NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

Borrow Pit Sampling Manual

Materials and Tests Unit
Field Operations Section

Borrow Pit Sampling

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North Carolina Department of Transportation
Materials and Tests Unit – Field Operations Section

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Section 1 - Purpose

The purpose of this manual, in conjunction with the class presentation and other related NCDOT reference manuals (described in Section 2), is to explain the techniques for obtaining soil samples from a proposed borrow pit or stockpile of existing soil. A borrow pit is generally utilized by the Contractor when a project requires a larger amount of fill material versus amount of usable material obtained from cut sections. Additional fill material which must meet other specification criteria may also be required for pipe backfill (i.e. Select Material). Due to various soil types in North Carolina, a field investigation must be performed to determine if the material meets minimum criteria for use in a project. This field investigation must include documented observations from the borrow pit/stockpile and laboratory testing of soil samples obtained from the proposed site. Borrow Material, Select Material – Class I, Class II Type 2, Class III Type 2 and Shoulder/Slope Material must be naturally occurring soil (i.e. not from a manufacturing process) and tested for "Source Approval/Evaluation". Appendix A provides a summary of various select material products that may be used on a project. Soil sampling and recorded observations completed during the field investigation of a proposed borrow pit or stockpile of material must be performed by project personnel having a valid Borrow Pit Sampling Certification.

Section 2 - Importance of Proper Sampling

A sample is defined as a "portion, piece, or segment that is representative of a whole". It is therefore important that the procedure(s) used to obtain this small portion not compromise the requirement that it be representative of the larger portion.
As will be discussed in the sections that follow, each borrow pit sample will be taken to a NCDOT laboratory and tested for soil classification. The soil classification is utilized to determine if the soil has the desired engineering properties (i.e. load-carrying capacity). Unsuitable soils placed in an embankment or subgrade may cause structural failure in the roadway leading to costly maintenance repairs; therefore, following proper sampling procedures cannot be overemphasized. The **NCDOT Construction Manual** can provide guidance when sampling a proposed borrow pit or, during the construction phase, provide guidance when excavating soil from the pit. Project personnel should become familiar with Divisions and/or Sections listed in Table 1.

Classification	Reference Division
Materials (borrow sampling)	Division 10 (pages 10-21 thru 10-23)
Earthwork (borrow excavation)	Division 5 Section 230

Table 1 Reference sections from the NCDOT Construction Manual

The **NCDOT Standard Specifications for Roads and Structures (***Standard Specifications***)** can also provide guidance when sampling a proposed borrow pit/stockpile or, during the construction phase, provide guidance when excavating soil. Project personnel should become familiar with sections listed in Table 2.

Classification	Reference Section
Select Material	Section 1016
Borrow Material	Section 1018
Shoulder and Slope Material	Section 1019
Borrow Excavation	Section 230

Table 2 Reference sections from the *Standard Specifications*

Project personnel should also review all contract related documents including the Project Special Provisions for any items that may influence the sampling and/or excavation of a borrow pit or stockpile.

Section 3 - AASHTO Classification System

The American Association of State Highway Transportation Officials (AASHTO) has adopted a standardized method for determining soil classification or AASHTO classification. Soils are grouped by the same general load-carrying capacity from the best being A-1 to the worst being A-7. There is a wide range of load-carrying capacity within groups and an overlapping of capacity between groups. For example, an A-2 soil may contain material that makes it inferior to a specific A-5 soil. A Group Index number is used to designate the load-carrying capacity within the same AASHTO classification. For example, an A-4 (5) and A-4 (20) have the same AASHTO classification however; the group index number indicates that A-4 (5) has the greater load-carrying capacity. Several tests must be performed to determine AASHTO classification for a particular soil.

First, the overall distribution or "gradation" of particle sizes is analyzed by performing AASHTO T 88. For this AASHTO soil test, two different test methods must be utilized. The first method measures the distribution of coarse and fine sand by screening a representative sample over specific sieves to determine the percent passing each sieve. The second method measures the distribution of fine particles such as clay or silt by using a hydrometer. The hydrometer test relies on the general concept of how quickly different soil particles settle when placed in a solution of water. For example, when soil is placed in a container with water and the mixture is agitated, the sand will settle to the bottom of the container first followed by the silt and finally the clay particles.

The second step is to determine the Liquid Limit, Plastic Limit, and Plasticity Index. These tests are commonly referred as the Atterburg Limits of the soil. AASHTO T 89 is performed to determine the Liquid Limit (L.L.) of the soil. The Liquid Limit is defined as the moisture content where the soil passes from the plastic state to the liquid state. A high Liquid Limit indicates a high clay content and low load-carrying capacity. AASHTO T 90 is also performed to determine the Plastic Limit (P.L.) and the Plasticity Index (P.I.) of a soil. The Plastic Limit is defined as the moisture content at which the

soil changes from a semisolid state to a plastic state. Load-carrying capacity of a soil increases rapidly below the Plastic Limit and decreases rapidly above the Plastic Limit. The Plasticity Index is defined as the numerical difference between the Liquid Limit and the Plastic Limit. Refer to the formula given below.

P.I. = L.L. – P.L.

The general concept behind the Atterburg Limits tests relies on the reaction soil particles have with water. Depending on the type and amount of particles in a given soil, different states of consistency will exist based on the amount of water within the soil. For example, "beach sand" generally has extremely small amounts of clay particles and therefore would have a Plasticity Index (P.I.) of 0 or, what is commonly reported as, Non-Plastic (N.P.). Figure 1 graphically demonstrates these differences as water is added or removed. Refer to the glossary provided in the back of this manual for definitions of the terms in Figure 1.

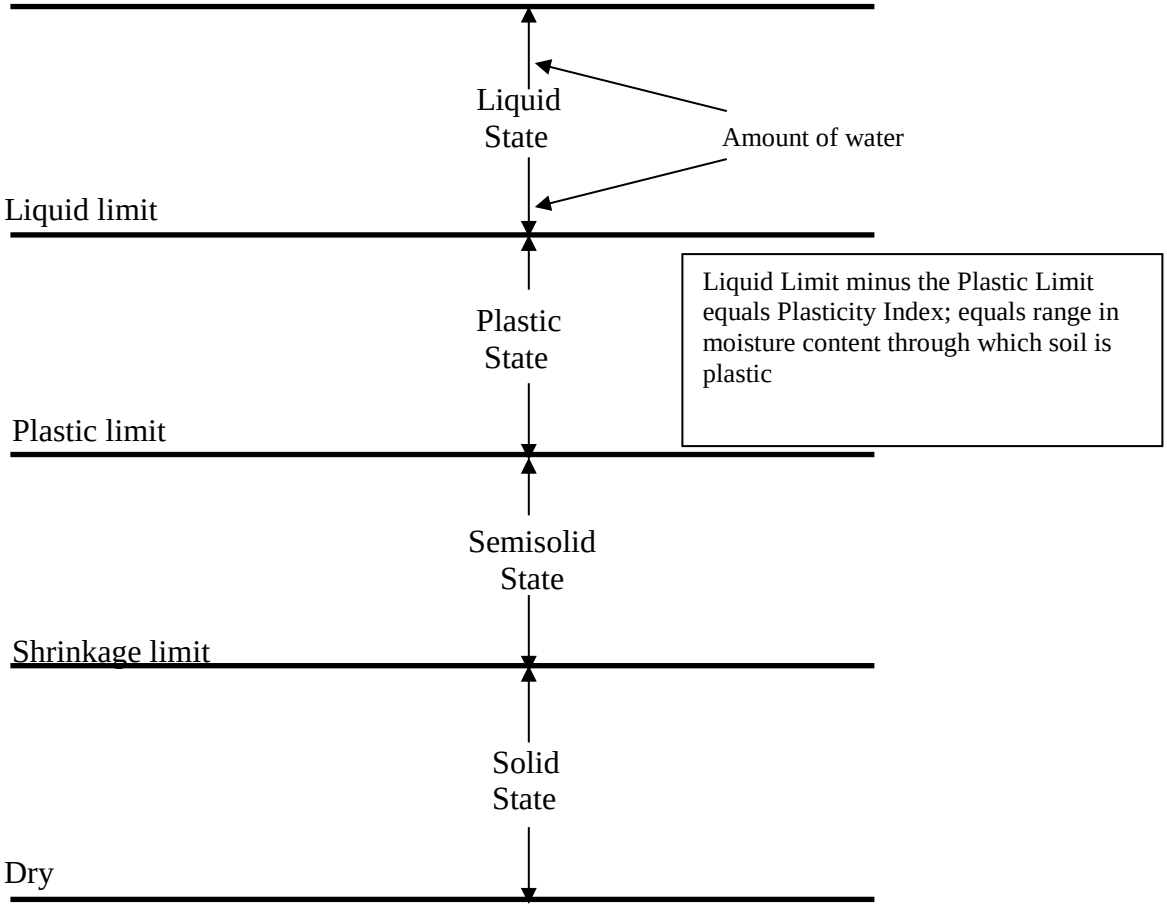


Figure 1 Summary – Characteristics of soil and water relationship

Results from each AASHTO test are used to determine the soil classification. Table 3 lists the main AASHTO groups, a general rating for use in subgrade, and a general description.

AASHTO Classification	General Subgrade Rating	General Description
A-1	Excellent	Well graded coarse to fine; non-plastic or feebly plastic; includes coarse without binder
A-1-a	Excellent	Mostly stone fragments or gravel
A-1-b	Excellent	Mostly coarse sand; may need added fines for a firm base; suitable or can be made suitable for granular base coarse
A-2-4 A-2-5	Excellent	Granular with binder characteristics of A-4 and A-5 soils
A-2-6 A-2-7	Excellent to Good	Granular with binder characteristics of A-6 and A-7 soils
A-2	Good	Soils are inferior to A-1 soils due to poor grading, inferior binder, or both generally are suitable as a blanket for very plastic subgrades slated to receive concrete pavement
A-3	Good	Sands deficient in soil binder and coarse material; equigranular; examples are fine beach or desert blown sands. Water has little effect on A-3 soils
A-4	Fair	Composed mostly of silt with only moderate to small amounts of coarse material and only small amounts of clay; can vary texturally from sandy loams to silt to clay loams
A-5	Fair	Similar to A-4 except that they include very poorly graded soils containing such things as mica; is a poor stability soil.
A-6	Fair to Poor	Composed predominately of clay with moderate to negligible amounts of coarse material; have low stability at high moisture contents but are pretty stable otherwise; show shrinkage cracks during dry weather; is a good soil other than the fact that it has great affinity for water
A-7	Poor	Composed predominately of clay like A-6 but due to the presence of one-size silt particles, organic matter, mica flakes, or lime carbonate, is elastic
A-7-5	Poor	Moderate plasticity indexes; may be highly elastic. P.I. less than or equal to L.L. –30
A-7-6	Poor	High plasticity indexes P.I. greater than L.L. –30

Table 3 Summary of AASHTO Classifications (subgrade rating and general description)

Section 4 - Soil Terminology and Identification Properties

When sampling a borrow pit or existing stockpile, a boring log must be completed with a description of the material encountered. To aid in completing a general description for a boring log, refer to the general terms and definitions provided in Table 4.

Terms	Definition
Boulder	A rock fragment, usually rounded by weathering or abrasion, with average dimension of 12 inches or more
Cobble	A rock fragment, usually rounded by weathering or abrasion, with average dimension between 3 to 12 inches
Gravel	Rounded, sub-rounded, or angular particles of rock that will pass a 3-inch square opening sieve and be retained on a Number 4 Sieve.
Sand	Particles that will pass the Number 4 Sieve and be retained on the Number 200 Sieve
Silt	Material passing the Number 200 Sieve that is non-plastic and exhibits little or no strength when dried
Clay	Material passing the Number 200 Sieve that can be made to exhibit plasticity within a wide range of water contents and exhibits considerable dry strength
Fines	The portion of a soil sample passing a Number 200 Sieve
Marl	Unconsolidated white or dark gray calcium carbonate deposit
Muck	Finely divided organic material containing various amounts of mineral soil
Peat	Organic material in various stages of decomposition
Organic Clay	Clay containing microscopic size organic matter
Organic Silt	Silt containing microscopic size organic matter
Coarse-Grained Soil	Soil having a predominance of gravel and/or sand
Fine-Grained Soil	Soil having a predominance of silt and/or clay
Mixed-Grained Soil	Soil having significant proportions of both fine and coarse grained soil particles

Table 4 Soil terminology and description

Table 5 provides methods for identifying items encountered while performing the field investigation.

Item	Method of Identification
Boulder	Identify by particle size
Cobble	Identify by particle size
Gravel	Identify by particle size.
Sand	Identify by particle size. Gritty grains that can easily be seen and felt. No plasticity or cohesion. Size ranges between gravel and silt.
Silt	Identify by behavior. Fines that have no plasticity. May be rolled into a thread but will easily crumble. Has no cohesion. When dry, can be easily broken by hand into powdery form.
Clay	Material passing the Number 200 Sieve that can be made to exhibit plasticity within a wide range of water contents and exhibits considerable dry strength.
Marl	A white or gray calcium carbonate paste. May contain granular spheres, shells, organic material or inorganic soils.
Muck	Black or dark brown finely divided organic material mixed with various proportions of sand, silt, and clay. May contain minor amounts of fibrous materials such as roots, leaves, and sedges.
Peat	Black or dark brown plant remains. The visible plant remains range from coarse fibers to finely divided organic material.
Organic Clay	Dark gray clay with microscopic size organic material dispersed throughout. May contain shell and/or fibers. Has weak structure which exhibits little resistance to kneading.
Organic Silt	Silt containing microscopic size organic matter.
Fill	Man-made deposits of natural soils and/or waste materials. If encountered, document components carefully.

Table 5 Summary of identification methods for types of soil

The following steps can be followed in identifying a soil encountered during the field investigation:

Step 1 - Decide if soil sample is coarse-grained, fine-grained, mix-grained or organic. If mix-grained, decide whether coarse-grained or fine-grained predominates and record conclusion

Step 2 – Determine principal or primary component. Use noun in soil description (i.e. Sand).

Step 3 – Determine secondary component. Use adjective in soil description (i.e. Silty Sand).

Step 4 – Determine if additional components exist. Use as additional adjectives (i.e. Silty Sand, Gravelly) and record conclusion

Some typical examples of soil component descriptions include: Silty Fine Sand, Gravelly Sand, Clayey Gravel, Clayey Silt, Silty Clay, etc.

Table 6 lists additional information which should be documented on the boring log.

Item	Descriptions
Color of sample	Brown, Gray, Red, Black, etc.
Moisture Condition	Dry, Moist, Wet Judge by appearance as the material is initially removed
Plasticity	Plastic, Low Plastic, Non-plastic. Sample must be in moist or wet condition for plasticity determination.

Table 6 Additional descriptive information for field investigation

The data obtained from the field investigation and the GeoMaterials Laboratory test results will serve to establish a soil profile of the borrow pit. The soil profile is the vertical cross-section composed of three major layers designated as A, B, and C-horizons.

Horizon A: basically topsoil containing organic matter except for possibly the bottom part of the layer
Horizon B: the subsoil
Horizon C: the mother soil

The usable soil can primarily be found in the B-horizon however, the lowest portion of the A-horizon and the top part of the C-horizon may also contain usable material.

Section 5 – General Sampling Procedures

When sampling a borrow pit/stockpile, the Contractor or NCDOT may provide equipment and personnel for obtaining soil samples. The sampling procedures outlined below shall apply to either the Contractor or NCDOT. When sampling from an existing stockpile, follow procedures provided in Appendix F of this manual

1. Prior to performing any sampling, the Contractor shall furnish the Resident Engineer with a dimensioned plot plan of the proposed site to a scale such that it can be placed on 8 ½" X 11" or 11" X 17" sheet. The Contractor shall also provide a release from the property owner allowing access to the property and the right to obtain samples from the property.

2. Samples shall be obtained by the use of hand auger or power flight auger. Other equipment such as a dragline or backhoe may be used if approved by the Engineer.

3. Samples shall be obtained by the Resident Engineer or his/her representative with a valid Borrow Pit Sampling Certification

4. Each sample shall consist of **5 to 8 pounds** of soil (fill sample bag one quarter full). Place a **completed** sample card (refer to Appendix C) in each bag.

5. A minimum of two **(2) test borings per acre** will be required. The minimum number shall be increased if determined necessary in order to obtain representative samples for the entire source.

6. Each test boring shall be identified by a stake driven adjacent to the test boring hole. The test boring number shall be shown on the stake.

7. Within each bore site samples will be acquired from any significantly different layer of soil. Combining materials from different layers into a composite sample will not be permitted.

8. Each test boring shall be designated numerically (S-1, S-2, S-3, etc.) in the order of drilling.

9. The first sample from a test boring shall be identified by the test boring number. Any additional samples from a test boring shall be identified by the test boring number plus an alphabetical letter (S-1, S-1A, S-1B, etc.) These additional samples shall be designated alphabetically in order from the surface down.

10. If the same soil type exists between multiple bore sites the sample can be referenced to the original soil sample. For example, if bore location number 3 from 0 – 2 feet in depth contains the same soil as encountered at bore location number 1 (0 - 2 feet) then an entry can be made on the boring log to reference soil at site #3 back to S-1 (i.e. R S-1). Therefore, no sample would be required from bore location number 3 from 0 – 2 feet in depth. Referencing soils should only be completed when the individual is confident that the material is the same (if in doubt take a sample). Refer to Appendix B for a boring log example.

11. A boring log shall be kept of each test boring and will show the following:

    a. Test boring number
    b. Visual description of the material encountered
    c. Elevation or depth below surface of layer of material encountered
    d. Location of samples obtained
    e. Location of water table
    f. Total depth of boring

12. For each source, a site map shall be prepared showing the following:

    a. The location of the source in relation to natural landmarks, property lines and/or existing public roads in the area.
    b. A plan view of the property and all test borings with identifying numbers labeled

Section 6 - Sampling Procedures – Contractor

If the Contractor provides resources used in obtaining samples, the following procedures will apply in addition to the procedures listed in the previous section.

1. The Contractor shall furnish all sampling equipment and competent personnel to operate the equipment.

2. A Division of Highways representative with a valid Borrow Pit Sampling Certification shall determine the frequency and location of all test borings.

3. All samples will be taken according to Section 5 of this manual in the presence of the Resident Engineer or his/her Borrow Pit Sampling Certified representative.

4. The Resident Engineer shall be responsible for ensuring that sufficient test borings are made and samples taken are representative of the proposed source.

5. The Contractor will be responsible for marking and placing an identifying stake at each boring site.

6. The Division of Highways representative shall transport all samples to a Materials and Test Unit laboratory. The Contractor shall not deliver any samples for testing. The Division of Highways will be responsible for any soil treatment necessary because of quarantine regulations of the U. S. and/or N.C. Department of Agriculture.

7. The Division of Highways representative shall maintain the boring log and prepare the site map. Upon completion of the investigation, one (1) copy of each will be transmitted to the Materials and Tests Unit.

Section 7 – Sampling Procedures – NCDOT

If the Department provides resources to obtain samples, the following procedures will apply in addition to the procedures listed in the general sampling section.

1. The Contractor’s request for Department to perform the sampling shall be submitted to the Resident Engineer in writing.

2. The Resident Engineer will forward the request and the other required data to the Geotechnical Engineering Unit.

3. The Geotechnical Engineering Unit, prior to performing any sampling, will contact the Resident Engineer to determine if he/she desires that project personnel be present.

4. The Geotechnical Engineering Unit will obtain the samples in accordance to Section 5 of this manual and transport them to a Materials and Tests Unit laboratory for testing.

5. The Geotechnical Engineering Unit will be responsible for marking and placing an identifying stake at each boring site.

6. The Geotechnical Engineering Unit will be responsible for any soil treatment necessary due to quarantine regulations of the U. S. and/or N. C. Department of Agriculture.

7. The Geotechnical Engineering Unit will be responsible for submitting cost data to the Finance Department for invoicing the Contractor.

Section 8 – Approving Borrow Source

The Materials and Tests Unit will submit copies of all test reports to the Resident Engineer for analysis. The Resident Engineer, utilizing the appropriate section(s) of the *Standard Specifications*, will analyze the test results, boring logs, and site map to determine the acceptability of the source. The Resident Engineer will also consider any applicable project special provisions as the basis for making the determination. The Geotechnical Engineering Unit, if requested, will assist the Resident Engineer in evaluating the material. The Resident Engineer will advise the Contractor in writing the following issues:

1. The limits of acceptable material.

2. If special handling of the material is necessary.

3. Approval of the source for borrow material is based on the limited sampling and test results of the samples submitted. Therefore, such approval is with the understanding that the Division of Highways reserves the right to use visual inspection and additional sampling on the roadway, as deemed appropriate by the Engineer, to reject any unsuitable material encountered. The rejection may occur regardless of whether or not such material was indicated as acceptable during initial borrow pit sampling.

4. Where deemed appropriate, the Resident Engineer will designate how the material is to be removed from the pit and also where to isolate areas or layers of unsuitable material in the pit.

5. Any material found on the roadway that fails to meet the acceptability requirements, shall be removed and replaced with acceptable material at no cost to the Department.

Appendix A

Borrow Material Criteria

The following information taken from Section 1018 of the *Standard Specifications* is provided in this manual for instructional purposes only. Use the latest edition of the *Standard Specifications* and/or appropriate Project Special Provisions when evaluating borrow material.

Statewide Criteria for Acceptance Borrow Material

Use only natural earth material. Any other materials are subject to rejection.

Piedmont and Western Area Criteria for Acceptance of Borrow Material	
Soil with PI of 25 or less	Acceptable
Soil with PI 26 through 35	Acceptable, but not to be used in top 3 feet of embankment or backfill
Soil with PI of more than 35	Not Acceptable

Table 6 Piedmont and Western Criteria for Acceptance of Borrow Material

Exceptions to Statewide Criteria for Acceptance of Borrow Material

1) Soils in the Coastal Plain (area described below) will be accepted in accordance with the following table.

Coastal Area Criteria for Acceptance of Borrow Material	
Soil with PI of 15 or less	Acceptable
Soil with PI 16 through 20	Acceptable, but not to be used in top 3 feet of embankment or backfill
Soil with PI of more than 20	Not Acceptable

Table 7 Coastal Area Criteria for Acceptance of Borrow Material

Areas where Coastal criteria are applicable are as follows:

Division 1 – Entire Division except Northampton (West of I-95)
Division 2 – Entire Division
Division 3 – Entire Division
Division 4 – Edgecombe, Wayne, Johnston, (East of US 301), Wilson (East of I-95), Nash (East of I-95), Halifax (East of I-95)
Division 6 – Bladen, Columbus, Robeson, Cumberland, Harnett, (South of NC 27)
Division 8 – Scotland, Hoke, Moore, (Southeast of US 15-501, NC 73, NC 211), Richmond (East of US 220 North and US 1 South)

The Coastal criteria shall be applicable to the flood plains of the Roanoke, Tar, Neuse, Cape Fear and Lumber Rivers and their tributaries that are outside the above described areas.

2) Waste or by-products from industrial processes or mining operations are not acceptable except by specific written approval.
3) When tested, soils having a pH of less than 5.5 or an organic content more than 4.0% may be rejected.
4) When material is to be used for placing embankment or backfilling of undercut areas that are excessively wet, the material shall consist of Class II, III, or IV select material.

Appendix B

Product Summary of Select Material and Shoulder / Slope Material

Refer to Section 1016 of the *Standard Specifications* for additional information

Material Type Select Material	General Description	Spec Book Reference Section	Sampled for:	QC/QA Program applies	Sampled by:	Sampled from:	Tested by:	Sampling Frequency	Sampling Certification Required	Some typical uses
Class I	Natural Soil	1016	Source Approval	No	Project Personnel	Borrow Pit or Stockpile	Soils Lab.	See comments below	Borrow Pit Sampling	Backfill, slope material, etc.
	Must be naturally occurring soil. Samples are tested for AASHTO Soil Classification. Tests performed include: AASHTO T 88, T 89, and T 90. For sampling frequency in a borrow pit, refer to the Borrow Pit Sampling Manual. When sampling from a stockpile, a minimum of 3 samples must be obtained using the alternate sampling method described in Appendix F of the Borrow Pit Sampling Manual. The Borrow Pit Sampling Manual is provided at the following website: https://connect.ncdot.gov/resources/Materials/Pages/SoilsLaboratory.aspx, under "Soils Laboratory Documents: Resource Type: Manuals". Indicate on the sample cards which select material specification the sample should be tested against (i.e. Select - Class I).									

Material Type Select Material	General Description	Spec Book Reference Section	Sampled for:	QC/QA Program applies	Sampled by:	Sampled from:	Tested by:	Sampling Frequency	Sampling Certification Required	Some typical uses
Class II Type 1	Manufactured fine aggregate product	1016 and 1006	Acceptance	Yes	Aggregate Producer	Stockpile	QC - Producer Lab QA - NCDOT	Refer to QC/QA Program	QC/QA Sampling	Bedding or backfill for pipe
	Acceptance is based on QC and QA Samples. Refer to Section 1006 of the Standard Specifications and the QC/QA Program manual for additional information. Project obtained samples are required if material is used to backfill a MSE wall. Refer to the "Mechanically Stabilized Earth Wall Fine Aggregate Sampling and Testing Procedures" manual for additional information. The manual is provided at the following website: https://connect.ncdot.gov/resources/Materials/Pages/default.aspx, and listed under "Forms, Manuals, and Other Documents", "Work Group - Chemical Laboratory".									
Class II Type 2	Natural Soil	1016	Source Approval	No	Project Personnel	Borrow Pit or Stockpile	Soils Lab.	See comments below	Borrow Pit Sampling	Backfill, slope material, etc.
	Must be naturally occurring soil. Samples are tested for AASHTO Soil Classification. Tests performed include: AASHTO T 88, T 89, and T 90. For sampling frequency in a borrow pit, refer to the Borrow Pit Sampling Manual. When sampling from a stockpile, a minimum of 3 samples must be obtained using the alternate sampling method described in Appendix F of the Borrow Pit Sampling Manual. The Borrow Pit Sampling Manual is provided at the following website: https://connect.ncdot.gov/resources/Materials/Pages/SoilsLaboratory.aspx, under "Soils Laboratory Documents: Resource Type: Manuals". Indicate on the sample cards which select material specification the sample should be tested against (i.e. Select - Class II Type 2).									

Material Type Select Material	General Description	Spec Book Reference Section	Sampled for:	QC/QA Program applies	Sampled by:	Sampled from:	Tested by:	Sampling Frequency	Sampling Certification Required	Some typical uses
Class III Type 1	Manufactured fine aggregate product	1016 and 1006	Acceptance	Yes	Aggregate Producer	Stockpile	QC - Producer Lab QA - NCDOT	Refer to QC/QA Program	QC/QA Sampling	Bedding or backfill for pipe
	Acceptance is based on QC and QA Samples. Refer to Section 1006 of the Standard Specifications and the QC/QA Program manual for additional information. Project obtained samples are required if material is used to backfill a MSE wall. Refer to the "Mechanically Stabilized Earth Wall Fine Aggregate Sampling and Testing Procedures" manual for additional information. The manual is provided at the following website: https://connect.ncdot.gov/resources/Materials/Pages/default.aspx, and listed under "Forms, Manuals, and Other Documents", "Work Group - Chemical Laboratory".									
Class III Type 2	Natural Soil	1016	Source Approval	No	Project Personnel	Borrow Pit or Stockpile	Soils Lab.	See comments below	Borrow Pit Sampling	Bedding or backfill for pipe
	Must be naturally occurring soil. Samples are tested for AASHTO Soil Classification. Tests performed include: AASHTO T 88, T 89, and T 90. For sampling frequency in a borrow pit, refer to the Borrow Pit Sampling Manual. When sampling from a stockpile, a minimum of 3 samples must be obtained using the alternate sampling method described in Appendix F of the Borrow Pit Sampling Manual. The Borrow Pit Sampling Manual is provided at the following website: https://connect.ncdot.gov/resources/Materials/Pages/SoilsLaboratory.aspx, under "Soils Laboratory Documents: Resource Type: Manuals" Indicate on the sample cards which select material specification the sample should be tested against (i.e. Select - Class III Type 2).									
Class III Type 3	Manufactured fine aggregate product	1016 and 1006	Acceptance	Yes	Aggregate Producer	Stockpile	QC - Producer Lab QA - NCDOT	Refer to QC/QA Program	QC/QA Sampling	Backfill for MSE walls
	Acceptance is based on QC and QA Samples. Refer to Section 1006 of the Standard Specifications and the QC/QA Program manual for additional information. Project obtained samples are required if material is used to backfill a MSE wall. Refer to the "Mechanically Stabilized Earth Wall Fine Aggregate Sampling and Testing Procedures" manual for additional information. The manual is provided at the following website: https://connect.ncdot.gov/resources/Materials/Pages/default.aspx, and listed under "Forms, Manuals, and Other Documents", "Work Group - Chemical Laboratory".									

Material Type Select Material	General Description	Spec Book Reference Section	Sampled for:	QC/QA Program applies	Sampled by:	Sampled from:	Tested by:	Sampling Frequency	Sampling Certification Required	Some typical uses
Class IV	Similar to ABC	1016 and 1006	Acceptance (QC/QA) Optional (roadway)	Yes	Aggregate Producer	Stockpile	QC - Producer Lab QA - NCDOT	Refer to QC/QA Program	QC/QA Sampling	Backfill for undercut
	Acceptance is based on QC and QA Samples. Refer to Section 1006 of the Standard Specifications and the QC/QA Program manual for additional information. **Project acceptance samples are optional.** If samples are taken, follow procedures in the Aggregate (ABC) Sampling Manual. The Aggregate (ABC) Sampling Manual is provided at the following website:https://connect.ncdot.gov/resources/Materials/Pages/SoilsLaboratory.aspx, under "Soils Laboratory Documents Resource Type: Manuals".									

Material Type Select Material	General Description	Spec Book Reference Section	Sampled for:	QC/QA Program applies	Sampled by:	Sampled from:	Tested by:	Sampling Frequency	Sampling Certification Required	Some typical uses
Class V	78M	1016 and 1006	Acceptance	Yes	Aggregate Producer	Stockpile	QC - Producer Lab QA - NCDOT	Refer to QC/QA Program	QC/QA Sampling	Foundation conditioning for pipe
	Acceptance is based on QC and QA Samples. Refer to Section 1006 of the Standard Specifications and the QC/QA Program manual for additional information.									

Material Type Select Material	General Description	Spec Book Reference Section	Sampled for:	QC/QA Program applies	Sampled by:	Sampled from:	Tested by:	Sampling Frequency	Sampling Certification Required	Some typical uses
Class VI	57	1016 and 1006	Acceptance	Yes	Aggregate Producer	Stockpile	QC - Producer Lab QA - NCDOT	Refer to QC/QA Program	QC/QA Sampling	Foundation conditioning for pipe
	Acceptance is based on QC and QA Samples. Refer to Section 1006 of the Standard Specifications and the QC/QA Program manual for additional information.									

Material Type Select Material	General Description	Spec Book Reference Section	Sampled for:	QC/QA Program applies	Sampled by:	Sampled from:	Tested by:	Sampling Frequency	Sampling Certification Required	Some typical uses
Class VII	Rip Rap	1016	N/A	N/A	N/A	N/A	N/A	See comments below	N/A	Rock embankment in open water, erosion control, etc
	Material is visually inspected for compliance with Specifications.									

Material Type Shoulder / Slope Material	General Description	Spec Book Reference Section	Sampled for:	QC/QA Program applies	Sampled by:	Sampled from:	Tested by:	Sampling Frequency	Sampling Certification Required	Some typical uses
Shoulder Slope Borrow	Soil for constructing or plating shoulders	1019	Source Approval	No	Project Personnel	Borrow Pit or Stockpile	Soils Lab	See comments below	Borrow Pit Sampling	Slope plating to support vegetation
	Samples are tested to determine if the material meets criteria set in Section 1019-2 of the Specifications. For sampling frequency in a borrow pit, refer to the Borrow Pit Sampling Manual. When sampling from a stockpile, a minimum of 3 samples must be obtained using the alternate sampling method described in Appendix F of the Borrow Pit Sampling Manual. The Borrow Pit Sampling manual is provided at the following website: https://connect.ncdot.gov/resources/Materials/Pages/SoilsLaboratory.aspx, under "Soils Laboratory Document Resource Type: Manuals". Tests include AASHTO T 88, T 89, T 90 and T 289. If the pH exceeds specification limitations it maybe treated with lime if approved by the Engineer. Indicate on the sample cards what the sample should be tested against. (i.e. Shoulder Construction - Article 1019 P.I. and pH).									
Aggregate Shoulder Borrow	Blend of coarse and fine aggregate	1019	Acceptance	No	Project Personnel	Borrow Pit or Stockpile	Soils Lab	See comments below	ABC Sampling and Borrow Pit	Rebuilding shoulders after re-surfacing roadway
	Samples are tested to determine if the material meets criteria set in Section 1019-3 of the Specifications. For sampling frequency in a borrow pit, refer to the Borrow Pit Sampling Manual. When sampling from a stockpile on the project follow procedures listed in Appendix E of the Aggregate (ABC) Sampling Manual. The Borrow Pit and Aggregate (ABC) Sampling Manuals are provided at the following website: https://connect.ncdot.gov/resources/Materials/Pages/SoilsLaboratory.aspx, under "Soils Laboratory Document Resource Type: Manuals". Obtain one sample for each 2,500 tons. Tests include AASHTO T 88. Indicate on the sample cards what the sample should be tested against. (i.e. A.S.B. - Table 1019-1).									

Appendix C

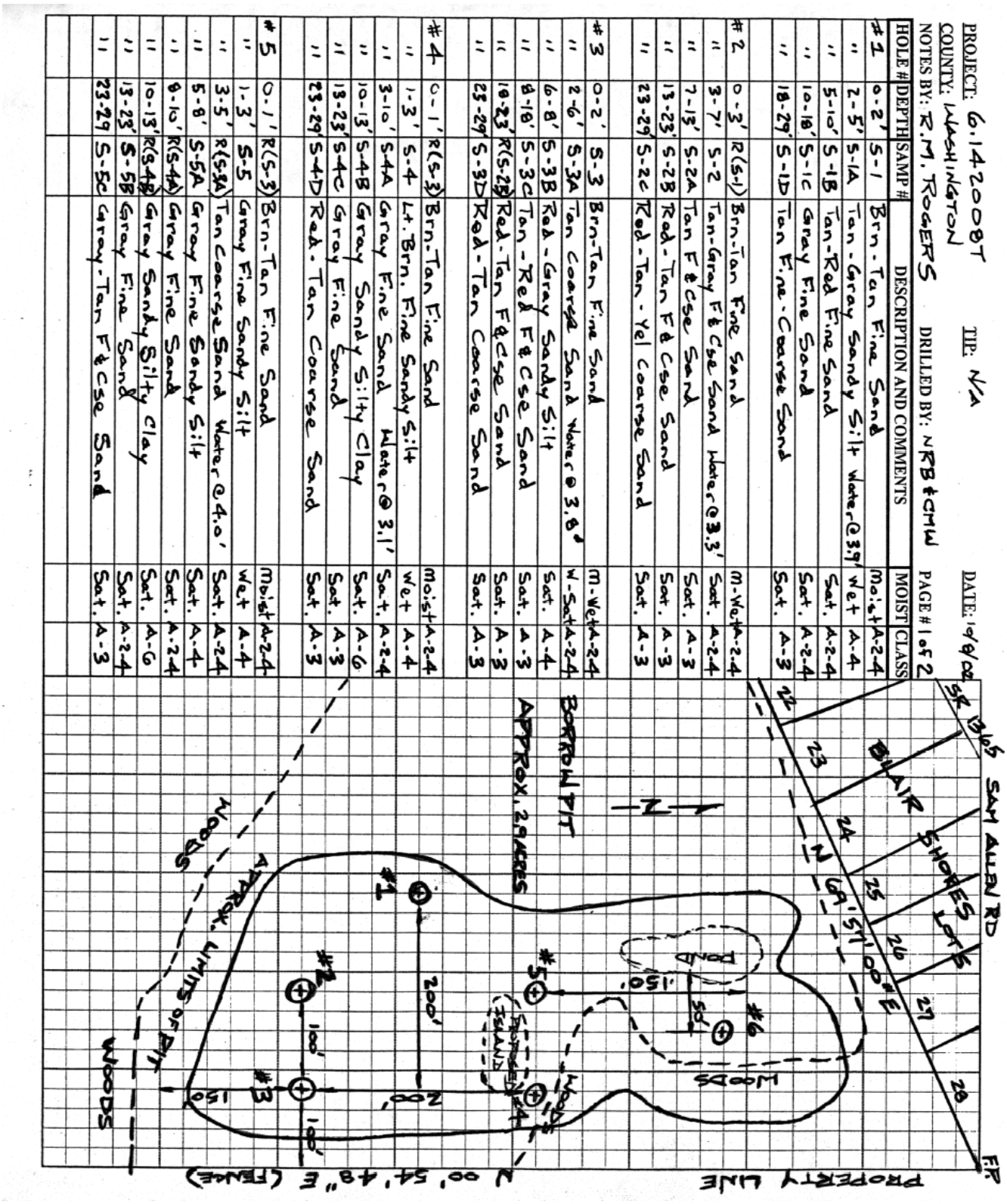
Boring Log Example and Blank Boring Log Sheets

PROJECT: 6.142008T TIP: N/A DATE: 10/9/08

COUNTY: WASHINGTON

NOTES BY: R.M. ROGERS DRILLED BY: NRB & CMW PAGE # 1 OF 2

HOLE #	DEPTH	SAMP #	DESCRIPTION AND COMMENTS	MOIST	CLASS
#1	0-2'	S-1	Brn-Tan Fine Sand	Moist	A-2-4
"	2-5'	S-1A	Tan-Gray Sandy Silt Water@3.9'	wet	A-4
"	5-10'	S-1B	Tan-Red Fine Sand	Sat.	A-2-4
"	10-18'	S-1C	Gray Fine Sand	Sat.	A-2-4
"	18-29'	S-1D	Tan F.ne-Coarse Sand	Sat.	A-3
#2	0-3'	R(S-1)	Brn-Tan Fine Sand	M-Wet	A-2-4
"	3-7'	S-2	Tan-Gray F&Cse Sand Water@3.3'	Sat.	A-2-4
"	7-13'	S-2A	Tan F&Cse Sand	Sat.	A-3
"	13-23'	S-2B	Red-Tan F&Cse Sand	Sat.	A-3
"	23-29'	S-2C	Red-Tan-Yel Coarse Sand	Sat.	A-3
#3	0-2'	S-3	Brn-Tan Fine Sand	M-Wet	A-2-4
"	2-6'	S-3A	Tan Coarse Sand Water@3.8'	W-Sat	A-2-4
"	6-8'	S-3B	Red-Gray Sandy Silt	Sat.	A-4
"	8-18'	S-3C	Tan-Red F&Cse Sand	Sat.	A-3
"	18-23'	R(S-2B)	Red-Tan F&Cse Sand	Sat.	A-3
"	23-29'	S-3D	Red-Tan Coarse Sand	Sat.	A-3
#4	0-1'	R(S-3)	Brn-Tan Fine Sand	Moist	A-2-4
"	1-3'	S-4	Lt. Brn. Fine Sandy Silt	wet	A-4
"	3-10'	S-4A	Gray Fine Sand Water@3.1'	Sat.	A-2-4
"	10-13'	S-4B	Gray Sandy Silty Clay	Sat.	A-6
"	13-23'	S-4C	Gray Fine Sand	Sat.	A-3
"	23-29'	S-4D	Red-Tan Coarse Sand	Sat.	A-3
#5	0-1'	R(S-3)	Brn-Tan Fine Sand	Moist	A-2-4
"	1-3'	S-5	Gray Fine Sandy Silt	wet	A-4
"	3-5'	R(S-5A)	Tan Coarse Sand Water@4.0'	Sat.	A-2-4
"	5-8'	S-5A	Gray Fine Sandy Silt	Sat.	A-4
"	8-10'	R(S-4A)	Gray Fine Sand	Sat.	A-2-4
"	10-13'	R(S-4B)	Gray Sandy Silty Clay	Sat.	A-6
"	13-23'	S-5B	Gray Fine Sand	Sat.	A-2-4
"	23-29	S-5C	Gray-Tan F&Cse Sand	Sat.	A-3



PROJECT: 6.142008T TIP: N/A DATE: 10/8/02

COUNTY: WASHINGTON

NOTES BY: R. M. ROGERS DRILLED BY: NRB & CMW PAGE # 2 of 2

HOLE #	DEPTH	SAMP #	DESCRIPTION AND COMMENTS	MOIST	CLASS
# 6	0-4'	S-6	Brn-Tan Fine Sand	m-Wet	A-2-4
"	4-10'	S-6A	White-Gray Fine Sand Water @ 5.0'	Sat.	A-3
"	10-12'	R(S-6B)	Gray Sandy Silty Clay	Sat.	A-6
"	12-18'	S-6B	Gray Fine & Coarse Sand	Sat.	A-3
"	18-23'	S-6C	Gray F-Coarse Sand	Sat.	A-3
"	23-29'	S-6D	Gray Coarse Sand	Sat.	A-3

PROJECT: **TIP:** **DATE:**

COUNTY:

NOTES BY: **DRILLED BY:** **PAGE #**

HOLE #	DEPTH	SAMP #	DESCRIPTION AND COMMENTS	MOIST	CLASS

PROJECT: **TIP:** **DATE:**

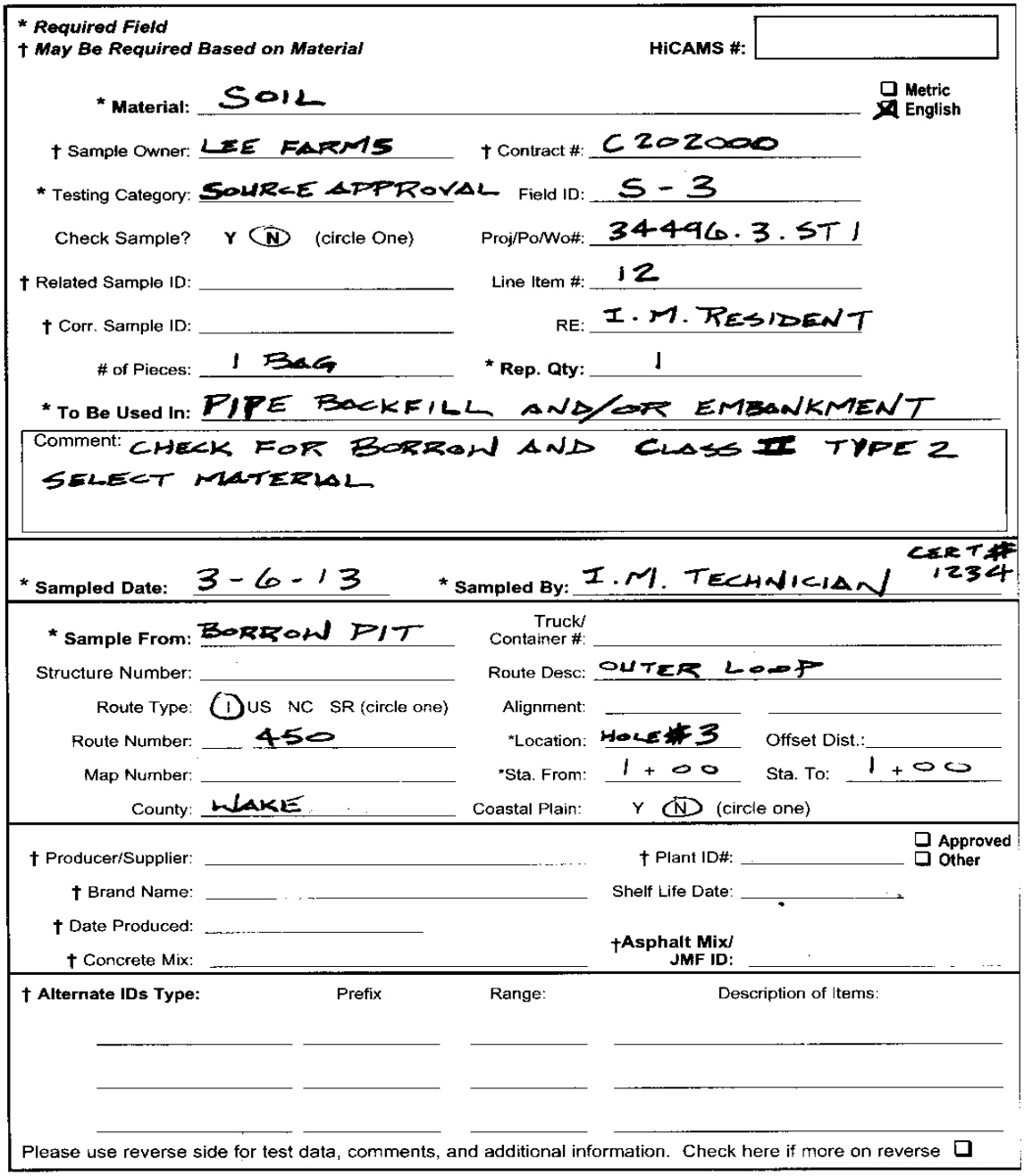
COUNTY:

NOTES BY: **DRILLED BY:** **PAGE #**

HOLE #	DEPTH	SAMP #	DESCRIPTION AND COMMENTS	MOIST	CLASS

Appendix D
Sample Card Examples

The following sample card examples represent typical borrow samples obtained from a pit. Note the samples in this example are to be checked for borrow source approval and Select Material Class II Type 2 source approval. Sample cards shall be legible and completed with all required information.



* *Required Field*
† *May Be Required Based on Material*

HiCAMS #:

* Material: SOIL ☐ Metric ☒ English

† Sample Owner: LEE FARMS † Contract #: C202000

* Testing Category: SOURCE APPROVAL Field ID: S-3

Check Sample? Y (N) (circle One) Proj/Po/Wo#: 34496.3.ST1

† Related Sample ID: Line Item #: 12

† Corr. Sample ID: RE: I.M. RESIDENT

# of Pieces: 1 BAG * Rep. Qty: 1

* To Be Used In: PIPE BACKFILL AND/OR EMBANKMENT

Comment: CHECK FOR BORROW AND CLASS II TYPE 2 SELECT MATERIAL

* Sampled Date: 3-6-13 * Sampled By: I.M. TECHNICIAN CERT# 1234

* Sample From: BORROW PIT Truck/ Container #:

Structure Number: Route Desc: OUTER LOOP

Route Type: (I) US NC SR (circle one) Alignment:

Route Number: 450 *Location: HOLE #3 Offset Dist.:

Map Number: *Sta. From: 1+00 Sta. To: 1+00

County: WAKE Coastal Plain: Y (N) (circle one)

† Producer/Supplier: † Plant ID#: ☐ Approved ☐ Other

† Brand Name: Shelf Life Date:

† Date Produced:

† Concrete Mix: †Asphalt Mix/ JMF ID:

† Alternate IDs Type:	Prefix	Range:	Description of Items:

Please use reverse side for test data, comments, and additional information. Check here if more on reverse ☐

* ***Required Field***
† ***May Be Required Based on Material***

HiCAMS #:

* **Material:** SOIL ☐ Metric ☒ English

† Sample Owner: LEE FARMS † Contract #: C202000

* Testing Category: SOURCE APPROVAL Field ID: S-4A

Check Sample? Y (N) (circle One) Proj/Po/Wo#: 34496.3.ST1

† Related Sample ID: _____ Line Item #: 12

† Corr. Sample ID: _____ RE: I.M. RESIDENT

# of Pieces: 1 BAG * Rep. Qty: 1

* To Be Used In: PIPE BACKFILL AND/OR EMBANKMENT

Comment: CHECK FOR BORROW AND CLASS II TYPE 2 SELECT MATERIAL

* Sampled Date: 3-6-13 * Sampled By: IM TECHNICIAN CERT# 1234

* Sample From: BORROW PIT Truck/ Container #: _____

Structure Number: _____ Route Desc: OUTER LOOP

Route Type: (US) NC SR (circle one) Alignment: _____ _____

Route Number: 450 *Location: HOLE #4 Offset Dist.: _____

Map Number: _____ *Sta. From: 2+00 Sta. To: 2+00

County: WAKE Coastal Plain: Y (N) (circle one)

† Producer/Supplier: _____ † Plant ID#: _____ ☐ Approved ☐ Other

† Brand Name: _____ Shelf Life Date: _____

† Date Produced: _____

† Concrete Mix: _____ †Asphalt Mix/ JMF ID: _____

† Alternate IDs Type:	Prefix	Range:	Description of Items:

Please use reverse side for test data, comments, and additional information. Check here if more on reverse ☐

Appendix E
Soil Classification Test Report Examples

Using test reports, appropriate sections of the *Standard Specifications*, and the Boring Log, establish a soil profile of the proposed pit. Designate sections of the pit where soil may not be acceptable or have restricted uses (i.e. not to be used in top 2 feet of embankment). Refer to Section 8 in this manual for additional information.

M & T Form 503

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAY
MATERIALS & TESTS UNIT
SOILS LABORATORY

T. I. P. No. -

REPORT ON SAMPLES OF BORROW --- Statewide Criteria

Project	8.2428603	**County**	DAVIDSON	**Owner**	J. C. SMOE
Date: Sampled	2/26/93	**Received**	3/1/93	**Reported**	3/8/093
Sampled from	PIT#3			**By**	GILLIAM&WEAVER
Submitted by	R. O. BLACK JR.				1990 **Standard Specifications**

931061 TO 931074
10/17/02

TEST RESULTS

Proj. Sample No.		1	1A	1B	2	2A	3
Lab. Sample No.		931061	931062	931063	931064	931065	931066
Retained #4 Sieve	%	-	-	-	-	-	-
Passing #10 Sieve	%	100	100	100	100	100	100
Passing #40 Sieve	%	99	100	100	100	100	97
Passing #200 Sieve	%	77	83	87	85	94	82

MINUS NO. 10 FRACTION

SOIL MORTAR - 100%							
Coarse Sand Ret - #60	%	18.0	14.0	12.0	21.0	16.0	19.0
Fine Sand Ret - #270	%	18.0	7.0	10.0	17.0	10.0	17.0
Silt 0.05 - 0.005 mm	%	43.0	40.0	32.0	27.0	29.0	40.0
Clay < 0.005 mm	%	21.0	39.0	46.0	35.0	45.0	24.0
Passing #40 Sieve	%	-	-	-	-	-	-
Passing #200 Sieve	%	-	-	-	-	-	-

L. L.		49	54	62	55	59	46
P. I.		10	21	28*	16	28*	14
AASHTO Classification		A-5(10)	A-7-5(20)	A-7-5(29)	A-7-5(18)	A-7-5(32)	A-7-5(13)
Station							
Hole No.		1	1	1	2	2	3
Depth (Ft)		0.00	3.00	8.00	0.00	4.00	0.00
	to	3.00	8.00	11.00	4.00	9.00	2.00
		OK	OK	--	OK	--	OK

cc: R. O. BLACK
Soils File

* Acceptable But Not to be used in the top 2 ft of embankment or backfill.

Soils Engineer

Page 1

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAY
MATERIALS & TESTS UNIT
SOILS LABORATORY

T. I. P. No. _____

REPORT ON SAMPLES OF BORROW --- Statewide Criteria

Project	8.2428603	**County**	DAVIDSON	**Owner**	J. C. SMOE
Date: Sampled	2/26/93	**Received**	3/1/93	**Reported**	3/8/093
Sampled from	PIT#3			**By**	GILLIAM&WEAVER
Submitted by	R. O. BLACK JR.			1990	**Standard Specifications**

931061 TO 931074
10/17/02

TEST RESULTS

Proj. Sample No.		3A	3B	4	4A	5	5A
Lab. Sample No.		931067	931068	931069	931070	931071	931072
Retained #4 Sieve	%	-	-	-	-	-	-
Passing #10 Sieve	%	100	100	100	100	100	100
Passing #40 Sieve	%	100	100	99	100	89	99
Passing #200 Sieve	%	92	98	81	92	70	87

MINUS NO. 10 FRACTION

SOIL MORTAR - 100%							
Coarse Sand Ret - #60	%	13.0	16.0	36.0	21.0	29.0	19.0
Fine Sand Ret - #270	%	11.0	12.0	13.0	11.0	14.0	8.0
Silt 0.05 - 0.005 mm	%	47.0	29.0	40.0	27.0	38.0	29.0
Clay < 0.005 mm	%	29.0	43.0	21.0	41.0	29.0	44.0
Passing #40 Sieve	%	-	-	-	-	-	-
Passing #200 Sieve	%	-	-	-	-	-	-

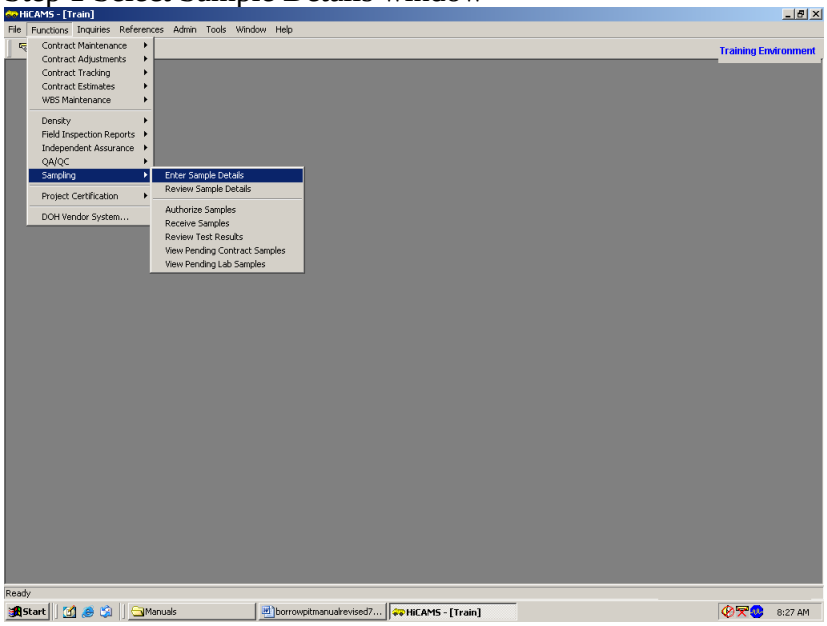
L. L.	49	67	64	59	58	67
P. I.	19	30*	18	27*	19	26*
AASHTO Classification	A-7-5(21)	A-7-5(38)	A-7-5(20)	A-7-5(30)	A-7-5(15)	A-7-5(29)
Station						
Hole No.	3	3	4	4	5	5
Depth (Ft)	2.00	7.00	0.00	4.00	0.00	4.00
to	7.00	10.00	4.00	10.00	4.00	9.00
	OK	--	OK	--	OK	--

_____
Soils Engineer

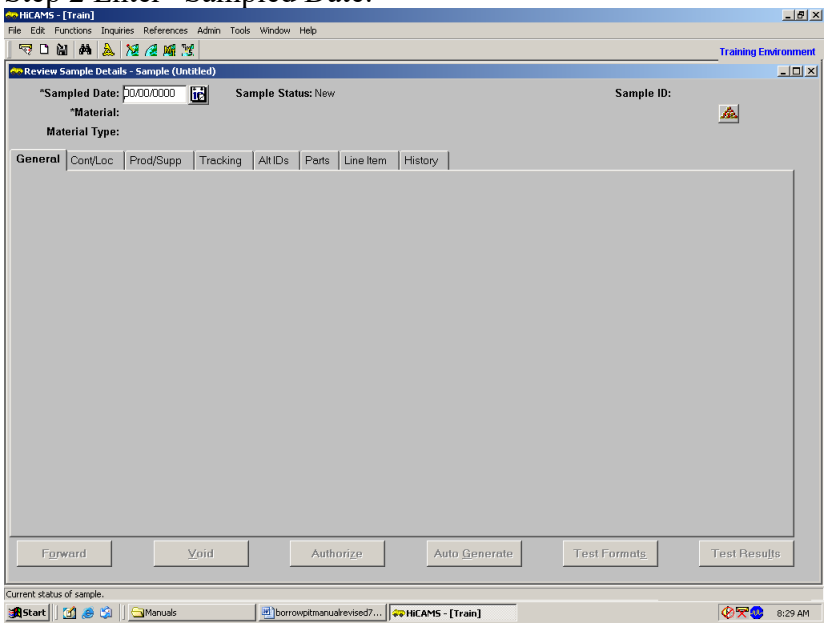
Appendix F

This appendix summarizes the steps for entering borrow pit soil samples into HiCAMS. If the technician sampling a proposed borrow pit does not have an active Borrow Pit Sampling Certification the sample will not count towards the minimum sampling frequency as required by the Minimum Sampling Guide. Any samples obtained by a technician without a valid certification will be used for information only. For this example, the sample was obtained for a construction project in the Cumberland County area.

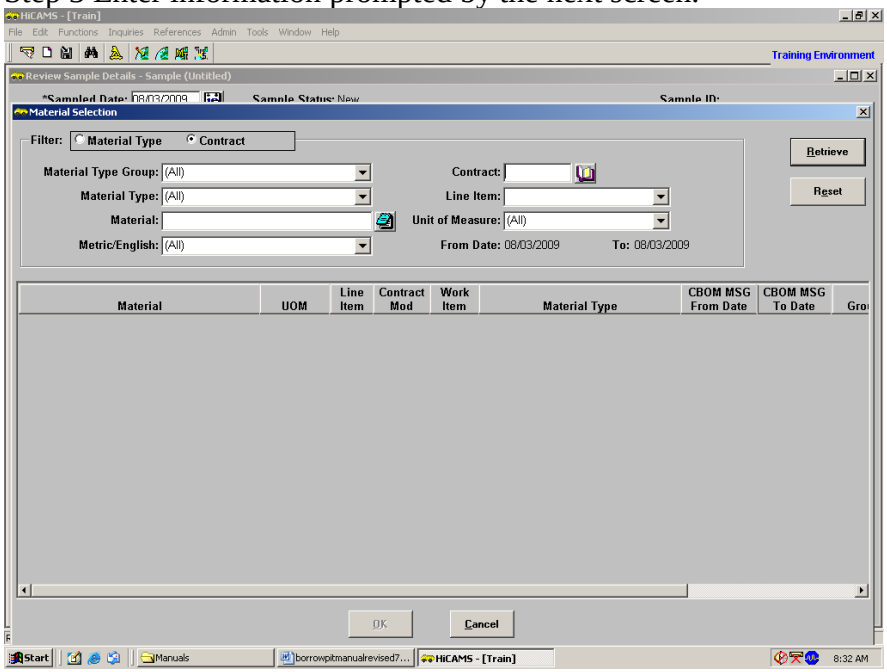
Step 1 Select Sample Details window



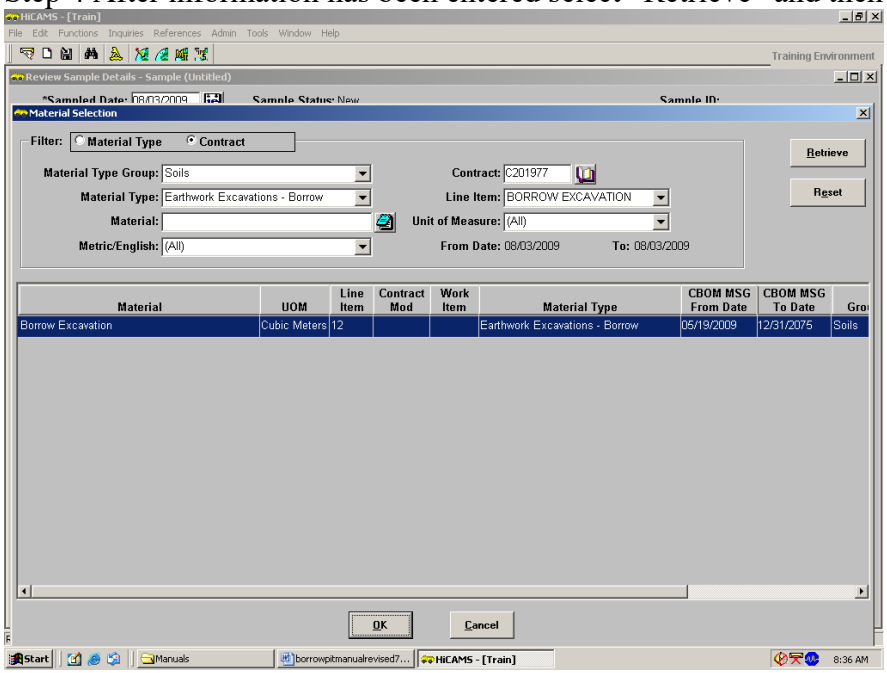
Step 2 Enter "Sampled Date:"



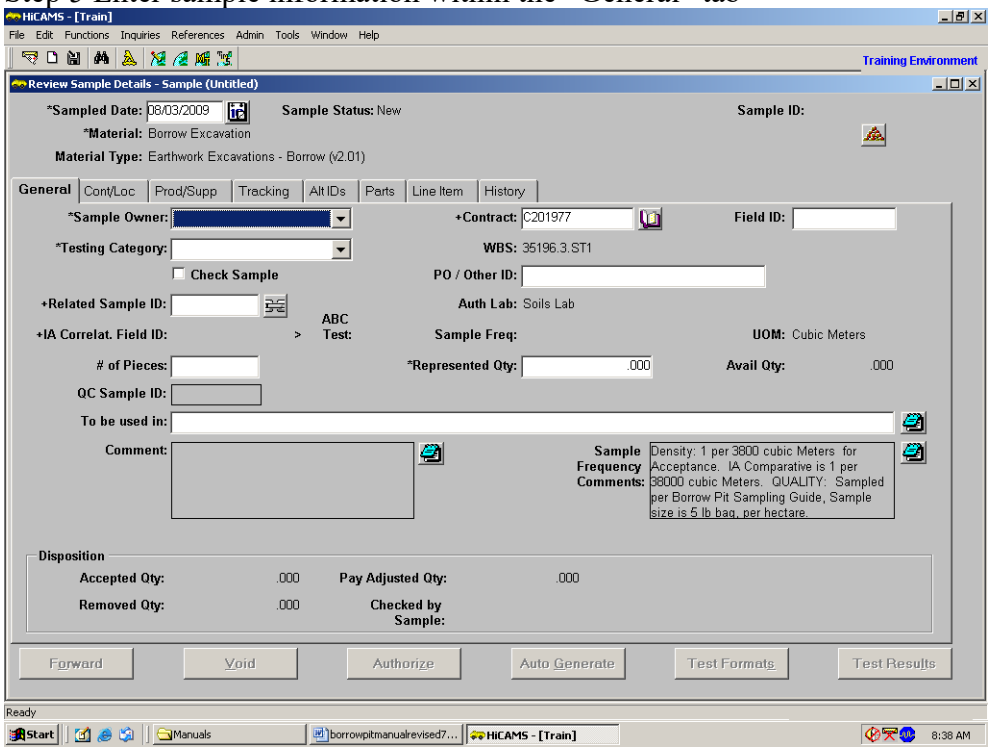
Step 3 Enter information prompted by the next screen.



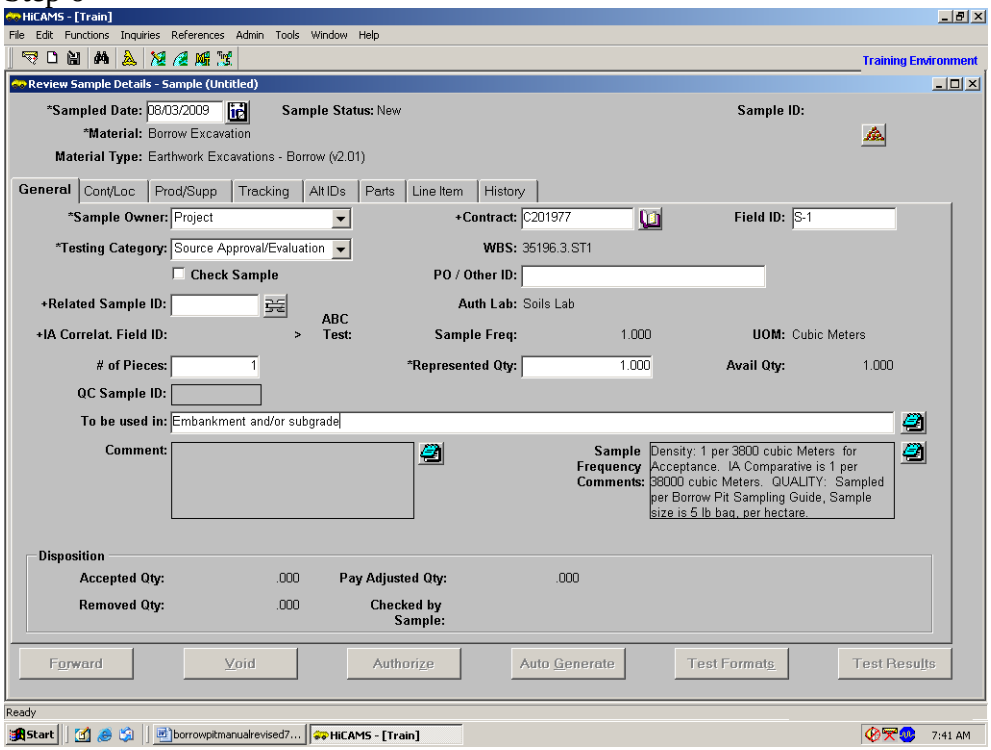
Step 4 After information has been entered select “Retrieve” and then select “OK”



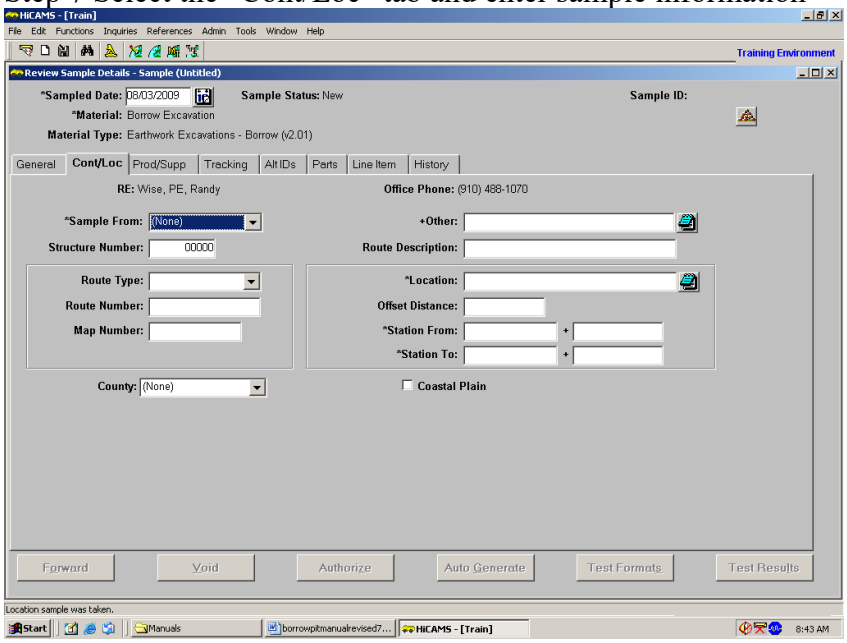
Step 5 Enter sample information within the “General” tab



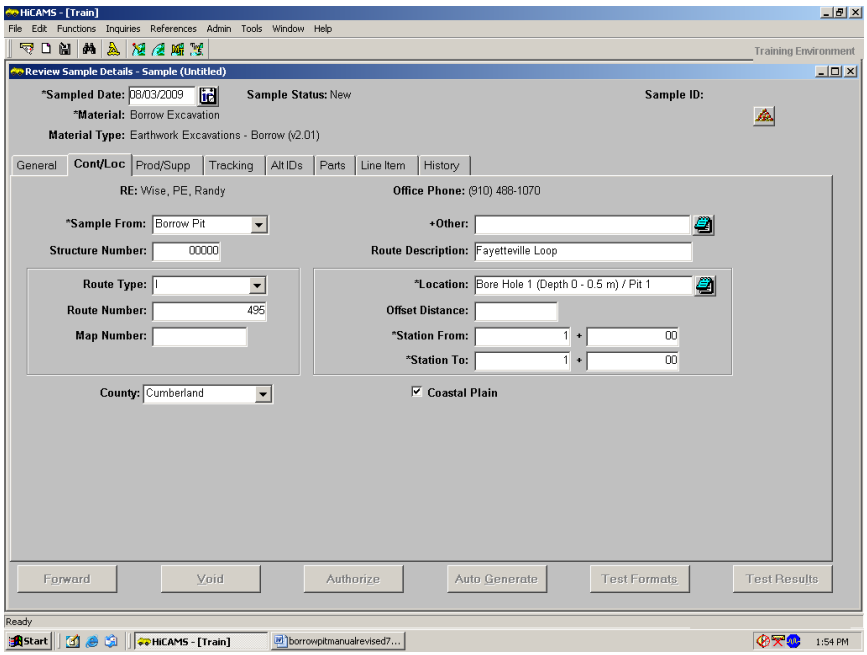
Step 6



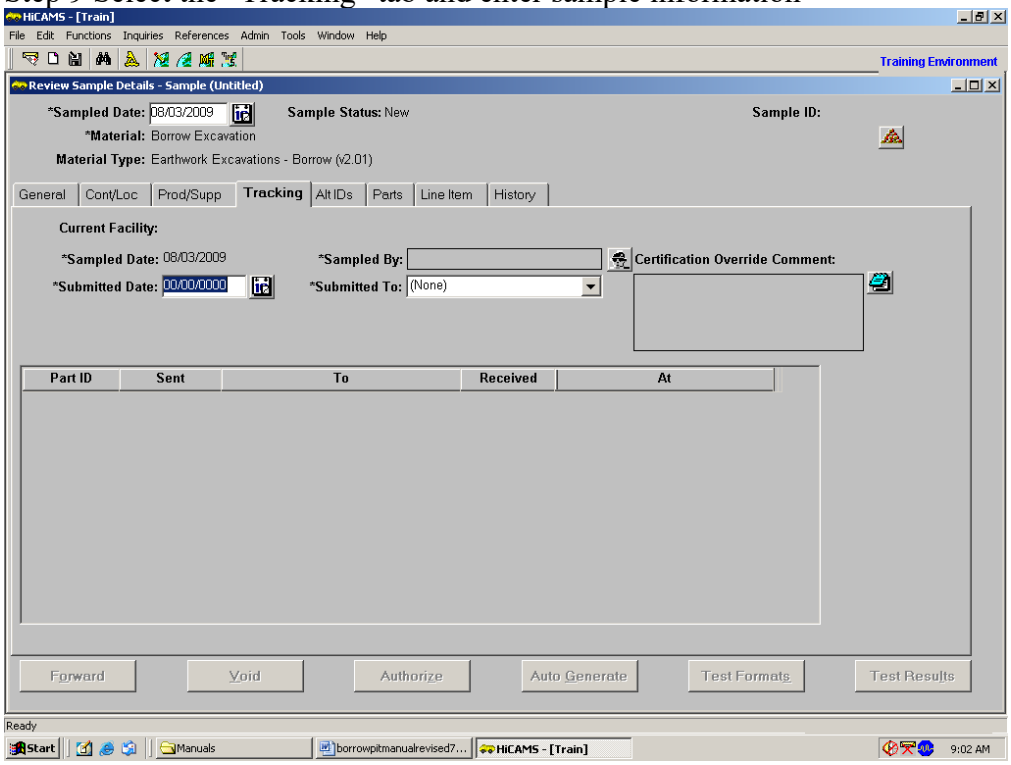
Step 7 Select the “Cont/Loc” tab and enter sample information



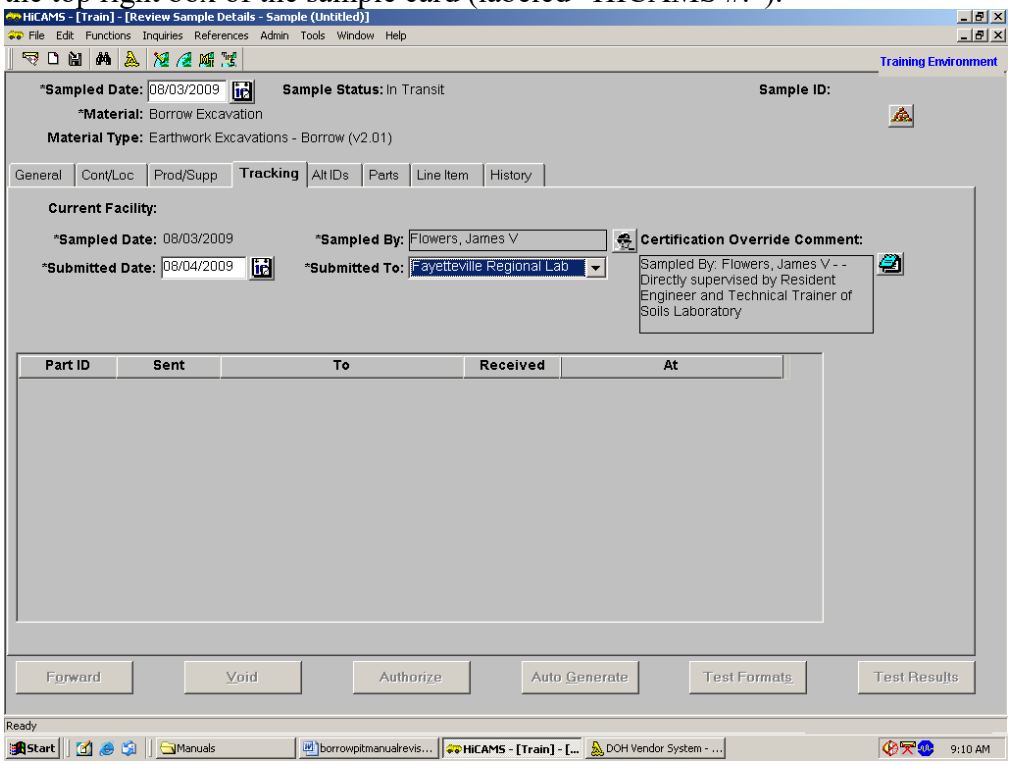
Step 8 Note: this project has more than one borrow pit as indicated in the “Location” entry window. The approximate depth from which the soil sample was obtained is also listed in the “Location” window. If station(s) are provided, enter into “Station” windows. “Coastal Plain” is checked due to Cumberland County falling within the coastal plain criteria requirements. Refer to Section 1018 Borrow Material in the *Standard Specifications* to determine if the proposed borrow pit meets statewide or coastal plain criteria.



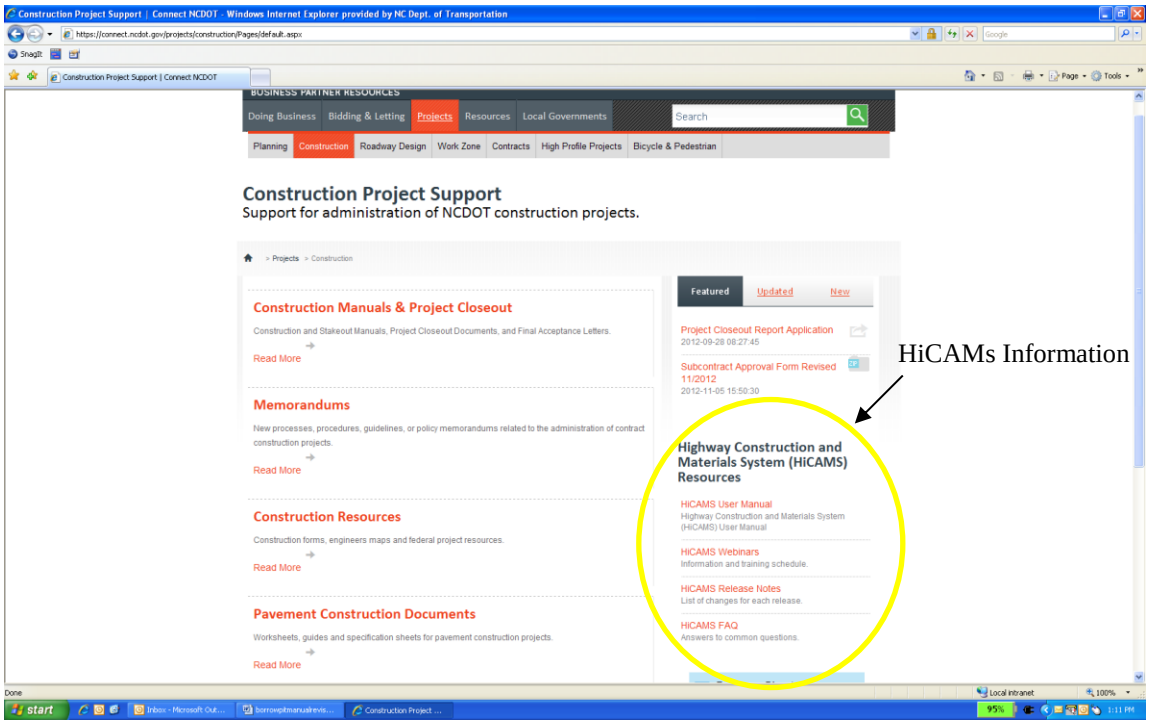
Step 9 Select the “Tracking” tab and enter sample information



Step 10 Enter sample information and select the save button. Record the “Sample ID” in the top right box of the sample card (labeled “HICAMS #:”).



Since the HiCAMs database is changed periodically, personnel responsible for entering data into the system should monitor the Construction Unit's website for updates.



Appendix G

This appendix describes sampling procedures when obtaining soil samples from a stockpile. Samples are to be tested for "Source Approval/Evaluation". Utilize plans, *Standard Specifications* or appropriate Project Special Provisions to determine which minimum criteria the soil must meet. Indicate on each sample card which criteria the sample should be checked against (i.e. Class I, Class II Type 2, etc.) Additional information regarding select material is provided in Appendix A.
If the material to be sampled has been stockpiled, a wheeled or tracked loader unit should be used to obtain representative samples. The equipment and procedures for obtaining a sample are as follows:

Equipment

1. Flat shovel
2. Large scoop
3. Sample bags (in good condition)
4. Plastic ties
5. Sample cards
6. Plastic bags (for sample cards)
7. Boring log sheet

Procedures

1. A minimum of three samples should be taken from three different locations around the stockpile
2. The loader unit should approach the pile with the bucket as low as possible
3. While moving forward push the bucket into the pile and lift the bucket up through the pile
4. This first bucket of material is placed to the side
5. Repeat steps 2 and 3 at the same location and obtain one full loader bucket of material
6. Dump the material and, using the loader unit, strike off the top half of the conical shaped pile
7. Using a flat shovel divide the flat surface of the struck off pile into four quadrants by scribing a "plus"sign.
8. Designate the quadrants as "A" , "B", "C" and "D"
9. Obtain one large scoop or shovel full of material from two opposing quadrants (i.e. A and D or B and C)
10. Repeat steps 2 through 10 at opposing locations around the stockpile for the remaining two samples
11. If needed, additional samples may be taken (especially if the material within the pile varies)
12. Complete a sample card for each bag (note on the sample card which criteria to check sample against i.e. Class I, Class II - Type 2, etc.)
13. Place each sample card in a plastic bag

14. Place a completed sample card in each bag
15. Complete boring log and include a sketch of stockpile along with approximate sample locations
16. Submit samples to the GeoMaterials Laboratory
17. As soil is excavated from the stockpile and delivered to the project note if changes occur in the material
18. If needed re-sample soil to verify it meets minimum specification criteria
19. Complete boring log and include sketch of stockpile along with approximate sample locations

Glossary

Atterburg Limits – Four states of soil consistency as defined by the liquid limit, plastic limit and shrinkage limit tests.

Capillary Action (Capillarity) – The rise or movement of water in the interstices of a soil due to capillary forces

Capillary Water – Water subject to the influence of capillary action

Cohesion – All of the shear strength of a soil not due to friction; the capacity of sticking or adhering together

Consolidation – The gradual reduction in volume of a soil mass resulting from an increase in compressive stress

Elasticity – Ability of a soil to return to its original shape after having been deformed by a load for a short period of time

Equigranular – A soil that is made up of predominately one grain size

Friable – Easily crumbled, as would be the case with rock that is poorly cemented

Liquid Limit – The water content, as determined by the standard liquid limit test, at which a soil passes from a plastic to a liquid state.

Optimum Moisture Content – The moisture content at which a soil can be compacted to its maximum dry density with a given compactive effort.

Plasticity – The property of a soil that allows it to be deformed beyond the point of recovery without cracking or appreciable volume change.

Plastic Index – The numerical difference between the liquid limit and the plastic limit.

Plastic Limit – The lowest water content, as determined by the standard plastic limit test, at which a soil remains plastic.

Shrinkage and Swell – Volume change due to build-up and release of capillary tensile stresses within the soil's pore water.

Soil – Any earthen material, excluding bed rock, composed of loosely bound mineral grains of various sized and shapes, organic material, water, and gases.

Soil Binder – The finer sized particles in a soil that serve the purpose of holding the soil together.

Soil Horizon – One of the layers of the soil profile, distinguished principally by its various layers, as developed by deposition or weathering or both.

Soil Profile – Vertical section of a soil, showing the nature and sequence of the various layers, as developed by deposition or weathering or both.

Soil Texture (Grain Size Distribution or Gradation) – Proportion of a material of each grain size present in a given soil.

Water Content (Moisture Content) – The ratio, expressed as a percentage, of the weight of water in a given soil mass to the weight of solid particles

References

FHWA. (August 2000) *Soils and Foundation Workshop Reference Manual.* USDOT, FHWA NHI-00-045.