

LIST OF TABLES

Table A-1	Data Quality Objectives
Table A-2	Decision Criteria used for Initial Disposal Classification of Sediments under RCRA and TSCA Disposal Rules
Table B-1	Example Sample ID and Horizontal Coordinates
Table B-2	River Section 1 Program Summary
Table B-3	River Section 2 Program Summary
Table B-4	River Section 3 Program Summary
Table B-5	Sample Container and Preservation Requirements
Table B-6a – B-6j	Reference Limit and Evaluation Tables for Analytical Methods
Table B-7a – B-7n	Measurement Performance Criteria Tables for Analytical Methods
Table B-8	Data Collected During Sediment Core Collection
Table B-9	Data Collected During Sample Processing in the Field Lab
Table B-10	Valid Values for PCBs
Table C-1	Summary of Analyses for Initial PE Acceptance Criteria Development
Table C-2	Summary of Analyses for Inter-Laboratory Comparison Study
Table D-1	Format of an Environmental Standards Quality Assurance Review

APPENDICES

Appendix 1	SOP for Sediment Core Collection
Appendix 2	SOP for Bathymetric Survey
Appendix 3	SOP for Sub-Bottom Acoustic and Electromagnetic Surveying Equipment
Appendix 4	SOP for Sediment Probing
Appendix 5	SOP for the Analysis of PCBs by SW-846 Method 8082 (GEHR8082)
Appendix 6	SOP for the Extraction and Cleanup of Sediment/Solid Samples for PCB Analysis Using the Pressurized Fluid Extraction by SW-846 Method 3545 (GEHR3545)
Appendix 7	SOP for the Extraction and Cleanup of Sediment/Soil Samples for PCB Analysis Using the Soxhlet Extraction by SW-846 Method 3540C (GEHR3540C)
Appendix 8	SOP for Analysis of PCB Homologs by EPA Method 680 (GEHR680)
Appendix 9	SOP for Data Package Deliverable (DPSOP)
Appendix 10	SOP for Grain Size
Appendix 11	SOP for Atterberg Limit
Appendix 12	SOP for Specific Gravity
Appendix 13	SOP for Bulk Density

APPENDICES (Cont.)

- Appendix 14 *(This appendix is no longer necessary. It has been left for convenience for potential future use).*
- Appendix 15 SOP for Total Organic Carbon
- Appendix 16 SOP for USCS Classification
- Appendix 17 SOP for Side Scan Survey Procedures
- Appendix 18 SOP for Core Processing
- Appendix 19 *(This appendix is no longer necessary. It has been left for convenience for potential future use).*
- Appendix 20 SOP for ¹³⁷Cs
- Appendix 21 SOP for TCLP Preparation by 1311
- Appendix 22 SOP for VOAs With TCLP Preparation
- Appendix 23 SOP for SVOAs With TCLP Preparation
- Appendix 24 SOP for Pesticides With TCLP Preparation
- Appendix 25 SOP for Herbicides With TCLP Preparation
- Appendix 26 SOP for Preparation of Metals and Mercury and Analysis of Mercury in Leachate
(Refer to Appendix 29 for the Analysis of Metals by ICP)
- Appendix 27 SOP for Ignitability
- Appendix 28 SOP for PCDD/PCDF
- Appendix 29 SOP for Preparation and Analyses of Metals and Mercury in Sediment
- Appendix 30 Performance and Reporting of Field Audits
- Appendix 31 Performance and Reporting of Analytical Laboratory Audits
- Appendix 32 SOP for Data Validation of VOA Data (DV8260B)
- Appendix 33 SOP for Data Validation of SVOA Data (DV8270C)
- Appendix 34 SOP for Data Validation of Pesticide Data (DV8081A)
- Appendix 35 SOP for Data Validation of Herbicide Data (DV8151A)
- Appendix 36 SOP for Data Validation of PCBs (DV8082)
- Appendix 37 SOP for Data Validation of PCB (Homolog) Data (by GEHR680)
- Appendix 38 SOP for Data Validation of PCDD and PCDF Data (DV1613B)
- Appendix 39 SOP for Data Validation of ICP Metals Data (DV6010B)
- Appendix 40 SOP for Data Validation of Mercury Data (DV74707471)
- Appendix 41 SOP for Data Validation of TOC Data (DVTOC)
- Appendix 42 EDD Specifications

APPENDICES

APPENDIX 16

DRAFT

STANDARD OPERATING PROCEDURE FOR
Classification of Soils for Engineering Purposes
Applicable matrix or matrices:
Standard Compound List and Reporting Limits:

Approvals and Signatures

Laboratory Director:

Michael Wheeler Ph.D.

Date: _____

QA Manager:

Kirstin L. McCracken

Date: _____

Organic Prep Manager:

Jon K. Zygmuntowicz

Date: _____

This documentation has been prepared by STL Burlington (STL) solely for STL's own use and the use of STL's customers in evaluating its qualifications and capabilities in connection with a particular project. The user of this document agrees by its acceptance to return it to STL upon request and not to reproduce, copy, lend, or otherwise disclose its contents, directly or indirectly, and not to use it for any other purpose other than that for which it was specifically provided. The user also agrees that where consultants or other outside parties are involved in the evaluation process, access to these documents shall not be given to said parties unless those parties also specifically agree to these conditions.

THIS DOCUMENT CONTAINS VALUABLE CONFIDENTIAL AND PROPRIETARY INFORMATION. DISCLOSURE, USE OR REPRODUCTION OF THESE MATERIALS WITHOUT THE WRITTEN AUTHORIZATION OF STL IS STRICTLY PROHIBITED. THIS UNPUBLISHED WORK BY STL IS PROTECTED BY STATE AND FEDERAL LAW OF THE UNITED STATES. IF PUBLICATION OF THIS WORK SHOULD OCCUR THE FOLLOWING NOTICE SHALL APPLY:

©COPYRIGHT 2002 STL BURLINGTON. ALL RIGHTS RESERVED.

1.0 SCOPE AND APPLICATION

This method describes a system for classifying mineral and organo-mineral soils for engineering purposes based on laboratory determination of particle size characteristics, liquid limit and plasticity index and is used when precise classification is required.

2.0 SUMMARY OF METHOD

This classification system identifies three major soil divisions: coarse grained soils, fine grained soils and highly organic soils. These three divisions are further subdivided into a total of 15 basic soil groups.

Based on the results of visual observations and prescribed laboratory tests a soil is catalogued according to the basic soil groups and thereby classified. The various soil groups have been devised to correlate in a general way with the engineering behaviors of soils.

3.0 DEFINITIONS

NA

4.0 INTERFERENCES

See laboratory SOPs LM-SL-D422, LM-SL-D854 and LM-SL-D4318.

5.0 SAFETY

- 5.1 The toxicity or carcinogenicity of each chemical used in this procedure has not been fully established. Each chemical should be regarded as a potential health hazard and exposure should be minimized as reasonably possible. A reference file of Material Safety Data Sheets (MSDS) for this test method is available to all personnel and must be read prior to performing this procedure. All laboratory personnel must be familiar with the laboratory environmental health and safety plan described in the STL Corporate Safety Manual (CSM).

6.0 EQUIPMENT AND SUPPLIES

See laboratory SOPs LM-SL-D422, LM-SL-D854 and LM-SL-D4318.

7.0 REAGENTS AND STANDARDS

See laboratory SOPs LM-SL-D422, LM-SL-D854 and LM-SL-D4318.

8.0 SAMPLE COLLECTION, PRESERVATION, SHIPMENT & STORAGE

See laboratory SOPs LM-SL-D422, LM-SL-D854 and LM-SL-D4318.

9.0 QUALITY CONTROL

See laboratory SOPs LM-SL-D422, LM-SL-D854 and LM-SL-D4318.

10.0 CALIBRATION & STANDARDIZATION

See laboratory SOPs LM-SL-D422, LM-SL-D854 and LM-SL-D4318.

11.0 PROCEDURE

- 11.1 Perform ASTM Methods D422, D854 and D4318.

- 11.2 The soil is an inorganic clay if the position of the plasticity index versus liquid limit plot, Fig. 3, falls on or above the "A" line, the plasticity index is greater than 4, and the presence of organic matter does not influence the liquid limit.
- 11.3 Classify the soils as a lean clay, CL, if the liquid limit is less than 50. See area identified as CL on Fig 3.
- 11.4 Classify the soils as a fat clay, CH, if the liquid limit is greater than 50. See area identified as CL on Fig 3.
- 11.5 Classify the soils as a silty clay, CL-ML, if the position of the plasticity index versus the liquid limit plot falls on or above the "A" line and the plasticity index is in the range of 4 to 7. See area identified as CL-ML on Fig 3.
- 11.6 The soil is an inorganic silt if the position of the plasticity index versus liquid limit plot, fig. 3, falls below the "A" line or the plasticity index is less than 4, and presence of organic matter does not influence the liquid limit.
- 11.7 Classify the soil as silt, ML, if the liquid limit is less than 50. See area identified as ML on Fig. 3
- 11.8 Classify the soil as an elastic silt, MH, if the liquid limit is 50 or greater. See area identified as ML on Fig. 3
- 11.9 The soil is an organic silt or clay if organic matter is present in sufficient amounts to influence the liquid limit.
- 11.10 If the soil has a dark color and an organic odor when warm and moist, a second liquid limit test should be performed on a test specimen that has been dried at 110°C +/- 5°C, to a constant weight.
- 11.11 The soil is an organic silt or clay if the liquid limit after oven drying is less than 75% of the liquid limit of the original specimen determined before oven drying.
- 11.12 Classify the soil as organic silt or clay, OL, if the liquid limit (not oven dried) is less than 50%. Classify the soil as an organic silt, OL, if the plasticity index is less than 4, or the position of the plasticity index versus liquid limit plot falls below the "A" line. Classify the soil as an organic clay, OL, if the plasticity index is 4 or greater and the position of the plasticity index versus the liquid limit plot falls on or above the "A" line. See the area identified as OL (or CL-ML) on Fig. 3.

- 11.13 Classify the soil as an organic clay or organic silt, OH, if the liquid limit (not oven dried) is 50 or greater. Classify the soil as an organic silt, OH, if the position of the plasticity index versus the liquid limit plot falls on or above the "A" line. See area identified as OH on Fig. 3.
- 11.14 If less than 30% but 15% or more of the sample is retained on the No. 200 sieve the words "with sand" or "with gravel" (whichever is predominant) shall be added to the group name.
- 11.15 If 30% or more of the sample is retained on the No. 200 sieve, the words "sandy" or "gravelly" shall be added to the group name. Add the word "sandy" if 30% or more of the test specimen is retained on the No. 200 and the coarse grained portion is predominately sand, likewise for gravel.
- 11.16 When more than 50% of the test specimen is retained on the No. 200 sieve classify the soil as gravel if more than 50% of the coarse fraction is retained on the No. 4 sieve. Classify the soil as sand if 50% or more of the coarse fraction passes the No. 4 sieve.
- 11.17 If 12% or less of the test specimen passes the No. 200 sieve, plot the cumulative particle size distribution and compute the coefficient of uniformity, Cu and coefficient of curvature, Cc, as given in equation 1 and 2.

$$Cu = D_{60}/D_{10} \quad (1)$$

$$Cc = (D_{30})^2/(D_{10} \times D_{60}) \quad (2)$$

where: D_{10} , D_{30} and D_{60} = the particle size diameters corresponding to 10, 30 and 60%, respectively, passing on the cumulative particle size distribution curve.

- 11.18 If less than 5% of the test specimen passes the No. 200 sieve, classify the soils as well graded gravel, GW, or well graded sand, SW, if Cu is greater than or equal to 4.0 for gravel or greater than 6.0 for sand and Cc is at least 1.0 but not more than 3.0.
- 11.19 If less than 5% of the test specimen passes the No. 200 sieve, classify the soil as poorly graded gravel, GP, or poorly graded sand, SP, if either the Cu or the Cc criteria for well graded soils are not satisfied.
- 11.20 If 12% of the test specimen passes the No. 200 sieve, the soil shall be considered a coarse-grained soil with fines. The fines are determined to be either clayey or silty based on the plasticity index versus the liquid limit plot.

- 11.21 Classify the soil as clayey gravel, CG, or clayey sand, SC, if the fines are clayey, that is, the position of the plasticity index versus liquid limit plot falls on or above the “A” line and the plasticity index is greater than 7.
- 11.22 Classify the soil as a silty gravel, GM, or silty sand, SM, if the fines are silty, that is, the position of the plasticity index versus liquid limit plot falls below the “A” line and the plasticity index is less than 4.
- 11.23 If the fines plot as a silty clay, CL-ML, classify the soil as a silty, clayey gravel, GC-GM, if it is a gravel or a silty, clayey sand, SC-MC, if it is sand.
- 11.24 If 5 to 12% of the test specimen passes the No. 200 sieve, give the soil a dual classification using two group symbols. The first group of symbols shall correspond to that for a gravel or sand having less than 5% fines (GW, GP, SW, SP) and the second symbol shall correspond to a gravel or sand having more than 12% fines (GC, GM, SC, SM).
- 11.25 The group name shall correspond to the first group symbol plus “with clay”, or “with silt” to indicate the plasticity characteristics of the fines.
- 11.26 If the specimen is predominantly sand or gravel but contains 15% or more of the other coarse grained constituent, the words, “with gravel” or “with sand” shall be added to the group name.
- 11.27 If the field sample contains any cobbles or boulders or both the words “with cobbles” or “with boulders” shall be added to the group names.

12.0 CALCULATIONS

- 12.1 Compute the coefficient of uniformity, C_u and coefficient of curvature, C_c , as given in equation 1 and 2.

$$C_u = D_{60}/D_{10} \quad (1)$$

$$C_c = (D_{30})^2/(D_{10} \times D_{60}) \quad (2)$$

where: D_{10} , D_{30} and D_{60} = the particle size diameters corresponding to 10, 30 and 60%, respectively, passing on the cumulative particle size distribution curve.

13.0 DATA ASSESSMENT, CRITERIA & CORRECTIVE ACTION

See laboratory SOPs LM-SL-D422, LM-SL-D854 and LM-SL-D4318.

14.0 METHOD PERFORMANCE

- 14.1 An Initial Demonstration of Capability is required for each analyst before unsupervised performance of this method.

15.0 POLLUTION PREVENTION & WASTE MANAGEMENT

- 15.1 The laboratory optimizes technology to minimize pollution and reduce the production of hazardous waste whenever possible.
- 15.2 The laboratory procedures for waste management comply with applicable federal, state and local regulations and are described in SOP LP-LB-001HAZWD.

16.0 REFERENCES

- 16.1 Annual Book of ASTM Standards, volume 04.08 Soil and Rock (I): D 420 - D4914, Section 4, Construction edition; American Society for Testing and Materials, Philadelphia, Pa., 1994.

17.0 TABLES, DIAGRAMS, FLOWCHARTS

NA

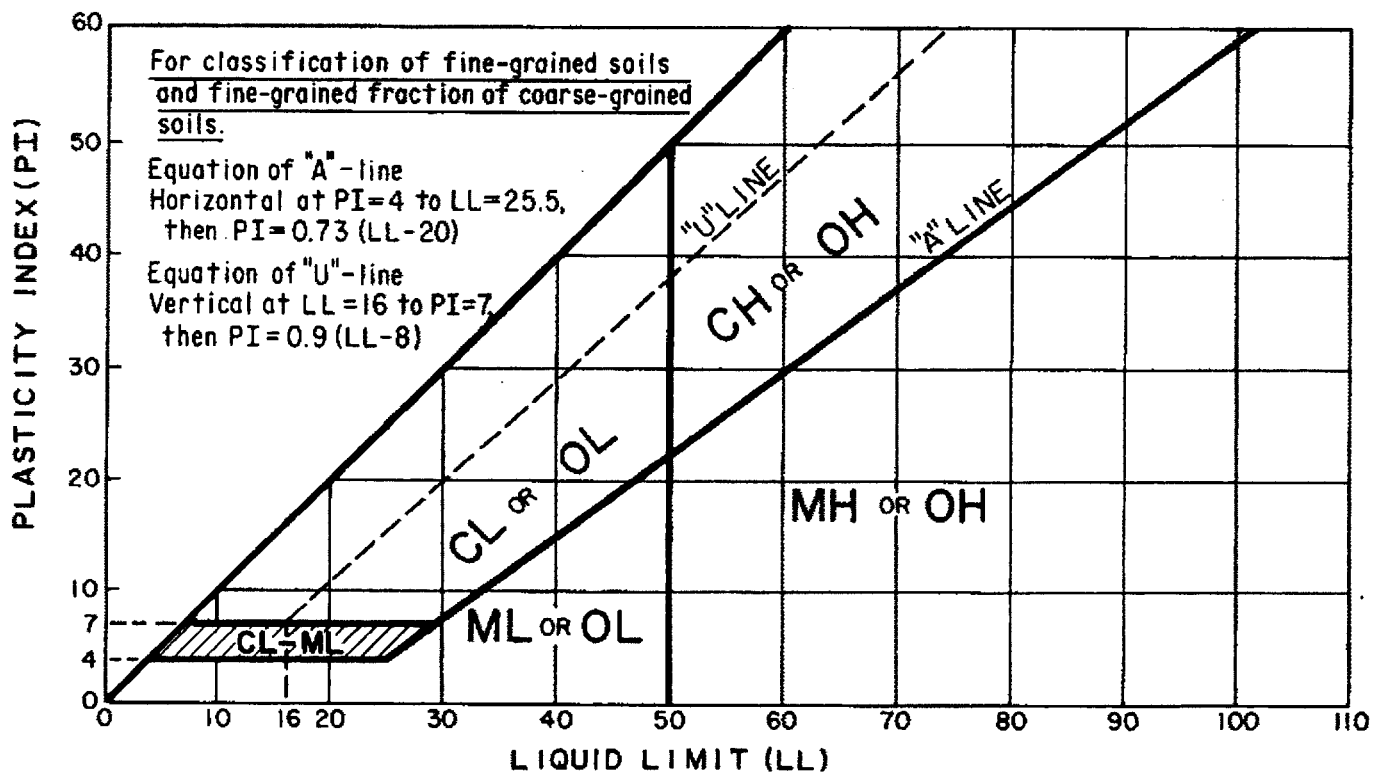
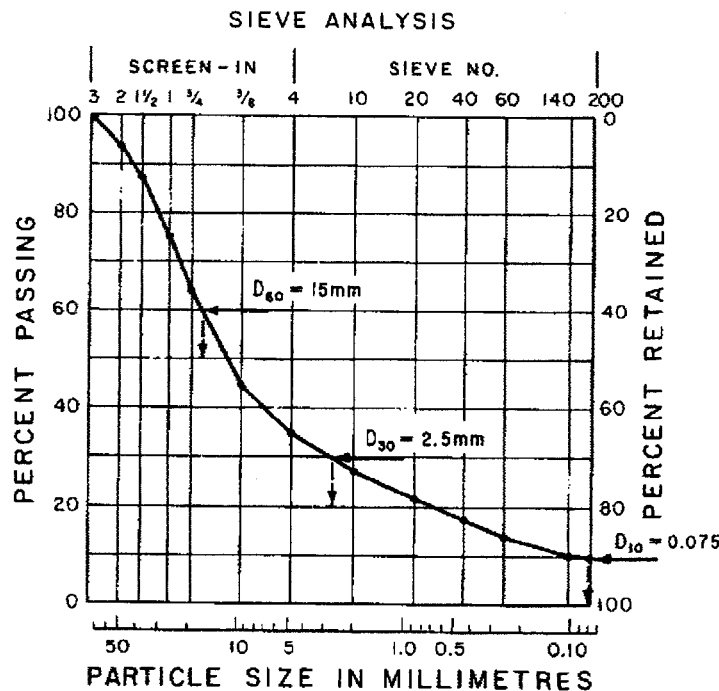


FIG. 3 Plasticity Chart



$$Cu = \frac{D_{60}}{D_{10}} = \frac{15}{0.075} = 200 \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = \frac{(2.5)^2}{0.075 \times 15} = 5.6$$

FIG. 4 Cumulative Particle-Size Plot

GP, or *poorly graded sand*, SP, if either the Cu or the Cc criteria for well-graded soils are not satisfied.

12.4 If more than 12 % of the test specimen passes the No. 200 (75- μ m) sieve, the soil shall be considered a coarse-

grained soil with fines. The fines are determined to be either clayey or silty based on the plasticity index versus liquid limit plot on Fig. 3. (See 9.8.2.1 if insufficient material available for testing). (See Note 6)