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SOLID WASTE SECTION
ASHEVILLE REGIONAL OFFICE

November 2, 2009

Mr. Allen Gaither
NCDENR – Solid Waste Section
Asheville Regional Office
2090 US Highway 70
Swannanoa, NC 28778

Fac/Perm/Co ID #	Date	Doc ID#
95-02	11, 5, 09	8876

**RE: Watauga County Solid Waste Management Facility, Permit No. 95-02
LCID Landfill Permit Application
Draper Aden Associates Job No.: 6520-48**

Dear Mr. Gaither:

On behalf of Watauga County, Draper Aden Associates respectfully submits a LCID Landfill Permit Application. A notified LCID Landfill currently exists on the Watauga County Solid Waste Management Facility. Watauga County wishes to expand the area to a LCID disposal area greater than two acres, thereby, requiring a formal permit application.

Please find two hard copies and one CD copy of the permit documents which include a narrative and nine drawing sheets. These documents are based on North Carolina Rule .0564 through Rule .0566.

If you have further questions or require additional information, please feel free to contact me on my direct line at (540) 557-1346.

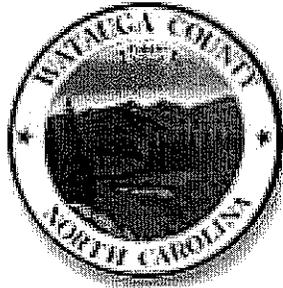
Sincerely,
DRAPER ADEN ASSOCIATES

Susan Estes, P.E.
Staff Engineer

Attachments

- cc: Mr. Rocky Nelson, Watauga County Manager
- Mr. J.V. Potter, Watauga County Operations Services Director
- Mr. Jeff Crate, P.G., Director, Waste Resource Engineering, Draper Aden Associates
- Mr. Mike Cavell, P.E., Draper Aden Associates

PERMIT SUBMITTAL
FOR
LAND CLEARING AND INERT DEBRIS LANDFILL
WATAUGA COUNTY SOLID WASTE FACILITY
PERMIT # 95-02



Prepared for:

North Carolina Department of Environment and Natural Resources

Prepared by:

Draper Aden Associates
2206 South Main Street
Blacksburg, VA 24060

DAA JN 6520-48

October 15, 2009



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I. INTRODUCTION

A. Permit requirements

Rules .0560 - .0566 of Title 15A Subchapter 13B of the North Carolina Administrative Code (15A NCAC 13B) cover the siting, design, and permitting requirements of land clearing and inert debris landfills as regulated by the North Carolina Department of Environment and Natural Resources (DENR) – Division of Solid Waste. A land clearing and inert debris landfill is defined as, “*a facility for the land disposal of land clearing waste, concrete, brick, concrete block, uncontaminated soil, gravel and rock, untreated and unpainted wood, and yard trash.*”

In accordance with Rule .0563(1), all land clearing and inert debris landfill (LCID) facilities are required to obtain a permit to construct and operate the facility unless all the following requirements are met:

- 1. The facility is to be operated for the disposal of land clearing waste, inert debris, untreated wood, and yard trash. Operations must be consistent and in compliance with the local government solid waste management plan as approved by the Division of Solid Waste Management.*
- 2. The total disposal area is less than 2 acres in size.*
- 3. The facility and practices comply with the siting criteria under Rule .0564 and operational requirements of Rule .0566.*
- 4. The fill activity is not exempt from, and must comply with all other Federal, State, or Local laws, ordinances, Rules, regulations, or orders including but not limited to zoning restrictions, flood plain restrictions, wetland restrictions, sedimentation and erosion control requirements, and mining regulations.*

In 1998 Watauga County closed their municipal solid waste (MSW) landfill which was permitted to handle a wide variety of materials and constructed an LCID disposal area that was less than 2 acres in size to handle a portion of the demolition waste. The proposed expansion of the LCID area will increase the acreage to greater than 2 acres in which case Watauga County must permit the facility in accordance with Rule .0563 (3) with the permit not issued for more than five years.

B. Watauga County LCID Landfill Organization

The solid waste program for Watauga County is operated as an enterprise fund. This means that the program must be or work towards being self-sufficient without need for money from the general fund of the County. Because of the financial requirements for independence, the operations are conducted as a business and all activities continuously assessed for efficiency and cost effectiveness. The program is organized as follows:

- 1. The Watauga County Board of Commissioners has ultimate control of all activities and makes the final decisions on all appropriated funding. They approve the program budget, approve all major expenditures including equipment*

and disposal contracts and all bid awards. In addition, they can evaluate personnel and make changes as necessary although they leave this role primarily up to the County Manager and Operations Manager. The Board is not involved in day-to-day decisions. The Board is contacted through the County Manager.

2. The County Manager works for the Board of Commissioners and provides them with the necessary information for their decisions. The County Manager oversees the Operations Manager and evaluates all operational requests prior to taking the request to the Board. The County Manager may be involved in day-to-day decisions of the operations but defers to the Operations Manager. The County Manager can be reached at 1-828-265-8000.
3. The Operations Manager works for the Board of Commissioners and answers directly to the County Manager. The Operations Manager oversees daily operations of the solid waste management program, oversees collection of the waste from the County's convenience sites, develops the annual budget, makes recommendations on tipping fees, hires and evaluates the operating personnel, evaluates and recommends equipment purchases, develops bid packages, works with engineering consultants, maintains compliance with State regulations and develops new programs as directed by the Board. In addition, the Operations Manager may be trained to operate equipment and/or to repair equipment. This individual is involved in all day-to-day decisions. The Operations Manager can be reached at 1-828-264-5305.

The physical address of site is the following:

Watauga County Solid Waste Management Facility
336 Landfill Road
Boone, North Carolina 28607

The mailing address for the facility is the following:

Watauga County Solid Waste Director
842 West King Street, Suite 1
Boone, North Carolina 28607-3525

C. Siting Requirements

The siting criteria for a LCID landfill as established under Rule .0654 are listed below in italics with the actual condition existing at the Watauga facility following.

- 1) *Facilities or practices, shall not be located in a 100 year flood plain*

The Flood Hazard Map included in Appendix A indicates that the area in question is outside the 500 year flood plan.

- 2) *Facilities or practices shall not cause or contribute to the taking of any endangered or threatened species of plants, fish or wildlife.*

The area in which the Facility is located was originally used for borrow material for the now closed municipal solid waste landfill. There are no endangered species to affect as the area was stripped over 5 years ago of vegetation etc. for operations.

- 3) *Facilities or practices shall not result in the destruction or adverse modification of the critical habitat of endangered or threatened species*

The area in which the Facility is located was originally used for borrow material for the now closed municipal solid waste landfill. There are no endangered species to affect as the area was stripped over 5 years ago of vegetation etc. for operations.

- 4) *Facilities or practices shall not damage or destroy an archeological or historical site.*

The area in which the Facility is located was originally used for borrow material for the operating landfill. There were no known archeological or historical sites discovered during these operations.

- 5) *Facilities or practices 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.*

The Facility is not located near a state park, recreation or scenic area, or any other lands included in the state nature and historic preserve.

- 6) *Facilities shall not be located in any wetland as defined in the Clean Water Act, Section 404(b).*

The Facility is not located in any wetland as defined in the Clean Water Act, Section 404(b).

- 7) *It must be shown that adequate suitable soils are available for cover, either from on or off site.*

The current borrow area is adjacent to the LCID site. As of this submittal the area is nearly depleted. Another on-site borrow area is located near the old demolition landfill area. This site will provide approximately 29,000 cubic yards of cover material. This soil quantity is enough to satisfy the cover requirements for the life of the LCID landfill. See the existing conditions sheet for a map of the borrow area.

8) *Land Clearing and Inert Debris landfills shall meet the following surface and ground water requirements:*

(a) Facilities or practices shall not cause a discharge of pollutants into waters of the state that is in violation of the requirements of the National Pollutant Discharge Elimination System (NPDES), under Section 402 of the Clean Water Act, as amended.

The stormwater from the Facility drains to an existing sediment pond prior to discharge off site. The Facility will operate under a Stormwater Pollution Prevention Plan (see copy of document in Appendix F, submitted to the Department of Environmental and Natural Resources on October 14, 2009).

(b) Facilities or practices shall not cause a discharge of dredged materials or fill material into waters of the state that is in violation of the requirements under Section 404 of the Clean Water Act, as amended.

The operational soil stockpiles have the appropriate E&S controls. There are no dredged materials or fill materials associated with the LCID landfill activities.

(c) Facilities or practices shall not cause non-point source pollution of waters of the state that violates assigned water quality standards.

Run-off from landfilling activities are controlled through operations and ultimately flows through a sediment pond prior to discharge off site.

(d) Waste in landfills with a disposal area greater than two acres shall be placed a minimum of four feet above the seasonal high water table, except where in alternative separation is approved by the Division.

Appendix C includes a groundwater potentiometric map dated September 16, 2009. Ground water ranges from 4' to 25' below the ground surface. In addition, boring logs from B-17, B-18 and B-22 demonstrate the type of soils found in the area of the LCID landfill. These are also known as PZ-17, PZ-18 and PZ-22.

(e) Waste in landfills with a disposal area less than two acres shall be placed above the seasonal high water table.

Not applicable. The Facility site is greater than two acres.

9) *The facility shall meet the following minimum buffer requirements:*

(a) 50 feet from the waste boundary to all surface waters of the state as defined in G.S. 143-212.

The Facility is approximately 100' from an unnamed tributary of the New River, 800' from Rocky Branch and 2,400' from the New River.

(b) 100 feet from the disposal area to property lines, residential dwellings, commercial or public buildings, and wells.

The Facility disposal area is at least 100' from property lines, residential dwellings, commercial or public buildings, and wells.

(c) Buffer requirements may be adjusted as necessary to insure adequate protection of public health and the environment.

The Facility is 100' from the northwest property line. The facility cannot be moved as it is bounded on the south by the Transfer Station and Convenience Center, on the northeast by the Mulching Operation area. The northwest property line is wooded and there is a significant buffer between the Facility and any off-site facilities. No complaints have been received from nearby property owners relative to the operations.

10) The facility shall meet all requirements of any applicable zoning ordinance.

The Watauga County Landfill property is not zoned.

D. Local Government Approval

The Watauga County Landfill property is not zoned. A copy of a letter from Watauga County is contained in Appendix B. A copy of the deed for the property is included in Appendix B.

E. Location Relative to High Water Table

Appendix C includes a groundwater potentiometric map dated September 16, 2009. Ground water ranges from 4' to 25' below the ground surface.

II. FACILITY INFORMATION

A. Location of LCID landfill

The Watauga County LCID landfill operation is located within the original permit area of the Watauga County Solid Waste Management Facility site as illustrated on the Site Map included in Appendix A. An overall site location map of the Facility is also included in Appendix A.

B. Design Capacity

The total acreage of the Watauga County LCID Landfill is approximately 4.23 acres. The Landfill is divided into three phases. Phase 1 is the current LCID landfill and occupies 1.95 acres of the site. With this expansion, Phase 1 will increase in size to 2.23 acres. Phase 2 will be the next phase developed and will occupy 0.72 acres of the site. The final phase, Phase 3, will occupy 1.28 acres.

The total capacity of the expanded portion of the Watauga County LCID Landfill adds approximately 90,850 cubic yards. This capacity is for the full build-out of Phases 1 through 3. The disposal capacity of the Landfill expansion is approximately 84,090 cubic yards. This figure does not include the 1 foot-thick cover soil layer over the landfill which is calculated to be approximately 6,760 cubic yards

III. PERSONNEL

A. Manpower

An operator is assigned to handle LCID waste at the Facility as part of his duties at the Facility. This operator is not stationed at the LCID site on a full-time basis as waste materials are delivered sporadically. When LCID materials are processed through the scale house, an operator is notified to travel to the LCID site to oversee the unloading.

B. Training

Training is available for employees from many sources. Solid waste trade and professional associations sponsor seminars and training at low or no cost. One such training seminar is the Manager of Landfill Operations program conducted by the Solid Waste Association of North America (SWANA). Watauga County participates in this program and enters key personnel for certification.

The American Red Cross, Fire Department and National Safety Council can provide first aid, fire and vehicle safety information. Equipment manufacturers are a source of information on equipment operation.

New and current employees are expected to be cross-trained on all aspects of the operation of the Watauga County facility. As such, personnel are given classes concerning the various operations, vehicles, equipment and software packages utilized by the Facility.

IV. OPERATIONAL REQUIREMENTS

A. Site Access

1. Hours of Operation

The Watauga County LCID landfill accepts waste during these hours of operation:

Monday through Friday:	8:00 AM to 4:00 PM
Saturday:	8:00 AM to 12:00 PM
Sunday:	closed

All traffic for the facility crosses the scales at the entrance to the Facility. The scale house attendant directs traffic to the appropriate facility on the site.

2. Traffic Routing

The access road will be graded and graveled as necessary to minimize safety concerns, minimize dust and to minimize mud tracked onto the main landfill road.

Signs identifying the Owner and operator, listing acceptable materials, and providing emergency phone numbers are placed at the entrance to the site before the scales.

The site is secured at night by the entrance gate.

3. Inclement Weather

A gravel-surfaced area is currently maintained at the LCID area for off-loading during inclement weather. The area will be resurfaced and maintained periodically as required.

B. Filling Operation

After material is unloaded by the customer, the operator will push the material into position in the landfill. As the material is being pushed into place, an additional inspection of the waste will be made to assure that unacceptable waste is not included in the materials. If unacceptable material is found, it will be segregated from the acceptable waste and removed from the area to the transfer station or other acceptable handling facility. The material will be covered with periodic cover on an as-needed basis.

The working face of the LCID landfill shall be restricted to the smallest possible area feasible and compacted as densely as practical into the landfill cell.

Adequate soil cover shall be applied monthly, or when the active area reaches one acre in size, whichever occurs first.

C. Waste Handling

The facility receives mostly inert debris as the woody vegetative material is handled by the mulching operation. Material is delivered by commercial and private haulers who must pass over the facility scales.

1. Control Program for Unauthorized Waste

The Facility shall only accept the solid wastes which it is permitted to receive. All LCID landfill traffic must cross the Facility scales. The scale house attendant visually checks for unauthorized waste and redirects the generator/hauler as appropriate. Hazardous waste and liquids are not accepted. If the material is found to be acceptable through discussion of its origination and a visual inspection, it is delivered to the landfill and dumped at the location indicated through signage and/or by the operator.

2. Acceptable and Non-Acceptable Wastes

The list of wastes accepted at the LCID landfill is as follows:

- stumps,
- trees,
- limbs,
- brush,
- other naturally occurring vegetative material.
- concrete,
- brick,
- concrete block,
- uncontaminated soil,
- asphalt,
- gravel,
- rock,
- untreated, unpainted wood such as pallets

D. Compaction and Cover

The County will push the material into position in the landfill and compact to the greatest extent possible. Adequate soil cover shall be applied monthly, or when the active area reaches one acre in size, whichever occurs first. The working face of the landfill will be kept as small as possible and compacted as densely as practical to minimize erosion control issues and maximize landfill capacity.

E. Equipment

A dozer and a loader are assigned to the facility for movement and compaction of waste materials and placement/spreading of cover soil. A tracked excavator is sometimes used for moving material. Additional vehicles available for use in landfill operations include a backup loader, recycling truck and trash truck.

F. Open Burning

Open burning is not permitted at the Watauga County Solid Waste Management Facility.

G. Placement of Waste in State Waters

Deposits of solid wastes, wind-blown wastes, leachate, or other sources of waste contamination in State waters are strictly prohibited.

H. Safety

A copy of the Emergency Contingency Plan which describes the safety precautions in place at the Watauga County LCID landfill can be found in Appendix IV.

I. Inspection Plan

Periodically, the Landfill Supervisor should evaluate the overall landfill operations. A monthly evaluation of the general site conditions should look for problems with routine operations. A checklist is included in Appendix E. Any deficiencies can be incorporated into a "punch list" for further action. Items appearing for more than two months should trigger a more detailed look at that portion of the operation. Twice yearly, the landfill should be evaluated in detail. After the evaluation, a plan to correct any deficiencies should be developed.

In addition, other items should be inspected regularly. These include:

1. Security Control Devices

The security control devices include the gate and lock at the entrance and the fence surrounding the facility. The gate and lock should be inspected daily, the fence surrounding the facility quarterly. Any damage that would interfere with the function of the devices should be immediately corrected.

2. Safety and emergency equipment

Safety equipment includes the following:

1. Hand-held Fire Extinguishers: inspected monthly,
2. First Aid Kits: inspected quarterly for dated or contaminated products,

- and
3. Communications Systems: checked daily.

3. Incoming Wastes

The Scalehouse Attendant shall check incoming LCID loads for any unacceptable wastes. Those not permitted into the LCID landfill will be turned away or directed to the Transfer Station. If the Scale Clerk does not recognize the hauler, the load will be visually inspected if possible before the vehicle is allowed onto the facility. Enclosed containers cannot be inspected at the scalehouse. The scalehouse attendant will contact the operator before releasing load to the working face. These shall be checked at the working face of the LCID landfill.

Even though there are wastes which are prohibited at the landfill and the prohibition is posted at the entrance, some small quantities of prohibited waste may unknowingly get into the LCID landfill. The personnel working at the scalehouse and the operator should be aware of the more common items they might find and how to handle those items. The items shall be removed from the working face if found.

Waste will consist of only those materials that are considered acceptable for an LCID facility. Wastes will come from businesses and private citizens from within Watauga County only.

J. Closure

1. Closure activities

On or before 120 calendar days after completion of any phase of disposal operations, or upon revocation of a permit, the disposal area shall be covered with a minimum of one foot of suitable soil cover sloped to allow surface water runoff in a controlled manner. The soil cover will be fertilized, limed and seeded. Erosion control matting will be applied to assist in achieving stabilization. Further actions in order to correct any condition which is or may become injurious to the public health or a nuisance to the community may be required by DENR.

2. Post closure activities

Due to the non-putrescible nature of LCID waste, it is anticipated that the post-closure activities for the LCID landfill will not extend beyond cover/site maintenance. Once the LCID landfill is closed, the site will be stabilized with vegetation. Erosion and sediment control measures will be monitored and maintained throughout the post closure care period.

Groundwater and gas monitoring for the LCID landfill is not necessary due to the nature of the waste disposed at the landfill.

Under post closure care, the County shall maintain the closure cap on the LCID landfill as necessary. It is important that the vegetative cover be retained in a good condition and this task is accomplished through reseeding, liming and mowing. The LCID landfill will have a soil cap. The grass on the LCID landfill shall be mowed once a year. In addition, the access roads into and on the facility caps, and the stormwater conveyance system shall be maintained in good condition. These facilities shall be inspected periodically and repaired as necessary.

The LCID landfill property will be maintained as open space after completion of closure activities.

V. CONTROL AND MONITORING OF LIQUIDS AND GASES

A. Drainage and Erosion Control Systems

Adequate erosion control measures, structures, or devices shall be utilized to prevent silt from leaving the site and to prevent excessive on-site erosion. Surface water shall be diverted from the working face and shall not be impounded over the waste. The County addresses these erosion control issues in several ways as follows:

- A sediment pond which captures the runoff from the facility
- Stone filters
- Seeding
- Silt fence
- Proper road and culvert maintenance
- Stormwater conveyance channels and diversions

A ground cover sufficient to restrain erosion will be accomplished within 30 working days or 120 calendar days upon reaching final grade of any phase of the landfill development.

The following maintenance schedule is suggested for erosion and sedimentation control, but it represents a minimum. Inspection and repair should be increased as necessary:

- **Sediment Pond**

The sediment pond will be inspected after each major rainfall to determine if any repairs are needed. If repairs are needed they will be completed as soon as possible. In addition, the County will monitor the depth of sediment in the ponds and schedule cleanout as necessary. Typically, when a pond is 50% full, it should be cleaned out. Sediments from the pond can be placed on land to drain provided that there is not waste beneath the drying area and provided that the runoff from the drying area will be directed back into the sediment pond. The sediment once sufficiently dry can be used as cover in the LCID landfill or can be seeded in place. As a precautionary measure, the County may consider installing silt fence around the drying area.

The condition of the outlet structure should also be evaluated periodically to assure that the structure has not become clogged with debris or structurally compromised. If problems are noted, the County will schedule repairs as appropriate.

- **Stone Filters**

The stone filters are located at the low point of each of the cells and serve to detain the stormwater runoff from the landfill cells to allow for settlement of

sediment. These filters shall be checked quarterly and after every major storm event, repaired immediately and stone replenished as necessary.

- **Working face**

The working face shall be managed to discourage stormwater run-on and sediment run-off. The BMPs used to manage the stormwater include temporary diversion dikes, rock check dams, and surface grading.

The working face shall be observed on a daily basis and thoroughly inspected on a quarterly basis. Any erosion damage shall be repaired immediately and measures taken to eliminate reoccurrence.

- **Stockpiles**

The soil stockpile areas shall be managed to discourage stormwater run-on and sediment run-off. The BMPs used to manage the stormwater include temporary diversion dikes, rock check dams, and surface grading.

The stockpile areas shall be observed on a regular basis and thoroughly inspected on a quarterly basis. Any erosion damage shall be repaired immediately and measures taken to eliminate reoccurrence.

- **Storm water conveyance channels/Diversion ditches/Roadside ditches**

During the initial establishment, grass-lined channels should be inspected quarterly and after every major storm event, repaired immediately and grass reestablished as necessary. After grass has become established, the channel should be checked periodically to determine if the grass is remaining viable. The channels should be mowed periodically, being sure that the grass cover is protected from damage. It is particularly important to check the channel outlet and all road crossings for bank stability and evidence of piping or scour holes. All significant sediment accumulation should be removed to maintain the designed carrying capacity.

Riprap channels shall be inspected quarterly and after every major storm event and repaired or cleaned as soon as possible.

- **Matting**

Matting may be used in areas with slopes greater than 3:1 susceptible to erosion in conjunction with seeding. Areas which have been matted will be inspected after each rainfall for the first year to assure that erosion rills do not develop under the matting. If they do, the matting will be stripped back, the area regraded and reseeded. A check will also be made to determine where water is entering and repairs made accordingly.

All erosion control installation, inspection, and maintenance shall be completed in accordance with the North Carolina Erosion and Sediment Control Handbook, latest edition.

- **Seeding**

Disturbed areas unused for longer than 7 days will be stabilized with temporary seeding in accordance with the NC Erosion and Sedimentation Control Manual. For areas which have either reached final grade or not used in 30 days shall have permanent seeding applied. Prior to seeding, the soil shall be tested for nutrient and pH levels. Fertilizer and lime shall be added according to test results. Seeding shall be accomplished per the NC Erosion and Sediment Control Manual.

If timing for permanent seeding is inappropriate, temporary seeding per the manual shall be used with mulch. Annually all seeded areas will be inspected and a maintenance plan prepared as necessary.

- **Silt Fences**

Silt fences will be installed as necessary at the LCID landfill or during cleanout of the sediment basin. Silt fences shall be inspected after each rainfall and daily during a prolonged rainfall event. Repairs will be made as soon as practical. Should the fabric on a silt fence decompose or become ineffective prior to the end of the expected usable life, the fabric shall be replaced promptly. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier. Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, prepared and seeded.

Calculations for the diversion ditches and sediment pond can be found in the Erosion and Sediment Control Plan under separate cover.

B. Environmental Control Systems

The nature of the waste disposed at the LCID landfill is inert and nonputrescible. As such, leachate generation, groundwater impacts and landfill gas production is not expected.

1. Leachate Collection System

Leachate shall be properly managed through the use and maintenance of best management practices for stormwater control. Stone filters similar to those used in sediment traps will be installed at locations where runoff leaves the LCID cells.

The sediment basin collects all drainage from the LCID area before it leaves the property.

2. Groundwater Monitoring System

Because of the inert, nonputrescible nature of the materials received at the LCID landfill, it is not anticipated the LCID landfill will have an impact on the site groundwater. While not specific to the operation of the LCID landfill, the LCID landfill is within a Solid Waste Management Facility which is covered by a Groundwater Monitoring System.

3. Gas Collection and Monitoring Systems

Because of the inert, non putrescible nature of the materials received at the LCID landfill, a gas collection and monitoring is not believed to be necessary.

4. Surface Water Monitoring

The LCID landfill is a part of the Watauga County Solid Waste Management Facility. The SWM Facility conducts surface water monitoring in accordance with the Watauga County Landfill Assessment Plan (DAA, September 3, 1993) and the Remedial Investigation and Alternatives Report (DAA, January 12, 1996). These programs include monitoring points adjacent to the LCID landfill; therefore, any potential surface water constituents will be detected.

VI. RECORDS

A. Recordkeeping and reporting

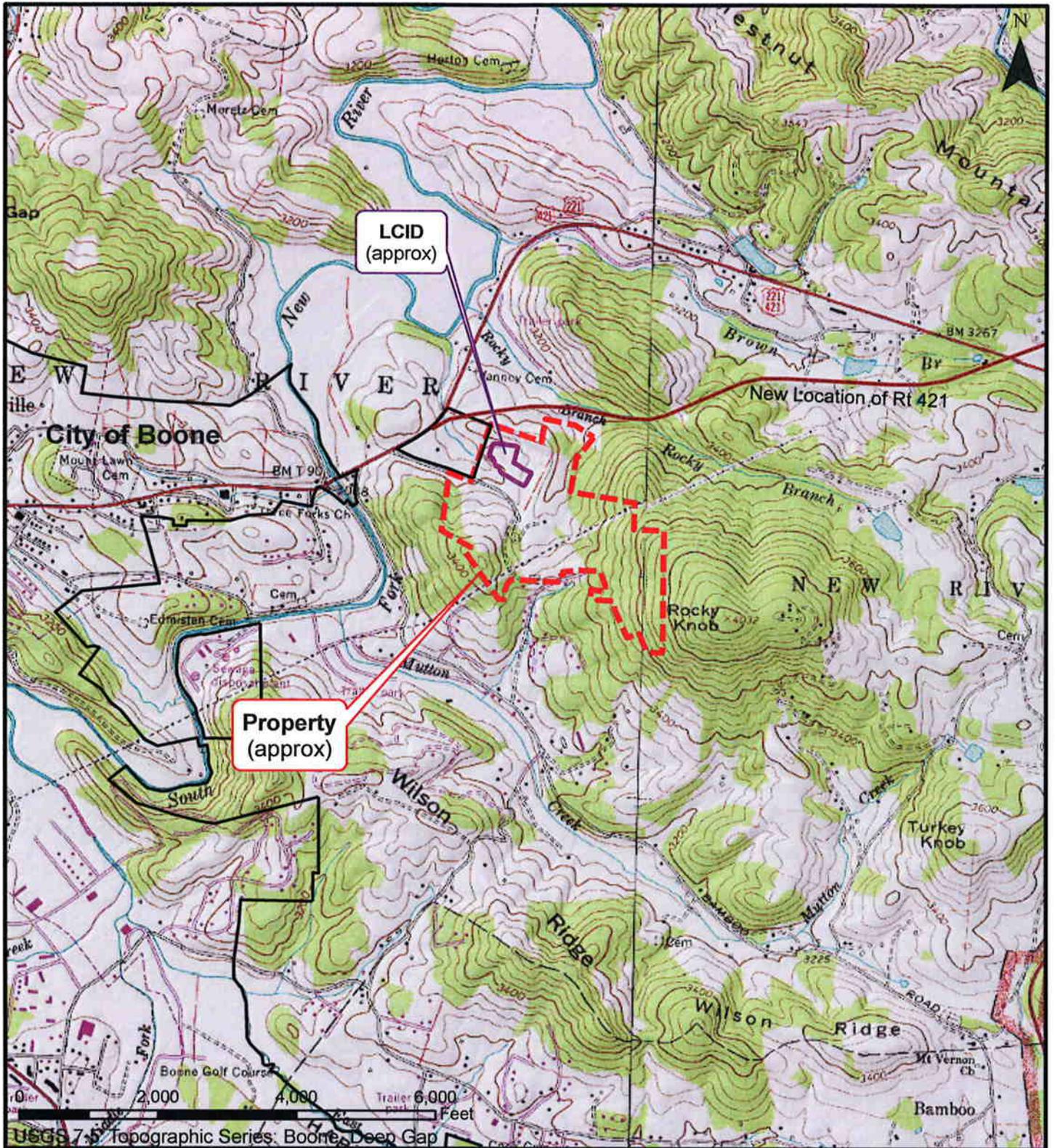
All incoming waste is weighed. Records of the materials are kept at the scale house.

Annually by August 1 of each year, the County will submit a report to DENR summarizing the activities at the LCID landfill from July 1(of the previous year) to June 30.

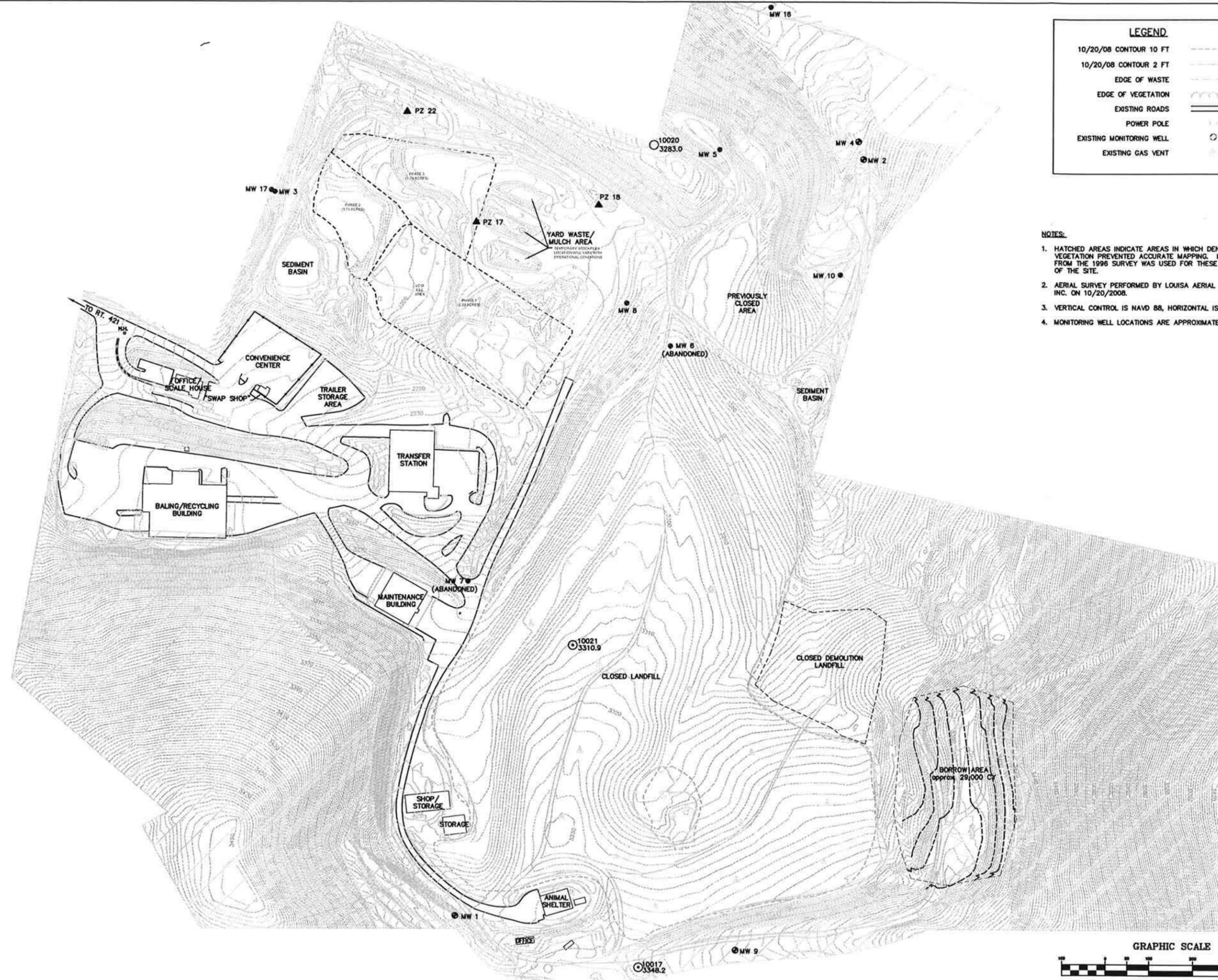
APPENDIX A

SITE & FACILITY MAPS

1. Vicinity Map
2. Site Map
3. Flood Map



Site Location Watauga County Solid Waste Facility Permit #95-02 Watauga County, North Carolina		SCALE 1" = 2000' PLAN NO. 6520-48	
 Draper Aden Associates Engineering • Surveying • Environmental Services 2206 South Main Street Blacksburg, VA 24060 540-552-0444 Fax: 540-552-0291		DESIGNED SE DRAWN MF CHECKED LK DATE 10-06-09	
Richmond, VA Charlottesville, VA Hampton Roads, VA		FIGURE 1	



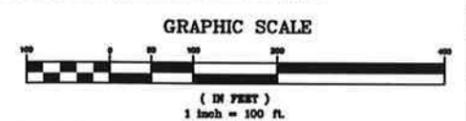
LEGEND	
10/20/08 CONTOUR 10 FT	
10/20/08 CONTOUR 2 FT	
EDGE OF WASTE	
EDGE OF VEGETATION	
EXISTING ROADS	
POWER POLE	
EXISTING MONITORING WELL	
EXISTING GAS VENT	

- NOTES:**
1. HATCHED AREAS INDICATE AREAS IN WHICH DENSE VEGETATION PREVENTED ACCURATE MAPPING. INFORMATION FROM THE 1996 SURVEY WAS USED FOR THESE PORTIONS OF THE SITE.
 2. AERIAL SURVEY PERFORMED BY LOUISA AERIAL SURVEYS, INC. ON 10/20/2008.
 3. VERTICAL CONTROL IS NAVD 88, HORIZONTAL IS ASSUMED.
 4. MONITORING WELL LOCATIONS ARE APPROXIMATE.

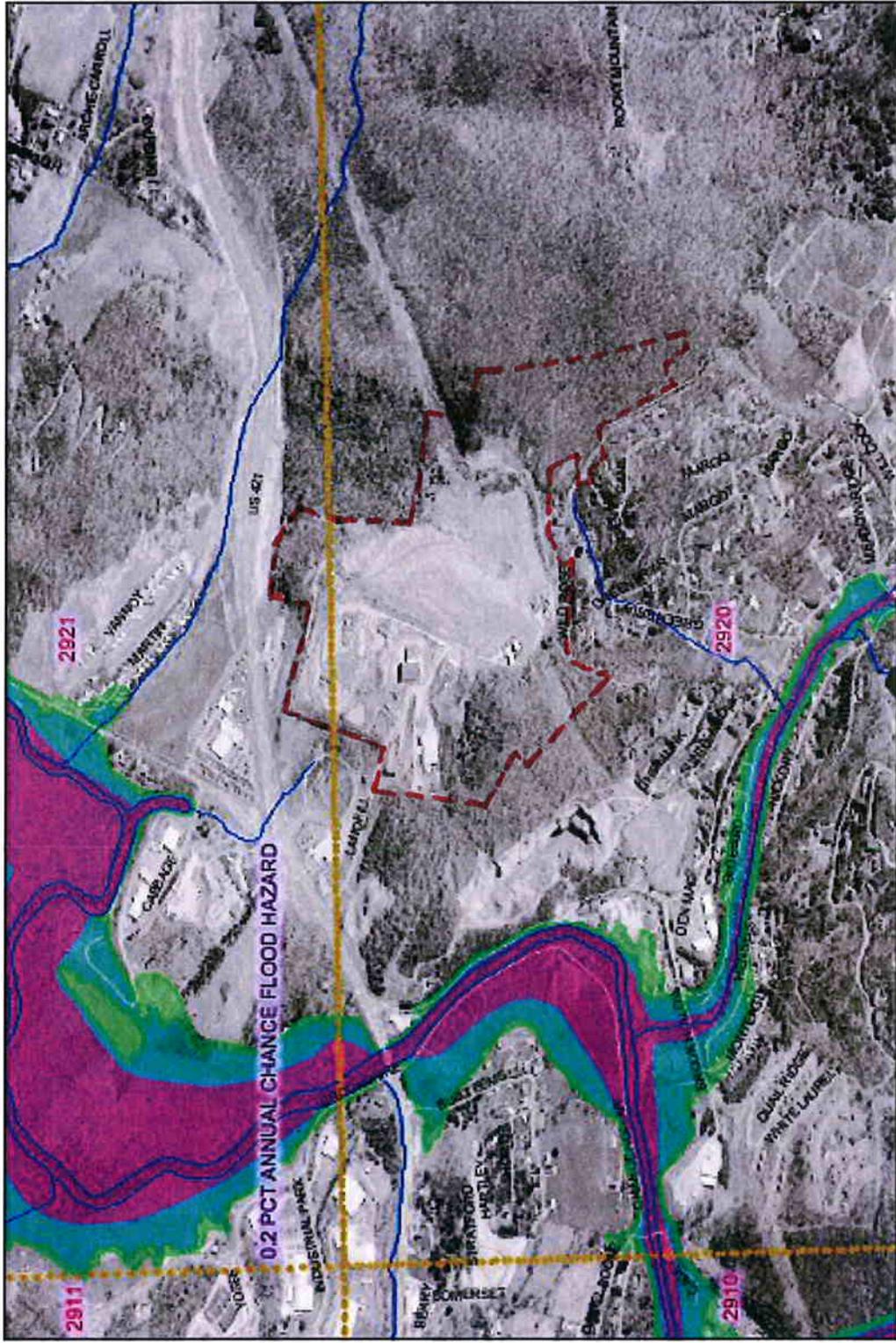
Draper Aden Associates
 Engineering • Surveying • Environmental Services
 Blacksburg, VA
 2206 South Main Street
 Blacksburg, VA 24060
 540-552-0291
 www.daa.com

SITE MAP
LCID LANDFILL PERMIT APPLICATION
WATAUGA COUNTY SOLID WASTE FACILITY
 WATAUGA COUNTY, NC

REVISIONS	
DESIGNED BY:	N/A
DRAWN BY:	KJS
CHECKED BY:	MAC
SCALE:	1" = 100'
DATE:	OCTOBER 5, 2009
PROJECT NUMBER:	6520-48
FIG 2	



FILE: 05022009.DWG DATE: 10/05/09 11:00 AM PLOT: 10/05/09 11:00 AM



- 100yr Flooding - Has SFEs (AE)
 - 100yr Flooding - Floodway (AE)
 - 100yr Flooding - No SFEs (A)
 - 100yr Flood - Velocity Zone (V or VE)
 - 100yr Shallow Flooding (AO or AH)
 - 100yr Future Conditions Flooding (X Future)
 - 500yr Flooding (Shaded X)
- DFIRM Grid
 - Cross Sections
 - Rivers and Streams
 - Coastal Sounds
 - Coastal Barrier Resource
 - Systems (CBS)
- Major Cities
 - Urban Areas
 - Extm Territorial Jurisdictions
 - Interstate Highway
 - US Highway
 - NC Highway
 - Roads
- Benchnarks
 - Transects
 - Parks, Game land, Forests, Reserves and Open Space
 - Landfill Property Boundary

APPENDIX B

LOCAL GOVERNMENT DOCUMENTS

1. Local Government Approval Letter
2. Copy of Property Deed



WATAUGA COUNTY

331 Queen Street Suite A • Boone, North Carolina 28607

Department of
Planning & Inspections

Phone (828) 265-8043
TTY 1-800-735-2962
Voice 1-800-735-8262
or 711
FAX (828) 265-8080

July 8, 2009

RE: Zoning certification

Ms. Susan Estes
Draper Aden Associates
2206 South Main Street
Blacksburg, Va. 24060

Dear Ms. Estes,

It is my understanding that you are preparing an application for the County to expand its LCID landfill, and for that purpose you need a zoning certification. This is to certify that there is no zoning in effect for the landfill area. If you need further information, please let me know.

Sincerely,

Joseph A. Furman, AICP
Director

BOOK 0252 PAGE 739

FILE NO. _____

FILM NO. _____

NORTH CAROLINA
WATAUGA COUNTY

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION

WATAUGA COUNTY,
Plaintiff

MEMORANDUM OF ACTION CONDEMNATION

VS.

CLOYD S. BOLICK and wife,
ROSE R. BOLICK; and W. O.
MCGIBONY, Trustee under the
Deed of Trust in Deed of
Trust Book 97 at Page 643;
and RICHARD HAYES AND DALE
HAYES, Lessees under Lease
recorded in Deed Book 247 at
page 521; and LOWE FORD, Lessee
under Lease recorded in Deed
Book 247 at Page 523,

Defendants

TAKE NOTICE:

1. On the 7th day of September, 1984, the County of Watauga duly instituted the above captioned civil action in the Superior Court of Watauga County, North Carolina, condemning an interest in your property pursuant to the provisions of North Carolina General Statutes 40A.

2. The Condemnor is informed and believes that the following are the owners of the property:

Cloyd S. Bolick and Rose R. Bolick of Route 1, Boone, North

BK025276740

Carolina;

and that W. G. McGibony, Trustee under the Deed of Trust in Deed of Trust Book 97 at Page 643; and Richard Hayes and Dale Hayes, Lessees under Lease recorded in Deed Book 247 at Page 521; and Lowe Ford, Lessee under Lease recorded in Deed Book 247 at Page 523, have an interest in the property.

3. A Description of the tract of land affected by the taking sufficient for identification thereof is as follows: 21.10 acres, said 21.10 acres being a portion of that property described in Deed Book 85 at Page 33 and said 21.10 acres being more particularly described as follows:

BEGINNING at a point which represents the extreme southern corner of the subject tract of land and being located on the South side of an existing road to the Boone Landfill and running thence N 56° 2' 49" W 790' to a point; thence running N 21° 2' 11" E 935.02' to a point; thence running S 68° 56' 42" E 779.13' to a point; thence South 58° 19' 29" E 206.90' to a point; thence running S 30° 54' 8" W 1,023' to a point; thence running S 45° 37' 8" W 51.63' to a point at the edge of the access road to the Boone Landfill; thence continuing S 59° 32' 11" W 23.92' to the point of beginning and containing 21.10 acres by D.M.D.

4. A statement of the property and the interest therein which is being taken for public use is as follows: Fee simple ownership in 21.10 acres more particularly described as follows:

BEGINNING at a point which represents the extreme southern corner of the subject tract of land and being located on the south side of an existing road to the Boone Landfill and running thence N 56° 2' 49" W 790' to a point; thence running N 21° 2' 11" E 935.02' to a point; thence running S 68° 56' 42" E 779.13' to a point; thence South 58° 19' 29" E 206.90' to a point; thence running S 30° 54' 8" W 1,023' to a point; thence running S 45° 37' 8" W 51.63' to a point at the edge of the access road to the Boone Landfill; thence continuing S 59° 32' 11" W 23.92' to the point of beginning and containing 21.10 acres by D.M.D.

BK0252PG741

This 7th day of September, 1984.

COUNTY OF WATAUGA:

James M. Deal, Jr.
 BY: James M. Deal, Jr.
 County Attorney for the County
 of Watauga
 P. O. Box 311
 Boone, North Carolina 28607
 Tel (704) 264-4734

NORTH CAROLINA
 WATAUGA COUNTY
 Filed for registration on the 7th day of September
 19 84 at 1:05 P.M. and registered in the
 office of the Register of Deeds of Watauga County, North Carolina
 on the 7th day of September 19 84
 in Book 252 of Deeds
 at page 733

Phyllis K. Foster
 Register of Deeds

by *Eric Lee Allen*
 Deputy

APPENDIX C
BORING LOGS
AND
POTENTIOMETRIC MAP

FIELD BORING LOG FORM

PROJECT:Watauga Landfill Hydrogeologic Study 6520-02 SHEET 1 OF 2
 LOCATION:Central Drainage HOLE NO.:B-17
 DRILLER:Eng. Tectonics (Ron and Rodney) DATE STARTED:8-4-92
 RIG TYPE:Hollow Stem Auger BIT/AUGER SIZE:4.25" DATE FINISHED:8-4-92
 LOGGED BY:JES APPROX. GROUND ELEV.: -3210 TOTAL DEPTH:20.5

DEPTH IN FEET	SPECIAL NOTES	SOIL SAMPLE			SOIL / ROCK DESCRIPTION / COMMENTS
		TYPE & #	BLOWS OR REC	DEPTH RANGE	
0-5.0					dark maroon brown clayey, fine sandy silt moist, moderate to low plasticity
5-6.5		SS1	7	5-5.5	same, moist to dry, crumbly
	bulk sample		10	5.5-6	
	collected		8	6-6.5	
	from 5'-10'				
6.5- 10.0					dark orange brown clayey, fine sandy silt, moist, moderate to low plasticity
10.0- 11.5		SS2	7	10.0- 10.5	same, moist, crumbly
			7	10.5- 11.0	
			6	11.0- 11.5	
11.5- 13.0		SS3	5	11.5- 12.0	same,
			12	12.0- 12.5	saturated,
			14	12.5- 13.0	crumbly to low plasticity
13.0- 14.5		SS4	12	13.0- 13.5	dark orange-brown-black-green clayey, silty, fine sandy
			14	13.5- 14.0	micaceous schistose saprolitic hornblende gneiss, saturated,
			15	14.0- 14.5	crumbly
14.5- 16.0		SS5	6	14.5- 15.0	same, saturated, crumbly
			7	15.0- 15.5	
			9	15.5- 16.0	

FIELD BORING LOG FORM

PROJECT:Watauga Landfill Hydrogeologic Study 6520-02 SHEET 1 OF 2
 LOCATION:Top of excavated North drainage HOLE NO.:B-18
 DRILLER:Eng. Tectonics (Ronnie and Rodney) DATE STARTED:8-6-92
 RIG TYPE:Hollow Stem Auger BIG/AUGER SIZE:4.25" DATE FINISHED:8-6-92
 LOGGED BY:JES APPROX. GROUND ELEV.:~3234 TOTAL DEPTH:50.0'

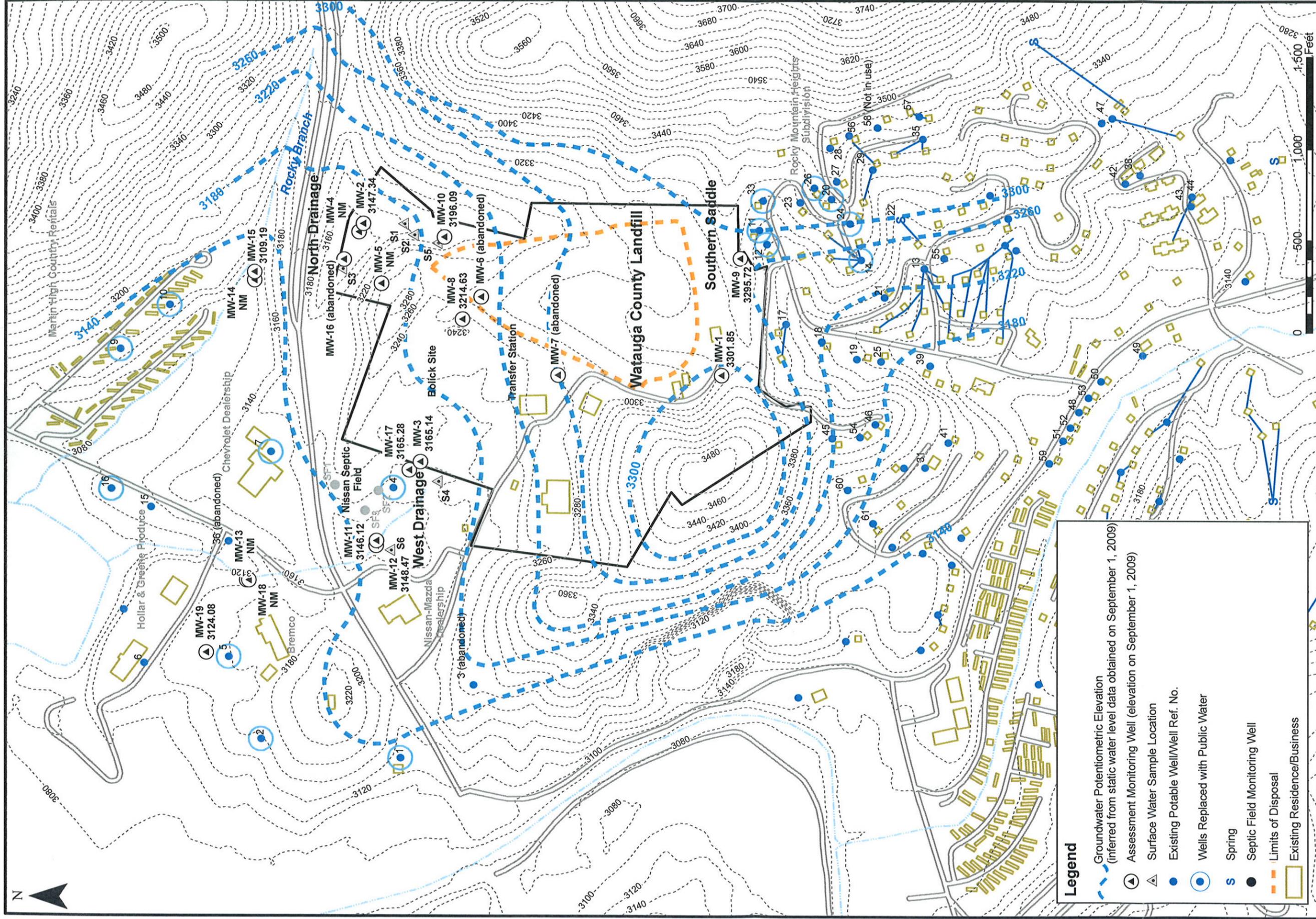
DEPTH IN FEET	SPECIAL NOTES	SOIL SAMPLE			SOIL / ROCK DESCRIPTION / COMMENTS
		TYPE & #	BLOWS OR REC	DEPTH RANGE	
0-2.0					lite tan silty fine sand with trace clay, dry, crumbly
2-2.5					brown silty fine sand with trace clay, dry, crumbly
2.5-5					dark gray green micaceous silty fine sand w/ gneiss rock fragments dry, crumbly
5-6	bulk sample collected from 5.0'-10.0'	SS1	20	5-5.5	same grading into schistose,
			50/3"	5.5-6	saprolitic hornblende gneiss dry
			----	6-6.5	crumbly
6-10					dark green grading into brown micaceous, silty fine sand dry crumbly
10.0-10.5		SS2	50/6"	10.0-10.5	dark green-brown-orange-black white-tan schistose, micaceous saprolitic gneissic schist dry, crumbly
11.5-12.0		SS3	50/3"	11.5-12.0	same
13.0-13.5		SS4	50/6"	13.0-13.5	same
14.5-15.0		SS5	50/3"	14.5-15.0	same with Qtz-feldspar phenocryst
16.0-16.5		SS6	50/4"	16.0-16.5	same
17.5-18.5	groundwater	SS7	35	17.5-18.0	white-gray green-black saprolitic hornblende gneiss
			50/2"	18.0-18.5	wet crumbly

FIELD BORING LOG FORM

PROJECT:Watauga Landfill Hydrogeologic Study 6520-02
 LOCATION:North Drainage
 DRILLER:Eng. Tectonics (Ron and Rodney)
 RIG TYPE:Hollow Stem Auger BIT/AUGER SIZE:4.25"
 LOGGED BY:JES APPROX. GROUND ELEV.:3200

SHEET 1 OF 1
 HOLE NO.:B-22
 DATE STARTED:8-4-92
 DATE FINISHED:8-4-92
 TOTAL DEPTH:26.0

DEPTH IN FEET	SPECIAL NOTES	SOIL SAMPLE			SOIL / ROCK DESCRIPTION / COMMENTS
		TYPE & #	BLOWS OR REC	DEPTH RANGE	
0-5.0					brown-gray green micaceous, silty medium sand, dry, crumbly
5-6.5	bulk sample collected from 5.0-7.5	SS1	4	5-5.5	orange-black-yellow-brown
			4	5.5-6	saprolitic mica schist
			4	6-6.5	moist, crumbly
7.5	groundwater				orange micaceous silty medium sand with trace clay
10.0-11.5		SS2	5	10.0-10.5	orange-yellow-brown-green-black clayey saprolitic mica schist
			6	10.5-11.0	wet, crumbly
			6	11.0-11.5	
15.0-16.5		SS3	9	15.0-15.5	same
			10	15.5-16.0	
			12	16.0-16.5	
20.0-21.5		SS4	25	20.0-20.5	saprolitic mica schist grading into very schistose saprolitic
			35	20.5-21.0	hornblende gneiss saturated
			50/5"	21.0-21.5	
25.0-26.0		SS5	50/5"	25.0-25.5	schistose saprolitic micaceous hornblende gneiss, saturated
				25.5-	
				26.0	



Legend

- Groundwater Potentiometric Elevation (inferred from static water level data obtained on September 1, 2009)
- Assessment Monitoring Well (elevation on September 1, 2009)
- Surface Water Sample Location
- Existing Potable Well/Well Ref. No.
- Wells Replaced with Public Water
- Spring
- Septic Field Monitoring Well
- Limits of Disposal
- Existing Residence/Business

**Potentiometric Surface Map
Watauga County Landfill**

Watauga County, North Carolina

SCALE 1" = 500'

PLAN NO. 6520-39



Draper Aden Associates
 Engineering • Surveying • Environmental Services
 2206 South Main Street
 Blacksburg, VA 24060
 540-552-0444 Fax: 540-552-0291

DESIGNED JES
 DRAWN SMF
 CHECKED MDL
 DATE 09-16-09

FIGURE
2

File: P:\065000\6520-39\GIS\MAP - 09 0916 - Fig 2 - Watauga Landfill - Potentiometric.mxd

APPENDIX D
EMERGENCY CONTINGENCY PLAN

EMERGENCY CONTINGENCY PLAN

A. GENERAL

This Emergency Contingency Plan details responses to fires on the Watauga County LCID landfill and to releases from the facility. The plan includes the names of persons responsible for emergency coordination and lists the emergency telephone numbers.

B. PLAN CONTENTS

1. Fire Control Plan

Although open burning is not permitted on the landfill, fires can occasionally start in the disposal area. In the event of small fires within the landfill disposal area, each piece of equipment should be fitted with at least two multi-purpose dry chemical 10 lb. fire extinguishers. Whenever smoke is noticed, the source should be investigated. If detected early, the hand held fire extinguishers should stop most small fires. Equipment should be parked off of the working cell and disposal halted while the fire is extinguished. The fire department can provide training in proper use of fire extinguishers.

1.1 Brush/Forest Fire

1. Call 911 and describe situation.
2. Alert on-site personnel in path of fire to evacuate.
3. Remove equipment in path of fire, but only if this can be performed without endangering operator.
4. Fire control will be the responsibility of the Fire Department personnel.
5. If active workplace appears to be in the path of the fire, and as directed by Fire Department personnel, place cover soil over exposed waste, if combustible.

1.2 Fire in an Active Cell

1. Operator shall notify the scale personnel of the fire so they can call 911 and describe situation.
2. If the fire appears to be dangerous, the operator will immediately leave the area. The Fire Department may require the utilization of on-site earth moving equipment to extinguish the fire.
3. If the fire cannot be extinguished with cover soil, the Fire Department must apply water as the operator turns the debris in order to ensure complete saturation of the debris to put out the fire. At no time should the operator move the landfill equipment directly into an active blaze.
4. If the operator is involved in fire fighting measures, the operator should take care to avoid equipment contact with the fire and breathing the smoke generated from the fire.
5. The Fire Department personnel should utilize their fire suppression methods when they arrive. A limited amount of non-potable water is available on site in case of fire. The source is the sediment basin west of the LCID landfill. Landfill

equipment shall be used to expose any dirt or debris material, ensure that live coals are no longer present. After the fire has been suppressed, all combustible materials and the surrounding area shall be thoroughly soaked with water. The Fire Department personnel shall determine when the fire is totally extinguished.

1.3 Equipment Fire

1. Make sure no person is inside of or on the equipment.
2. The person who discovered the fire should notify the scalehouse of the situation and have them alert the local Fire Department of the situation.
3. If the blaze appears to be suppressible by means of a hand held extinguisher, the onboard fire extinguisher (if accessible) or another available one shall be used. Suppression will depend upon the fuel source of the fire.
4. In the case of an uncontrollable equipment fire, the personnel shall leave the immediate area and wait for the Fire Department.

1.4 Fire or Suspected Fire in an Incoming Waste Load

1. If the vehicle is on the scales, have the vehicle move to an open area away from other equipment and buildings.
2. If not on the scales, alert the scalehouse personnel and move vehicle to open area away from other equipment, buildings or combustible materials.
3. Ascertain the extent of fire in load by visual inspection of vehicle.
4. Dump load on an area of the landfill with intermediate cover away from the working face.
5. Separate combustibles from burning material if possible.
6. Attack source of fire with available building and/or vehicle fire extinguishers.
7. Put water on the fire and remaining smoldering materials to completely extinguish the fire.
8. At all times make every effort to avoid breathing smoke.
9. If deemed necessary at any point in this process, clear the immediate area and call 911.

2. OTHER EMERGENCIES:

2.1 Harmful Liquid Spills

Potential liquid spills could include fuels or lubricants for the equipment at the working face or fluids hidden in the loads. Management of the spill would proceed as follows:

1. The landfill personnel shall attempt to contain the spilled liquid through the use of soil berms and absorbent materials.
2. Any contaminated soils or absorbent materials shall be disposed of using proper methods.

3. If liquids spill on the working face resulting in toxic or harmful fumes being released, all personnel shall be evacuated from the area of spill and 911 shall be called.
4. If a person has been splashed with a harmful liquid in the process of operations, he/she shall be immediately taken to the nearest eye-wash or shower area to shower off. Eye-wash/shower facilities are located in the Maintenance Shop.

2.2 Harmful Gas Release

Due to the screening process at the scalehouse, the likelihood of a large gas holding container reaching the working face is remote. However, in the event such a gas container leaks or is punctured, there are two primary scenarios possible.

1. An explosion or fire caused by the escaping gas:

1. If injuries result from the explosion or fire, personnel should immediately notify the scalehouse to call 911 and should attempt to stabilize the injured.
2. If no injuries have occurred due to an exploding container and containment of any fire generated as a result has taken place, there is very little that can be done after an explosion. Policing the area for additional containers will be warranted after such an event. If the damaged container has any source identification on it, Watauga County personnel should make every effort to inform the source of the illegality of depositing such containers in the LCID landfill.

2. Gas is hazardous to breathe:

1. If an operator senses that his breathing (or that of others in the vicinity) is being affected by something in the air, he should notify the scalehouse personnel by radio and ensure that all personnel leave the area.
2. The scalehouse personnel should call 911 and describe the nature of the problem and maintain contact with the personnel being affected.
3. Once the gas has been identified, appropriate measures shall be taken to contain, neutralize and/or disperse the gas.
4. The Emergency Coordinator shall determine if residences downwind of the facility should be notified of the problem and/or be evacuated.

2.3 Physical Injury

1. In the event of injury of landfill employees or private citizens at the site, the scalehouse should be immediately notified to call 911 and describe the nature of the problem and maintain contact with the personnel being affected.
2. First aid shall be administered to the injured by available personnel until the Rescue Squad can arrive.

Emergency numbers are listed in Section 4 of this Plan. This list should be posted in a

conspicuous place and updated as needed. The landfill operator should review the fire fighting procedures with the fire department to gain their cooperation and to avoid confusion when they arrive at the landfill.

In case of fires after hours when landfill personnel are not present, authorized representatives of the Fire Department should be provided access to the facility property entrance gate. They should also be given permission to cut the lock if necessary to gain entry.

3. Release of Wastes

Since the types of wastes accepted at the Watauga LCID landfill are strictly controlled, releases of wastes that would constitute an emergency are highly unlikely. Some debris may fall from vehicles in route to the disposal area. The routine cleanup of roads and ditches will resolve this problem. If a large quantity of debris is dumped outside of the disposal area, equipment will be used to load and move the waste to the landfill.

4. Emergency Arrangements

The local fire and sheriff's departments will be provided with copies of this emergency plan. Since all parties are departments of the same Watauga County government, formal arrangements for emergency responses are not needed. The following are telephone numbers for emergency situations:

Emergency Telephone Numbers

Fire, Police, Rescue:	911
Watauga Medical Center 336 Deerfield Road Boone, North Carolina 28607	(828) 262-4100
Department of Environment and Natural Resources, Division of Waste Management Winston-Salem Regional Office	(919) 508-8400 (336) 771-5000

5. Emergency Coordinator

Director of Solid Waste (828) 264-5305 (Landfill)

Office Address:

Watauga County Solid Waste/Recycling Department
842 West King Street, Suite 1
Boone, North Carolina 28607-3525

6. Emergency Equipment

The emergency equipment on site will include the multi-purpose dry chemical 10 lb hand held fire extinguishers. The pickup truck used by the landfill personnel carries an extinguisher. One extinguisher will be stored in the attendant's trailer and one will be kept in the equipment building. Every employee will be shown the location of each extinguisher. Each extinguisher will be inspected on a monthly basis. The equipment fire suppressant systems will be inspected by qualified personnel at least yearly.

7. Evacuation Plan

Formal evacuation plans for the habitable structures at landfill are posted in each building. In the event of a building fire, personnel should evacuate the structures as outlined in the plans. The structures are one story, with multiple exit points. Evacuation will begin as soon as a fire is detected.

For fires on the landfill, there are typically only one or two employees at the workface at any one time. These operators will move their equipment away from larger fires, except to fight the fires as discussed earlier. Vehicles hauling waste into the landfill will be directed away from the area of the fire. If the fire is small, the customers will be instructed to wait until the fire is extinguished before dumping their loads on the landfill. For larger fires, when the fire fighting time will be significant, a separate disposal area will be designated, and landfilling operations will continue as the fire is contained. If the fire is large enough to raise concerns about spreading, the landfill operations will cease until the fire is stopped. Haulers will be directed to leave the landfill disposal area until the fire is completely extinguished. Since the fire will be on the landfill, the main access road will not be blocked and alternate routes are not necessary.

8. Emergency Contractor

The Solid Waste/Recycling Department has an additional loader on-site for use when maintenance is required on the landfill loader. In addition, equipment can be borrowed from other County departments should the need arise.

C. PLAN DISSEMINATION

Copies of this emergency plan will be maintained at the following:

Watauga County Solid Waste Facility Scalehouse
336 Landfill Road
Boone, North Carolina 28607

Watauga County Solid Waste Director
842 West King Street, Suite 1
Boone, North Carolina 28607

Boone Fire Department
721 West King Street
Boone, North Carolina 28607

Watauga County Sheriff's Department
184 Hodges Gap Road
Boone, North Carolina 28607

D. PLAN AMENDMENTS

The emergency plan will be reviewed and revised if:

1. The facility permit is amended;
2. The plan fails in an emergency;
3. Changes in the facility design, construction, operation, or other circumstances materially increase the potential for fires, explosions, or releases or change the response necessary in an emergency; or
4. The emergency coordinator or emergency equipment list changes.

APPENDIX E
INSPECTION CHECKLIST

QUARTERLY INSPECTION CHECKLIST

WATAUGA COUNTY LCID LANDFILL

Date of Inspection _____ Weather _____
 Inspector's Name _____

Category	No.	Inspection to be Conducted	Yes	No
Security Control Devices	1	Is entrance gate and lock functioning properly?	Yes	No
	2	Is fencing maintained?	Yes	No
	3	Is access controlled by wooded areas where no fence exists?	Yes	No
Site Accessibility	4	Site accessible to vehicles by all-weather roads leading from public system?	Yes	No
	5	Scale attendant at entrance?	Yes	No
	6	Is traffic pattern safe for landfill users?	Yes	No
Waste Handling	7	Are wastes deposited in proper designated areas?	Yes	No
	8	Landfill equipment capable of functioning on a slope not steeper than one (vertical) to three (horizontal)?	Yes	No
Compaction	9	Wastes compacted to smallest practical volume?	Yes	No
	10	Is working face small enough to manage?	Yes	No
	11	Adequate equipment on site to cover wastes periodically?	Yes	No
Cover Material	12	Is periodic soil cover adequate?	Yes	No
	13	Final cover applied to areas at final grade	Yes	No
	14	Is vegetative cover established on closed areas	Yes	No
	15	Is vegetative cover established on exterior landfill slopes	Yes	No
	16	Do areas required seeding within the LCID area	Yes	No
	17	Is there sign of settlement on the landfill	Yes	No
	18	Is there evidence of slope failures on the landfill cover	Yes	No
	19	Does the vegetation require mowing	Yes	No
	20	Does the vegetation appear healthy	Yes	No
	Aesthetics	21	Is dust controlled on site	Yes
22		Are vectors (birds, rodents, other animals) controlled on site	Yes	No
Erosion Damage	23	Is there sign of erosion damage on the landfill such as gullies or rills on the surface	Yes	No
	24	Do any of the ditches and channels need maintenance	Yes	No
	25	Does the sedimentation basin need cleaning	Yes	No
	26	Are surface water control features functional (is run on collected and run-off diverted from site)	Yes	No
	27	Is ponding of water on top of waste in evidence	Yes	No

(Note: Erosion damage to be inspected after every major storm event in addition to quarterly inspections)

APPENDIX F

EROSION AND SEDIMENTATION CONTROL PLAN

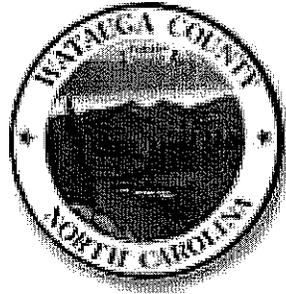
EROSION AND SEDIMENTATION CONTROL PLAN

FOR

LAND CLEARING AND INERT DEBRIS LANDFILL

WATAUGA COUNTY SOLID WASTE FACILITY

PERMIT # 95-02



Prepared for:

North Carolina Department of Environment and Natural Resources

Prepared by:

Draper Aden Associates
2206 South Main Street
Blacksburg, VA 24060

DAA JN 6520-50

October 13, 2009

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LIST OF APPENDICES

- Appendix A: Maps, Figures and Specifications
- Appendix B: Vegetative Plan
- Appendix C: Engineering Calculations
- Appendix D: Financial Responsibility/Ownership Form
- Appendix E: Erosion and Sedimentation Control Plan Review Checklist

NARRATIVE

PROJECT DESCRIPTION

The proposed project will expand the existing land clearing and inert debris fill area at the Watauga County Landfill site. The current site is 1.95 acres and the expansion will increase the size to 4.23 acres. The expansion will take place in three phases. Phase 1 is the current LCID landfill and occupies 1.95 acres of the site. With this expansion, Phase 1 will increase in size to 2.23 acres. Phase 2 will be the next phase developed and will occupy 0.72 acres of the site. The final phase, Phase 3, will occupy 1.28 acres.

The expansion work will consist of excavation of the fill area and small perimeter drainage channels to control run-on surface flows. The portion of the site that will be used for the fill area is within the drainage area of an existing sedimentation basin.

SITE DESCRIPTION

The project site is located approximately 1 mile east of Boone, NC. In the area to be disturbed, slopes range from 5 percent to 33 percent. The ground is covered with mixed grasses and brush, with the coverage varying from good to sparse. The sediment basin that collects the runoff from this portion of the site was designed to accept runoff from approximately 28 acres. Structures on the property include a baling/transfer facility, scale house and animal shelter. These will not be impacted by this project.

ADJACENT PROPERTY

The Facility is bounded by U.S. Route 421 to the north, the New River to the west, a residential development to the south and a wooded area on the east side of the property. U.S. Route 421 is the route of access to the landfill property.

SOILS

The weathering of migmatitic gneiss underlying the site has produced approximately twenty feet of micaceous silty sands and sandy silts above the bedrock. Groundwater contained in the bedrock fracture system is released above bedrock along the drainages and lower elevations of the site. The plasticity index calculated for the bulk sample collected indicates this soil to be non-plastic. Non-plastic soils have little or no cohesion and are compacted with difficulty.

These soils are mapped as silts and sandy silts in the Porters, Tusquitee and Watauga groups, belonging Hydrologic Group B which indicates a moderate infiltration rate. The soil erodibility factor is in the range of 0.24 to 0.28 for these soils.

Due to the moderate infiltration rates and the slopes found at the site, no standing water problems are anticipated.

Topsoil at this site is virtually nonexistent. However, past efforts to establish vegetation using the available soil with lime and fertilizer additions have been successful.

PLANNED EROSION AND SEDIMENTATION CONTROL PRACTICES

Temporary Seeding (Practice 6.10)

Areas which will be left in a disturbed condition for more than 30 days and areas within the fill area which will not require stabilization for more than one year will be covered with a stand of temporary vegetation. The seed mix will be as shown on the drawings and lime and fertilizer shall be applied in accordance with the recommendations of the Erosion and Sediment Control Design Manual or the local Extension Service, whichever is more stringent.

Permanent Seeding (Practice 6.11)

Disturbed areas which will not be involved in any further operations, including drainage channels and deposition areas for soil excavated from the new fill area, shall be seeded permanently using a seed mix as shown on the drawings. Seeded areas shall be protected by mulch or erosion control matting as required. Lime and fertilizer shall be applied at rates recommended in Extension Service soil testing report.

Matting – Rolled Erosion Control Products (Practice 6.17)

Erosion control matting shall be used in the permanent stabilization of slopes 2:1 or greater and with more than 10 feet of vertical relief. Matting should be used when mulch cannot be adequately tacked and where immediate ground cover is required to prevent erosion damage.

Sediment Fence (Practice 6.62)

Sediment fence shall be installed at the locations shown on the plans and at any location that becomes vulnerable during construction. Sediment fence shall also be placed at the downslope edges of those areas where soil excavated from the fill area are deposited. Fence shall be placed level along contours to the greatest extent possible. If it is necessary to place sediment fence along a slope, gravel outlets for collected water will be provided at 100-foot intervals.

CONSTRUCTION SCHEDULE

1. Obtain plan approval and other required permits.
2. Hold preconstruction conference at least one week prior to starting construction.
3. Inspect existing sediment basin and perform any required maintenance. Clean out basin to assure that the required 1800 CF / acre of storage volume is provided.
4. When constructing a new phase of the landfill, install sediment fence along the edges of the LCID landfill as shown on the drawings.

5. When constructing a new phase of the landfill, construct drainage channels along the edges of the LCID landfill as shown on the drawings.
6. Excavate and grade new phase of the LCID landfill. Excavated soil will be spread and compacted in the adjacent open area.
7. Finish grade soil deposition area and place seed and erosion matting as appropriate.
8. Permanent seed and matting shall be placed after final elevations are attained in a phase and fine grading is complete.
9. Drainage berms and downslope drainage channels shall be installed as shown on the plans. The cross sections for the drainage berms and downslope drainage channels are found on Sheet 9 of the Design drawings.

MAINTENANCE PLAN

1. During the construction and stabilization periods, all erosion and sediment control practices will be checked for stability and operation following every runoff-producing rainfall and every 7 days. Any needed repairs will be made immediately to maintain all practices as designed. The construction contractor shall be responsible for maintenance and repair during the construction period; the owner shall be responsible after the construction contractor has completed his work and departed from the work site.
2. The sediment basin will be cleaned out when the level of sediment reaches the cleanout elevation indicated on the plans.
3. Sediment will be removed from behind the sediment fence when it becomes 0.5 feet deep at the fence. The sediment fence will be repaired as necessary to maintain a barrier.
4. All seeded areas will be fertilized, reseeded as necessary, and mulched to maintain a vigorous, dense vegetative cover.

The contact information for on-site Watauga County personnel is the following:

Watauga County Solid Waste Management Facility
336 Landfill Road
Boone, North Carolina 28607

Office Phone: 1-828-264-5305

APPENDIX A

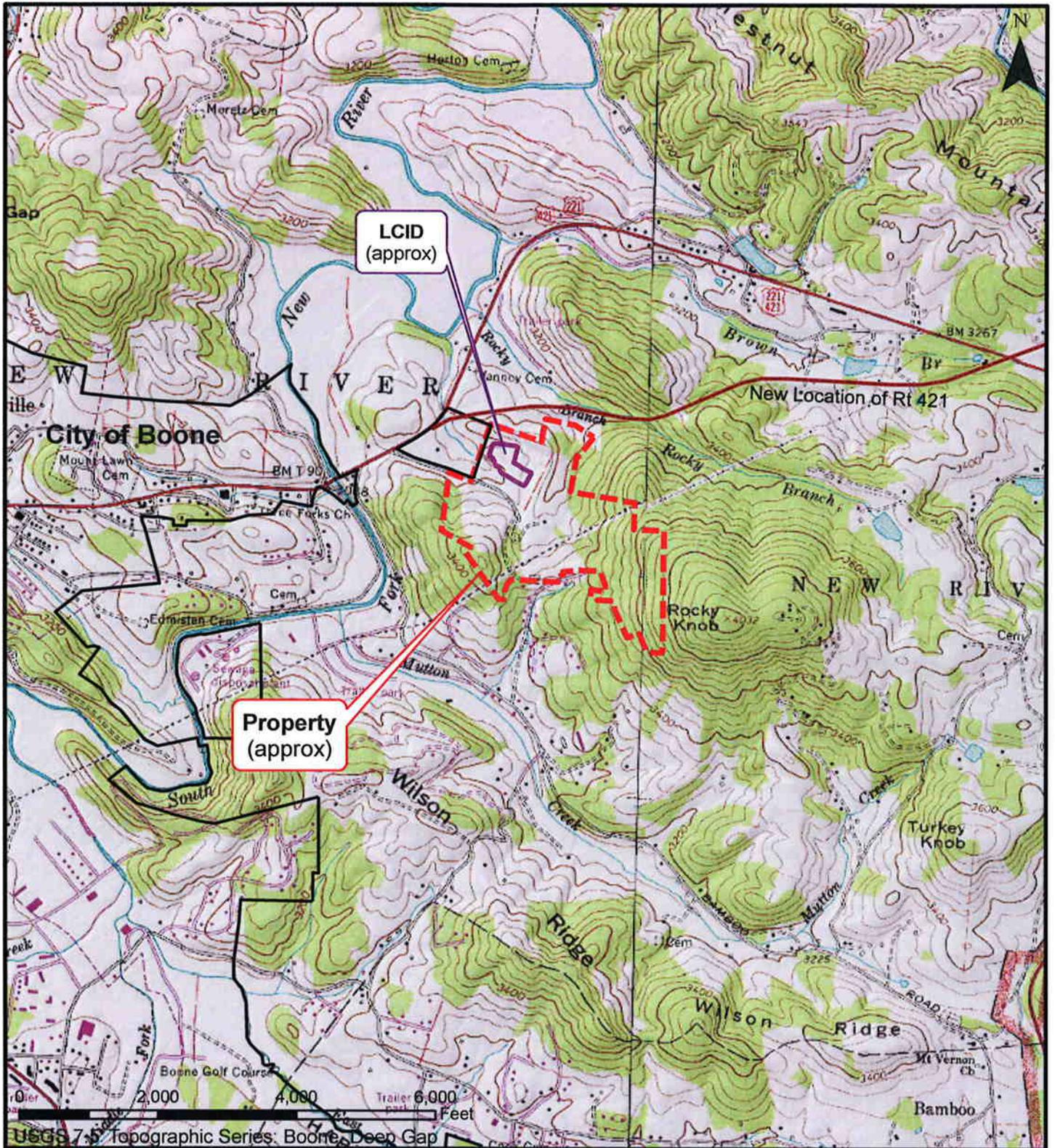
MAPS, FIGURES AND SPECIFICATIONS

Site Location Map

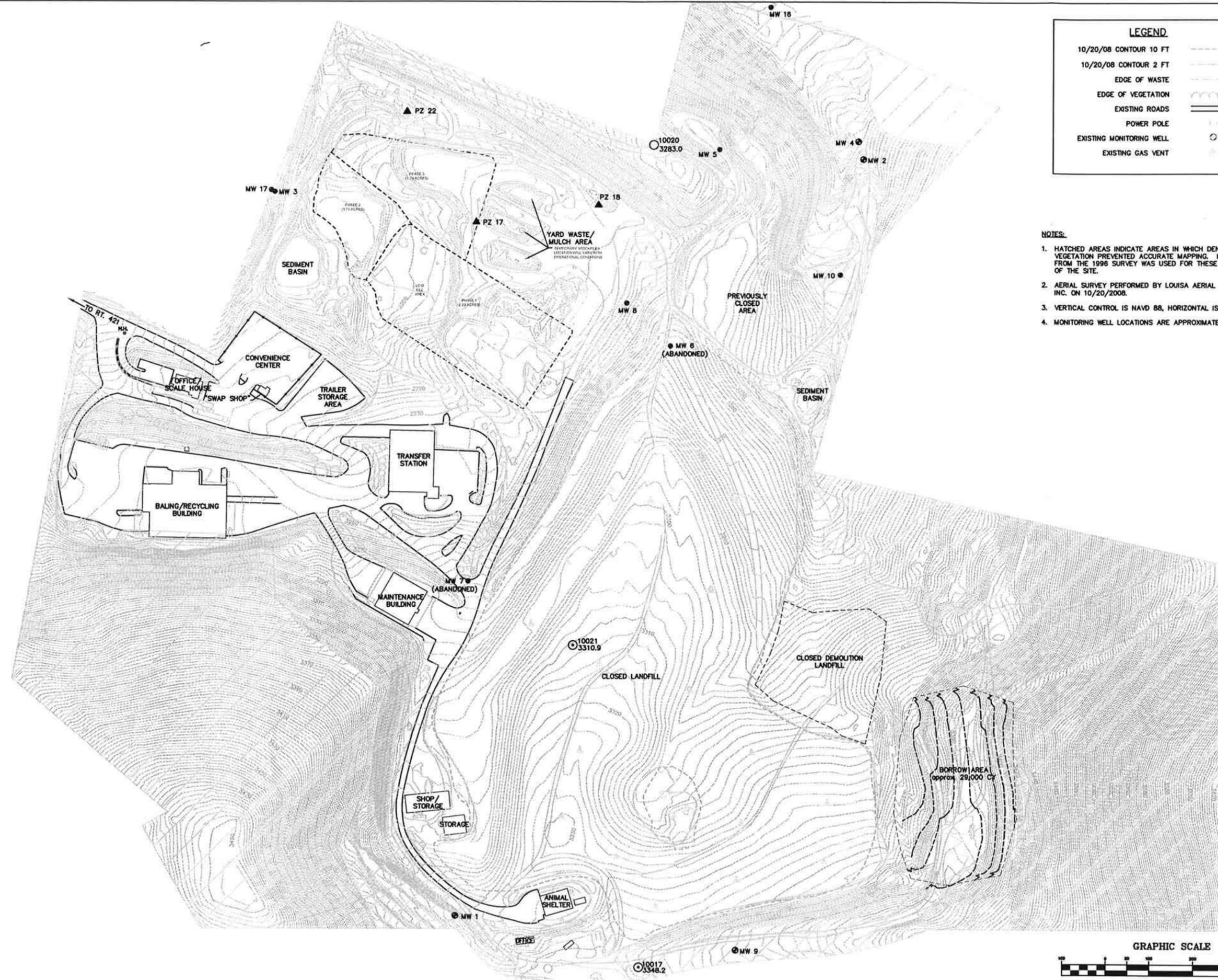
Site Map

Site Erosion and Sedimentation Control Plan Sheets (from LCID permit
submittal)

Erosion and Sedimentation Details and Specifications



Site Location Watauga County Solid Waste Facility Permit #95-02 Watauga County, North Carolina		SCALE 1" = 2000' PLAN NO. 6520-48
 Draper Aden Associates Engineering • Surveying • Environmental Services 2206 South Main Street Blacksburg, VA 24060 540-552-0444 Fax: 540-552-0291	DESIGNED SE DRAWN MF CHECKED LK DATE 10-06-09	FIGURE 1



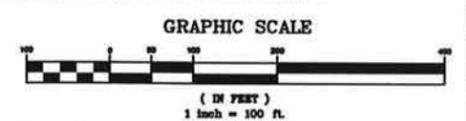
LEGEND	
10/20/08 CONTOUR 10 FT	
10/20/08 CONTOUR 2 FT	
EDGE OF WASTE	
EDGE OF VEGETATION	
EXISTING ROADS	
POWER POLE	
EXISTING MONITORING WELL	
EXISTING GAS VENT	

- NOTES:**
1. HATCHED AREAS INDICATE AREAS IN WHICH DENSE VEGETATION PREVENTED ACCURATE MAPPING. INFORMATION FROM THE 1996 SURVEY WAS USED FOR THESE PORTIONS OF THE SITE.
 2. AERIAL SURVEY PERFORMED BY LOUISA AERIAL SURVEYS, INC. ON 10/20/2008.
 3. VERTICAL CONTROL IS NAVD 88, HORIZONTAL IS ASSUMED.
 4. MONITORING WELL LOCATIONS ARE APPROXIMATE.

Draper Aden Associates
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 Blacksburg, VA
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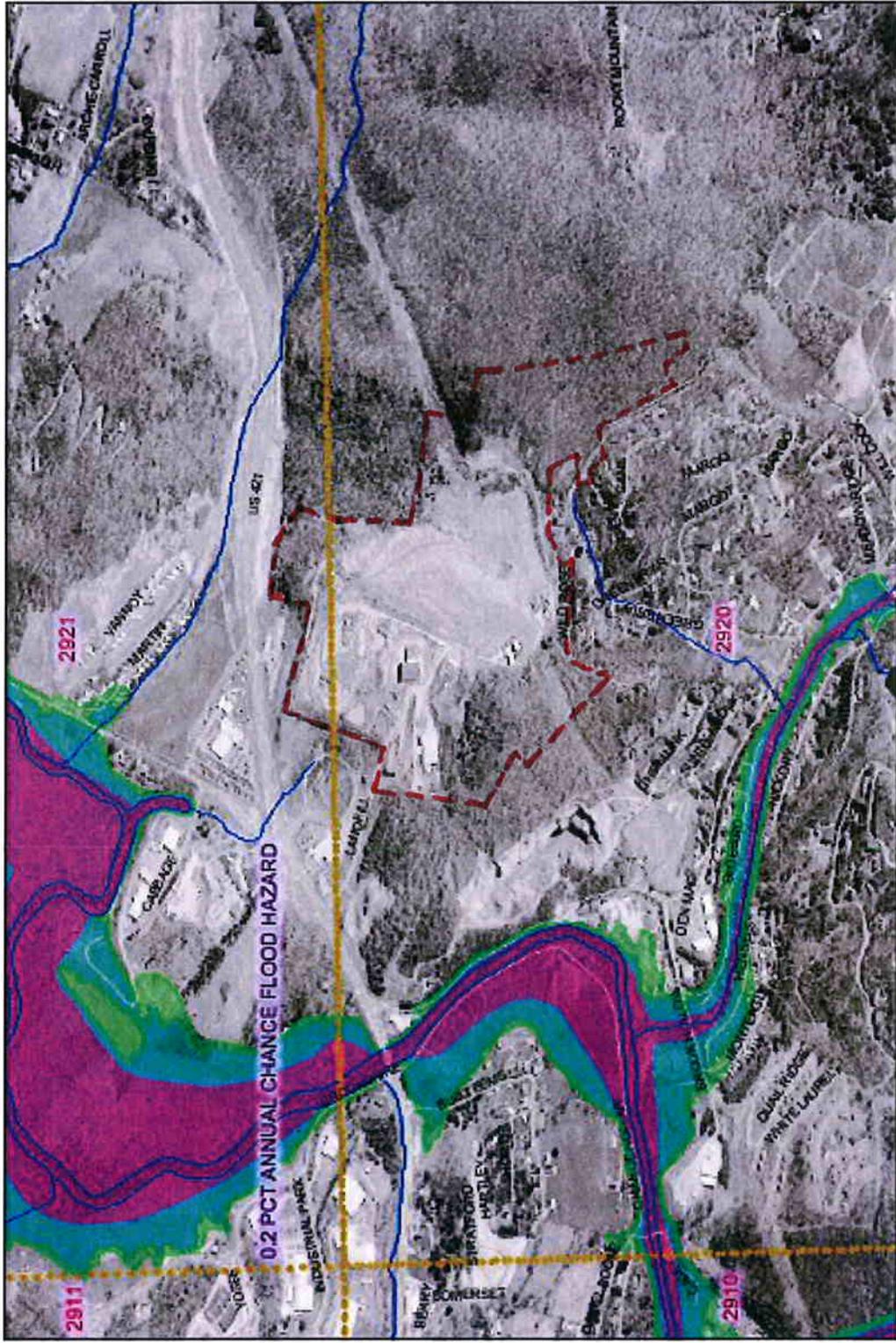
SITE MAP
LCID LANDFILL PERMIT APPLICATION
WATAUGA COUNTY SOLID WASTE FACILITY
 WATAUGA COUNTY, NC

REVISIONS	
DESIGNED BY:	N/A
DRAWN BY:	KJS
CHECKED BY:	MAC
SCALE:	1" = 100'
DATE:	OCTOBER 5, 2009
PROJECT NUMBER:	6520-48
FIG 2	

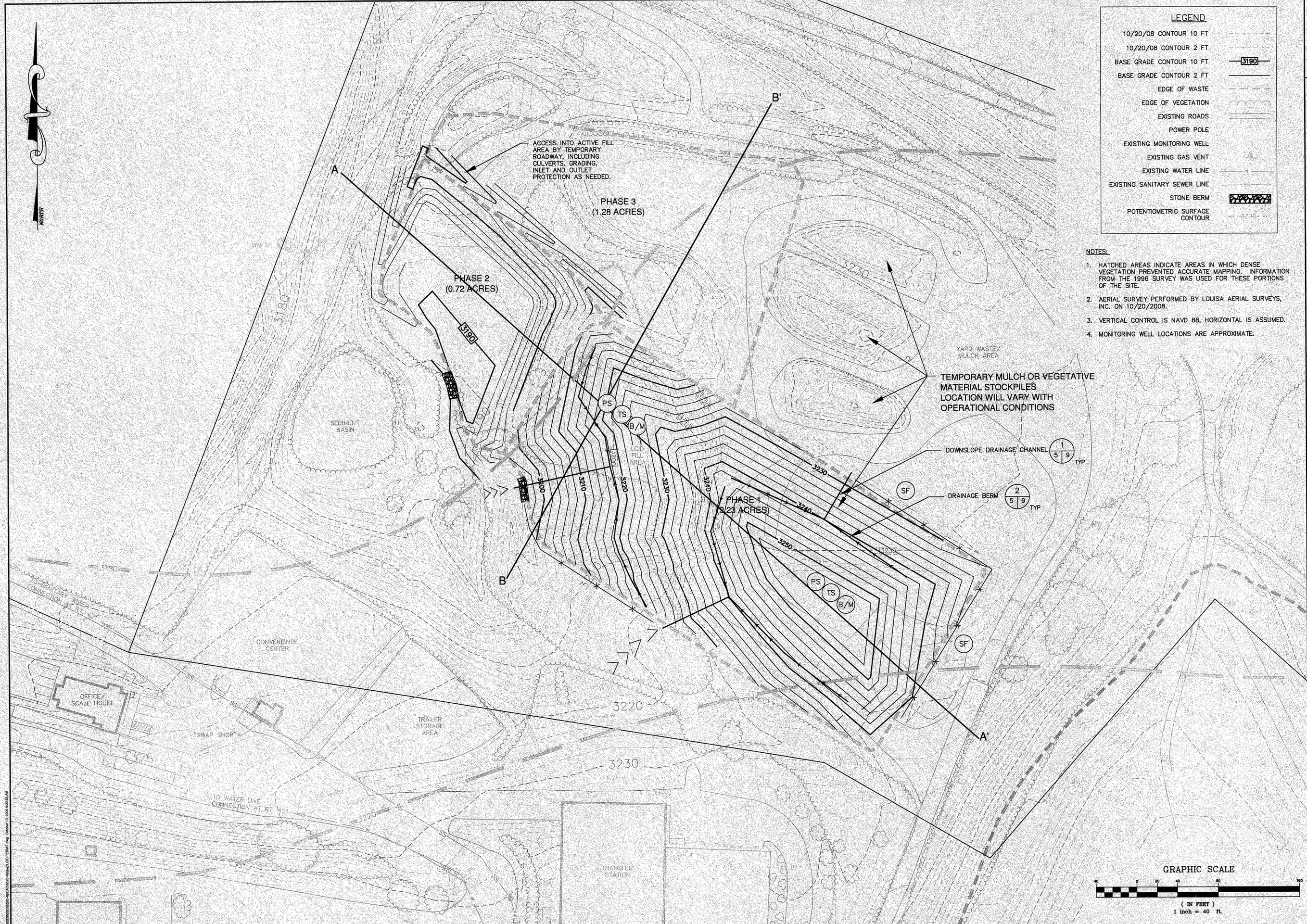


FILE: 081023.DWG DATE: 10/05/09 10:58:00 AM PLOT: 10/05/09 10:58:00 AM

Watauga Co Landfill



- 100yr Flooding - Has SFEs (AE)
 - 100yr Flooding - Floodway (AE)
 - 100yr Flooding - No SFEs (A)
 - 100yr Flood - Velocity Zone (V or VE)
 - 100yr Shallow Flooding (AO or AH)
 - 100yr Future Conditions Flooding (X Future)
 - 500yr Flooding (Shaded X)
- 0.2 PCT ANNUAL CHANGE FLOOD HAZARD
 - Cross Section
 - Rivers and Streams
 - Coastal Sounds
 - Coastal Barrier Resource
 - Systems (C BRS)
- Major Cities
 - Urban Areas
 - Extm Teritorial Jurisdictions
 - Interstate Highway
 - US Highway
 - NC Highway
 - Roads
- Benchmarks
 - Transcrib
 - Public Ground, Forest, Parks and Open Space
 - Landfill Property Boundary



LEGEND

10/20/08 CONTOUR 10 FT	
10/20/08 CONTOUR 2 FT	
BASE GRADE CONTOUR 10 FT	
BASE GRADE CONTOUR 2 FT	
EDGE OF WASTE	
EDGE OF VEGETATION	
EXISTING ROADS	
POWER POLE	
EXISTING MONITORING WELL	
EXISTING GAS VENT	
EXISTING WATER LINE	
EXISTING SANITARY SEWER LINE	
STONE BERM	
POTENTIOMETRIC SURFACE CONTOUR	

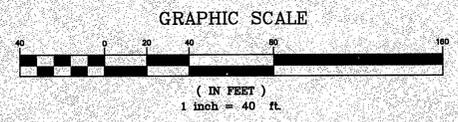
- NOTES:**
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 - AERIAL SURVEY PERFORMED BY LOUISA AERIAL SURVEYS, INC. ON 10/20/2008.
 - VERTICAL CONTROL IS NAVD 88, HORIZONTAL IS ASSUMED.
 - MONITORING WELL LOCATIONS ARE APPROXIMATE.

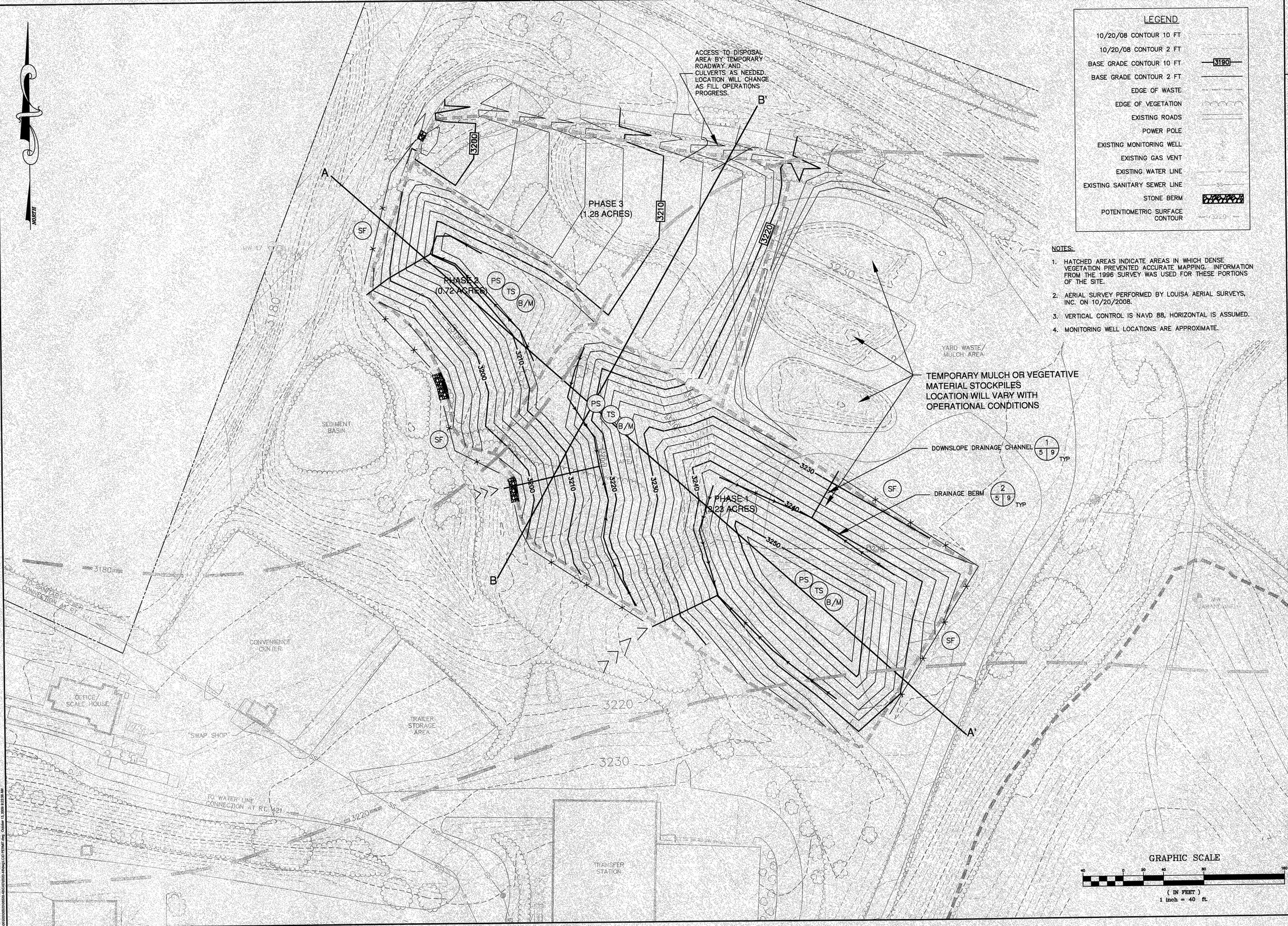


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 Hampton Roads, VA
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**BASE GRADE - PHASE 2 - INTERMEDIATE COVER GRADE - PHASE 1
 LCID LANDFILL PERMIT APPLICATION
 WATAUGA COUNTY SOLID WASTE FACILITY
 WATAUGA COUNTY, NC**

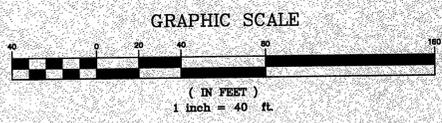
DESIGNED BY:	N/A
DRAWN BY:	KJS
CHECKED BY:	MAC
SCALE:	1" = 40'
DATE:	OCTOBER 8, 2009
PROJECT NUMBER:	6520-48
REVISIONS:	
5 OF 9	





LEGEND	
10/20/08 CONTOUR 10 FT	
10/20/08 CONTOUR 2 FT	
BASE GRADE CONTOUR 10 FT	
BASE GRADE CONTOUR 2 FT	
EDGE OF WASTE	
EDGE OF VEGETATION	
EXISTING ROADS	
POWER POLE	
EXISTING MONITORING WELL	
EXISTING GAS VENT	
EXISTING WATER LINE	
EXISTING SANITARY SEWER LINE	
STONE BERM	
POTENTIOMETRIC SURFACE CONTOUR	

- NOTES:**
- HATCHED AREAS INDICATE AREAS IN WHICH DENSE VEGETATION PREVENTED ACCURATE MAPPING. INFORMATION FROM THE 1996 SURVEY WAS USED FOR THESE PORTIONS OF THE SITE.
 - AERIAL SURVEY PERFORMED BY LOUISA AERIAL SURVEYS, INC. ON 10/20/2008.
 - VERTICAL CONTROL IS NAVD 88, HORIZONTAL IS ASSUMED.
 - MONITORING WELL LOCATIONS ARE APPROXIMATE.



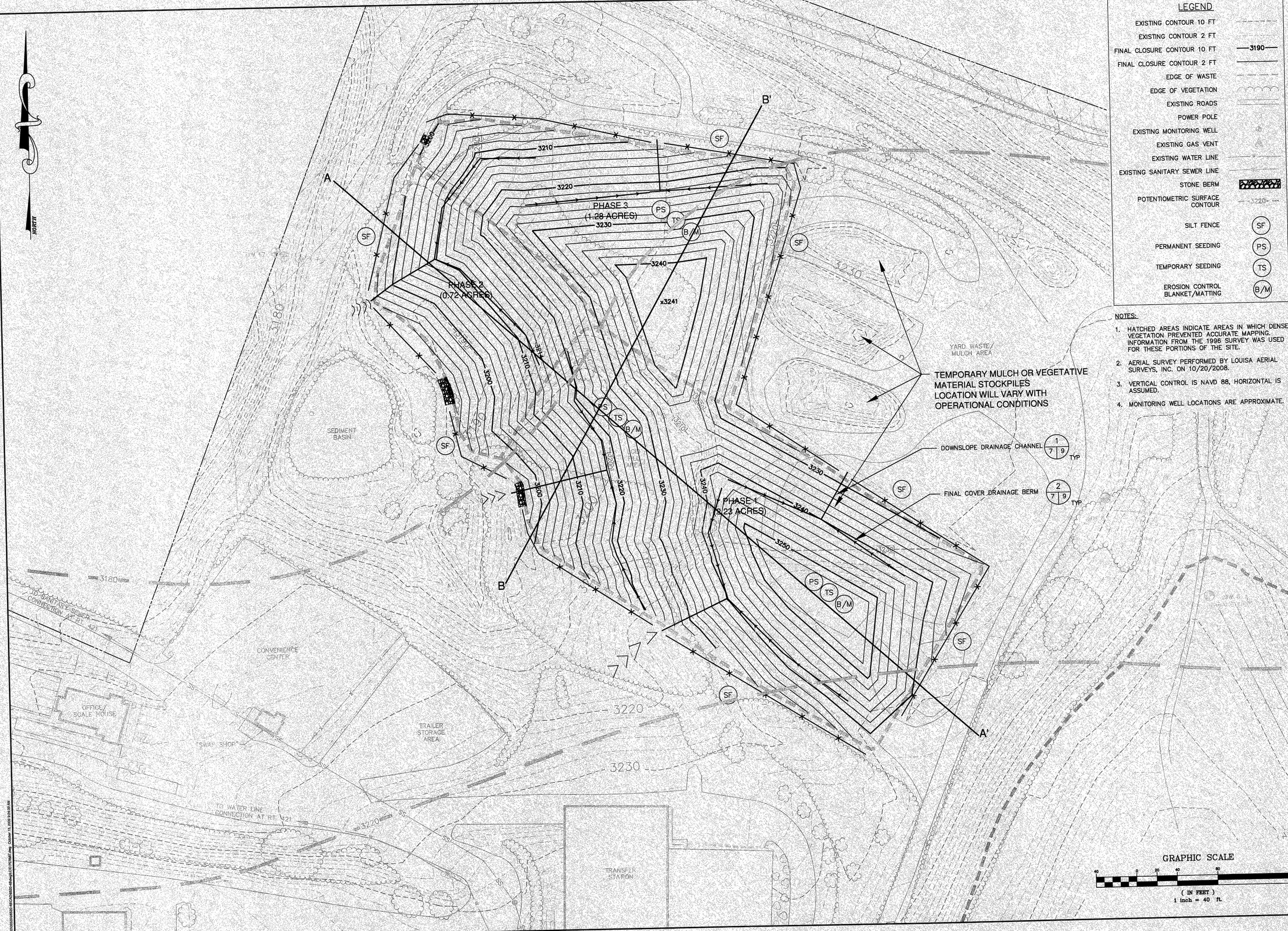
Draper Aden Associates
 Engineering • Surveying • Environmental Services
 Richmond, VA
 Charlottesville, VA
 Hampton Roads, VA



**BASE GRADE - PHASE 3 - INTERMEDIATE COVER GRADE - PHASE 1 & 2
 LCID LANDFILL PERMIT APPLICATION
 WATAUGA COUNTY SOLID WASTE FACILITY
 WATAUGA COUNTY, NC**

REVISIONS	
DESIGNED BY:	N/A
DRAWN BY:	KJS
CHECKED BY:	MAC
SCALE:	1" = 40'
DATE:	OCTOBER 6, 2009
PROJECT NUMBER:	6520-48

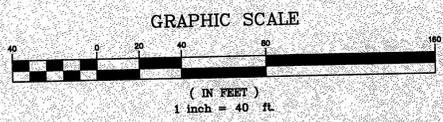
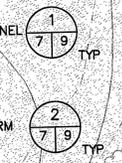
6 OF 9



LEGEND

EXISTING CONTOUR 10 FT	
EXISTING CONTOUR 2 FT	
FINAL CLOSURE CONTOUR 10 FT	
FINAL CLOSURE CONTOUR 2 FT	
EDGE OF WASTE	
EDGE OF VEGETATION	
EXISTING ROADS	
POWER POLE	
EXISTING MONITORING WELL	
EXISTING GAS VENT	
EXISTING WATER LINE	
EXISTING SANITARY SEWER LINE	
STONE BERM	
POTENTIOMETRIC SURFACE CONTOUR	
SILT FENCE	
PERMANENT SEEDING	
TEMPORARY SEEDING	
EROSION CONTROL BLANKET/MATTING	

- NOTES:**
1. HATCHED AREAS INDICATE AREAS IN WHICH DENSE VEGETATION PREVENTED ACCURATE MAPPING. INFORMATION FROM THE 1996 SURVEY WAS USED FOR THESE PORTIONS OF THE SITE.
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**FINAL GRADE
 LCID LANDFILL PERMIT APPLICATION
 WATAUGA COUNTY SOLID WASTE FACILITY
 WATAUGA COUNTY, NC**

DESIGNED BY:	N/A
DRAWN BY:	KJS
CHECKED BY:	MAC
SCALE:	1" = 40'
DATE:	OCTOBER 8, 2009
PROJECT NUMBER:	6520-48
7 OF 9	

6.10

TEMPORARY SEEDING

TS

Definition Planting rapid-growing annual grasses, small grains, or legumes to provide initial, temporary cover for erosion control on disturbed areas.

Purpose To temporarily stabilize denuded areas that will not be brought to final grade for a period of more than 21 calendar days.

Temporary seeding controls runoff and erosion until permanent vegetation or other erosion control measures can be established. In addition, it provides residue for soil protection and seedbed preparation, and reduces problems of mud and dust production from bare soil surfaces during construction.

Conditions Where Practice Applies On any cleared, unvegetated, or sparsely vegetated soil surface where vegetative cover is needed for less than 1 year. Applications of this practice include diversions, dams, temporary sediment basins, temporary road banks, and topsoil stockpiles.

Planning Considerations Annual plants, which sprout and grow rapidly and survive for only one season, are suitable for establishing initial or temporary vegetative cover. Temporary seeding preserves the integrity of earthen sediment control structures such as dikes, diversions, and the banks of dams and sediment basins. It can also reduce the amount of maintenance associated with these devices. For example, the frequency of sediment basin cleanouts will be reduced if watershed areas, outside the active construction zone, are stabilized.

Proper seedbed preparation, selection of appropriate species, and use of quality seed are as important in this Practice as in Practice 6.11, *Permanent Seeding*. Failure to follow established guidelines and recommendations carefully may result in an inadequate or short-lived stand of vegetation that will not control erosion.

Temporary seeding provides protection for no more than 1 year, during which time permanent stabilization should be initiated.

Specifications Complete grading before preparing seedbeds, and install all necessary erosion control practices such as, dikes, waterways, and basins. Minimize steep slopes because they make seedbed preparation difficult and increase the erosion hazard. If soils become compacted during grading, loosen them to a depth of 6-8 inches using a ripper, harrow, or chisel plow.

SEEDBED PREPARATION

Good seedbed preparation is essential to successful plant establishment. A good seedbed is well-pulverized, loose, and uniform. Where hydroseeding methods are used, the surface may be left with a more irregular surface of large clods and stones.

Liming—Apply lime according to soil test recommendations. If the pH (acidity) of the soil is not known, an application of ground agricultural limestone at the

rate of 1 to 1 1/2 tons/acre on coarse-textured soils and 2-3 tons/acre on fine-textured soils is usually sufficient. Apply limestone uniformly and incorporate into the top 4-6 inches of soil. Soils with a pH of 6 or higher need not be limed.

Fertilizer—Base application rates on soil tests. When these are not possible, apply a 10-10-10 grade fertilizer at 700-1,000 lb/acre. Both fertilizer and lime should be incorporated into the top 4-6 inches of soil. If a hydraulic seeder is used, do not mix seed and fertilizer more than 30 minutes before application.

Surface roughening—If recent tillage operations have resulted in a loose surface, additional roughening may not be required, except to break up large clods. If rainfall causes the surface to become sealed or crusted, loosen it just prior to seeding by disking, raking, harrowing, or other suitable methods. Groove or furrow slopes steeper than 3:1 on the contour before seeding (Practice 6.03, *Surface Roughening*).

PLANT SELECTION

Select an appropriate species or species mixture from Table 6.10a for seeding in late winter and early spring, Table 6.10b for summer, and Table 6.10c for fall.

In the Mountains, December and January seedings have poor chances of success. When it is necessary to plant at these times, use recommendations for fall and a securely tacked mulch.

SEEDING

Evenly apply seed using a cyclone seeder (broadcast), drill, cultipacker seeder, or hydroseeder. Use seeding rates given in Tables 6.10a-6.10c. Broadcast seeding and hydroseeding are appropriate for steep slopes where equipment cannot be driven. Hand broadcasting is not recommended because of the difficulty in achieving a uniform distribution.

Small grains should be planted no more than 1 inch deep, and grasses and legumes no more than 1/2 inch. Broadcast seed must be covered by raking or chain dragging, and then lightly firmed with a roller or cultipacker. Hydroseeded mixtures should include a wood fiber (cellulose) mulch.

MULCHING

The use of an appropriate mulch will help ensure establishment under normal conditions, and is essential to seeding success under harsh site conditions (Practice 6.14, *Mulching*). Harsh site conditions include:

- seeding in fall for winter cover (wood fiber mulches are not considered adequate for this use),
- slopes steeper than 3:1,
- excessively hot or dry weather,
- adverse soils (shallow, rocky, or high in clay or sand), and
- areas receiving concentrated flow.

If the area to be mulched is subject to concentrated waterflow, as in channels, anchor mulch with netting (Practice 6.14, *Mulching*).

Maintenance Reseed and mulch areas where seedling emergence is poor, or where erosion occurs, as soon as possible. Do not mow. Protect from traffic as much as possible.

References *Site Preparation*
6.03, Surface Roughening
6.04, Topsoiling

Surface Stabilization
6.11, Permanent Seeding
6.14, Mulching

Appendix
8.02, Vegetation Tables

Table 6.10a
Temporary Seeding
Recommendations for Late
Winter and Early Spring

Seeding mixture	
Species	Rate (lb/acre)
Rye (grain)	120
Annual lespedeza (Kobe in Piedmont and Coastal Plain, Korean in Mountains)	50

Omit annual lespedeza when duration of temporary cover is not to extend beyond June.

Seeding dates
Mountains—Above 2500 feet: Feb. 15 - May 15
Below 2500 feet: Feb. 1- May 1
Piedmont—Jan. 1 - May 1
Coastal Plain—Dec. 1 - Apr. 15

Soil amendments
Follow recommendations of soil tests or apply 2,000 lb/acre ground agricultural limestone and 750 lb/acre 10-10-10 fertilizer.

Mulch
Apply 4,000 lb/acre straw. Anchor straw by tacking with asphalt, netting, or a mulch anchoring tool. A disk with blades set nearly straight can be used as a mulch anchoring tool.

Maintenance
Refertilize if growth is not fully adequate. Reseed, refertilize and mulch immediately following erosion or other damage.

**Table 6.10b
Temporary Seeding
Recommendations for
Summer**

Seeding mixture	
Species	Rate (lb/acre)
German millet	40
<p>In the Piedmont and Mountains, a small-stemmed Sudangrass may be substituted at a rate of 50 lb/acre.</p>	
Seeding dates	
Mountains—May 15 - Aug. 15	
Piedmont—May 1 - Aug. 15	
Coastal Plain—Apr. 15 - Aug. 15	
Soil amendments	
Follow recommendations of soil tests or apply 2,000 lb/acre ground agricultural limestone and 750 lb/acre 10-10-10 fertilizer.	
Mulch	
Apply 4,000 lb/acre straw. Anchor straw by tacking with asphalt, netting, or a mulch anchoring tool. A disk with blades set nearly straight can be used as a mulch anchoring tool.	
Maintenance	
Refertilize if growth is not fully adequate. Reseed, refertilize and mulch immediately following erosion or other damage.	

Table 6.10c
Temporary Seeding
Recommendations for Fall

Seeding mixture	
Species	Rate (lb/acre)
Rye (grain)	120
Seeding dates	
Mountains—Aug. 15 - Dec. 15	
Coastal Plain and Piedmont—Aug. 15 - Dec. 30	
Soil amendments	
Follow soil tests or apply 2,000 lb/acre ground agricultural limestone and 1,000 lb/acre 10-10-10 fertilizer.	
Mulch	
Apply 4,000 lb/acre straw. Anchor straw by tacking with asphalt, netting, or a mulch anchoring tool. A disk with blades set nearly straight can be used as a mulch anchoring tool.	
Maintenance	
Repair and refertilize damaged areas immediately. Topdress with 50 lb/acre of nitrogen in March. If it is necessary to extent temporary cover beyond June 15, overseed with 50 lb/acre Kobe (Piedmont and Coastal Plain) or Korean (Mountains) lespedeza in late February or early March.	

6.11

PERMANENT SEEDING



Definition Controlling runoff and erosion on disturbed areas by establishing perennial vegetative cover with seed.

Purpose To reduce erosion and decrease sediment yield from disturbed areas, to permanently stabilize such areas in a manner that is economical, adapts to site conditions, and allows selection of the most appropriate plant materials.

Conditions Where Practice Applies Fine-graded areas on which permanent, long-lived vegetative cover is the most practical or most effective method of stabilizing the soil. Permanent seeding may also be used on rough-graded areas that will not be brought to final grade for a year or more.

Areas to be stabilized with permanent vegetation must be seeded or planted within 15 working days or 90 calendar days after final grade is reached, unless temporary stabilization is applied.

Introduction During the initial phase of all land disturbing projects, the protective layer, either natural or man-made, is removed from the earth's surface. As the protective layer is removed, the resulting bare areas are exposed to the natural forces of rainfall, freezing, thawing, and wind. The result is soil erosion that leads to sediment pollution of North Carolina streams, rivers, lakes, and estuaries.

This design manual presents many alternative strategies for preventing erosion and reducing sediment loss during the construction process. Establishment of protective vegetative cover during the construction project, however, is the crucial step in achieving soil stabilization, controlling soil erosion, and preventing sedimentation of waterways. Without a sufficient amount of root mat and leaf cover to protect and hold the soil in place, large volumes of soil will be lost and waterways will be degraded long after projects are considered complete.

Sections of this practice standard address many of these various situations and set forth selection criteria for the appropriate cover based on purpose and adaptability. Some sediment and erosion control practices recommended in earlier editions of the manual may no longer be applicable. For example, many popular and commonly used seed and plant varieties have been identified as invasive. Invasive plants are defined as species that aggressively compete with, and displace, locally adapted native plant communities. In select cases where no practical alternative is available, these plants may be considered on a limited basis for soil stabilization, understanding that the goal is to eliminate the use of all invasive plants in favor of non-invasive native and/or introduced species that will provide an equally acceptable vegetative cover. Where there is no alternative to the use of invasive species, measures need to be incorporated in the installation and maintenance of these plants to limit their impacts.

It is imperative that disturbed soils be totally protected from erosion and sediment loss during construction and before a project is considered complete and acceptable. Installing appropriate vegetation in an immediate and timely fashion is the optimal means of achieving this stabilization. Vegetative specifications for most exposed soil conditions across North Carolina are provided in this section of the manual. It should be noted however, that no two sites in the State are exactly alike; therefore the protective vegetative cover for individual sites should be carefully selected. Each requires its own investigation, analysis, design and vegetative prescription as set forth in this section of the manual.

This practice standard describes three stages of vegetative cover; immediate, primary and long term. Effective and acceptable stabilization can be provided only when the optimum combination of immediate, primary, and long term vegetative practices are applied.

The vegetative measures presented in this chapter include application of seed, sod and sprigs. Use of field and container grown plants are not addressed in this manual. Planting of these types of vegetation is typically at spacing and intervals that will not provide the required protective cover. However, the design professional is encouraged to utilize these larger plants to compliment the required protective cover, particularly where these types of plants will provide seed for continued long term cover and wildlife habitat.

PLANNING CONSIDERATIONS

SOILS

Test and analyze the type(s) and quality of the existing soils on a site, their pH ranges, and their nutrient levels. Taking soil samples from the different areas of the project site and having them tested at a state or independent lab will provide a baseline for determining the pH modifiers and additional nutrients required for the selected plant varieties.

Disturbed conditions on a site may produce a variety of soil communities. Nutrient and pH levels in deeply cut soils will be quite different from those soils found on the original surface. When sites are highly disturbed through mechanical means such as grading, the soils become mixed together in many different ratios. These areas should be identified and tested.

Results from soil tests will usually include recommended application rates of soil modifiers such as lime and fertilizer for the selected plant species in the particular soils. Application rates will be itemized in the report.

The texture of the soil on a site, which is the proportion of sand, silt, and clay in the soil, is an important physical indicator of the site's ability to support vegetation. In heavy clay soils amendments may be necessary to provide an adequately drained planting medium. Conversely, in extremely sandy soils, amendments may be required to provide for moisture and nutrient retention.

Soil tests will indicate the texture of the given soil but will not provide recommendations for amendments that will improve the soil texture. Generally, the addition of organic materials will improve the porosity of heavy clay soils and improve the water holding capacity of extremely sandy soils. On sites where these different soil conditions exist, it is recommended that a design professional with experience in soil modification be employed to recommend the proper amendments.

For more information visit the NCDA Agronomic Services Soil Testing web page <http://www.agr.state.nc.us/agronomic/sthome.htm>

SOIL PREPARATION

Proper soil preparation is necessary for successful seed germination and root establishment. It is also necessary for establishment of rooted sprigs, sod and woody plants. Heavily compacted soils prevent air, nutrients and moisture from reaching roots thereby retarding or preventing plant growth. The success of site stabilization and reduction of future maintenance are dependent on an adequately prepared soil bed. Following are the requirements for preparation of areas to be vegetated by grassing, sprigging, sodding, and/or planting of woody plants:

General Requirements:

- Preparation for primary/permanent stabilization shall not begin until all construction and utility work within the preparation area is complete. However, it may be necessary to prepare for nurse crops prior to completion of construction and installation of utilities.
- A North Carolina Department of Agriculture Soils Test (or equal) shall be obtained for all areas to be seeded, sprigged, sodded or planted. Recommended fertilizer and pH adjusting products shall be incorporated into the prepared areas and backfill material per the test.
- All areas to be seeded or planted shall be tilled or ripped to a depth specified on the approved plans, construction sequence and/or construction bid list. Ripping consists of creating fissures in a criss-cross pattern over the entire surface area, utilizing an implement that will not glaze the side walls of the fissures. Site preparation that does not comply with these documents shall not be acceptable. The depth of soil preparation may be established as a range based on the approval of the reviewing state or local agency. Once tilled or ripped according to the approved plan, all areas are to be returned to the approved final grade. pH modifiers and/or other soil amendments specified in the soil tests can be added during the soil preparation procedure or as described below.
- All stones larger than three (3) inches on any side, sticks, roots, and other extraneous materials that surface during the bed preparation shall be removed.

Areas to be Seeded:

- Till or disc the prepared areas to be seeded to a minimum depth of four (4) inches. Remove stones larger than three (3) inches on any side, sticks, roots and other extraneous materials that surface. If not incorporated during the soil preparation process, add pH modifier and fertilizers at the rate specified in the soil test report.
- Re-compact the area utilizing a cultipacker roller. The finished grade shall be a smooth even soil surface with a loose, uniformly fine texture. All ridges and depressions shall be removed and filled to provide the approved surface drainage. Seeding of graded areas is to be done immediately after finished grades are obtained and seedbed preparation is completed.

Areas to be Sprigged, Sodded, and/or Planted:

- At the time of planting till or disc the prepared areas to a depth of four (4) to six (6) inches below the approved finished grade. Remove all stones larger than three (3) inches on any side, sticks, roots and other extraneous materials that surface. If not incorporated in the ripping process, add pH modifier, fertilizer, and other recommended soil amendments.
- Re-compact the area utilizing a cultipacker roller and prepare final grades as described above. Install sprigs, sod and plants as directed immediately after fine grading is complete. Mulch, mat and/or tack as specified.

VEGETATION

Availability of seed and plant materials is an important consideration of any construction stabilization effort. Throughout North Carolina, climate, economics, construction schedule delays and accelerations, and other factors present difficult challenges in specifying the different vegetation needed for site stabilization. To help resolve this issue, vegetative stabilization requires consideration in three categories:

- Immediate Stabilization – nurse crop varieties (Note: temporary mulching may be utilized for immediate stabilization if outlined on the approved plans and construction sequence.)
- Primary Stabilization – plant varieties providing cover up to 3 years with a specified maintenance program
- Long Term Stabilization – plant varieties providing protective cover with maintenance levels selected by the owner

An adequate job in one of these areas does not guarantee success in the later phases. Horticultural maintenance must be included in the plans.

Immediate vegetative cover will always require additional fertilization, soil amendments, soil tests, overseeding and/or other horticultural maintenance until primary vegetative cover is established.

Where provisions are made for regular maintenance, primary vegetative cover may be the end result. An example of primary vegetative cover being acceptable as an end use would be lawns in residential and commercial developments that are established, monitored and complimented with regular and approved horticultural maintenance practices. (See Example 6.11.a.)

In projects where continual maintenance will not be provided or scheduled following the primary stabilization of a project, long-term stabilization will be necessary. Maintenance of initial and long-term stabilization can cease only after the long-term cover has established and hardened to local climatic conditions. Maintenance of long-term vegetation must be included in the project construction sequence and on the approved plans. Examples of areas suitable for long term vegetation include roadsides, reforestation areas, restored flood plains, restored riparian areas, phased closing of landfills, and mining reclamations.

Complete stabilization requires using at least two, and most times, all three vegetative phases. The design professional must clearly communicate this point in their specifications, construction sequence, and in direct communications to owners and installers. The charts in tables 6.11.a through 6.11.d provide information to assist the design professional in this task. The tables are not inclusive and are presented only as alternatives. The professional is expected and required to provide design and specifications that combine the information in the manual with knowledge of the particular sites and their constraints.

pH AND NUTRIENT AMENDMENTS

Determining the nutrients that enable seed and container plants to grow, flourish, and become established after planting are critical elements of the design and stabilization process. The soils tests previously described will provide a recipe for amendments based on particular plants and particular soils. The test results will recommend the amounts of base elements (nitrogen, phosphorous, potassium), pH modifiers and other trace elements that should to be added to the soil for selected species of seeds and plants.

The acid/base characteristic of the soil is a primary component of soil fertility. If the soil acidity is not in the proper range, other nutrients will be ineffective, resulting in less productive plant growth. Most plants grow best in a pH range of 6.5 – 7.0 (slightly acidic to neutral). The soil tests will recommend the specific amendments and application rates required to achieve this range. These amendments must be incorporated into the soil (not applied on the surface) to be effective. (See the General Requirements for soil preparation specifications and timing for incorporation of soil amendments.)

The base elements are easily found in bulk quantities. Lime can also be obtained in large quantities. They all must be thoroughly incorporated into the soil through appropriate mechanical means. Ground surface applications without proper soil mixing will result in poor results.

In addition to the base fertilizers, other trace elements are needed to produce healthy and vigorous growth. These include but may not be limited to sulfur, manganese, zinc, boron, chlorine and molybdenum. If not already included with bulk mixes of the base elements, they can be obtained from commercial suppliers.

Provisions for soils test during and/or after initial grading is complete shall be included on the approved plan, in the approved construction sequence, and on the bid item list utilized for the project. *If you did not obtain a soil test:* Follow these recommendations for all grasses except centipedegrass.

1. Apply 75 pounds of ground limestone per 1,000 sq. ft.
2. Apply a starter type fertilizer (one that is high in phosphorus) based on the type of grass and planting method. Fertilizer bags have a three-number system indicating the primary nutrients, such as 8-8-8 or 5-10-10. These numbers denote the N-P-K ratio—the percentage of each nutrient in a fertilizer. The percentages are always noted in the following order:

N Nitrogen for green color and growth.

P₂O₅ Phosphorus for good establishment and rooting.

K₂O Potassium to enhance pest and environmental stress tolerance.

Some common examples of starter type fertilizers required for a 1,000 sq. ft. area include 40 pounds of 5-10-10, 20 pounds of 10-20-20, or 16 pounds of 18-24-6. For sandy soils, typical to coastal plain and sandhills of North Carolina, fertilizer rates should be increased by 20 percent.

Where available, it is recommended that the design professional specify organic compounds that meet the fertilization requirements, pH and other element requirements. Initial studies have indicated that these compounds have a more positive effect on the environment than some of the synthetic compounds used to manufacture inorganic fertilizers. These materials are readily available in the commercial trade as well as found in recycled yard waste debris, sewerage sludge, lime-stabilized sludge and animal manures. Materials proposed for use must be industry certified and/or privately tested and certified to be acceptable for proposed areas of use and application prior to approval.

MULCHES AND TACKING AGENTS

Mulches and tacking agents may be required or necessary to protect a seedbed's disturbed surface until the seed can germinate and provide the required protection from erosion. Selection of the materials used in this application should be based on their ability to hold moisture in the soil, as well as protect exposed soil from rainfall, storm water runoff, and wind. The availability of the selected material and the means to apply it are critical factors to consider when planning for the stabilization of any disturbed area. The mulch must cover a minimum of eighty (80) percent of the soil surface and must be secured by a tacking agent, crimping, or protective biodegradable netting. Netting that incorporates plastic mesh and/or plastic twine should not be used in wetlands, riparian buffers or floodplains due to the potential of small animal mortality. See Section 6.14 for detailed specifications and product applications.

SOIL BLANKETS

Soil blankets can be an acceptable and effective method of temporary sediment and erosion control in lieu of nurse crops. See Section 6.17 of the manual for descriptions of this product and how it can be used in conjunction with this section. In absence of mulches and tracking agents other means of protection may be necessary and required.

PROTECTIVE MATTING

Protective matting consists of an impervious cover secured to the soil surface in lieu of vegetative cover. It is used to protect and stabilize the surface where the process of seeding or planting forms of vegetation may cause more erosion and off-site sedimentation than application of the mat. It is also used where a disturbed area is intended to lay fallow for a period of time before additional construction or land disturbance takes place. If a pervious matting is selected, a combination of vegetation and matting is required. Seeds can be applied prior to installation of the matting only after proper seedbed preparation has been provided. Also, live stakes, dormant sprigs, and other vegetation forms can be inserted in the pervious matting once it has been installed. Pre-seeded pervious matting may be used for quicker root establishment and stabilization only if certified dating and germination guarantees are provided. The reviewing agency must approve all pre-seeded matting on site prior to installation. Matting that incorporates plastic mesh and/or plastic twine should not be used in wetlands, riparian buffers or floodplains due to the potential of small animal mortality. See Section 6.17 for detailed specifications and recommended product applications.

STABILIZATION IN WETLANDS, RIPARIAN BUFFERS, AND FLOODPLAINS

Land disturbing activity involving streams, wetlands or other waterbodies may also require permitting by the U.S. Army Corps of Engineers or the N.C. Division of Water Quality. Approval of an erosion and sedimentation control plan is conditioned upon the applicant's compliance with federal and State water quality laws, regulations, and rules. Additionally, a draft plan should be disapproved if implementation of the plan would result in a violation of rules adopted by the Environmental Management Commission to protect riparian buffers along surface waters. Care should be taken in selecting vegetative stabilization of wetlands and riparian buffers to comply with permitting requirements of other agencies, as well as provide adequate ground cover.

Planning Considerations for Land Disturbing Activities Within Wetland, Riparian, and Floodplain Areas

Wetlands, riparian areas, floodplains, and/or terrestrial areas between streams and uplands, serve to buffer surface water and provide habitat for aquatic and terrestrial flora and fauna. When cleared and disturbed, these sensitive areas are difficult to protect. Because of their proximity to water courses, relatively high ground water tables, and flooding potential, detailed analysis and design is necessary to determine the appropriate erosion control measures during construction. Determining the appropriate and most expeditious means of permanent vegetative stabilization in these areas requires equally detailed analysis and design. The following considerations for erosion control and stabilization should be taken into account during the design phase of the land disturbing project where sensitive areas are involved:

- Obtain soil tests to determine the soil type, pH, texture and available nutrients.
- Based on the soil tests provide a schedule of nutrients and other soil amendments that will be required.

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- Select a seeding mix of non-invasive species that will provide immediate stabilization (a short-term environment that will support and compliment permanent vegetative stabilization) and include a selective native species mix that will eventually provide a permanent cover (a long-term environment that, with minimal maintenance, will provide adequate root and leaf cover).
 - Invasive species are to be avoided. If native species and introduced non-invasive seed sources are not available, protective matting that will hold and foster the development of native cover from adjacent seed sources should be used. Continuous maintenance must be employed until the selected species have matured and are no longer susceptible to competition from invasive plants. If no alternative to the use of invasive seeds and plants is available, invasives approved on the plans may be utilized only with strict containment measures outlined in detail on the plans, in the construction sequence and in the maintenance specifications.
 - A quickly germinating nurse crop of non-invasive, non-competitive annual grass species can be used along with native seeding and/or matting. These temporary systems should be planted at minimal density so that they do not inhibit the growth and establishment of the permanent, native species. (See the plant chart in Table 6.11.a for recommended native and nurse crop species.)
 - Seed bed preparation is key to successful establishment of seeds. Particular care should be taken, however, when working in wetlands, riparian areas, or floodplains due to their sensitive nature. Careful consideration should be given to the types and placement of large equipment working in these areas. This process must be outlined in detail on the plan's construction sequence.
 - Installation techniques vary and should be planned for accordingly.
 - A maintenance plan must be established for optimal plant establishment, submitted with the plans and included in the bid list for the project.

Like all construction sites, wetlands, riparian areas, and floodplains will vary widely in physical makeup across North Carolina. Different conditions will dictate specific treatment, design and plant selection within the Mountains, Piedmont, and Coastal Plain regions. Soil tests, seedbed preparation, mulching, matting, and maintenance will be critical for successful vegetative establishment and long-term protection of these environmentally sensitive areas. Unavoidable impacts to these areas during land disturbing activities need to be addressed in detail on the plan sheets and construction sequence.

Native Seed and Plant Selection for Stabilization of Wetlands, Riparian Areas, and Floodplains

Upon the completion of the land disturbing activity, vegetative cover must be established on all areas not stabilized by other means. If work in these areas stops for more than 15 working days, temporary vegetative cover and/or matting must be applied to all disturbed areas. The goal is to protect these areas from erosion and to prevent sedimentation of adjacent streams, wetlands, lakes, and other water bodies.

Planning considerations for wetlands, riparian areas and floodplains will require additional research, detail and specifications. Native grasses are usually required as a condition of a 401 Water Quality Certification or a trout buffer variance.

Native vegetative species are plant species that naturally occur in the region in which they evolved. These plants are adapted to local soil types and climatic variations. Because most native species do not germinate and establish as readily as some introduced species, it is necessary to provide a non-native nurse crop or matting to stabilize the soil until the native crop can become established as the dominant cover. Once established, the native plants will produce an extensive root structure that, if properly maintained, will stabilize soils and reduce erosive forces of rainfall and overland stormwater flow. Many of these plants also possess characteristics that, when established, allow them not only to survive, but also to thrive under local conditions.

Seeding a mixture of perennial native grasses, rushes, and sedges is a way to establish permanent ground cover within wetlands, riparian areas and floodplains. The use of propagated plants is another method of reestablishing natives in these environments. Selecting a seed mixture and/or propagated plants of different species with complimentary characteristics will provide vegetation to fill select niches on sites with varying physical conditions. The design professional should note that because most native species do not germinate and establish as readily as some introduced species, it is necessary to provide a non-native nurse crop or matting to stabilize the soil until the native crop can become established as the dominant cover. For additional information about acceptable nurse crop varieties, consult the planting list in Appendix 8.02, local seed and plant suppliers, the North Carolina Cooperative Extension Service or a qualified design professional to assure the proper selection and plant mix.

Permanent native seed species within the seed mixture should be selected based on natural occurrence of each species in the project site area. Climate, soils, topography, and aspect are major factors affecting the suitability of plants for a particular site and these factors vary widely across North Carolina, with the most significant contrasts occurring among the three major physiographic regions of the state – Mountains, Piedmont, and Coastal Plain. Sub-regions of the state should also be considered. For example, the Triassic Basin in the Piedmont region may have characteristics that call for special soil treatment, limited plant selection, and special maintenance. Even within the riparian area, there may be need for different species depending on site conditions (i.e., dry sandy alluvial floodplains with wet pockets). Therefore, thoughtful planning is required when selecting species for individual sites in order to maximize successful vegetation establishment.

Native seed and plant species are included on the plant list in Appendix 8.02 of this manual.

The design professional should note that regardless of the benefits and advantages of native seeds and plants, there are potential issues if proper planning, installation and maintenance do not occur. These may include:

- Potential for erosion or washout during the establishment stage;
- Seasonal limitation on suitable seeding dates and availability of seed and plants;
- Adaptability of species at specific sites;
- Availability of water and appropriate temperatures during germination and early growth; and
- Lack of maintenance to control invasive plants and undesirable competition.

PLANTING

- **Seed** – Prepare the seed bed as described above in soil preparation. Apply seed at rates specified on the plans, and/or as recommended in Tables 6.11a-c of this manual, with a cyclone seeder, prop type spreader, drill, or hydroseeder on and/or into the prepared bed. Incorporate the seed into the seed bed as specified. Provide finished grades as specified on the approved plan and carefully culti-pack the seedbed as terrain allows. If terrain does not allow for the use of a cultipacker, the approved plans and construction sequence must provide an alternative method of lightly compacting the soil. Mulch immediately.
- **Sprigs and Sod** – Install onto the prepared seed bed per the most current guidance in Carolina Lawns, NCSU Extension Bulletin AG-69, or Practice 6.12 *Sodding*.

- **Woody plants (liners, container, B&B)** – These materials are typically used to complement an herbaceous protective cover. They eventually are major components of long-term, permanent stabilization and should be chosen and planned in conjunction with immediate and long-term maintenance. The plants should be selected and specified by the design professional for each individual project. See Practice 6.13 *Trees, Shrubs, Vines, and Ground Covers*.

MAINTENANCE

The absence of or an incomplete landscape management specification and/or complete maintenance schedule shall constitute grounds for disapproval of the plans. Proper maintenance is critical for the continued stabilization once vegetative cover is established. Although maintenance strategies for different sites may be similar, no two construction sites in North Carolina have been or will be able to be controlled or protected in identical ways. Variations in climate, topography, soils, available moisture, size and many other conditions will dictate the maintenance methodology to be used. A detailed schedule of maintenance will be required on the plans. This schedule will illustrate how the initial planting will be maintained to assure immediate, short term and permanent protection. The schedule will address topics such as appropriate irrigation of plants during the early establishment phase, drought conditions, excessive rainfall, mulch replacement, supplemental seeding, supplemental soils tests, application of nutrients and amendments, control of competitive and invasive species, disease and insect control, and corrective maintenance, measures to address failure of vegetation to become established. Contractual responsibility for maintenance after initial establishment of vegetative cover will be provided on the plans, in the construction sequence and on the bid list for the project. Maintenance bonds and/or warranty guarantee may be required of the responsible party, especially for areas in or adjacent to environmentally sensitive sites such as wetlands, riparian buffers, floodplains, and waters of the State. See Example 6.11a for a sample maintenance specification and a minimum maintenance check list that shall be provided on all plans.

RECOMMENDED BID LIST

(These items should be itemized on documents utilized to obtain pricing for planting pertaining to vegetative stabilization of land disturbing projects in North Carolina.)

- Soil test prior to grading (price per each test).
- Soil test during grading operations (price per each test).
- Soil test at completion of grading and/or prior to seeding, sprigging, sodding and application of fertilizer, lime, and other soil amendments (price per each test).
- Ripping/subsoiling to a depth of six (6) inches. (Provide an alternate for ripping to a depth greater than six (6) inches.) (price per acre)
- Tilling/discing ripped area to a depth of four (4) inches and re-compacting with a cultipacker roller (include in seeding price).

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- Seeding (price per square foot).
 - Mulching (price per square foot).
 - Repair seeding (price per square foot).
 - Repair mulching (price per square foot).
 - Matting (price per square yard).
 - Watering (price per thousand gallons).
 - Mowing (price per square foot).

SEEDING RECOMMENDATIONS

The following tables list herbaceous plants recommended for use as nurse crops for immediate stabilization and primary crops for initial and long-term stabilization. Nurse crops are expected to develop in two to five weeks and, with adequate maintenance, be an effective method of soil stabilization for a period of six months to one year. Nurse crops are not effective as primary long-term cover, however if properly maintained they can be an adequate cover and protection for the development of primary crops.

The goal for a primary crop is for it to develop over a three-week to one-year period and be effective up to three years with a well-defined maintenance program. The long-term goal for a primary crop is the initial step toward a sustainable protective cover without the need of maintenance. Where the primary crop is intended for a managed lawn and landscape aesthetics, the effective period can be extended by a more intense maintenance program. Where native species are utilized and become established during the planned maintenance program, a permanent cover that will support future succession species should exist and require little or no additional maintenance or management.

In uses of both nurse and primary crops, the development periods listed on the tables are optimal based on normal climatic conditions for the planting dates listed. The sediment and erosion control maintenance program must recognize that optimum temperatures and rainfall are the exception rather than the rule. The design professional needs to provide flexibility in the stabilization plan to address the potential ranges of temperature and moisture conditions we experience in North Carolina.

Practice Standards and Specifications

Information is provided for seeding rates, optimum planting dates in the state's three regions, sun and shade tolerance, invasive characteristics, compatibility in wetlands and riparian buffers, and installation maintenance considerations. By going through the lists the design professional can select the nurse and primary seed varieties and maintenance characteristics they feel are best suited for their site conditions, vegetation management expertise and maintenance capabilities.

To use the information in the seeding charts the plan preparer must:

- Determine what nurse crop best fits their site, soil conditions, and permanent seed mix.
- Obtain soil tests for all areas to be seeded.
- Know the site's region: mountains, piedmont, or coastal plain.
- Know if the areas to be seeded are sunny, part shade, or full shade.
- Know if the areas are well or poorly drained.
- Know if wetlands or riparian buffers are included in the areas to be seeded.
- Know if a chosen crop is invasive and if so, what potential impacts it will have on the site and adjacent properties.

With this knowledge the plan preparation may proceed utilizing the charts provided to provide the several seed mixes that will be applicable to the different areas requiring stabilization.

Table 6.11.a

HERBACEOUS PLANTS-Seeding recommendations for immediate stabilization/nurse crops (2 to 5 weeks for development; effectiveness goal: 6 months to 1 year stabilization)
NURSE CROP SPECIES

Common Name	Botanical Name	Native / Introduced	Seeding Rates (lb/acre)	Fertilization (lb/acre)	Optimal Planting Dates			Sun/Shade Tolerant	Wellands	Riparian Buffers	Invasive Yes or No	Installation / Maintenance Considerations	Other information, commentary
					Mountains	Piedmont	Coastal Plains						
Rye Grain	<i>Sacale cereale</i>	I	40 lbs	By soil test	1/11 - 4/30	8/15 - 4/15	Sun	Yes	Yes	No	Must be mown to reduce competitiveness with permanent or long term vegetation		
Wheat	<i>Triticum aestivum</i>	I	30 lbs	By soil test	1/11 - 4/30	8/15 - 4/15	Sun	Yes	Yes	No	Must be mown to reduce competitiveness with permanent or long term vegetation	Not water tolerant. May be used in wetlands that are not continuously saturated.	
German Millet	<i>Setaria italica</i>	I	10 lbs	By soil test	5/11 - 9/30	5/15 - 8/15	Sun	Yes	Yes	No	Crop should be cut / disc prior to planting primary or long term vegetation	Not water tolerant. May be used in wetlands that are not continuously saturated.	
Browntop Millet	<i>Urochloa ramosa</i>	I	10 lbs	By soil test	5/11 - 9/30	5/15 - 8/15	Sun	Yes	Yes	No	Crop should be cut / disc prior to planting primary or long term vegetation	Not water tolerant. May be used in wetlands that are not continuously saturated.	
Sudangrass (hybrids)	<i>Sorghum saccharatum</i> <i>S. bicolor</i> ssp. <i>Drummondii</i>	I	15 lbs	By soil test	NR	NR	Sun	No	No	Yes	Crop should be cut / disc prior to planting primary or long term vegetation	Use only where plants and seed can be contained and controlled.	
Kobe Lespedeza	<i>Kummerowia striata</i> v. <i>kobe</i>	I	10 lbs	By soil test	5/1 - 9/1	5/1 - 9/1	Sun	No	No	No	Consult qualified horticulturalist or extension agent for over-seeding with primary cover	Use in Coastal Plain	
Korean Lespedeza	<i>Kummerowia stipulacea</i>	I	10 lbs	By soil test	5/1 - 9/1	5/1 - 9/1	Sun	No	No	No	Consult qualified horticulturalist or extension agent for over-seeding with primary cover	Use in Piedmont and Mountains. May become invasive with primary cover	

NOTES:

1. Seeding rates are for hulled seed unless otherwise noted.
2. Fertilizer & Limestone - rates to be applied in absence of soils tests. Recommended application rate assumes significantly disturbed site soils with little or no residual value.
3. NR means Species not recommended for this region or application area.
4. Invasive designation as determined by the N.C. Exotic Pest Plant Council and N.C. Native Plant Society.
5. Sprigging is not recommended for immediate stabilization unless terrain is flat heavy mulch is applied and no other immediate stabilization method is practical.

Table 6.11.b

HERBACEOUS PLANTS- Seeding recommendations for primary stabilization
 Successful development depends on planting date (effectiveness goal: 6 mo. - 3 yrs. without an ongoing maintenance program)

NON-NATIVE SPECIES

Common Name	Botanical Name / Cultivar	Native / Introduced	Broadcast Seeding Rates lbs/acre	Fertilization/ limestone lbs/acre	Optimal Planting Dates				Sun/Shade tolerant	Wellands	Riparian Buffers	Invasive Yes or No	Installation / Maintenance Considerations	Other information, commentary
					Mountains	Piedmont	Coastal Plains	Severe Threat Invasive species						
Scarica Lespedeza	<i>Lespedeza cuneata</i> <i>Durandii</i>	I	15 lbs	By soil test	9/1 - 5/1	9/1 - 5/1	10/1 - 4/1	Sun	NR	NR	Yes	Resprouts well to controlled burns		
Crown Vetch	<i>Securigera varia</i> (<i>Coronilla varia</i>)	I	15 lbs	By soil test	3/15-4/30	NR	NR	Sun	NR	NR	Yes	Highly competitive, not recommended unless an acceptable alternative is not available.	Prefers neutral soils	
Centipede Grass	<i>Eremochloa ophiuroid</i>	I	5 lbs 10 lbs. for road shoulders	By soil test	NR	Eastern only	9/1 - 5/1	Sun	NR	NR	No	Significant maintenance may be required to obtain desired cover	Does not tolerate high traffic. Acceptable for sodding	
KY 31 Tall Fescue	<i>Schedonorus phoenix</i> (<i>Festuca arundinacea</i>)	I	100 lbs	By soil test	8/15-5/1	9/1-4/15	9/30 - 3/15	Sun / mod. Shade	NR	NR	Yes	If utilized, it is imperative that maintenance includes a containment plan	Acceptable for sodding	
KY Blue Grass	<i>Poa pratensis</i>	I	15 lbs	By soil test	8/15-5/1	NR	NR	Sun	NR	NR	Yes	If utilized, it is imperative that maintenance includes a containment plan	Prefers neutral soils, highly competitive, not recommended unless an acceptable alternative is not available. Acceptable for sodding	
Hard Fescue	<i>Festuca brevipila</i> (<i>Festuca longifolia</i>)	I	15 lbs	By soil test	8/1 - 6/1	NR	NR	Shade	NR	NR	No	Not recommended for slopes greater than 5%	Low growing, bunch grass	
Bermuda Grass	<i>Cynodon dactylon</i>	I	25 lbs	By soil test	NR	4/15-6/30	4/15-6/30	Sun	NR	NR	Yes	If utilized, it is imperative that maintenance includes a containment plan	Extremely aggressive, not recommended and should be avoided unless an acceptable alternative is not available. May be sodded or sprigged	

Table 6.11.c

HERBACEOUS PLANTS-Seeding recommendations for primary stabilization
 Successful development depends on planting date (effectiveness goal: 6 mo. - 3 yrs. without an ongoing maintenance program)

NATIVE SPECIES

Common Name	Botanical Name / Cultivar	Native / Introduced	See Table 6.1d for variety seeding rates	Fertilization/ limonite lime/sulfate By soil test	Optimal Planting Dates				Sun/Shade tolerant	Wetlands	Riparian Buffers	Invasive Yes or No	Installation / Maintenance Considerations	Other information, commentary
					Moisture 12/1-4/15	Piedmont NR	Coastal Pines NR	Well drained only						
Switchgrass	<i>Panicum virgatum</i> / Cave-In-Rock	N	A	By soil test	NR	NR	NR	Sun	NR	Well drained only	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.		
Switchgrass	<i>Panicum virgatum</i> / Blackwell	N	A	By soil test	12/1 - 4/1	12/1-4/1	12/1-4/1	Sun	NR	Well drained only	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.		
Switchgrass	<i>Panicum virgatum</i> / Sheffer	N	A	By soil test	12/1 - 4/1	12/1-4/1	12/1-4/1	Sun	NR	Well drained only	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.		
Switchgrass	<i>Panicum virgatum</i> / Carriage	N	A	By soil test	12/1 - 4/1	12/1-4/1	12/1-4/1	sun	Yes	Yes	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.		
Switchgrass	<i>Panicum virgatum</i> / Karlo	N	A	By soil test	12/1 - 4/1	12/1-4/1	12/1-4/1	Sun	No	Poorly drained	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.		
Switchgrass	<i>Panicum virgatum</i> / Alamo	N	A	By soil test	NR	12/1 - 5/1	1/1 - 5/1	Sun	No	Poorly drained	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.		
Indiangrass	<i>Sorghastrum nutans</i> / Rumsey	N	B	By soil test	12/1-4/15	12/1 - 4/1	12/1-4/1	Sun	NR	Well drained	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Western coastal plain only	
Indiangrass	<i>Sorghastrum nutans</i> / Osage	N	B	By soil test	12/1-4/15	12/1 - 4/1	12/1-4/1	Sun	NR	Well drained	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Western coastal plain only	

Table 6.11.c (cont)

HERBACEOUS PLANTS-Seedling recommendations for primary stabilization
 Successful development depends on planting date (effectiveness goal: 6 mo. - 3 yrs. without an ongoing maintenance program)

NATIVE SPECIES

Common Name	Botanical Name / Cultivar	Native / Introduced	See Table 6.11.d for variety seedling rates	Fertilization/limes/acre	Optimal Planting Dates				Wetlands	Riparian Buffer's Well drained	Invasive Yes or No	Installation / Maintenance Considerations	Other information, commentary
					Mountains	Piedmont	Coastal Plains	Sun/Shade tolerant					
Indiangrass	<i>Sorghastrum nutans</i> / <i>Chaparral</i>	N	B	By soil test	12/1-4/15	12/1-4/1	12/1-4/1	Sun	NR		Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Western coastal plain only	
Indiangrass	<i>Sorghastrum nutans</i> / <i>LoneB</i>	N	B	By soil test	NR	12/1-5/1	1/1-5/1	Sun	NR	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Only Indiangrass adaptable to Eastern coastal plain (Zone B)	
Deertongue	<i>Dichanthum demissum</i> / <i>TagR</i>	N	C	By soil test	5/1-4/15	5/1-4/1	NR	Sun & Shade	Yes	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.		
Big Bluestem	<i>Andropogon grandis</i> / <i>Rainee</i>	N	D	By soil test	12/1-4/15	12/1-4/1	NR	Sun	NR	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Warm season grass	
Big Bluestem	<i>Andropogon grandis</i> / <i>Kaw</i>	N	D	By soil test	12/1-4/15	12/1-4/1	NR	Sun	NR	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Warm season grass	
Big Bluestem	<i>Andropogon grandis</i> / <i>Euf</i>	N	D	By soil test	12/1-4/15	12/1-4/1	12/1-5/1	Sun	NR	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Warm season grass	
Little Bluestem	<i>Scirpocalyptus scoparium</i> / <i>ACTS</i>	N	E	By soil test	12/1-4/15	NR	NR	Sun	NR	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Warm season grass	
Little Bluestem	<i>Scirpocalyptus scoparium</i> / <i>Common</i>	N	E	By soil test	12/1-4/15	12/1-4/1	NR	Sun	NR	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Warm season grass	

Table 6.11.c (con't)

HERBACEOUS PLANTS-Seedling recommendations for primary stabilization
 Successful development depends on planting date (effectiveness goal: 6 mo. - 3 yrs. without an ongoing maintenance program)

NATIVE SPECIES

Common Name	Botanical Name / Cultivar	Native / Introduced	See Table 6.11.d for variety seedling rates	Fertilizer/ limestone / bioreactor	Mountains	Placid	Consist Plains	Sun/Shade tolerant	Wetlands	Riparian Buffers	Invasive Yes or No	Installation / Maintenance Considerations	Other information, commentary
Little Bluestem	<i>Schizanthus</i>	N	E	By soil test	NR	NR	12/1-4/1	Sun	NR	Well drained	No	Responds well to controlled burns. Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Warm season grass
Sweet Woodruff	<i>Chrysanthemum</i>	N	F	By soil test	12/1-4/15	12/1-4/1	12/1-4/1	Sun & mod. Shade	Yes	Poorly to well drained	No	Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Warm season grass
Rice Cutgrass	<i>Leptocarpus</i>	N	G	By soil test	12/1-4/15	12/1-4/1	12/1-4/1	Sun	Yes	Poorly drained	No	Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Warm season grass
Indian Woodruff	<i>Chrysanthemum</i>	N	H	By soil test	3/1-5/15 7/15-9/15	2/15-4/1 9/15-10/15	2/15-3/20 9/15-11/1	Sun & mod. Shade	NR	Well drained	No	Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Cool season grass
Virginia Wild Rye	<i>Elymus virginicus</i>	N	I	By soil test	3/1-5/15 7/15-9/15	2/15-4/1 9/15-10/15	2/15-3/20 9/15-11/1	Sun & mod. Shade	NR	Well drained	No	Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Cool season grass
Eastern Bottlebrush Grass	<i>Elymus hystrix</i>	N	J	By soil test	3/1-5/15 7/15-9/15	2/15-4/1 9/15-10/15	NR	Sun & mod. Shade	NR	Well drained	No	Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	Cool season grass
Soft Rush	<i>Juncus effusus</i>	N	K	By soil test	12/1-5/15 8/15-10/15	12/1-5/1 9/1-11/1	12/1-4/15	Sun	Yes	Poorly drained	No	Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	
Shallow Sedge	<i>Carex flacca</i>	N	L	By soil test	12/1-5/15 8/15-10/15	12/1-5/1 9/1-11/1	12/1-4/15	Sun	Yes	Poorly drained	No	Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	
Fox Sedge	<i>Carex acutata</i>	N	L	By soil test	12/1-5/15 8/15-10/15	12/1-5/1 9/1-11/1	12/1-4/15	Sun	Yes	Poorly drained	No	Mix with 3 to 5 other seed varieties that have similar soil drainage adaptations.	

NOTE:

1. Seeding rates are for hulled seed unless otherwise noted.
2. Fertilizer & Limestone - rates to be applied in absence of soils tests.
3. NR means Species not recommended for this region or application area.
4. Native, warm season grasses require six or more months to germinate under optimum conditions. If they are planted in the summer, then a whole year will have to pass before they germinate.
5. Invasive designation as determined by the N.C. Exotic Pest Plant Council and N.C. Native Plant Society.
6. Sprigging is not recommended for immediate stabilization unless terrain is flat, heavy mulch is applied and no other immediate stabilization method is practical.
7. Sodding for immediate stabilization - see primary stabilization charts (other information column) and Section 6.12.
8. Long term stabilization can only be accomplished with an adequate, immediate, and primary stabilization program. To achieve long term protective cover with the species listed in

Table 6.11.d

Seed Mixes for Native Species (lbs/ac)
When Mixed with 3, 4, or 5 Other Native Species
 (See Table 6.11.a for nurse crop species to be added to these mixes)

	3 Other (total 4 species)	4 Other (total 5 species)	5 Other (total 6 species)
Switch Grasses (A)	3.5 lbs.	3.0 lbs.	2.5 lbs.
Indian Grasses (B)	7.0 lbs.	6.0 lbs.	5.0 lbs.
Deertongue (C)	6.0 lbs.	5.0 lbs.	4.0 lbs.
Big Bluestem (D)	7.0 lbs.	6.0 lbs.	5.0 lbs.
Little Bluestem (E)	7.0 lbs.	6.0 lbs.	5.0 lbs.
Sweet Woodreed (F)	2.5 lbs.	2.0 lbs.	1.5 lbs.
Rice Cutgrass (G)	6.0 lbs.	5.0 lbs.	4.0 lbs.
Indian Woodoats (H)	2.5 lbs.	2.0 lbs.	1.5 lbs.
Virginia Wild Rye (I)	6.0 lbs.	5.0 lbs.	4.0 lbs.
Eastern Bottlebrush Grass (J)	2.5 lbs.	2.0 lbs.	1.5 lbs.
Soft Rush (K)	2.5 lbs.	2.0 lbs.	1.5 lbs.
Sedges (L)	2.5 lbs.	2.0 lbs.	1.5 lbs.

NOTE:

With the native varieties, the seed mix should be in the range of 15 pounds per acre. Depending on availability of native seeds adaptable to North Carolina, the percentage of a particular variety used may be reduced or increased accordingly. Although diversity is desirable, it is imperative that the primary crop develop and become an effective protective cover. In addition to the native species mix, additional nurse crop species must be included to provide immediate stabilization and an adequate ground cover.

Example 6.11.a GUIDELINES FOR WRITING MINIMUM LANDSCAPE MANAGEMENT SPECIFICATIONS

Following is an outline that demonstrates what should be included in specifications that will insure the long term stabilization of disturbed sites in North Carolina. As noted before in this manual, each construction site in the state is unique and has features that will require special provisions for revegetation and stabilization. The outline provided below cannot address these individual sites. It is the responsibility of the design professional and the financially responsible party to see that the specifications are edited to fit their site and to assure that permanent stabilization is achieved.

General Provisions

A. Intent:

1. These specifications are prepared with the intent of promoting outstanding performance in long-term stabilization. They are to be used as guidelines in establishing sediment control and vegetative standards for the sites. Final technical decisions such as herbicides, fertilizer ratios, times of application and schedules are to be determined by the Contractor, who has the responsibility to obtain soil test and to manage the vegetation to achieve the desired results. The maintenance specifications must address maintenance for sediment and erosion control vegetation during construction and for permanent/long-term stabilization.

B. Description of Work:

1. Perform all work necessary and required for the (insert period of contract) maintenance of the project as indicated on the drawings, in the project manual, and specified herein.
2. Licensing:
 - a) Contractor shall provide verification of current, applicable pesticide applicator licensing for each applicator that will handle pesticides on the contracted sites.
3. Contract Administration
 - a) Staffing: The Contractor shall provide adequate staffing, with the appropriate expertise, to perform all required work.
 - b) Monthly Site Review meetings will be held. Attendees will include the Contractor's Project Manager and Site Foreman and the property manager or other representative designated by the financially responsible party. Result of site reviews will be documented and circulated to the attendees and the owner by the contractor.
 - c) The Contractor will communicate with the proper person on a monthly basis to summarize work performed and immediately notify the project manager of any failure of the site to remain stabilized.

II. Materials

- A. Soil Additives: Additives are to be applied per soils test taken prior to, during and after construction. **(Use this section to provide the types and quantities of fertilizers, lime, and other soil amendments called for in the soils report. Include all soils test reports in the specifications document. This narrative or list should include quantities, rates, mixes, organic information, manufacturer, sources, and other information suggested in the soils test.)**

A. Pesticides:

1. Establish an Integrated Pest Management (IPM) program for the site that relies on targeted insect and disease control coupled with sound stabilization management and water management practices.
2. These specifications do not include pesticide treatments for infestations of Southern Pine Beetle, Gypsy Moth, or Fire Ants. The contractor shall notify the Owner if these pests are observed on site.
3. All pesticides shall be applied by a North Carolina licensed applicator in accordance with all State and Federal regulations and per manufacturer's recommendations.

B. Mulches: Mulch for areas not subject to erosion and over wash by storm water should be called out in this section addressing its maintenance, replacement, removal and conversion to other uses. Those subject to erosion and over wash by storm water must be addressed on the plans and in the calculations.

III. Execution

A. General:

1. Good long term stabilization is based on the proper maintenance, management and balance of nutrients, soil moisture and general cultural practices. It is recognized that fewer fungicide and pesticide treatments as well as lower fertility rates are required with a well managed, balanced landscape. The following section is meant to promote this balance and therefore do not highlight specific quantitative standards. **(Quantitative standards should be addressed as site specific by the design professional in conjunction with the owner and contractor.)** Calendar references are general and are to be used only as a guide. Weather and soil conditions that are most appropriate for a given process, procedure and/or area of the state shall be the determining factor in scheduling work.

B. Soil Tests:

1. After the soil test prior to stabilization, tests shall be made yearly in the fall to determine the required soil additives for all stabilized areas. If known nitrogen requirements are not specified by previous test, they need to be determined by the subsequent soils test and the proper applications made. Fertilizer ratios may be determined through analysis of the soil tests coupled with the contractor's experience and knowledge of the site.

C. Mowing

1. Mowing for maintained turf/lawns

- a. Mow areas intended for "groomed appearance" on a schedule during the growing season and as required throughout the year to provide the desired appearance. **(Establish a mowing frequency here that addresses the specific plant species used and their growing habits.)** This frequency will be a minimum standard. Particular properties and their peculiar characteristics as well as individual plant species may require mowing more often than the stated minimum may be required. This should be noted in this section.
- b. The range of turf species suggested for lawns in the three growing regions of North Carolina vary as to optimum maintained height. The selected species should be maintained at a height recommended by the seed producer. Do not cut too short and do not allow the turf to attain a height that will cause the crop to decline or die. Consult individual seed producers and/or packaging for recommended mowing heights.
- c. Mow with a mulching mower to limit the amount of clippings removed, or mow and blow in such a manner that clippings are not evident and not to adversely effect the growing capacity

and/or health of the existing vegetation turf. It is important clippings are allowed to remain spread throughout the lawn area, to the extent possible, so that they might aid in building a more productive soil profile and root zone.

2. Mowing other stabilized areas to promote continued growth. Include mowing specification here for other stabilized areas which require maintenance but not a "groomed" appearance. Also include specifications for mowing areas where it is desirable for woody native volunteer vegetation to become established. This should include attention to mowing stakes or other way of protecting the desired woody natives from the mowing operation.

D. Watering

1. Irrigation System Maintenance and Monitoring: If stabilized areas are to be irrigated the design professional should include specifications for the system, its maintenance and its operation in this section.

2. In the absence of an automatic or manual irrigation system, provisions for providing adequate water to stabilized areas should be addressed in this section.

3. **(Provisions should be made in this section for adjustments to application rates of water during times of regulated droughts and/or periods of excessive rainfall.)**

E. CONTROL OF INVASIVES: Competition from invasive species can be detrimental to the establishment of the permanent vegetative cover. Left unchecked, these invasives can undermine a revegetation process in a short period of time and eventually lead to unprotected soil and sediment damage. Make site observations monthly to check for the presence of such species and, if found, treat them immediately with the appropriate cultural practices and/or by the use of seasonally-appropriate and site appropriate herbicides.

F. Maintenance items including fertilization, mowing, continued soils testing, repair, mulching, matting and soil preparation are to be addressed in the approved construction sequence and on the project bid list.

6.17



ROLLED EROSION CONTROL PRODUCTS

Definition Rolled erosion control products are manufactured or fabricated into rolls designed to reduce soil erosion and assist in the growth, establishment and protection of vegetation. Examples of RECP's are blankets, nets, and matting.

Purpose Erosion control mats and blankets are intended to protect soil and hold seed and mulch in place on slopes and in channels so that vegetation can become well established. Turf reinforcement mats can be used to permanently reinforce grass in drainage ways during high flows. Nets are made of high tensile material woven into an open net which overlays mulch materials. Blankets are made of interlocking fibers, typically held together by a biodegradable or photodegradable netting (for example, excelsior or straw blankets). They generally have lower tensile strength than nets, but cover the ground more completely. Coir (coconut fiber) fabric comes as both nets and blankets.

Conditions Where Practice Applies Rolled Erosion Control Products (RECP's) should be used to aid permanent vegetated stabilization of slopes 2:1 or greater and with more than 10 feet of vertical relief. RECP's should also be used when mulch cannot be adequately tacked and where immediate ground cover is required to prevent erosion damage.

RECP's should be used to aid in permanent stabilization of vegetated channels when runoff velocity will exceed 2 ft/sec on bare earth during the 2-year rainfall event that produces peak runoff. The product selected must have a permissible shear stress that exceeds the shear stress of the design runoff event.

Planning Considerations

- Good ground contact is critical to the effectiveness of these products. If good ground contact is not achieved, runoff can concentrate under the product, resulting in significant erosion.
- Nets must be used in conjunction with mulch. Excelsior, woven straw blankets and coir (coconut fiber) blankets may be installed without mulch. There are many other types of erosion control nets and blankets on the market that may be appropriate in certain circumstances. In general, most nets (e.g. jute matting) require mulch in order to prevent erosion because they have a fairly open structure. Blankets typically do not require mulch because they usually provide complete protection of the surface.
- Most netting used with blankets is photodegradable, meaning they break down under sunlight (not UV stabilized). However, this process can take months or years even under bright sun. Once vegetation is established, sunlight does not reach the mesh. It is not uncommon to find non-degraded netting still in place several years after the installation. This can be a problem if maintenance requires the use of mowers or ditch cleaning equipment. In addition, birds and small animals can become trapped in the netting.

- Biodegradable blankets are available for use in sensitive areas. These organic blankets are usually held together with a fiber mesh and stitching which may last up to a year.

Design Criteria The following discussion and examples of design are adapted from "*Green Engineering, Design Principles and Applications Using Rolled Erosion Control Products*" by C. Joel Sprague.

Slope Protection: Reducing raindrop and overland flow erosion. The Revised Universal Soil Loss Equation (RUSLE), as shown below, is commonly used to estimate erosion due to rainfall and sheet runoff.

$$A = R * K * LS * C * P$$

where:

A = soil loss in tons/acre/year
R = rain factor
K = soil erodibility
LS = topographic factor
C = cover factor
P = practice factor

The United States Department of Agriculture's handbook, "Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE), 1997," provides agriculture-oriented values for all of these variables. Yet, when the equation is used to estimate construction-related erosion, the following unique C- and P-factors developed specifically for these applications should be used.

The C-Factor—C-factors are equal to the reduction in soil loss when using a specific erosion control system when compared to the comparable bare soil (control) condition. The designer will require C-factors representing various conditions from unvegetated to fully vegetated, including vegetation, which has been mulched or, alternatively, protected by an RECP, in order to determine an appropriate factor to be used to represent the design condition. (See Table 6.17a for a range of C-factors.)

Table 6.17a C-Factor for Various Slope Treatments

Treatment	Dry Mulch Rate		C-Factor for Growing Period*			
	kg/m ³	Slope %	<6 Weeks	1.5-6 Months	6-12 Months	Annualized**
No mulching or seeding	—	all	1.00	1.00	1.00	1.00
Seeded grass	none	all	0.70	0.10	0.05	0.15
	0.22	<10	0.20	0.07	0.03	0.07
	0.34	<10	0.12	0.05	0.02	0.05
	0.45	<10	0.06	0.05	0.02	0.04
	0.45	11 - 15	0.07	0.05	0.02	0.04
	0.45	16 - 20	0.11	0.05	0.02	0.04
	0.45	21 - 25	0.14	0.05	0.02	0.05
	0.45	26 - 33	0.17	0.05	0.02	0.05
	0.45	34 - 50	0.20	0.05	0.02	0.05
Second-year grass	—	all	0.01	0.01	0.01	0.01
Organic and Synthetic Blankets	—	all	0.07	0.01	0.005	0.02
Composite Mats	—	all	0.07	0.01	0.005	0.02
Synthetic Mats	—	all	0.14	0.02	0.005	0.03
Fully Vegetated Mats	—	all	0.005	0.005	0.005	0.005

* Approximate time periods for humid climates: Conversion: kg/m³ x 4.45 = tons/acre.

** Annualized C-Factor = (<6 weeks value x 6/52) + (1.5-6 months value x 20/52) + (6-12 months value x 26/52).

Table 6.17b Permissible Shear Stress, τ_p , of Various RECP's

Category	Product Type	Max. Permissible Shear Stress (lb/ft ²)	Slopes* Up To
Degradable RECP's (Unvegetated)	Nets and Mulch	0.1 - 0.2	20:1
	Coir Mesh	0.4 - 3.0	3:1
	Blanket - Single Net	1.55 - 2.0	2:1
	Blanket - Double Net	1.65 - 3.0	1:1
Nondegradable RECP's	Unvegetated TRM**	2 - 4	1:1
	Partially Vegetated TRM	4 - 6	>1:1
	Fully Vegetated	5 - 10	>1:1

* Steeper slope limits may apply. For further information, contact the manufacturer.

** Turf Reinforcement Mat.

The P-Factor—when examining erosion by itself, is commonly taken as 1.0, since this assumes that no special “practices” (i.e. terracing, contouring, etc.) will be used. Yet, the use of silt fences or other storm water management/ sediment control practices may be integrated into the RUSLE using a P-factor that is less than 1.0, which reflects the effectiveness of the sediment control practice in removing sediment from runoff.

Sample Problem 6.17a

A steep slope is to be protected from erosion using RECP. The 3H:1V slope is 100 feet long and comprised of silty loam. The RUSLE will be used to evaluate the effectiveness of RECP in limiting annual soil loss. Following are the inputs to the RUSLE equation from the U.S. Department of Agriculture:

R = 250
K = 0.33
LS = 6.2
P = 1.0 (assuming no sediment control)

From Table 6.17a:

$C_{\text{unprotected}} = 1.00$
 $C_{\text{protected, year 1}} = 0.03$
 $C_{\text{protected, year 2+}} = 0.005$
 $A_{\text{unprotected}} = 250 \times 0.33 \times 6.2 \times 1.0 \times 1.0 = 511 \text{ tons/acre/year}$
 $A_{\text{protected, year 1}} = 250 \times 0.33 \times 6.2 \times 0.03 \times 1.0 = 15 \text{ tons/acre/year}$
 $A_{\text{protected, year 2+}} = 250 \times 0.33 \times 6.2 \times 0.005 \times 1.0 = 3 \text{ tons/acre/year}$

This example shows that vegetation, protected by an RECP, is 97 percent effective in reducing erosion in the first year and 99.5 percent effective in the longer-term.

Table 6.17b aids in selecting an appropriate type of RECP for the project-specific slope.

Drainage Channels Concepts—Permissible shear design is commonly used to determine if a channel liner is stable. This method requires the input of an appropriate expected flow rate (discharge) as well as the determination of flow depth. A broader presentation of channel design is located in Appendix 8.05, *Design of Stable Channels and Diversions*.

The design flow rate will be based on local storm frequency design standards and flow depth is calculated - commonly using Manning’s equation. With these inputs the designer can then perform a permissible shear design, which compares the permissible shear of the prospective liner materials to the expected flow-induced shear as calculated using the equation below.

$$\tau_c = Y D S$$

where:

Y = unit weight of water (62.4lb/ft³)
D = depth of flow (ft)
S = channel slope (ft/ft)

If the permissible shear stress, τ_p , is greater than the computed shear, τ_c , the lining is considered acceptable. Values for permissible shear stress, τ_p , for linings are based on research conducted at laboratory facilities and in the field. Typical values are given in Table 6.17b. The permissible shear stress, τ_p , indicates the force per unit area resulting from flowing water required to create instability of the lining material and/or adjacent soil.

Manning's Equation and Roughness Coefficient, n—The condition of uniform, steady flow in a channel at a known discharge is computed using the Manning's Equation below. Numerous computer programs are available to facilitate the use of this equation since a trial-and-error solution relating channel width, B, and depth, D, is required.

$$Q = (1.49/n) (A) (R)^{2/3} (S)^{1/2}$$

Manning's equation for determining velocity:

$$V = (1.49/n) (R)^{2/3} (S)^{1/2}$$

where:

- Q = discharge (cfs)
- V = average velocity in cross section (ft/s)
- n = Manning's roughness coefficient
- A = cross-sectional area (ft²)
- R = hydraulic radius = A/P (ft)
- P = wetted perimeter (ft)
- S = energy gradient (commonly taken as equivalent to the channel bed slope, ft/ft)

The appropriate Manning's "n" to use when designing with RECP's depends on whether one is designing for bare soil retention and vegetation establishment (short-term) or for fully grassed conditions (long term), or both. The "n" values for RECP's can vary significantly with material type and flow depth, but they typically range from 0.02 to 0.04 and are usually provided by the manufacturer.

In lieu of product-specific information, the following values can be used as approximations.

- $n_{unvegetated} = 0.02$
- $n_{vegetated} =$ refer to Table 6.17c and Figure 6.17a
- $n_{lined} =$ refer to Table 8.05e

Table 6.17c Grass Retardance Categories

Average Grass Length	Retardance
>24 in.	A
10 in. to 24 in.	B
6 in. to 10 in.	C
2 in. to 6 in.	D
Less than 2 in.	E

Figure 6.17a Hydraulic roughness of grass

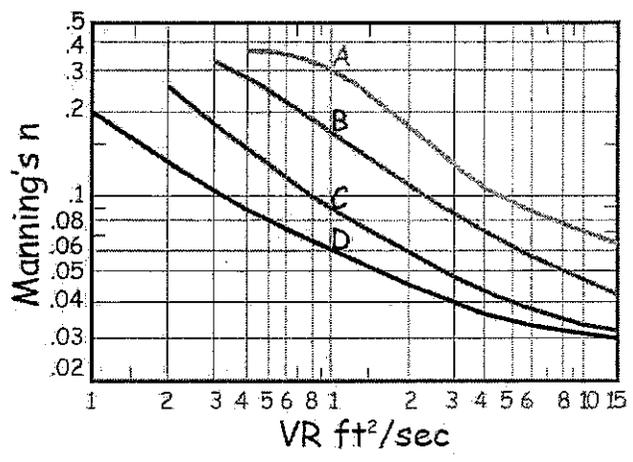


Figure 6.17b Limiting values for bare and TRM protected soils

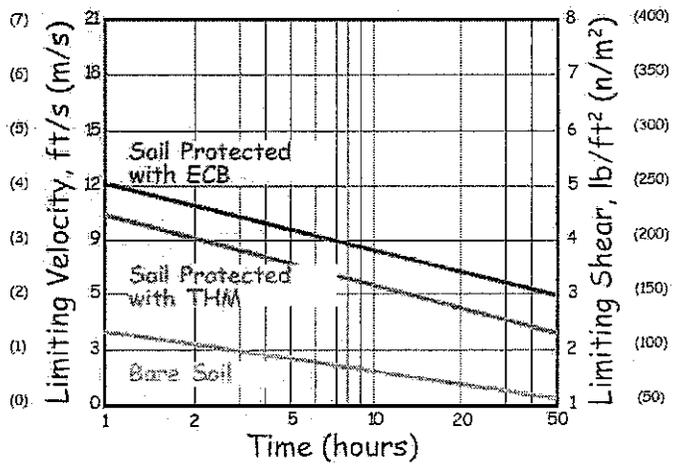
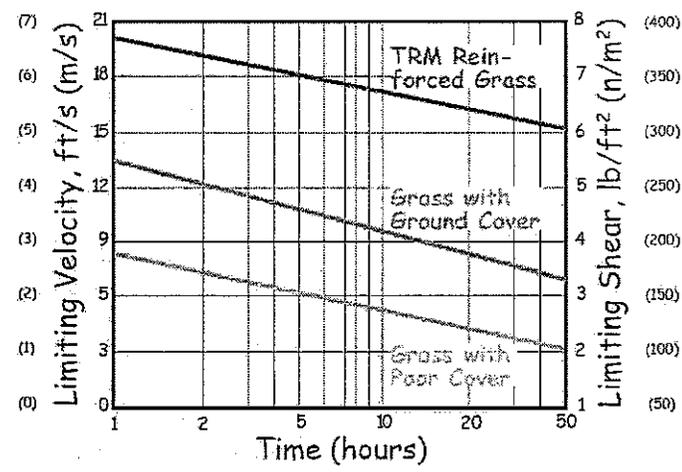


Figure 6.17c Limiting values for plain and TRM reinforced grass



Sample Problem
6.17b

Determine if an RECP-lined drainage channel will be stable for a long-term peak flow (10-year design storm) of 70 cfs down a 20:1 slope ($S=0.05$) with a 4 foot bottom width and 1:1 side slopes. The duration of flow is 50 hours for long-term and one hour for short-term design. The grass cover is expected to be in retardance group D. Short-term stability can be checked using the two-year design storm, which produces a short-term peak flow of 45 cfs.

Long-term design = vegetated channel stability

- Use $Q_{\text{peak}} = Q_{10\text{-year}} = 70$ cfs
- From Figure 6.17c: Limiting shear = 6 lb/ft²
- Assume $n_{\text{vegetated}} = 0.05$

Solve for the depth of flow using iterations of Manning's equation. An Excel spreadsheet located on the internet at <http://www.dlr.enr.state.nc.us/pages/sedimenttecassist.html> or commercially available channel software is recommended.

For trapezoidal channels:

$$(bd + zd^2) \left[\frac{(bd + zd^2)}{b + 2d(z^2 + 1)^{1/2}} \right]^{2/3} = \frac{Qn}{1.49S^{1/2}}$$

From trial-and-error, $d = 1.7$ ft

Determine area of flow A, from $A = (bd + zd^2)$
= 9.8ft²

Since slope < 1:10, calculate VR using:

$$V_{\text{estimate}} = 7.1 \text{ ft/s};$$

$$VR = (7.1 \text{ ft/s}) (1.11) = 7.88 \text{ ft/s}$$

From Figure 6.17a: Use $n = 0.032$. Recalculate $d = 1.34$ ft
 $A = 7.14$ ft²

$$\text{Check shear stress } \tau_c = YDS$$

$$= (62.4) (1.34) (0.05)$$

$$= 4.18 \text{ lb/ft}^2$$

$4.18 < 6 \text{ lb/ft}^2$, therefore acceptable

Sample Problem
6.17b con't.

Short-term design = bare soil channel stability

- Use $Q_{\text{peak}} = Q_{2\text{-year}} = 45$ cfs
- From Figure 6.17b: Limiting shear = 4.5 lb/ft²
- For mat on bare soil, $n = 0.03$

Determine depth of flow via trial-and-error using Manning's Equation:

For trapezoidal channels: $(bd + zd^2)$

$$(bd + zd^2) \left[\frac{(bd + zd^2)}{b + 2d(z^2 + 1)^{1/2}} \right]^{2/3} = \frac{Qn}{1.49S^{1/2}}$$

From trial-and-error, $d = 1.0$ ft

Check shear stress $\tau = YDS$

$$= (62.4)(1.0)(0.05)$$

$$= 3.12 \text{ lb/ft}^2$$

$3.12 < 4.5$ lb/ft², therefore acceptable

Construction
Specifications

Construction

Even if properly designed, if not properly installed, RECP's will probably not function as desired. Proper installation is imperative. Even if properly installed, if not properly timed and nourished, vegetation will probably not grow as desired. Proper seed/vegetation selection is also imperative.

Grade the surface of installation areas so that the ground is smooth and loose. When seeding prior to installation, follow the steps for seed bed preparation, soil amendments, and seeding in *Surface Stabilization*, 6.1. All gullies, rills, and any other disturbed areas must be fine graded prior to installation. Spread seed before RECP installation. (**Important:** Remove all large rocks, dirt clods, stumps, roots, grass clumps, trash, and other obstructions from the soil surface to allow for direct contact between the soil surface and the RECP.)

Terminal anchor trenches are required at RECP ends and intermittent trenches must be constructed across channels at 25-foot intervals. Terminal anchor trenches should be a minimum of 12 inches in depth and 6 inches in width, while intermittent trenches need be only 6 inches deep and 6 inches wide.

Installation for Slopes— Place the RECP 2-3 feet over the top of the slope and into an excavated end trench measuring approximately 12 inches deep by 6 inches wide. Pin the RECP at 1 foot intervals along the bottom of the trench, backfill, and compact. Unroll the RECP down (or along) the slope maintaining direct contact between the soil and the RECP. Overlap adjacent rolls a minimum of 3 inches. Pin the RECP to the ground using staples or pins in a 3 foot center-to-center pattern. Less frequent stapling/pinning is acceptable on moderate slopes.

Installation in Channels— Excavate terminal trenches (12 inches deep and 6 inches wide) across the channel at the upper and lower end of the lined channel sections. At 25-foot intervals along the channel, anchor the RECP across the channel either in 6 inch by 6 inch trenches or by installing two closely spaced rows of anchors. Excavate longitudinal trenches 6 inches deep and wide along channel edges (above water line) in which to bury the outside RECP edges. Place the first RECP at the downstream end of the channel. Place the end of the first RECP in the terminal trench and pin it at 1 foot intervals along the bottom of the trench.

Note: The RECP should be placed upside down in the trench with the roll on the downstream side of the bench.

Once pinned and backfilled, the RECP is deployed by wrapping over the top of the trench and unrolling upstream. If the channel is wider than the provided rolls, place ends of adjacent rolls in the terminal trench, overlapping the adjacent rolls a minimum of 3 inches. Pin at 1 foot intervals, backfill, and compact. Unroll the RECP in the upstream direction until reaching the first intermittent trench. Fold the RECP back over itself, positioning the roll on the downstream side of the trench, and allowing the mat to conform to the trench.

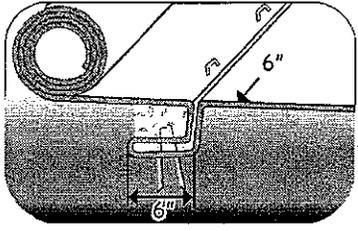
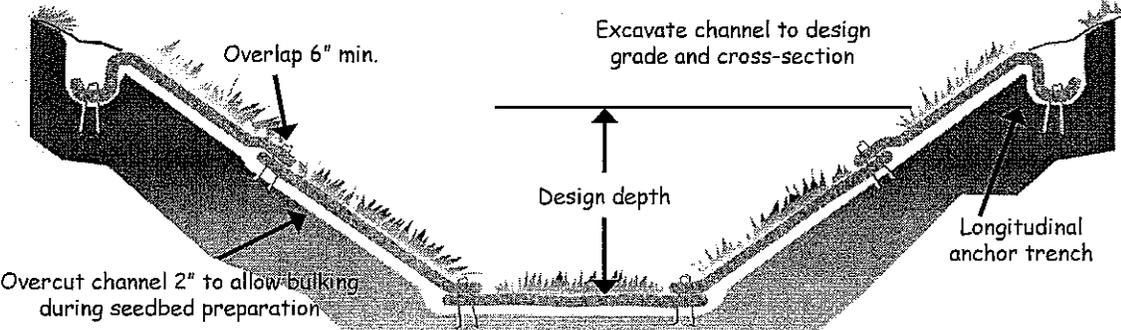
Then pin the RECP (two layers) to the bottom of the trench, backfill, and compact. Continue up the channel (wrapping over the top of the intermittent trench) repeating this step at other intermittent trenches, until reaching the upper terminal trench.

At the upper terminal trench, allow the RECP to conform to the trench, secure with pins or staples, backfill, compact and then bring the mat back over the top of the trench and onto the existing mat (2 to 3 feet overlap in the downstream direction), and pin at 1 foot intervals across the RECP. When starting installation of a new roll, begin in a trench or shingle-lap ends of rolls a minimum of 1 foot with upstream RECP on top to prevent uplifting. Place the outside edges of the RECP(s) in longitudinal trenches, pin, backfill, and compact.

Anchoring Devices—11 gauge, at least 6 inches length by 1 inch width staples or 12 inch minimum length wooden stakes are recommended for anchoring the RECP to the ground.

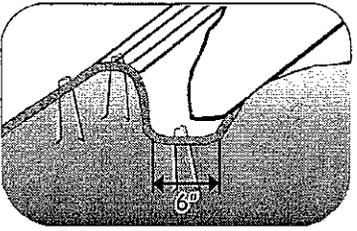
Drive staples or pins so that the top of the staple or pin is flush with the ground surface. Anchor each RECP every 3 feet along its center. Longitudinal overlaps must be sufficient to accommodate a row of anchors and uniform along the entire length of overlap and anchored every 3 feet along the overlap length. Roll ends may be spliced by overlapping 1 foot (in the direction of water flow), with the upstream/upslope mat placed on top of the downstream/downslope RECP. This overlap should be anchored at 1 foot spacing across the RECP. When installing multiple width mats heat seamed in the factory, all factory seams and field overlaps should be similarly anchored.

Figure 6.17d Temporary Channel Liners; Washington State Department of Ecology

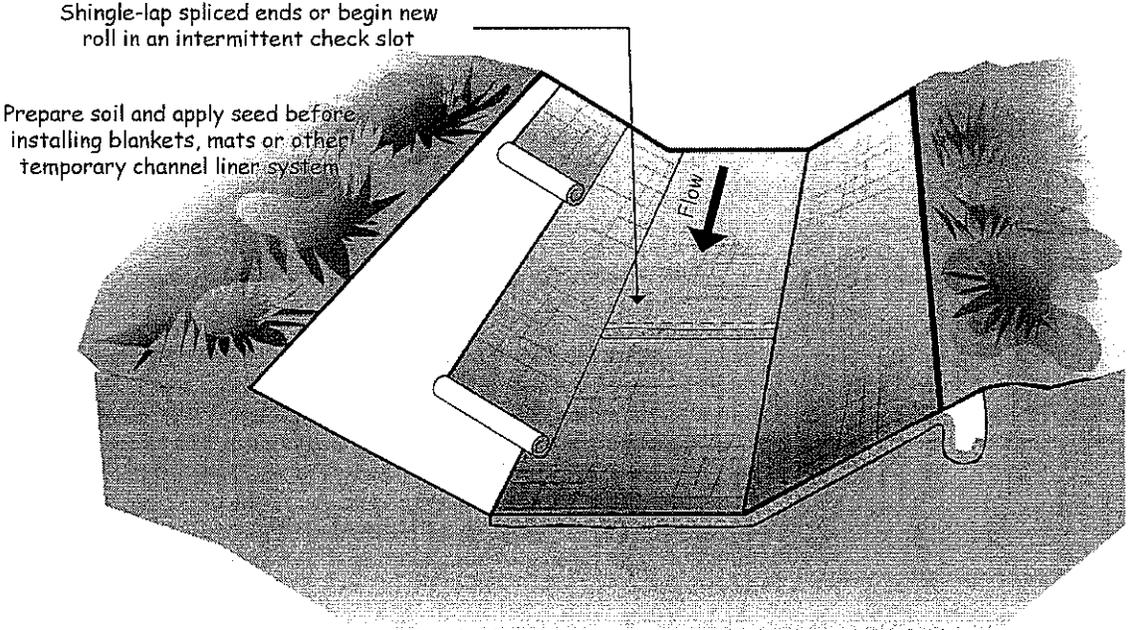


Intermittent check slot

Typical installation with erosion control blankets or turf reinforcement mats



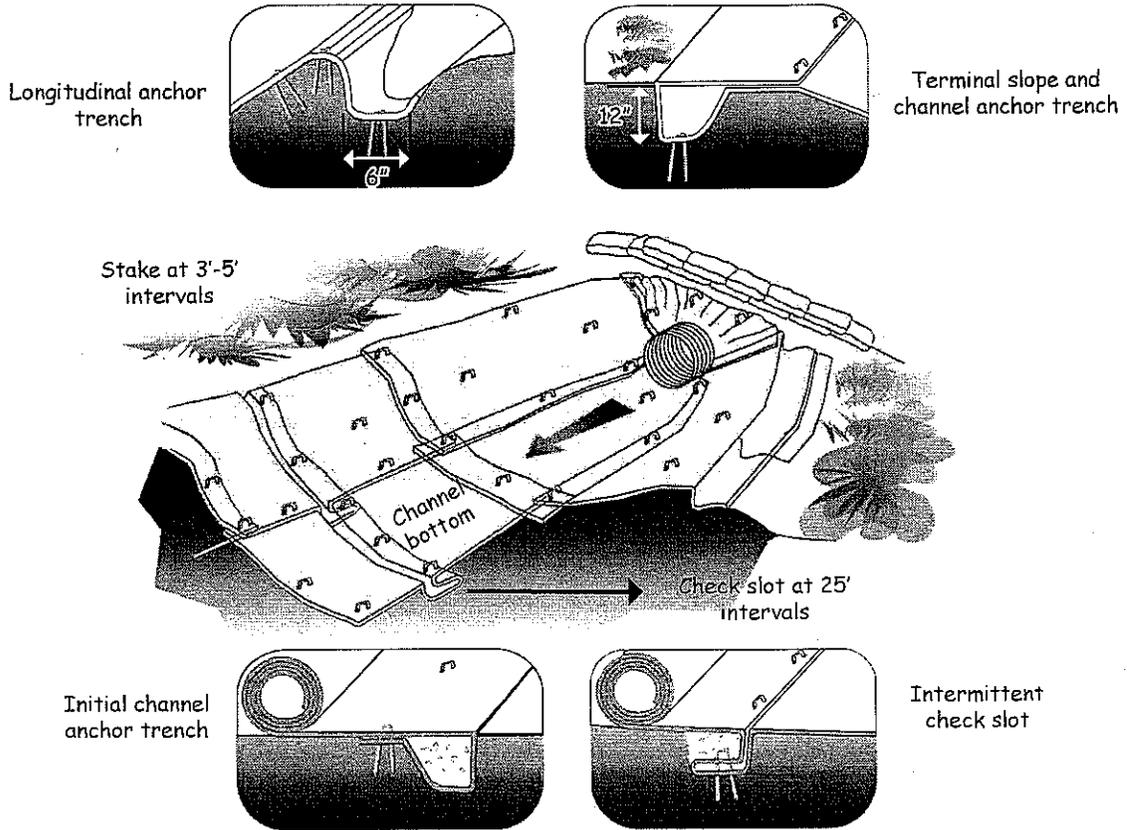
Longitudinal anchor trench



NOTES:

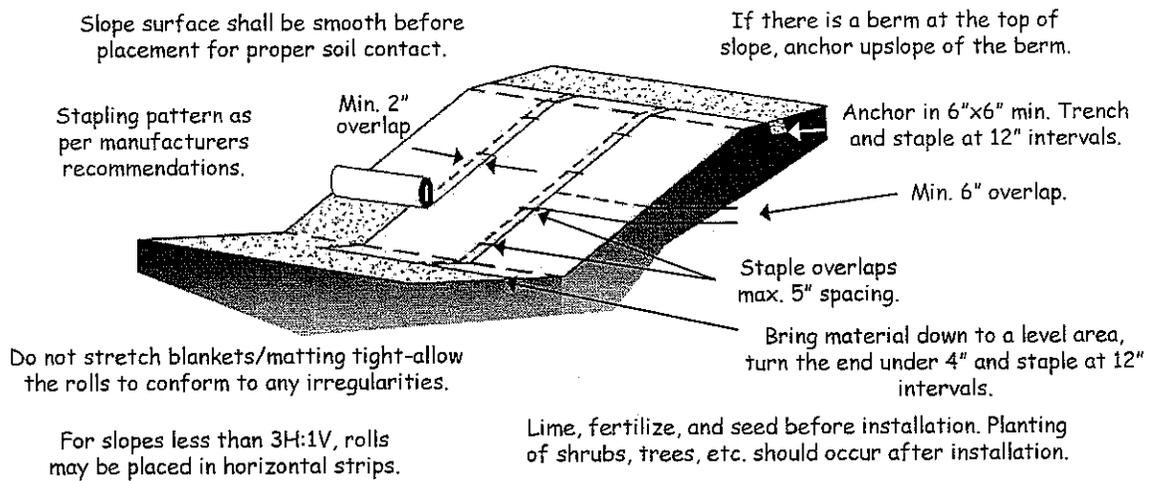
- 1. Design velocities exceeding 2 ft/sec require temporary blankets, mats or similar liners to protect seed and soil until vegetation becomes established.
- 2. Grass-lined channels with design velocities exceeding 6 ft/sec should include turf reinforcement mats

Figure 6.17e Channel Installation and Slope Installation; Washington State Ecology Department



NOTE:

1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.



Maintenance

1. Inspect Rolled Erosion Control Products at least weekly and after each significant (1/2 inch or greater) rain fall event repair immediately.
2. Good contact with the ground must be maintained, and erosion must not occur beneath the RECP.
3. Any areas of the RECP that are damaged or not in close contact with the ground shall be repaired and stapled.
4. If erosion occurs due to poorly controlled drainage, the problem shall be fixed and the eroded area protected.
5. Monitor and repair the RECP as necessary until ground cover is established.

References

Sprague, C. Joel. TRI/ Environmental, Inc. "Green Engineering, Design principles and applications using rolled erosion control products"

Storm Water Management Manual for Western Washington, Washington State Department of Ecology, Water Quality Program
<http://www.ecy.wa.gov/programs/wq/stormwater/index.html>

Erosion Control Technology Council, <http://www.ectc.org>

6.62

SEDIMENT FENCE

Definition A temporary sediment control measure consisting of fabric buried at the bottom, stretched, and supported by posts.

Purpose To retain sediment from small disturbed areas by reducing the velocity of sheet flows to allow sediment deposition.

Conditions Where Below small-disturbed areas that are less than $\frac{1}{4}$ acre per 100 feet of fence.

Practice Applies Where runoff can be stored behind the sediment fence without damaging the fence or the submerged area behind the fence.

Do not install sediment fences across streams, ditches, or waterways, or other areas of concentrated flow.

Sediment fence should be placed along topographic elevation contours, where it can intercept stormwater runoff that is in dispersed sheet flow. Sediment fence should not be used alone below graded slopes greater than 10 feet in height.

Planning Considerations

A sediment fence is a system to retain sediment on the construction site. The fence retains sediment primarily by retarding flow and promoting deposition. In operation, generally the fence becomes clogged with fine particles, which reduce the flow rate. This causes a pond to develop behind the fence. The designer should anticipate ponding and provide sufficient storage areas and overflow outlets to prevent flows from overtopping the fence. Since sediment fences are not designed to withstand high water levels, locate them so that only shallow pools can form. Tie the ends of a sediment fence into higher ground to prevent flow around the end of the fence before the pool reaches design level. Curling each end of the fence uphill in a "J" pattern may be appropriate to prevent end flow. Provide stabilized outlets to protect the fence system and release storm flows that exceed the design storm.

Deposition occurs as the storage pool forms behind the fence. The designer can direct flows to specified deposition areas through appropriate positioning of the fence or by providing an excavated area behind the fence. Plan deposition areas at accessible points to promote routine cleanout and maintenance. Show deposition areas in the erosion and sedimentation control plan. A sediment fence acts as a diversion if placed slightly off the contour. A maximum slope of 2 percent is recommended. This technique may be used to control shallow, uniform flows from small disturbed areas and to deliver sediment-laden water to deposition areas. The anchoring of the toe of the fence should be reinforced with 12 inches of NC DOT #5 or #57 washed stone when flow will run parallel to the toe of the fence.

Sediment fences serve no function along ridges or near drainage divides where there is little movement of water. Confining or diverting runoff unnecessarily with a sediment fence may create erosion and sedimentation problems that would not otherwise occur.

Straw barriers have only a 0-20% trapping efficiency and are inadequate. Straw bales may not be used in place of sediment fence. Prefabricated sediment fence with the fabric already stapled to thin wooden posts does not meet minimum standards specified later in this section.

Anchoring of sediment fence is critical. The toe of the fabric must be anchored in a trench backfilled with compacted earth. Mechanical compaction must be provided in order for the fence to effectively pond runoff.

Design Criteria

Ensure that drainage area is no greater than ¼ acre per 100 feet of fence. This is the maximum drainage area when the slope is less than 2 percent. Where all runoff is to be stored behind the fence, ensure that the maximum slope length behind a sediment fence does not exceed the specifications shown in Table 6.62a. The shorter slope length allowed for steeper slopes will greatly reduce the maximum drainage area. For example, a 10–20 % slope may have a maximum slope length of 25 feet. For a 100-foot length of sediment fence, the drainage area would be 25ft X 100ft = 2500sq.ft., or 0.06 acres.

Table 6.62a Maximum Slope Length and Slope for which Sediment Fence is Applicable

Slope	Slope Length (ft)	Maximum Area (ft ²)
<2%	100	10,000
2 to 5%	75	7,500
5 to 10%	50	5,000
10 to 20%	25	2,500
>20%	15	1,500

Make the fence stable for the 10-year peak storm runoff.

Ensure that the depth of impounded water does not exceed 1.5 feet at any point along the fence.

If non-erosive outlets are provided, slope length may be increased beyond that shown in Table 6.62a, but runoff from the area should be determined and bypass capacity and erosion potential along the fence must be checked. The velocity of the flow at the outlet or along the fence should be in keeping with Table 8.05d, Appendix 8.05.

Provide a riprap splash pad or other outlet protection device for any point where flow may overtop the sediment fence, such as natural depressions or swales. Ensure that the maximum height of the fence at a protected, reinforced outlet does not exceed 2 feet and that support post spacing does not exceed 4 feet.

The design life of a synthetic sediment fence should be 6 months.

Construction Specifications

MATERIALS

1. Use a synthetic filter fabric of at least 95% by weight of polyolefins or polyester, which is certified by the manufacturer or supplier as conforming to the requirements in ASTM D 6461, which is shown in part in Table 6.62b.

Synthetic filter fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 to 120° F.

2. Ensure that posts for sediment fences are 1.33 lb/linear ft steel with a minimum length of 5 feet. Make sure that steel posts have projections to facilitate fastening the fabric.
3. For reinforcement of standard strength filter fabric, use wire fence with a minimum 14 gauge and a maximum mesh spacing of 6 inches.

Table 6.62b Specifications For Sediment Fence Fabric

Temporary Silt Fence Material Property Requirements					
	Test Material	Units	Supported ¹ Silt Fence	Un-Supported ¹ Silt Fence	Type of Value
Grab Strength	ASTM D 4632	N (lbs)			
Machine Direction			400 (90)	550 (90)	MARV
X-Machine Direction			400 (90)	450 (90)	MARV
Permittivity ²	ASTM D 4491	sec-1	0.05	0.05	MARV
Apparent Opening Size ²	ASTM D 4751	mm (US Sieve #)	0.60 (30)	0.60 (30)	Max. ARV ³
Ultraviolet Stability	ASTM D 4355	% Retained Strength	70% after 500h of exposure	70% after 500h of exposure	Typical

¹ Silt Fence support shall consist of 14 gage steel wire with a mesh spacing of 150 mm (6 inches), or prefabricated polymer mesh of equivalent strength.

² These default values are based on empirical evidence with a variety of sediment. For environmentally sensitive areas, a review of previous experience and/or site or regionally specific geotextile tests in accordance with Test Method D 5141 should be performed by the agency to confirm suitability of these requirements.

³ As measured in accordance with Test Method D 4632.

CONSTRUCTION

1. Construct the sediment barrier of standard strength or extra strength synthetic filter fabrics.
2. Ensure that the height of the sediment fence does not exceed 24 inches above the ground surface. (Higher fences may impound volumes of water sufficient to cause failure of the structure.)
3. Construct the filter fabric from a continuous roll cut to the length of the barrier to avoid joints. When joints are necessary, securely fasten the filter cloth only at a support post with 4 feet minimum overlap to the next post.
4. Support standard strength filter fabric by wire mesh fastened securely to the **upslope** side of the posts. Extend the wire mesh support to the bottom of the trench. Fasten the wire reinforcement, then fabric on the upslope side of the fence post. Wire or plastic zip ties should have minimum 50 pound tensile strength.
5. When a wire mesh support fence is used, space posts a maximum of 8 feet apart. Support posts should be driven securely into the ground a minimum of 24 inches.
6. Extra strength filter fabric with 6 feet post spacing does not require wire mesh support fence. Securely fasten the filter fabric directly to posts. Wire or plastic zip ties should have minimum 50 pound tensile strength.

7. Excavate a trench approximately 4 inches wide and 8 inches deep along the proposed line of posts and upslope from the barrier (Figure 6.62a).
8. Place 12 inches of the fabric along the bottom and side of the trench.
9. Backfill the trench with soil placed over the filter fabric and compact. Thorough compaction of the backfill is critical to silt fence performance.
10. Do not attach filter fabric to existing trees.

SEDIMENT FENCE INSTALLATION USING THE SLICING METHOD

Instead of excavating a trench, placing fabric and then backfilling trench, sediment fence may be installed using specially designed equipment that inserts the fabric into a cut sliced in the ground with a disc (Figure 6.62b).

Installation Specifications

1. The base of both end posts should be at least one foot higher than the middle of the fence. Check with a level if necessary.
2. Install posts 4 feet apart in critical areas and 6 feet apart on standard applications.
3. Install posts 2 feet deep on the downstream side of the silt fence, and as close as possible to the fabric, enabling posts to support the fabric from upstream water pressure.
4. Install posts with the nipples facing away from the silt fabric.
5. Attach the fabric to each post with three ties, all spaced within the top 8 inches of the fabric. Attach each tie diagonally 45 degrees through the fabric, with each puncture at least 1 inch vertically apart. Also, each tie should be positioned to hang on a post nipple when tightened to prevent sagging.
6. Wrap approximately 6 inches of fabric around the end posts and secure with 3 ties.
7. No more than 24 inches of a 36 inch fabric is allowed above ground level.
8. The installation should be checked and corrected for any deviations before compaction.
9. Compaction is vitally important for effective results. Compact the soil immediately next to the silt fence fabric with the front wheel of the tractor, skid steer, or roller exerting at least 60 pounds per square inch. Compact the upstream side first, and then each side twice for a total of 4 trips.

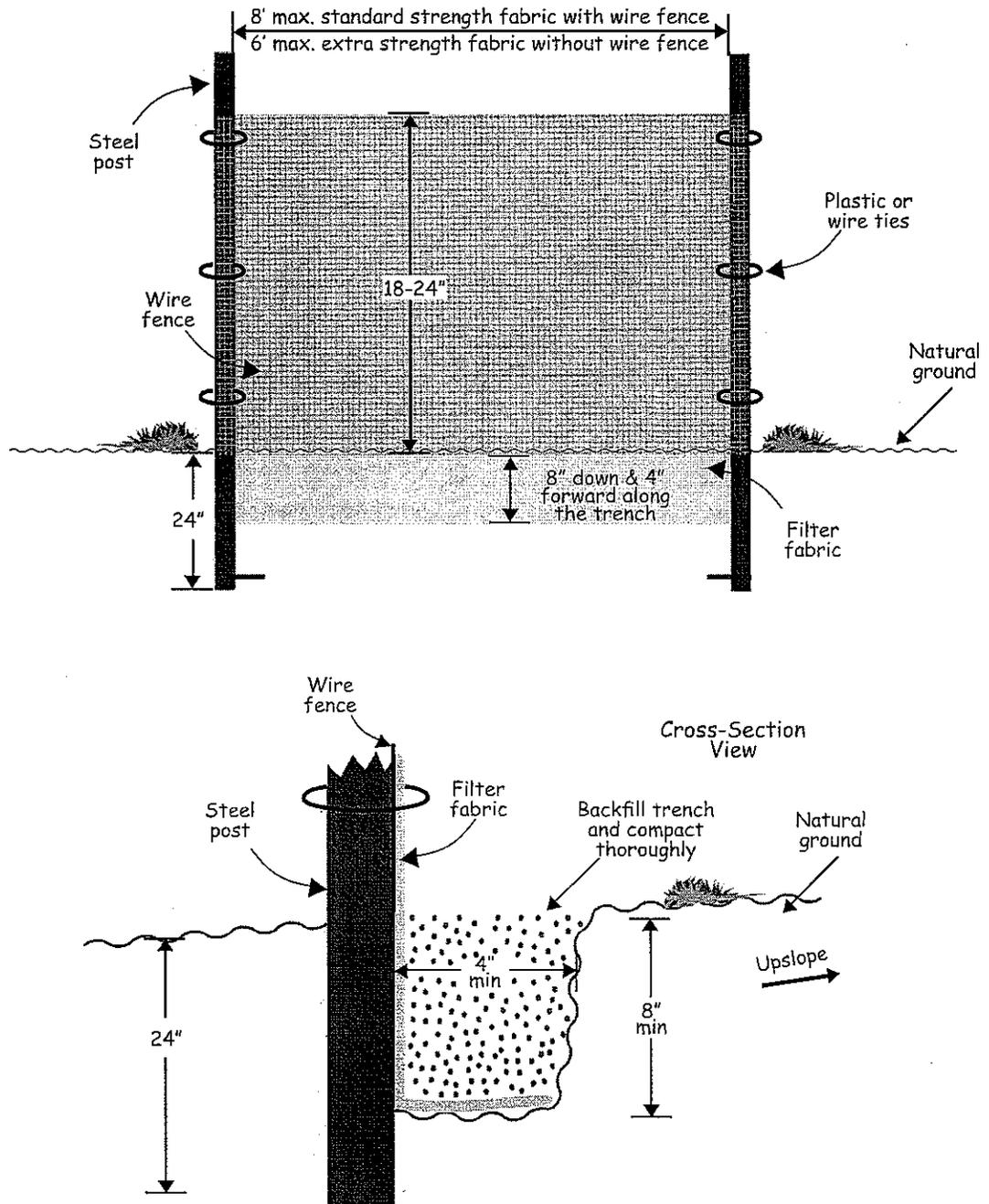
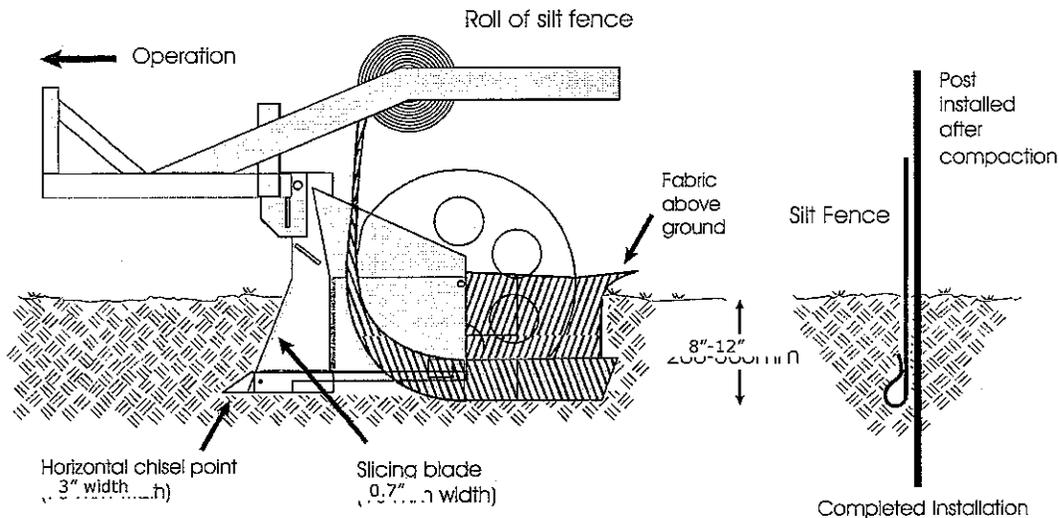
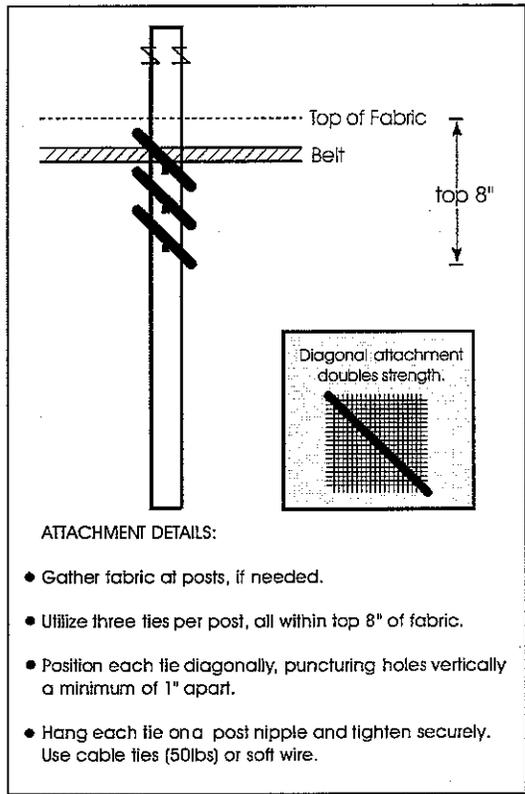
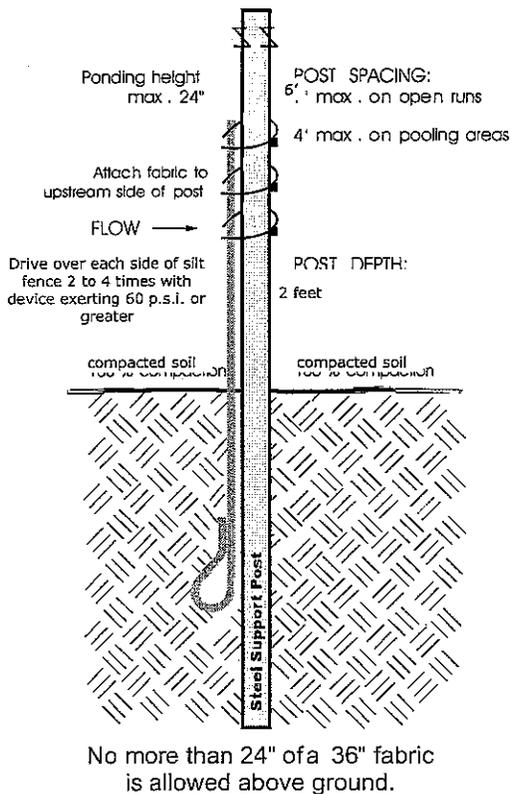


Figure 6.62a Installation detail of a sediment fence.

The Slicing Method



Vibratory plow is not acceptable because of horizontal compaction

Figure 6.62b Schematics for using the slicing method to install a sediment fence. Adapted from *Silt Fence that Works*

Maintenance Inspect sediment fences at least once a week and after each rainfall. Make any required repairs immediately.

Should the fabric of a sediment fence collapse, tear, decompose or become ineffective, replace it promptly.

Remove sediment deposits as necessary to provide adequate storage volume for the next rain and to reduce pressure on the fence. Take care to avoid undermining the fence during cleanout.

Remove all fencing materials and unstable sediment deposits and bring the area to grade and stabilize it after the contributing drainage area has been properly stabilized.

References ASTM D 6461 – 99. “Standard Specification for Silt Fence Materials” ASTM International. For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard’s Document Summary page on the ASTM website.

ASTM D 6462 – 03. “Standard Practice for Silt Fence Installation” ASTM International. For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard’s Document Summary page on the ASTM website.

C. Joel Sprague, PE, Silt Fence Performance Limits and Installation Requirements. Sprague and Sprague Consulting Engineers and TRI/Environmental, Inc.

Carpenter Erosion Control. <http://www.tommy-sfm.com/>

Kentucky Erosion Prevention and Sediment Control Field Manual, 2004.

Runoff Control Measures

6.20, Temporary Diversions

Outlet Protection

6.41, Outlet Stabilization Structure

Appendix

8.03, Estimating Runoff

APPENDIX B
VEGETATIVE PLAN

VEGETATIVE PLAN

Seedbed Preparation (SP)

SP-1: Fill slopes 3:1 or steeper need to be seeded with a hydraulic seeder (permanent seedings)

1. Leave the last 4-6 inches of fill loose and uncompacted, allowing rocks, roots, large clods and other debris to remain on the slope.
2. Roughen slope faces by making grooves 2-3 inches deep, perpendicular to the slope.
3. Spread lime evenly over slopes at rates recommended by soil tests.

SP-2: Fill slopes 3:1 or steeper (temporary seedings)

1. Leave a loose, uncompacted surface. Remove large clods, rocks, and debris which might hold netting above the surface.
2. Spread lime and fertilizer evenly at rates recommended by soil tests.
3. Incorporate amendments by roughening or grooving soil surface on the contour.

SP-3: Gentle or flat slopes where topsoil is not used.

1. Remove rocks and debris.
2. Apply lime and fertilizer at rates recommended by soil test; spread evenly and incorporate into the top 6" with a disk, chisel plow, or rotary tiller.
3. Break up large clods and rake into a loose, uniform seedbed.
4. Rate to loosen surface just prior to applying seed.

Seeding Methods (SM)

SM-1: Fill slopes steeper than 3:1 (permanent seedings)

Use hydraulic seeding equipment to apply seed and fertilizer, a wood fiber mulch at 45 lb/1,000 ft², and mulch tackifier.

SM-2: Gentle to flat slopes or temporary seedings

Broadcast seed at the recommended rate with a cyclone seeder, drop spreader, or cultipacker seeder.

Rake seed into the soil and lightly pack to establish good contact.

Mulch (MU)

MU-1: Steep slopes (3:1 or greater)

In mid-summer, late fall or winter, apply 100 lb/1,000 ft² grain straw, cover with netting and staple to the slope. In spring or early fall use 45 lb/1,000 ft² wood fiber in a hydroseeder slurry.

MU-2: Grass lined channels

Install excelsior mat in the channel, extend up the channel banks to the highest calculated depth of flow, and secure according to manufacturer's specifications.

On channel shoulders, apply 100 lb/1,000 ft² grain straw and anchor with 0.1 gal/yd² (11 gal/1,000 ft²) asphalt.

MU-3: Temporary seedings

Apply 90 lb/1,000 ft² (4,000 lb/acre) grain straw and attack with 0.1 gal/yd² asphalt (11 gal/1,000 ft²).

Maintenance (MA)

MA-1: Refertilize in late winter or early spring the following year. Mow as desired.

MA-2: Keep mowed to a height of 2-4 inches. Fertilize with 40 lb/acre (1 lb/1,000 ft²) nitrogen in winter and again in the fall.

MA-3: Inspect and repair mulch and lining. Refertilize in late winter of the following year with 150 lb/acre 10-10-10 (3.5 lb/1,000 ft²). Mow regularly to a height of 3-4 inches.

MA-4: Topdress with 10-10-10 fertilizer if growth is not fully adequate.

MA-5: Topdress with 50 lb/acre (1 lb/1,000 ft²) nitrogen in March. If cover is needed through the following summer, overseed with 50 lb/acre Kobe lespedeza.

Table 1: Vegetative Plan

Description	Season	Seeding Mixture		Seedbed Preparation	Seeding Method	Mulch	Maintenance	Notes
		Permanent lb/ac	Temporary lb/ac					
Steep slopes (3:1); low maintenance	Spring or Fall	Tall fescue 100 Kobe lespedeza 10 Bahia grass 25 Rye grain 40		SP-1	SM-1	MU-1	MA-1	Permanent mixture also used for low maintenance areas. Overseed winter plantings of rye with Kobe lespedeza in March if grading not complete.
	Summer		German millet 40	SP-2	SM-2		MA-5	
	Winter		Rye grain 120					
		Fall-Spring	Tall fescue 200 Rye grain 40		SP-3	SM-2	MU-2	
	Summer	Tall fescue 200 German millet 10						
Grassed channels with side slopes 3:1	Spring or Fall	Tall fescue 100 Kobe lespedeza 10 Bahia grass 25 Rye grain 40		SP-3	SM-2	MU-3	MA-1	For temporary seeding in spring or fall, see section below. Use these specs for temporary diversions.
	Summer	Tall fescue 100 Kobe lespedeza 10 Bermudagrass 15 German millet 10						
	Winter		Rye grain 120					
		Spring	Rye grain 120 Kobe lespedeza 50					
Areas requiring cover for less than 1 year	Summer		German millet 40	SP-3	SM-2	MU-3	MA-4	Treat temporary diversions as low maintenance, permanent. Include topsoil stockpiles here.
	Fall & Winter		Rye grain 120 Kobe lespedeza 50					

Notes:
Seasons are as follows: Spring (2/1 – 4/15), Summer (4/15 – 8/20), Fall (8/20 – 10/25), Winter (10/25 – 1/31).

APPENDIX C
ENGINEERING CALCULATIONS

Table 1

Watauga County Solid Waste Facility
 LCID Permit Application
 July 17, 2009

Drainage Area	Acreage	C	Sheet Flow			Shallow Channel Flow			Channel Flow			Total t-c	i-2	i-10	i-25	Q-2	Q-10	Q-25
			Distance	Delta Z	t-c	Distance	Delta Z	t-c	Distance	Delta Z	t-c							
DA-1	7.3	0.45	122	9	2.0	480	66	1.8	550	28	3.2	7.0	3.5	5.2	5.8	11.5	17.1	19.1
DA-2	0.8	0.3	180	11	1.5	110	4	1.2	170	7	1.4	4.1	4.1	6.2	7.2	1.0	1.5	1.7
DA-3	3.9	0.35	175	39	1.5	250	8	2.0	0	0	0.0	3.5	4.1	6.2	7.2	5.6	8.5	9.8
DA-4	6.0	0.3	240	7	4.2	570	42	2.8	560	14	4.0	11.0	3	4.4	5	5.4	7.9	9.0
DA-5	13.5	0.45	90	7	1.0	275	14	1.8	1400	78	5.1	7.9	3.3	4.9	5.7	20.0	29.8	34.6
DA-6	1.0	0.6	145	46	1.0	0	0	0.0	0	0	0.0	1.0	4.1	6.2	7.2	2.5	3.7	4.3

Note:

Rainfall intensities determined using I-D-F Curve for Asheville, NC

Table 2
Watauga County Solid Waste Facility
LCID Permit Application
Channel Flows
July 17, 2009

Channel	Contributing Drainage Areas/Upstream Channels	Length (ft)	Slope (%)	Q-25(CFS)	25 Year Channel Flow(CFS)
SCC-1	DA-3	708	2.9	9.8	9.8
SCC-2	DA-2	168	4.1	1.7	1.7
SCC-3	DA-6	415	5.3	4.3	
	SCC-1	548	5.6	9.8	
	SCC-2			1.7	15.8
SCC-4	DA-1			19.1	
	SCC-3			15.8	34.9

Worksheet for Triangular Channel - SCC-1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02900	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	9.80	ft ³ /s

Results

Normal Depth	1.00	ft
Flow Area	1.99	ft ²
Wetted Perimeter	4.46	ft
Top Width	3.99	ft
Critical Depth	1.08	ft
Critical Slope	0.01867	ft/ft
Velocity	4.93	ft/s
Velocity Head	0.38	ft
Specific Energy	1.37	ft
Froude Number	1.23	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	1.08	ft
Channel Slope	0.02900	ft/ft
Critical Slope	0.01867	ft/ft

Worksheet for Triangular Channel - SCC-2

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.04100	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	1.70	ft ³ /s

Results

Normal Depth	0.48	ft
Flow Area	0.47	ft ²
Wetted Perimeter	2.17	ft
Top Width	1.94	ft
Critical Depth	0.54	ft
Critical Slope	0.02358	ft/ft
Velocity	3.62	ft/s
Velocity Head	0.20	ft
Specific Energy	0.69	ft
Froude Number	1.30	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.48	ft
Critical Depth	0.54	ft
Channel Slope	0.04100	ft/ft
Critical Slope	0.02358	ft/ft

Worksheet for Triangular Channel -SCC-3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030
Channel Slope	0.05300 ft/ft
Left Side Slope	2.00 ft/ft (H:V)
Right Side Slope	2.00 ft/ft (H:V)
Discharge	15.80 ft ³ /s

Results

Normal Depth	1.07 ft
Flow Area	2.27 ft ²
Wetted Perimeter	4.77 ft
Top Width	4.26 ft
Critical Depth	1.31 ft
Critical Slope	0.01752 ft/ft
Velocity	6.96 ft/s
Velocity Head	0.75 ft
Specific Energy	1.82 ft
Froude Number	1.68
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.07 ft
Critical Depth	1.31 ft
Channel Slope	0.05300 ft/ft
Critical Slope	0.01752 ft/ft

Worksheet for Triangular Channel -SCC-4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.05600	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	34.90	ft ³ /s

Results

Normal Depth	1.42	ft
Flow Area	4.03	ft ²
Wetted Perimeter	6.35	ft
Top Width	5.68	ft
Critical Depth	1.80	ft
Critical Slope	0.01576	ft/ft
Velocity	8.66	ft/s
Velocity Head	1.17	ft
Specific Energy	2.58	ft
Froude Number	1.81	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.42	ft
Critical Depth	1.80	ft
Channel Slope	0.05600	ft/ft
Critical Slope	0.01576	ft/ft

Worksheet for Triangular Channel - Bench

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02000	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	1.53	ft ³ /s

Results

Normal Depth	0.45	ft
Flow Area	0.61	ft ²
Wetted Perimeter	2.87	ft
Top Width	2.71	ft
Critical Depth	0.44	ft
Critical Slope	0.02350	ft/ft
Velocity	2.50	ft/s
Velocity Head	0.10	ft
Specific Energy	0.55	ft
Froude Number	0.93	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.45	ft
Critical Depth	0.44	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.02350	ft/ft



Draper Aden Associates

Engineering ♦ Surveying ♦ Environmental Services

Blacksburg, VA: 540 / 552-0444
Charlottesville, VA: 434 / 295-0700
Hampton Roads, VA: 757 / 599-9800
Richmond, VA: 804 / 264-2228
Raleigh/Durham, NC: 919 / 369-9994

Subject WATAUGA LCID

Sheet No. 1 of 1

FINAL SLOPE - DRAINAGE BENCHES

Job No. 6520 - 48

By MAC Date 7/21/09

$$\text{AREA} = 15865 \text{ ft}^2 = 0.36 \text{ AC.} \rightarrow \text{LARGEST DRAINAGE AREA}$$

$$\text{Slope} = 25\%$$

$$t_c = 5 \text{ min}$$

$$C = 0.6 - \text{BARE GROUND}$$

$$I_{25} = 7.1 \text{ (I-D-F - ASHEVILLE)}$$

$$Q_{25} = (0.6)(0.36)(7.1) = 1.53 \text{ CFS}$$

Worksheet for Trapezoidal Channel - Downslope

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient	0.069
Channel Slope	0.25000 ft/ft
Left Side Slope	3.00 ft/ft (H:V)
Right Side Slope	3.00 ft/ft (H:V)
Bottom Width	2.00 ft
Discharge	4.00 ft ³ /s

Results

Normal Depth	0.32 ft
Flow Area	0.97 ft ²
Wetted Perimeter	4.05 ft
Top Width	3.95 ft
Critical Depth	0.40 ft
Critical Slope	0.10851 ft/ft
Velocity	4.14 ft/s
Velocity Head	0.27 ft
Specific Energy	0.59 ft
Froude Number	1.48
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.32 ft
Critical Depth	0.40 ft
Channel Slope	0.25000 ft/ft
Critical Slope	0.10851 ft/ft

WEST SEDIMENT POND

The existing sediment pond located on the western edge of the Facility property was modified in 1998. During the design process for the closure construction of the MSW landfill, it was discovered the sediment pond adjacent to the MSW landfill could not be modified to accommodate all of the stormwater runoff from the closed landfill. A series of diversion berms and pipes were installed to reroute the stormwater runoff to the west sediment pond.

The west sediment pond, as a result, was resized to ensure a 25-year, 24-hour storm would be contained within the pond. The riser elevation was raised to the current elevation of 3187'. The calculations for the pond follow this narrative.



Draper Aden Associates

CONSULTING ENGINEERS
BLACKSBURG - RICHMOND, VIRGINIA
NASHVILLE, TENNESSEE

Subject Ex. Sediment Pond

Sheet No. ___ of ___

Job No. _____

By LJ Date 3-9-6

TOP BERM = 3195

AREA 3194 48770 sf

AREA 3190 34093 sf

AREA 3188 23461 sf

3186 19965 sf

3184 14643 sf

3182 10728 sf

3180 6654 sf

Drainage Area = 1233915 = 28.3 Ac

Vol Req'd = 102486 cf

USE RISE CRIST @ 3187.05 VOL = 102836 cf

DEWATER @ 1/2 VOLUME = 51418 cf

DEWATER @ 3184.415 ⇒ 51421 cf

CLEANOUT @ 1/2 volume = 25710

3182.725 ⇒ 25,712 cf.

TL 2084

POND-2 Version: 5.17

S/N:

EXISTING POND SYSTEM..

CALCULATED 03-11-1996 11:09:10
DISK FILE: WATAUGA .VOL

Planimeter scale: 1 inch = 1 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	* Volume (cubic-ft)	Volume Sum (cubic-ft)
3,180.00	6,654.00	6,654	0	0	0
3,182.00	10,728.00	10,728	25,831	17,221	17,221
EXPAN 3,182.73	*I*	12,723	35,134	8,492	25,712
3,184.00	16,643.00	16,643	40,733	27,155	44,376
INTER 3,184.42	*I*	17,308	50,923	7,045	51,421
3,186.00	19,965.00	19,965	54,836	36,558	80,934
USER 3,187.05	*I*	21,765	62,576	21,903	102,836
3,188.00	23,461.00	23,461	65,069	43,379	124,313
3,190.00	34,093.00	34,093	85,836	57,224	181,537
3,194.00	48,770.00	48,770	123,639	164,853	346,389

I ---> Interpolated area from closest two planimeter readings.

* Incremental volume computed by the Conic Method for Reservoir Volumes.

TR-55 TABULAR HYDROGRAPH METHOD
 Type II Distribution
 (24 hr. Duration Storm)

Executed: 03-11-1996 12:25:06
 Watershed file: --> WATAUGA .WSD
 Hydrograph file: --> WATAUGA .HYD

25 year storm

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
ALL	28.30	80.0	0.10	0.00	5.25	3.11	.1 .10

* Travel time from subarea outfall to composite watershed outfall point.
 Total area = 28.30 acres or 0.04422 sq.mi
 Peak discharge = 139 cfs

>>>> Computer Modifications of Input Parameters <<<<

Subarea Description	Input Values		Rounded Values		Ia/p Interpolated	Ia/p Messages
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	(Yes/No)	
ALL	0.10	0.00	**	**	No	--

* Travel time from subarea outfall to composite watershed outfall point.
 ** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 03-11-1996 12:25:06
Watershed file: --> WATAUGA .WSD
Hydrograph file: --> WATAUGA .HYD

25 year storm

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
ALL	139	12.1
Composite Watershed	139	12.1

TR-55 TABULAR HYDROGRAPH METHOD
 Type II Distribution
 (24 hr. Duration Storm)

Executed: 03-11-1996 12:25:06
 Watershed file: --> WATAUGA .WSD
 Hydrograph file: --> WATAUGA .HYD

25 year storm

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
LL	3	5	7	46	89	139	86	30	20
Total (cfs)	3	5	7	46	89	139	86	30	20

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
LL	17	14	12	10	9	8	7	6	6
Total (cfs)	17	14	12	10	9	8	7	6	6

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
LL	5	5	4	4	4	3	3	3	3
Total (cfs)	5	5	4	4	4	3	3	3	3

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
LL	2	2	2	2	0
Total (cfs)	2	2	2	2	0

TR-55 TABULAR HYDROGRAPH METHOD
 Type II Distribution
 (24 hr. Duration Storm)

Executed: 03-11-1996 12:25:06
 Watershed file: --> WATAUGA .WSD
 Hydrograph file: --> WATAUGA .HYD

25 year storm

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	3	14.8	4
11.1	4	14.9	4
11.2	4	15.0	4
11.3	5	15.1	4
11.4	6	15.2	4
11.5	6	15.3	4
11.6	7	15.4	4
11.7	20	15.5	4
11.8	33	15.6	4
11.9	46	15.7	4
12.0	89	15.8	3
12.1	139	15.9	3
12.2	86	16.0	3
12.3	30	16.1	3
12.4	20	16.2	3
12.5	17	16.3	3
12.6	14	16.4	3
12.7	12	16.5	3
12.8	10	16.6	3
12.9	9	16.7	3
13.0	9	16.8	3
13.1	8	16.9	3
13.2	8	17.0	3
13.3	8	17.1	3
13.4	7	17.2	3
13.5	7	17.3	3
13.6	6	17.4	3
13.7	6	17.5	3
13.8	6	17.6	3
13.9	6	17.7	3
14.0	5	17.8	2
14.1	5	17.9	2
14.2	5	18.0	2
14.3	5	18.1	2
14.4	5	18.2	2
14.5	4	18.3	2
14.6	4	18.4	2

TR-55 TABULAR HYDROGRAPH METHOD
 Type II Distribution
 (24 hr. Duration Storm)

Executed: 03-11-1996 12:25:06

Watershed file: --> WATAUGA .WSD

Hydrograph file: --> WATAUGA .HYD

25 year storm

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	2	22.4	2
18.7	2	22.5	2
18.8	2	22.6	2
18.9	2	22.7	2
19.0	2	22.8	2
19.1	2	22.9	2
19.2	2	23.0	2
19.3	2	23.1	1
19.4	2	23.2	1
19.5	2	23.3	1
19.6	2	23.4	1
19.7	2	23.5	1
19.8	2	23.6	1
19.9	2	23.7	1
20.0	2	23.8	1
20.1	2	23.9	1
20.2	2	24.0	1
20.3	2	24.1	1
20.4	2	24.2	1
20.5	2	24.3	1
20.6	2	24.4	1
20.7	2	24.5	1
20.8	2	24.6	1
20.9	2	24.7	1
21.0	2	24.8	1
21.1	2	24.9	1
21.2	2	25.0	0
21.3	2	25.1	0
21.4	2	25.2	0
21.5	2	25.3	0
21.6	2	25.4	0
21.7	2	25.5	0
21.8	2	25.6	0
21.9	2	25.7	0
22.0	2	25.8	0
22.1	2	25.9	0
22.2	2		
22.3	2		

Outlet Structure File: WATAUGA .STR

POND-2 Version: 5.17

S/N:

Date Executed:

Time Executed:

WATAUGA EXISTING SED POND:

***** COMPOSITE OUTFLOW SUMMARY *****

Elevation (ft)	Q (cfs)	Contributing Structures
-----	-----	-----
3184.42	0.0	
3184.92	0.0	
3185.42	0.0	
3185.92	0.0	
3186.42	0.0	
3186.92	0.0	
3187.42	2.8	1
3187.92	7.0	1
3188.42	10.0	1
3188.92	11.6	1
3189.42	13.1	1
3189.92	14.4	1
3190.42	15.6	1
3190.92	16.7	1
3191.42	17.8	1
3191.92	18.8	1
3192.42	19.7	1
3192.92	20.6	1
3193.42	21.5	1
3193.92	22.3	1
3194.00	22.4	1

Outlet Structure File: WATAUGA .STR

POND-2 Version: 5.17
Date Executed:

S/N:
Time Executed:

WATAUGA EXISTING SED POND:

Outlet Structure File: WATAUGA .STR
Planimeter Input File: WATAUGA .VOL
Rating Table Output File: WATAUGA .PND

Min. Elev.(ft) = 3184.42 Max. Elev.(ft) = 3194 Incr.(ft) = .5

Additional elevations (ft) to be included in table:
* * * * *

SYSTEM CONNECTIVITY

Structure	No.	Q Table	Q Table
-----	---	-----	-----
STAND PIPE	1		-> 1

Outflow rating table summary was stored in file:
WATAUGA .PND

Outlet Structure File: WATAUGA .STR

POND-2 Version: 5.17

S/N:

Date Executed:

Time Executed:

WATAUGA EXISTING SED POND:

>>>>> Structure No. 1 <<<<<<
(Input Data)

STAND PIPE

Stand Pipe with weir or orifice flow

E1 elev.(ft)?	3187.05
E2 elev.(ft)?	3194.001
Crest elev.(ft)?	3187.05
Diameter (ft)?	1.5
Weir coefficient?	3.1
Orifice coefficient?	.6
Start transition elev.(ft) @ ?	
Transition height (ft)?	1

Outlet Structure File: WATAUGA .STR

POND-2 Version: 5.17

S/N:

Date Executed:

Time Executed:

WATAUGA EXISTING SED POND:

Outflow Rating Table for Structure #1
STAND PIPE Stand Pipe with weir or orifice flow

***** INLET CONTROL ASSUMED *****

Elevation (ft)	Q (cfs)	Computation Messages
3184.42	0.0	E < Inv.El = 3187.05
3184.92	0.0	E < E1 = 3187.05
3185.42	0.0	E < E1 = 3187.05
3185.92	0.0	E < E1 = 3187.05
3186.42	0.0	E < E1 = 3187.05
3186.92	0.0	E < E1 = 3187.05
3187.42	2.8	Transition: H = .37
3187.92	7.0	Transition: H = .870
3188.42	10.0	Orifice: H = 1.37
3188.92	11.6	Orifice: H = 1.87
3189.42	13.1	Orifice: H = 2.37
3189.92	14.4	Orifice: H = 2.87
3190.42	15.6	Orifice: H = 3.37
3190.92	16.7	Orifice: H = 3.87
3191.42	17.8	Orifice: H = 4.37
3191.92	18.8	Orifice: H = 4.87
3192.42	19.7	Orifice: H = 5.37
3192.92	20.6	Orifice: H = 5.87
3193.42	21.5	Orifice: H = 6.37
3193.92	22.3	Orifice: H = 6.87
3194.00	22.4	Orifice: H = 6.95

Weir Cw = 3.1 Weir length = 4.712389 ft

Orifice Co = .6 Orifice area = 1.767146 sq.ft.

Q (cfs) = (Cw * L * H**1.5) or (Co * A * sqrt(2*g*H))

Transition interpolated between elev. 3187.133 and 3188.133 ft

Weir equation = Orifice equation @ elev. = 3187.633 ft

```

*****
*
*   25 YEAR STORM  96 AERIAL
*   WATAUGA EXISTING SED POND:
*
*
*
*****
  
```

Inflow Hydrograph: WATAUGA .HYD
 Rating Table file: WATAUGA .PND

----INITIAL CONDITIONS----
 Elevation = 3184.42 ft
 Outflow = 0.00 cfs
 Storage = 51,505 cu-ft

GIVEN POND DATA

INTERMEDIATE ROUTING
 COMPUTATIONS

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (cu-ft)	2S/t (cfs)	2S/t + 0 (cfs)
3184.42	0.0	51,505	286.1	286.1
3184.92	0.0	60,367	335.4	335.4
3185.42	0.0	69,642	386.9	386.9
3185.92	0.0	79,341	440.8	440.8
3186.42	0.0	89,466	497.0	497.0
3186.92	0.0	100,019	555.7	555.7
3187.42	2.8	111,007	616.7	619.5
3187.92	7.0	122,440	680.2	687.2
3188.42	10.0	134,596	747.8	757.8
3188.92	11.6	147,999	822.2	833.8
3189.42	13.1	162,721	904.0	917.1
3189.92	14.4	178,825	993.5	1007.9
3190.42	15.6	196,149	1089.7	1105.3
3190.92	16.7	214,335	1190.7	1207.4
3191.42	17.8	233,393	1296.6	1314.4
3191.92	18.8	253,345	1407.5	1426.3
3192.42	19.7	274,210	1523.4	1543.1
3192.92	20.6	296,011	1644.5	1665.1
3193.42	21.5	318,766	1770.9	1792.4
3193.92	22.3	342,497	1902.8	1925.1
3194.00	22.4	346,389	1924.4	1946.8

Time increment (t) = 0.100 hrs.

Pond File: WATAUGA .PND
 Inflow Hydrograph: WATAUGA .HYD
 Outflow Hydrograph: OUT .HYD

INFLOW HYDROGRAPH

ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - 0 (cfs)	2S/t + 0 (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	3.00	-----	286.1	286.1	0.00	3184.42
11.100	4.00	7.0	293.1	293.1	0.00	3184.49
11.200	4.00	8.0	301.1	301.1	0.00	3184.57
11.300	5.00	9.0	310.1	310.1	0.00	3184.66
11.400	6.00	11.0	321.1	321.1	0.00	3184.78
11.500	6.00	12.0	333.1	333.1	0.00	3184.90
11.600	7.00	13.0	346.1	346.1	0.00	3185.02
11.700	20.00	27.0	373.1	373.1	0.00	3185.29
11.800	33.00	53.0	426.1	426.1	0.00	3185.78
11.900	46.00	79.0	505.1	505.1	0.00	3186.49
12.000	89.00	135.0	632.0	640.1	4.08	3187.57
12.100	139.00	228.0	835.8	860.0	12.07	3189.08
12.200	86.00	225.0	1030.7	1060.8	15.05	3190.19
12.300	30.00	116.0	1114.6	1146.7	16.05	3190.62
12.400	20.00	50.0	1132.2	1164.6	16.24	3190.71
12.500	17.00	37.0	1136.6	1169.2	16.29	3190.73
12.600	14.00	31.0	1135.0	1167.6	16.27	3190.72
12.700	12.00	26.0	1128.6	1161.0	16.20	3190.69
12.800	10.00	22.0	1118.5	1150.6	16.09	3190.64
12.900	9.00	19.0	1105.6	1137.5	15.95	3190.58
13.000	9.00	18.0	1092.0	1123.6	15.80	3190.51
13.100	8.00	17.0	1077.7	1109.0	15.64	3190.44
13.200	8.00	16.0	1062.8	1093.7	15.46	3190.36
13.300	8.00	16.0	1048.2	1078.8	15.27	3190.28
13.400	7.00	15.0	1033.1	1063.2	15.08	3190.20
13.500	7.00	14.0	1017.3	1047.1	14.88	3190.12
13.600	6.00	13.0	1001.0	1030.3	14.68	3190.04
13.700	6.00	12.0	984.0	1013.0	14.46	3189.95
13.800	6.00	12.0	967.6	996.0	14.23	3189.85
13.900	6.00	12.0	951.6	979.6	13.99	3189.76
14.000	5.00	11.0	935.1	962.6	13.75	3189.67
14.100	5.00	10.0	918.1	945.1	13.50	3189.57
14.200	5.00	10.0	901.6	928.1	13.26	3189.48
14.300	5.00	10.0	885.6	911.6	13.00	3189.39
14.400	5.00	10.0	870.1	895.6	12.71	3189.29
14.500	4.00	9.0	854.3	879.1	12.42	3189.19
14.600	4.00	8.0	838.1	862.3	12.11	3189.09
14.700	4.00	8.0	822.4	846.1	11.82	3188.99
14.800	4.00	8.0	807.4	830.4	11.53	3188.90
14.900	4.00	8.0	793.0	815.4	11.21	3188.80
15.000	4.00	8.0	779.1	801.0	10.91	3188.70
15.100	4.00	8.0	765.9	787.1	10.62	3188.61
15.200	4.00	8.0	753.2	773.9	10.34	3188.53
15.300	4.00	8.0	741.1	761.2	10.07	3188.44
15.400	4.00	8.0	729.8	749.1	9.63	3188.36

Pond File: WATAUGA .PND
 Inflow Hydrograph: WATAUGA .HYD
 Outflow Hydrograph: OUT .HYD

INFLOW HYDROGRAPH

ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - 0 (cfs)	2S/t + 0 (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
15.500	4.00	8.0	719.5	737.8	9.15	3188.28
15.600	4.00	8.0	710.1	727.5	8.71	3188.21
15.700	4.00	8.0	701.5	718.1	8.31	3188.14
15.800	3.00	7.0	692.7	708.5	7.90	3188.07
15.900	3.00	6.0	683.7	698.7	7.49	3188.00
16.000	3.00	6.0	675.5	689.7	7.10	3187.94
16.100	3.00	6.0	668.2	681.5	6.64	3187.88
16.200	3.00	6.0	661.8	674.2	6.19	3187.82
16.300	3.00	6.0	656.2	667.8	5.80	3187.78
16.400	3.00	6.0	651.3	662.2	5.45	3187.74
16.500	3.00	6.0	647.0	657.3	5.15	3187.70
16.600	3.00	6.0	643.3	653.0	4.88	3187.67
16.700	3.00	6.0	640.0	649.3	4.65	3187.64
16.800	3.00	6.0	637.1	646.0	4.44	3187.62
16.900	3.00	6.0	634.6	643.1	4.26	3187.59
17.000	3.00	6.0	632.4	640.6	4.11	3187.58
17.100	3.00	6.0	630.4	638.4	3.97	3187.56
17.200	3.00	6.0	628.7	636.4	3.85	3187.54
17.300	3.00	6.0	627.2	634.7	3.74	3187.53
17.400	3.00	6.0	625.9	633.2	3.65	3187.52
17.500	3.00	6.0	624.8	631.9	3.57	3187.51
17.600	3.00	6.0	623.8	630.8	3.50	3187.50
17.700	3.00	6.0	622.9	629.8	3.44	3187.50
17.800	2.00	5.0	621.3	627.9	3.32	3187.48
17.900	2.00	4.0	619.0	625.3	3.16	3187.46
18.000	2.00	4.0	616.9	623.0	3.01	3187.45
18.100	2.00	4.0	615.2	620.9	2.89	3187.43
18.200	2.00	4.0	613.6	619.2	2.78	3187.42
18.300	2.00	4.0	612.2	617.6	2.72	3187.40
18.400	2.00	4.0	610.8	616.2	2.65	3187.39
18.500	2.00	4.0	609.7	614.8	2.60	3187.38
18.600	2.00	4.0	608.6	613.7	2.54	3187.37
18.700	2.00	4.0	607.6	612.6	2.50	3187.37
18.800	2.00	4.0	606.7	611.6	2.45	3187.36
18.900	2.00	4.0	605.8	610.7	2.41	3187.35
19.000	2.00	4.0	605.1	609.8	2.38	3187.34
19.100	2.00	4.0	604.4	609.1	2.34	3187.34
19.200	2.00	4.0	603.8	608.4	2.31	3187.33
19.300	2.00	4.0	603.2	607.8	2.29	3187.33
19.400	2.00	4.0	602.7	607.2	2.26	3187.32
19.500	2.00	4.0	602.2	606.7	2.24	3187.32
19.600	2.00	4.0	601.8	606.2	2.22	3187.32
19.700	2.00	4.0	601.4	605.8	2.20	3187.31
19.800	2.00	4.0	601.0	605.4	2.18	3187.31
19.900	2.00	4.0	600.7	605.0	2.16	3187.31
20.000	2.00	4.0	600.4	604.7	2.15	3187.30

Pond File: WATAUGA .PND
 Inflow Hydrograph: WATAUGA .HYD
 Outflow Hydrograph: OUT .HYD

INFLOW HYDROGRAPH

ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - 0 (cfs)	2S/t + 0 (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
20.100	2.00	4.0	600.1	604.4	2.14	3187.30
20.200	2.00	4.0	599.9	604.1	2.13	3187.30
20.300	2.00	4.0	599.6	603.9	2.11	3187.30
20.400	2.00	4.0	599.4	603.6	2.10	3187.30
20.500	2.00	4.0	599.2	603.4	2.09	3187.29
20.600	2.00	4.0	599.1	603.2	2.09	3187.29
20.700	2.00	4.0	598.9	603.1	2.08	3187.29
20.800	2.00	4.0	598.8	602.9	2.07	3187.29
20.900	2.00	4.0	598.6	602.8	2.07	3187.29
21.000	2.00	4.0	598.5	602.6	2.06	3187.29
21.100	2.00	4.0	598.4	602.5	2.05	3187.29
21.200	2.00	4.0	598.3	602.4	2.05	3187.29
21.300	2.00	4.0	598.2	602.3	2.05	3187.29
21.400	2.00	4.0	598.1	602.2	2.04	3187.28
21.500	2.00	4.0	598.1	602.1	2.04	3187.28
21.600	2.00	4.0	598.0	602.1	2.03	3187.28
21.700	2.00	4.0	597.9	602.0	2.03	3187.28
21.800	2.00	4.0	597.9	601.9	2.03	3187.28
21.900	2.00	4.0	597.8	601.9	2.03	3187.28
22.000	2.00	4.0	597.8	601.8	2.02	3187.28
22.100	2.00	4.0	597.7	601.8	2.02	3187.28
22.200	2.00	4.0	597.7	601.7	2.02	3187.28
22.300	2.00	4.0	597.6	601.7	2.02	3187.28
22.400	2.00	4.0	597.6	601.6	2.02	3187.28
22.500	2.00	4.0	597.6	601.6	2.02	3187.28
22.600	2.00	4.0	597.6	601.6	2.01	3187.28
22.700	2.00	4.0	597.5	601.6	2.01	3187.28
22.800	2.00	4.0	597.5	601.5	2.01	3187.28
22.900	2.00	4.0	597.5	601.5	2.01	3187.28
23.000	2.00	4.0	597.5	601.5	2.01	3187.28
23.100	1.00	3.0	596.5	600.5	1.96	3187.27
23.200	1.00	2.0	594.8	598.5	1.88	3187.26
23.300	1.00	2.0	593.2	596.8	1.80	3187.24
23.400	1.00	2.0	591.7	595.2	1.73	3187.23
23.500	1.00	2.0	590.4	593.7	1.67	3187.22
23.600	1.00	2.0	589.1	592.4	1.61	3187.21
23.700	1.00	2.0	588.0	591.1	1.56	3187.20
23.800	1.00	2.0	587.0	590.0	1.51	3187.19
23.900	1.00	2.0	586.1	589.0	1.46	3187.18
24.000	1.00	2.0	585.2	588.1	1.42	3187.17
24.100	1.00	2.0	584.5	587.2	1.39	3187.17
24.200	1.00	2.0	583.8	586.5	1.35	3187.16
24.300	1.00	2.0	583.1	585.8	1.32	3187.16
24.400	1.00	2.0	582.5	585.1	1.29	3187.15
24.500	1.00	2.0	582.0	584.5	1.27	3187.15
24.600	1.00	2.0	581.5	584.0	1.24	3187.14

Pond File: WATAUGA .PND
 Inflow Hydrograph: WATAUGA .HYD
 Outflow Hydrograph: OUT .HYD

INFLOW HYDROGRAPH

ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - 0 (cfs)	2S/t + 0 (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
24.700	1.00	2.0	581.1	583.5	1.22	3187.14
24.800	1.00	2.0	580.7	583.1	1.20	3187.13
24.900	1.00	2.0	580.3	582.7	1.18	3187.13
25.000	0.00	1.0	579.1	581.3	1.12	3187.12
25.100	0.00	0.0	577.0	579.1	1.03	3187.10
25.200	0.00	0.0	575.1	577.0	0.94	3187.09
25.300	0.00	0.0	573.4	575.1	0.85	3187.07
25.400	0.00	0.0	571.9	573.4	0.78	3187.06
25.500	0.00	0.0	570.4	571.9	0.71	3187.05
25.600	0.00	0.0	569.1	570.4	0.65	3187.04
25.700	0.00	0.0	568.0	569.1	0.59	3187.03
25.800	0.00	0.0	566.9	568.0	0.54	3187.02
25.900	0.00	0.0	565.9	566.9	0.49	3187.01

***** SUMMARY OF ROUTING COMPUTATIONS *****

Pond File: WATAUGA .PND
Inflow Hydrograph: WATAUGA .HYD
Outflow Hydrograph: OUT .HYD

Starting Pond W.S. Elevation = 3184.42 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow = 139.00 cfs
Peak Outflow = 16.29 cfs
Peak Elevation = 3190.73 ft

***** Summary of Approximate Peak Storage *****

Initial Storage = 51,505 cu-ft
Peak Storage From Storm = 156,016 cu-ft

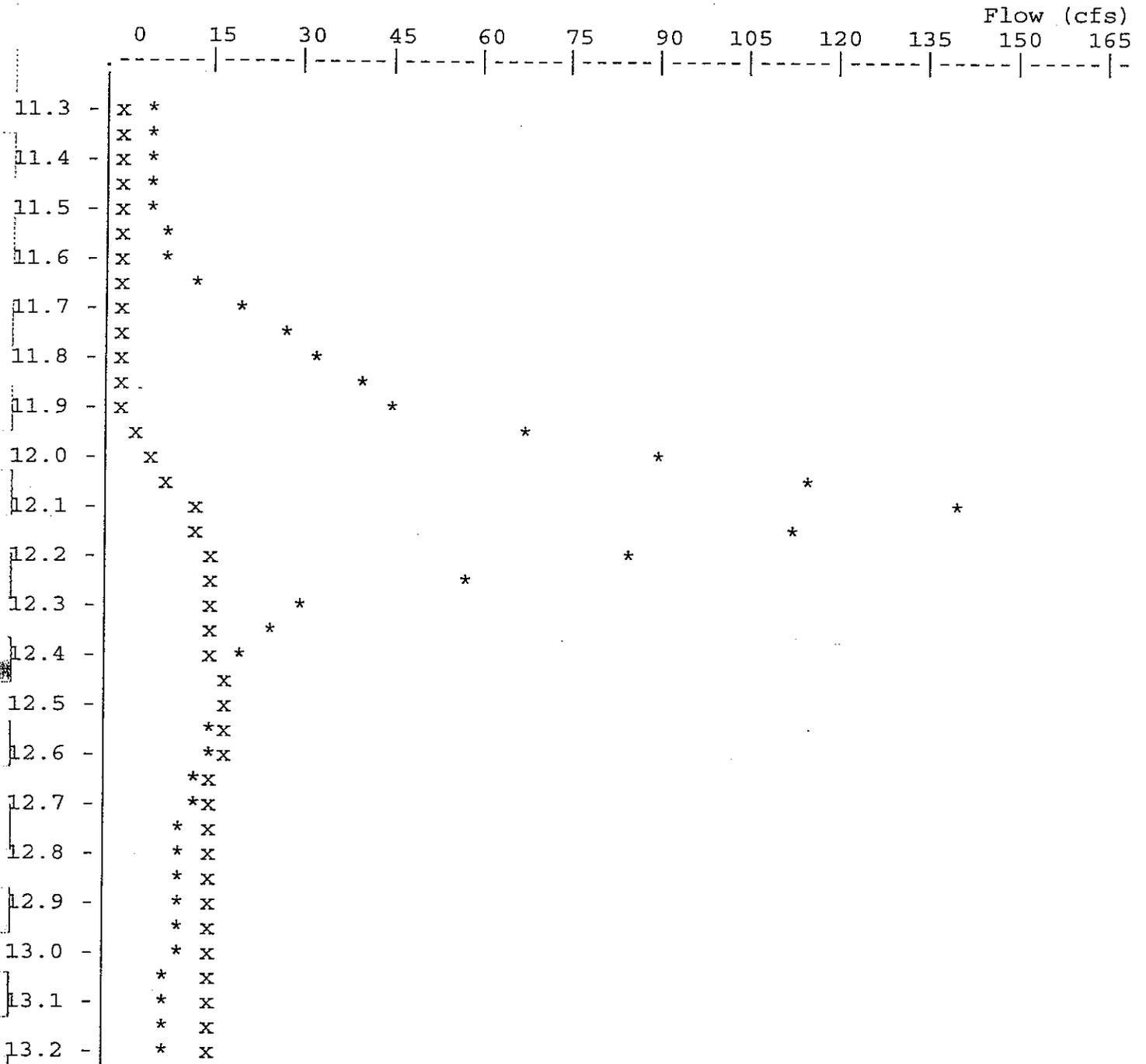
Total Storage in Pond = 207,521 cu-ft

Warning: Inflow hydrograph truncated on left side.

Pond File: WATAUGA .PND
Inflow Hydrograph: WATAUGA .HYD
Outflow Hydrograph: OUT .HYD

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12:28:37

Peak Inflow = 139.00 cfs
Peak Outflow = 16.29 cfs
Peak Elevation = 3190.73 ft



TIME
(hrs)

* File: WATAUGA .HYD Qmax = 139.0 cfs
 x File: OUT .HYD Qmax = 16.3 cfs



Draper Aden Associates

CONSULTING ENGINEERS
BLACKSBURG · RICHMOND, VIRGINIA
NASHVILLE, TENNESSEE

Subject _____ Sheet No. ___ of _____

_____ Job No. _____

_____ By _____ Date _____

Dewatering Outlet

$$Q(\text{6 hour drawdown}) = \frac{51421 \text{ cf}}{21,600} = 2.38 \text{ cfs}$$

$$h(\text{head}) = 2.5 \text{ ft}$$

$$A = \frac{Q}{\left(64.32 \times \frac{h}{2}\right)^{1/2} (0.6)}$$

$$\frac{2.38}{\left(64.32 \times \frac{2.5}{2}\right)^{1/2} (0.6)} = 0.44$$

$$d = 2 \times \left(\frac{A}{3.14}\right)^{1/2} = 0.75 \text{ ft} = 9''$$

APPENDIX D

FINANCIAL RESPONSIBILITY/OWNERSHIP FORM

**FINANCIAL RESPONSIBILITY/OWNERSHIP FORM
SEDIMENTATION POLLUTION CONTROL ACT**

No person may initiate any land-disturbing activity on one or more acres as covered by the Act before this form and an acceptable erosion and sedimentation control plan have been completed and approved by the Land Quality Section, N.C. Department of Environment and Natural Resources. (Please type or print and, if the question is not applicable or the e-mail and/or fax information unavailable, place N/A in the blank.)

Part A.

1. Project Name Watauga County LCID Landfill
2. Location of land-disturbing activity: County Watauga City or Township Boone
Highway/Street Landfill Road Latitude 36 deg 13 min 14 sec N Longitude 81 deg 38 min 00 sec W
3. Approximate date land-disturbing activity will commence: November 1, 2009
4. Purpose of development (residential, commercial, industrial, institutional, etc.): Industrial
5. Total acreage disturbed or uncovered (including off-site borrow and waste areas): 5 acres
6. Amount of fee enclosed: \$ 250.00. The application fee of \$50.00 per acre (rounded up to the next acre) is assessed without a ceiling amount (Example: a 9-acre application fee is \$450).
7. Has an erosion and sediment control plan been filed? Yes No Enclosed
8. Person to contact should erosion and sediment control issues arise during land-disturbing activity:
Name J.V. Potter E-mail Address jv.potter@ncmail.net
Telephone 828-264-5305 Cell # N/A Fax # 828-264-1702
9. Landowner(s) of Record (attach accompanied page to list additional owners):

<u>Watauga County</u>	<u>828-265-8000</u>	<u>828-264-3230</u>
Name	Telephone	Fax Number
<u>842 West King Street, Suite 1</u>	<u>842 West King Street, Suite 1</u>	
Current Mailing Address	Current Street Address	
<u>Boone, North Carolina 28607-3532</u>	<u>Boone, North Carolina 28607-3532</u>	
City State Zip	City State Zip	
10. Deed Book No. 0252 Page No. 739 Provide a copy of the most current deed.

Part B.

1. Person(s) or firm(s) who are financially responsible for the land-disturbing activity (Provide a comprehensive list of all responsible parties on an attached sheet):

<u>Watauga County Solid Waste Department</u>	<u>N/A</u>
Name	E-mail Address
<u>842 West King Street, Suite 1</u>	<u>842 West King Street, Suite 1</u>
Current Mailing Address	Current Street Address
<u>Boone, North Carolina 28607-3532</u>	<u>Boone, North Carolina 28607-3532</u>
City State Zip	City State Zip
Telephone <u>828-265-8000</u>	Fax Number <u>828-264-3230</u>

2. (a) If the Financially Responsible Party is not a resident of North Carolina, give name and street address of the designated North Carolina Agent:

_____ Name	_____ E-mail Address
_____ Current Mailing Address	_____ Current Street Address
_____ City	_____ City
_____ State	_____ State
_____ Zip	_____ Zip
_____ Telephone	_____ Fax Number

(b) If the Financially Responsible Party is a Partnership or other person engaging in business under an assumed name, **attach a copy of the Certificate of Assumed Name.** If the Financially Responsible Party is a Corporation, give name and street address of the Registered Agent:

_____ Name of Registered Agent	_____ E-mail Address
_____ Current Mailing Address	_____ Current Street Address
_____ City	_____ City
_____ State	_____ State
_____ Zip	_____ Zip
_____ Telephone	_____ Fax Number

The above information is true and correct to the best of my knowledge and belief and was provided by me under oath (This form must be signed by the Financially Responsible Person if an individual or his attorney-in-fact, or if not an individual, by an officer, director, partner, or registered agent with the authority to execute instruments for the Financially Responsible Person). I agree to provide corrected information should there be any change in the information provided herein.

_____ Type or print name	_____ Title or Authority
_____ Signature	_____ Date

I, _____, a Notary Public of the County of _____

State of North Carolina, hereby certify that _____ appeared personally before me this day and being duly sworn acknowledged that the above form was executed by him.

Witness my hand and notarial seal, this _____ day of _____, 20_____

Seal

Notary
My commission expires _____

APPENDIX E

**EROSION AND SEDIMENTATION CONTROL PLAN
REVIEW CHECKLIST**

**NORTH CAROLINA DEPARTMENT OF ENVIRONMENT & NATURAL RESOURCES
LAND QUALITY SECTION**

EROSION and SEDIMENTATION CONTROL PLAN PRELIMINARY REVIEW CHECKLIST

The following items shall be incorporated with respect to specific site conditions, in an erosion & sediment control plan:

LOCATION INFORMATION

- Project location (roads, streets, landmarks)
- North arrow and scale

GENERAL SITE FEATURES (Plan elements)

- Legend: North arrow, scale, etc.
 - Property lines
 - Existing contours (topographic lines)
 - Proposed contours
 - Limits of disturbed area (provide acreage total, delineate limits, and label)
 - Planned and existing building locations and elevations
 - Planned & existing road locations & elevations
 - Lot and/or building numbers
 - Geologic features: rock outcrops, seeps, springs, wetland and their limits, streams, lakes, ponds, dams, etc.
 - Easements and drainage ways
 - Profiles of streets, utilities, ditch lines, etc.
 - Stockpiled topsoil or subsoil locations
 - If the same person conducts the land-disturbing activity & any related borrow or waste activity, the related borrow or waste activity shall constitute part of the land-disturbing activity unless the borrow or waste activity is regulated under the Mining Act of 1971, or is a landfill regulated by the Division of Waste Management. If the land-disturbing activity and any related borrow or waste activity are not conducted by the same person, they shall be considered separate land-disturbing activities and must be permitted either thru the Sedimentation Pollution Control Act as a one-use borrow site or through the Mining Act.
- N/A Required Army Corps 404 permit and Water Quality 401 certification (e.g. stream disturbances over 150 linear feet)

EROSION CONTROL MEASURES (on plan)

- Legend
- Location of temporary measures
- Location of permanent measures
- Construction drawings and details for temporary and permanent measures
- Maintenance requirements of measures
- Contact person responsible for maintenance

SITE DRAINAGE FEATURES

- Existing and planned drainage patterns (include off-site areas that drain through project)
- Method of determination of and calculations for Acreage of land being disturbed
- Size and location of culverts and sewers
- Soil information: type, special characteristics
- Soil information below culvert storm outlets
- Name and classification of receiving water course or name of municipal operator (only where stormwater discharges are to occur)

STORMWATER CALCULATIONS

- Pre-construction runoff calculations for each outlet from the site (at peak discharge points)
- Design calculations for peak discharges of runoff (including the construction phase & the final runoff coefficients of the site)
- Design calcs of culverts and storm sewers
- Discharge and velocity calculations for open channel and ditch flows (easement & right-of-ways)
- Design calcs of cross sections and method of stabilization of existing and planned channels (include temporary linings)
- Design calcs and construction details of energy dissipators below culvert and storm sewer outlets (diameters & apron dimensions)
- Design calcs and dimension of sediment basins
- Surface area and settling efficiency information for proposed sediment traps and/or basins

VEGETATIVE STABILIZATION

- Area & acreage to be vegetatively stabilized
- Method of soil preparation
- Seed type & rates (temporary & permanent)
- Fertilizer type and rates
- Mulch type and rates

NOTE: Plan should include provisions for groundcover on exposed slopes within 21 calendar days following completion of any phase of grading; permanent groundcover for all disturbed areas within 15 working days or 90 calendar days (whichever is shorter) following completion of construction or development.

FINANCIAL RESPONSIBILITY/OWNERSHIP FORM

- Completed, signed & notarized FR/O Form
- Accurate application fee (\$50.00 per acre rounded up the next acre with no ceiling amount)
- Certificate of assumed name, if the owner is a partnership
- Name of Registered Agent (if applicable)
- Copy of the most current Deed for the site

NOTE: For the Express Permitting Option, inquire at the local Regional Office for availability.

NARRATIVE AND CONSTRUCTION SEQUENCE

- Narrative describing the nature & purpose of the construction activity
- Construction sequence related to erosion and sediment control (including installation of critical measures prior to the initiation of the land-disturbing activity & removal of measures after areas they serve are permanently stabilized)
- Bid specifications related only to erosion control