From: John A.K. Tucker, PE
To: Wootton, Brian;
Subject: Re: Currin Brothers Landfill
Date: Monday, August 23, 2010 3:29:43 PM

Brian - you are correct. The report was intended for 32-I LCID. Since they are both in Durham and close to each other, this is not unusual.

Regards

JT

John A.K. Tucker, PE
Consulting Engineer
PO Box 297
Fuquay Varina, NC 27526

Phone (919) 567-0483

On 8/23/2010 11:52 AM, Wootton, Brian wrote:

> John,
>
> Pertaining to the Hydrogeologic Evaluation Report by David Garret submitted on August 20, 2010; the documentation refers to Permit No. 32D – LCID, instead of 32-I LCID. Please respond with an e-mail correction verification. A brief sentence confirming the correct permit number for this LCID landfill will suffice.
>
> Thanks,
>
> Brian
>
> **From:** John A.K. Tucker, PE [mailto:johnak@johntuckerpe.com]
> **Sent:** Friday, August 20, 2010 9:00 AM
> **To:** Wootton, Brian
> **Subject:** Currin Brothers Landfill
>
> Attached is the report regarding ground water conditions. Do you need a paper copy as well?
>
> Thanks,

JT

--

John A.K. Tucker, PE
Consulting Engineer
PO Box 297
Fuquay Varina, NC 27526

Phone (919) 567-0483

David Garrett & Associates
Engineering and Geology

August 20, 2010

Mr. John Tucker, P.E.
Consulting Engineer
P.O. Box 297
Fuquay-Varina, North Carolina 27526

RE: Report of Hydrogeologic Evaluation
Currin LCID Landfill
Durham County, NC
Solid Waste Permit #32D-LCID

Dear Mr. Tucker:

I am pleased to present the following report of a limited-scope evaluation of the geology and hydrogeology of the subject site. I understand that a planned expansion is under consideration within a portion of the site (contiguous with the existing LCID footprint) that was previously used for borrow soil. This work is limited to the hydrogeologic aspects of the LCID permit, specifically focusing on the depth to ground water below planned base grades, i.e., existing grades within the borrow area. Ground water at the site is not monitored – not required for LCID facilities – nor have any NC DENR Division of Water Resources research wells been identified near the site, so we do not have an extensive data base for historic water levels.

However, the geologic aspects of the site are fairly well understood – the site is located in the Durham Triassic Basin – and there is adequate exposure of subsurface conditions present in the former borrow area that a generalized conclusion can be drawn from this work that the proposed base grades will provide the minimum required vertical separation of 4 feet, without an extensive ground water investigation or lengthy observation period. Inasmuch as this is the conclusion of this work, the remainder is a brief summary of the research and field work upon which this conclusion is based. I have assumed that any necessary studies for wetlands, endangered species, riparian buffers, and historic sites have been taken care of outside the scope of this work.

Please contact me at your earliest convenience if you gave questions or comments, or if I may be of further service.

Consulting Engineer and Geologist

5105 Harbour Towne Drive • Raleigh • North Carolina • 27604
919-418-4375 (Mobile) • 919-231-1818 (Office/fax) • E-mail: david@davidgarrettpe.com

1.0 Scope of the Investigation

This work – discussed in advance with NC DENR Solid Waste officials – includes a literature review and a test pit investigation to confirm evidence of past ground water movement (or the lack thereof) within the upper 4 feet beneath planned LCID base grades.

2.0 Regional Geology

Figure 1 is an excerpt of the NC Carolina Geologic Map,[a] which depicts the site within the Durham Triassic Basin, a geologic feature characterized with low permeability "redbed" sandstone, siltsone, mudstone, and conglomerate. The map shows the LCID vicinity underlain by clayey sandstone interbedded with mudstone. These units were described by Stuckey[b] as follows:

> "Predominantly of a brownish or reddish color . . . beds are lenticular and therefore usually pinch out in a short distance . . . materials are poorly sorted, resulting in a low porosity and permeability, which has been further reduced by compaction and cementation. The result is that ground water movement is generally reduced to bedding planes, joints and other fractures. Jointing and fracturing is generally more pronounced in the coarser and harder strata such as the sandstone and conglomerate than it is in the shales and mudstones, so that the former usually furnish larger supplies. The Triassic sedimentary rocks have been intruded by many "trap" dikes which have fractured and baked the adjacent strata. Therefore, a well drilled near such a dike usually furnishes a larger water supply than a well drilled in the same strata at some distance from the dike."

There are no major diabase dikes mapped in the immediate vicinity of the site.[c] In regional water resources and engineering practice, the Triassic formations typically support low yields in water wells, owing to low permeability and a generally deep water table. Ground water can be "perched" within the upper low permeability soils, which is subject to conditions, but true ground water is present is typically found deep within the fractured bedrock.

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[a] North Carolina Geologic Survey, 1985 State Geologic Map, viewed on-line at http://www.geology.enr.state.nc.us/maps/ncgs_main_maps_page.html

[b] M. J. Mundorff, Progress Report on Ground Water in North Carolina, Bulletin 47, U.S. Geological Survey, 1945, and the NC Department of Conservation and Development, Division of Mineral Resources, Jasper L. Stuckey, State Geologist (quoted from an earlier work in the text), viewed on-line at http://www.ncwater.org/Education_and_Technical_Assistance/Ground_Water/Publications

Other classic descriptions of groundwater conditions within the Triassic Basins can be found in:

George L. Bain and J. D. Thomas, Geology & Ground Water Resources in Durham Area, Ground Water Bulletin 7, U.S. Geological Survey, 1966

H.E. LeGrand, Ground Water of the Piedmont and Blue Ridge Provinces in the Southeastern States, Geological Survey Circular 538, U.S. Geological Survey, 1967

[c] E.R. Burt, P.A. Carpenter, III, R.D. McDaniel, and W.F. Wilson, Diabase Dikes of the Eastern Piedmont of North Carolina, Information Circular 23, North Carolina Geological Survey,1978.

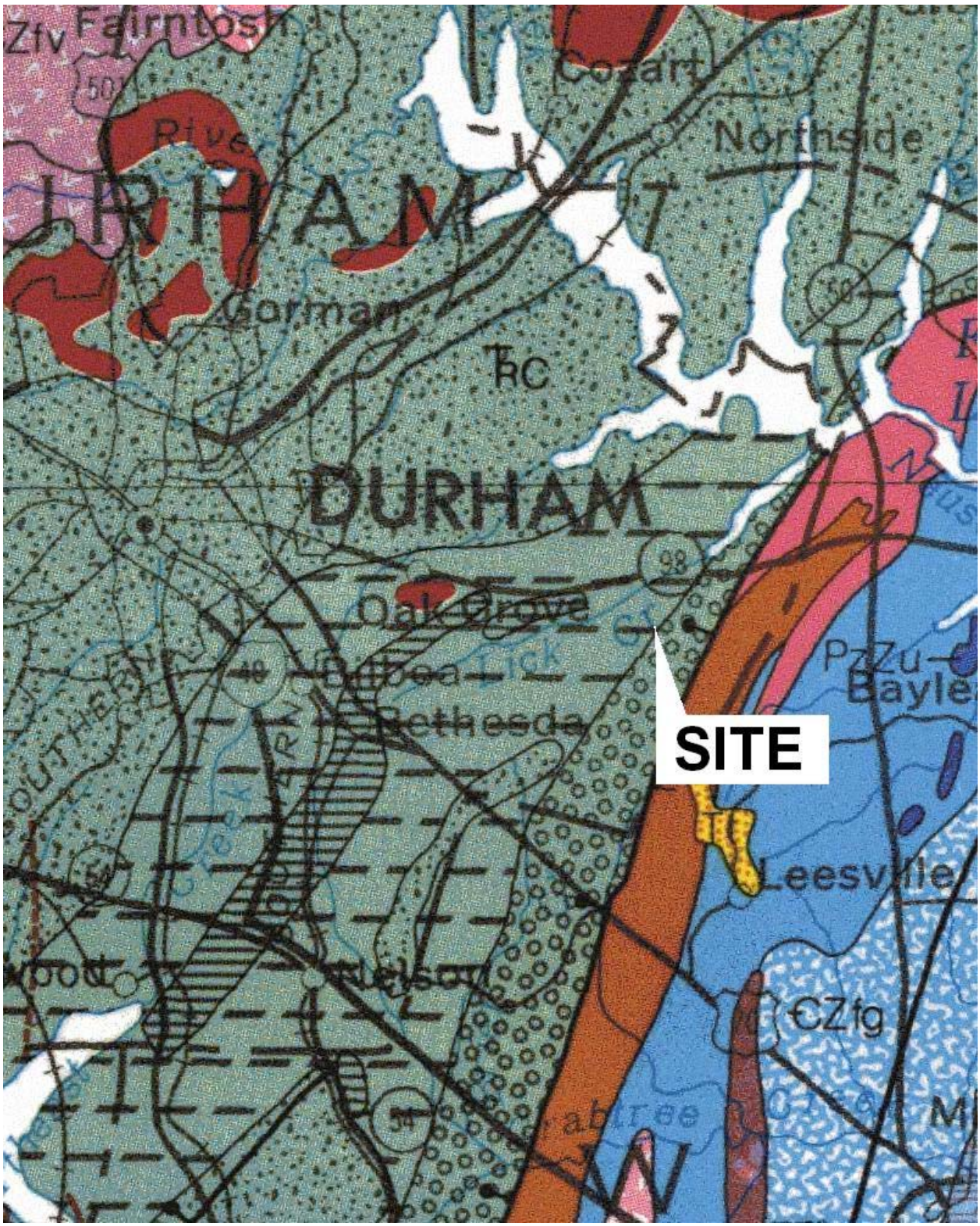

Figure 1 – Excerpt from NC Geologic Map, 1985

3.0 Mapped Soil Series

The following soil types are mapped within the facility boundary (see **Figure 2**) [d]:

Series Name		USDA Texture	USCS Classification	Flood Hazard	Depth to Seasonal High Water	Depth to Bedrock	Available Water Capacity[4]
CrB	Cecil	fine sandy loam	SM-SC, SM, ML, CL-ML	None	>6'	>5'	0.12 – 0.14
CrC[1, 2]	Cecil	fine sandy loam	SM-SC, SM, ML, CL-ML	None	>6'	>5'	0.12 – 0.14
PfC	Pinkston	fine sandy loam	SM-SC, SM, ML, CL-ML	None	>6'	>2.5'	0.12 – 0.15
PfE[1, 3]	Pinkston	fine sandy loam	SM-SC, SM, ML, CL-ML	None	>6'	>2.5'	0.12 – 0.15
WsC	White Store	sandy loam	SM, SM-SC, CH, CL	None	>1.5'	>4'	0.10 – 0.15

[1]predominant within the proposed expansion footprint
[2]permeability varies 2 to 0.6 inches per hour, or 1.4E-3 to 4.3E-4 cm/sec
[3]permeability varies 6 to 2 inches per hour, or 8.5E-3 to 1.4E-3 cm/sec
[4]given in inches of water per inch of soil – though used in an agricultural context, this index indicates the availability of water to sustain plants and (ostensibly) to recharge the ground water; values below 0.2 are low [e]

The Cecil and Pinkston soils are generally located in the higher elevations – these soils drain moderately well to slow and have a low field capacity, i.e., the ability for the soils to hold moisture is low. The literature describes both the Cecil and Pinkston soils as clayey with "slow intake" and poorly suited for constructing spring-fed ponds – from an agricultural standpoint – due to "no water" availability. This is consistent with the author's experience working in the Triassic Basin. White Store soils are generally located within lower elevations (out of the proposed development area), but with similarly low permeability and water availability.

Based on the foregoing soil descriptions, it does not appear that the Cecil and Pinkston soils are likely to produce water tables that are detrimental to the proposed landfill expansion, which is consistent with the findings of the test pit investigation (see **Section 6.0**).

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[d] USDA, Natural Resource Conservation Service, Soil Survey of Durham County, June 1976

[e] USDA, Natural Resource Conservation Service, Soil Quality Indicators, June 2008, available on-line at http://soils.usda.gov/sqi/assessment/files/available_water_capacity_sq_physical_indicator_sheet.pdf

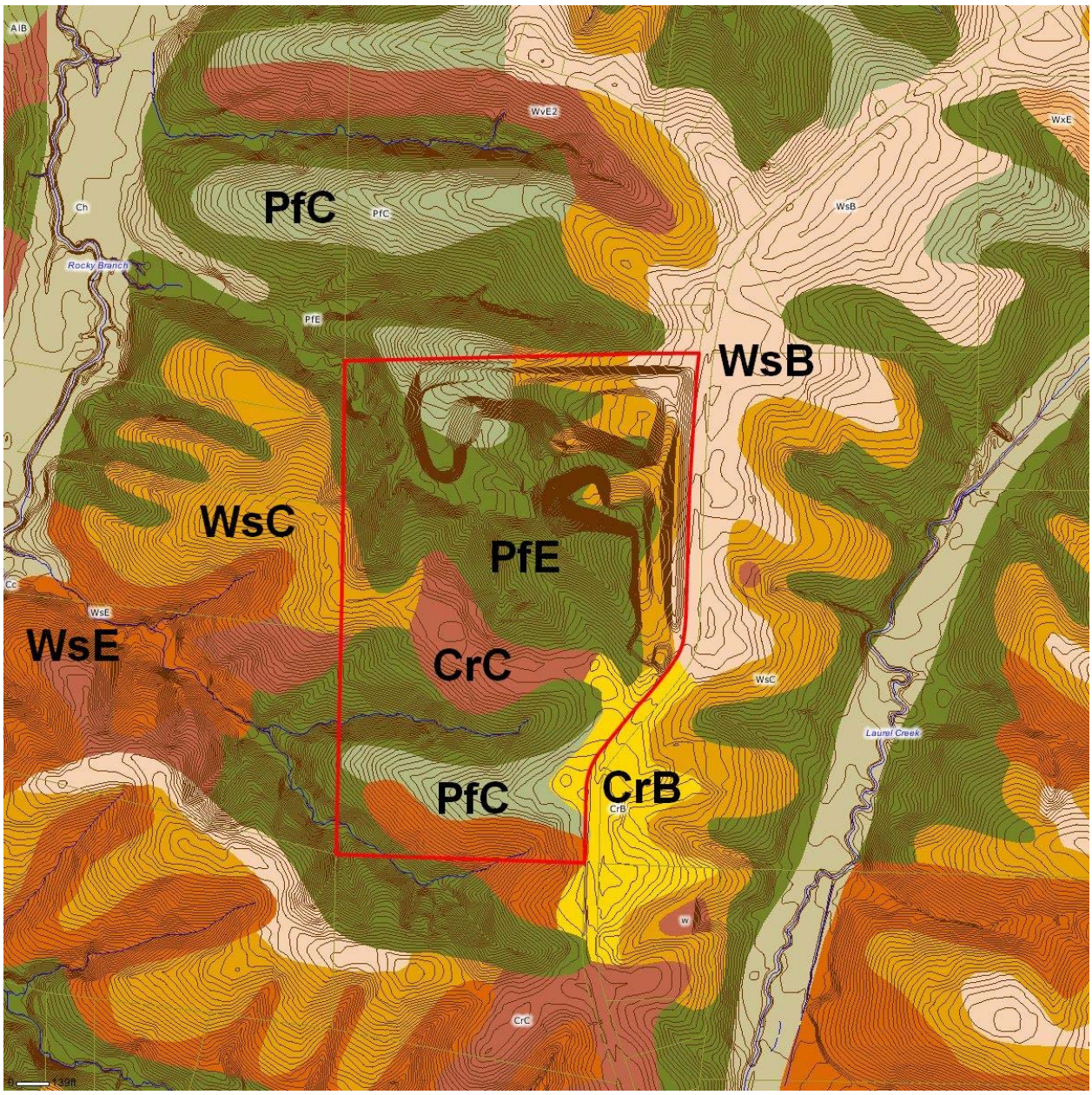


Figure 2 – Area Soils Map (from Durham County GIS)

4.0 Physical Site Description

The following information was acquired from Durham County GIS tax data:

Parcel Ref No.	194924
PIN	0870-02-67-3639
Deed Bk/Pg	1969 / 204
Plat Bk/Pg	000131 / 000078
Physical Address	1810 Coley Rd (SR 1900)
Map Acres	63.385
GPS COORDINATES:	N: 35.97071 E: -78.74075

The site is partly wooded with the existing LCID covering less than 12 acres. The site is situated on the western flank of a north-south sloping dissected ridge, with ground surface elevations within the eastern portion the site varying from El. 390 near the entrance drive on Coley Road and El. 400 along the crest of the landfill (ca. 2005), decreasing to El. 320 where the main drainage feature exists along the west property line. General drainage on the west side of the ridge is to the west via an unnamed tributary to Rocky Branch, which in turn flows north-northeast to the Neuse River (Falls Lake). The east side of the ridge (off the subject property) flows east toward Laurel Creek, which is subparallel to Rocky Creek and also flows north to the Neuse River (see **Figure 3**). The larger creeks reflect a prominent regional fracture pattern with a north-northeast trend; the smaller unnamed tributaries mark a less prominent fracture pattern oriented northwest-southeast – these may be a conjugate joint set. Manmade "outcrops" of the reddish-brown Triassic siltstone-mudstone are visible in the borrow site (LCID expansion area).

5.0 Regional Hydrogeologic Conditions

Ground water recharge occurs over much of the site and the higher elevations nearby, but recharge is slow due to slow percolation of surface water into the subsurface. Ground water discharge occurs at local streams via numerous isolated, short-segmented "closed loop" aquifers formed along regional jointing, typical of the piedmont. A regional well survey has not been completed at present, but municipal water is present in the vicinity of the site. The Facility Boundary includes an on-site discharge feature, which is typically desirable for solid waste facilities. Parcels west of the Facility did not contain houses in 2005.

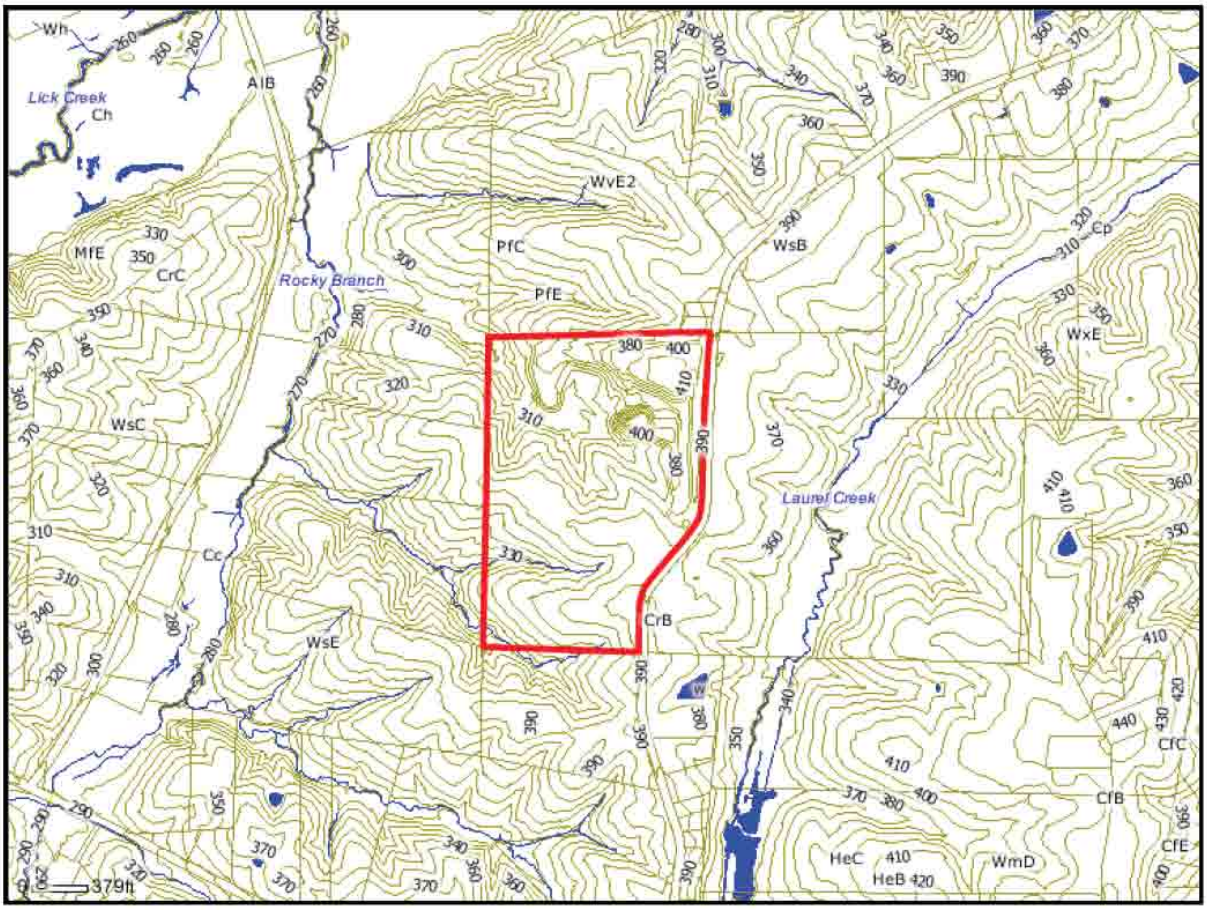


Figure 3 – Topography of Site and Vicinity

6.0 Test Pit Investigation

Two test pits – shallow trenches, really – were excavated with a track-mounted excavator equipped with rock teeth. The soils exposed at the surface were very hard and dry. The test pit locations are shown on a hand-drawn figure in **Appendix 1**. Locations for the test pits were verified with a hand-held GPS unit and shown on the master drawings for the project (by others). A skilled environmental technician observed the test pits, specifically looking for soil moisture conditions, soil texture, and chroma (gleying or staining) which would indicate past ground water movement. Logs of the test pits can be found in **Appendix 1**. Photographs of the test pits are presented in **Appendix 2**.

The soils were observed to be very dry and exhibited no staining associated with ground water movement. Test Pit #1 encountered slightly moist clayey soils with roots and minor inert debris, which did exhibit color variation – believed to be fill – extending to a depth of 2.5 feet beneath the surface (see **Photo 1.1**). The underlying soils consist of dry, hard sandy-silt (see **Photo 1.2**). Refusal occurred at 3.5 feet. Test Pit #2 refused at a depth of 2 feet – that is, the equipment being used to excavate the pit was not sufficiently powerful to dig deeper. No evidence of water, past or present, was observed in either test pit. Even though the pits did not extend a full four feet beneath the proposed base grade (i.e., the ground surface), nothing was observed to suggest that the seasonal high water table would rise higher than four feet beneath the surface.

7.0 Conclusions and Recommendations

The base of the proposed LCID expansion will meet the vertical separation requirement of four feet to seasonal high ground water, based on the findings of the investigation. Care should be taken to avoid ponding surface water uphill of the proposed LCID expansion, via proper waste placement practices and drainage. This report satisfies the typical investigation requirements for LCID landfills in the State of North Carolina. No further investigations or monitoring of the ground water is considered necessary.

8.0 Certification

This work was performed by, or under the supervision of, a qualified geologist duly licensed in the State of North Carolina, who is experienced with the applicable regulations for the subject project and familiar with subsurface conditions at and in the vicinity of the project site. The work meets the customary standard of care appropriate for the project and applicable regulations.

Signed Name: _____

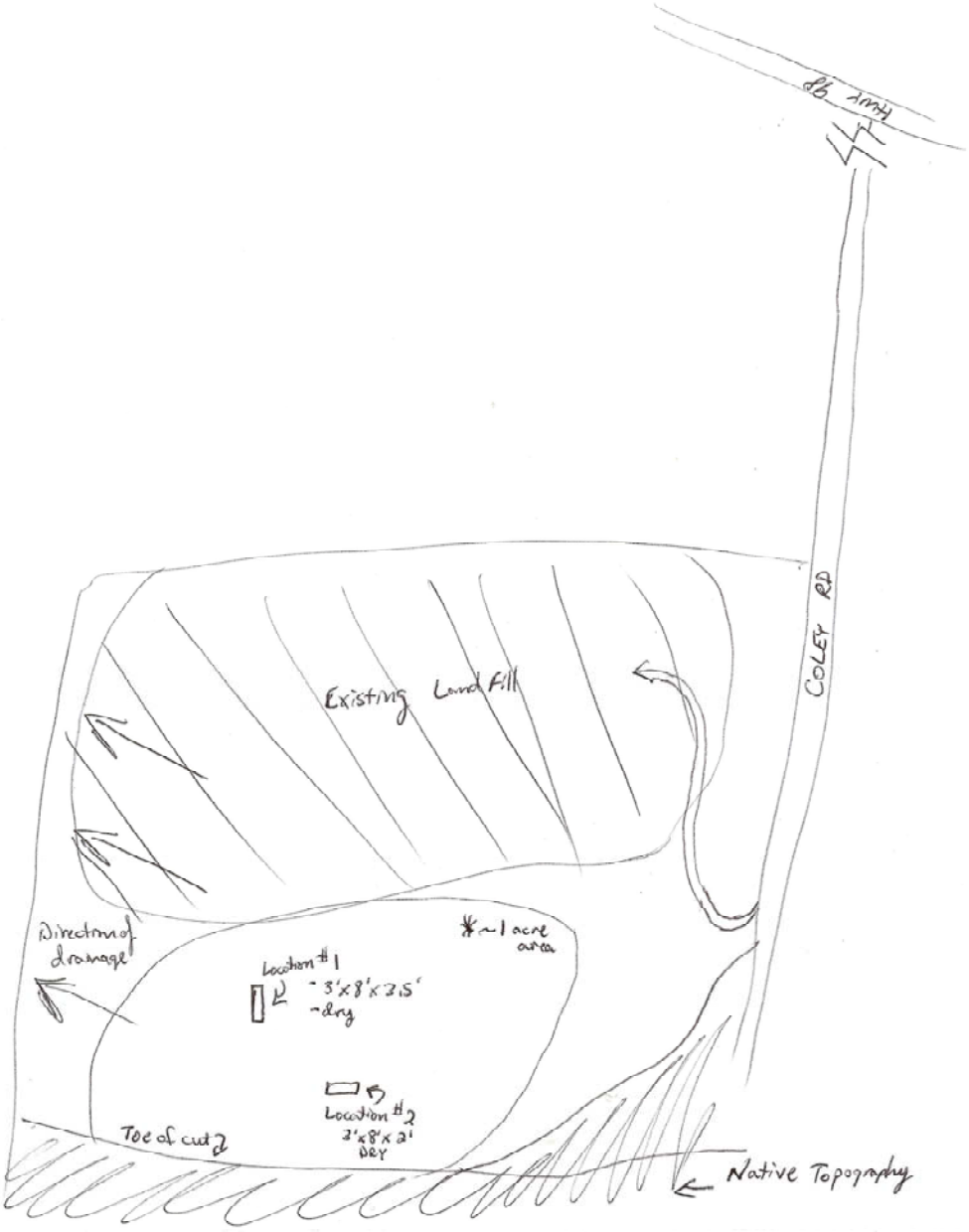
Printed Name: G. David Garrett, PG, PE

Original Date: August 19, 2010

Appendix 1

Test Pit Logs and Map

Test Pit Location Map



Test Pit Logs

Date: July 29, 2010
Weather: Sunny, mid-90's
Observer: Aaron Hill – Environmental Field Management

Test Pit #1

0 – 2.5'	Moist, tan and brown clay, possible fill, with roots and inert debris (Photo 1.1)
2.5 – 3.5'	Hard, dry, red-brown sandy silt (Photo 1.2)
3.5'	Track hoe refusal

Test Pit #2

0 – 2.0'	Hard, dry, red-brown sandy silt (Photo 2.1 and Photo 2.2)
2.0'	Track hoe refusal
	Note: material difficult to dig but friable and crumbly when excavated

Appendix 2

Test Pit Photographs

Overview of test pit investigation – expansion site is at approximate proposed base grades

Photo 1.1 – Clayey soils (suspected fill) within upper 2.5 feet beneath surface

Photo 1.2 – Hard, dry sandy silt or silty sand below depth of 2.5 feet

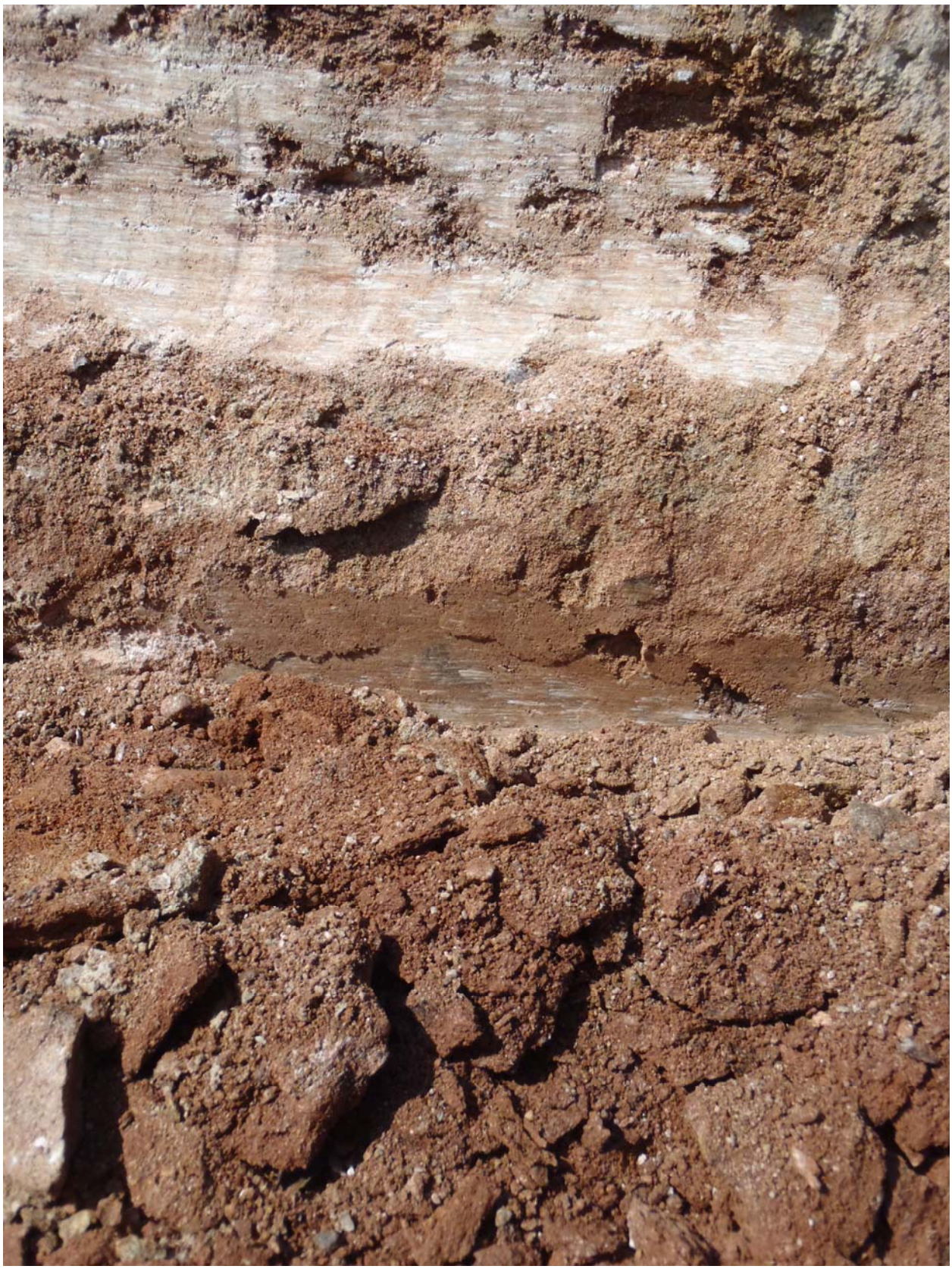


Photo 2.1 – Hard, dry, red-brown sandy silt

Photo 2.2 – Hard, dry, red-brown sandy silt