CQA Certification Report

Don Tyson Parkway Interchange

Sunray #1 Landfill Final Cover Reconstruction
Class 1 Landfill
AFIN: 72-00144

September 2014

Project No. 35139161

Prepared for:
Garver, LLC
2049 E. Joyce Blvd., Ste. 400
Fayetteville, Arkansas 72703

Prepared by:
Terracon Consultants, Inc.
25809 Interstate 30 South
Little Rock, Arkansas 72022
(501) 847-9292

Terracon

PROFESSIONAL ENGINEER'S CERTIFICATION

"I certify to the best of my professional judgment that the final cover system for the Sunray #1 Landfill located at the Don Tyson Parkway Interchange in Springdale, Arkansas was constructed in accordance with Arkansas Department of Environmental Quality regulations and the Work Plan dated March 29, 2012 and approved by email from Bryan Leamons (ADEQ SWMD) to Dave McCormick (Terracon Consultants, Inc.) dated March 30, 2012, except where noted. This certification is contingent on the fact that all information supplied to the signatory authority, at the time of this certification is unquestionably accurate and was provided in good faith."

Oct. 3, 2014

F. Owen Carpenter, P.E., P.G.
Arkansas Professional Engineer No. 8653

Date

Terracon Certificate of Authorization No. 223

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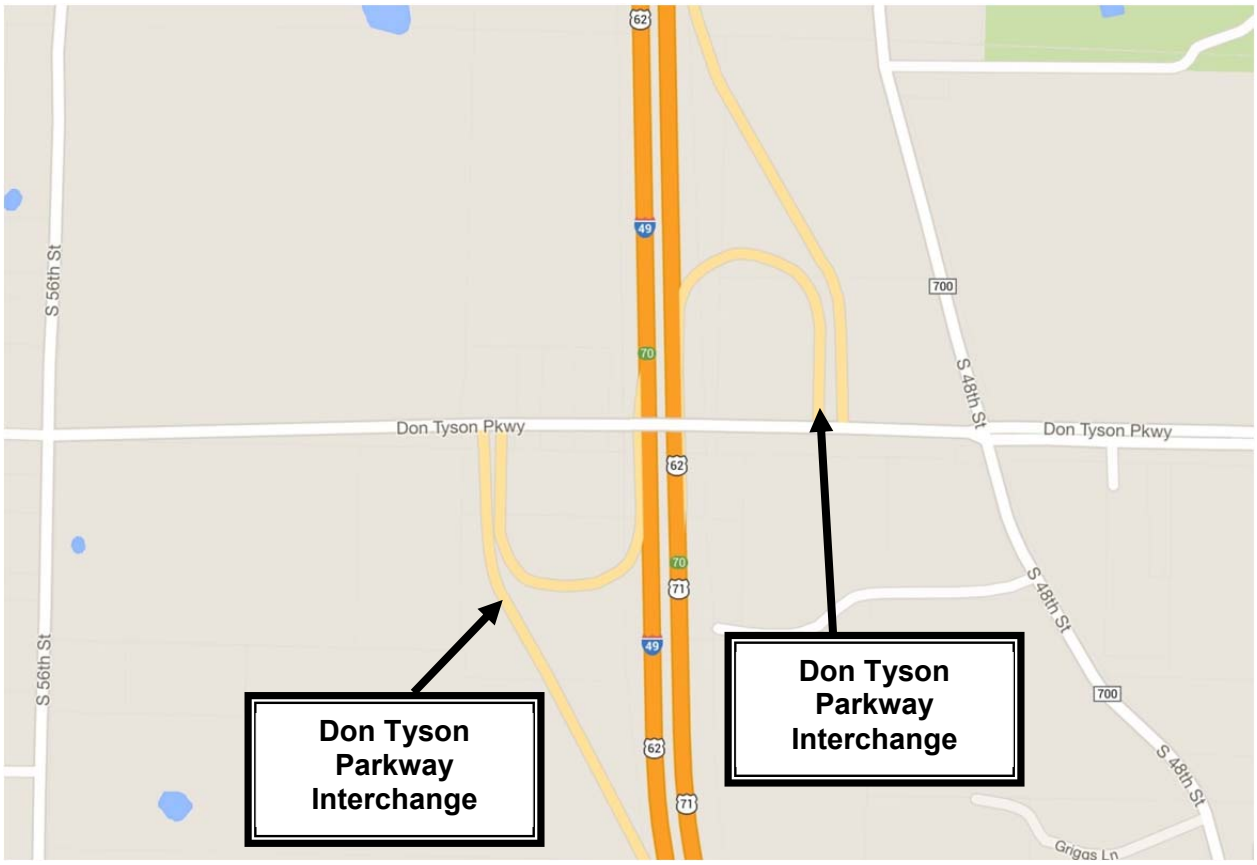
1.0 INTRODUCTION

This construction quality assurance (CQA) report summarizes testing and documentation activities performed by Terracon Consultants, Inc. (Terracon) during the construction of the final clay cover system work associated with the Don Tyson Interchange located in Springdale, Arkansas. **FIGURE 1 - Site Location Map** below illustrates the geographic location of the site.

FIGURE 1 Site Location Map



This document summarizes the construction of the compacted clay cover (CCC) portion of the final cover system. Correspondence, details, quality control test results, and certifications associated with the construction have also been provided in the Appendices. This document, in conjunction with project as-built drawing, is intended to satisfy the requirements of the *Arkansas Department of Environmental Quality (ADEQ) Regulation 22.428*.

1.1 General

The construction of the compacted clay cover for the closed Sunray Landfill was conducted in accordance with the following documents:

- *"Regulation Number 22, Solid Waste Management,"* by Arkansas Department of Pollution Control and Ecology, Solid Waste Management Division
- *Work Plan* prepared by Terracon Consultants, Inc. and submitted to ADEQ for approval in March 2012.

1.2 Site Description

Two existing, closed landfill cells, Sunray #1 and Sunray #2 (AFIN 72-00144), were located within impact areas of the proposed Tyson Parkway interchange ramps during the project planning and design phase. Limited information was provided or could be obtained regarding the landfills. An initial interchange geometrical layout indicated the potential crossing of the two landfill cells with highway access ramps. Terracon was engaged by the project design engineer Garver, LLC (Garver) to further define and delineate the two landfill cells that would potentially be impacted by the interchange ramps construction. Terracon provided a final Geophysical Report dated July 2, 2009 that illustrated the approximate landfill limits in both the horizontal and vertical directions in the project area.

Terracon performed complementary geophysical techniques to delineate the waste mass. The geophysical survey lines and boring locations were established and documented by using GPS methods. The locations were recorded in State Plane coordinates. Lateral limits of the landfill were determined by an electromagnetic conductivity survey utilizing an EM-31 transmitting and receiving system. Electrical resistivity surface geophysical methods coupled with induced polarization (IP) methods were used to develop electrical imaging of the horizontal and vertical extent of waste.

An intrusive subsurface exploration and sampling program was developed and performed to correlate and verify the landfill delineation using "ground truth" borings. The program included four temporary monitoring wells, two per landfill, to monitor groundwater levels and to obtain groundwater samples for analytical laboratory testing. **FIGURE 1**, **FIGURE 2,** and **FIGURE 20** of the Landfill Waste Delineation project are presented at the beginning of **APPENDIX B**. **FIGURE 1** presents the preliminary interchange layout and the approximate landfill areas that were studied in the Landfill Waste Delineation project. **FIGURE 2** illustrates the study areas of interest during the delineation project. **FIGURE 20** presents the approximate waste boundaries resulting from the combined waste delineation methods.

The finalized interchange project design entailed one crossing over the Sunray #1 Landfill (western cell) A dynamic deep compaction (DDC) technique combined with constructed stone columns was used within the area of the interchange ramp that crossed the landfill. The March 2012 Work Plan was prepared to indicate the methods that were to be used to replace the low permeability soil cover of the landfill after site preparation for the roadway construction. The Work Plan presented in **APPENDIX B,** and subsequent amendments to the plan, were followed for the cover replacement in the landfill crossing.

FIGURE 2 in **APPENDIX A** presents the as-built topographic map and layout of the Don Tyson Parkway Interchange landfill crossing project area. The Figure also shows the approximate delineated limits of the closed Sunray #1 landfill that lies south of the interchange and west of I-540 in the project area. The area which received compacted clay cover reconstruction was approximately 100 feet by 300 feet.

1.3 Project Description

This project involved the construction of approximately 0.7 acres of the clay barrier portion of the final cover system for this landfill. The following information summarizes the construction sequence associated with the construction of the Don Tyson Interchange.

- Site preparation including DDC, fill to subgrade, and grading of area;
- Installation and quality assurance testing of a 18-inch thick CCC, placed at a minimum of 90% of the Standard Proctor density with a maximum hydraulic conductivity of 1.0×10^{-7} cm/s;

The CQA Report is organized using tables, figures, and appendices to provide documentation of the observations and material testing during the construction of the final cover system for the Don Tyson Parkway Interchange.

As required by Reg.22.428(i) the CQA Report includes record drawings of the project area, and appendices and figures that identify the following:

The limits of liner or final cover barrier construction;
FIGURE 2 in **APPENDIX A** depicts the limits of the DDC area and constructed final cover system for the project.

Compaction and permeability testing locations;
Field logs, **FIGURE 3** in **APPENDIX A, APPENDIX F** and **APPENDIX G** provide compaction and permeability test locations and results for the final cover system.

In addition, the certifying professional shall make a statement that the cell was constructed in accordance with the permit drawings and narrative. The report should also include a list of any deviations from the permitted drawings, if they exist, and reasons for the deviations.
The compacted clay cover was constructed as close as possible and in accordance with the approved Work Plan except as indicated in **SECTION 5.0** below.

1.4 Key Personnel

Emory Sapp & Sons, Inc. was the general contractor who performed the earthwork for the installation of the final cover and the other improvements at the site. The key personnel for each participating firm in the project are listed below.

- **CQA Consultant:**
  Terracon Consultants, Inc.
  - Certifying Engineer: F. Owen Carpenter, P.E., P.G.
  - CQA Monitor: Stephen Billingsley

- **Soils Contractor:**
  Emory Sapp & Sons, Inc.
  - Construction Manager: David Tag, P.E.

- **Soil Testing Laboratory:**
  Terracon Consultants, Inc. (Cincinnati, OH)
  - Lab Manager: Tim Goodall

- **Survey Control:**
  Garver
  - Project Manager: Jeff Webb, P.E.

2.0 SUBGRADE PREPARATION

This section summarizes the preparation and establishment of the subgrade surface corresponding to the design for the project. The subgrade elevations conform to the approved construction drawings.

2.1 Project Specifications

The approved Work Plan for the landfill cover construction (see **APPENDIX B**) called for Dynamic Deep Compaction (DDC) as the landfill improvement method for the crossing over the former Sunray #1 sanitary landfill. The DDC incorporated aspects of a variant of DDC, termed Dynamic Replacement, by creating deep columns of compacted crushed stone ("stone columns") below the proposed ramp. A geo-grid reinforced aggregate pad was then constructed above the DDC treated area to act as a load transfer platform to distribute load to the stone columns and further reduce potential differential settlements. This provided a structurally sound platform for placement of the low permeability soil cover.

Following the DDC improvements and construction of the aggregate pad, the subgrade surface was graded, compacted, and tested to ensure that a suitable foundation for landfill cover and roadway materials was established. Quality control of the foundation (subgrade) elements was provided by the Terracon Tulsa, Oklahoma office under separate contract.

2.2 Construction Period

The subgrade preparation and fill for placement of the low permeability soil cover occurred during September and October of 2013.

3.0 FINAL COVER PREPARATION

This section summarizes the establishment of the compacted clay final cover barrier layer corresponding to the Sunray #1 Landfill crossing. The area was constructed as indicated in the Work Plan, for the establishment of the final cover system.

3.1 Project Specifications

The Work Plan specifications called for the final cover to be established to the lines and grades shown on the project construction plans and to consist of a minimum of 18 inches of low permeability soil compacted in lifts.

3.2 Construction Procedures

The preparation and construction for placement of the compacted clay barrier associated with the cover system occurred during September and October of 2013. The established elevations associated with the final cover system are provided in **FIGURE 2** in **APPENDIX A**.

4.0 LOW PERMEABILITY SOIL COVER SYSTEM INSTALLATION

The following section describes the construction of the compacted clay cover (CCC). The CCC corresponding to the project was constructed during October 2013 and was amended during March 2014 in accordance with **SECTION 5.0** below.

4.1 Project Specifications

The project construction plans indicated the CCC was to be constructed in three 6-inch thick compacted lifts to form a minimum 18-inch thick re-compacted clay barrier. Each clay lift was to be placed and compacted to a minimum 95% of the Standard Proctor maximum dry density at or above the optimum moisture content for the clay material. As required in the Work Plan and ADEQ Regulation 22, the hydraulic conductivity of the clay was not to exceed 1.0×10^{-7} cm/s.

4.2 Construction Procedures

Placement of the clay cover material was accomplished using excavators, 30 cubic yard haul trucks, dozers (including a dozer equipped with a sheepsfoot drum), a sheepsfoot compactor, a motor grader for proper lift thickness, and a water truck. The clay barrier was moisture conditioned during placement to achieve acceptable emplacement conditions. Dozers and the motor grader graded each lift, and compaction was achieved by utilizing a sheepsfoot compactor. Finish grading of the surface was accomplished by utilizing a total station survey and surveyor. The as-built drawing provided in **APPENDIX A** provides the final elevations associated with the top of the clay barrier for the final cover system.

4.3 Pre-Construction Testing of Clay Cover Material

Field and laboratory testing of the clay barrier system material was completed as specified in the ADEQ Regulation 22. Before placement, and during construction, soil samples were obtained from candidate clay stockpiles. **APPENDIX D** contains the results of the compacted clay cover pre-construction testing for the selected borrow source. **TABLE 1** summarizes the results of the pre-construction testing. It was noted during pre-construction testing of the selected clay (Cobblestone North Stockpile) that the moisture content requirement was a minimum of 2% wet of optimum moisture content at standard compactive effort. Acceptable permeability was confirmed in the lab for specimens compacted at least two percent wet of optimum at standard compactive effort (See **TABLE 1** below).

Table 1. Clay Cover Materials Pre-Construction Test Summary

Test Description	Moisture/Density Relationships ASTM D698	Atterberg Limits ASTM D4318	Particle Size Analysis ASTM D1140, D422	Soils Classification (USCS)	Permeability (cm/sec) D5084
Project Requirements	Minimum 95% Standard Proctor maximum dry density	P.I. greater than 10	> 30% passing No. 200 sieve < 20% retained No. 4 sieve No Particles >1-in diameter	SC, CL, or CH	$1.0X10^{-7}$
Sample Number			**Test Results**		
Cobblestone North Stockpile (10.21.13)	Max Dry Density: 110.2 pcf Optimum Moisture: 14.0%	L.L. 32 P.L. 16 P.I. 16	88.5% passing No. 200 Sieve 3.2% retained No. 4 sieve	CL	$8.1X10^{-7}$
Cobblestone North Stockpile (10.28.13 retest)	Max Dry Density: 110.2 pcf Optimum Moisture: 14.0%	L.L. 32 P.L. 16 P.I. 16	88.5% passing No. 200 Sieve 3.2% retained No. 4 sieve	CL	$8.8X10^{-8}$

4.4 Construction Testing of Compacted Clay Cover Material

During the construction of the compacted cover clay barrier, samples were obtained for laboratory testing to verify the consistency of the materials during construction. The results of the construction laboratory testing are included in **APPENDIX E**. **TABLE 2** summarizes the results obtained from laboratory testing of the CCC material. Based upon the results of the construction testing performed, all of the clay cover material complied with the project specifications. After placement and verification of the clay cover material, the clay cover in the roadway alignment was amended in accordance with **SECTION 5.0** below. Compaction characteristics of the lime treated soils discussed in **SECTION 5.0** are presented in **TABLE 2** below.

Table 2. Compacted Clay Cover Materials Construction Test Summary

Test Description	Moisture/Density Relationships ASTM D698	Atterberg Limits ASTM D4318	Particle Size Analysis ASTM D1140, D422	Soils Classification (USCS)	Permeability (cm/sec) D5084
Project Requirements	Minimum 95% Standard Proctor maximum dry density	P.I. greater than 10	> 30% passing No. 200 sieve <20% retained No. 4 sieve No Particles >1-in diameter	SC, CL, or CH	$1.0X10^{-7}$
Sample Number	**Test Results**				
Bulk #2 Cobblestone North Stockpile	Max Dry Density: 108.3 pcf Optimum Moisture: 16.3%	L.L 31 P.L.17 P.I. 14	59.3% passing No. 200 Sieve 17.2% retained No. 4 Sieve	CL	$1.2X10^{-8}$
Lime Treated Cobblestone North Stockpile	Max Dry Density: 105.5 pcf Optimum Moisture: 18.3%				

Field moisture and density tests were planned to be performed at a minimum rate of one test for every 10,000 square feet per compacted lift of newly emplaced cover system clay barrier soil. **FIGURE 3** illustrates the locations of the field moisture and density tests for each compacted lift of new clay cover. **APPENDIX F** includes the field logs for the moisture and density testing performed in association with the CCC construction. Based upon the results of the moisture and density tests performed by Terracon, the three lifts of compacted clay cover comply with the project specifications.

Shelby tube samples were obtained from each lift at a minimum rate of one test for every 40,000 square feet. **FIGURE 3** illustrates the permeability testing locations where the Shelby Tube samples were taken for each compacted lift of clay. The tubes were sealed and delivered to the laboratory for permeability testing using a flexible-wall permeameter (ASTM D-5084). As indicated in **TABLE 3**, permeability results for the completed compacted clay cover met the project requirements (less than 1×10^{-7} cm/s from Reg. 22.428). **APPENDIX G** contains the compacted clay cover permeability test results.

Table 3 Permeability Results Summary

Test No.	Lift No./ Layer	Test Results	
		K (cm/sec)	Pass/ Fail
P-1	1/CCC	$3.9X10^{-8}$	Pass
P-2	2/CCC	$3.0X10^{-8}$	Pass
P-3	3/CCC	$4.9X10^{-8}$	Pass
P-4	3/CCC	$3.5X10^{-8}$	Pass

NOTE: CCC = Compacted Clay Cover, K = Hydraulic Conductivity

5.0 CONSTRUCTION MODIFICATIONS

CCC clay soils were constructed with in-place moisture content wet of optimum moisture content as described in **SECTION 4.3**. Subsequent to emplacement and testing of the CCC clay soils, it was determined that the relatively moist soils exhibited unacceptable pumping conditions with respect to providing an adequate roadway structural subgrade. Therefore, the clay soils were amended with 6% lime dust by weight and re-compacted to a minimum density of 95% of the Standard Proctor maximum dry density at a moisture content of plus or minus two percent of optimum moisture content for the lime amended soils. **APPENDIX F** includes the field logs for the moisture and density testing performed on the lime amended clay barrier soils.

Correspondence related to the amended and replaced soils is presented in **APPENDIX B**. The lime amended soils are expected to exhibit slow permeabilities and act as an infiltration barrier as demonstrated by testing of the initial placement of the barrier soils as documented above. The amended soils in the roadway area were also to receive hard armoring in the form of asphalt paving which will increase the capacity of the roadway section to limit infiltration into the underlying landfill.

The pavement will exhibit enhanced run-off when compared to soils in the assignment of curve numbers for soils versus pavement in TR-55 software. Pavement is assigned a curve number of 98 corresponding to run-off in TR-55 software. The highest available curve number within the TR-55 run-off modeling software for a soil in Hydrologic Soil Group D (includes clay used for the CCC) is 94. Therefore it is expected that the hard armoring within the roadway will more efficiently limit infiltration into the landfill than the barrier soils.

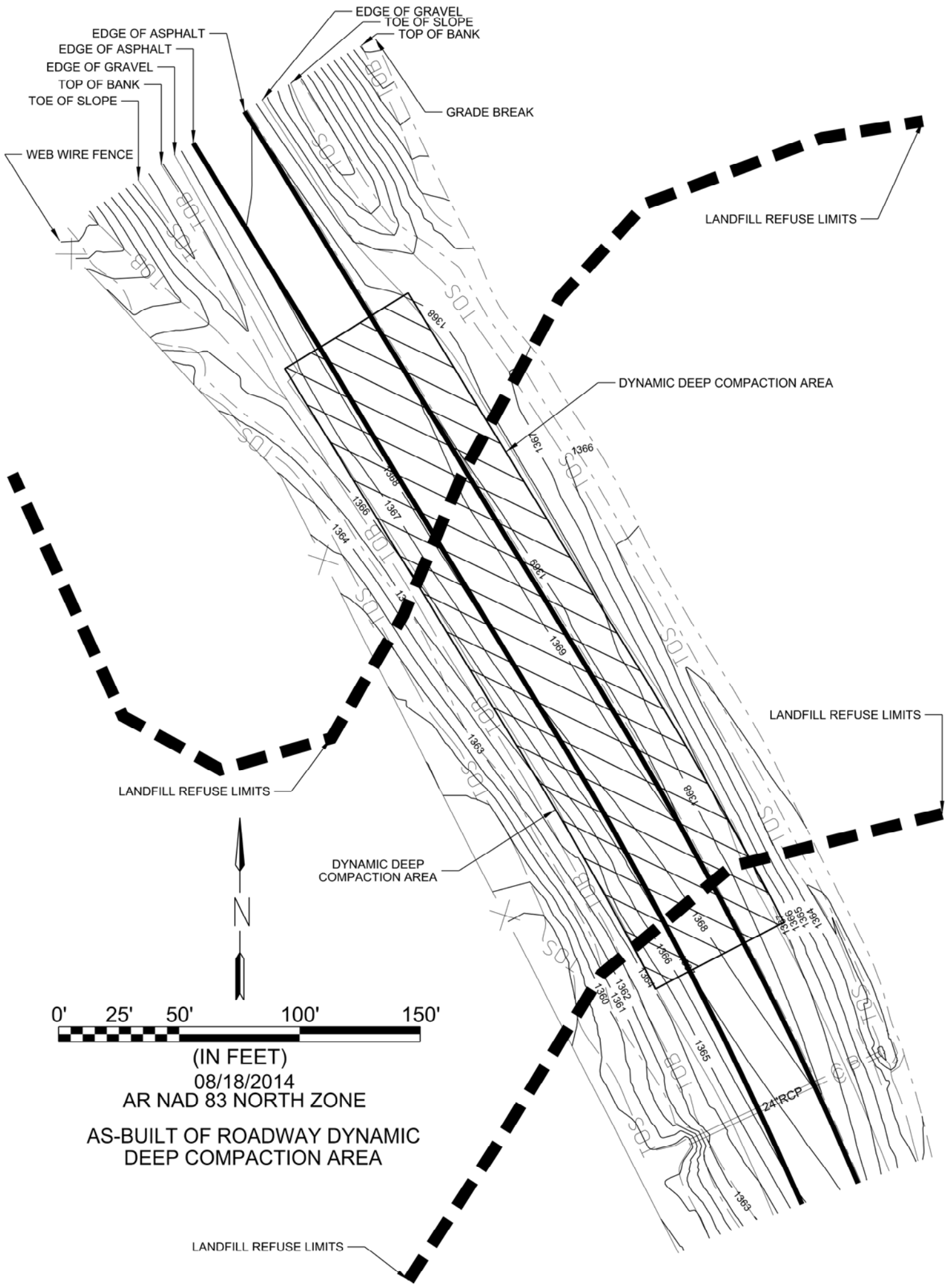
6.0 SUMMARY

Terracon was retained by Garver, LLC to provide construction quality control services during the construction of the compacted clay cover reconstruction for the Sunray Landfill. The lines, grades, thickness, and elevations of the CCC were documented and certified by Garver, LLC. Survey data is available upon request.

The quality control program conducted by Terracon included: pre-construction sampling of soils; observation, sampling, and testing of construction and materials. Laboratory testing of the materials was conducted by Terracon Consultants, Inc. in Cincinnati, OH.

The observations made by and the results of tests conducted by Terracon and the referenced laboratory indicate that the compacted clay barrier portion of the final cover in the affected areas of the Sunray Landfill was constructed in compliance with the documents referenced in this report except as documented in **SECTION 5.0**.

Appendix A
As-Built Drawings



08/18/2014
AR NAD 83 NORTH ZONE

AS-BUILT OF ROADWAY DYNAMIC
DEEP COMPACTION AREA

REV.	DATE	BY	DESCRIPTION

Terracon
Consulting Engineers and Scientists
11400 WEST BASELINE ROAD LITTLE ROCK, AR 72209
PH. (501) 455-2199 FAX. (501) 455-4547

AS-BUILT

DON TYSON PARKWAY

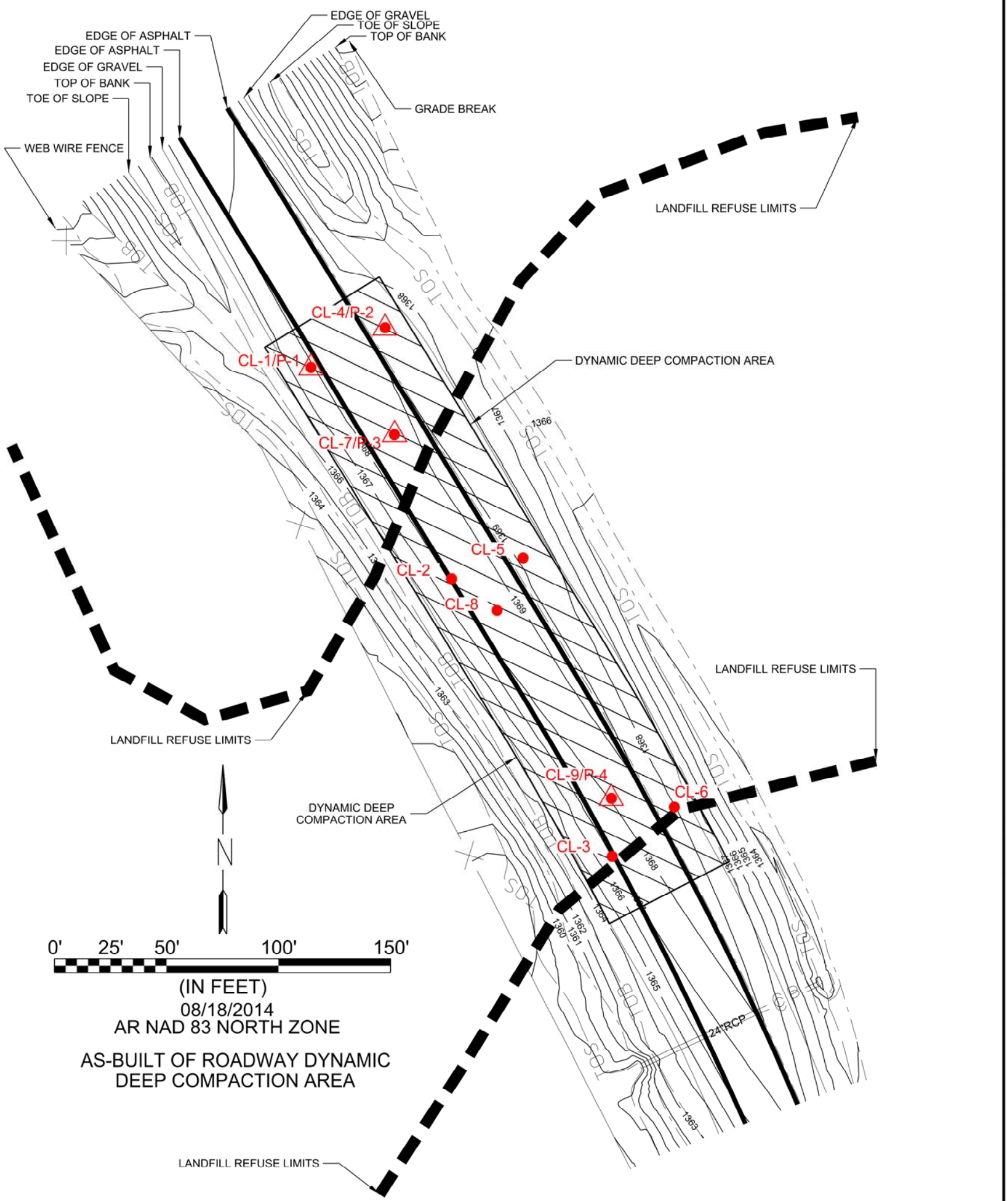
GARVER

HIGHWAY INTERCHANGE LANDFILL CROSSING

SPRINGDALE ARKANSAS

FIGURE 1

DESIGNED BY:	JSB
DRAWN BY:	JSB
APPVD. BY:	FOC
SCALE:	1"=50'
DATE:	09/15/2014
JOB NO.	544-001-35139161
ACAD NO.	001
SHEET NO.:	1 OF 2



AS-BUILT OF ROADWAY DYNAMIC DEEP COMPACTION AREA

LEGEND

CL-1 ● TEST LOCATION

P-1 △ PERMEABILITY SAMPLE LOCATION

REV.	DATE	BY	DESCRIPTION

Terracon
Consulting Engineers and Scientists
11400 WEST BASELINE ROAD LITTLE ROCK, AR 72209
PH. (501) 455-2199 FAX. (501) 455-4547

TEST LOCATION MAP

DON TYSON PARKWAY

GARVER

HIGHWAY INTERCHANGE LANDFILL CROSSING

SPRINGDALE ARKANSAS

FIGURE 2

DESIGNED BY:	JSB
DRAWN BY:	JSB
APPVD. BY:	FOC
SCALE:	1"=50'
DATE:	09/15/2014
JOB NO.	544-001-35139161
ACAD NO.	002
SHEET NO.:	2 OF 2

Appendix B
General Project Correspondence

Terracon
Consulting Engineers & Scientists

Terracon Consultants, Inc.
25809 I-30
Bryant, Arkansas 72022
Phone 501.847.9292
Fax 501.847.9210

July 2, 2009

Garver Engineers, LLC
1088 East Millsap Road
Fayetteville, Arkansas 72703

Attention: Ms. Natalie Becknell, P.E.

Re: Geophysical Report
Landfill Waste Delineation
Don Tyson Parkway Interchange
Springdale, Arkansas
Project No. 39085057

Dear Ms. Becknell,

We are submitting, herewith, the results of the subsurface exploration and forensic consulting services performed for the Don Tyson Parkway Interchange landfill delineation project in Springdale, Arkansas. The geophysical subsurface exploration was completed as outlined in Terracon Proposal No. P3908032, authorized on October 31, 2008.

We appreciate the opportunity to be of service to you on this project. If you have any questions, we would be pleased to discuss our findings and recommendations in greater detail with you.

Sincerely,

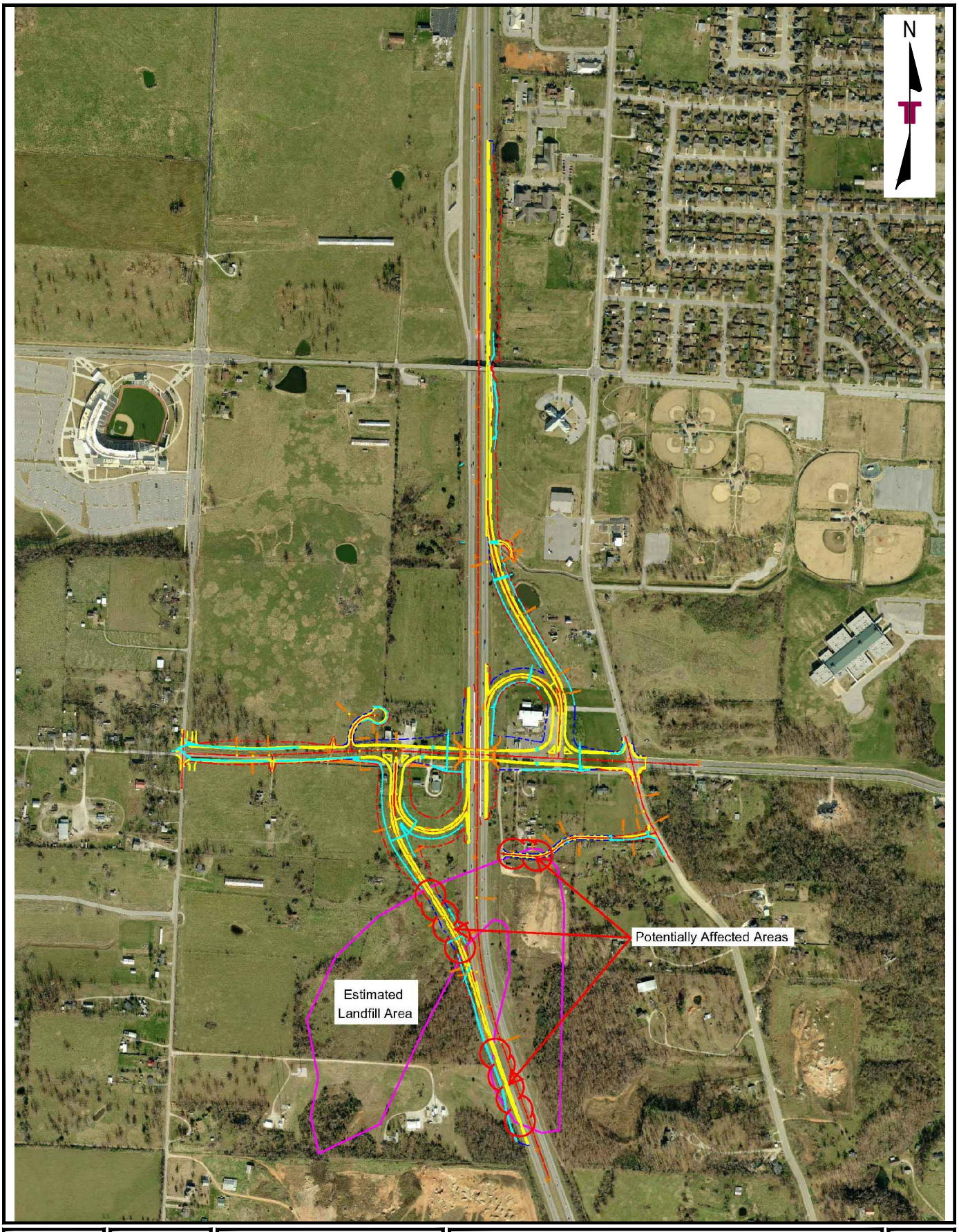
Terracon
Certificate of Authorization #223, Expires 12/31/09

ARKANSAS
★★★ 7/2/2009
REGISTERED
PROFESSIONAL
Shaun P. Baker, P.E.
Arkansas No. 11817
No. 11817
SHAUN P. BAKER

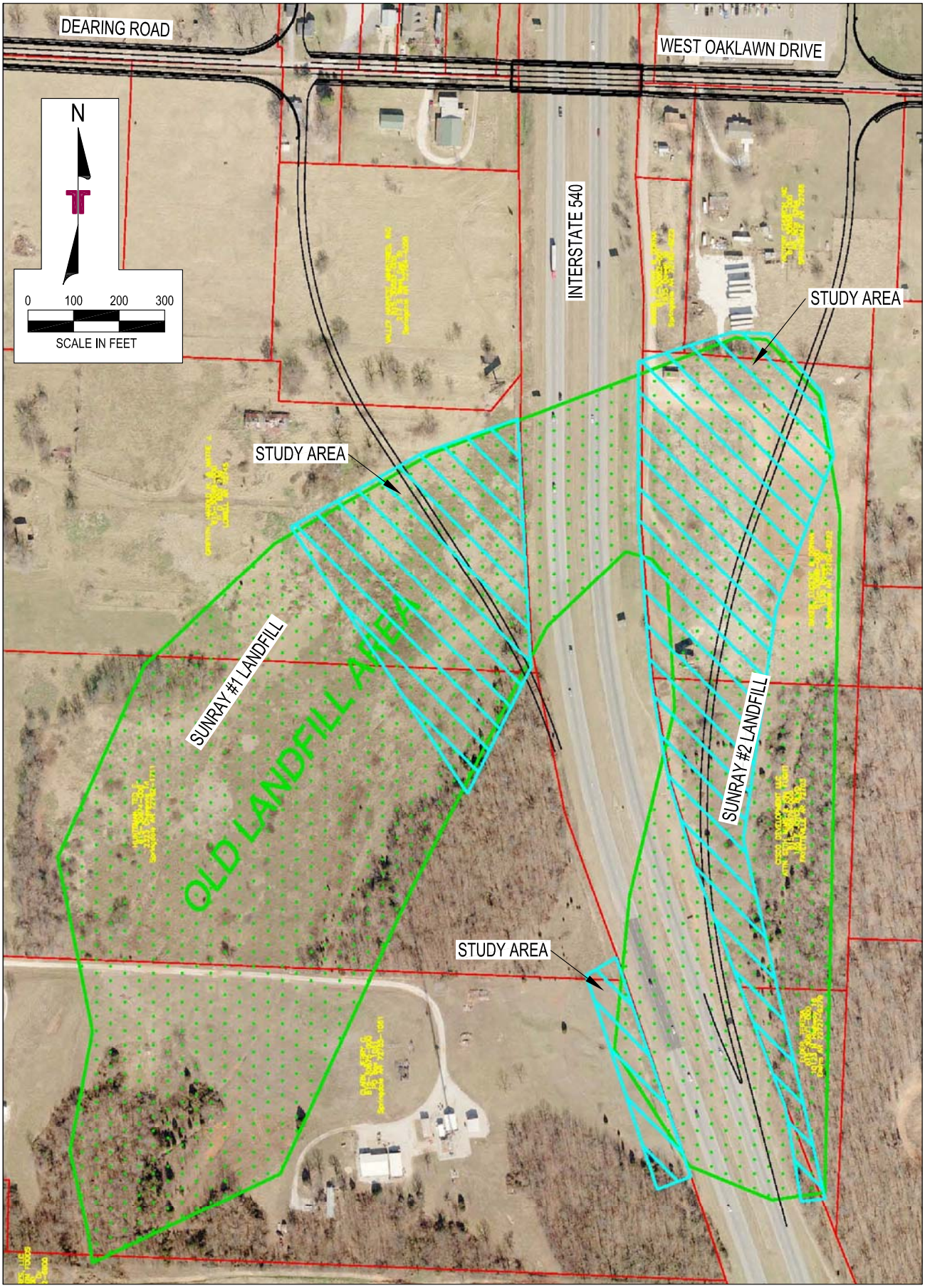
SPB:FOC:DWM
Enclosures

Daniel W. McCullough, P.G.
Arkansas No. 1802

Copies to: Addressee (3+e-mail)

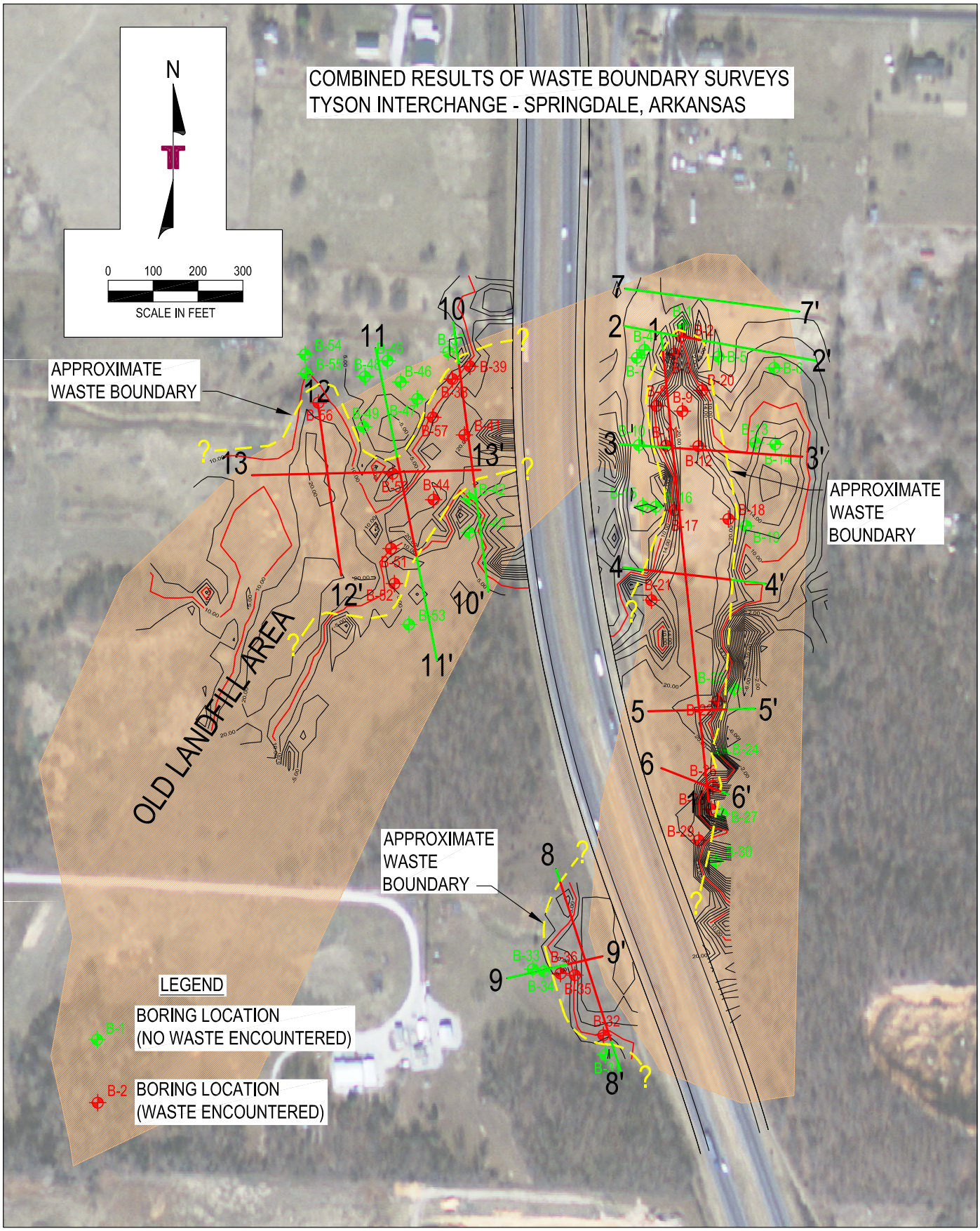


Project Mngr: DCM Drawn By: PTG Checked By: DCM Approved By: DCM	Project No. 167-024-39085057 Scale: N.T.S. File No. 024 Date: 3/27/2012	Terracon Consulting Engineers and Scientists 25809 I-30 SOUTH BRYANT, AR 72022 PH. (501) 847-9292 FAX. (501) 847-9210	GENERAL SITE LAYOUT GARVER ENGINEERS, LLC. TYSON PARKWAY INTERCHANGE SPRINGDALE ARKANSAS	FIG. No. 1



Project Mngr: SPB	Project No. 167-024-39085057	Terracon Consulting Engineers and Scientists	AREA OF INTEREST
Drawn By: JEG	Scale: AS SHOWN	25809 I-30 SOUTH BRYANT, AR 72022	LANDFILL WASTE DELINEATION
Checked By: TSW	File No. 005	PH. (501) 847-9292 FAX. (501) 847-9210	GARVER ENGINEERS, LLC.
Approved By: SPB	Date: 06/18/2009		TYSON PARKWAY INTERCHANGE
			SPRINGDALE ARKANSAS

FIG. No. 2



Project Mngr: SPB	Project No. 167-024-39085057	Terracon Consulting Engineers and Scientists	APPROXIMATE WASTE BOUNDARY
Drawn By: JEG	Scale: AS SHOWN	25809 I-30 SOUTH BRYANT, AR 72022	LANDFILL WASTE DELINEATION
Checked By: TSW	File No. 022	PH. (501) 847-9292 FAX. (501) 847-9210	GARVER ENGINEERS, LLC.
Approved By: SPB	Date: 06/18/2009		TYSON PARKWAY INTERCHANGE
			SPRINGDALE ARKANSAS

FIG. No. 20

WORK PLAN

Don Tyson Parkway Interchange
Springdale, Arkansas

March 29, 2012
Project No. 35117167

Prepared for:
Garver, LLC
1088 East Milsap Road
Fayetteville, Arkansas 72703

Prepared by:
Terracon Consultants, Inc.
Little Rock, Arkansas

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WORK PLAN

DON TYSON PARKWAY INTERCHANGE
SPRINGDALE, ARKANSAS

Project No. 35117167
March 29, 2012

INTRODUCTION

We understand that the project will include an extension of Don Tyson Parkway beginning at the intersection of Don Tyson Parkway and 48th Street, then extending to 56th Street. The extension of Don Tyson Parkway will include reconstruction (widening) and renaming of West Oaklawn Drive and Dearing Road and include a new interchange at Interstate 540. The proposed project will also include an extension of 56th Street from recent improvements at Arvest Ballpark to, and including, a new intersection at 56th Street and Don Tyson Parkway. The proposed project will provide a 4-lane or 5-lane facility on Don Tyson Parkway and 56th Street through the project limits, with medians, where feasible, and curb and gutter and sidewalks on both sides of the roadway. Storm drainage systems, new and relocated utility facilities, traffic signals, street lighting, and other incidental systems and facilities will be constructed as necessary. The project will be constructed both along existing roadways and in new locations. A portion of the project will be constructed above closed landfills as described below. Construction will be on right of way acquired by the City of Springdale, Arkansas and on Arkansas Highway and Transportation (AHTD) right of way.

PROJECT SITE HISTORY

Two landfills, Sunray #1 and Sunray #2, are located in areas of the proposed Tyson Parkway interchange ramps. Limited information was provided or could be obtained regarding the landfills. **Figure 1** shows the approximate extent of the landfill waste relative to Interstate 540. **Figure 1** shows the proposed Tyson Parkway Interchange project area with the approximate limits of the abandoned Sunray #1 and Sunray #2 landfills that lie south of the proposed interchanges, stretching across I-540 and under the proposed ramps.

Sunray #1 landfill was permitted to begin operations in December 1973. The closure date could not be determined. The Sunray #2 landfill was permitted to begin operations in February 1977 and continued through November 1978. A generally north-south oriented ravine was filled from north to south with municipal solid waste for both the Sunray # 1 and Sunray # 2 landfills. Industrial and/or hazardous wastes were not permitted for disposal in the landfills.

ROAD SUBGRADE IMPROVEMENT METHODS

It is estimated that an approximately 200 to 300 feet of the proposed Ramp 4 will be constructed over buried landfill waste. Based on borings drilled previously by Terracon, landfill waste was encountered at depths of about 2 to 5.5 feet below the existing ground surface. The waste extends to depths of about 6 to 23 feet. We also understand that up to 5 feet of embankment fill will be required to reach the final pavement grade within that section.

The proposed landfill improvement method for the crossing over the former Sunray #1 sanitary landfill is Dynamic Deep Compaction (DDC) incorporating aspects of a variant of DDC, sometimes termed Dynamic Replacement, with the intention of creating deep columns of compacted crushed stone ("stone columns") below the proposed ramp. A geo-grid reinforced aggregate pad is proposed to be constructed above the DDC treated area to act as a load transfer platform to distribute load to the stone columns and further reduce potential differential settlements. A conceptual cross section of the ramp, incorporating the proposed ground improvement measures, is provided by the attached **Figure 2**. The DDC method was used to treat a larger area of the Sunray #1 and #2 landfills during previous construction of U. S. Rte. 71/I-540 in the mid-1980s.

Dynamic deep compaction (DDC)

Dynamic compaction consists of using a heavy tamper that is repeatedly raised and dropped from varying heights to impact the ground. The mass of the tampers generally ranges from about 5 to 30 tons and drop heights range from about 40 to 100 feet. Lighter tampers and smaller drop heights result in depths of improvement on the order of about 10 to 15 feet and heavier tampers and greater drop heights result in improvements on the order of 20 to 30 feet.

The proposed roadway (travel lanes plus paved shoulders) is indicated to be 25 feet wide on a 60-foot wide embankment. Assuming that the primary concern is with the paved roadway, we have tentatively assumed a width to be treated that is effectively 48 to 60 feet wide or roughly twice the width of the roadway (see **Figures 2 & 3**).

Stone columns

Stone columns are vertical piers of compacted crushed stone that act to carry loads through zones of loose or compressible soil and/or waste. Construction of stone columns also typically results in densification of the loose or unsuitable soil. A form of "stone column" can be created in conjunction with dynamic compaction process by filling the craters resulting from dropping the weight with crushed stone after each drop. The stone columns will improve the transmission of energy to greater depths than would otherwise occur with conventional dynamic compaction. The stone columns will also form a strong skeleton in the landfill waste, and therefore reduce the potential for the long-term settlement due to further decay and decomposition of the landfill waste (See **Figure 2**).

Geogrid reinforced aggregate mat

Geogrid reinforced aggregate mats consist of alternate layers of geogrid and crushed aggregate base materials. Construction of a layer of geogrid reinforced aggregate mat is intended to distribute stress over a larger area and reduce differential settlement. Geogrid reinforced aggregate mats are used both for roadway construction across soft subgrades and as a load transfer platform used with an intermediate foundation system, such as Geopiers or stone columns.

The combination of dynamic compaction, stone columns and geogrid reinforced aggregate mats will reduce both short-term and long-term settlement. A more detailed description of the site preparation above the landfills are discussed below.

LANDFILL AREA PREPARATION

Site Preparation

The grading of the working surface for the DDC work will need to be coordinated with the ramp design so that the horizontal and vertical alignment can be accommodated. There is an existing final cover of 2 to 3 feet of clayey soil over the waste that is assumed to act as the landfill cap. As the DDC process will disrupt this "cap" and render it ineffective, this soil can be removed as necessary to establish the appropriate geometry for ramp construction. However, grading that exposes the waste below the existing cover should be avoided. If waste is exposed, it should be covered with the crushed stone working mat (see below) on the same day it is exposed, consistent with sanitary landfill operating practices. Also, any excess waste will be required to be removed and disposed in an approved Subtitle D landfill. The surrounding work area will be graded such that rain drains away from the work area. If there is a possibility of rain, the work area will be covered with at least 6-inches of temporary soil or a tarp in order to keep moisture out of the waste area. Any liquids encountered that have come in contact with the waste will be treated as leachate and disposed of at a permitted facility.

Once the desired preparation grades are achieved, the DDC work area should be covered with 18 to 24 inches of crushed stone as a working mat.

Crushed Stone

Most any "clean" (less than 5 percent fines) durable granular material (to include crushed concrete and masonry rubble) can be used in conjunction with the DDC process. It is expected that a crushed stone quarry product would be used as was used

in the original I-540 construction. The specification for the previous DDC work was crushed limestone or dolomite with a maximum stone size of 6 inches, no more than 15% passing 1.5-inch and no more than 5% passing ¾-inch. The same type of materials will be used or equivalent as deemed by the Project Engineer.

DDC Process

As described above, dynamic deep compaction (DDC) is a process whereby a heavy weight (called a "pounder" or "tamper") is repeatedly raised and dropped from a specified height to impact onto the ground surface, thereby transmitting high compaction energy into the soil mass. The depth of the improvement depends upon the amount of energy and the height of the fall. The degree of the improvement depends upon the amount of energy applied per unit area which also takes into consideration the number of passes over the work area and the number of times the weight is dropped at each location. For the dynamic replacement variant of DDC, the crater resulting from the pounder impact is backfilled with granular material after each drop, with the intention of driving the backfill into the ground to displace the loose or unsuitable material and create a vertical column of compacted granular material. The displacement of existing soil from the column results in densification of the surrounding soil. The preliminary drop point pattern and sequence of treatment is shown in **Figure 3**.

The DDC/dynamic replacement work sequence is envisioned as follows:

1. Clear, grub, strip and grade to desired preparation grading. Place working mat of 18 to 24 inches of crushed stone.

2. Layout drop points for primary pass.

3. Start on ramp centerline at center of area to be treated. Drop pounder to create crater. After each drop, backfill crater with crushed stone. Continue until the incremental ground surface displacement totals less than six inches after two consecutive drops. Eight to twelve drops per location are expected in areas underlain by waste. Maintain records of ground displacement (crater depths) after each drop and the volume of crushed stone added as backfill.

4. Repeat the foregoing drop/backfill process at each primary drop point in the sequence indicated on Exhibit A-2.

5. Regrade the work area surface after completion of the primary pass. Layout secondary pass drop locations.

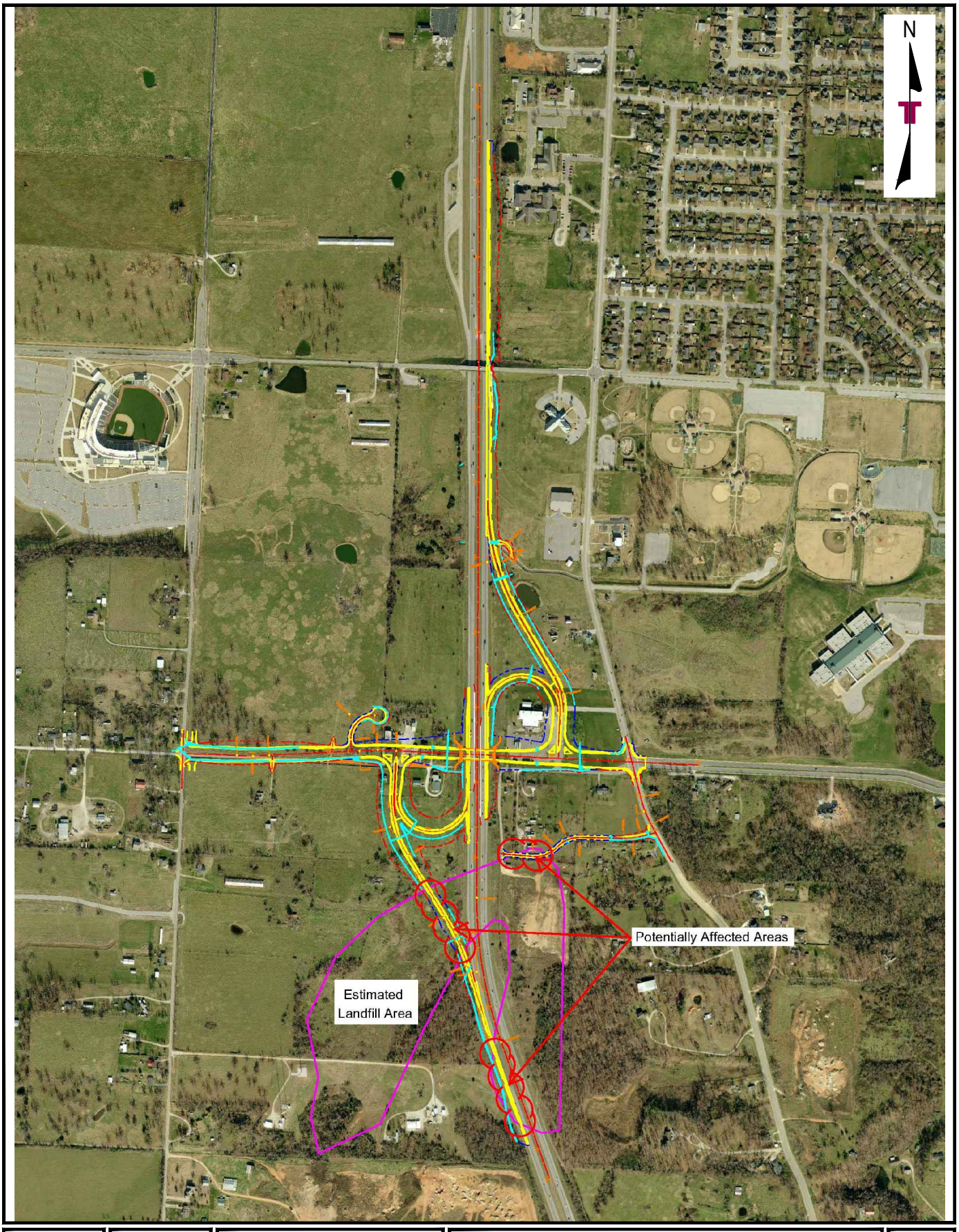
6. Perform drop/backfill procedure at each secondary drop location in sequence. The number drops per location is expected to be less than for the primary pass.

7. Perform “ironing pass”, incrementally compacting entire work area surface.

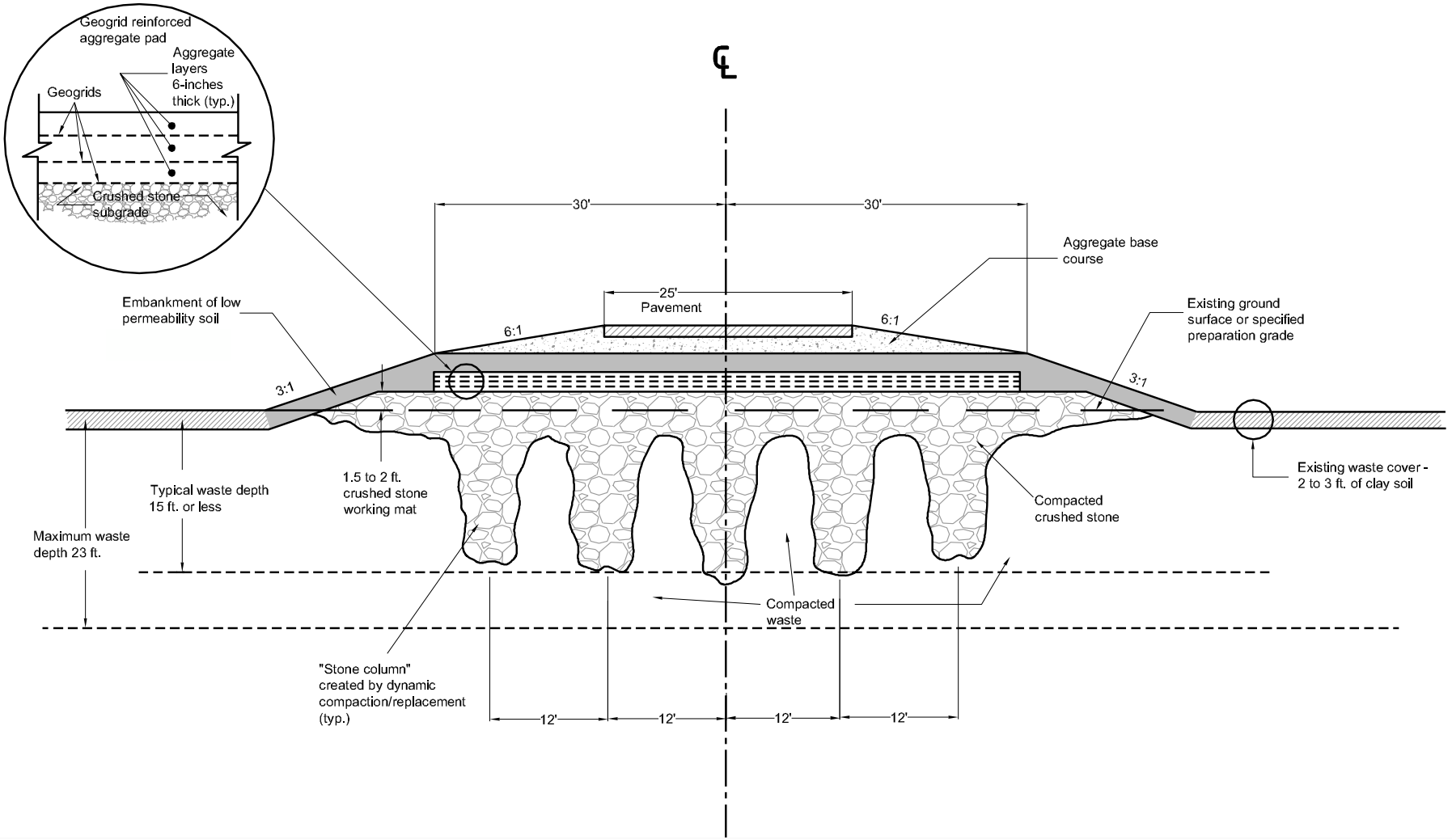
8. After “ironing pass”, grade work area surface smooth and proof compact with at least six passes of a large self-propelled vibratory drum roller with a dynamic force of at least 8,000 pounds per foot of drum width. Perform elevation survey of surface after proof compaction.

Embankment Construction

Once the DDC process is completed, construction of the embankment and roadway will proceed normally. The geo-grid reinforce aggregate mat would act as a load transfer platform to span between drop point locations and to “smooth out” potential differential settlement. The geo-grid reinforced aggregate mat concept is illustrated on **Figure 2**. Detailed design of the geo-grid reinforced aggregate mat would depend on the geometry of the embankment and expected loading. Typically it would consist of one to three layers of bi-axial or tri-axial geo-grid with each geo-grid covered by about 6 inches of compacted 3”(-) compacted aggregate. In consideration of the expected disruption of the existing landfill cover by the DDC process, **Figure 2** indicates that “embankment” material used above the landfill will consist of low permeability soil (1×10^{-7} cm/sec or slower). The replacement soil liner will consist of at least 18 inches of material that meets Regulation 22 requirements for materials and testing (**See Arkansas Department of Environmental Quality (ADEQ) Regulations, Reg.22.428 – Liner and Final Cover Design and Construction**). The 18 inches of replacement soil liner will transition into the current soil cover with a 3 H: 1V tie-in. A CQA report detailing the installation of the soil liner will be submitted to the ADEQ for review.



Project Mngr: DCM Drawn By: PTG Checked By: DCM Approved By: DCM	Project No. 167-024-39085057 Scale: N.T.S. File No. 024 Date: 3/27/2012	Terracon Consulting Engineers and Scientists 25809 I-30 SOUTH BRYANT, AR 72022 PH. (501) 847-9292 FAX. (501) 847-9210	GENERAL SITE LAYOUT GARVER ENGINEERS, LLC. TYSON PARKWAY INTERCHANGE SPRINGDALE ARKANSAS	FIG. No. 1



8 0 8 16

APPROXIMATE SCALE IN FEET

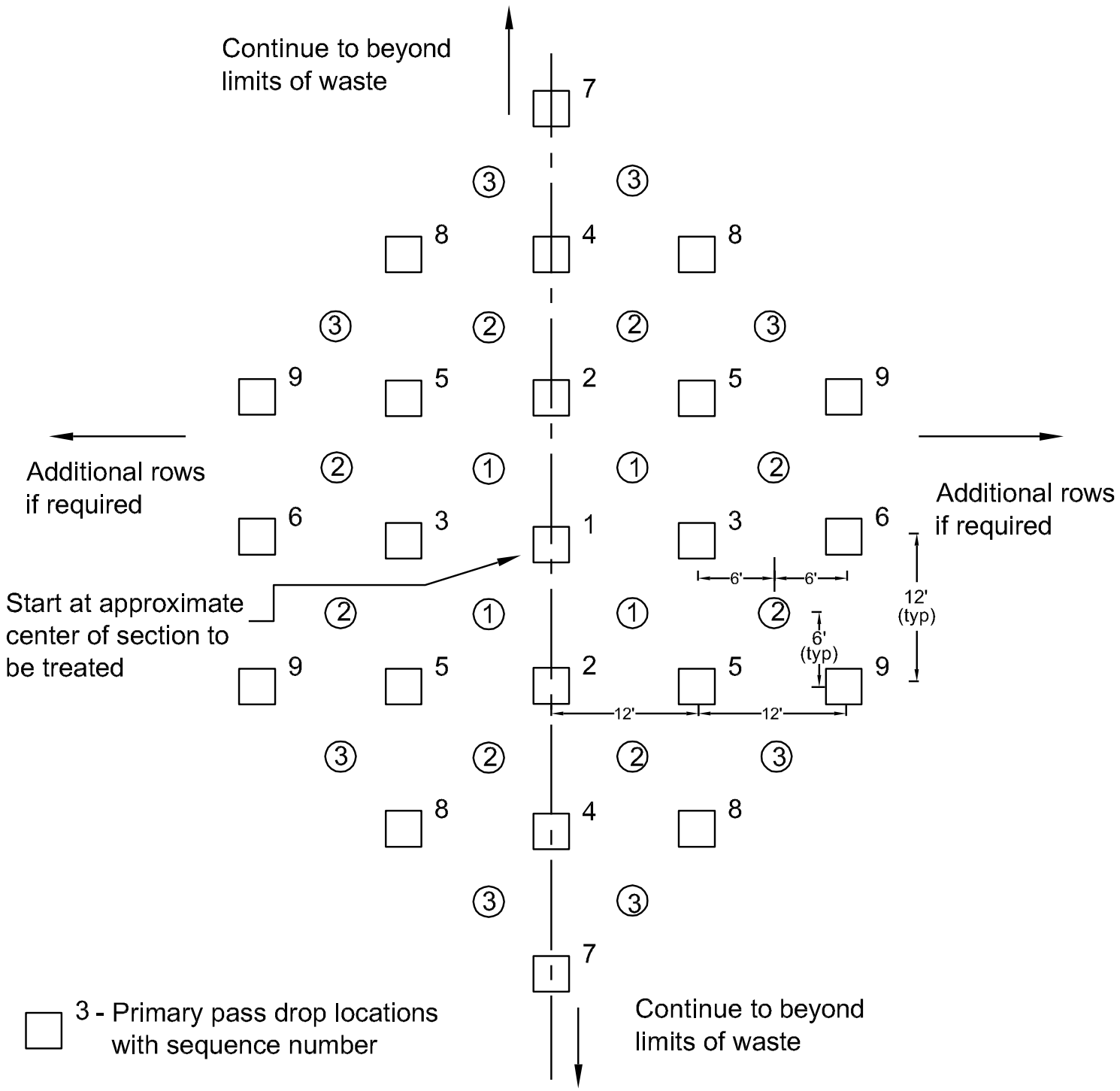
Project Mngr:	RMD
Drawn By:	MCR
Checked By:	RMD
Approved By:	RWM
Project No.	04115042
Scale:	1" = 16'
File No.	04115042.dwg
Date:	February 2012

Terracon
10930 E. 56th St. Tulsa OK 74146
PH. 918-250-0461 FAX 918-250-4570

CONCEPTUAL RAMP CROSS-SECTION AT OLD LANDFILL CROSSING

TYSON PARKWAY INTERCHANGE
SPRINGDALE, ARKANSAS

FIG. No.
2



Project Mngr: RMD	Project No. 04115042	Terracon	DDC DROP PATTERN AND SEQUENCE
Drawn By: MCR	Scale: 1" = 12'		TYSON PARKWAY INTERCHANGE SPRINGDALE, ARKANSAS
Checked By: RMD	File No. 04115042.dwg		FIG. No. 3
Approved By:	Date: February 2012	10930 E. 56th St. Tulsa OK 74146 PH. 918-250-0461 FAX 918-250-4570	

Memo

TO: **Justin Cox, P.E., Mike Homan, P.E. (Terracon Tulsa Office)**

FROM: **F. Owen Carpenter, P.E., P.G.**

CC: **Billy Butler, P.E.**

DATE: **Friday, January 17, 2014**

RE: **Don Tyson Parkway Interchange, Springdale, AR**
Clay Cover Soil

Approved Cover Soil Specifications Per ADEQ Regulation 22.428

The approved Workplan dated March 29, 2012, submitted to the Arkansas Department of Environmental Quality (ADEQ), required that the replacement soil cover will consist of 18 inches of material that meets Regulation 22 requirements for materials and testing (Reg.22.428 – Liner and Final Cover Design and Construction). Criteria are:

- Material passing #200 sieve – Greater than 30%
- USCS Classification – CL, CH or SC with PI greater than 10
- Material greater than #4 sieve less than 20% with no particles greater than 1.0 inch diameter
- Hydraulic conductivity of 1 X 10^{-7} cm/sec or less and at a minimum of 90% Standard Proctor maximum dry density at a moisture content above optimum as determined by ASTM D698

Cover Soil Characterization for Soils used in Cover Construction October 2013

Potential low permeability cover soils provided by David Tag of Emery Sapp & Sons, Inc. (David.Tag@Emerysapp.com) were tested and material characterized as Cobblewood – North Stockpile was used for clay cover construction. During pre-construction laboratory hydraulic conductivity testing at a specified compaction (ASTM D5084), required by Reg 22.428(c)(6)(v), it was concluded that specimens compacted at optimum moisture content did not exhibit acceptable hydraulic conductivity results (8.1 X 10^{-7} cm/sec). Subsequent testing indicated that specimens compacted at a minimum of 2% wet of optimum moisture content at standard compactive effort would yield acceptable permeability results (less than or equal to 1 X 10^{-7} cm/sec). Therefore the field specification based on pre-construction testing was to emplace the cover soils using standard compactive effort at a minimum of 2% wet of optimum moisture content and a maximum range of 2% to 6% wet of optimum. Resulting verification hydraulic conductivity values were acceptable and ranged from 3.0 X 10^{-8} to 4.9 X 10^{-8} cm/sec.

Carpenter, Owen

From: Carpenter, Owen
Sent: Tuesday, March 25, 2014 12:21 PM
To: DJWebb@GarverUSA.com
Cc: rspetrie@garverusa.com; Cox, Justin D; Butler, William P.; Leamons, Bryan (LEAMONS@adeq.state.ar.us)
Subject: Don Tyson Parkway Interchange - Proctor for 6% lime stabilized clay sample
Attachments: Std Proctor 6 percent lime.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Good morning Jeff,

Please pardon the delay in getting this confirmatory email to you following our discussion this morning.

First of all, I spoke with Bryan Leamons in the Solid Waste Management Division of the ADEQ. I am copying him on this email. In light of the fact that the clay soils exhibited too much deflection even when emplaced in a relatively dry state, the contractor plans to amend the soils within the roadway section with 6% lime dust by weight and to re-compact them to a specified Proctor moisture and density. We intend to test the soils for their in-situ properties after emplacement and document the deviation within our CQA report required by the ADEQ Work Plan. A statement regarding the hydraulic efficiency of the pavement in this application in removing stormwater from the area will be added to the CQA report.

The laboratory Proctor test results are attached to this email. This is for the roadway area clay cap materials with six percent lime added by weight.

Field moisture density testing will be performed by our Tulsa office. If at all possible, please notify the Tulsa office dispatch number (918) 250-6051 at least 24 hours in advance of needed testing. If you fail to reach the dispatcher, please contact Mr. Justin Cox at (918) 948-9871.

If you have any questions or desire any additional information, please contact me at your earliest convenience. Thank you for your assistance with these matters.

Sincerely,
Owen

F. Owen Carpenter, P.E., P.G.
Engineering Manager I Solid Waste Services
Terracon Consultants, Inc.
25809 I-30 South I Bryant, Arkansas 72022
P (501) 847 9292 I F (501) 847 9210
D (501) 943 1020 I C (501) 622 0887
focarpenter@terracon.com I www.terracon.com

LABORATORY COMPACTION CHARACTERISTICS OF SOIL REPORT

Report Number: 35139161.0001
Service Date: 03/24/14
Report Date: 03/24/14

Terracon
25809 I-30 South
Bryant, AR 72022
501-847-9292

Client

Garver
Attn: Ron Petrie
2049 E. Joyce Blvd. Ste 400
Fayetteville, AR 72703-5394

Project

Tyson Parkway Extension
Don Tyson Parkway and Interstate 540
Springdale, AR

Project Number 35139161

Material Information

Source of Material: On-site Fill
Proposed Use: Fill

Sample Information

Sample Date: 03/21/14
Sampled By: Gramling, Paul
Sample Location: On-site

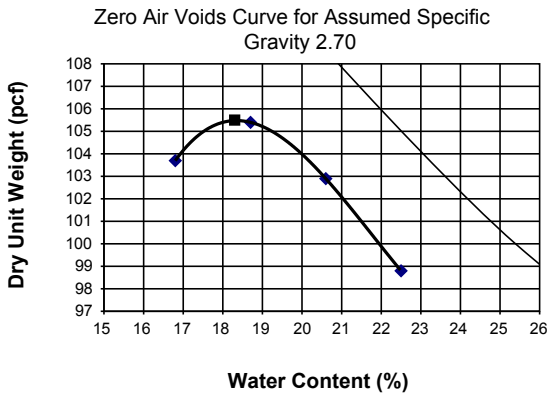
Sample Description: PENDING PROCTOR

Laboratory Test Data

Test Procedure: ASTM D698
Test Method: Method B
Sample Preparation: Wet
Rammer Type: Manual
Maximum Dry Unit Weight (pcf): 105.5
Optimum Water Content (%): 18.3

	Result	Specifications
Liquid Limit:		
Plastic Limit:		
Plasticity Index:		
In-Place Moisture (%):		

USCS:



Comments:

Services:

Terracon Rep.:
Reported To:
Contractor:
Report Distribution:
(1) Garver, Ron Petrie

Reviewed By: _____

William Butler
Senior Staff Engineer

Test Methods: AASHTO T99

Appendix C
Daily Project Field Records

Daily Project Construction Summary

Terracon
25809 Interstate 30 South
Bryant, AR 72022
(501) 847-9292

Project No: 35139161
Date of Report: 9.11.2013
Client Name: Garver Engineers
Contractor: ESS
Project Name: Don Tyson Parkway
Location: Springdale, Arkansas
Representative: Billy Butler, P.E.
Technician: Billingsley
Test Location:

WEATHER:

[X]	Clear	[ ]	Cold
[ ]	Cloudy	[ ]	Cool
[ ]	Partly Cloudy	[ ]	Warm
[ ]	Raining	[X]	Hot
[ ]	Windy	66	Low Temp. (°F)
[ ]	Foggy / Misty	89	High Temp. (°F)

REPORTING TIMES:

Depart Lab:	7:30 AM	Depart Site:	12:00 PM
Arrive Site:	11:45 PM	Arrive Lab:	

FIELD TESTING PERFORMED:

[ ]	Moisture/Density	[ ]	Subgrade
[ ]	Shelby Tube(s)	[ ]	Clay Liner

EQUIPMENT ONSITE:

1	Dozer(s)		Tractor & Pans
	Excavator(s)		Tractor & Disk
	Backhoe(s)		Water Truck
	Haul Truck(s)		Sheeps Foot Compactor
	Motor Grader(s)		Smooth Drum Compactor

PERSONNEL ONSITE:

	Client		Liner Crew
2	Contractor		Liner Installer
1	CQA Consultant		Concrete Crew
	Design Engineer		Pipe Installer
	Surveyor		Gas Line Inst.

SUMMARY OF ACTIVITIES OBSERVED:

Observed ESS working at site. Spoke with Rick Smith(ESS) about proposed material for clay liner. He escorted me to an area that they were excavating and stated that they would be taking material whenever they find it.

Obtained pre-construction sample PCS-1. Material is taken back to the Little Rock office where it is shipped to H.C. Nutting for laboratory testing.

Note: Copies of all completed "Project Field Record Forms" are to be submitted to the Project Manager at the end of each day and should be maintained with the Project Records.

Daily Project Construction Summary

Terracon
25809 Interstate 30 South
Bryant, AR 72022
(501) 847-9292

Project No: 35139161
Date of Report: 10.23.2013
Client Name: Garver Engineers
Contractor: ESS
Project Name: Don Tyson Parkway
Location: Springdale, Arkansas
Representative: Billy Butler, P.E.
Technician: Billingsley
Test Location: Final Cover

WEATHER:

[X]	Clear	[ ]	Cold
[ ]	Cloudy	[X]	Cool
[ ]	Partly Cloudy	[ ]	Warm
[ ]	Raining	[ ]	Hot
[ ]	Windy	41	Low Temp. (°F)
[ ]	Foggy / Misty	63	High Temp. (°F)

REPORTING TIMES:

Depart Lab:	6:30 AM	Depart Site:	5:30 PM
Arrive Site:	7:00 AM	Arrive Lab:	6:00 PM

FIELD TESTING PERFORMED:

[X]	Moisture/Density	[ ]	Subgrade
[ ]	Shelby Tube(s)	[X]	Clay Liner

EQUIPMENT ONSITE:

2	Dozer(s)		Tractor & Pans
	Excavator(s)		Tractor & Disk
	Backhoe(s)	1	Road Grader
	Haul Truck(s)	2	Sheeps Foot Compactor
	Motor Grader(s)		Smooth Drum Compactor

PERSONNEL ONSITE:

	Client		Liner Crew
3	Contractor		Liner Installer
1	CQA Consultant		Concrete Crew
	Design Engineer		Pipe Installer
	Surveyor		Gas Line Inst.

SUMMARY OF ACTIVITIES OBSERVED:

Observed ESS working on the final cover for the on ramp area to the southwest of the Don Tyson/I540 overpass. Material is being hauled in from an offsite borrow source, end dumped and spread with a dozer equiped with a sheeps-foot drum and a pad foot roller also rolls material for compaction. A road grader grades lifts to proper thickness.

Performed nuclear density tests on the first lift of clay liner material.
Obtatined hydraulic conductivity sample P-1.

Observed ESS placing the second lift of clay liner material.
Performed nuclear density tests on second lift of clay liner material.
Obtained hydraulic conductivity sample P-2.

Observed ESS placing material for third lift of clay liner material.
Performed nuclear density tests on the third lift of clay liner material.
Obtained hydraulic conductiviy samples P-3 and P-4.
Obtained construction sample CS-1 for suite of laboratory testing.

Note: Copies of all completed "Project Field Record Forms" are to be submitted to the Project Manager at the end of each day and should be maintained with the Project Records.

FIELD DENSITY TEST REPORT

Report Number: 04131111.0005
Service Date: 03/26/14
Report Date: 03/28/14
Task:

Terracon
9522 E. 47th Pl. Unit D
Tulsa, OK 74145
918-250-0461

Client

Garver
Attn: Ron Petrie
2049 E. Joyce Blvd. Ste 400
Fayetteville, AR 72703-5394

Project

Tyson Parkway Extension
I-540 & Don Tyson Parkway
Springdale, AR

Project Number: 04131111

Material Information

Mat. No.	Proctor Ref. No.	Classification and Description	Laboratory Test Method	Lab Test Data: Optimum Water Content (%)	Lab Test Data: Max. Lab Density (pcf)	Project Requirements: Water Content (%)	Project Requirements: Compaction (%)
1	04129999.0001	Lime treated light brown fat clay		18.3	105.5	16.3 - 20.3	Min 95

Field Test Data

Test No.	Test Location	Lift / Elev.	Mat. No.	Probe Depth (in)	Wet Density (pcf)	Water Content (pcf)	Water Content (%)	Dry Density (pcf)	Percent Compaction (%)
	Ramp #4								
1	188+25	-12"	1	6	125.2	18.1	16.9	107.1	102
2	187+25	-12"	1	6	124.8	18.1	17.0	106.7	101
3	187+50	-6"	1	6	123.8	18.2	17.2	105.6	100
4	188+75	-6"	1	6	125.2	18.3	17.1	106.9	101

Datum: **Serial No:**

Comments: **Test and/or retest results on this report meet project requirements as noted above.**

Services:
Terracon Rep.: Joseph K. Rock
Reported To: Justin Smith with Emery Sapp
Contractor:
Report Distribution:
(1) Garver

Start/Stop: 0000-0700

Reviewed By: Justin Cox
Staff Materials Engineer

Test Methods: *, ASTM D6938

FIELD DENSITY TEST REPORT

Report Number: 04131111.0007
Service Date: 03/27/14
Report Date: 03/28/14
Task:

Terracon
9522 E. 47th Pl. Unit D
Tulsa, OK 74145
918-250-0461

Client

Garver
Attn: Ron Petrie
2049 E. Joyce Blvd. Ste 400
Fayetteville, AR 72703-5394

Project

Tyson Parkway Extension
I-540 & Don Tyson Parkway
Springdale, AR

Project Number: 04131111

Material Information

Mat. No.	Proctor Ref. No.	Classification and Description	Laboratory Test Method	Lab Test Data: Optimum Water Content (%)	Lab Test Data: Max. Lab Density (pcf)	Project Requirements: Water Content (%)	Project Requirements: Compaction (%)
1	04131111.0001	Subgrade	AASHTO T180	18.3	105.5	16.3 - 20.3	Min 95
2	04129999.0001	Lime treated light brown fat clay		18.3	105.5	16.3 - 20.3	Min 95

Field Test Data

Test No.	Test Location	Lift / Elev.	Mat. No.	Probe Depth (in)	Wet Density (pcf)	Water Content (pcf)	Water Content (%)	Dry Density (pcf)	Percent Compaction (%)
	Ramp #4								
1	Station 188+20	SG	2	6	120.6	19.8	19.6	100.8	96
2	Station 187+00	SG	2	6	125.2	19.8	18.8	105.4	100
3	Station 186+10	SG	2	6	121.1	18.4	17.9	102.7	97

Datum: **Serial No:**

Comments: **Test and/or retest results on this report meet project requirements as noted above.**

Services:
Terracon Rep.: Anthony Reinking
Reported To: Justin Smith with Emery Sapp
Contractor:
Report Distribution:
(1) Garver

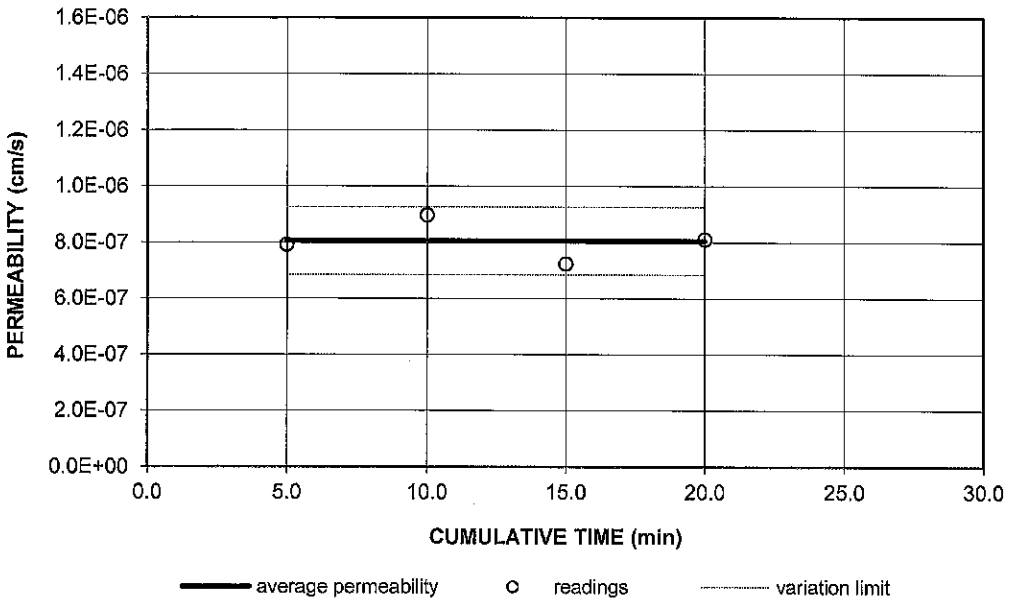
Reviewed By:
Justin Cox
Staff Materials Engineer

Test Methods: *, ASTM D6938

Appendix D

Compacted Clay Cover Pre-Construction Test Results

FLEXIBLE WALL PERMEABILITY TEST



Test Specification: ASTM D 5084 Method F

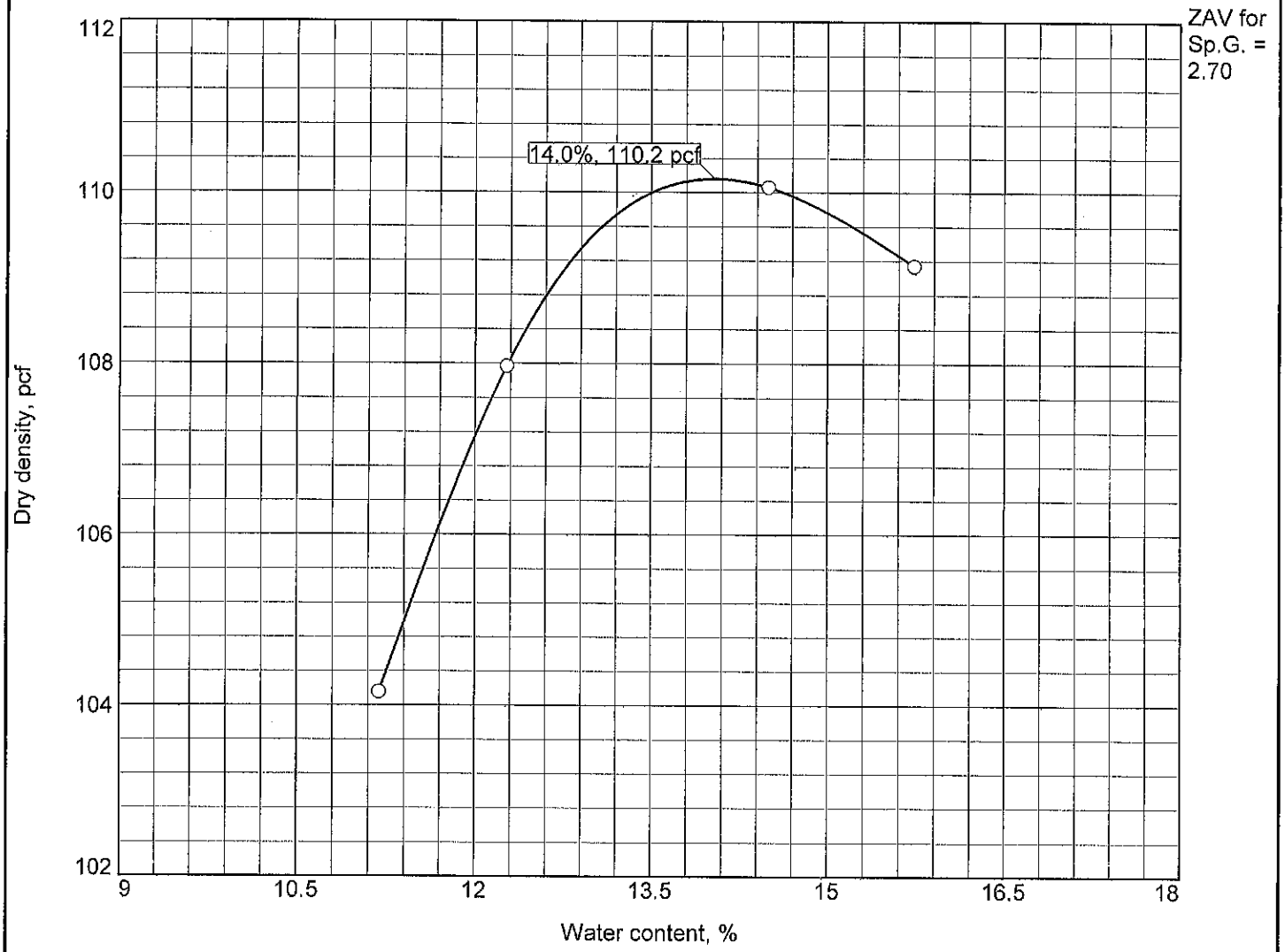
Fluid Temp. (°C)	Elapsed Time (min.)	Cumulative Time (min.)	Gradient (cm-Hg)	Calculated Permeability (cm/sec)	Average Permeability (cm/sec)
21.00	5.00	5.00	5.00	7.92E-07	
21.00	5.00	10.00	1.48	8.97E-07	
21.00	5.00	15.00	0.56	7.23E-07	**8.1E-07**
21.00	5.00	20.00	0.19	8.10E-07	

Compaction Data		Sample Data	Initial	Final
Proctor (pcf)	110.1	Specimen Height, (inches)	3.00	3.00
Opti. M.C., (%)	14.0	Specimen Diameter, (inches)	4.00	4.00
Comp. Method		Specimen Volume, (cu. In.)	37.68	37.68
% Recompct.	95.0	Moisture Content, (%)	14.15	22.82
Test Pressures (psi)		Percent Saturation (%)	62.32	100.00
Backpressure	90.00	Wet Mass Density (pcf)	119.24	128.30
Cell pressure	95.00	Dry Mass Density (pcf)	104.46	104.46
Eff. Stress	**5.00**	Void Ratio	0.61	0.62
Specific Gravity	2.70	Calculated Porosity, %	38.00	38.12

USCS	SG Assumed	LL	PI
Permeant Used:	WATER	Remarks	BROWN LEAN CLAY

Project Name	Tyson Parkway Extension			Tested by FCE	Reviewed by TGG
Client	Garver	W.O.#	35139161		
Sample Number	North Stockpile			FLEXIBLE WALL PERMEABILITY TEST	
Sample Location	Cobblewood		0-5'	Terracon	
Date	10/21/2013	Lab No.	6456		

COMPACTION TEST REPORT



Test specification: ASTM D 698-07 Method B Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
	CL	A-6(13)	18.8	2.70	32	16	1.3	88.5

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 110.2 pcf Optimum moisture = 14.0 %	BROWN LEAN CLAY

Project No. 35139161 **Client:** GARVER
Project: TYSON PARKWAY EXTENSION

○ **Source of Sample:** 6456

Remarks:
SOURCE: COBBLESTONE - NORTH STOCKPILE

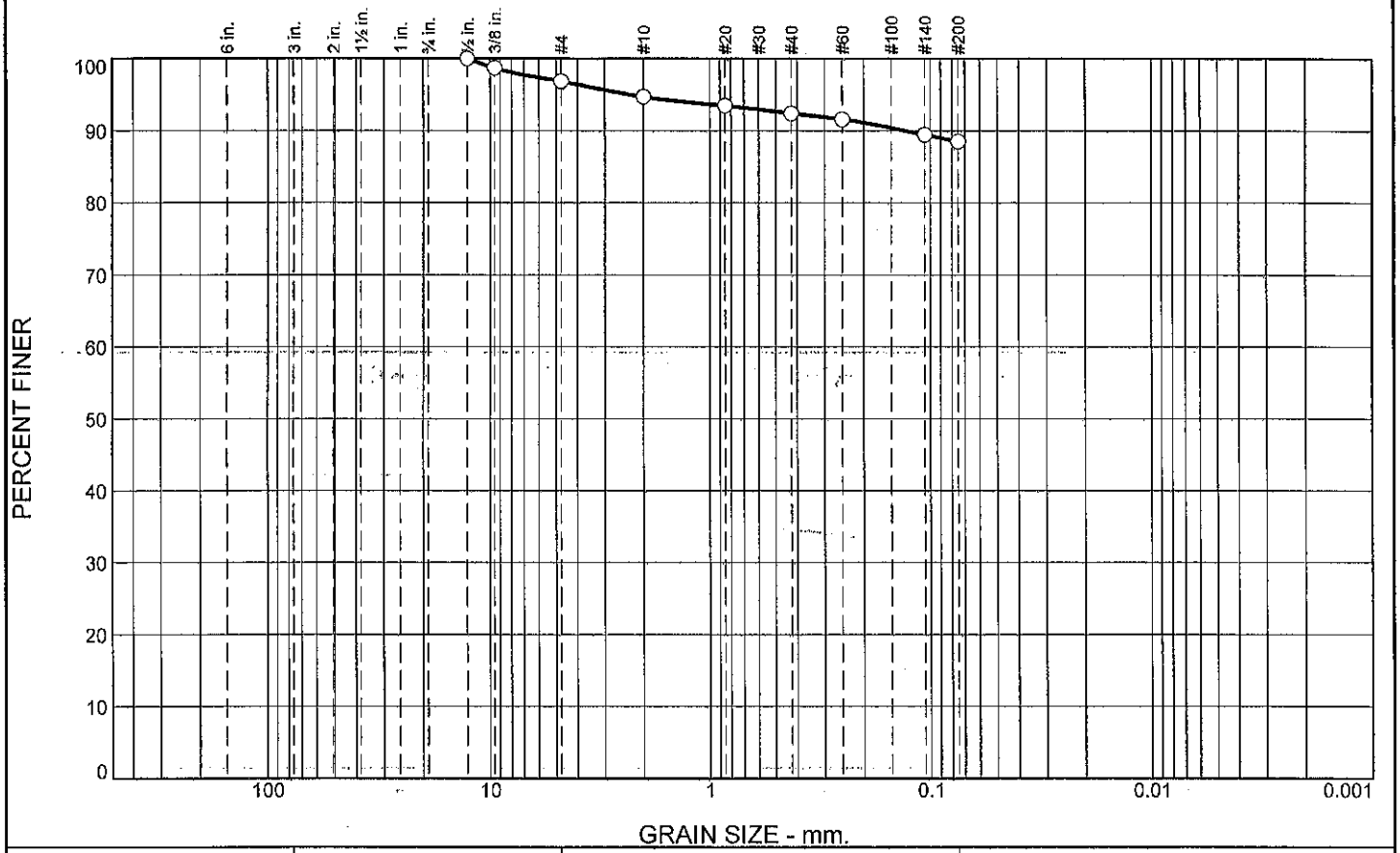
Terracon, Inc.

Cincinnati, Ohio

Exhibit 6456

Tested By: MRM **Checked By:** GS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.2	2.1	2.3	3.9	88.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
.375	98.7		
#4	96.8		
#10	94.7		
#20	93.5		
#40	92.4		
#60	91.6		
#140	89.5		
#200	88.5		

* (no specification provided)

Material Description

BROWN LEAN CLAY

SOURCE: COBBLESTONE - NORTH STOCKPILE

Atterberg Limits

PL= 16 LL= 32 PI= 16

Coefficients

D_{90}= 0.1278 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(13)

Remarks

WC=18.8%

Source of Sample: 6456

Date: 10-15-13

Terracon, Inc.

Cincinnati, Ohio

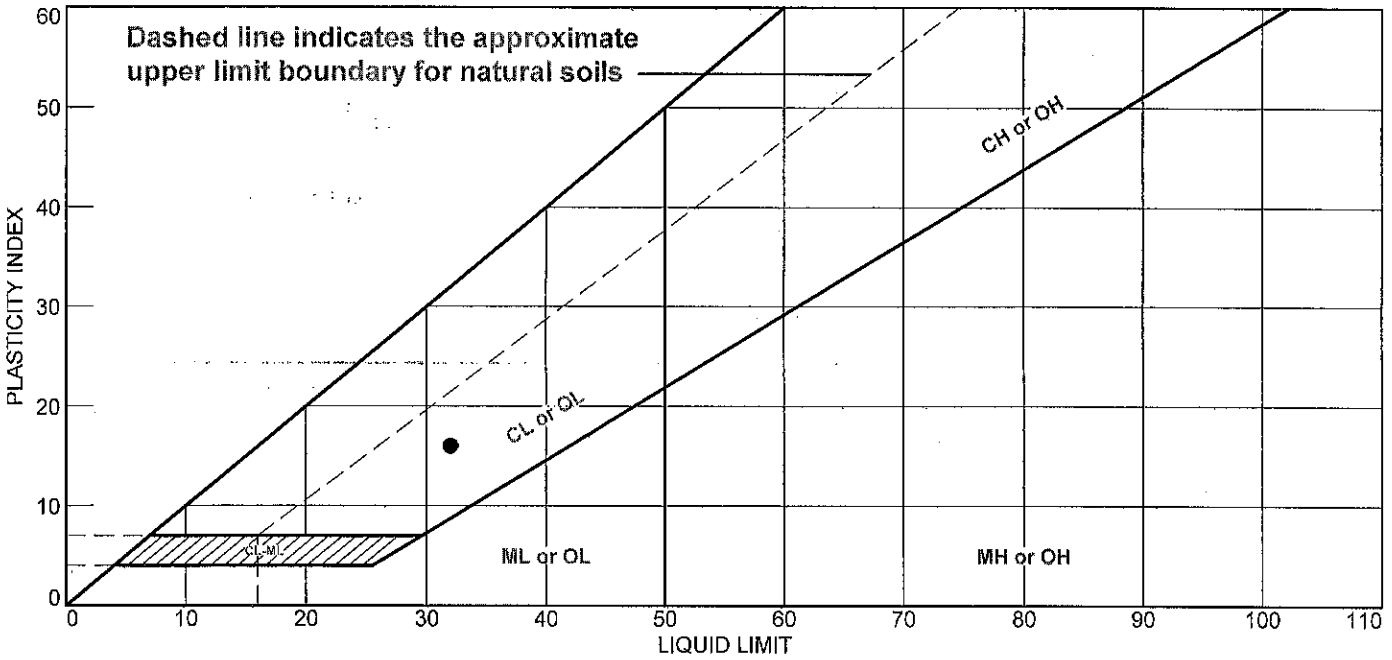
Client: GARVER

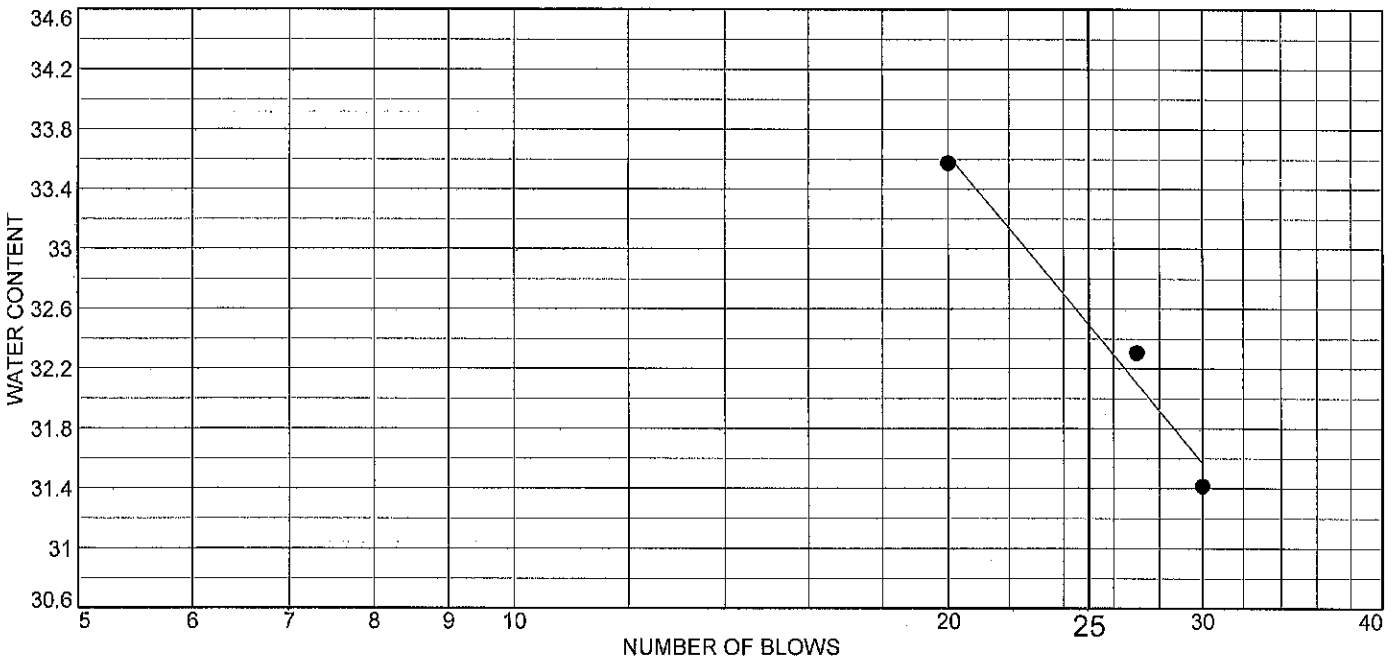
Project: TYSON PARKWAY EXTENSION

Project No: 35139161 **Exhibit** 6456

Tested By: DR **Checked By:** GS

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	BROWN LEAN CLAY SOURCE: COBBLESTONE - NORTH STOCKPILE	32	16	16	92.4	88.5	CL

Project No. 35139161 **Client:** GARVER

Project: TYSON PARKWAY EXTENSION

Source of Sample: 6456

Remarks:
● WC=18.8%

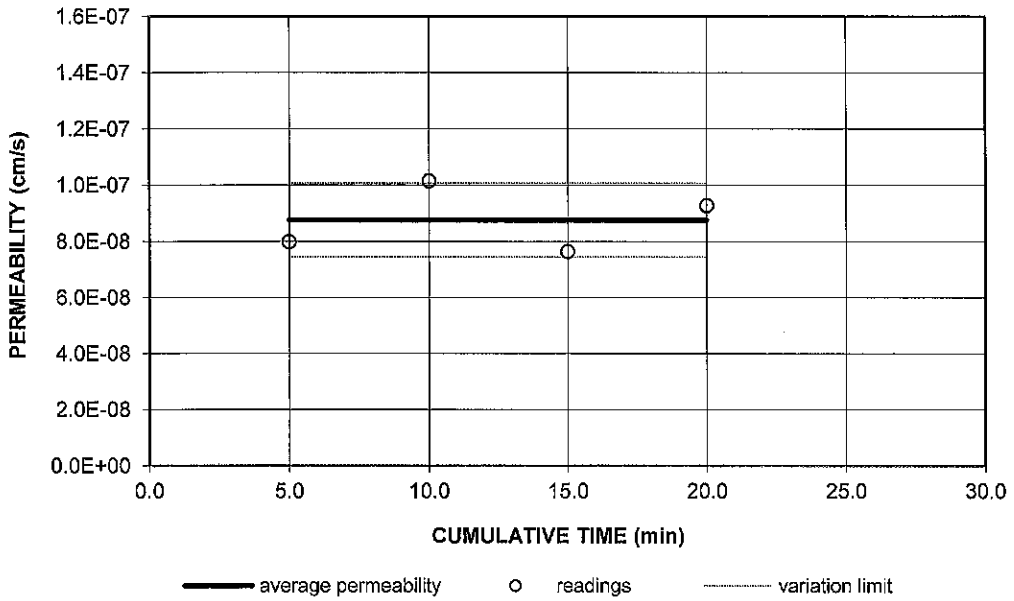
Terracon, Inc.

Cincinnati, Ohio

Exhibit 6456

Tested By: JK **Checked By:** GS

FLEXIBLE WALL PERMEABILITY TEST



Test Specification: ASTM D 5084 Method F

Fluid Temp. (°C)	Elapsed Time (min.)	Cumulative Time (min.)	Gradient (cm-Hg)	Calculated Permeability (cm/sec)	Average Permeability (cm/sec)
21.00	5.00	5.00	12.97	7.98E-08	
21.00	5.00	10.00	11.30	1.01E-07	
21.00	5.00	15.00	10.19	7.64E-08	**8.8E-08**
21.00	5.00	20.00	8.98	9.27E-08	

Compaction Data		Sample Data	Initial	Final
Proctor (pcf)	110.1	Specimen Height, (inches)	3.00	3.00
Opti. M.C., (%)	14.0	Specimen Diameter, (inches)	4.00	4.00
Comp. Method		Specimen Volume, (cu. In.)	37.68	37.68
% Recompct.	99.0	Moisture Content, (%)	16.04	19.42
Test Pressures (psi)		Percent Saturation (%)	79.28	95.97
Backpressure	90.00	Wet Mass Density (pcf)	126.44	130.12
Cell pressure	95.00	Dry Mass Density (pcf)	108.96	108.96
Eff. Stress	**5.00**	Void Ratio	0.55	0.55
Specific Gravity	2.70	Calculated Porosity, %	35.33	35.33

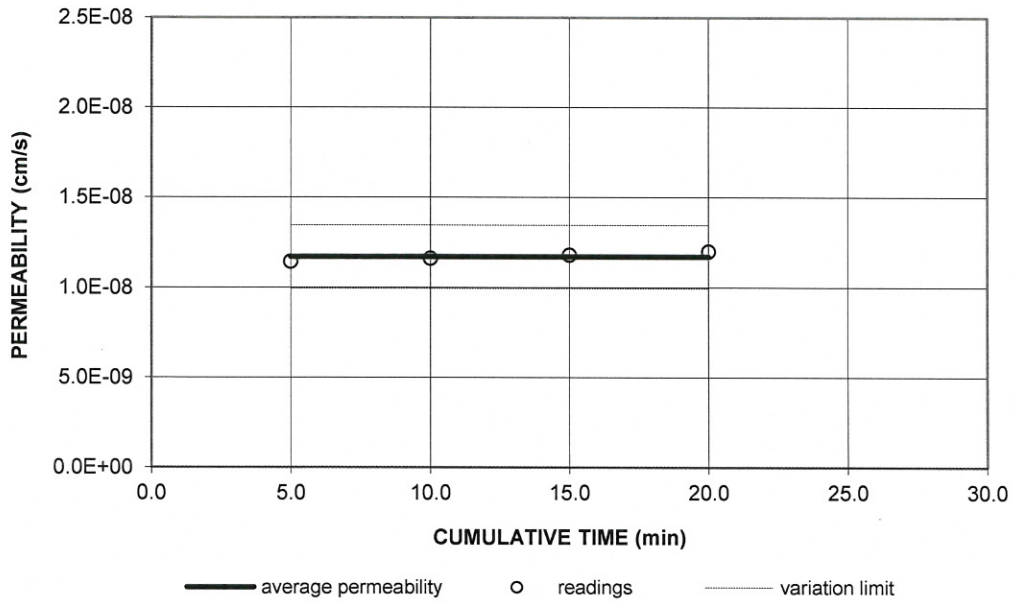
USCS	SG Assumed	LL	PI
Permeant Used:	WATER	Remarks	BROWN LEAN CLAY

Project Name	Tyson Parkway Extension			Tested by	FCE Reviewed by TGG
Client	Garver	W.O.#	35139161		
Sample Number	North Stockpile			FLEXIBLE WALL PERMEABILITY TEST	
Sample Location	Cobblewood		0-5'	Terracon	
Date	10/28/2013	Lab No.	6456rr		

Appendix E

Compacted Clay Cover Construction Test Results

FLEXIBLE WALL PERMEABILITY TEST



Test Specification: ASTM D 5084 Method F

Fluid Temp. (°C)	Elapsed Time (min.)	Cumulative Time (min.)	Gradient (cm-Hg)	Calculated Permeability (cm/sec)	Average Permeability (cm/sec)
21.00	5.00	5.00	11.86	1.14E-08	
21.00	5.00	10.00	11.67	1.16E-08	
21.00	5.00	15.00	11.48	1.18E-08	**1.2E-08**
21.00	5.00	20.00	11.30	1.20E-08	

Compaction Data		Sample Data	Initial	Final
Proctor (pcf)	108.3	Specimen Height, (inches)	3.00	3.01
Opti. M.C., (%)	16.3	Specimen Diameter, (inches)	4.00	4.00
Comp. Method		Specimen Volume, (cu. In.)	37.68	37.81
% Recompct.	100.0	Moisture Content, (%)	18.50	20.41
Test Pressures (psi)		Percent Saturation (%)	90.61	99.03
Backpressure	90.00	Wet Mass Density (pcf)	128.70	130.34
Cell pressure	93.00	Dry Mass Density (pcf)	108.61	108.25
Eff. Stress	**3.00**	Void Ratio	0.55	0.56
Specific Gravity	2.70	Calculated Porosity, %	35.54	35.75

USCS	SG Assumed	LL	PI
Permeant Used:	WATER	Remarks	BR SANDY LEAN CLAY W/GRAVEL

Project Name	Tyson Parkway Extension			Tested by FCE	Reviewed by TGG
Client	Garver	W.O.#	35139161		
Sample Number	#2			**FLEXIBLE WALL PERMEABILITY TEST**	
Sample Location	Cobble				
Date	11/11/2013	Lab No.	6934	Terracon	

5/15/2014

COMPACTION TEST REPORT

Test specification: ASTM D 698-07 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
	CL	A-6(5)	20.1	2.70	31	14	17.2	59.3

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 108.3 pcf Optimum moisture = 16.3 %	BROWN SANDY LEAN CLAY WITH GRAVEL

Project No. 35139161 **Client:** GARVER
Project: TYSON PARKWAY EXTENSION

○ **Source of Sample:** Construction **Sample Number:** Comp. from Cobble

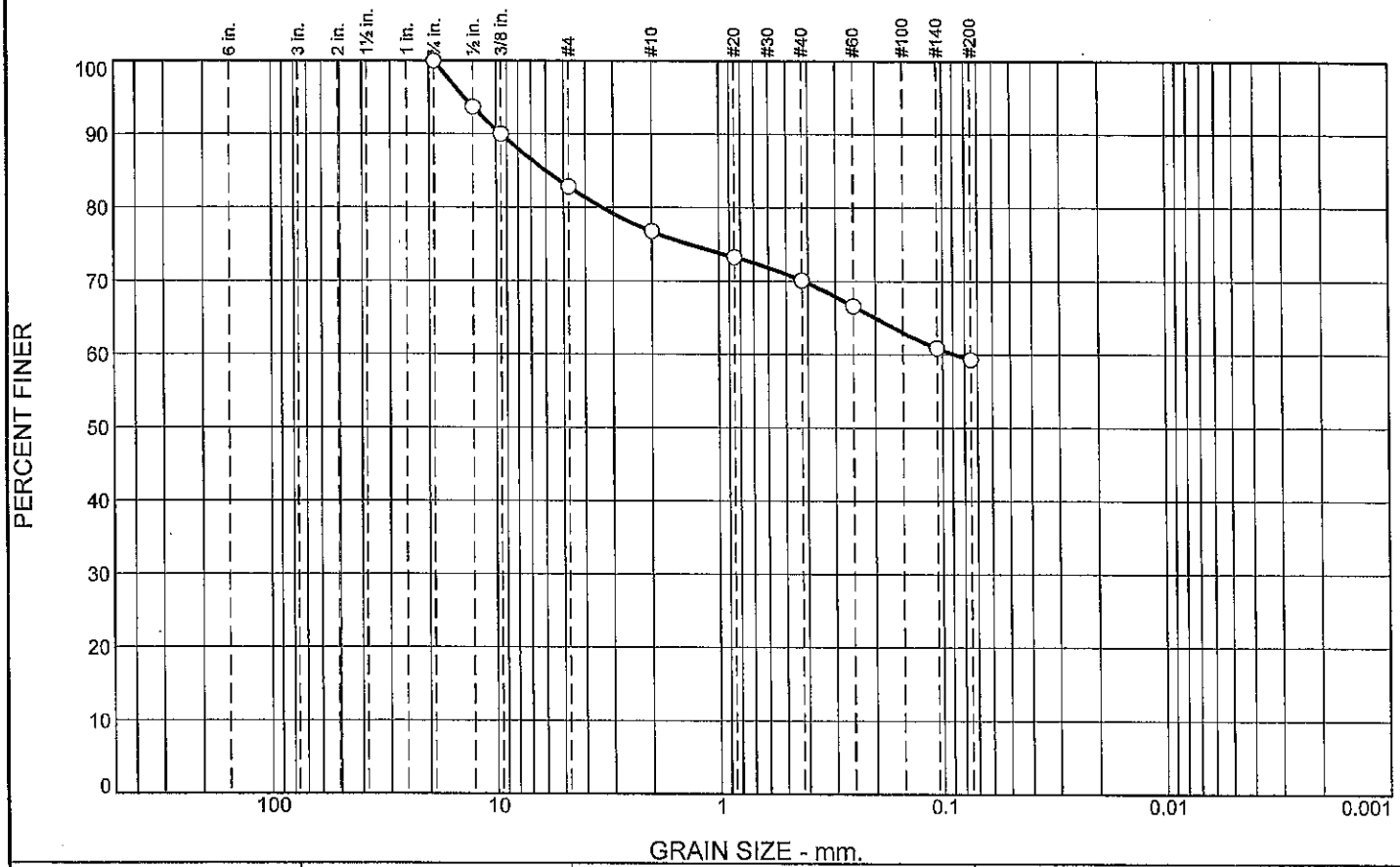
Remarks:
Obtained by S. Billingsly
Date obtained 10-25-13

Terracon, Inc.
Cincinnati, Ohio

Exhibit 6934

Tested By: LH **Checked By:** GS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	17.2	6.0	6.7	10.8	59.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	93.7		
.375	90.0		
#4	82.8		
#10	76.8		
#20	73.3		
#40	70.1		
#60	66.7		
#140	60.9		
#200	59.3		

* (no specification provided)

Material Description

BROWN SANDY LEAN CLAY WITH GRAVEL

Atterberg Limits

PL= 17 LL= 31 PI= 14

Coefficients

D_{90}= 9.5460 D_{85}= 6.0081 D_{60}= 0.0873
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(5)

Remarks

WC=20.1%

Source of Sample: Construction
Sample Number: Comp. from Cobble

Date: 11-13-13

Terracon, Inc.

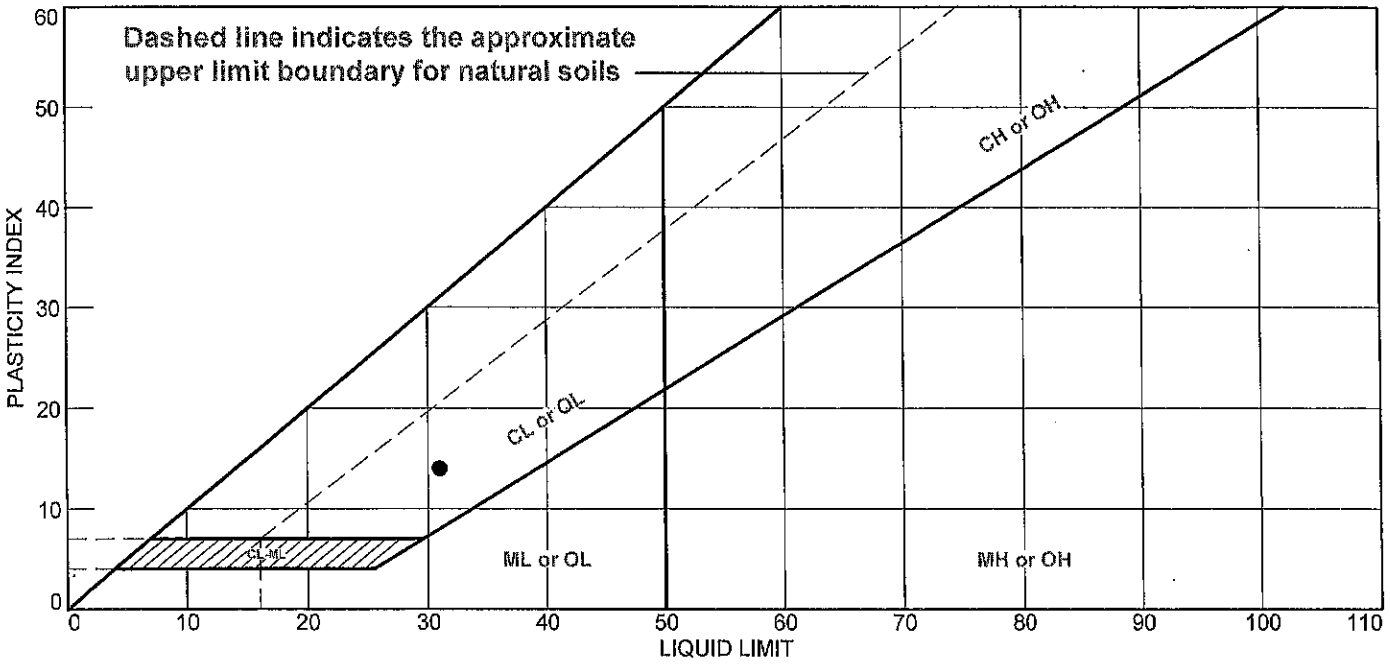
Cincinnati, Ohio

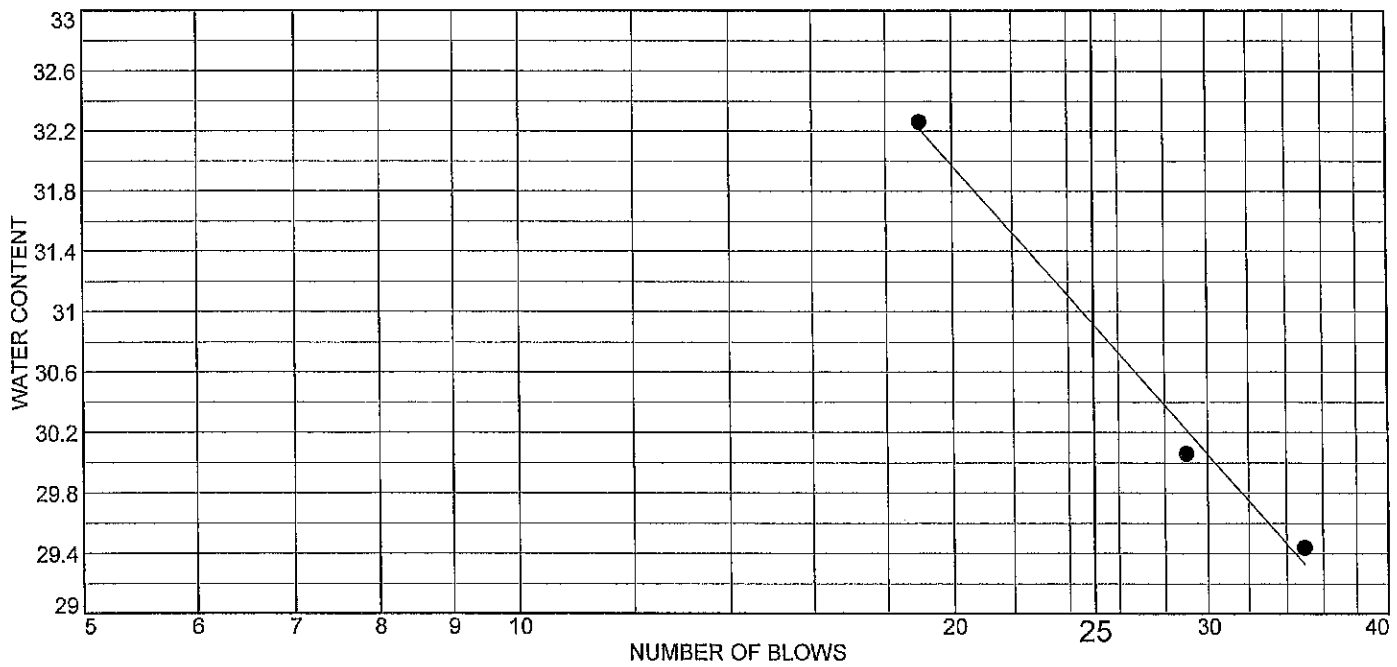
Client: GARVER
Project: TYSON PARKWAY EXTENSION

Project No: 35139161 **Exhibit** 6934

Tested By: DR **Checked By:** GS

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	BROWN SANDY LEAN CLAY WITH GRAVEL	31	17	14	70.1	59.3	CL

Project No. 35139161 **Client:** GARVER

Project: TYSON PARKWAY EXTENSION

Source of Sample: Construction
Sample Number: Comp. from Cobble

Remarks:
● WC=20.1%

Terracon, Inc.

Cincinnati, Ohio

Exhibit 6934

Checked By: GS

LABORATORY COMPACTION CHARACTERISTICS OF SOIL REPORT

Report Number: 35139161.0001
Service Date: 03/24/14
Report Date: 03/24/14

Terracon
25809 I-30 South
Bryant, AR 72022
501-847-9292

Client

Garver
Attn: Ron Petrie
2049 E. Joyce Blvd. Ste 400
Fayetteville, AR 72703-5394

Project

Tyson Parkway Extension
Don Tyson Parkway and Interstate 540
Springdale, AR

Project Number 35139161

Material Information

Source of Material: On-site Fill
Proposed Use: Fill

Sample Information

Sample Date: 03/21/14
Sampled By: Gramling, Paul
Sample Location: On-site

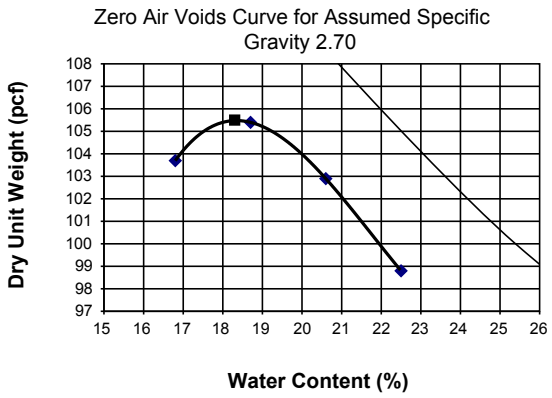
Sample Description: PENDING PROCTOR

Laboratory Test Data

Test Procedure: ASTM D698
Test Method: Method B
Sample Preparation: Wet
Rammer Type: Manual
Maximum Dry Unit Weight (pcf): 105.5
Optimum Water Content (%): 18.3

	Result	Specifications
Liquid Limit:		
Plastic Limit:		
Plasticity Index:		
In-Place Moisture (%):		

USCS:



Comments:

Services:

Terracon Rep.:
Reported To:
Contractor:
Report Distribution:
(1) Garver, Ron Petrie

Reviewed By: _____

William Butler
Senior Staff Engineer

Test Methods: AASHTO T99

LABORATORY COMPACTION CHARACTERISTICS OF SOIL REPORT

Report Number: 35139161.0001
Service Date: 03/24/14
Report Date: 03/24/14

Terracon
25809 I-30 South
Bryant, AR 72022
501-847-9292

Client

Garver
Attn: Ron Petrie
2049 E. Joyce Blvd. Ste 400
Fayetteville, AR 72703-5394

Project

Tyson Parkway Extension
Don Tyson Parkway and Interstate 540
Springdale, AR

Project Number 35139161

Material Information

Source of Material: On-site Fill
Proposed Use: Fill

Sample Information

Sample Date: 03/21/14
Sampled By: Gramling, Paul
Sample Location: On-site

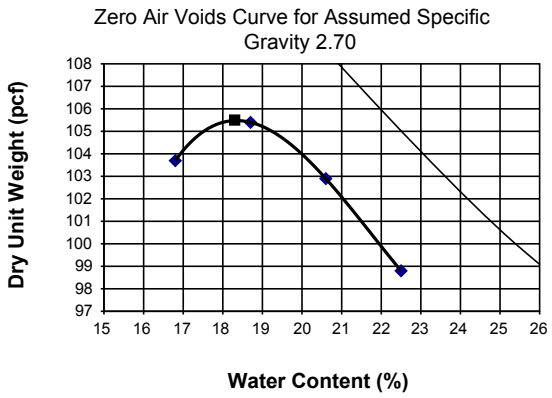
Sample Description: PENDING PROCTOR

Laboratory Test Data

Test Procedure: ASTM D698
Test Method: Method B
Sample Preparation: Wet
Rammer Type: Manual
Maximum Dry Unit Weight (pcf): 105.5
Optimum Water Content (%): 18.3

	Result	Specifications
Liquid Limit:		
Plastic Limit:		
Plasticity Index:		
In-Place Moisture (%):		

USCS:



Comments:

Services:

Terracon Rep.:
Reported To:
Contractor:
Report Distribution:
(1) Garver, Ron Petrie

Reviewed By: _____

William Butler
Senior Staff Engineer

Test Methods: AASHTO T99

Appendix F
Field Moisture/Density Test Results

Summary of Field Density Test Results
ASTM D 2922

Terracon
25809 Interstate 30 South
Bryant, AR 72022
(501) 847-9292

Project No: 35139161
Date of Report: 10.23.2013

Client Name: Garver
Contractor: Emery Sapps and Sons
Project Name: Don Tyson Parkway
Location: Springdale, Arkansas
Reviewed by: Billy Butler, P.E.
Technician: Billingsley
Test Location: Final Cover

Depart Lab: 6:30 AM **Depart Site:** 5:30 PM
Arrive Site: 7:00 AM **Arrive Lab:** 6:00 PM

MATERIAL INFORMATION

Mat'l. No.	Material Description	Maximum Dry Density (pcf)	**Optimum Moisture (%)**
1-NS	Brown Lean Clay	110.2	14.0
	Cobblewood North Stockpile		

Test No.	Lift or Elev.	Test Location		Shelby Tube Sample	Mat'l. No.	Wet Density, pcf	Dry Density, pcf	Lab Max. Dry Density, pcf	Percent Compaction %	Pecent Compaction Required	Moisture Content %	Optimum Moisture %	PASS or FAIL
		Northing	Easting										
1	1			P-1	1-NS	125.3	105.6	110.2	95.9	95.0	18.6	14.0	PASS
2	1			N	1-NS	125.8	105.1	110.2	95.4	95.0	19.7	14.0	PASS
3	1			N	1-NS	125.4	108.4	110.2	98.4	95.0	15.7	14.0	PASS
4	2			P-2	1-NS	126.5	105.4	110.2	95.7	95.0	20.0	14.0	PASS
5	2			N	1-NS	125.0	107.3	110.2	97.4	95.0	16.5	14.0	PASS
6	2			N	1-NS	125.7	105.2	110.2	95.5	95.0	19.5	14.0	PASS
7	3			P-3	1-NS	123.0	105.7	110.2	95.9	95.0	16.4	14.0	PASS
8	3			N	1-NS	125.2	106.4	110.2	96.5	95.0	17.7	14.0	PASS
9	3			P-4	1-NS	127.3	108.8	110.2	98.7	95.0	17.0	14.0	PASS

Summary of Field Density Test Results
ASTM D 2922

Terracon
25809 Interstate 30 South
Bryant, AR 72022
(501) 847-9292

Project No: 35139161
Date of Report: 3.26.14

Client Name: Garver
Contractor: Emery Sapps and Sons
Project Name: Don Tyson Parkway
Location: Springdale, Arkansas
Reviewed by:
Technician: Rock
Test Location: Final Cover

Depart Lab: **Depart Site:**
Arrive Site: **Arrive Lab:**

MATERIAL INFORMATION

Mat'l. No.	Material Description	Maximum Dry Density (pcf)	**Optimum Moisture (%)**
1	Lime Treated Brown Clay	105.5	18.3
	Ramp #4		

Test No.	Lift or Elev.	Test Location		Shelby Tube Sample	Mat'l. No.	Wet Density, pcf	Dry Density, pcf	Lab Max. Dry Density, pcf	Percent Compaction %	Pecent Compaction Required	Moisture Content %	Optimum Moisture %	PASS or FAIL
		Northing	Easting										
1	-12			N	1	125.2	107.1	105.5	101.5	95.0	16.9	18.3	PASS
2	-12			N	1	124.8	106.7	105.5	101.1	95.0	17.0	18.3	PASS
3	-6			N	1	123.8	105.6	105.5	100.1	95.0	17.2	18.3	PASS
4	-6			N	1	125.2	106.9	105.5	101.3	95.0	17.1	18.3	PASS

Summary of Field Density Test Results
ASTM D 2922

Terracon
25809 Interstate 30 South
Bryant, AR 72022
(501) 847-9292

Project No: 35139161
Date of Report: 3.27.14

Client Name: Garver
Contractor: Emery Sapps and Sons
Project Name: Don Tyson Parkway
Location: Springdale, Arkansas
Reviewed by:
Technician: Reinking
Test Location: Final Cover

Depart Lab: **Depart Site:**
Arrive Site: **Arrive Lab:**

MATERIAL INFORMATION

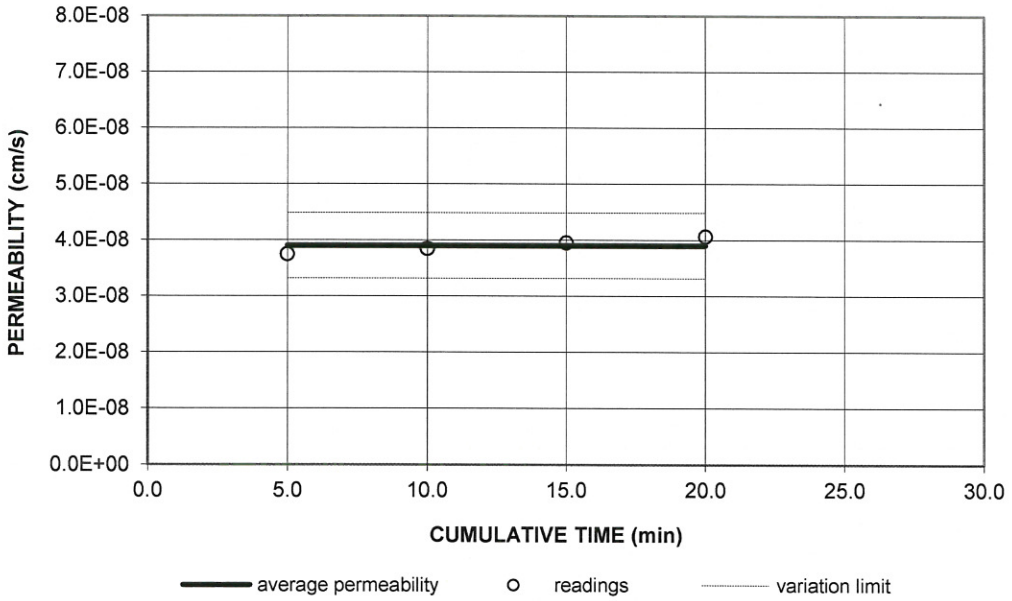
Mat'l. No.	Material Description	Maximum Dry Density (pcf)	**Optimum Moisture (%)**
1	Subgrade	105.5	18.3
2	Lime Treated Brown Clay	105.5	18.3
	Ramp #4		

Test No.	Lift or Elev.	Test Location		Shelby Tube Sample	Mat'l. No.	Wet Density, pcf	Dry Density, pcf	Lab Max. Dry Density, pcf	Percent Compaction %	Pecent Compaction Required	Moisture Content %	Optimum Moisture %	PASS or FAIL
		Northing	Easting										
1	SG			N	2	120.6	100.8	105.5	95.6	95.0	19.6	18.3	PASS
2	SG			N	2	125.2	105.4	105.5	99.9	95.0	18.8	18.3	PASS
3	SG			N	2	121.1	102.7	105.5	97.4	95.0	17.9	18.3	PASS

Appendix G

Compacted Clay Cover Permeability Test Results

FLEXIBLE WALL PERMEABILITY TEST



Test Specification: ASTM D 5084 Method F

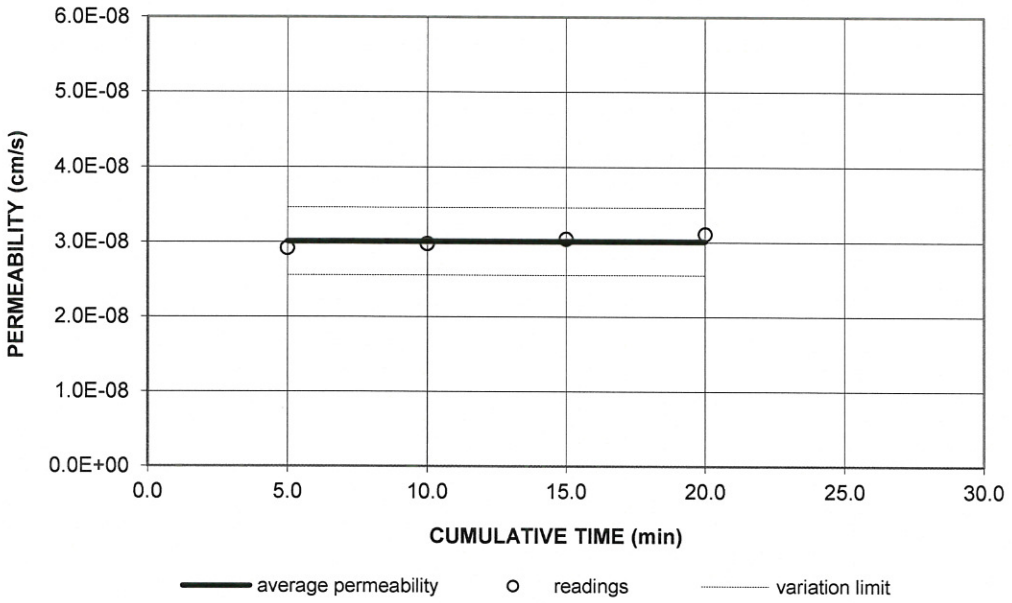
Fluid Temp. (°C)	Elapsed Time (min.)	Cumulative Time (min.)	Gradient (cm-Hg)	Calculated Permeability (cm/sec)	Average Permeability (cm/sec)
21.00	5.00	5.00	14.40	3.74E-08	
21.00	5.00	10.00	14.02	3.84E-08	
21.00	5.00	15.00	13.64	3.95E-08	**3.9E-08**
21.00	5.00	20.00	13.26	4.06E-08	

Compaction Data		Sample Data	Initial	Final
Proctor (pcf)		Specimen Height, (inches)	2.93	2.91
Opti. M.C., (%)		Specimen Diameter, (inches)	2.83	2.83
Comp. Method		Specimen Volume, (cu. In.)	18.43	18.29
% Recompct.		Moisture Content, (%)	19.95	20.39
Test Pressures (psi)		Percent Saturation (%)	92.02	95.89
Backpressure	90.00	Wet Mass Density (pcf)	127.47	128.85
Cell pressure	93.00	Dry Mass Density (pcf)	106.27	107.03
Eff. Stress	**3.00**	Void Ratio	0.59	0.57
Specific Gravity	2.70	Calculated Porosity, %	36.93	36.47

USCS	SG Assumed	LL	PI
Permeant Used:	WATER	Remarks	BROWN SANDY LEAN CLAY W/ GRAVEL

Project Name	Tyson Parkway Extension			Tested by FCE	Reviewed by TGG
Client	Garver	W.O.#	35139161		
Sample Number	P-1			**FLEXIBLE WALL PERMEABILITY TEST**	
Sample Location					
Date	10/31/2013	Lab No.	6935	Terracon	

FLEXIBLE WALL PERMEABILITY TEST



Test Specification: ASTM D 5084 Method F

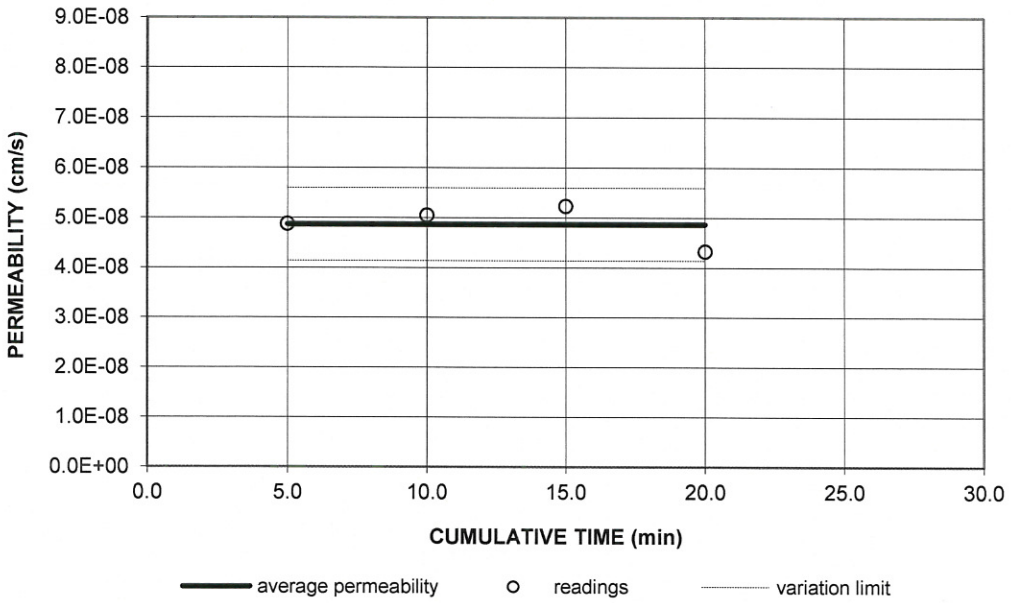
Fluid Temp. (°C)	Elapsed Time (min.)	Cumulative Time (min.)	Gradient (cm-Hg)	Calculated Permeability (cm/sec)	Average Permeability (cm/sec)
21.00	5.00	5.00	13.86	2.92E-08	
21.00	5.00	10.00	13.58	2.98E-08	
21.00	5.00	15.00	13.29	3.04E-08	**3.0E-08**
21.00	5.00	20.00	13.00	3.11E-08	

Compaction Data		Sample Data	Initial	Final
Proctor (pcf)		Specimen Height, (inches)	2.91	2.85
Opti. M.C., (%)		Specimen Diameter, (inches)	2.83	2.83
Comp. Method		Specimen Volume, (cu. In.)	18.31	17.98
% Recompct.		Moisture Content, (%)	20.97	20.39
Test Pressures (psi)		Percent Saturation (%)	96.64	98.76
Backpressure	90.00	Wet Mass Density (pcf)	128.52	130.23
Cell pressure	93.00	Dry Mass Density (pcf)	106.24	108.18
Eff. Stress	**3.00**	Void Ratio	0.59	0.56
Specific Gravity	2.70	Calculated Porosity, %	36.94	35.79

USCS	SG Assumed	LL	PI
Permeant Used:	WATER	Remarks	BROWN SANDY LEAN CLAY W/ GRAVEL

Project Name	Tyson Parkway Extension			Tested by	FCE Reviewed by TGG
Client	Garver	W.O.#	35139161		
Sample Number	P-2			FLEXIBLE WALL PERMEABILITY TEST	
Sample Location				Terracon	
Date	10/31/2013	Lab No.	6936		

FLEXIBLE WALL PERMEABILITY TEST



Test Specification: ASTM D 5084 Method F

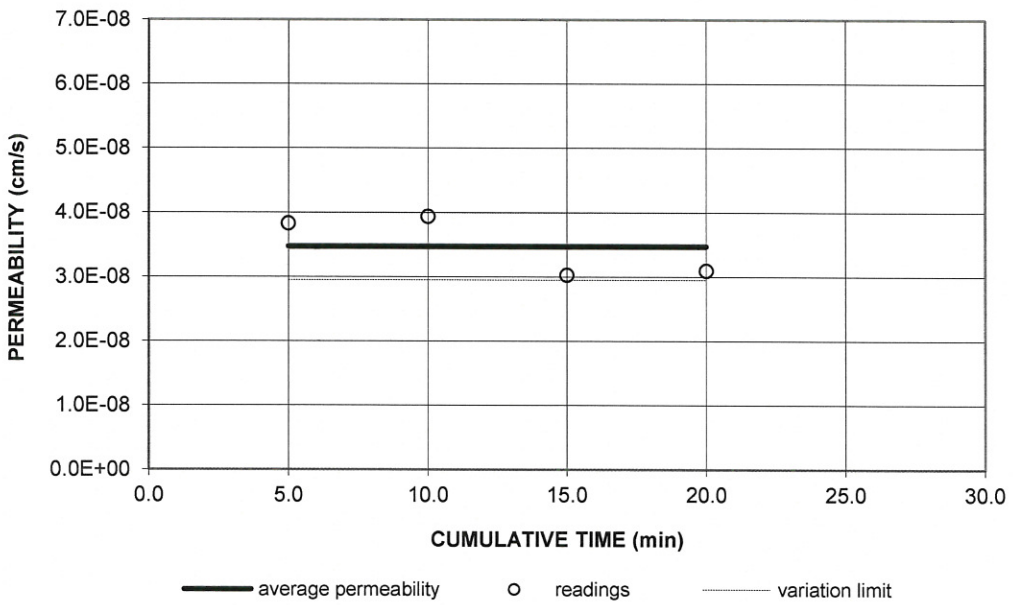
Fluid Temp. (°C)	Elapsed Time (min.)	Cumulative Time (min.)	Gradient (cm-Hg)	Calculated Permeability (cm/sec)	Average Permeability (cm/sec)
21.00	5.00	5.00	14.05	4.87E-08	
21.00	5.00	10.00	13.56	5.05E-08	
21.00	5.00	15.00	13.08	5.23E-08	**4.9E-08**
21.00	5.00	20.00	12.69	4.32E-08	

Compaction Data		Sample Data	Initial	Final
Proctor (pcf)		Specimen Height, (inches)	2.87	2.81
Opti. M.C., (%)		Specimen Diameter, (inches)	2.80	2.80
Comp. Method		Specimen Volume, (cu. In.)	17.66	17.32
% Recompct.		Moisture Content, (%)	20.57	20.46
Test Pressures (psi)		Percent Saturation (%)	94.77	99.42
Backpressure	90.00	Wet Mass Density (pcf)	128.07	130.46
Cell pressure	93.00	Dry Mass Density (pcf)	106.22	108.30
Eff. Stress	**3.00**	Void Ratio	0.59	0.56
Specific Gravity	2.70	Calculated Porosity, %	36.95	35.72

USCS	SG Assumed	LL	PI
Permeant Used:	WATER	Remarks	BROWN SANDY LEAN CLAY W/ GRAVEL

Project Name	Tyson Parkway Extension			Tested by FCE	Reviewed by TGG
Client	Garver	W.O.#	35139161		
Sample Number	P-3			FLEXIBLE WALL PERMEABILITY TEST	
Sample Location					
Date	10/31/2013	Lab No.	6937	Terracon	

FLEXIBLE WALL PERMEABILITY TEST



Test Specification: ASTM D 5084 Method F

Fluid Temp. (°C)	Elapsed Time (min.)	Cumulative Time (min.)	Gradient (cm-Hg)	Calculated Permeability (cm/sec)	Average Permeability (cm/sec)
21.00	5.00	5.00	14.02	3.83E-08	
21.00	5.00	10.00	13.63	3.94E-08	
21.00	5.00	15.00	13.34	3.03E-08	**3.5E-08**
21.00	5.00	20.00	13.05	3.09E-08	

Compaction Data		Sample Data	Initial	Final
Proctor (pcf)		Specimen Height, (inches)	2.85	2.75
Opti. M.C., (%)		Specimen Diameter, (inches)	2.83	2.83
Comp. Method		Specimen Volume, (cu. In.)	17.99	17.28
% Recompct.		Moisture Content, (%)	20.93	19.69
Test Pressures (psi)		Percent Saturation (%)	99.64	100.00
Backpressure	90.00	Wet Mass Density (pcf)	130.01	133.96
Cell pressure	93.00	Dry Mass Density (pcf)	107.50	111.93
Eff. Stress	**3.00**	Void Ratio	0.57	0.53
Specific Gravity	2.70	Calculated Porosity, %	36.19	34.71

USCS	SG Assumed	LL	PI
Permeant Used:	WATER	Remarks	BROWN SANDY LEAN CLAY W/ GRAVEL

Project Name	Tyson Parkway Extension			Tested by FCE	Reviewed by TGG
Client	Garver	W.O.#	35139161		
Sample Number	P-4			FLEXIBLE WALL PERMEABILITY TEST	
Sample Location				Terracon	
Date	10/31/2013	Lab No.	6938		

Appendix H
Project Photographs