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SCS ENGINEERS, PC

May 19, 2015
File No. 02214704.00

Mr. Ed Mussler, PE.
Permitting Branch, Solid Waste Section
NCDENR Division of Waste Management
Green Square, 217 West Jones Street
Raleigh, North Carolina 27603

Subject: Design Hydrogeologic Investigation and Report Revisions
Permit Application for A-1 Sandrock CDLF Phase 2A
Greensboro, North Carolina (Guilford County)
Facility Permit No. 4117-CDLF-2008

Dear Ed:

On behalf of A-1 Sandrock, Inc., SCS Engineers, PC (SCS) has revised the Design Hydrogeologic Report submitted in May 2015. Edits were made to the drawings and text based on comments received from Ms. Christine Ritter in correspondence dated June 12. 2015. All of the comments have been addressed and the issues amicably resolved.

This submittal includes several attachments: 1) revised drawings in 11x17" format, 2) revised individual pages of the report, 3) a written explanation of the changes following this letter, and 4) a revised report with noted changes and revision update (now version 0.1, July 23, 2015). Also included are revised pages for Appendices 7, 8, and 9, i.e., 5) Test Pit documentation and maps for the 6) Ground Water Monitoring Plan, and 7) Landfill Gas Monitoring Plan, respectively. No undocumented changes have been made to the report text or attachments.

We appreciate the Section's cooperation with this project. Please contact me if you have any questions regarding this submittal.

Sincerely,

G. David Garrett, PG, PE
Project Manager
SCS ENGINEERS

NORTH CAROLINA PROFESSIONAL SEAL 25462 ENGINEER G. DAVID GARRETT

7/24/2015

cc: Ronnie Petty, III, A-1 Sandrock, Inc,
Christine Ritter, Solid Waste Section

C:\Users\3921gdg\Documents\Projects\A1 Sandrock\Phase 2 Design Hydro\documents\DH transmittal letter 7-24-2015.doc

Documentation of Report Revisions based on regulatory review comments

Drawings

S1	Revision of symbols and other clarifications on "Initial Conditions" map
S2	Simplification of Final Base Grades with March 2015 Estimated Maximum Seasonal High Ground Water Contours, showing 4 feet of separation*
S3	Simplification of Final Base Grades with March 2015 Bedrock Contours, showing 4 feet of separation*
S4	Minor revision of Vertical Separation Isopach map, including a renaming
X1	Minor revision of cross sections showing March 2015 test pit data and line work clarifications
M1	Finalization of monitoring plan map, no revision except for topo clarifications

* References to 2002 data removed, prompting removal of two drawings

Report Pages

ii	Revision of the drawing list
1	Corrected paragraph 1, sentence 2
3	Corrected paragraph 1, sentence 2
6	Corrected a date in paragraph 2
7	Corrected captions on both photographs
12	Section 1.3, added paragraphs 2 and 3 to discuss test pit investigation
13	Section 1.3, shifted last paragraph to next page

Appendices

7	Addition of Test Pit Logs (four pages) Page 12 substitution of correct photo for TP-13
8	Revision of Drawing M1 (small map) for Ground Water Monitoring Plan
9	Revision of Drawing M1 (small map) for Landfill Gas Monitoring Plan

TABLE OF CONTENTS

INTRODUCTION

A-1 Sandrock, Inc., owns and operates a Construction and Demolition debris landfill (CDLF), located at 2091 Bishop Road, near Greensboro, North Carolina, in southeastern Guilford County. The Owner is seeking a Permit to Construct (PTC) and Permit to Operate (PTO) for Phase 2A. This document presents a Design Hydrogeologic Study prepared in accordance with Solid Waste Rules 15A NCAC 13B .0538, with updates to the facility monitoring plan in accordance with Rule 15A NCAC 13B .0544. This work supports a permit amendment application submitted in March 2015, which details the facility plan, engineering plan and operations plan. The PTO was renewed in early 2014, but the new phase was not ready at that time. This report is presented in two sections: **Section 1** excerpts Site Suitability hydrogeology criteria from 2002, specific to Phase 2; **Section 2** presents the Design Hydrogeologic report based on the March 2015 study.

The landfill began operation in 2009 as the reclamation program for an open pit mine (essentially a large borrow pit). The initial Site Suitability Study was performed in 2002, and mining commenced using solid waste buffer criteria ca. 2003. The permitted facility boundary encompasses approximately 75 acres, whereas the footprint is divided into three contiguous phases covering approximately 21 acres. One PTC and three separate PTO's were issued for three cells as completed, identified as Phases 1A, 1B and 1C, located in the northern third of the footprint. Phase 1 straddled a geologic boundary between hard diorite bedrock to the east and deeply weathered granite ("sandrock") to the west, with a north-south oriented diabase dike located near the contact.

Excavation to design base grades in Phase 1 encountered a few rock outliers that required padding with soil to provide the required 4 feet of separation. The diabase dike generally proved to be easier to excavate than was indicated by the "auger refusal" conditions mapped in the Site Suitability investigation. The upper 20-30 feet of diabase in Phase 1C consisted of variable size cobbles and boulders nested in a matrix of clayey soil. A variable rock surface was suspected during the earlier studies, thus when the mining was completed in each cell a second investigation with test pits was performed to confirm the vertical separation, albeit some of the grades were adjusted up or down as conditions dictated. A tally of lost or gained airspace was kept in Phase 1 (and Phase 2A).

Similar excavation conditions were encountered in Phase 2A, whereas the cell is centered on the diabase dike but ground water separation became the controlling factor in the westernmost third of that 4-acre cell. The confirmation test pits in Phase 2A demonstrated sufficient separation to bedrock, but ground water was encountered within the lowest elevations at depths of 2 to 3 feet beneath the prepared base grades evaluated March 18, 2015. Due to the cell geometry and wet conditions over the recent winter, surface water collected in the low elevations and recharged the porous sandrock aquifer. It was not determined whether the water levels observed were "perched" or hydraulically connected to the base flow aquifer, but in the interest of expediting the permit the Owner raised the base grades and had the cell resurveyed on April 4, 2015.

A third significant rock unit, a diabase dike of Triassic-Jurassic age (Jd), was observed along a north-south lineament, just west of the apparent granite-diorite contact. This unit is large enough to be mapped on the regional geologic map but not the state map. The "baked zone" appeared to be approximately 30 to 50 feet wide, but later exposure shows the dike to be approximately 10 feet wide. The upper surface of the diabase is weathered and contains "nests" of hard, rounded, black boulders and cobbles, embedded in a matrix of dark orange, plastic, silty clay. Diabase dikes have generated a lot of interest for solid waste site monitoring. Based on historic data, the diabase is not a significant factor here.

Other mafic rock units were observed as small, disconnected pods, called "xenoliths," of moderately hard, green-gray, foliated gneiss, generally too fine-grained for positive visual mineral identification. Such occurrences are common throughout the region and are believed to represent either old, post-depositional dikes within the granite (not to be confused with the much younger diabase) or diorite inclusions that were assimilated into the granite, now obscured by later thermo-tectonic events. These relatively small rock bodies are too small and isolated to map as individual units, thus they are believed to have no significance for water quality monitoring.

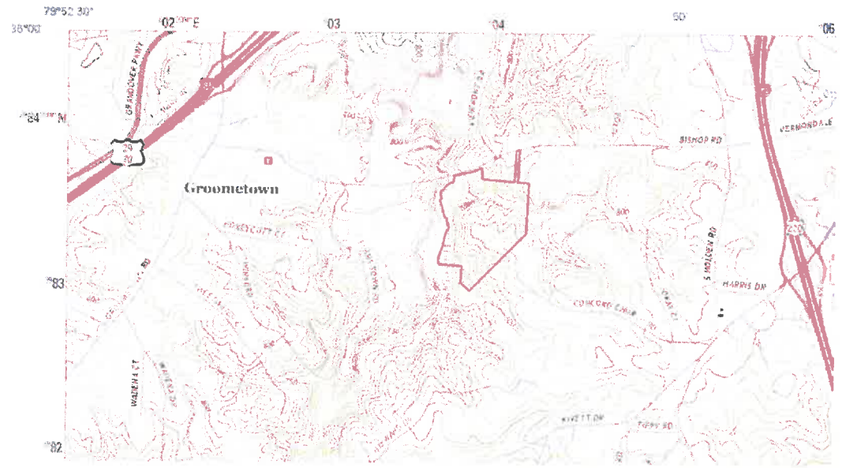


Figure 2 – USGS Pleasant Garden 7.5 minute series topographic quadrangle[3]

Surface topography serves as a guide to the direction of groundwater flow and influences hydraulic gradients. The variable topography observed at the site and throughout the region (**Figure 2**) is largely a manifestation of differential weathering of the bedrock,

[3] http://nationalmap.gov/ustopo

1.2 Field Reconnaissance

1.2.1 Bedrock Characteristics – Typical of the Piedmont region, near-surface soils are characterized as saprolite, weathered from the underlying bedrock (saprolite), either diorite or granite on this site, and exhibits a relict texture and mineralogy derived from the parent bedrock. Stratigraphy is based more on the in-situ weathering pattern of the underlying bedrock than actual depositional units. Earlier test borings indicate standard penetration test (SPT) values vary spatially due to localized density variations and the degree of saturation. The on-site soils exhibit SPT values typically in excess of 20 blows per foot and varying with increasing depth to values in excess of 100 blows per foot. These densest soils are known locally as "partially weathered rock," which can be penetrated by power-driven hollow stem augers and transitions to bedrock, defined by "auger refusal." Several borings were cored or advanced into the bedrock with rotary-air drilling methods.

Based on the test boring data, the top of rock exhibits a differential weathering pattern, typical of a transitional boundary between the saprolite and bedrock. No additional test borings were performed for Phase 2A, whereas sufficient coverage (one per acre) was present throughout the footprint at the conclusion of studies that supported the permitting of Phase 1. Site visits made during the excavation of Phases 1 and 2A afforded ample opportunity to observe the soils and rock conditions, documented by numerous photos following this section. The subsurface data were supplemented by 15 test pits excavated on March 17, 2015 and observed with SWS staff on March 18, 2015, to demonstrate the required 4 feet of vertical separation between the base grade and either bedrock or groundwater. **Drawing S1** shows the layout of the investigation.

Within the eastern portions of Phase 2A, the upper soils are stiff to hard, orange-tan (occasionally greenish-gray) sandy silt and clayey silt, extending to depths of 15 to 25 feet below the surface. These soils are variably moist and often exhibit mottling due to past moisture fluctuations, in addition to occasional dark brown iron-manganese staining along joint surfaces. Within the western portion of Phase 2A, the soils are dense to very dense, tan-yellow and white silty sands with occasional pockets of sandy silt, extending from 25 to 50 feet beneath the original ground. The base grade slopes toward the west following the upper bedrock surface. Both the granite and diorite form few outcrops in the uplands, but minor exposures of both are to be found within the excavations, whereas the saprolite exhibits outliers of rock-like materials (not "bedrock") and small veins. The diabase is very conspicuous in the excavations and was visible as a line of boulders prior to grading. However, the diabase was easily excavated with large power equipment, thus final base grades in Phase 2A vary from those estimated using the earlier test borings.

Photo 1 – looking southeast across Phase 2A on May 18, 2015; test pits visible in foreground; dark soils exposed in the south wall (above the excavator) mark the diabase; C&D waste is exposed in the north wall on the left; Phase 2A extends to the base of the large stockpile; the sump is in the right foreground

Photo 2 – looking north across Phase 2A on May 18, 2015; test pits are visible across the bottom; a sliver of Phase 1 waste is exposed to the left on the far wall; lower area was subject to ponding of surface water during the recent winter months; sump is visible along the toe of the perimeter berm on the left side; this berm is residual soil (not structural embankment fill); rocky material to the right is the diabase dike

1.3 Test Borings/Test Pits

Drawing S1 shows test locations performed in 2002 and test pits excavated in March 2015. Including two previous test borings drilled within Phases 2A, i.e. B-16 and B-29, and 15 test pits, a total of 17 data points exist within the 4.4 acre expansion site. This exceeds the requirement of one boring per acre. In addition, 8 more borings located along the margins are considered relevant: B-7, B-15, B-18, B-12, B-21, B-27, B-19 and B-20. The earlier piezometers have long since been removed, but the data are useful to supplement bedrock information. Two more data points outside the Phase 2A footprint are monitoring wells MW-3 and MW-4, which provide semi-annual water level data.

The test borings were drilled with an all-terrain vehicle-mounted drill rig turning hollow stem augers for a considerable distance into the dense "sandrock" (100+ bpf material). The borings extended to auger refusal depths, which varied from 18 feet at B-7 to 65 feet at B-19. Rock cores were taken at B-12, B-19 and B-27. Some of the variability in auger refusal depths depended on the presence of a relatively narrow (5 to 10 feet wide) diabase dike, a hard linear rock feature oriented north-south in the western side of the site. The upper portion of the dike, just beneath the surface, weathers into hard rounded nodules embedded in soil, transitioning at depth to a friable, chunky material and large boulders at shallower depths than the surrounding sandrock. This feature had influenced bedrock contours used in the 2002 base grades. Later it was found that the material could be excavated easily with conventional earthwork equipment.

This prompted slight changes to the base grades in 2014-2015, which was evaluated with a test pit investigation in March 2015. The investigation started with base grades that were surveyed in March 2015, shown as "initial conditions" in **Drawing S1**, to verify that 4 feet of vertical separation existed below those grades. The test pits were excavated with a CAT 225 track-hoe (or equivalent) on March 17, 2015, observed and documented by an experienced professional geologist. The test pits were inspected with SWS personnel approximately 24 hours later, sufficiently long to achieve stabilized water levels. The test pits were mapped and depths measured by the geologist. Water elevations were calculated by subtracting depths from references on extant surveyor's stakes. Depth of fill required to provide minimum required separation was calculated and additional grading was performed over the next week.

The finished base grade was resurveyed in early April 2015, which is represented in **Drawings S2, S3, S4** and **X1**. These drawings demonstrate that 4 feet of vertical separation, or more, exists between the finished grades and the bedrock or ground water.

A recent monitoring well installation, MW-6, located north of Phase 1C, provides confirmation of subsurface conditions in this portion of the site. Test locations were selected based on topography and other features to demonstrate the vertical separation characteristics within Phase 2A. A summary of relevant test boring data, e.g. elevations of weathered rock, bedrock, termination depths, and piezometer screen intervals, is presented on **Table 1**. A summary of the test pit data is presented on **Table 7**. Test boring records and photographic documentation of the test pits are presented in **Appendices 3** and **7**, respectively.

1.4 Laboratory and Field Testing

1.4.1 Laboratory Analysis – Table 2 presents a summary of laboratory test data for selected samples obtained in 2002. The laboratory test program consists of the following:

Flexible wall permeability – remolded*	D5084	2
Standard Proctor Compaction	D698	2
Grain Size w/Hydrometer	D422, D1140	7
Atterberg Limits	D4318	7
Natural Moisture	D2216	7

*Flexible wall permeability test were performed on relatively undisturbed (Shelby tube) samples.

The soils were classified in the laboratory according the Unified Soil Classification System (USCS). These descriptions were matched to the boring logs to verify the visual soil classifications. Laboratory data is presented in **Appendix 6**. Based on the laboratory data, a majority of the on-site soils classify as silty sands (SM) and sandy silt (SM-ML). Near surface soils exhibited clay contents varying from 6% to 18% by weight, whereas the deeper soils show lower clay contents of 0% to 4%. Silt contents are typically 10% to 40%, whereas sand content was measured from 40% to 85%. The lab reported liquid limits varying from 23 to 41, while the plasticity indices are generally vary from 5 to 13, consistent with sand and silt. Moisture content was reported as less than 10%.

In keeping with Division requirements, the effective porosity was estimated from the grain size distribution analysis using the Textural Classification diagram,[4] originally developed by the US Geological Survey for estimating specific yields in porous aquifers. In an unconfined aquifer, specific yield and effective porosity are close enough to be

[4] Johnson, A.I., Specific Yield – Compilation of Specific Yields for Various Materials, Geological Survey Water Supply Paper 1662, US Department of the Interior, 1967

Test Pit Log for A-1 Sandrock Phase 2A

See Drawing S1 for locations

Supervision and documentation performed by David Garrett, PG, PE

Refer to accompanying photos, taken 3/18/2015 before final grading

Test Pit 1

Encountered TAN-YELLOW VERY SILTY SAND, SM

Depth of excavation is 4 feet

Water stabilized at 3'6" after 24 hours

Test Pit 2

Encountered TAN-YELLOW VERY SILTY SAND, SOME CLAY SMEARS, RELICT TEXTURE, SM-ML

Depth of excavation is 4 feet

Water stabilized at 3'6" after 24 hours

Test Pit 3

Encountered RED-BROWN SLIGHTLY SANDY CLAYEY SILT, ML-CL

Depth of excavation is 4 feet

Water stabilized at 3'0" after 24 hours

Test Pit 4

Encountered TAN-YELLOW VERY SILTY SAND, SM-ML

Depth of excavation is 5 feet

Water stabilized at >5' after 24 hours, capillary zone starts at 4'0"

Test Pit 5

Encountered TAN-RED VERY SILTY SAND, SM-ML

Depth of excavation is 4 feet

Water stabilized at 3'0" after 24 hours, capillary zone starts at 3'6"

Test Pit 6

Encountered TAN-YELLOW VERY SILTY SAND, SM

Depth of excavation is 6 feet

Water stabilized at 6'0" after 24 hours, capillary zone starts at 5'0"

Test Pit 7

Encountered RED-GRAY CLAYEY SILT, DIABASE NODULES, ML

Depth of excavation is 4 feet

Dry at 4' after 24 hours

Test Pit 8

Encountered RED-GRAY VERY SILTY SAND, SM-ML

Depth of excavation is 4 feet

Water stabilized at 2'0" after 24 hours

Test Pit 9

Encountered RED-GRAY VERY SILTY SAND, SM, SMALL ROCK FRAGMENTS

Depth of excavation is 4 feet

Water stabilized at 2'0" after 24 hours

Test Pit 10

Encountered TAN-YELLOW VERY SILTY SAND, SM

Depth of excavation is 5.5 feet

Water stabilized at 5.0" after 24 hours, capillary zone starts at 4'6"

Test Pit 11

Encountered TAN-GRAY CLAYEY SILT, ABUNDANT DIABASE NODULES, ML

Depth of excavation is 6 feet

Dry at 6' after 24 hours

Test Pit 12

Encountered TAN-RED CLAYEY SILT, DIABASE NODULES, ML

Depth of excavation is 4 feet

Dry at 4' after 24 hours

Test Pit 13

Encountered TAN-BROWN VERY SILTY SAND, SM-ML, LAYERED ROCK FRAGMENTS

Depth of excavation is 5 feet

Dry at 5' after 24 hours

Test Pit 14

Encountered TAN-BROWN VERY SILTY SAND, SM-ML, SCATTERED ROCK FRAGMENTS

Depth of excavation is 6 feet

Dry at 6' after 24 hours

Test Pit 15

Encountered TAN-BROWN VERY SILTY SAND, VERY SILTY SAND, SOME CLAY SMEARS, RELICT TEXTURE, SM-ML

Depth of excavation is 4 feet

Water at 3.5' after 24 hours, capillary zone starts at 3'6"

Notes:
Test pits excavated with a CAT 225 track-hoe (or equivalent) on 3/17/2015

Observations with SWS personnel conducted on 3/18/2015

Later that day, pits were surveyed and measured, documented on the field map

Water elevations calculated by subtracting depths from references on extant surveyors stakes

Depth of fill required to provide minimum required separation was calculated

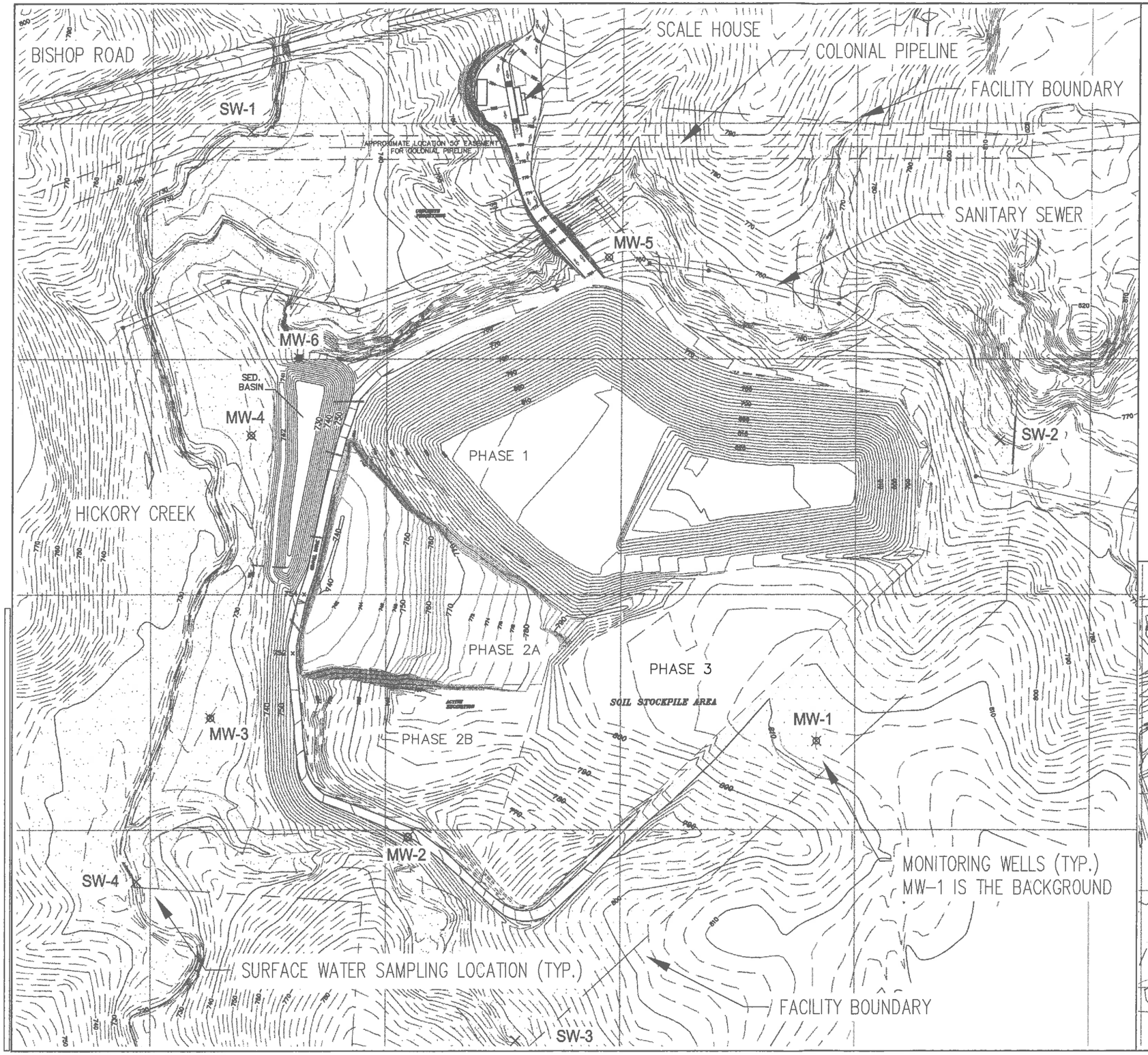
Additional grading was performed over the next week

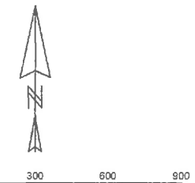
The finished base grade was resurveyed in early April 2015, which is represented in Drawings S2, S3, and S4

TEST PIT	GRD ELEV	DEPTH	BOT ELEV	WATER	GWE
1	740.2	4.0	736.2	3.5	736.7
2	740.2	4.0	736.2	3.5	736.7
3	741.3	4.0	737.3	3.0	738.3
4	742.4	5.0	737.4	<5	<737.4
5	744.1	4.0	740.1	3.0	741.1
6	745.5	6.0	739.5	6.0	739.5
7	753.0	4.0	749.0	<4	<749.0
8	741.3	4.0	737.3	2.0	739.3
9	741.3	4.0	737.3	2.0	739.3
10	744.1	5.5	738.6	5.0	739.1
11	741.0	6.0	735.0	<6	<735.0
12	758.0	4.0	754.0	<4	<754.0
13	769.0	5.0	764.0	<5	<764.0
14	757.0	6.0	751.0	<6	<751.0
15	743.5	4.0	739.5	3.5	740.0

Test Pit 12

Test Pit 13





Scale 1" = 300'

Bar is 1" on original drawing

LEGEND

PROPOSED

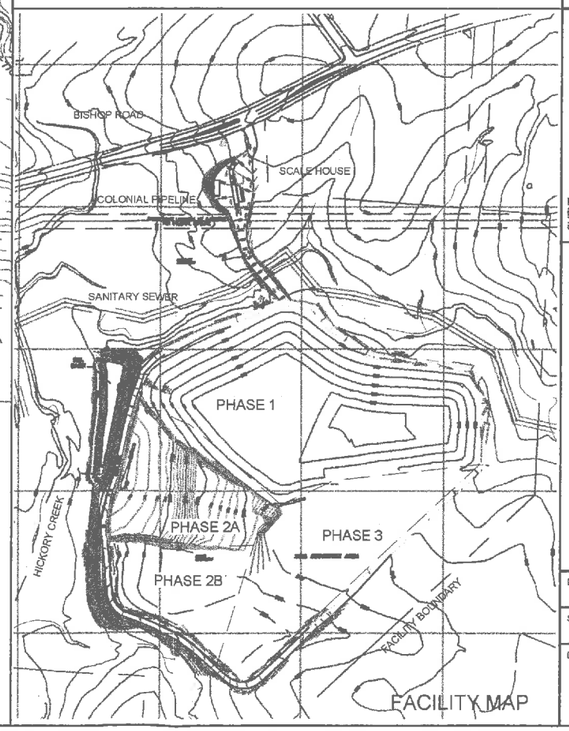
- 2 FOOT ELEVATION CONTOUR
- 280 — 10 FOOT ELEVATION CONTOUR
- CELL AND WASTE LIMITS

NOTE:
CONTOURS SHOWN FOR CELLS 1A / 1B, 2A AND 2B REPRESENT FINAL TOP OF WASTE GRADES

EXISTING

- 2 FOOT ELEVATION CONTOUR
- 280 — 10 FOOT ELEVATION CONTOUR
- FACILITY BOUNDARY
- SANITARY SEWER
- WATERCOURSE BUFFER ZONE
- PROPERTY BUFFER ZONE
- 100 YR FLOODPLAIN
- WATERCOURSE

BASE GRADE CONTOURS FOR PHASE 2 ARE AS SURVEYED IN APRIL 2015



FACILITY MAP

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25468 DAVID GARRETT
7/28/2015
NC CORP. LICENSE NO. C-1637

NO.	REVISION	DATE
1	ADDED MW-5 AND REGULATORY REVIEW	7-14-2014

SHEET TITLE: WATER AND GAS MONITORING LOCATIONS

PROJECT TITLE: PERMIT RENEWAL APPLICATION PHASE 2 PERMIT TO CONSTRUCT

CLIENT
A-1 SANDROCK, INC.
PERMIT NO. 41-17-CDLF-2008
2091 BISHOP ROAD
GREENSBORO, NC 27406

SCS ENGINEERS, PC
2920 WHITEHALL PARK DRIVE, SUITE 450
CHARLOTTE, NORTH CAROLINA 28273
PHONE: (704) 504-3107 FAX: (704) 504-3174

PROJ. NO. 02214704.00 T3
DWN. BY: GDG
CHK. BY: SCL
QUA. REVW BY:
APP. BY:
DES. BY:
DRW. BY: GDG

DATE: 4/30/2015

SCALE: AS SHOWN

DRAWING NO. GW - M1

BISHOP ROAD

SCALE HOUSE

COLONIAL PIPELINE

FACILITY BOUNDARY

APPROXIMATE LOCATION 50' EASEMENT FOR COLONIAL PIPELINE

SANITARY SEWER

LG-6

LG-5

LG-7

LG-8

LG-4

SED. BASIN

PHASE 1

LG-3

HICKORY CREEK

FUTURE LG-9

PHASE 2A

PHASE 3

LG-2

SOIL STOCKPILE AREA

PHASE 2B

LG-1

FUTURE LG-10

FUTURE LG-11

LG-12 FUTURE

SURFACE WATER SAMPLING LOCATION (TYP.)

LANDFILL GAS MONITORING POINT (TYP.)

FACILITY BOUNDARY

300 0 300 600 900

Scale 1" = 300'

Bar is 1" on original drawing

LEGEND

PROPOSED

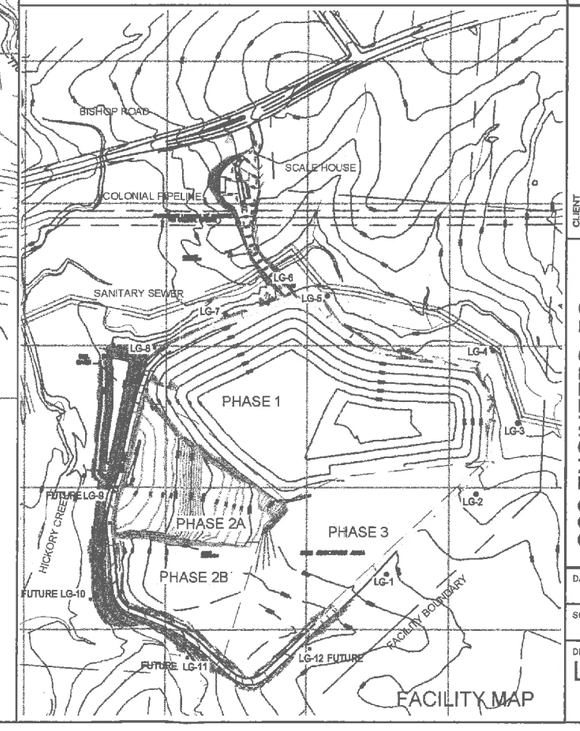
- 2 FOOT ELEVATION CONTOUR
- 280 - 10 FOOT ELEVATION CONTOUR
- CELL AND WASTE LIMITS

NOTE:
CONTOURS SHOWN FOR CELLS 1A / 1B, 2A AND 2B REPRESENT FINAL TOP OF WASTE GRADES

EXISTING

- 2 FOOT ELEVATION CONTOUR
- 280 - 10 FOOT ELEVATION CONTOUR
- FACILITY BOUNDARY
- SANITARY SEWER
- WATERCOURSE BUFFER ZONE
- PROPERTY BUFFER ZONE
- 100 YR FLOODPLAIN
- WATERCOURSE

BASE GRADE CONTOURS FOR PHASE 2 ARE AS SURVEYED IN APRIL 2015



FACILITY MAP

NORTH CAROLINA PROFESSIONAL SEAL 20652 ENGINEER G. DAVID GARRETT

7/28/2015

NC CORP. LICENSE NO. C-1827

NO.	REVISION	DATE
	ADDED MW-6 AND REGULATORY REVIEW	7-14-2014

SHEET TITLE: WATER AND GAS MONITORING LOCATIONS

PROJECT TITLE: PERMIT RENEWAL APPLICATION PHASE 2 PERMIT TO CONSTRUCT

CLIENT: A-1 SANDROCK, INC.
PERMIT NO. 41-17-CDLF-2008
2091 BISHOP ROAD
GREENSBORO, NC 27406

SCS ENGINEERS, PC
2520 WHITEHALL PARK DRIVE, SUITE 450
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PHONE: (704) 504-3107 FAX: (704) 504-3174

PROJ. NO. 02214704.00 T3
DSN. BY: GDG
DWN. BY: GDG
CHK. BY: SCL
CHK'D/WR BY:
APP. BY:

DATE: 4/30/2015

SCALE: AS SHOWN

DRAWING NO. LFG - M1