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December 26, 2008

Mr. Matt Windom
General Manager
Carroll County Water Authority
1737 Bankhead Highway
Carrollton, GA 30117

Re: Carroll County Water Authority
Reservoir Evaluation
HHNT Project No. 1720-010-01

Dear Mr. Windom:

As requested, Hodges, Harbin, Newberry & Tribble, Inc. (HHNT) reviewed the siting of a potential reservoir on Indian Creek north of the City of Bowdon in Carroll County. Of particular concern is the County's SR-166 closed sanitary landfill (original permit issued February 8, 1980) east of Bowdon on the Little Tallapoosa River. Two intakes for feed water to the reservoir are proposed first on Indian Creek, West of Bowdon, and then later on the Little Tallapoosa River south of Bowdon.

For purposes of this evaluation, we considered the reservoir and the two intake points as separate potential receptors from the closed landfill, and the risk it could pose to any of the three.

Landfill Evaluation

Our evaluation began with a site visit to the closed landfill, then a review of the Environmental Protection Division's (EPD) records of the landfill's environmental monitoring. Listed below is a summary of our findings.

A. Site Visit

The facility is generally grassed with no signs of leachate outbreaks (visual or odor), and no signs of significantly distressed vegetation.

B. Methane

The facility received a Notice of Deficiency (NOD) on January 23, 2007 for a methane exceedance at MM-1 in November 2006 (64 % methane by volume) and was required to switch from quarterly to monthly monitoring. In November of 2007 the facility was allowed to return to quarterly monitoring, after six months of no methane exceedances. Since that time the facility has had no further exceedances. In the past the facility has also had high levels of methane in the groundwater monitoring wells.

C. Groundwater

The facilities first Assessment Monitoring (Appendix II) event was in March of 1997. Since that time four (4) Appendix II constituents have been detected. These four (4) constituents were added to the Appendix I list to create the Appendix I Expanded List. Currently some wells are monitored for this Expanded List and some wells are monitored for the Appendix II list. The most recent Assessment of Corrective Measures Report (ACM) was submitted in November of 2006. This report suggested monitored Natural Attenuation as the primary remediation and installation of a passive landfill gas extraction system as a secondary remediation. During the two (2) semi-annual events of 2007, various metals and VOCs were detected. Cadmium, Cobalt, Mercury, Benzene, Chloroethane, Dichloromethane, 4-Methyl-2-pentanone, and Vinyl Chloride were determined to have statistically significant increases (SSI) when compared to background levels.

D. Operations

Between 1990 and 1996 the facility failed numerous inspections which have resulted in Non-Compliance Notifications and Notice of Violations from the Georgia EPD. Most of the violations were in reference to operational issues such as erosion, exposed waste, excessive litter, poor vegetation, etc. We found no evidence in the files that the site ever accepted any hazardous waste or substance. The non-compliance issues noted in the file were typically "housekeeping issues" and not more serious environmental issues.

Based on the results of this review, the majority of the contaminants in the site's groundwater are found in upgradient monitoring wells, indicating these contaminants are most likely methane gas transported. Methane gas tends to rise and based on this, it is indicated that the contaminants moved in an upgradient direction with the methane gas migration. Upgradient is away from the Little Tallapoosa River. These contaminants are also found at very low levels, further indicating no risk to the Little Tallapoosa River at this location, or any downstream location. Georgia EPD reviewed the groundwater data and analysis and accepted "monitored natural attenuation," since it was demonstrated by the data that contaminants would not reach the Little Tallapoosa River.

Reservoir Site

The reservoir site, located on Indian Creek, is not downstream or downgradient of the closed sanitary landfill, and therefore is at no risk whatsoever from the closed landfill.

Phase I Intake

The Phase I Intake located on Indian Creek, is not downstream or downgradient of the closed sanitary landfill, and therefore is at no risk whatsoever from the closed landfill.

Phase II Intake

The Phase II Intake is located on the Little Tallapoosa River, about 14 miles downstream of the closed sanitary landfill. Based on the extremely low levels of contaminants detected at the landfill, and the 14 mile distance from the landfill to this intake, there is no reasonable risk to the Phase II Intake from the closed sanitary landfill. In fact, Georgia Solid Waste Regulations Circular 14 allows a landfill to be located within a water intake watershed. The regulation reads:

Protection of Water Supply Watersheds

"The Rules for Environmental Planning Criteria (Chapter 391-3-16-.01) specify certain minimum protection criteria for water supply watersheds. In particular: (1) Within seven (7) miles upstream of a governmentally owned public drinking water supply intake or water supply reservoir, there shall be a 100 foot buffer on both sides of perennial streams as measured from the stream banks. (2) Within seven (7) miles upstream of a governmentally owned public drinking water supply intake or water supply reservoir, no impervious surface shall be constructed within a 150 foot setback as measured from the stream banks of any perennial stream. (Note: This means that if the site is to be lined, no portion of the liner shall be within 150 feet of a perennial stream). (3) Beyond the aforementioned seven miles, and if the watershed is less than 100 square miles, the perennial stream buffer and setback shall be 50 feet and 75 feet respectively. (4) If the watershed is less than 100 square miles, new municipal solid waste landfills are allowed only if they have synthetic liners and leachate collection systems."

The watershed contributing to the Little Tallapoosa River at the Phase II Intake is greater than 100 square miles, making this a large water supply watershed. The existing closed sanitary landfill has 100' buffers off of perennial streams and therefore it meets the requirements of the "Rules for Environmental Planning Criteria."

Findings and Summary

Based on our on-site inspection of the closed sanitary landfill, review of the EPD environmental monitoring records for this facility, a review of the watersheds for the reservoir and the intakes, it is our professional opinion that the closed sanitary landfill east of Bowdon on the Little

Tallapoosa River, poses no threat of contamination to the proposed reservoir or the two proposed intakes.

Should you have any questions, please call.

Sincerely,

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.

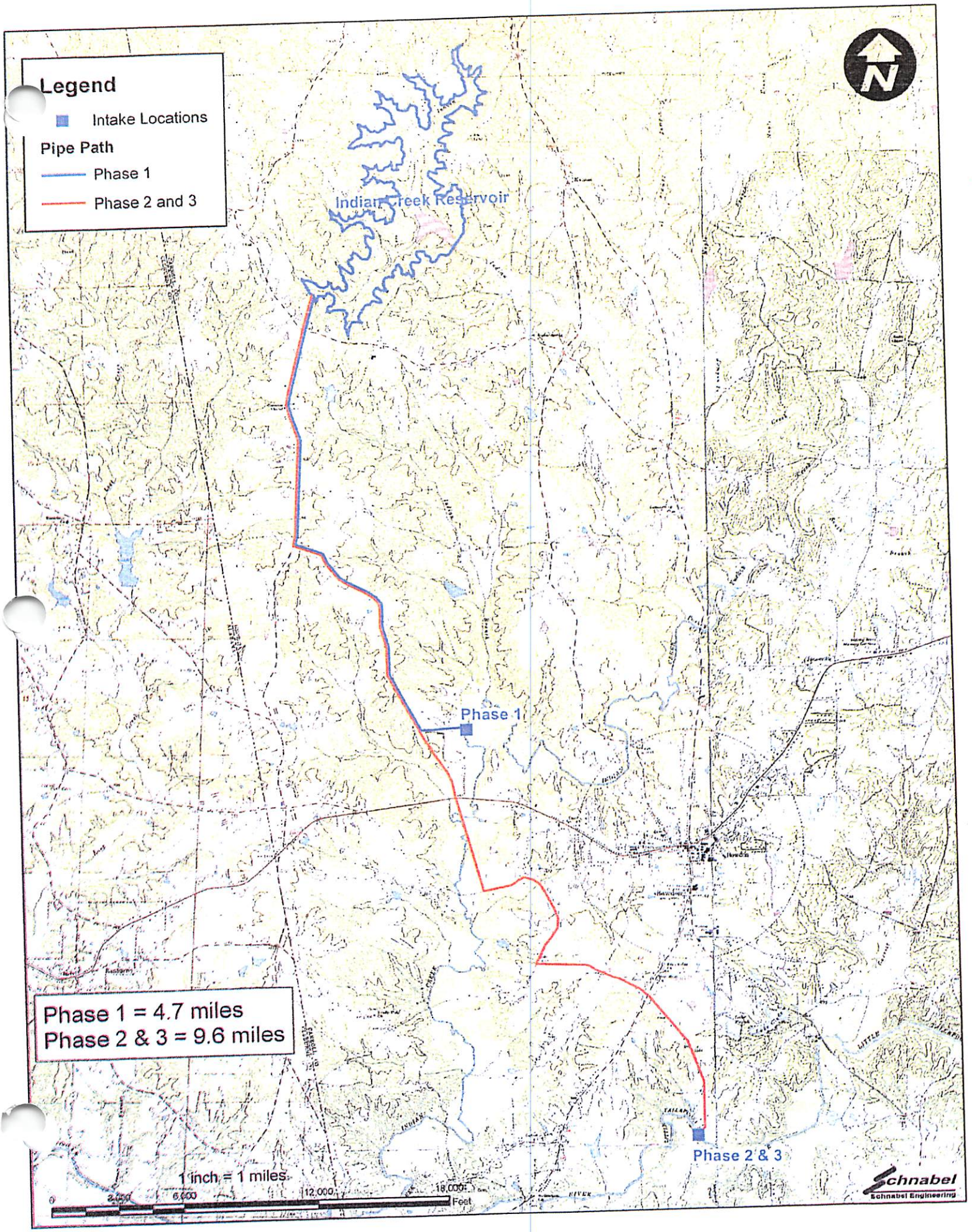
William F. Hodges, P.E.
Professional Engineer

WFH/rm

Enclosures

Figures:
1. Reservoir and Intake Map by Schnabel Engineering
2. Indian Creek Reservoir by Schnabel Engineering
3. Map showing Landfill, Reservoir and Intakes
4. Sketch showing Landfill
5. Criteria for Performing Site Acceptability Studies for Solid Waste Landfills in Georgia – Circular 14 – Georgia DNR

cc: Clint Courson (w/o enclosures)


Legend
Intake Locations
Pipe Path
Phase 1
Phase 2 and 3
Indian Creek Reservoir
Phase 1
Phase 2 & 3
Phase 1 = 4.7 miles
Phase 2 & 3 = 9.6 miles
1 inch = 1 miles
0
6,000
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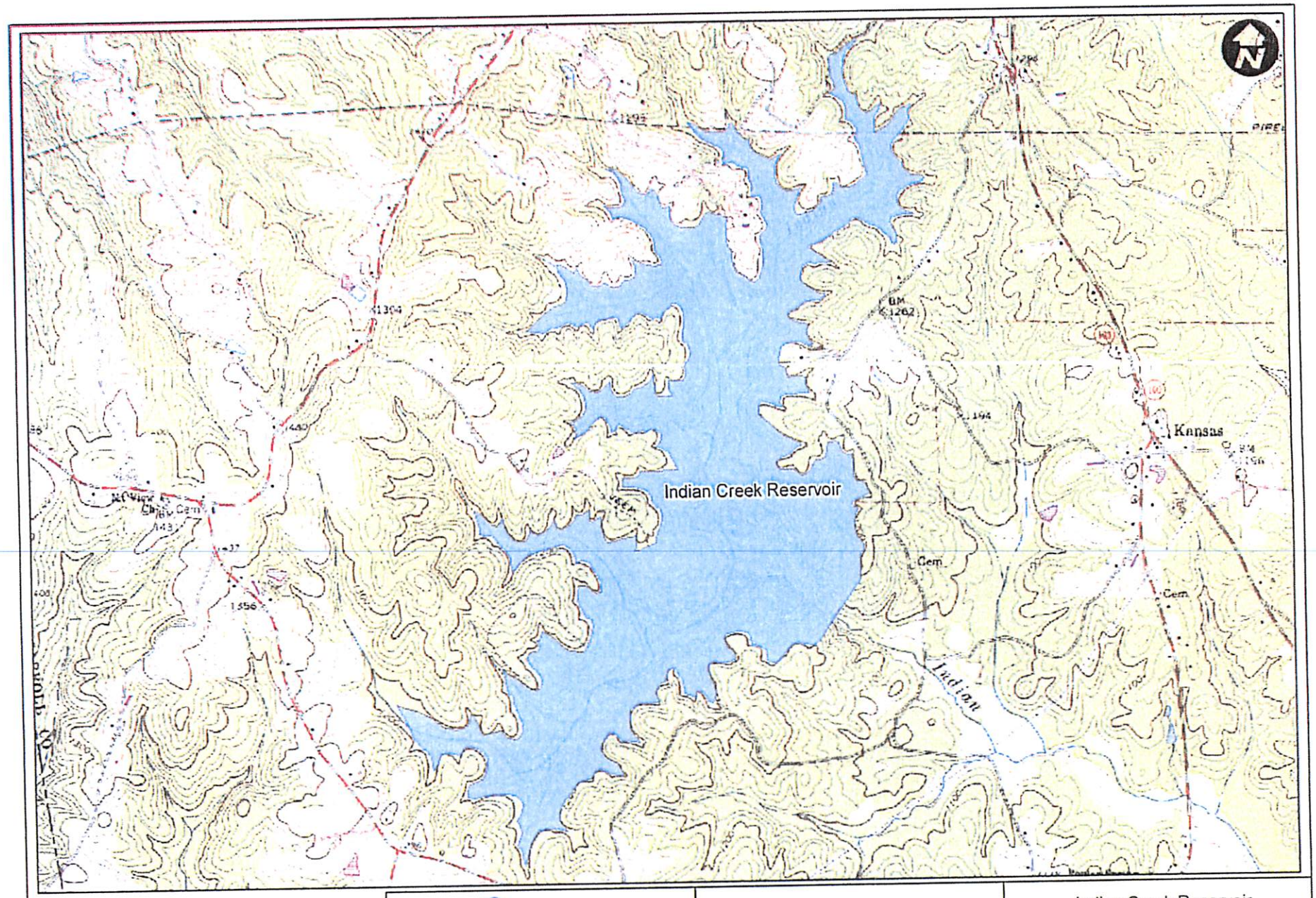
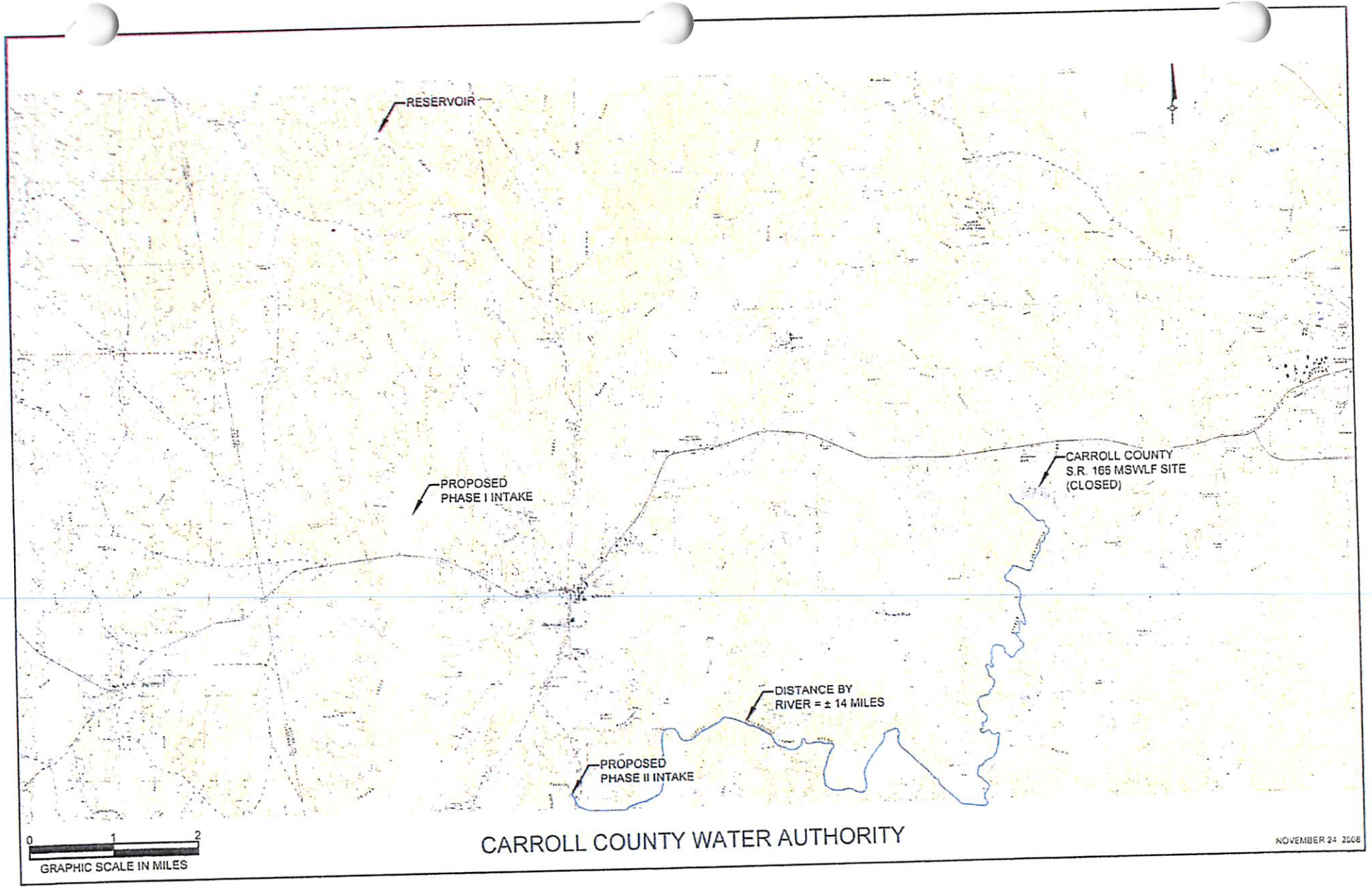
Schnabel Engineering



Schnabel Engineering

Tallapoosa Reservoir Options
Carroll County, Georgia

Indian Creek Reservoir



CARROLL COUNTY WATER AUTHORITY

NOVEMBER 24 2008

FIGURE 2 SITE BOUNDARY CARROLL CO - SR 166 MSWLF - BOWDEN EAST, GA & CARROLLTON, GA USGS 7.5 Min. Quadrangle

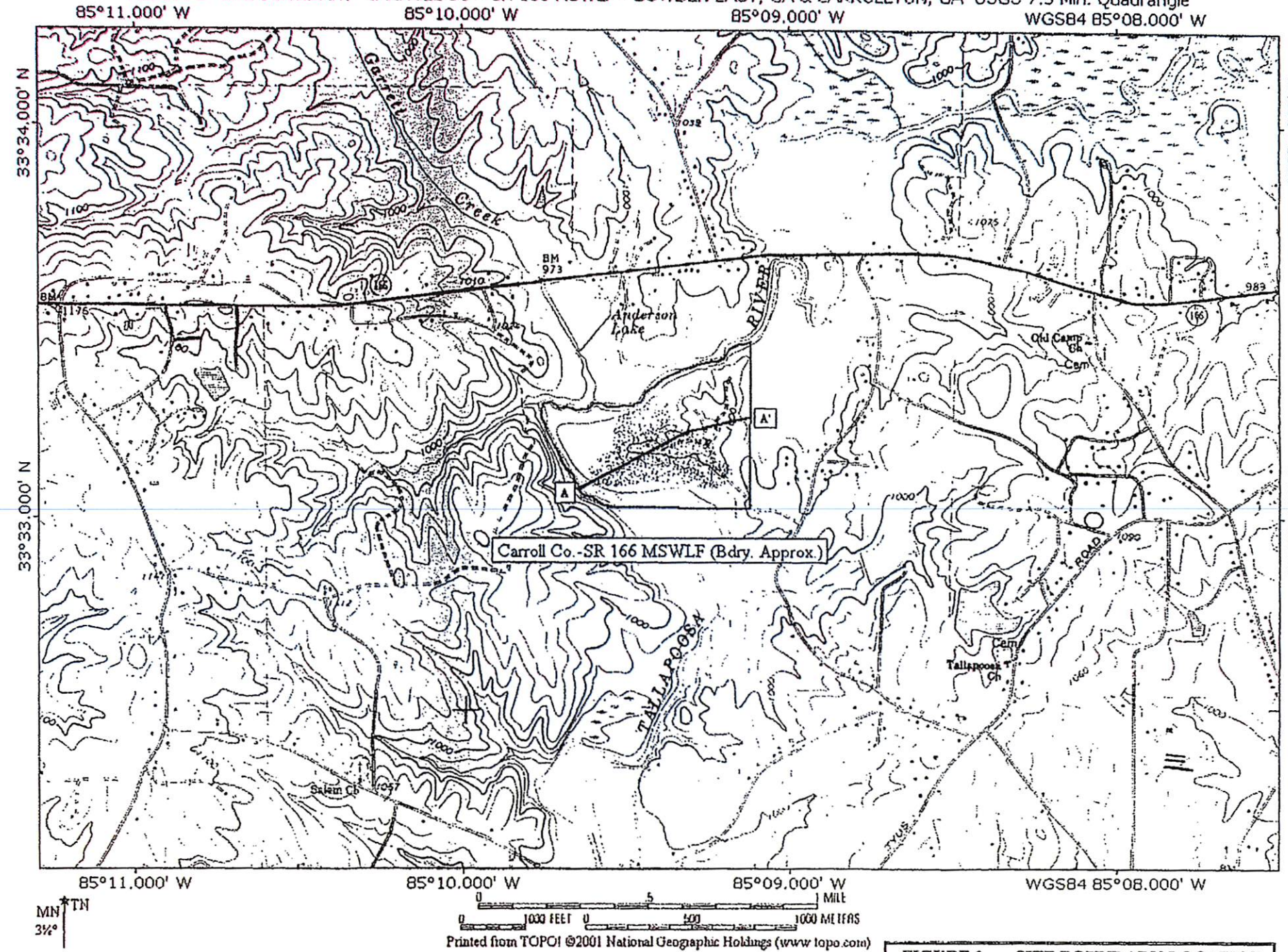


FIGURE 2 SITE BOUNDARY LOCATION

CRITERIA FOR PERFORMING SITE ACCEPTABILITY STUDIES FOR SOLID WASTE LANDFILLS IN GEORGIA

William H. McLemore
Paul D. Perriello

Department of Natural Resources
Environmental Protection Division
Georgia Geologic Survey

CIRCULAR 14

CRITERIA FOR PERFORMING SITE ACCEPTABILITY STUDIES FOR SOLID WASTE LANDFILLS IN GEORGIA

William H. McLemore
Paul D. Perriello

Georgia Department of Natural Resources
Lonice C. Barrett, Commissioner

Environmental Protection Division
Harold F. Reheis, Director

Georgia Geologic Survey
William H. McLemore, State Geologist

Atlanta
1991
(amended, 1997)

CIRCULAR 14

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Illustrations

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CRITERIA FOR PERFORMING SITE ACCEPTABILITY STUDIES FOR SOLID WASTE LANDFILLS IN GEORGIA

William H. McLemore
Paul D. Perriello

Background

Siting of municipal solid waste landfills rarely was a scientific process prior to the reorganization of State Government and the creation of the Georgia Environmental Protection Division (EPD) in 1972. Wastes of all types were often "dumped" in local borrow pits, quarries or simply alongside rural roads. However, with passage of the Solid Waste[1] Management Act in 1972, site selection for municipal solid waste landfills became a rigorous application of both engineering and geology. Almost all municipal solid waste landfill site evaluations were performed by EPD geologists between 1973 and 1983. Since 1984, consulting engineers and geologists have performed progressively more evaluations. While consultants in 1984 rarely performed anything more than drilling and logging boreholes, their current activities often include substantial evaluations of the ground-water flow regime, the behavior of potential pollutants in the subsurface, and the design of liner/leachate collection systems. The Georgia Department of Natural Resources' 5-year plan called for EPD to require all solid waste landfill applicants to conduct their own site acceptability assessments on all proposed solid waste sites beginning in 1989, as opposed to EPD conducting the assessment.

This circular does not provide information as to how a site acceptability study should be performed or what EPD will regard as an acceptable site. Rather, the purpose of this manual is to explain how EPD will evaluate the completeness of consultants' reports so that EPD will be in a position to make a determination as to whether or not a letter of site acceptability should be issued for a proposed landfill. This will be done by reviewing how the various laws and rules affect landfill siting.

In reviewing reports, EPD will base its decision-making on (a) actual measurements versus estimates; (b) direct measurements versus indirect measurements; and (c) consistency with commonly accepted engineering and geologic practices. EPD recognizes that strict adherence to the above is not always possible. For example, EPD would not necessarily expect a consultant to make water-level measurements over a year's period of time simply to evaluate seasonal ground-water fluctuations. An estimate based on EPD-USGS monitoring wells in similar geologic terranes should be adequate in this case.

One final point needs to be made; simply because a consultant's report is complete and thorough does not mean that the site is acceptable. There are some sites that cannot be reasonably made suitable for solid wastes without posing an undue risk to public health and the environment.

Types of Landfills Considered

From a regulatory perspective, there are four types of solid waste landfills:

(1) municipal solid waste landfills,
(2) industrial solid waste landfills,
(3) construction/demolition solid waste landfills, and
(4) inert solid waste landfills.

A municipal solid waste landfill, as defined by the Rules for Solid Waste Management, is a disposal site where solid wastes from homes, commercial buildings, governmental buildings or institutional facilities are disposed of by means of placing an earth cover thereon. Industrial solid waste is solid waste generated by manufacturing or industrial processes that is not a hazardous waste under regulations promulgated by the Board of Natural Resources, Chapter 391-3-11. A construction/demolition solid waste landfill accepts waste building materials and rubble resulting from construction, remodeling, repair and demolition operations of pavements, houses, commercial buildings and/or other structures. Such wastes include, but are not necessarily limited to wood, bricks, metal, concrete, wall board, paper or cardboard. An inert solid waste landfill, on

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1 "Solid Waste" means discarded putrescible and nonputrescible wastes, except water-carried body waste and recovered materials, and shall include garbage, rubbish such as paper, cartons, boxes, wood, tree branches, yard trimmings, furniture and appliances, metal, tin cans, glass, crockery, or dunnage; ashes; street refuse; dead animals; sewage sludges; animal manures; industrial wastes such as waste materials generated in industrial operations; residue from solid waste thermal treatment technology; food processing wastes; demolition wastes; abandoned automobiles; dredging wastes; construction wastes; and any other waste material in a solid, semi-solid or liquid state not otherwise defined in the Solid Waste Management Act. Solid waste shall not include any material which is regulated pursuant to Article 2 of Chapter 5 of the Georgia Water Quality Control Act or Chapter 9 of the Georgia Air Quality Act of 1978.

the other hand, is a disposal site accepting only wastes that will not or is not likely to produce leachate that is deleterious to the environment (such wastes are limited to earth and earth-like products, concrete, cured asphalt, rock, bricks, yard trimmings, stumps, limbs and leaves; this definition excludes industrial and some types of demolition solid waste). Site assessments are not required for inert waste landfills, but EPD does expect that such wastes will be disposed of in a manner that does not adversely affect adjacent properties and surface waters.

This guidance manual is directed primarily at the siting of municipal solid waste landfills. Guidance is also provided for industrial solid waste landfills and construction/demolition solid waste landfills in Appendices A and B respectively.[2]

Statutory Authority

General

There are several Georgia laws that directly affect the siting of municipal solid waste landfills. The primary law relevant to site evaluation is the Comprehensive Georgia Solid Waste Management Act (O.C.G.A. 12-8-20). Rules promulgated thereunder specify geologic, hydrologic and other criteria that must be satisfied for an acceptable site. Rules for recharge area and watershed protection promulgated under the Growth Strategies Planning Act (O.C.G.A. 12-2-8); rules for wellhead protection, promulgated under the Georgia Safe Drinking Water Act of 1977 (O.C.G.A. 12-5-170); rules governing development along designated "trout streams," promulgated under the Georgia Erosion and Sedimentation Act of 1975 (O. C. G. A. 12-7-1), may affect the siting and/or the development of a landfill.

Significant Recharge Areas

The Growth Strategies Planning Act required that EPD promulgate rules or standards that give Significant Ground-Water Recharge Areas special protection (Chapter 391-3-16-.02). For the purposes of solid waste management, a Significant Ground-Water Recharge Area means any area so designated on Hydrologic Atlas 18, Most Significant Ground-Water Recharge Areas of Georgia, 1989, as published by the Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources. Any municipal solid waste landfill that is sited in a Most Significant Ground-Water Recharge Area shall have a synthetic liner and a leachate collection system. A further restriction has been placed on sites located in significant ground-water recharge areas. In particular, the Comprehensive Solid Waste Management Act (§12-8-25.3(d)) states that: "No permit shall be issued for a municipal solid waste landfill within two miles of a federally restricted military air space which is used for a bombing range."

Limits on the Number of Solid Waste Facilities in a Given Area

The Comprehensive Solid Waste Management Act (§12-8-25.4(b)) also limits the number of private waste disposal facilities that may be permitted in a given geographic area. No permit shall be issued for a private industry solid waste disposal facility if any part of the area proposed for permitting would lie within a geographic area which would meet the following criteria:

(1) The geographic area is in the shape of a circle with a two mile radius, the centerpoint of which may be any point within the area proposed for permitting; and

(2) The circular geographic area already includes all or a portion of three or more landfills (including the landfill proposed for permitting in the case of a proposed expansion).

Erosion Control Along "Trout Streams"

Under the Georgia Erosion and Sedimentation Act of 1975, as amended through 1995 (§12-7-6.(b)(16)) land-disturbing activities are regulated along designated "trout streams" in Georgia. The implementation of this act may affect landfill siting decisions, and will certainly affect the design and construction of landfills sited adjacent to the designated "trout streams." The act states that:

> Land-disturbing activities shall not be conducted within 100 horizontal feet, as measured from the point where vegetation has been wrested by normal stream flow or wave action, of banks of any state waters classified as "trout streams" pursuant to Article 2 of Chapter 5 of this title, the "Georgia Water Quality Act," unless a variance for such activity is granted by the Director except where a roadway drainage structure must be constructed, provided that adequate erosion control measures are incorporated in the project plans and specifications and are implemented.

If a proposed landfill site is located adjacent to a perennial stream, it is the applicant's responsibility to

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2 Unless granted a variance by EPD, industrial waste landfills must conform to the criteria for siting of municipal waste landfills. The basis for this variance will be the characterization of the waste as well as the hydrologic data provided in the consultant's site acceptability assessment. In other words, site acceptability assessments for industrial waste landfills must contain adequate data to justify EPD's not imposing the more rigorous municipal waste landfill environmental protection criteria.

determine if the stream is a designated "trout stream", and to summarize this determination in the site assessment report.

Protection of Water Supply Watersheds

The Rules for Environmental Planning Criteria (Chapter 391-3-16-.01) specify certain minimum protection criteria for water supply watersheds. In particular:

(1) Within seven (7) miles upstream of a governmentally owned public drinking water supply intake or water supply reservoir, there shall be a 100 foot buffer on both sides of perennial streams as measured from the stream banks.

(2) Within seven (7) miles upstream of a governmentally owned public drinking water supply intake or water supply reservoir, no impervious surface shall be constructed within a 150 foot setback as measured from the stream banks of any perennial stream. (Note: This means that if the site is to be lined, no portion of the liner shall be within 150 feet of a perennial stream).

(3) Beyond the aforementioned seven miles, and if the watershed is less than 100 square miles, the perennial stream buffer and setback shall be 50 feet and 75 feet respectively.

(4) If the watershed is less than 100 square miles, new municipal solid waste landfills are allowed only if they have synthetic liners and leachate collection systems.

Wellhead Protection

The Rules for Safe Drinking Water (Chapter 391-3-5-.40) specify a wellhead protection area around wells and springs used as sources of water supply for community public water systems serving municipalities, counties, and authorities, to protect them from nearby pollution sources. Every wellhead protection area consists of two zones, a smaller (15 to 25 feet) control zone and a larger management zone. Within the management zone, certain potential pollution sources are prohibited or certain activities must be performed in accordance with the wellhead protection rules. The management zone, in turn, has two parts: an inner management zone and an outer management zone. The size and shape of the management zone will vary according to aquifer type, aquifer hydraulic conductivity, pumpage rate, hydrologic province, and proximity to recharge. EPD shall delineate the size and shape of the management zone of a wellhead protection area as follows:

(1) Wells determined by EPD as drawing water only from confined aquifers shall have an inner management zone extending outward from the center of the borehole for a radius of 100 feet. No outer management zone is required for such wells.

(2) Wells drawing water from unconfined aquifers as determined by EPD and springs, except those determined by EPD to lie in areas of karst, shall have an inner management zone extending outward from the center of the borehole or spring head for a radius of 250 feet.

(3) Wells drawing water from unconfined aquifers as determined by EPD and springs, which EPD has identified as being in areas of karst, shall have an inner management zone extending outward from the center of the borehole or spring head for a radius of 500 feet.

(4) Unconfined wells which EPD has determined utilize fractured crystalline rock aquifers shall have an outer management zone determined according to the "Capture Zone Curve" contained in the EPA approved Georgia Wellhead Protection Plan.

(5) Unconfined aquifer wells determined by EPD as lying in karst regions and all springs shall have an outer management zone determined by hydrogeologic mapping.

(6) Other wells not meeting the above criteria shall have their outer management zones determined by time travel calculations (a minimum of a 5-year time of travel) or by volumetric calculations as appropriate.

EPD will not issue any new permits for municipal solid waste landfills, industrial waste landfills or construction/demolition waste landfills within the inner and outer management zones of those existing wells and springs, for which a wellhead protection plan has been developed. Delineation of wellhead protection areas for municipal water supply wells is ongoing and should be completed by July 1, 2003. The assessment report must show the outer management zone of all applicable wells that are located within two miles of the proposed landfill site boundary. (Note: While it is EPD's responsibility to delineate the size and shape of the management zone of a wellhead protection area, it is the applicant's responsibility to provide EPD with sufficient data to make the delineation when a management zone has not already been established for a well).

Areas Poorly Suited For a Municipal Solid Waste Landfill

EPD has completed a series of maps showing areas considered to be poorly suited for a municipal solid waste landfill. These maps, at a scale of 1:100,000 (one centime-

ter equals one kilometer) are available for each of the Regional Development Centers, with the first maps being available around March 1, 1990.

The maps were created by putting demographic, topographic, hydrologic and geologic data into a computer-based Geographic Information System (GIS) and then integrating the data. This integration or "stacking" of data bases results in a composite map that depicts, in red, areas considered by EPD to be geotechnically poorly suited for the construction and/or operation of a municipal solid waste landfill. In a map area denoted by red, the potential for finding a municipal solid waste landfill that will be acceptable in its natural state is unlikely, but not impossible.

Uncolored areas on the GIS composite maps represent land where the available data suggest that the potential for finding a viable municipal solid waste landfill site is better. Actual site investigations meeting the State's Rules for Solid Waste Management, will have to be performed before any site approval can be given. These maps should help identify areas where the potential for siting a municipal solid waste landfill is least favorable, so that applicants can direct their site selection activities to those areas where the potential for successful siting is better.

One note of caution about using these maps must be given. In some counties, such as those in the Dougherty Plain area of southwest Georgia, virtually all of the land area is poorly suited for solid waste landfilling, because it is located in a karst terrain. EPD would not preclude the construction of a municipal solid waste landfill where this is the case, but rather, EPD would require the applicant to implement engineering designs that would ensure that the integrity of the structural components in the landfill would not be disrupted. A digital GIS data base showing areas poorly suited for a municipal solid waste landfill is available for sale from the Georgia Geologic Survey.

Proximity to County Boundaries and to Significant Ground-Water Recharge Areas

No permit shall be issued to any applicant for a solid waste disposal facility in any county, if any part of the site is within one-half mile of an adjoining county, without the applicant first receiving express approval from the governing authority of the adjoining county. EPD does not interpret these statutes to apply to counties of adjacent states. A site within one-half mile of the Florida border does not need the approval of the adjoining Florida county in order to be permitted.

The Comprehensive Solid Waste Management Act also stipulates:

> "that no permit shall be issued for any municipal solid waste landfill, which accepts waste generated outside the county, if any part of the site is within a Most Significant Ground-Water Recharge Area, unless the boundaries of the counties (or special districts) approved to engage in solid waste management activities are contiguous and such counties (or special districts) have entered into a joint contract for the collection and disposal of solid waste."

Criteria for Siting

The following criteria must be met for a site proposed as a municipal solid waste landfill:

(A) Zoning: The site must conform to all local zoning/land use ordinances. Written verification must be submitted to the Division by the applicant demonstrating that the proposed site complies with local zoning and land use ordinances, if any. This verification shall include a letter from the local governmental authority stating that the proposed site complies with local zoning or land use ordinances, if any. This verification shall be provided at the time of submission of a permit application and reaffirmed by the governmental authority prior to permit issuance.

(B) Disposal Facility Siting Decision: Whenever any county, municipality, group of counties, or authority begins a process to select a site for a municipal solid waste disposal facility, documentation shall be submitted which demonstrates compliance with O.C.G.A. 12-8-26(a), and whenever the governing authority of any county or municipality takes action resulting in a publicly or privately owned municipal solid waste disposal facility siting decision, documentation shall be submitted which demonstrates compliance with O.C.G.A 12-8-26(b).

(C) Airport Safety:

(1) New Municipal Solid Waste Landfill (MSWLF) units or lateral expansions of existing units shall not be located within 10,000 feet (3,048 meters) of any public-use or private-use runway end used by turbojet aircraft or within 5,000 feet (1,524 meters) of any public-use or private-use airport runway end used by only piston-type aircraft.

(2) Owners or operators of existing MSWLF units, that are located within 10,000 feet (3,048 meters) of any public-use or private-use airport runway end used by turbojet aircraft or within 5,000 feet (1,524 meters) of any public-use or private-use airport runway end used by only piston-type aircraft must demonstrate that the units are designed and operated so that the MSWLF units do not pose a bird hazard to aircraft.

(3) Owners or operators proposing to site new

MSWLF units and lateral expansions within a five-mile radius of any public-use or private-use airport runway end used by turbojet or piston-type aircraft must notify the affected airport and the Federal Aviation Administration (FAA).

(4) The owner or operator must place the demonstration in paragraph (2) of this section of the operating record and notify the Director that it has been placed in the operating record not later than October 1, 1993.

(5) For purposes of this section:

(a) "Public-use airport" means an airport open to the public without prior permission and without restrictions within the physical capacities of available facilities.

(b) "Private-use airport" means an airport that is not open to the public and which may not be used without prior permission of the airport owner and which has restrictions other than the physical capacities of available facilities and such airport is shown on the Sectional Aeronautical Charts published by the U. S. Department of Commerce for Atlanta, Jacksonville, or New Orleans, which charts are dated at least one year prior to the submission of a MSWLF permit or major permit modification application.

(c) "Bird hazard" means an increase in the likelihood of bird/aircraft collisions that may cause damage to the aircraft or injury to its occupants.

(D) Floodplains: A solid waste handling facility located in the 100-year floodplain shall not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in a washout of solid waste so as to pose a hazard to human health and the environment. The owner or operator must place a demonstration of compliance in the operating record and notify the Director that it has been placed in the operating record.

(1) For purposes of this section:

(a) "Floodplain" means the lowland and relatively flat areas adjoining inland and coastal waters, including flood-prone areas of offshore islands, that are inundated by the 100-year flood.

(b) "100-year flood" means a flood that has a 1-percent or greater chance of recurring in any given year or a flood of a magnitude equaled or exceeded once in 100 years on the average over a significantly long period.

(c) "Washout" means the carrying away of solid waste by waters of the base flood.

(E) Wetlands: A solid waste handling facility shall not be located in wetlands, as defined by the U. S. Corps of Engineers, unless evidence is provided to the Director, by the applicant, that use of such wetlands has been permitted or otherwise authorized under all other applicable state and federal laws and rules. The owner or operator must place a demonstration of compliance in the operating record and notify the Director that it has been placed in the operating record.

(F) Fault Areas:[3]

(1) New landfill units and lateral expansions of existing landfills shall not be located within 200 feet (60 meters) of a fault that has had displacement in Holocene time unless the owner or operator demonstrates to the Director that an alternative setback distance of less than 200 feet (60 meters) will prevent damage to the structural integrity of the landfill unit and will be protective of human health and the environment.

(2) For the purposes of this section:

(a) "Fault" means a fracture or a zone of fractures in any material along which strata on one side have been displaced with respect to that on the other side.

(b) "Displacement" means the relative movement of any two sides of a fault measured in any direction.

(c) "Holocene" means the most recent epoch of the Quaternary period, extending from the end of the Pleistocene Epoch to the present.

(G) Seismic Impact Zones:

(1) New landfill units and lateral expansions shall not be located in seismic impact zones, unless the owner or operator demonstrates to the Director that all containment structures, including liners, leachate collection systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site. The owner or operator must place the demonstration in the operating record and notify the Director that it has been placed in the operating record.

(2) For the purposes of this section:

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[3] With the possible exception of a single fault shown between Dooly and Sumter Counties on the 1976 1:500,000 Geologic Map of Georgia, there are no known Holocene faults in Georgia.

(a) Seismic impact zone means an area with a ten percent or greater probability that the maximum horizontal acceleration in lithified earth material, expressed as a percentage of the earth's gravitational pull will exceed 0.10g in 250 years.

(b) Maximum horizontal acceleration in lithified earth material means the maximum expected horizontal acceleration depicted on a seismic hazard map, with a 90 percent or greater probability that the acceleration will not be exceeded in 250 years, or the maximum expected horizontal acceleration based on a site-specific seismic risk assessment.

(c) Lithified earth material means all rock, including all naturally occurring and naturally formed aggregates or masses of minerals or small particles of older rock that formed by crystallization of magma or by induration of loose sediments. This term does not include man-made materials, such as fill, concrete, and asphalt, or unconsolidated earth materials, soil, or regolith lying at or near the earth surface.

(H) Unstable areas:

(1) Owners or operators of new landfill units, existing landfill units, and lateral expansions located in an unstable area must demonstrate that the engineering measures have been incorporated into the landfill unit's design to ensure that the integrity of the structural components of the landfill unit will not be disrupted. The owner or operator must place the demonstration in the operating record and notify the Director that it has been placed in the operating record. The owner or operator must consider the following factors, at a minimum, when determining whether an area is unstable:

(a) on-site or local soil conditions that may result in significant differential settling;

(b) on-site or local geologic or geomorphologic features; and

(c) on-site or local human-made features or events (both surface and subsurface).

(2) For the purposes of this section:

(a) "Unstable area" means a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the landfill structural components responsible for preventing releases from a landfill. Unstable areas can include poor foundation conditions, areas susceptible to mass movements, and karst terrains.

(b) "Structural components" means liners, leachate collection systems, final covers, run-on/run-off systems, and any other component used in the construction and operation of the landfill that is necessary for the protection of human health and the environment.

(c) "Poor foundation conditions" means those areas where features exist which indicate that a natural or man-induced event may result in inadequate foundation support for the structural components of a landfill unit.

(d) "Areas susceptible to mass movement" mean those areas of influence (i.e., areas characterized as having an active or substantial possibility of mass movement) where the movement of earth material at, beneath, or adjacent to the landfill unit, because of natural or man-induced events, results in the downslope transport of soil and rock material by means of gravitational influence. Areas of mass movement include, but are not limited to, landslides, avalanches, debris slides and flows, soil fluction, block sliding, and rock fall.

(e) "Karst terrains" means areas where karst topography, with its characteristic surface and subterranean features, is developed as the result of dissolution of limestone, dolomite, or other soluble rock. Characteristic physiographic features present in karst terrains include, but are not limited to, sinkholes, sinking streams, caves, large springs, and blind valleys.

(I) Closure of existing municipal solid waste landfill units:

(1) Existing MSWLF units that cannot make the demonstration specified in section (C), pertaining to airports, section (D), pertaining to floodplains, or section (H), pertaining to unstable areas, must close by October 9, 1996 in accordance with Rule 391-3-4-.11 and conduct post-closure care activities in accordance with Rule 391-3-4-.12.

(2) The deadline for closure required by subparagraph (1) of this paragraph may be extended up to two years if the owner or operator demonstrates to the Director that:

(a) there is no available alternative disposal capacity; and

(b) there is no immediate threat to human health and the environment.

(J) Significant Ground-Water Recharge Areas: A new municipal solid waste landfill or lateral expansion of an existing municipal solid waste landfill shall not have any

part of such site located within two miles of any area that has been designated by the Director as a significant ground-water recharge area unless such municipal solid waste landfill will have a liner and leachate collection system. In the case of a regional landfill which accepts municipal solid waste generated outside of the counties or special districts constituting the region or a solid waste landfill which accepts solid waste generated outside the county in which the landfill is located, no part of such site shall be located within any area that has been designated as a Most Significant Ground-Water Recharge Area.

(K) Hydrogeological Assessment: A hydrogeological site investigation shall be conducted with the following factors, as a minimum, evaluated:

(1) Distance to nearest point of public or private drinking water supply: all public water supply wells or surface water intakes within two miles and private (domestic) water supply wells within one-half (½) mile of a landfill must be identified.

(2) Depth to the uppermost aquifer: for landfills, the thickness and nature of the unsaturated zone and its ability for natural contamination control must be evaluated.

(3) Uppermost aquifer gradient: for landfills, the direction and rate of flow of ground water shall be determined in order to properly evaluate the potential for contamination at a specific site. Measurements of water levels in site exploratory borings and the preparation of water table maps are required. Borings to water are required to estimate the configuration and gradient of the uppermost aquifer.

(4) Topographic setting: features which shall be provided include, but are not limited to, all upstream and downstream drainage areas affecting or affected by the proposed site, floodplains, gullies, karst conditions, wet-lands, unstable soils and percent slope.

(5) Geologic setting: for landfills, the depth to bedrock, the type of bedrock and the amount of fracturing and jointing in the bedrock shall be determined. In limestone or dolostone regions, obvious karst terrain shall not be used for waste disposal. This consideration does not preclude the siting of landfills in limestone terrains, but rather is intended to prevent landfills from being sited in or adjacent to sinkholes, provided, however, that the demonstration required by section (H) has been made.

(6) Hydraulic conductivity: evaluation of landfill sites shall take into consideration the hydraulic conductivity of the surface material in which the wastes are to be buried, as well as the hydraulic conductivity of the subsurface materials underlying the fill.

(7) Sorption and attenuation capacity: for landfills, the sorptive characteristics of an earth material and its ability to absorb contaminants shall be determined.

(8) Distance to surface water: municipal solid waste landfills shall not be situated within two miles upgradient of any surface water intake for a public drinking water source unless engineering modifications such as liners and leachate collection systems and ground-water monitoring systems are provided.

(L) Proximity to National Historic Sites: Municipal solid waste landfills shall not be located within 5,708 yards of a National Historic Site.

(M) Proximity to County Boundaries: Municipal solid waste landfills shall not be located within one-half (½) mile of a county boundary except when the governing authority of the adjoining county gives written approval.

Construction/demolition waste landfills must comply with the siting criteria specified in "Criteria for Performing Site Acceptability Studies for Solid Waste Landfills in Georgia", Circular 14, Appendix B.

Industrial waste landfills permitted to receive only a single type of waste (monofill) or receive only a single industry's waste, must comply with the siting criteria specified in "Criteria for Performing Site Acceptability Studies for Solid Waste Landfills in Georgia", Circular 14, Appendix A. Commercial industrial waste landfills must meet the same siting criteria as municipal solid waste landfills.

A site assessment report addressing the criteria listed above shall be prepared by a geologist registered in Georgia or a geotechnical engineer registered in Georgia and shall be submitted to the Environmental Protection Division for review at the time of submitting a permit application. A geologist, registered to practice in Georgia, must be part of the work effort if the assessment report title contains the word "hydrogeologic" or if the assessment report contains substantial geologic work. The person signing a report as a registered geologist should be either:

(1) a full time employee, if the consultant is representing the work as their own; or,

(2) a clearly identified subcontractor. (Note: consultants, at their option, may choose to subcontract the geological portions of their work to registered geologists. If this is the case, the subcontractor's geological report should be separated from the main body of the report as a separate and clearly identifiable chapter or as an appendix).

The site assessment report shall be prepared in accordance with Circular 14, 1991 (amended, 1997), as published by the Georgia Geologic Survey, Georgia Environmental Protection Division.

Monitoring wells and borings shall be constructed by a driller having a valid and current bond with the Water Well Standards Advisory Council.

Report Format

In order to better assure consistency of municipal solid waste landfill site assessments, EPD recommends that consultants' reports follow a prescribed format (Table I). This means that reports prepared by different consultants for different sites would have a similar technical content and format even though actual site conditions will be quite different. All site assessments, for example, need to have an inventory of domestic drinking water wells within one-half mile of the site boundary. The inventory for some sites may reveal only a few domestic wells, whereas for other sites there may be a relatively large number of domestic wells.

Having reports written in a consistent format will permit EPD to utilize "check-off" sheets (see Appendix C) so that the completeness of site assessment reports can be determined readily. Consultants can use the "check-off" sheets in a similar fashion to assess whether their report will meet EPD's criteria. If a particular part of the assessment were missing (e.g., the aforementioned inventory of domestic water wells), then the consultant would know in advance that the assessment was incomplete and would run the risk of being rejected by EPD.

Standards

EPD will not review any landfill site assessment study not prepared under the technical direction of a geologist and/or a geotechnical engineer registered to practice in Georgia. That geologist or engineer is expected to sign the report. EPD may request documentation that the geologist or engineer actually directed the study and actually visited the site. Simply bringing in a registered geologist or engineer to review and then sign the final report is professionally unacceptable. Site topographic maps and borehole locations, with elevations, should be established under the supervision of a land-surveyor or an engineer registered to practice in Georgia. All investigations and analytical procedures should either be performed according to:

(1) published methods generally accepted in the professional practice of geology and geotechnical engineering (e.g., ASTM, USGS, EPA, etc.); or

(2) published methods generally recognized in the professional practice of geology and geotechnical engineering (e.g., Jacob Method for calculating aquifer properties, etc.).

These "accepted" and "recognized" procedures should be cited or described in sufficient detail so that EPD can make a determination as to their appropriateness. If mathematical formulae are used in calculations (e.g., calculations of ground-water flow velocities) then the formulae should be cited.

Site Acceptability Report

General

As mentioned earlier, EPD recommends a format for municipal solid waste landfill site assessments (refer to Table I). Consultants may deviate from, expand or contract the format, as appropriate, to make their reports more readable or more understandable. Because of the wide variety of geologic, hydrologic and engineering conditions in Georgia, it is not possible to identify or discuss all of the possible investigative techniques that might need to be employed for a thorough site evaluation. There is no substitute for good professional engineering and good professional geological judgement during the investigative process.

General Site Area

The discussion of the general site area in Section 1.1 should contain sufficient information so that EPD can have a basic understanding of the physical and demographic/cultural character of the site. The following issues should be addressed: general character and sources of the wastes (e.g., particularly if wastes are special solid waste), general character of the site (i.e., urban, rural or suburban); the presence of facilities permitted by either the state or federal governments (e.g., industrial operations handling hazardous materials, ground-water withdrawal wells, natural gas pipelines, etc.); current land use (i.e., agricultural, forest, mixed, etc.); population and population trends; general topography and physiography (including area relief and typical slope gradient); general geology, including proximity to major geologic features such as faults or shear zones (Note: if faults and shear zones are present, their hydraulic characteristics should be discussed); general hydrology, including proximity to aquifers, streams, rivers and lakes; general traffic conditions on adjoining roads; wildlife habitat as well as a general review of flora and fauna; and the latitude and longitude of the approximate geographic center of the site.

Sections 1.2 and 1.3 address proximity to roads, airports, federally restricted military air space which is used for a bombing range, railroads, county boundaries and National Historic Sites. These should be described and,

where possible, shown on a 1:24,000 USGS topographic map of the site area. Sections 1.4 and 1.5 deal with surface hydrology. Data for these sections should be presented on a site topographic map (prepared by or under the supervision of an engineer or surveyor registered to practice in Georgia). Generally the map scale should not be smaller than 1:2,400, but the scale should not be so large that the entire site cannot be represented on a 2' x 3' sheet of paper. The topographic contour interval should not be larger than five feet. The site topographic map should show the surveyed boundaries of the site as well as all rivers, streams (including intermittent streams), ponds, lakes, reservoirs, wetlands, sinkholes and springs (or seeps) occurring within or immediately adjacent to the site. Where available, 100-year flood elevation data from FEMA flood insurance maps should be shown on the site topographic map. If FEMA maps are not available, the general elevation of the 100-year flood may be calculated by an engineer and shown on the site topographic map. (Note: There are few, if any, valid reasons for locating a municipal solid waste landfill in a 100-year floodplain.) Wetlands (meeting the criteria of 33 CFR parts 320 through 330 and 40 CFR part 230) should be located by site traverses and shown on the aforementioned site topographic map. (Note: EPD will not review a site acceptability report not accompanied by a map delimiting on-site wetlands.) Section 1.6 should describe, through narrative and map information, the site proximity to the nearest Most Significant Ground-Water Recharge Area as shown in Hydrologic Atlas No. 18.

Information on proximity of the site to public and domestic water supplies (Section 1.7) is critical to site design. Any site, which in its natural state might allow leachate to adversely affect identified drinking water sources, would have to be specially engineered to mitigate leachate migration. The consultant will need (a) to identify the nearest downstream surface water withdrawal facility, if any, and (b) to inventory all public drinking water wells within two miles and all domestic water wells within one-half mile of the site.[4] The consultant should also provide information about the character of the watershed downstream from the site; the information should address the watershed protection criteria promulgated under the Growth Strategies Planning Act. The inventory of domestic wells generally will have to be performed by identifying all residences and making an evaluation of whether each residence is or is not served by a well. The mere presence of municipal water lines in rural or suburban areas should not be considered as evidence that some people do not derive their water from wells. People often do not choose to "hook-up" to municipal water supplies and instead continue to use their wells. Conversations with local water supply officials or with nearby residents can provide information regarding ground-water use in the vicinity of the site.

Section 1.8 should contain a copy (on letterhead) from the appropriate governmental authority stating that the site conforms with local zoning and land-use ordinances.

Surface and Subsurface Investigations

The general topography of the site should be discussed in Section 2.1 and shown on a site topographic map. (Note: this should be the base map used to illustrate surface hydrology; see Sections 1.4 and 1.5.) The map also should show the location of all borings and monitoring wells, the location of cross-sections, rock outcrops (if any) and any areas where slopes exceed 25 percent. All borings and monitoring wells should be located (vertically and horizontally) by surveying methods as well as referenced to the same datum as the topographic map.

The boring plan and sampling program should be described in detail in Section 2.2. The number of borings at any site is a function of actual site conditions, but certain guidelines can be applied. There should be a minimum of three borings per site or per permanent drainage divide (e.g., per each isolated drainage regime at the site) and at least one boring per twenty acres.[5] Figure 1 illustrates an imaginary Piedmont site and provides the methodology for calculating the minimum number of borings. The borings should be of sufficient depth to extend through all perched water zones to twenty feet below the water table. All borings should be witnessed and logged by a geologist or geotechnical engineer. Boring logs should include the following types of information: boring number, dates of drilling, drilling contractor, boring method (i.e., hollow stem auger, rock coring, etc.), surveyed elevation, depth, description of cuttings (an actual description as well as the Unified Soil Classification), sample intervals (at least one split spoon sample every five feet), blow counts, core recovery, and water levels (immediately after drilling and after a 24 to 48 hour stabilization period) with date(s) of measurements. Figure 2 represents an example of an acceptable boring log. (Note: Hollow stem auger boring and rock coring are the preferred drilling methods; use of other drilling methods (mud rotary, air rotary, etc.) should be discussed with EPD

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4 It has been EPD's experience that groundwater flow pathways may vary in response to pumpage; therefore, the inventory should extend in all directions from the site. Doing this will provide a better understanding of potentially affected wells. For example, if the inventory revealed a number of domestic wells upgradient from the landfill, the possibility of reversals in ground-water flow directions would have to be evaluated.

5 A program of one boring per twenty acres represents a minimal drilling program. Most sites will require a greater density of borings. At a few sites, however,one boring per twenty acres may be excessive; in these cases, EPD will waive this requirement, provided the consultant can clearly demonstrate that a program of fewer borings is adequate.

personnel prior to initiating the subsurface investigation). Undisturbed samples, such as Shelby Tubes, should be collected from some of the borings; generally there will be at least as many undisturbed samples as there are borings (i.e., if there were seven borings at a site, at least seven undisturbed samples would be collected; it is not necessary, however, that there be one undisturbed sample for every boring). The undisturbed samples should be tested for grain size, hydraulic conductivity, and, if appropriate, for engineering design characteristics such as consolidation and shear strength. The undisturbed samples should be collected at different stratigraphic intervals so that a representative picture can be obtained of the subsurface distribution of soil and rock properties. Hydraulic conductivities of the material in which solid waste is to be buried and hydraulic conductivities of the material that will underlie the solid waste should be evaluated. This should involve testing both horizontal and vertical hydraulic conductivity, either by field or laboratory methods. EPD expects that hydraulic conductivity should be established by direct measurements rather than estimated. There should be some measurements made of infiltration rates so that flow through the vadose zone can be generally described (see Section 2.3).

If bedrock (weathered or unweathered) at the site occurs within 20 feet of the water table, continuous core (generally NX-sized) of the bedrock should be collected and described with RQD's calculated.[6] Coring should extend at least 10 feet below the top of bedrock or until recovery exceeds 95% for each of the last five feet.[7] Each significantly different type of bedrock identified at the site should be cored and described with RQD's calculated. In addition to coring and RQD calculations of bedrock, any rock outcrops at or near the site should be mapped (i.e., strike and dip) with emphasis placed on the orientation of any observed fracturing and/or jointing patterns.

Consultants should be aware that all drillers constructing borings, coreholes, and installing monitoring wells shall have a valid bond on file with the Water Well Standards Advisory Council and shall carry out such drilling under the direct supervision of a registered professional geologist or a registered professional engineer. Borings and other drilling operations carried out for landfill site investigations shall meet the requirements of the Water-Well Standards Act. EPD will not review MSWLF site acceptability reports not meeting these two criteria.

Soils and rocks should be described in Section 2.3. The description should be of sufficient detail so that EPD can have a basic understanding of the site's framework geology. At least two cross-sections should be presented (one generally parallel to geologic strike or parallel to topographic contour lines and one generally perpendicular to geologic strike or perpendicular to topographic contour lines); the cross-sections should be tied to borings and/or monitoring wells. The cross-sections should not have a vertical exaggeration exceeding 1:10 (vertical:horizontal), and should use hydrologic and lithologic symbols consistent with those used by the USGS.

Sections 2.4, 2.5 and 2.6 include descriptions of the general ground-water flow regime including that of the vadose zone. The descriptions should be accompanied by a potentiometric map of the uppermost aquifer (generally unconfined). Ground-water gradients and flow velocities of the uppermost aquifer should be measured and calculated. Confining units and their areal distribution should be described.

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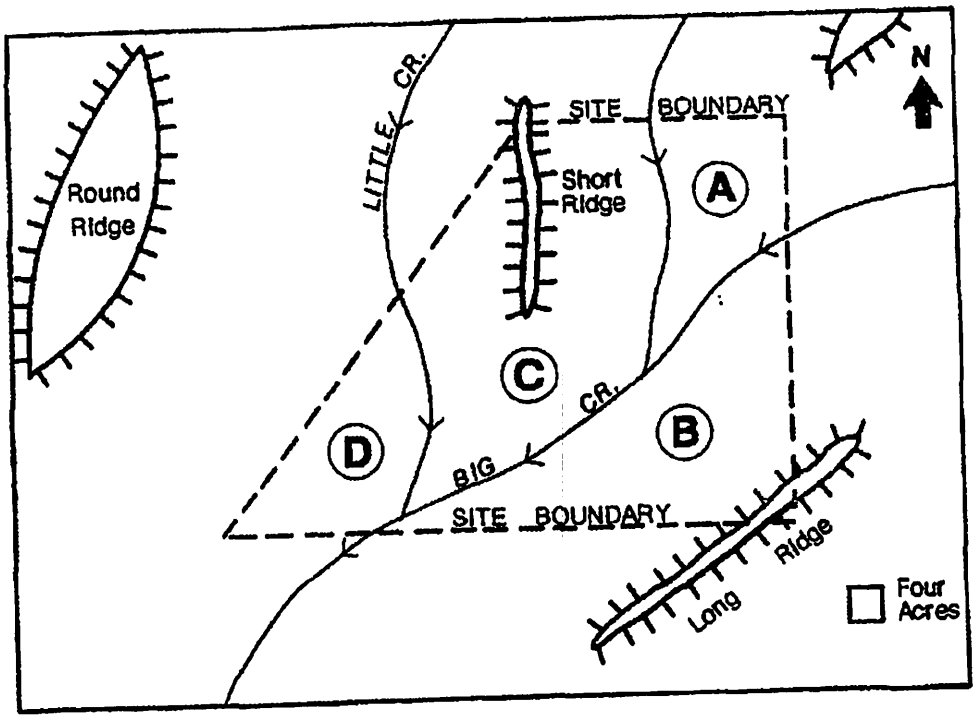
6 While the Rules state, "the depth to bedrock, the type of bedrock and the amount of fracturing and jointing in the bedrock shall be determined", these types of data are of less significance where bedrock is 20 feet or more below the permanent water table. EPD, therefore, may waive these criteria for those sites where the minimum number of borings demonstrate that bedrock is 20 feet or more below the permanent water table.

7 As an example to illustrate the maximum boring depth, consider a site having a perched water table at a depth of 20 feet, the permanent water table at a depth of 50 feet, weathered bedrock at 58 feet and competent bedrock at 73 feet. In this case, since bedrock occurs within 20 feet of the permanent water table, the depth of the boring would be 78 feet as there would be better than 95% core recovery from 73 to 78 feet. In some cases rock may disintegrate during core drilling operations, and it may not be possible to achieve 95% core recovery. If the consultant has reason to believe that 95% recovery is not possible, he or she may terminate borings at shallower depths, provided that he/she documents, to EPD's satisfaction, the justification for terminating the core drilling.



DRAINAGE AREA (A) = 75 acres, will need 4 borings.

DRAINAGE AREA (B) = 180 acres, will need 9 borings.

DRAINAGE AREA (C) = 240 acres, will need 12 borings more or less equally divided on the east and west flanks of the Short Ridge.

DRAINAGE AREA (D) = 92 acres, will need 5 borings.

TOTAL BORINGS NEEDED = 30 BORINGS

Figure 1. Imaginary Piedmont site showing method of calculating minimum number of borings.

GEORGIA GEOLOGIC SURVEY

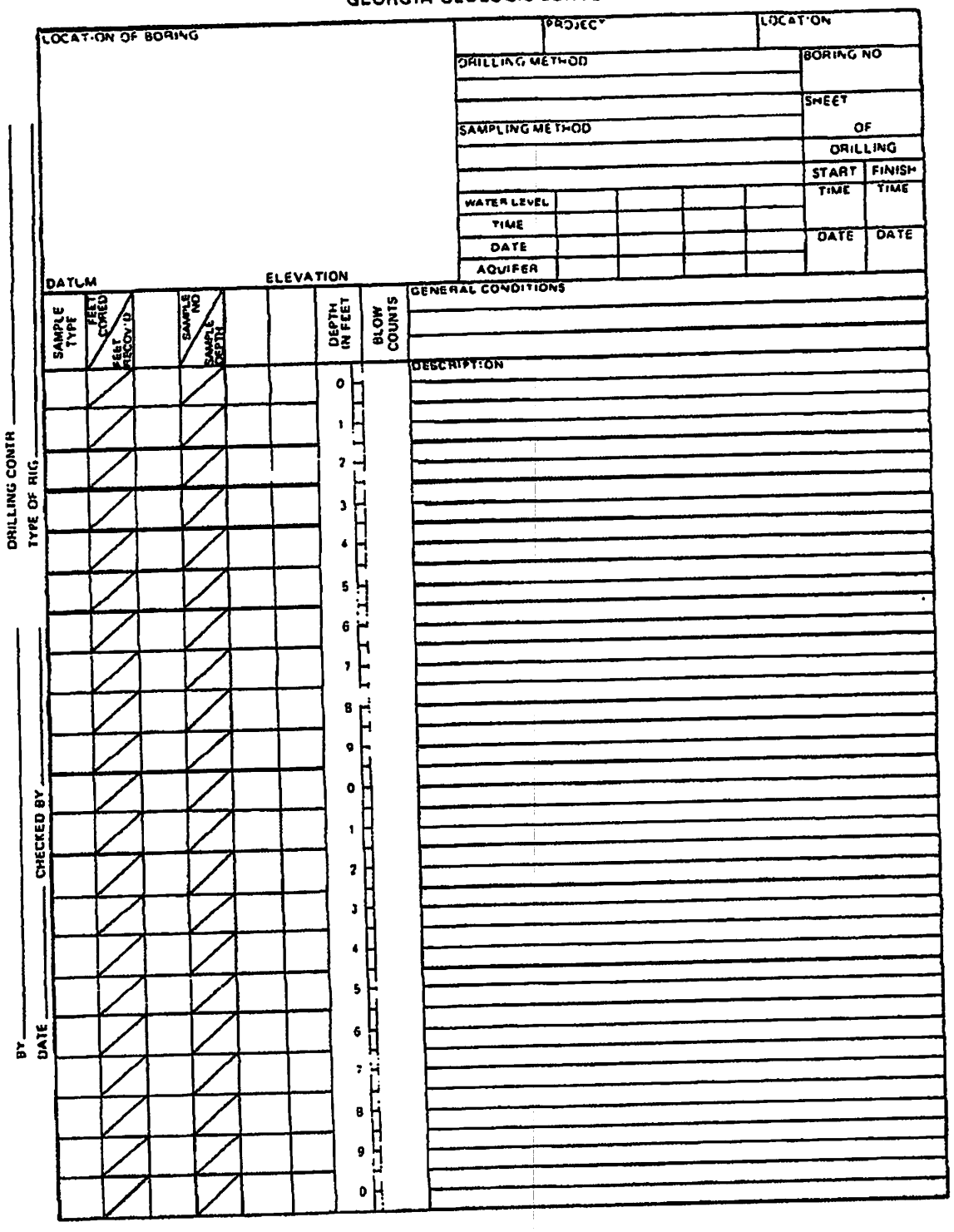


Figure 2. Example of acceptable boring log to be used for sanitary landfill site assessments.

Information also should be provided on estimated recharge, on discharge locations, on seasonal ground-water fluctuations, on changes in aquifer and confining unit facies, and on the potential for all aquifers underlying the site to be sources of drinking water.

Potential geologic or natural hazards should be described in Section 2.7. Examples of these include karst (sinkhole collapse), hurricane tidal surge, subsidence-prone areas, seismic impact zones, fault areas, unstable areas, swelling clays, paleolandslides and bedrock shear zones having high hydraulic conductivity. Sinkholes are the most significant of these, because they could lead to a catastrophic failure of the landfill. For this reason, all sites underlain by carbonate rocks should be assessed for sinkholes. The assessment should include (a) visually inspecting the site, and (b) examining soils maps, aerial photographs and USGS 1:24,000 topographic maps of the site and adjacent lands. If any of the above suggest the presence of sinkholes on or bordering the site, a drilling survey or a geophysical survey (i.e., ground-penetrating radar, electromagnetism, micro-gravity, seismic refraction or possibly resistivity) should be performed at a detail adequate to evaluate the presence or absence of solution cavities beneath the site. If any of these surveys indicate significant voids beneath the site, the anomalous areas should be core drilled to a depth of at least 25 feet into rock. Alternate methodologies may be considered if, in the consultants evaluation, drilling and geophysics appear inappropriate. The consultant should bring this matter to EPD's attention before initiating such alternate evaluation technologies.

Although faults and fault zones are fairly common in Georgia, very few, if any, have been recognized as having had displacement in Holocene time. However, any faulted material noted at a site should be described in detail in the text portion of the report; particular emphasis should be given to discussing the potential for enhanced permeability in the fault or fault zone. The trace of the fault should be shown on the cross sections and on the site topographic base map. A Holocene fault should be described in great detail; additional borings or additional geologic field work may be required to quantify the amount of displacement and delineate the fault trace.

Portions of Georgia, slightly less than one half (½) of the State, mainly in the northern part of the State and along the Savannah River, are located in a seismic impact zone, as defined in the Rules for Solid Waste Management (Chapter 391-3-4-.05(1)(g)(2.)(a.)). In Georgia the upper limit of horizontal acceleration, with a 90% probability of not being exceeded in 250 years, is 0.22 g.[8] If a new landfill unit or a lateral expansion is located in a seismic impact zone, a Georgia registered professional engineer should stamp and seal all design engineering drawings with the accompanying written notation:

> I have reviewed the information presented on this drawing, and in my professional opinion, all containment structures are designed to resist a maximum horizontal ground acceleration of 0.15 g/0.20 g/0.22 g (zone dependent) in 250 years. (Note: It is the consultants responsibility to ascertain in which seismic impact zone the landfill will be located, and to recommend the appropriate design requirements for that zone.)

All design drawings having the above statement shall meet the Director's demonstration requirement as stipulated in the Rules.

Pathway Analysis

The purpose of the pathway analysis is to evaluate how leachate might percolate downward from the waste burial areas to the water table and then migrate offsite to human receptors. This analysis is significant because if the analysis demonstrates that leachate could reach local domestic or public water supplies, the site would have to be designed to mitigate pollutants moving offsite.

The inter-relationship between the vadose zone, the uppermost aquifer and deeper aquifers should be described in Section 3.1 and illustrated in a schematic cross-sectional diagram. The hydraulic interconnection between the base of the burial trenches and underlying permeable zones should be evaluated in particular. The analysis should address: seasonal and yearly fluctuations in the water table; recharge mechanisms, including leakage from overlying and underlying strata; pinchouts or lenses of permeable and impermeable materials; variation of hydraulic conductivity with depth; variations of flow velocity and flow direction between aquifers; protective clay strata and so forth.

Horizontal ground-water flow velocities of the uppermost aquifer should be calculated and discussed in Section 3.2 so that EPD can have some understanding of how fast leachate could migrate from the site. For most Coastal Plain and Piedmont/Blue Ridge saprolite/soil sites where the uppermost aquifer is a porous media, the calculation should be based on the Darcy Equation:

$$\bar{V} = \frac{-K\,\Delta h}{n\,\Delta l}$$

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8 Algermissen, S. T., et al, 1990, Probabilistic Earthquake Acceleration and Velocity Maps for the United States and Puerto Rico, U. S. Geological Survey Miscellaneous Filed Studies Map MF-2120, two sheets - Map C of the study indicates that much of north Georgia would experience horizontal acceleration of 0.10g or more in 250 years. A copy of Map C is available at the Georgia Geologic Survey.

where: $\bar{V}$ is the average linear velocity, K is the hydraulic conductivity (based on laboratory and field tests), n is the effective porosity (based on laboratory tests), and $\Delta h/\Delta l$ is the hydraulic gradient (based on the potentiometric map of the uppermost aquifer).

For those sites where there have been multiple measurements of hydraulic conductivity, velocity should be calculated firstly by using an average of all measurements of hydraulic conductivity and secondly by using the highest measured value of hydraulic conductivity (Note: this would provide typical as well as worst-case scenario values). Effective porosity and hydraulic gradient should be based on typical or average measurements. For those situations where Darcy's Equation may not be appropriate (e.g., some karstic, carbonate terranes; crystalline terranes; etc.), the consultant should discuss and provide some estimate or calculation of horizontal ground-water flow velocities.

Section 3.3 should be a discussion of ground-water pollution potential of sites in their natural state. Pollutants in ground water generally tend to be removed or reduced in concentration with time and with distance traveled. Mechanisms of such attenuation include: filtration, sorption, chemical processes, microbiological decomposition and dilution. Sorptive capacity (generally cation/anion exchange capacity) should be measured in at least two locations in each significant soil type encountered on the site. The soil should be tested for constituents that would be found in leachate. At each test location the sorptive capacity should be measured at varying depths (i.e., at a depth lateral to and at depths of five to ten feet below the proposed solid waste fill or the proposed depth of the liner), and, if appropriate, at least one point several feet above the rock-soil interface.

The rate of pollution attenuation depends on the type of pollutant as well as the local hydrogeological conditions. In evaluating the ground-water pollution potential from municipal solid waste landfills and as an adjunct to making measurements of sorption and estimations or modeling of attenuation, EPD plans to follow a somewhat more conservative version of the empirical point-count system developed by LeGrand (see LeGrand, H.E., 1964, System for Evaluation of Contamination Potential of Some Waste Disposal Sites; Journal American Water Works Association, v. 56, no. 8, pp. 959-974).[9]

However, as pointed out by LeGrand, the method is not foolproof and should not imply precision. Nevertheless, the method does provide a reasonable qualification of the pollution potential of municipal solid waste landfill sites. The method is not appropriate if the critical consideration is the movement of chemical wastes that attenuate slowly. The LeGrand method only applies to unconfined ground water conditions for two types of solid-waste landfill site settings:

(1) Unconsolidated granular materials extending 100 feet or more below the ground surface (typical Coastal Plain sites) - see Figure 3.

(2) Two-media sites characterized by unconsolidated granular materials at the ground surface underlain at shallow depths by dense rocks with linear openings (typical Piedmont/Blue Ridge sites with soil-saprolite overlying crystalline bedrock) - see Figure 4.

LeGrand's concept, which is the basis of EPA's recently developed DRASTIC pollution susceptibility methodology, assumes the uppermost aquifer is unconfined and considers the following factors: depth to water table, sorption above the water table, aquifer permeability, water table gradient, horizontal distance, and the thickness of unconsolidated material at two-media sites. Addition of points from each of the factors provides a measure of pollution potential as follows:

Total Points	Pollution Potential of a Site in Its Natural Condition
0-4	Imminent
4-8	Probable
8-12	Possible
12-25	Possible, but not likely
25+	Approaching impossible

LeGrand's method only considers sites in their natural state and does not take into account engineered sites having liners and leachate collection systems. If a site is to be lined, the consultant may,:

(a) for a compacted clay lined site without a leachate collection system, assume maximum sorption (LeGrand gives a sorption rating of either 4 or 6 for clay);

(b) for a compacted clay liner with a leachate collection system, assume maximum sorption and a favorable water table gradient;

(c) for a synthetic liner with a leachate collection system, assume maximum sorption, a favorable water table gradient, and a permeability rating of 3.

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[9] If, based on the consultant's evaluation of the site, the LeGrand method appears inappropriate, the consultant may substitute other methods of evaluating ground-water pollution potential. Such other methods should be clearly described and referenced.

(d) for a composite liner (e.g. compacted clay plus a synthetic liner) without a leachate collection system assume maximum sorption (see (a) above), or with a leachate collection system assume maximum sorption, a favorable water table gradient, and a permeability rating of 3 (see (c) above).

Sites having an imminent or probable pollution potential in their natural state should have their pollution potential reduced through design engineering.

The general pathways and travel time for leachate to migrate from a landfill and reach receptors (e.g., persons or animals that might drink polluted ground water or surface water) should be evaluated in Section 3.4 and 3.5 respectively. The evaluation should be directed at identifying which receptors, if any, might be exposed to leachate contaminated ground or surface water as well as the time frame over which exposure might occur. The consultant, at his/her option, may include in his/her evaluation the following: the effects of liners and leachate-collection systems, presence or absence of ground-water divides, attenuation, likely alternate sources of water and so forth.

Recommendations for mitigation should be provided in Section 3.6 if geologic or natural hazards are present at the site.

Recommendations for Designs

There are very few sites in Georgia that are suitable in their natural state for the disposal of solid wastes. Most sites will require some engineering modifications before they can be made suitable. Therefore, the site assessment report should provide general recommendations for site engineering modifications. The recommendations should contain sufficient specifics (e.g., maximum depth of excavation, areas not deemed suitable for waste disposal, areas were there are steep slopes, areas that have highly erodible soils, etc.) so that EPD may incorporate them as part of the general approval conditions of site acceptability and so that the design engineer can use them to develop the design and operation plans. Actual landfill design, however, is the responsibility of the design engineer and is to be provided in the design and operation plans.

The consultant should identify, in Sections 4.1 and 4.2, those areas that appear to be favorable or unfavorable for the disposal of solid waste. The technical bases for determining suitability should be stated in the evaluation, and both areas should be shown on the site topographic map. The unfavorable areas will generally include floodplains, wetlands, permanent and intermittent streams with setbacks, areas underlain by shallow ground water and shallow bedrock, karstic areas, excessively steep slopes and buffers around the site perimeter and around environmentally sensitive areas.

Proposed cell depths throughout the favorable areas should be delineated in Section 4.4 and shown on the site topographic map. A minimum separation of five feet will normally be required between the liner and the seasonal high water table at a site. If information on the seasonal fluctuation of the ground-water table (based on measurements, not speculation) is **not** provided in the assessment report, EPD will arbitrarily increase the minimum vertical separation distance between the liner of the landfill and the measured ground-water table. (Note: for some Coastal Plain sites, the water table approaches the ground surface during wet periods; where this is the case raised or elevated sites are appropriate.) Alternatively, to compensate for seasonal fluctuations of the ground-water table, a French or other drain system could be constructed between the bottom of the landfill and the water table. The applicant should demonstrate, through standard engineering analysis, that the under-drain system can keep the ground water from rising, at any point between the drain lines, to within the requisite separation distance between the bottom of the landfill and the ground-water table. A conceptual design of the under-drain system should be incorporated in the assessment report package that is submitted to EPD.

The consultant may recommend other separations between the seasonal high water table and the base of the trench or liner, depending on the site's hydrogeological characteristics. Recommendations for sites underlain by bedrock should provide for the removal of rock encountered during cell excavation and the replacing of such rock with compacted fill having hydraulic characteristics similar to the in-situ soils.

Site drainage and erosion control measures, to the extent that they affect site acceptability, should be discussed in Section 4.5. These control measures possibly could include, but should not be necessarily restricted to French drains, diversion ditches, rerouting of streams, berms, settling basins, setbacks from streams, culverts, cut and fill practices, revegetation and so forth.[10]

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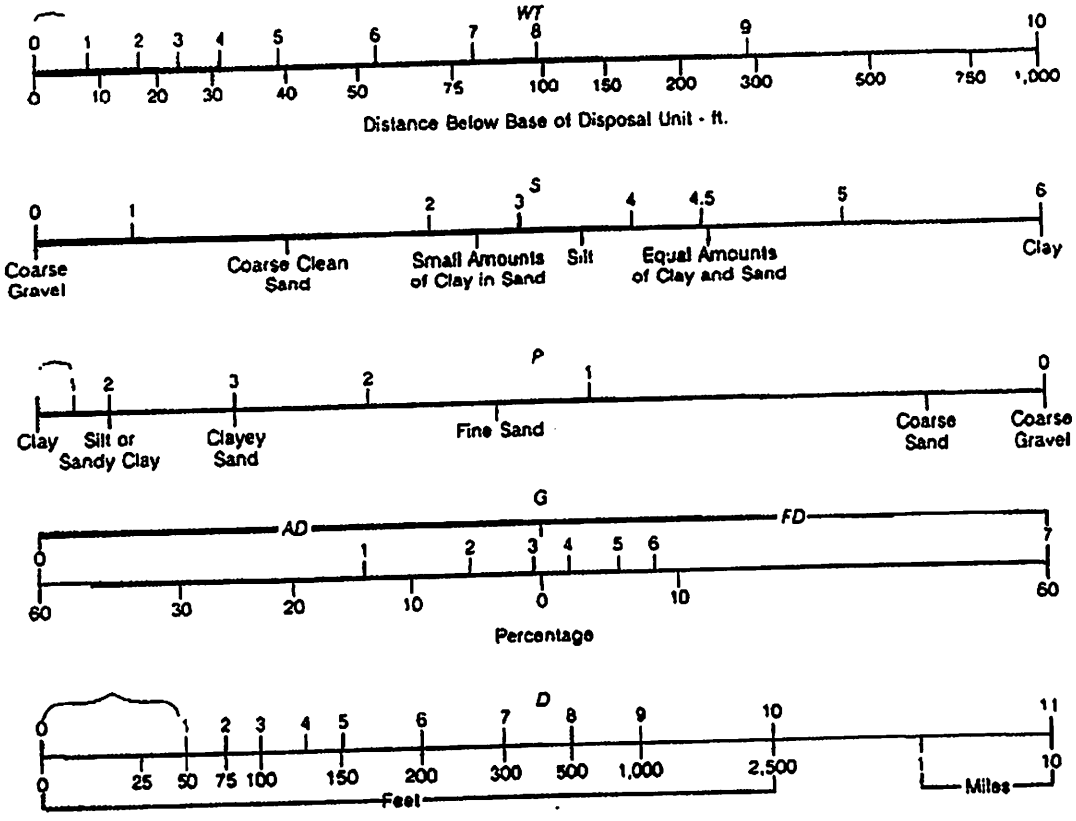
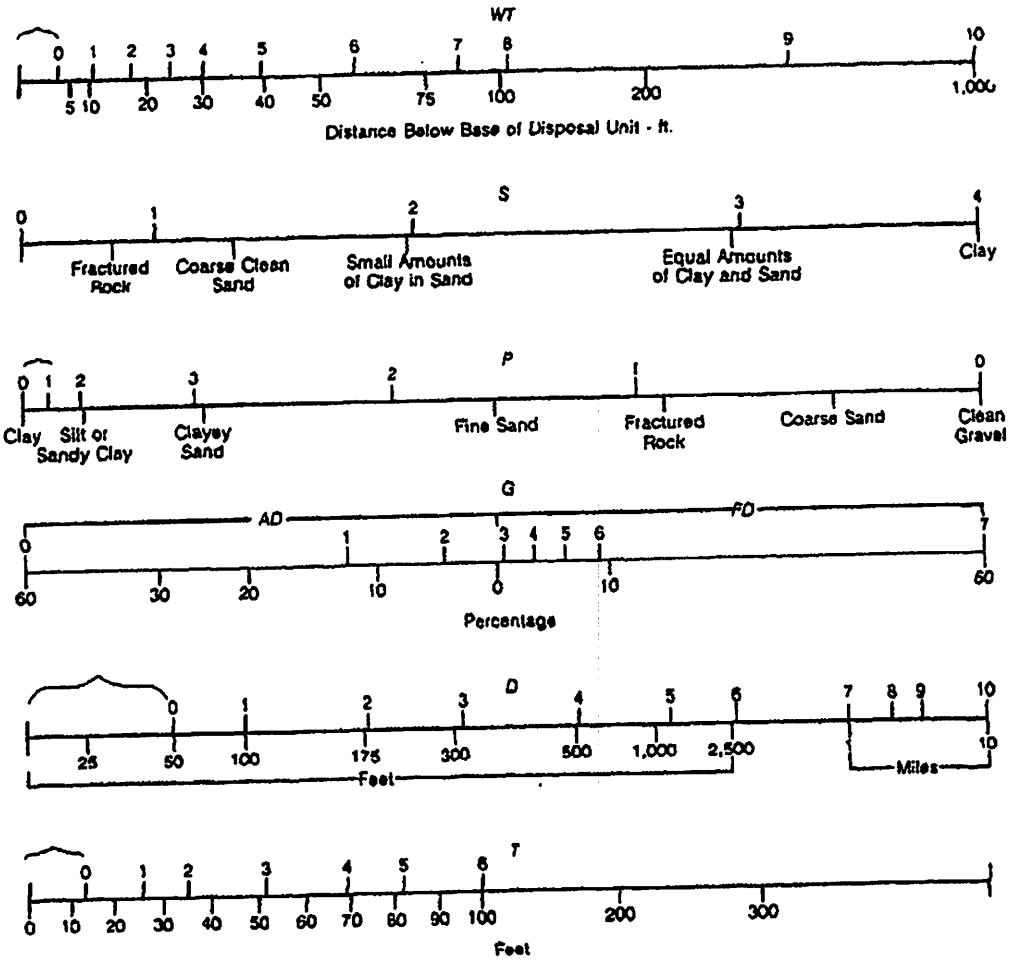
10 Normally these are developed in consultation with or exclusively by the design engineer. They need to be included or attached to the site assessment report in order for EPD to evaluate and consider.



The scales for the various factors are labeled as follows: WT, water table; S, sorption; P, permeability; G, gradient; and D, distance. On all scales the point values are indicated by the upper scale; the brackets indicate unacceptable ranges for any factor, except the two brackets on the gradient scale, one labeled AD, which is for an adverse direction of flow (toward point of water use), and one FD, which is for a favorable direction of flow. (From LeGrand, 1964).

Figure 3. Rating chart for sites in loose granular materials.



The scales for the various factors are labeled as follows: WT, water table; S, sorption; P, permeability; G, gradient; D, distance; and T, thickness of porous granular materials below disposal point. On all scales the point values are indicated by the upper scale; the brackets indicate unacceptable ranges for any factor, except the two brackets on the gradient scale, one labeled AD, which is for an adverse direction of flow (toward the point of water use), and one FD, which is for a favorable direction of flow. (From LeGrand, 1964).

Figure 4. Rating chart for two-media sites.

Buffer zones around the site perimeter and adjacent to streams and wetlands, as well as around any other environmentally sensitive areas, should be recommended in Section 4.6. (Note: EPD requires at least a 200 foot buffer be maintained around the site perimeter, and a minimum 500 foot buffer between the waste boundary and any occupied dwelling and the dwelling's water supply well.) Buffers and setbacks, consistent with the water supply watershed protection criteria, also should be recommended. The location of ground-water monitoring stations should be recommended in Section 4.7, along with sampling schedules and chemical parameters. The general design of monitoring wells also should be recommended.[11]

The Water Well Standards Act requires that all geologic and engineering borings be plugged in a timely manner. The responsibility for such plugging rests with the geologist or geotechnical engineer who supervised the drilling. Normally this would be the consultant. (Note: Boreholes clearly located in proposed waste disposal areas and boreholes that may be located in proposed waste disposal areas should be grouted with a cement or a bentonite-cement slurry from the bottom of the hole to at least within five feet of the existing ground surface, and then backfilled with clean soil. Boreholes clearly located outside of proposed waste disposal areas may be filled in with bentonite.) Borehole plugging and abandonment schedules should be provided in Section 4.8.

References Cited/Methods

Procedures, methods and technical references should be identified, and where appropriate, described in Section 5.0.

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11 The location, design, installation, and sampling of the ground-water monitoring system shall be consistent with Section 391-3-4-.14 of the Solid Waste Management Rules.

TABLE I

FORMAT FOR MUNICIPAL SOLID WASTE LANDFILL SITE ACCEPTABILITY STUDIES

Section/Figure	Title
1.0	GENERAL SITE AREA
1.1	Description of General Site Area
1.2	Proximity to Roads, Airports and Railroads
1.3	Proximity to County Boundaries and National Historic Sites
1.4	Proximity to Floodplains
1.5	Proximity to Streams and Wetlands
1.6	Proximity to Most Significant Ground-Water Recharge Areas
1.7	Proximity to Public and Domestic Water Supplies
1.8	Zoning and Notification
Figure 1-1	Topographic Map of General Site Area (1:24,000) (Where appropriate, the watershed of any downstream public water supplies should be shown; this may require topographic maps of another scale, such as 1:100,000.)
Figure 1-2	Topographic Map of Site (showing floodplains and wetlands exceeding 2 acres in size)
Figure 1-3	Map Showing Proximity of Site to Most Significant Ground-Water Recharge Areas
Figure 1-4	Map Showing Proximity of Site to Public Water Supplies
Figure 1-5	Map Showing Domestic Water Supplies within ½ Mile of Site Boundaries
2.0	SURFACE AND SUBSURFACE INVESTIGATIONS
2.1	Topographic Description
2.2	Boring and Sampling Program
2.3	Description of Soils and Rocks (includes measurements of hydraulic conductivity)
2.4	Description of Unconfined Aquifers (including depth to the water table)

APPENDICES

APPENDIX A

CRITERIA FOR INDUSTRIAL WASTE LANDFILLS

Waste generated by industrial and manufacturing processes can range from relatively benign scrap lumber and broken concrete blocks to materials that, while non-hazardous, can pollute ground and surface waters if improperly managed. This means that site acceptability criteria are variable and dependent upon the characteristics of the wastes as well as the characteristics of the site. Relatively simple criteria would be required for wastes such as scrap lumber and metal, which merely need to be sited in a relatively dry area. Industrial process waste which can dissolve and leach into ground water may require acceptability criteria almost as rigid as those for municipal solid waste landfills. Finally, commercial landfill sites accepting industrial waste must meet the same criteria as municipal solid waste landfills, because these sites may handle waste with a high potential to pollute ground water.

EPD has established three categories of industrial wastes based on their potential to pollute ground water. These are:

(1) LOW POTENTIAL: Industrial wastes having a low potential to contaminate ground water include various scrap metals, processed wood and paper products, nonmetallic mine tailings, inorganic sludges with low heavy metals content, and other nonputrescible waste not likely to leach hazardous constituents. Siting criteria for these types of wastes are the same as for construction/demolition wastes (see Appendix B).

(2) MODERATE POTENTIAL: Such wastes might include, incinerator bottom ash, fixed fly ash or fly ash with minor quantities of heavy metals, uncontaminated dredging waste, lime muds, etc. While these types of wastes need not be disposed of in lined sites, the site acceptability criteria are dependent upon whether the site is located within a Most Significant Ground-Water Recharge Area as shown on Hydrologic Atlas No. 18. If the site is located within a Most Significant Ground-Water Recharge Area, the acceptability criteria applicable for a municipal solid waste landfill, exclusive of information on the proximity to airports, shall apply. Sites located outside of Most Significant Ground-Water Recharge Areas which will handle moderate potential wastes will require the following information.

(A) Zoning: The site must conform to all local zoning/land use ordinances. Written verification must be submitted to the Division by the applicant demonstrating that the proposed site complies with local zoning and land use ordinances, if any. This verification shall include a letter from the local governmental authority stating that the proposed site complies with local zoning or land use ordinances, if any. This verification shall be provided at the time of submission of a permit application and reaffirmed by the governmental authority prior to permit issuance.

(B) Floodplains: An industrial waste landfill located in the 100-year floodplain shall not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in a washout of solid waste so as to pose a hazard to human health and the environment. The owner or operator must place a demonstration of compliance in the operating record and notify the Director that it has been placed in the operating record.

(1) For purposes of this section:

(a) "Floodplain" means the lowland and relatively flat areas adjoining inland and coastal waters, including flood-prone areas of offshore islands, that are inundated by the 100-year flood.

(b) "100-year flood" means a flood that has a 1-percent or greater chance of recurring in any given year or a flood of a magnitude equaled or exceeded once in 100 years on the average over a significantly long period.

(c) "Washout" means the carrying away of solid waste by waters of the base flood.

(C) Wetlands: An industrial waste landfill shall not be located in wetlands, as defined by the U. S. Corps of Engineers, unless evidence is provided to the Director, by the applicant, that use of such wetlands has been permitted or otherwise authorized under all other applicable state and federal laws and rules. The owner or operator must place a demonstration of compliance in the operating record and notify the Director that it has been placed in the operating record.

(D) Fault Areas:

(1) New industrial landfill units and lateral expansions of existing industrial landfills shall not be located within 200 feet (60 meters) of a fault that has had displacement in Holocene time unless the owner or operator demonstrates to the Director that an alternative setback distance of less than 200 feet (60 meters) will prevent damage to the structural integrity of the landfill unit and will be protective of human health and the environment.

(2) For the purposes of this section:

(a) "Fault" means a fracture or a zone of fractures in any material along which strata on one side have been displaced with respect to that on the other side.

(b) "Displacement" means the relative movement of any two sides of a fault measured in any direction.

(c) "Holocene" means the most recent epoch of the Quaternary period, extending from the end of the Pleistocene Epoch to the present.

(E) Seismic Impact Zones:

(1) New industrial landfill units and lateral expansions shall not be located in seismic impact zones, unless the owner or operator demonstrates to the Director that all containment structures, including liners, leachate collection systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site. The owner or operator must place the demonstration in the operating record and notify the Director that it has been placed in the operating record.

(2) For the purposes of this section:

(a) Seismic impact zone means an area with a ten percent or greater probability that the maximum horizontal acceleration in lithified earth material, expressed as a percentage of the earth's gravitational pull will exceed 0.10g in 250 years.

(b) Maximum horizontal acceleration in lithified earth material means the maximum expected horizontal acceleration depicted on a seismic hazard map, with a 90 percent or greater probability that the acceleration will not be exceeded in 250 years, or the maximum expected horizontal acceleration based on a site-specific seismic risk assessment.

(c) Lithified earth material means all rock, including all naturally occurring and naturally formed aggregates or masses of minerals or small particles of older rock that formed by crystallization of magma or by induration of loose sediments. This term does not include man-made materials, such

as fill, concrete, and asphalt, or unconsolidated earth materials, soil, or regolith lying at or near the earth surface.

(F) Unstable areas:

(1) Owners or operators of new industrial landfill units, existing industrial landfill units, and lateral expansions located in an unstable area must demonstrate that the engineering measures have been incorporated into the landfill unit's design to ensure that the integrity of the structural components of the landfill unit will not be disrupted. The owner or operator must place the demonstration in the operating record and notify the Director that it has been placed in the operating record. The owner or operator must consider the following factors, at a minimum, when determining whether an area is unstable:

(a) On-site or local soil conditions that may result in significant differential settling;

(b) On-site or local geologic or geomorphologic features; and

(c) On-site or local human-made features or events (both surface and subsurface).

(2) For the purposes of this section:

(a) "Unstable area" means a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the landfill structural components responsible for preventing releases from a landfill. Unstable areas can include poor foundation conditions, areas susceptible to mass movements, and karst terrains.

(b) "Structural components" means liners, leachate collection systems, final covers, run-on/run-off systems, and any other component used in the construction and operation of the landfill that is necessary for the protection of human health and the environment.

(c) "Poor foundation conditions" means those areas where features exist which indicate that a natural or man-induced event may result in inadequate foundation support for the structural components of a landfill unit.

(d) "Areas susceptible to mass movement" mean those areas of influence (i.e., areas characterized as having an active or substantial possibility of mass movement) where the movement of earth material at, beneath, or adjacent to the landfill unit, because of natural or man-induced events, results in the downslope transport of soil and rock material by means of gravitational influence. Areas of mass movement include, but are not limited to, landslides, avalanches, debris slides and flows, soil fluction, block sliding, and rock fall.

(e) "Karst terrains" means areas where karst topography, with its characteristic surface and subterranean features, is developed as the result of dissolution of limestone, dolomite, or other soluble rock. Characteristic physiographic features present in karst terrains include, but are not limited to, sinkholes, sinking streams, caves, large springs, and blind valleys.

(G) Hydrogeological Assessment: A hydrogeological site investigation shall be conducted with the following factors, as a minimum, evaluated:

(1) Distance to nearest point of public or private drinking water supply: all public water supply wells or surface water intakes within two miles and private (domestic) water supply wells within one-half (½) mile of an industrial landfill must be identified.

(2) Depth to the uppermost aquifer: for industrial landfills, the thickness and nature of the unsaturated zone

and its ability for natural contamination control must be evaluated.

(3) Uppermost aquifer gradient: for industrial landfills, the direction and rate of flow of ground water shall be determined in order to properly evaluate the potential for contamination at a specific site. Measurements of water levels in site exploratory borings and the preparation of water table maps are required. Borings to water are required to estimate the configuration and gradient of the uppermost aquifer.

(4) Topographic setting: features which shall be provided include, but are not limited to, all upstream and downstream drainage areas affecting or affected by the proposed site, floodplains, gullies, karst conditions, wetlands, unstable soils and percent slope.

(5) Geologic setting: for industrial landfills, the depth to bedrock, the type of bedrock and the amount of fracturing and jointing in the bedrock shall be determined. In limestone or dolostone regions, obvious karst terrain shall not be used for waste disposal. This consideration does not preclude the siting of landfills in limestone terrains, but rather is intended to prevent landfills from being sited in or adjacent to sinkholes, provided, however, that the demonstration required by section (F) has been made.

(6) Hydraulic conductivity: evaluation of industrial landfill sites shall take into consideration the hydraulic conductivity of the surface material in which the wastes are to be buried, as well as the hydraulic conductivity of the subsurface materials underlying the fill.

(7) Sorption and attenuation capacity: for industrial landfills, the sorptive characteristics of an earth material and its ability to absorb contaminants shall be determined.

(8) Distance to surface water: industrial solid waste landfills shall not be situated within two miles upgradient of any surface water intake for a public drinking water source unless engineering modifications such as liners and leachate collection systems and ground-water monitoring systems are provided.

(H) Proximity to National Historic Sites: Industrial solid waste landfills shall not be located within 5,708 yards of a National Historic Site.

(I) Proximity to County Boundaries: Industrial solid waste landfills shall not be located within one-half (½) mile of a county boundary except when the governing authority of the adjoining county gives written approval.

(J) Wellhead Protection: EPD will not issue any new permits for industrial waste landfills within the inner and outer management zones of existing wells and springs used as sources of water supply for community public water systems serving municipalities, counties, and authorities. Delineation of well head protection areas for municipal water supply wells is ongoing and should be completed by July 1, 2003. The assessment report must show the outer management zone of all applicable wells that are located within two miles of the proposed landfill site boundary. (Note: While it is EPD's responsibility to delineate the size and shape of the management zone of a wellhead protection area, it is the applicant's responsibility to provide EPD with sufficient data to make the delineation when a management zone has not already been established for a well).

(3) HIGH POTENTIAL: All industrial waste landfills receiving industrial wastes containing small quantities of hazardous wastes, wastes that are putrescible, wastes which contain any hazardous constituents which could leach into the groundwater, or commercial industrial sites accepting waste from multiple industries must meet the same criteria as a municipal solid waste landfill.

A topographic map of the site (prepared by or under the supervision of an engineer or surveyor registered to practice in Georgia) shall be presented in the assessment report; the topographic map must be both signed and stamped by said engineer or surveyor. Generally the map scale should not be smaller than 1:2,400, but the scale should not be so large that the entire site

cannot be represented on a 2' x 3' sheet of paper. The topographic contour interval should not be larger than five feet. The site topographic map shall show the surveyed boundaries of the site as well as all rivers, streams (including intermittent streams), ponds, lakes, reservoirs, wetlands, sinkholes and springs (or seeps) occurring within or immediately adjacent to the site. Where available, 100-year flood elevation data from FEMA flood insurance maps should be shown on the site topographic map. If FEMA maps are not available, the general elevation of the 100-year flood may be calculated by an engineer. (Note: There are few, if any, valid reasons for locating a industrial waste landfill in a 100-year floodplain.)

Wetlands (meeting the criteria of 33 CFR parts 320 through 330 and 40 CFR part 230) should be located by site traverses and shown on the aforementioned site topographic map. (Note: EPD will not review a site acceptability report not accompanied by a map delimiting on-site wetlands.)

Industrial waste landfills shall be sited so that the wastes do not adversely affect any floodplain, any wetland, any spring, or any perennial or intermittent stream. The base of all burial trenches or the liner shall be at least five feet above the wet season water table and/or bedrock, which has been established by borings. If information on the seasonal fluctuation of the ground-water table (based on measurements, not speculation) is **not** provided in the assessment report, EPD will arbitrarily increase the minimum vertical separation distance between the bottom of the landfill or liner and the measured ground-water table by 10 to 25 feet, depending on the permeability of the soil at the site. A description of the general ground-water flow regime shall be presented in the assessment report. The descriptions should be accompanied by a potentiometric map of the uppermost aquifer (generally unconfined). The site topographic map should be used as the base map for the potentiometric map. There shall be a minimum of three borings per site or hydrologic regime and at least one boring per twenty acres.

Consultants should be aware that all drillers constructing borings, coreholes, and installing monitoring wells shall have a valid bond on file with the Water Well Standards Advisory Council and shall carry out such drilling under the direct supervision of a registered professional geologist or a registered professional engineer. Borings and other drilling operations carried out for landfill site investigations shall meet the requirements of the Water-Well Standards Act. EPD will not review landfill site acceptability reports not meeting these two criteria.

Information on proximity of the site to public and domestic water supplies, through narrative and map information, shall be presented in the site assessment report. The consultant will need (a) to identify the nearest downstream surface water withdrawal facility, if any, and (b) to inventory all public drinking water wells within two miles and all domestic water wells within one-half mile of the site.

For those sites receiving industrial process wastes having moderate or high potential to pollute ground and surface waters, the consultant should apply the LeGrand method to estimate pollution potential. Sites having a high pollution potential in their natural state should have their pollution potential reduced through design engineering. Prior to proceeding with a site acceptability study, it is recommended that the applicant provide EPD with sufficient information to allow classification of its waste streams into one of the above three classifications. If the applicant elects to proceed with the site acceptability study prior to classification, the applicant should provide a clear and concise description of the ground-water pollution potential of the wastes. In the absence of such a description, EPD will assume that the waste has a high potential for ground-water pollution and will expect site acceptability studies consistent with those required for a municipal solid waste landfill.

A site acceptability study for an industrial waste landfill shall be performed under the direction of a geotechnical engineer registered to practice in Georgia or a geologist registered to practice in Georgia. A geologist, registered to practice in Georgia, must be part of the work effort if the assessment report title contains the word "hydrogeologic" or if the assessment report contains substantial geologic work.

APPENDIX B

CRITERIA FOR CONSTRUCTION/DEMOLITION WASTE LANDFILLS

Construction/demolition wastes are benign wastes generally including waste building materials and rubble resulting from the construction, remodeling, repair and demolition of buildings and pavements. These wastes typically include processed wood, metal, bricks, concrete, wallboard, paper, cardboard, etc. These materials are not considered as sources of pollution to ground and surface waters, nor do they require frequent cover; therefore, siting criteria need not be overly restrictive. It is important to note that some construction/demolition wastes may contain leachable, hazardous constituents or asbestos (e.g., wood flooring of a pesticide formulation facility). Where this is the case, these materials must be separated from the construction/demolition wastes. Site acceptability criteria for construction/demolition waste landfills include:

(1) Zoning: The site must conform to all local zoning/land use ordinances. Written verification must be submitted to the Division by the applicant demonstrating that the proposed site complies with local zoning and land use ordinances, if any. This verification shall include a letter from the local governmental authority stating that the proposed site complies with local zoning or land use ordinances, if any. This verification shall be provided at the time of submission of a permit application and reaffirmed by the governmental authority prior to permit issuance.

(2) Floodplains: A construction/demolition waste landfill located in the 100-year floodplain shall not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in a washout of solid waste so as to pose a hazard to human health and the environment. The owner or operator must place a demonstration of compliance in the operating record and notify the Director that it has been placed in the operating record.

(A) For purposes of this section:

(1.) "Floodplain" means the lowland and relatively flat areas adjoining inland and coastal waters, including flood-prone areas of offshore islands, that are inundated by the 100-year flood.

(2.) "100-year flood" means a flood that has a 1-percent or greater chance of recurring in any given year or a flood of a magnitude equaled or exceeded once in 100 years on the average over a significantly long period.

(3.) "Washout means the carrying away of solid waste by waters of the base flood.

(3) Wetlands: A construction/demolition waste landfill shall not be located in wetlands, as defined by the U. S. Corps of Engineers, unless evidence is provided to the Director, by the applicant, that use of such wetlands has been permitted or otherwise authorized under all other applicable state and federal laws and rules. The owner or operator must place a demonstration of compliance in the operating record and notify the Director that it has been placed in the operating record.

(4) Proximity to National Historic Sites: Construction/demolition waste landfills shall not be located within 5,708 yards of a National Historic Site.

(5) Proximity to County Boundaries: Construction/demolition landfills shall not be located within one-half (½) mile of

a county boundary except when the governing authority of the adjoining county gives written approval.

(6) Wellhead Protection: EPD will not issue any new permits for construction/demolition waste landfills within the inner and outer management zones of existing wells and springs used as sources of water supply for community public water systems serving municipalities, counties, and authorities. Delineation of well head protection areas for municipal water supply wells is ongoing and should be completed by July 1, 2003. The assessment report must show the outer management zone of all applicable wells that are located within two miles of the proposed landfill site boundary. (Note: While it is EPD's responsibility to delineate the size and shape of the management zone of a wellhead protection area, it is the applicant's responsibility to provide EPD with sufficient data to make the delineation when a management zone has not already been established for a well).

A topographic map of the site (prepared by or under the supervision of an engineer or surveyor registered to practice in Georgia) shall be presented in the assessment report; the topographic map must be both signed and stamped by said engineer or surveyor. Generally the map scale should not be smaller than 1:2,400, but the scale should not be so large that the entire site cannot be represented on a 2' x 3' sheet of paper. The topographic contour interval should not be larger than five feet. The site topographic map shall show the surveyed boundaries of the site as well as all rivers, streams (including intermittent streams), ponds, lakes, reservoirs, wetlands, sinkholes and springs (or seeps) occurring within or immediately adjacent to the site. Where available, 100-year flood elevation data from FEMA flood insurance maps should be shown on the site topographic map. If FEMA maps are not available, the general elevation of the 100-year flood may be calculated by an engineer. (Note: There are few, if any, valid reasons for locating a construction/demolition waste landfill in a 100-year floodplain.)

Wetlands (meeting the criteria of 33 CFR parts 320 through 330 and 40 CFR part 230) should be located by site traverses and shown on the aforementioned site topographic map. (Note: EPD will not review a site acceptability report not accompanied by a map delimiting on-site wetlands.)

Construction/demolition landfills shall be sited so that the wastes do not adversely affect any floodplain, any wetland, any spring, or any perennial or intermittent stream. The base of all burial trenches, which need not be lined, shall be at least five feet above the wet season water table and/or bedrock, which has been established by borings. If information on the seasonal fluctuation of the ground-water table (based on measurements, not speculation) is not provided in the assessment report, EPD will arbitrarily increase the minimum vertical separation distance between the bottom of the landfill and the measured ground-water table by 10 to 25 feet, depending on the permeability of the soil at the site. A description of the general ground-water flow regime shall be presented in the assessment report. The descriptions should be accompanied by a potentiometric map of the uppermost aquifer (generally unconfined). The site topographic map should be used as the base map for the potentiometric map. There shall be a minimum of three borings per site or hydrologic regime and at least one boring per twenty acres. This work shall

be performed under the direction of a geotechnical engineer registered to practice in Georgia or a geologist registered to practice in Georgia. A geologist, registered to practice in Georgia, must be part of the work effort if the assessment report title contains the word "hydrogeologic", or if the assessment report contains substantial geologic work. Consultants should be aware that all drillers constructing borings, coreholes, and installing monitoring wells shall have a valid bond on file with the Water Well Standards Advisory Council and shall carry out such drilling under the direct supervision of a registered professional geologis t or a registered professional engineer. Borings and other drilling operations carried out for landfill site investigations shal l meet the requirements of the Water-Well Standards Act. EPD will not review landfill site acceptability reports not meeting these two criteria.

Information on proximity of the site to public and domestic water supplies, through narrative and map information, shall be presented in the site assessment report. The consultant will need (a) to identify the nearest downstream surface water withdrawal facility, if any, and (b) to inventory all public drinking water wells within two miles and all domestic water wells within one-half mile of the site.

APPENDIX C

"CHECK OFF LIST" - TO BE USED BY EPD FOR EVALUATING THE ADEQUACY OF CONSULTANT'S MUNICIPAL SOLID WASTE LANDFILL SITE ACCEPTABILITY ASSESSMENTS

I QUALIFICATIONS

(a) Is the report primarily an engineering report, a geological report, or sub-surface investigation? _____

(b) Was the report signed by a geologist or an engineer registered in Georgia (check as appropriate)? _____ (yes) _____ (no)

(c) Provide registration number _____ (P.E.) _____ (P.G.)

(d) Did the P.G. or P.E. actually visit the site? _____ (yes) _____ (no)

(e) Did the drilling contractor have a bond as required by the Water Well Standards Act? _____ (yes) _____ (no)

(f) Who was the drilling contractor? _____

(g) Was the site map prepared by or under the supervision of an engineer or surveyor registered in Georgia? _____ (yes) _____ (no)

(h) Who was the engineer/surveyor? _____

(I) Were drilling operations observed by an engineer or geologist? _____ (yes) _____ (no)

(j) Who was this person? _____

(k) Did the P.G. or P.E. check boring logs, drawings, etc.? _____ (yes) _____ (no)

(l) If (k) above is no, explain why not _____

_____

II MAPPING

(a) Were site topographic maps showing perennial and intermittent streams, surface water bodies, wetlands, rock outcroppings, borehole locations, site boundaries, steep slopes and other environmental, geological, engineering, or cultural/demographic features provided? _____ (yes) _____ (no)

(b) Was a potentiometric map of the water table provided? _____ (yes) _____ (no)

(c) Was a map showing drinking water wells (public or domestic) within ½ mile of the site boundaries provided? _____ (yes) _____ (no)

(d) Was a map showing the approximate location of the 100-year flood elevation provided? _____ (yes) _____ (no)

(e) Was a map showing recommended ground- and surface-water monitoring locations provided? _____ (yes) _____ (no)

III BORINGS

(a) What type of drilling rig performed the boring operations? _____

(b) Describe sampling procedures: _____

_____

_____

_____

_____

_____

(c) Were SPT's performed? _____ (yes) _____ (no)

(d) Were undisturbed samples collected? _____ (yes) _____ (no)

(e) Were descriptive boring

logs provided? _____ (yes) _____ (no)

(f) What criteria were used by the consultant to establish boring depths (describe)? _____

_____

(g) Were water level measurements performed upon boring completion and at least 24 hours later? _____ (yes) _____ (no)

(h) Have the borings been plugged under the direction of a P.E. or P.G.? _____ (yes) _____ (no)

(l) How many borings were drilled? _____

(j) Is the boring density at least one boring per twenty acres? _____ (yes) _____ (no)

IV ANALYSIS

(a) Where and how far away are the nearest public drinking water sources (e.g., trailer parks, industries, etc.)? _____

_____

_____

_____

(b) Where and how far away are the nearest municipal drinking water sources? _____

_____

_____

_____

(c) Do the criteria for water supply watershed protection apply? _____ (yes) _____ (no)

(d) Do the criteria for wellhead protection areas apply? _____ (yes) _____ (no)

(e) Were water level measurements performed during wet (winter and spring) or dry (summer and fall)

seasons? _____ (wet) _____ (dry)

(f) Have ground-water flow directions been identified? _____ (yes) _____ (no)

(g) What is the annual anticipated fluctuation in the water table? _____ feet

(h) Has an analysis been performed to identify maximum trench depth? _____ (yes) _____ (no)

(I) What are the measured horizontal and vertical hydraulic conductivities? _____ cm/sec

(j) Were any actual field measurements made of horizontal hydraulic conductivity and laboratory measurements made of vertical hydraulic conductivity? _____ (yes) _____ (no)

(k) What is the recommended separation between the top of the water table (wet season) and the base of the liner? _____ feet

(l) Is the site entirely or partially within a Most Significant Ground-Water Recharge Area? _____ (yes) _____ (no)

(m) Have water quality monitoring locations been recommended? _____ (yes) _____ (no)

(n) Are monitoring specifications (including well design, analytical parameters, sampling frequency, etc.) recommended? _____ (yes) _____ (no)

(o) Where and how far away is the nearest airport? _____

(p) Is the site zoned for solid waste disposal? _____ (yes) _____ (no)

(q) Where and how far away is the nearest commercial development? _____ feet

(r) Describe this development: _____

_____

_____

(s) Is the site within ½ mile of a county boundary or within 5,708 yards of a National Historic Site? _____ (yes) _____ (no)

(t) Is the site susceptible to sinkholes, expansive soils, erosion, seismic impact zones, or any other geologic, topographic, or other feature that could impact the integrity of the landfill? _____ (yes) _____ (no)

(u) Is an undisturbed buffer zone recommended? _____ (yes) _____ (no)

(v) If (u) above is yes, what is the recommended width? _____ feet

(w) Was an analysis performed of potential pathways whereby leachate could reach human receptors? _____ (yes) _____ (no)

(x) Are there any unique flora or fauna habitats within the site boundary? _____ (yes) _____ (no)

(y) Describe the general character of highway access to the site: _____

(z) Is the applicant under any sort of time constraint (e.g., option to purchase, existing landfill has limited capacity, etc.)? _____ (yes) _____ (no)

(aa) If (z) above is yes, describe: _____

_____

_____

(bb) Using the LeGrand method, what is the pollution potential of the site under natural conditions? _____

(cc) What is the general anticipated life expectancy of the site? _____ years

(dd) Approximately how many people live or work within ½ mile of the site boundary? _____ persons

(ee) What percentage of these persons obtain drinking water from:

_____% domestic wells

_____% public water supply

_____% municipal water supply

(ff) What would be the pollution potential of the site after installing a liner (using EPD's recommended modifications to the LeGrand method)? _____

(gg) If water supply watershed protection criteria are appropriate, what is the recommended buffer _____ (in feet) and the recommended setback _____ (in feet).

(Note: The above checklist is only intended to be used as a tool to insure that EPD will receive as complete a report as possible. An omission of any particular piece or pieces of information will not necessarily result in an automatic rejection of the site assessment report.)

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