years. Based on our interpretation of these conditions, benzene concentrations will likely not cause future compliance issues in the area of monitor well MW-5. Elevated concentrations of 1,4-dichlorobenzene have also been historically detected in the groundwater samples collected from compliance monitor well MW-5. However, no trend is evident for 1,4-dichlorobenzene concentrations in monitor well MW-5. It appears that the presence of benzene and 1,4-dichlorobenzene at the landfill is likely due to the direct transport from an upgradient source within the waste disposal unit.

In addition, the concentration of cobalt in groundwater samples from monitor well MW-5 has strong evidence of an increasing trend. The historical increasing trend of cobalt concentrations in groundwater suggests a potential source of cobalt hydraulically upgradient of this area.

## 2.4 Exposure Pathways

The landfilled waste disposed at the site is the most likely source of groundwater contamination observed in the area surrounding the waste disposal unit. Historical data indicate that geochemical leachate indicator parameters detected in groundwater samples collected from temporary piezometers and monitor wells were more elevated in the downgradient groundwater samples, along the northern property boundary, than in the upgradient groundwater samples. These data suggest that leachate from the MSW is contributing to the contamination observed in the downgradient piezometers and wells. It

appears that the infiltration of precipitation through the disposed waste mass is "leaching" contaminants from the waste, through the bottom of the unlined waste disposal unit, and to the groundwater below the waste management unit. Subsequent lateral migration of groundwater further transports and distributes the contamination to a surrounding larger area. In addition, shallow groundwater flowing into the waste disposal unit and through the landfilled waste is further aiding in the transport of contamination outside of the waste boundary. Therefore, soil leachate from landfilled MSW to groundwater is the most likely source of groundwater contamination at the landfill.

In general, potential exposure pathways from soil leachate to groundwater include the use of potable wells or surface water within the area of the facility. The NES has delineated the downgradient extent of the groundwater contaminant plume along the northern property boundary of the waste disposal unit and found that the contaminant plume is contained within the facility boundaries. In addition, historical surface water data indicate that no VOCs or SVOCs have been detected exceeding 2B Standards in the surface water samples collected at the landfill since semi-annual sampling was initiated in 1994. Several inorganic constituents have been historically detected exceeding 2B Standards in the surface water samples collected at the landfill including beryllium, cadmium, chromium, cobalt, lead, and zinc. However, no inorganic constituents have been detected exceeding 2B Standards in the surface water samples collected since January 2003. Therefore, it appears that the groundwater contaminant plume has not impacted surface water quality at the landfill.

The potential for direct exposure to MSW and the contaminants of concern by direct contact is low. The MSWs are covered by daily cover soils and the landfill cap. A large portion of the MSW landfill is further covered by the C&D landfill wastes. Therefore, exposure from contaminated soil at the landfill is limited.

Landfill gas is another potential exposure pathway for the VOCs at the facility. Eleven gas wells located along the perimeter of the waste disposal unit and five building structures currently comprise the regular methane gas monitoring system for the landfill. The locations of methane gas wells for the landfill facility are shown on **Figure 2**. The regular network methane gas monitor wells and building structures at the landfill are monitored on a quarterly basis. At various times (June 2001 - November 2002) the methane concentrations have exceeded the North Carolina Solid Waste Standards as promulgated in 15A North Carolina Administrative Code 13B (13B Standard). Edgecombe County has performed corrective measures to reduce the concentrations of methane at the facility's compliance points. These corrective actions were described in the following reports previously submitted to the Section: *Response to Environmental Assessment Requirements* dated June 2001 and *Methane Monitoring and Corrective Action Report* dated March 2002. Methane gas concentrations have not exceeded the 13B Standards in any of the monitored gas wells or building structures at the landfill since November 2002. Exposure from landfill gas at the facility is limited to methane vents located on the top of the waste disposal unit and the potential for significant direct exposure to these gases is considered low.

It appears that the potential for exposure to landfill contaminants, either through migrating leachate from the buried waste to the groundwater, contaminated soil, or landfill gas, is limited to the site.

## 2.5 Receptor Survey

As part of the Nature and Extent Study, S&ME completed visual observations for evidence of drinking water wells within a 1,500-foot radius of the waste disposal unit. The results of the survey show that there are nine (9) identified potable wells within a 1,500-foot radius of the waste disposal unit, including one potable well located on-site at the County-owned property comprising part of the facility. The potable well located on-site at the facility has been removed from service. The water for the facility is supplied from the County-wide municipal water distribution system. Eight properties were identified within 1,500 feet of the waste disposal unit where the potential presence of a potable well is unknown. Two (2) of the nine potable wells identified are known to be used for drinking water purposes. The use for two (2) of the nine potable wells identified is unknown. The majority of the properties containing potable wells are located at least 1,200 feet away from the waste disposal unit and at a topographically higher elevation than the landfill. However, three (3) potable wells, located at 2549, 2577, and 2595 Colonial Road, were identified approximately 600 to 900 feet northeast of the waste disposal unit and at a similar topographic elevation as the landfill facility. Property owners at all three addresses indicated that they are currently connected to the municipal water supply and use their potable wells for non-drinking water purposes, i.e. washing vehicles. Based on groundwater levels collected at the site vicinity, and the resulting potentiometric contours calculated, it appears that all of the potable wells identified within 1,500 feet of the landfill are hydraulically upgradient. Therefore, the level of risk to human health is expected to be low.

Jerry's Creek is the primary receptor of surface water runoff from the landfill. Wright's Creek is present along the northern property boundary of the northern old landfill. Wright's Creek converges with Jerry's Creek to the east of the old landfill and continues east to the Tar River.

# 3. SELECTED REMEDY/TECHNICAL APPROACH

## 3.1 Introduction

The selection process of the ACM has not yet been fully completed, pending meetings for public comment and input. Due to schedule requirements for submission of this Corrective Action Plan, alternatives for in-situ isolation combined with monitored natural attenuation (MNA) have been selected for completion of this plan. In-situ isolation was chosen because the site conceptual model indicates that water management issues are the primary mechanism for addressing the release and migration of the COCs at the waste disposal unit. MNA will be incorporated into the facility's water quality monitoring plan (WQMP) to evaluate the effectiveness of the remedial measures. After completion of the ACM subsequent to the public meeting process, an addendum to this CAP will be submitted, if necessary, to reflect possible changes based on public comments.

In-situ isolation and MNA as the selected remedies at the Edgecombe County Landfill will involve the following:

- Installation of an upgradient groundwater barrier wall (Option 4A from ACM);
- Maintaining a consistent contour with pre-1998 waste area (Option 4B from ACM)
- Increase slope of the closed MSW area (Option 4C from ACM);
- Stormwater improvements on the western half of the landfill (Option 4D from ACM); and,
- Implementation of a MNA program to address impacted groundwater (Option 1 from ACM).

See **Figure 3** for a plan view of the conceptual remedies.

## 3.2 Technical Approach

### *3.2.1 Upgradient Groundwater Barrier Wall*

Because of the shallow depth to groundwater in the upgradient region of the waste disposal unit, as well as the available space between the waste boundary and the facility boundary, an upgradient physical barrier that diverts groundwater around the landfill will restore groundwater quality at the facility. Diverting the flow of groundwater around the waste disposal unit would minimize interaction of the groundwater with the waste mass, thereby reducing leachate production. Installation of a barrier wall consisting of interlocking sheet piles will be designed. See **Figure 3** for a plan view of the barrier wall location.

An approximately 1,900 feet long, barrier wall will be installed to approximately 15 – 30 feet below ground surface along the southern boundary of the landfill. The barrier wall

will be anchored into the low permeability confining unit of the Tertiary-age marine clay layer (Yorktown Formation).

Following approval of this CAP, a detailed design and contractor specifications package will be developed. Details that will be presented in the specifications package will include:

- Site Preparation Requirements: health and safety planning; securing construction permits; underground utility location and management; clearing, grading and erosion control.
- Installation of Barrier Wall: submittal of sheet pile materials make-up formulation for pre-approval by the Engineer; methods to determine the varying depth of the barrier wall in the field during construction to ensure that the barrier wall extends into the confining layer; installation of sheet pile wall methods; handling and relocation of excavated soil; quality control methods and testing.
- Site Restoration Requirements.

### *3.2.2 Maintaining a Consistent Contour with Pre-1998 Waste Area*

Maintaining consistent contour elevations across the waste disposal unit where C&D waste is not currently being placed (western portion of waste disposal unit) will reduce groundwater contamination by reducing vertical percolation of pounded rain water into the waste mass which can produce leaching. Maintaining a consistent contour entails some initial grading operations to remove or regrade existing stormwater slope diversion berms on the landfill cap and maintenance to those areas where ditches, slumps, and sinkholes have formed from waste decomposition. Maintenance would involve filling or grading over only those anomalous surface deficiencies that facilitate the influx of water into the waste mass.

Maintaining a consistent contour would involve a continuous process of inspection and backfilling on a quarterly basis for existing or potential surface water collection locations followed by timely addition of backfill soil and reseeding.

Following approval of this CAP, a detailed design and contractor specifications package will be developed. Details that will be presented in the specifications package will include:

- Site Preparation Requirements: health and safety planning; securing construction permits; clearing, grading and erosion control.
- Site Grading and Backfilling Operation: grading and soil application plans to maximize transfer of stormwater off the waste disposal unit; specifications for acceptable types of fill (backfill materials will likely be supplied from Edgecombe County's on-site borrow sources); reseeding and establishment of vegetation; quality control methods and testing.
- Site Restoration Requirements.

### *3.2.3 Increase Slope of the Closed MSW Area*

Increasing the slope of the cap will decrease the infiltration of stormwater into the MSW waste and reduce the potential for groundwater contamination. The eastern portion of the waste disposal unit is where the current C&D waste disposal is being conducted. The C&D waste has been placed over the existing MSW landfill cap and has increased the slope in this area. The waste placement also provides an additional barrier to stormwater infiltrating into the MSW landfill.

The slopes in the western portion of the MSW landfill are relatively flat with a majority of the area at a slope of approximately 5 to 6 percent. Increasing the slope in this area would involve moving the current C&D waste placement operations from the eastern portion of the waste disposal unit to the western portion. The C&D waste placement would increase the slope in this area and also provides an additional barrier to stormwater infiltrating into the MSW landfill.

Following approval of this CAP, a detailed design and contractor specifications package will be developed. Details that will be presented in the specifications package will include:

- Site Preparation Requirements: health and safety planning; securing construction permits; clearing, grading and erosion control.
- Site Grading and Filling Operation: soil and C&D waste application plans to maximize transfer of stormwater off the waste disposal unit; specifications for acceptable types of fill (backfill materials will likely be supplied from Edgecombe County's on-site borrow sources); an approximation of the application schedule versus project backfill and C&D waste applications; establishment of target fill grades and methods to measure the grades; quality control methods and testing.
- Site Restoration Requirements.

### *3.2.4 Stormwater Improvements on the Western Half of the Landfill*

There are currently stormwater diversion trenches which run parallel to the direction of groundwater flow on both sides (eastern and western) of the waste disposal unit. A stormwater diversion trench located along the southern boundary of the waste disposal unit runs perpendicular to the direction of groundwater flow.

The diversion trenches located along the western and southwestern boundaries of the waste disposal unit (totaling approximately 3,100 feet in length) will be expanded and improved to serve as groundwater diversion ditches to transport groundwater and surface water diverted from the top of the waste disposal unit and from around the sides of the upgradient physical barrier wall. Water diverted in the upgradient region of the waste disposal unit, before interaction with the landfilled wastes, would likely not require pre-treatment before discharging to the downgradient receiving creek. See **Figure 3** for a plan view of the ditch locations.

The old sedimentation pond just north of the landfill is to be lined with low permeability fill material and improved to capture stormwater run-off from the waste disposal unit before discharging off-site. Reference the Edgecombe County Landfill *Closure and Post-Closure Plan*, dated June 30, 2008, for details on the stormwater management system. The remainder of this "horseshoe-shaped" area will be backfilled with low permeability fill material. **See Figure 3** for the location of this area. The old sedimentation pond in the horseshoe provides a collection point for shallow leachate seeps along the north face during wet seasons. The surface water directed from the landfill cap and side slopes to the sedimentation pond also provides an infiltration source recharging and likely mounding the groundwater at the toe of the waste disposal unit. The sedimentation pond will be improved in order to isolate stormwater run-off collecting in the pond from shallow groundwater and leachate migrating from the waste disposal unit.

The old sedimentation pond is less than one acre in size and may have been up to eight feet deep in some locations before the pond filled with sediment and plant growth. The total volume of the old sedimentation pond before it filled may have been approximately 8,000 cubic yards or more.

The rest of the horseshoe area, minus the area of the old sedimentation pond, is approximately 2 ½ acres in size. This area will be capped with low permeable fill and graded to direct surface water flow over this area rather than percolating into the groundwater.

Following approval of this CAP, a detailed design and contractor specifications package will be developed. Details that will be presented in the specifications package will include:

- Site Preparation Requirements: health and safety planning; securing construction permits; underground utility location and management; clearing, grading and erosion control.
- Stormwater Diversion Ditches: specifications of dimensions (width and depth) along the center line of the ditches; surveying to confirm grade points; excavation and placement of engineered fill requirements; quality control methods and testing.
- Grade and Line Old Sedimentation Pond: submittal of design and low permeable fill materials for pre-approval by the Engineer; plant removal and disposal; mucking out of sediment; handling and relocation of excavated sediment; placement and grading of low permeable fill material (backfill materials may be supplied from Edgecombe County's on-site borrow sources); and quality control methods and testing.
- Cap and Grade Horseshoe Area: backfill and compaction requirements; surveying to confirm grade points; and quality control methods and testing.
- Site Restoration Requirements.

### *3.2.5 Monitored Natural Attenuation for Groundwater*

The COCs in groundwater at the landfill include the organic parameters: vinyl chloride, benzene, cis-1,2-dichloroethene, trichloroethene, and 1,4-dichlorobenzene, and the inorganic constituent: cobalt. Following construction of the corrective measures presented above, surface water and groundwater coming in contact with waste materials in the waste disposal unit will be minimized. Waste material leachate coming into contact with groundwater will then be minimized. The COCs in groundwater are then expected to naturally attenuate and trend toward cleanup goals. MNA will be implemented as the corrective measure for impacted groundwater.

Based on the years of groundwater monitoring, analytical data coupled with the various studies throughout the groundwater monitoring history of the facility, including the previously discussed NES, the primary substrate at the facility should contain a sufficient quantity of anthropogenic organic carbon to support biodegradation of the chlorinated solvent COCs. In addition, there is likely native organic carbon in trace amounts which will further enhance biodegradation rates of these constituents.

The contaminant of concern, cobalt, was detected in groundwater samples at levels of only up to 0.131 milligrams per liter (mg/L) within the last two years of groundwater monitoring (July 2006, January 2007, June 2007, and January 2008). The GWPST for cobalt is 0.07 mg/L. Cobalt in groundwater at the facility would be expected to attenuate by dispersion and absorption.

For the Edgecombe County Landfill, it has not yet been determined if the contaminant plume is still in a growth phase, stable phase, or if the plume has already reached its peak and is now a shrinking plume. At a time of one to three years following implementation of the isolation and water management correction measures presented above, the groundwater plume status at the facility would be determined during the MNA process.

This process would involve sampling the appropriate property boundary groundwater monitoring wells for the constituents found exceeding their respective 2L Standards/GWPST. After an appropriate amount of samples have been taken, assumptions may be drawn concerning the constituent magnitude concentration trend (increasing, decreasing, or static) in order to re-evaluate the dispersion and natural attenuation process effectiveness. The objectives for a MNA groundwater remediation program include the following:

- Demonstrate that natural attenuation is occurring;
- Be protective of human health and the environment;
- Monitor natural attenuation and environmental impact; and,
- Restore groundwater at the edges of the plume to below the 2L Standard and GWPST.

The existing monitoring network, plus additional monitor wells to be installed, will be used to monitor groundwater quality and trends. Monitoring wells MW-3B, MW-4, and MW-9, the upgradient wells, would allow determination of geochemical conditions in the

groundwater prior to entering the source area. Monitoring well MW-5 is located in the plume and will be utilized to collect data for bioremediation rate calculations. Additional wells will be installed along the downgradient facility boundary to define the edge of the plume and act as sentinel wells. These wells would be monitored and evaluated to determine if bioremediation is working as well as to determine if re-evaluation triggers have been exceeded. For additional information on the proposed evaluation of water quality at the landfill, see the updated Water Quality Monitoring Plan included in **Appendix II of the Facility Operation and Waste Acceptance Plan**.

# 4. WATER QUALITY MONITORING PLAN

An updated Water Quality Monitoring Plan (WQMP) is included in **Appendix II of the Facility Operation and Waste Acceptance Plan**. The updated WQMP summarizes the activities and protocol recommended to perform monitoring at the subject site in general accordance with the requirements as specified in Sections .0600 and .1637(a)(1) of the North Carolina Solid Waste Management Rules (15A NCAC 13B). The WQMP is designed to effectively monitor groundwater and surface water quality in order to detect a release from the landfill into the uppermost aquifer underlying the landfill; monitor groundwater and surface water diverted and discharged from the facility as part of the proposed corrective actions; and monitor surface water downgradient of the facility during the implementation of corrective measures for the closed landfill.

# 5. EVALUATION OF CORRECTIVE ACTION EFFECTIVENESS

## 5.1 Evaluation of Natural Attenuation

Geochemical data and changes of site constituent concentrations with time are important in evaluating the effectiveness of natural attenuation. The NES Report previously prepared for the landfill discussed the changes of site constituent concentrations and plume characteristics with time.

The facility's water quality monitoring network has been sampled on a semi-annual basis since 1994. Groundwater and surface water samples collected from the water quality monitoring network have historically been analyzed for Appendix I constituents including VOCs and metals and Appendix II constituents including VOCs, SVOCs, metals, sulfide, and cyanide. In addition, groundwater and surface water samples have also been historically analyzed for several other constituents including PCBs, pesticides, and herbicides. However, the facility's water quality monitoring network has only been sampled for geochemical parameters on two occasions, in January 2003 and June 2007. Therefore, the current historical pool of geochemical data collected from the facility's water quality monitoring network is insufficient to evaluate geochemical parameter trends over time.

According to historical groundwater analytical data, concentrations of the COCs at compliance monitor wells MW-1A, MW-6, and MW-7, located along the northern property boundary, have a decreasing trend or no trend, due to lack of detections, in recent years. The evidence suggests that natural degradation is likely occurring in the area of monitor wells MW-1A, MW-6, and MW-7.

The VOC levels at MW-5, located along the north-northeast property boundary, have remained relatively consistent with some increase in the degradation "daughter" products of the detected VOCs, indicating that degradation of the primary VOCs is occurring. Elevated concentrations of the chlorinated compound tetrachloroethene have been historically detected at monitor well MW-5, until 2004. Trichloroethene is a daughter product from the degradation of tetrachloroethene. Concentrations of trichloroethene detected at MW-5 show a significant downward trend in concentrations over time. Two of the daughter products from the degradation of trichloroethene are cis-1, 2-dichloroethene and 1,1-dichloroethane. The concentration of cis-1,2-dichloroethene in groundwater samples from monitor well MW-5 has strong evidence of an increasing trend. This increase is likely due to the degradation of trichloroethene through natural attenuation processes. The concentration of 1,1-dichloroethane in groundwater samples from monitor well MW-5 has strong evidence of a decreasing trend. Vinyl chloride is a degradation product of cis-1,2-dichloroethene and 1,1-dichloroethane, and further breaks down to water and carbon dioxide through natural processes. The analysis of vinyl chloride concentrations shows no significant upward or downward trend in concentration over time at monitor well MW-5. Due to the degradation characteristics of vinyl chloride, relatively steady concentrations are expected while the larger alkene compounds degrade (Montgomery, 1996). Therefore, it appears that the site conditions are condusive

to natural attenuation processes and that natural attenuation is occurring within and surrounding the waste disposal unit.

Semi-annual groundwater and surface water monitoring of the water quality monitoring network for Appendix I constituents, and possibly Appendix II constituents, will continue. Annual groundwater and surface water monitoring of select monitor wells and surface water locations for geochemical parameters and Appendix I constituents, and possibly Appendix II constituents, will begin with the approval of this CAP. For additional information on the semi-annual compliance monitoring and annual corrective measures monitoring, see the updated Water Quality Monitoring Plan included in **Appendix II of the Facility Operation and Waste Acceptance Plan**. Changes of site constituent concentrations and plume characteristics with time will be included in the annual corrective measures monitoring reports.

## 5.2 Evaluation of In-Situ Isolation

Changes in groundwater elevation data within the waste disposal unit are important in evaluating the effectiveness of the in-situ isolation program. In-situ isolation is proposed as part of the corrective measures in this report. However, there are currently no in-situ isolation structures in-place at the landfill facility.

Groundwater elevation data will be collected from the facility's water quality monitoring network, as discussed in the updated WQMP, on a quarterly basis. A decrease in groundwater levels under the waste disposal unit is expected after the in-situ isolation program is implemented. For additional information on the proposed collection of groundwater elevation data, see the updated Water Quality Monitoring Plan included in **Appendix II of the Facility Operation and Waste Acceptance Plan**. Operation and maintenance inspections of the in-situ isolation program will be conducted on a quarterly basis. Updated assessments of the effectiveness of the in-situ isolation program will be included in the annual reports.

# 6. CONTINGENCY PLAN

If it is determined that MNA in conjunction with in-situ isolation are not effectively reducing groundwater contamination at the landfill facility, then one or more of the following contingency plan options may be implemented.

## 6.1 Option 1 – Stormwater Improvements on the Eastern Half of the Landfill

If groundwater elevation data collected from monitor wells and piezometers at the landfill facility do not indicate a decrease in groundwater levels under the waste disposal unit, then improvement of stormwater structures on the eastern portion of the waste disposal unit will be implemented. Improving the stormwater structures on the eastern half of the landfill will decrease the infiltration of stormwater into the ground which could come in contact with the MSW waste and produce leaching. Structures that would be improved include the perimeter ditch which flows north along the eastern portion of the landfill, installing a new ditch between the southern access road and property line, and removing the pond located south of the maintenance building.

The eastern perimeter ditch would be re-graded to improve its slope and flow and be extended as necessary to convey stormwater away from the landfill. This would reduce the amount of stormwater infiltrating from the ditch and becoming groundwater which could come in contact with the waste and potentially produce leaching.

A new ditch will be installed between the southern access road and the property boundary. This ditch would intercept stormwater prior to reaching the landfill at a location farther away from the landfill than the existing perimeter ditch. During periods of high groundwater, the ditch would intercept a portion of the groundwater and divert it around the landfill.

The pond south of the maintenance building would be removed. This would reduce infiltration into groundwater and therefore reduce the groundwater level under the landfill.

## 6.2 Option 2 – Enhance Landfill CAP

If groundwater elevation data do not indicate a decrease in groundwater levels under the waste disposal unit after Option 1 of the contingency plan is implemented, then an alternate cover system will be placed on the eastern and western portions of the waste disposal unit to enhance the cap of the landfill. Enhancing the landfill cap will decrease the infiltration of stormwater into the ground which could come in contact with the MSW waste and produce leaching.

A proposed alternate cover system for the facility would be the following:

- erosion layer;
- low-permeability barrier; and
- geosynthetic clay liner (GCL).

The alternate cover system will be planted with grass to stabilize the cover soils, minimize erosion, and reduce maintenance. The soil will be prepared by fertilizing, amending the soil, and seeding in accordance with the North Carolina Erosion and Sediment Control Guidelines.

## 6.3 Option 3 – Landfill Gas Extraction

If statistically significant increasing trends are noted for the COCs trichloroethene, benzene, or 1,4-dichlorobenzene, then monitoring for that parameter(s) in the area of the increase may be expanded to quarterly for one year. During this time, a review of the contribution of landfill gas (LFG) to contaminant migration in that area will be completed to establish whether LFG extraction is needed if the trend continues. Groundwater contamination from LFG can occur through direct contact of groundwater with LFG; rising groundwater or infiltrating water washing contaminants from the vadose zone contaminated by LFG; LFG cooling in the soil outside the landfill causing condensate to form, which percolates to the groundwater; and acids in the LFG causing some naturally occurring metals in the soil to dissolve into the groundwater.

The waste disposal unit currently has a passive LFG system consisting of 60 vertical wells which vent the LFG to the atmosphere. The number of passive vents can be increased if a review of the spatial distribution and effective influence of the vents indicates a need for additional vents. Also, the passive system can be converted to an active system by installing new well heads which can be connected to a piping system which will connect to a blower. The blower will create a vacuum which will extract the LFG from the landfill. This reduces the pressure buildup of the LFG to prevent migration and potential groundwater contamination. Additional vertical wells can be installed to increase the effectiveness of the system.

Statistically significant increasing trends currently exist for the remaining COCs, vinyl chloride, cis-1,2-dichloroethene, and cobalt. If these increasing trends continue, the distribution of constituent concentrations will be evaluated to determine if quarterly monitoring and subsequent corrective actions are necessary.

# 7. SCHEDULE AND MAINTENANCE

Once the CAP is approved and a schedule has been finalized, implementation of the CAP will be initiated. An estimated schedule of tasks to be performed is provided below. The schedule assumes certain time frames for the regulator's review of submittals. Tasks and subtasks that are dependent on responses from the Section will be initiated after receipt of the Section's response. Per the North Carolina Solid Waste Management Rules, the Section has 90 days to complete their review of the submitted CAP and provide their comments.

The ACM Report has been submitted to the Section for approval, however, the selection process of the ACM has not yet been fully completed, pending meetings for public questions and input. Due to schedule requirements for submission of this CAP, alternatives for in-situ isolation combined with monitored natural attention (MNA) have been selected for completion of this plan. In-situ isolation was chosen because the site conceptual model indicates that water management issues are the primary mechanism for addressing the release and migration of the constituents of concern at the landfill. MNA has been incorporated into the facility's updated Water Quality Monitoring Plan to evaluate the effectiveness of the remedial measures. After completion of the ACM subsequent to the public meeting process, an addendum to this CAP will be submitted, if necessary, to reflect any changes based on public comments.

The first phase of the project involves the preparation, submittal, and review of this CAP. The second phase involves the ACM public meeting process and possible preparation, submittal, and review of an addendum to this CAP, if needed. The third phase of the project involves implementation of MNA in conjunction with in-situ isolation. The performance of the MNA and in-situ isolation program will be evaluated annually and will coincide with one of the groundwater and surface water compliance monitoring events conducted semi-annually at the landfill facility. In addition, the physical structures installed as part of the in-situ isolation program (i.e. barrier walls, monitor wells, trenches) will be evaluated quarterly and will coincide with the current quarterly methane and maintenance inspection monitoring. Groundwater elevation data will be collected from the facility's water quality monitoring network on a quarterly basis. This schedule will be revised periodically to reflect knowledge developed with the implementation of the monitoring program.

If the contingency plan is required, a schedule of response will be developed based on the appropriate activity needed. If a failure of the in-situ isolation program is observed, no immediate negative response would be anticipated and no emergency actions would be required. However, notification of the change in status will be provided immediately and a proposed plan of action will be developed within 30 days.

A proposed scheduled of activities from date of CAP approval (expected by the end of 2008) is as follows:

| | **Duration** | **Time from CAP Approval** |
|---|---|---|
| • Design and Specifications | 90 days | 90 days |
| • Specifications Out to Bid/ Pre-Bid Meeting | 60 days | 150 days |
| • Selection of Contractor(s) | 30 days | 180 days |
| • Installation of In-Situ Isolation Program<br>➢ Improve Diversion Ditches<br>➢ Install Barrier Wall<br>➢ Install Type II Monitor Wells<br>➢ Grade Cap<br>➢ Place Fill in Sedimentation Pond | 18 months – 36 months | 24 months – 42 months |
| • In-Situ Isolation Operation and Maintenance | Quarterly | N/A |
| • Collection of Groundwater Elevation Data | Quarterly | N/A |
| • Monitored Natural Attenuation (MNA) and Hydrogeological Monitoring | Annually | N/A |
| • Estimated Time Frame to Achieve Goals and Project Completion | Natural Attenuation Program and Performance Monitoring will be implemented until cleanup goals are achieved. | N/A |

# 8. FINANCIAL ASSURANCE

The County has prepared a written estimate, in current dollars, of the cost of hiring a third party to implement the Corrective Action Plan for the facility. The CAP cost estimate is based on the most expensive total costs of implementation of the proposed corrective measures and accounts for annual and periodic costs over the entire performance monitoring period.

The County shall annually adjust the CAP cost estimate for inflation within 30 days after the close of the local government's fiscal year and before submission of updated information to the Section.

The County shall increase the CAP cost estimate and the amount of financial assurance provided if changes in the CAP or facility conditions increase the maximum costs of the implementation of corrective measures.

The County may reduce the CAP cost estimate and the amount of financial assurance provided if the cost estimate exceeds the maximum remaining costs of corrective action. Prior to any reduction of the CAP cost estimate by the County, a written justification for the reduction shall be submitted to the Section. No reduction of the CAP cost estimate shall be allowed without the Section’s approval.

The capital costs for the implementation of the CAP in-situ isolation program will be approximately $700,000. The CAP costs for maintenance and monitoring of the landfill facility will be approximately $50,000 annually. The CAP costs for closure of the corrective actions will be approximately $35,000. The total CAP costs will be approximately $2,235,000 over a 30-year period.

# 9. COMPLETION OF CORRECTIVE ACTIONS

Because the MSW remains in place at the waste disposal unit and the MSW is covered by daily cover soils and the landfill cap, the proposed remedy is expected to continue for an extended period of time. At some future point, after the achievement of 2L Standards/GWPST, the monitoring program will be revised from MNA and into a long-term maintenance monitoring. Once the in-situ isolation program is no longer required, the effectiveness of the in-situ isolation structures (i.e. barrier walls, monitor wells, trenches) will be evaluated to determine if the structures require maintenance and can remain in-place or require removal.

# 10. REFERENCES

Department of Environment and Natural Resources, Division of Water Quality, *15A NC Administrative Code Subchapter 2B .0200 Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of NC,* August 2004.

Department of Environment and Natural Resources, Division of Water Quality, *15A NC Administrative Code Subchapter 2L .0200 Groundwater Quality Standards*, December 2005.

Department of Environment and Natural Resources, Division of Waste Management, *15A NC Administrative Code Subchapter 13B .1634(h) Solid Waste Groundwater Protection Standard, Solid Waste Management Rules*, November 2004.

Montgomery, John H., *Groundwater Chemicals, Second Edition Desk Reference*, CRC Press, Inc., 1996.

S&ME, Inc., *Alternate Source Demonstration Report, Edgecombe County Landfill*, June 10, 2008.

S&ME, Inc., *Assessment of Corrective Measures Report, Edgecombe County Landfill*, June 26, 2008.

S&ME, Inc., *Closure and Post-Closure Plan, Edgecombe County Landfill*, June 30, 2008.

S&ME, Inc., *Nature and Extent Study, Edgecombe County Landfill*, June 25, 2008.

S&ME, Inc., *Methane Monitoring and Corrective Action Report, Edgecombe County Landfill*, March 2002.

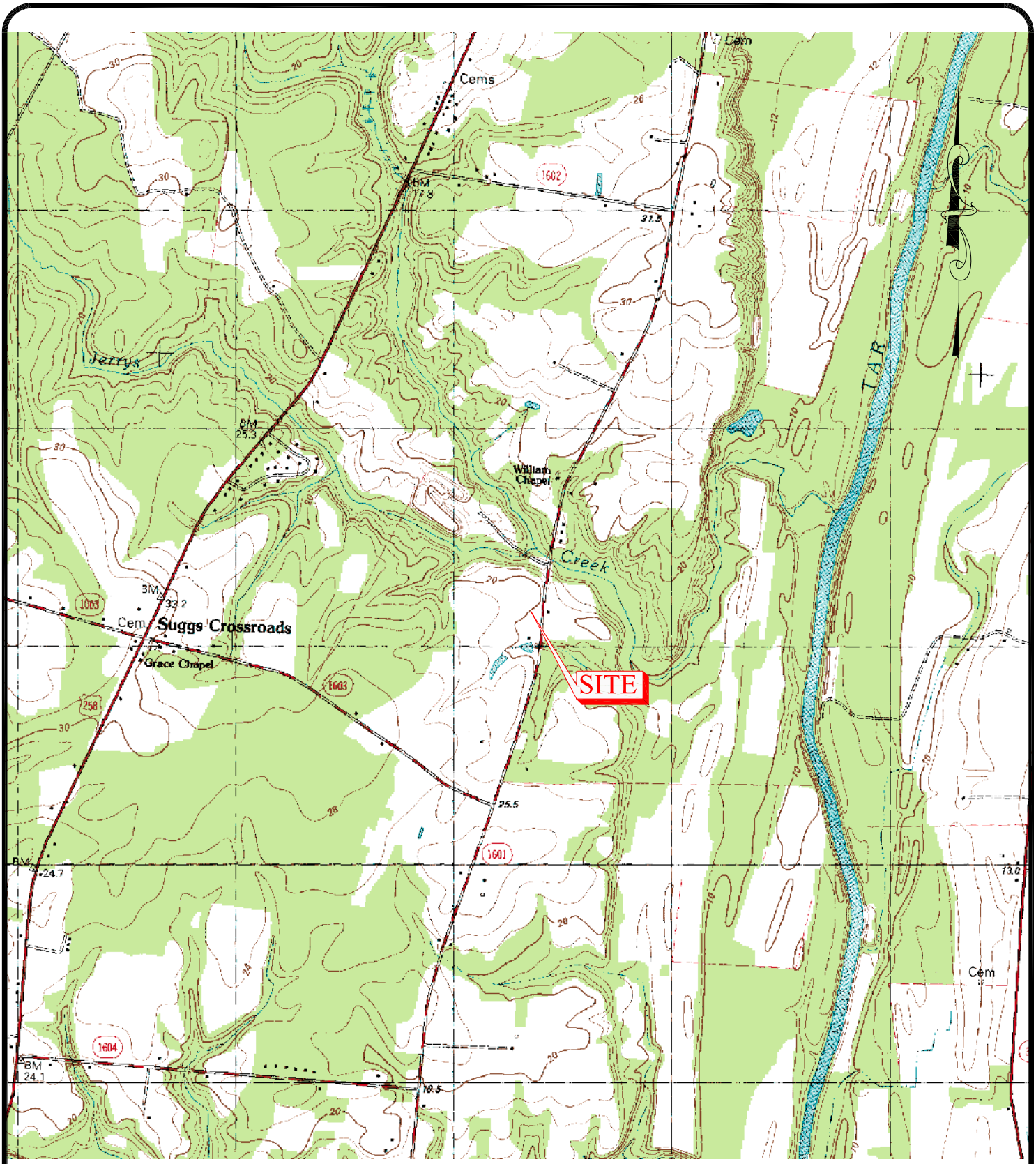
S&ME, Inc., *Response to Environmental Assessment Requirements, Edgecombe County Landfill*, June 2001.

S&ME, Inc, *Revision to the Sampling and Analysis Plan (SAP), Edgecombe County Landfill*, November 9, 1998.

S&ME, Inc., *Water Quality Monitoring Plan, Edgecombe County Landfill*, May 10, 1994.

US Department of Agriculture, Soil Conservation Service, *Soil Survey of Edgecombe County, NC*, November 1979.

FIGURES




TOPO SOURCE: NCGS DRG
OLD SPARTA, NC (035077G5) DATED 1981

A-1105

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|---|---|---|---|
| SCALE: 1" = 2,000' | S&ME WWW.SMEINC.COM | VICINITY MAP<br>CORRECTIVE ACTION PLAN<br>EDGECOMBE COUNTY LANDFILL<br>TARBORO, NORTH CAROLINA | FIGURE NO. |
| DATE: JUNE 2008 | | | 1 |
| DRAWN BY: | | | |
| PROJECT NO: 1054-07-241 | | | |

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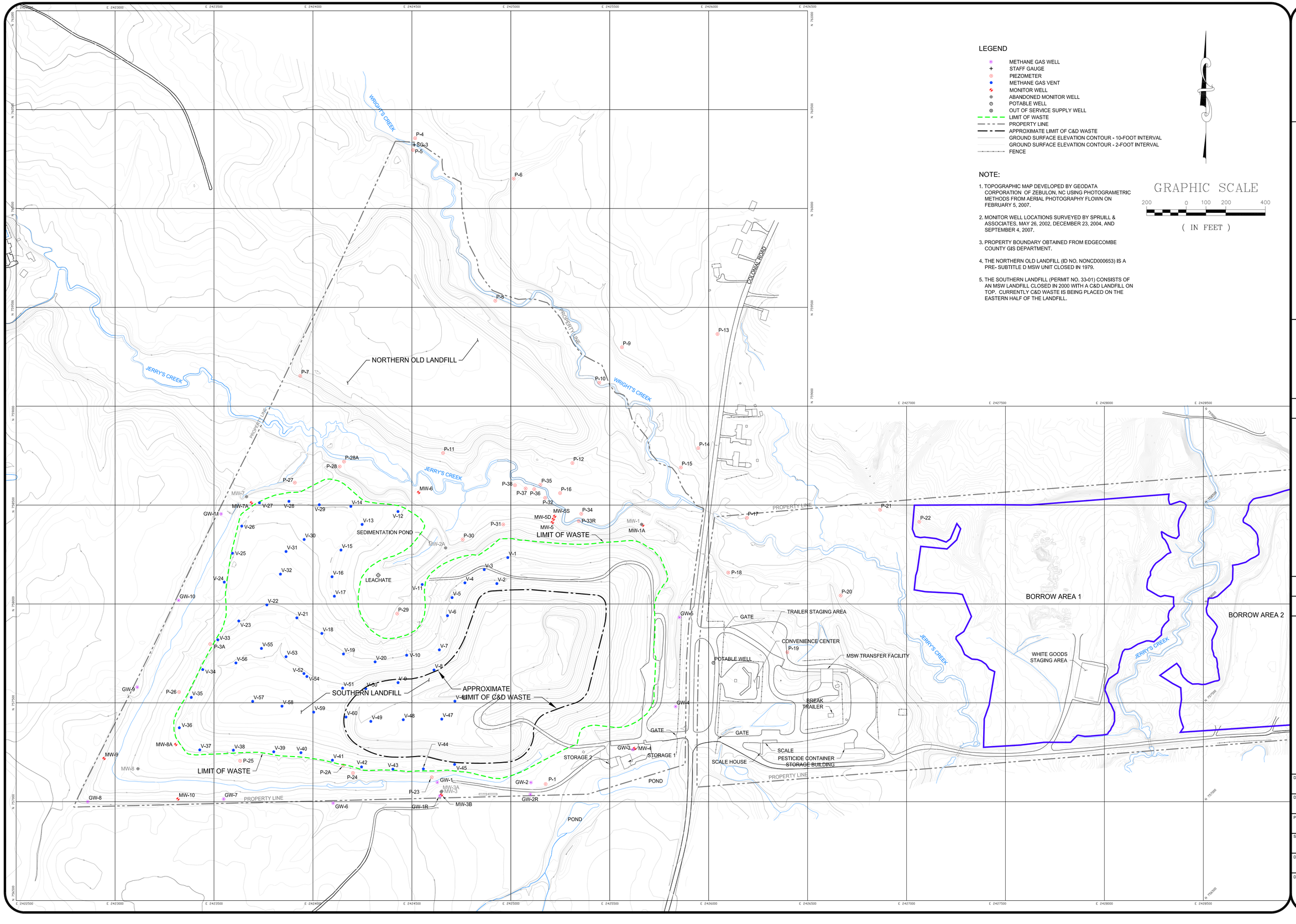


## LEGEND

- METHANE GAS WELL
- STAFF GAUGE
- PIEZOMETER
- METHANE GAS VENT
- MONITOR WELL
- ABANDONED MONITOR WELL
- POTABLE WELL
- OUT OF SERVICE SUPPLY WELL
- LIMIT OF WASTE
- PROPERTY LINE
- APPROXIMATE LIMIT OF C&D WASTE
- GROUND SURFACE ELEVATION CONTOUR - 10-FOOT INTERVAL
- GROUND SURFACE ELEVATION CONTOUR - 2-FOOT INTERVAL
- FENCE

## NOTE:

1. TOPOGRAPHIC MAP DEVELOPED BY GEODATA CORPORATION OF ZEBULON, NC USING PHOTOGRAMETRIC METHODS FROM AERIAL PHOTOGRAPHY FLOWN ON FEBRUARY 5, 2007.
2. MONITOR WELL LOCATIONS SURVEYED BY SPRUILL & ASSOCIATES, MAY 26, 2002, DECEMBER 23, 2004, AND SEPTEMBER 4, 2007.
3. PROPERTY BOUNDARY OBTAINED FROM EDGECOMBE COUNTY GIS DEPARTMENT.
4. THE NORTHERN OLD LANDFILL (ID NO. NONCD000653) IS A PRE- SUBTITLE D MSW UNIT CLOSED IN 1979.
5. THE SOUTHERN LANDFILL (PERMIT NO. 33-01) CONSISTS OF AN MSW LANDFILL CLOSED IN 2000 WITH A C&D LANDFILL ON TOP. CURRENTLY C&D WASTE IS BEING PLACED ON THE EASTERN HALF OF THE LANDFILL.

GRAPHIC SCALE

200 0 100 200 400

( IN FEET )

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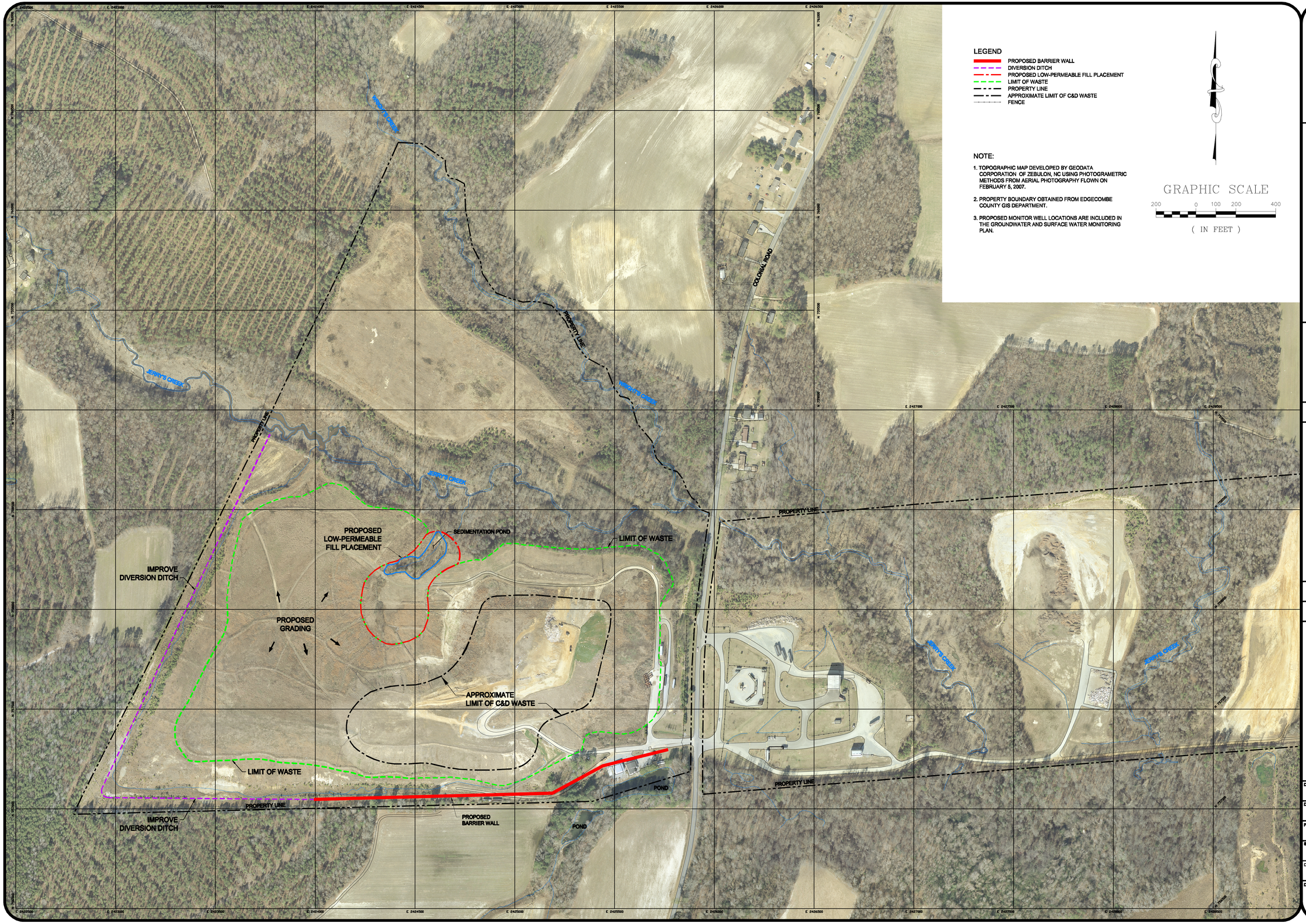
| NO. | DATE | DESCRIPTION | BY |
|---|---|---|---|

SITE MAP

CORRECTIVE ACTION PLAN
EDGECOMBE COUNTY LANDFILL
TARBORO, NORTH CAROLINA

| | |
|---|---|
| DRAWN BY: BTR | CHECKED BY: |
| DESIGNED BY: | APPROVED BY: |
| PROJECT NUMBER: 1054-07-241 | |
| SCALE: 1" = 200' | DATE: JUNE 2008 |
| DRAWING NUMBER: D-1029 | |
| DRAWING: 2 | OF: 3 |

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| NO. | DATE | DESCRIPTION | BY |
|---|---|---|---|

PROPOSED CORRECTIVE MEASURES

CORRECTIVE ACTION PLAN
EDGECOMBE COUNTY LANDFILL
TARBORO, NORTH CAROLINA

| | |
|---|---|
| DRAWN BY: BTR | CHECKED BY: |
| DESIGNED BY: | APPROVED BY: |
| PROJECT NUMBER: 1054-07-241 | |
| SCALE: 1" = 200' | DATE: JUNE 2008 |
| DRAWING NUMBER: D-1030 | |
| DRAWING: 3 | OF: 3 |

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