ENTO-002

ATTACHMENT 2

ENTO002-PI-01, Revision 0
(5 pages)

Project Instruction

for the

Entergy Nuclear Potomac
GGNS Early Site Permitting Project

Title:
Preparation and Control of Project Instructions

Project Instruction No.: ENTO002-PI-01

Revision No.: 0

Prepared By: _____ Printed Name: W.H. Chenault Date: 5-28-02

Approved By: _____ Printed Name: A.J. Schneider Date: 5/28/02

ENERCON SERVICES, Inc.
Kennesaw, GA

TABLE OF CONTENTS

1.0 PURPOSE

1.1 This instruction provides guidelines for preparation of Project Instructions (PI) to be used for control of tasks, requiring implementation of ENERCON's QA Program, in support of development of an application for ESP for Entergy Nuclear Potomac.

1.2 Responsibilities

The ENERCON Project Manager is responsible for approval of all PIs developed in connection with completion of this project.

2.0 APPLICABILITY

2.1 PIs are developed to control special activities which require implementation of the Enercon Quality Assurance Program, and are not addressed by ENERCON Corporate Standard Procedures (CSP). PIs may also be used in lieu of a CSP to provide more appropriate control for a specific activity; however, the applicable CSP requirements shall be adhered to by the PI instructions. With respect to use of a PI, the applicable requirements of the ENERCON Quality Assurance Program and this Project Planning Document (PPD) must be met.

3.0 DEFINITIONS and ACRONYMS

3.1 CSP – Corporate Standard Procedure

3.2 PI – Project Instruction

3.3 PPD – Project Planning Document

3.4 ESP – Early Site Permitting Application

4.0 DETAILED INSTRUCTIONS

4.1 PI Format

4.1.1 Title Page

The first page is the title page. See Appendix A to this PI for a sample Title Page.

4.1.2 Page Numbering

Each page subsequent to the Title Page will be numbered using the "Page ____ of ___ " method, and will contain the PI identification number and revision level.

4.2 PI Content

4.2.1 Purpose

The first section of the PI shall be an introduction, which should describe the purpose and scope of the instruction (i.e., a brief description of the tasks controlled by the instruction), and the responsibilities of the personnel performing the work as described.

4.2.2 Subsequent Sections

The remaining sections of the PI shall describe the activities to be controlled and accomplished by the PI, and the procedural requirements and methods for implementation of the activities. PI instructions shall not deviate from the requirements of the ENERCON Quality Assurance Program.

Instructions in the PI should be sufficiently detailed and be clear to the performers as to the intent and requirements, and should be written such that activities performed can be audited for compliance with the PI and the ENERCON QA Program.

Forms, when required, should be included as attachments to the PI.

A suggested list of PI major sections is provided below (subsections are listed only as examples); some or all of the sections may be used; others may be added as required for the specific activity. A Table of Contents may be used if desired, and should be used for PIs with more than 10 pages.

TABLE OF CONTENTS (Example)

4.2.3 References

This section shall list any relevant references used in preparation of the PI.

4.2.4 Appendices or Attachments

This section shall list each appendix or attachment included with the PI, and the total page count for each.

Each page of an attachment should be numbered and identified with the associated PI number, unless the document is a stand-alone document with page count, etc. If stand-alone, only a cover page for the attachment or appendix is needed in the PI to identify the document attached/appended.

Attach or append any documents as required to support accomplishment of the purpose of the PI.

4.3 PI Control

4.3.1 Identification

PIs shall be uniquely identified using a numbering scheme of the following format:

ENTO002-PI-xx, Rev. z, where,

xx is a sequential number beginning with 01, and
z is the revision designator, beginning with zero

4.3.2 Preparation and Approval

PIs may be prepared by any individual cognizant of the activities to be controlled by the instruction, and familiar with the requirements of the ENERCON QA Program.

The Project Manager will approve PIs for incorporation into the PPD. PIs will generally be prepared and approved during the process of approval of the PPD for the project.

4.3.3 PI Issuance

PIs shall be issued as an attachment to this PPD. Revision of a PI shall require revision of the governing PPD.

5.0 REFERENCES

5.1 None

6.0 APPENDICES

6.1 Appendix A, Example Project Instruction Title Page (1 page)

ENTO-002

ATTACHMENT 3

ENTO002-PI-02, Revision 1
(7 pages)

Hydrological and Meteorological Data Management

Project Instructions

for the

Entergy Nuclear Potomac

Early Site Permitting Project
Grand Gulf Nuclear Station Site

Hydrologic and Meteorological Data Management

Project Instruction No. ENTO002-PI-02

Revision No. 1

Prepared By: _____ Printed Name: Tim Basham Date: 1-12-02

Reviewed By: _____ Printed Name: Bennett C Howell III Date: 7/15/02

Approved: _____ Printed Name: A.J. Schneider Date: 7/16/02

TABLE OF CONTENTS

1.0 PURPOSE

1.1 The objective of this instruction is to provide data and references which will support the conclusions regarding potential impacts to the environment from construction and operation of (a) new nuclear power facility(ies) at the existing Grand Gulf Nuclear Station (GGNS) site, and will support conclusions with regards to acceptability of the site in meeting the applicable requirements of 10 CFR 52, 10 CFR 50.34 and 10 CFR 100 for an Early Site Permit (ESP).

1.2 Sources of data may include but are not limited to: GGNS licensing basis and design basis documents, calculations, reports, etc.; published documents, reports or raw data from agencies such as National Oceanic and Atmospheric Administration (NOAA), United States Geological Survey (USGS), Environmental Protection Agency (EPA), National Weather Service, US Fish and Wildlife Service, US Army Corps of Engineers; and reports, maps and documents from consultants, universities, or other organizations. Field acquisition of data required to support work done under the Enercon QA program is not expected.

1.3 This project instruction is applicable only to the hydrological and meteorological data collection, manipulation, and evaluation processes to support the safety assessment of the Grand Gulf site for the early site permit (ESP) application preparation. These instructions will ensure ENERCON project personnel performing data management tasks implement the requirements uniformly, and that appropriate QA requirements are applied to these data management activities.

1.4 This instruction is ONLY applicable to the collection, development and/or evaluation and control of hydrological and meteorological data required to support evaluations or assessment of the site as reported in the Site Safety Analysis Report (SSAR). The SSAR document itself is not required to be prepared under the QA Program, however.

1.5 Responsibilities:

1.5.1 Environmental Task Lead(s): Responsible for control of activities required for environmental data management, including collection, and review as required, and compliance with QA Program requirements for work conducted under this instruction. Supervises discipline (hydrological and meteorological, etc.) leads and technical staff. Provides technical direction based on experience and subject matter knowledge.

1.5.2 Discipline Leads and Technical Staff: Perform activities as required in accordance with this instruction for collection, development and manipulation of appropriate data. Prepare summary reports and data sets in support of ER and SSAR preparation.

1.6 This is a major revision; individual changes are not shown.

2.0 SCOPE AND APPLICABILITY

2.1 The scope of this project instruction includes several individual activities, listed below, which may be performed during the collection and/or development of the hydrological and meteorological data in support of preparation of an ESP application for the GGNS site. The data of concern are those that are to be used in the determination or evaluation

of the acceptability of the site (i.e., site safety assessment) as required by 10 CFR 52.17, Subpart A.

2.2 The following activities are addressed by this instruction:

2.2.1 Collection of current and historical GGNS data from sources such as the Final Environmental Report, Final Environmental Statement, Updated Final Safety Analysis Report, data sets or monitoring program results from current or past GGNS programs, and publicly available data.

2.2.2 Generation of data through (1) manipulation or interpretation of existing "generic" data, or (2) manipulation or interpretation of regional data sets, or (3) a combination of these methods. It is not expected that in-situ hydrologic or meteorological data sampling will be required to support this project.

2.3 This instruction is applicable to personnel performing environmental (hydrological and meteorological) data collection, review and evaluation in support of this project.

3.0 DEFINITIONS

3.1 ER – Environmental Report

3.2 ESP – Early Site Permit

3.3 GGNS – Grand Gulf Nuclear Station

3.4 SSAR – Site Safety Analysis Report

3.5 UFSAR – Updated Final Safety Analysis Report for the Grand Gulf Nuclear Station

4.0 METHODOLOGY

This section provides detailed instructions for collection and control of raw data; control of data analysis, manipulation or modeling to provide verifiable results, and reporting results in a consistent manner which can later be checked, or verified by independent reviewers, as required. The approach utilized for data collection in this project will center around development of data which is consistent with existing or historical data sets (i.e., reports depth to ground water as feet below-ground-surface (bgs) as opposed to meters below top-of-casing (TOC)), and which has traceability to its origin or source.

4.1 Data Collection

4.1.1 Sources of data from the GGNS documentation system which may be used in this project are:

a. (System, Topical or Analysis Basis) Design Criteria Documents;
b. Calculations;
c. Existing GGNS analyses and evaluations;
d. System and plant design drawings;
e. GGNS Final Environmental Report;
f. GGNS Final Environmental Statement, NUREG-0777 and Supplements;
g. GGNS Updated Final Safety Analysis Report (UFSAR);
h. Other GGNS documentation deemed necessary by the team.

4.1.2 Other GGNS data may include:

a. GGNS current and historical meteorological data;

b. GGNS current and historical hydrologic data;

c. Existing data from the groundwater test wells;

d. GGNS current licenses and permits (regarding hydrology and meteorology).

4.1.3 Data obtained from other sources such as NOAA, USGS, or National Weather Service, etc., shall be documented as to the source, date of receipt, date or revision level of the data/document, and title.

4.1.4 Data shall be retained in the project file as specified below:

4.1.4.1 Previously reviewed and published information (e.g., peer-reviewed reports or data) need not be retained in the project files.

4.1.4.2 Information not peer-reviewed shall be copied and retained in the project files.

4.1.4.3 GGNS documents used as sources of data do not need to be retained in the project files.

4.1.4.4 Raw data shall clearly indicate the source of the data and a copy shall be retained in the project files.

4.1.5 The data gatherer/user will ensure that data collected are appropriate for the task (based on the knowledge and experience of the individual), can be traced to its source, and the data support the intended use. GGNS data, such as meteorological data previously used for evaluations, calculations or analysis, will typically be accepted for use without further review. The user will ensure that the data are expressed in the correct units before use.

4.2 Data Manipulation

4.2.1 Calculations or algorithms utilized to derive results will utilize an appropriate method (e.g., arithmetic, weighted-arithmetic, geometric, or median) for the type of data being evaluated.

4.2.2 Differences in data (i.e., over time, or between geographic locations) that are either based upon data sets generated using the same basic measurement procedures and/or the same sampling locations/conditions (e.g., locations are "tied" to known/published third order or better topographic benchmarks) with reference to Industry/Government accepted published studies/reports (e.g., NOAA/USGS river gauge data for the Mississippi River between River Miles 408 and 400 from 1975 to 2002) should be documented, or a description of the statistical variance (i.e., standard deviation or other standard measure of the probability of statistical significance) and the methods utilized to calculate it should be provided.

4.2.3 Software used in manipulation of data for activities governed by the QA Program shall meet the requirements of ENERCON's QA Program Corporate Standard Procedure (CSP) 3.02.

4.3 Documentation of Data

4.3.1 Sources of data (from paragraphs 4.1.3.2 and 4.1.3.4 above) shall be documented on a form similar to that of Attachment 1. Fully referenceable or traceable (retrievable) sources of data do not require Attachment 1 completion. Any limitations regarding use or usefulness of the data should be indicated on the form.

4.3.2 Raw data documented using Attachment 1 shall be reviewed for concurrence with the conclusions of the data gatherer regarding use and usefulness of the data.

4.4 Project Files

4.4.1 The following records shall be maintained in the project files as required by the QA Program and the project PPD (see section 4.3.1 above).

a. Reference Summary Forms (Attachment 1)

b. Copies of unpublished (raw) data

5.0 REFERENCES

5.1 None

Attachment 1
Reference Summary Form

Data Collector: _____ *(print/sign name)*

Data Checker: _____ *(print/sign name)*

☐ Raw Data ☐ Unreviewed Information

Document/Data Review Required? ☐ Yes ☐ No Document Retained in Project File? ☐ Yes ☐ No

Document Number, Name, Title, Revision, Date, Etc.

_____

_____

_____

Applicability (e.g. related to meteorology, or hydrology)

_____

_____

_____

Summary of relevant information (or attach document / data)

_____

_____

_____

_____

_____

Data Usage Limitations (provide any limitations on use, etc.)? ☐ No ☐ Yes (see below)

_____

_____

_____

_____

ATTACHMENT 4

ENTO002-PI-03, Revision 1
(19 pages)

Compilation of Geosciences Database

Project Instructions

for the

Entergy Nuclear Potomac Early Site Permitting Project

Compilation of Geosciences Database

Project Instruction No: ENTO002-PI-03

Revision No: 1

Prepared by:	Printed Name:	Date:06/26/02
	James Hengesh (WLA)	6/26/02
Approved by:	Printed Name:	Date:06/26/02
	William Lettis (WLA)	6/26/02
Approved by:	Printed Name:	Date:
	A.J. Schneider Enercon Project Manager	7/17/02

1.0 PURPOSE

1.1 Project Scope

This Project Instruction provides guidelines for compilation of a geosciences database for an Early Site Permit Application for a potential new nuclear power plant to be located at the site of the existing Grand Gulf Nuclear Station (GGNS). The database will be formed from compiling and evaluating existing relevant data that may influence the seismic design of the proposed nuclear power plant. The sources of data will include, but not be limited to the existing UFSAR, FER, and NRC Safety Evaluation Report for the existing facility; published articles and maps from professional journals and periodicals; and unpublished reports, data, and maps from previous consultant reports, professional publications, or ongoing investigations.

Additional geological mapping will be conducted to document in more detail the distribution, extent and structure of geological units in the immediate site (1.6 km), site area (8 km), site vicinity (40 km), and site region (320 km).

These investigations will provide the data needed to assess the potential for permanent ground deformation at the site and to assess the suitability of the seismic source models used in development of the EPRI, LLNL, and USGS Probabilistic Seismic Hazard Analyses.

1.2 Responsibilities

William Lettis & Associates (WLA) will be responsible for compiling and evaluating the Geosciences database. The WLA Project Manager will provide overall direction of the data compilation. He will supervise a staff of Senior and Staff geologists. The Senior Geologist will be responsible for day-to-day performance of the technical work and will be either a Principal or Senior Geologist with WLA. Staff geologists will assist the Senior Geologist with specific tasks and duties, and work under his direction.

2.0 APPLICABILITY

This Project Instruction is applicable to all persons performing data compilation and data interpretation, and geologic mapping and evaluation for the Entergy GGNS Early Site Permit investigations.

3.0 DEFINITIONS AND ACRONYMS

The definitions of acronyms used in this PI are presented below:

- EPRI – Electrical Power Research Institute;
- ESP – Early Site Permit Application;
- PI – Project Instruction;
- FER – Final Environmental Report;
- GGNS – Grand Gulf Nuclear Station;

- LLNL – Lawrence Livermore Nation Laboratories;
- NRC – Nuclear Regulatory Commission;
- PSAR – Preliminary Safety Analysis Report;
- PSHA – Probabilistic Seismic Hazard Assessment;
- SER – NRC Safety Evaluation Report and Supplements;
- SSE – Safe Shutdown Earthquake;
- UFSAR – Updated Final Safety Analysis Report;
- WLA – William Lettis & Associates.

The definitions of data sources referred to in this PI are as follows:

- Peer-Reviewed Information – information (e.g., articles, maps and reports) published in professional journals that has undergone peer review prior to publication;
- Published Information – information (e.g., reports, articles and maps) that is published, but that has not undergone peer review prior to publication;
- Unpublished Data and Literature – information (e.g., technical articles and consulting reports) that contains significant relevant information, but that has not been formally peer reviewed or published in the public domain;
- "GGNS Licensing and Design Documents" – information (e.g., the PSAR, UFSAR, FER, and SER) approved and submitted to the NRC in support of the licensing, design and operation of the GGNS.
- WLA Field Data – information (e.g., maps, notes, photographs and other documentation) gathered during WLA's field reconnaissance.
- Third Party Data – information (e.g., seismicity catalogs, topographic maps, boring logs, and aerial photographs) from reputable sources, but that has not been through a formal technical review.

4.0 METHODOLOGY

This section describes the methodology to be used for the Geosciences Data Compilation and Field Mapping.

4.1 Data Compilation

4.1.1 Data compilation and review shall be completed for an area within 320 km of the project site. A Reference Summary Form (Attachment 1) shall be completed for

each source of data and retained in the WLA project file as specified in Paragraph 4.1.2.

4.1.2 All sources of data shall be reviewed and assigned to one of the following six categories:

4.1.2.1 "Peer Reviewed Information" shall be compiled, and a comprehensive reference list will be retained in the project file together with Reference Summary Forms for each reference. Copies of the peer-reviewed information need not be retained in the project file.

4.1.2.2 "Published Information" shall be copied, retained in the project file, and added to the comprehensive reference list.

4.1.2.3 "Unpublished Data and Literature" shall be copied, retained in the project file, and added to the comprehensive reference list.

4.1.2.4 "GGNS Licensing and Design Documents" shall be added to the reference list and do not need to be retained in full in the project file.

4.1.2.5 "WLA Field Data" shall be retained in a field notebook with identifiers as indicated in Subsection 4.2 below. The completed field notebooks shall be attached to a Reference Summary Form and retained in the project file.

4.1.2.6 "Third Party Data" shall be accompanied by the Reference Summary Form to clearly indicate the source of the data.

4.1.3 Reference citations shall follow the Geological Society of America citation format. All pertinent publications shall be summarized on the attached Reference Summary Form. Copies of the Reference Summary Forms will be kept in the WLA project file.

4.2 Field Mapping

4.2.1 Geologic mapping shall be based on field observation of surface features, review of existing literature and data; analysis of aerial photography, and subsurface information derived from exploratory borings, surface geophysical surveys, or other sources.

4.2.2 Geological data shall be compiled on a base map or photograph at a scale commensurate with the geological complexity and detail required to document conditions at the site.

4.2.3 Base maps or photographs shall be located using local geographic reference points, or handheld Global Positioning System coordinates.

4.2.4 Geological and geomorphic mapping techniques - including descriptions of rock and soil units, collection of structural and stratigraphic data, use of Brunton compass, analysis of aerial photography, and plotting of geological features on a topographic base map - shall follow the appropriate procedures of Compton (1985) "Manual of Field Geology".

4.2.5 The primary purpose for mapping shall be the identification and observation of geological formation contacts, marker beds, and structural features. These features shall be accurately located and indexed on topographic maps and supported by field notebook entries, samples, and photographs.

4.2.6 Interpretation of aerial photographs may be used to help identify and characterize features to be mapped.

4.2.7 Geological contacts that are well exposed shall be shown by solid lines. Bedrock contacts that are concealed by soils or thin surficial deposits- but are mappable based on topographic expression, vegetation differences, float, or soil changes - shall be shown by dotted lines. Inferred contacts shall be marked by dashed lines. Outcrops of bedrock shall be delineated.

4.2.8 Notebook entries shall be made for all outcrops that expose significant marker beds, formational contacts or potentially useful stratigraphic, geomorphic, or structural features. These outcrops shall be assigned a unique data point number and labeled on the topographic or photographic base map.

4.2.9 Material to be included in notebook entries is described below in Subsections 4.3 and 4.4.

Field Description Techniques

4.2.10 Controlled-number field notebooks shall be used to record data and field observations and measurements. Notebook pages shall be numbered and signed by the recording geologist.

4.2.11 Data to be recorded in the field notebook shall include characteristics of geological outcrops, characteristics of surficial features such as alluvium, levees, and areas of artificial fill, and characteristics of significant geomorphic features such as fluvial channels, flood plains, and shorelines.

4.2.12 Hand samples may be collected for general informational or descriptive purposes, as described in Section 4.3, below. Samples collected shall be numbered and labeled in a manner consistent with the outcrops identified in the field notebooks.

4.2.13 Data point entries in the notebook shall include data, data point number, type of data (outcrop, surficial or geomorphic feature), extent of outcrop, sample characteristics, approximate location or setting, and initials of person(s) making observations.

4.2.14 Sketches of field relationships may be made to illustrate specific geological features. All sketches shall include a scale; date; orientation of exposure;

approximate elevations; significant marker beds and contacts; and brief rock and surficial-deposit descriptions, including lithology, bedding or foliations, discontinuities, and color.

4.2.15 Soil and overburden shall be described using the Field Data Sheets in Attachment 2 and the standardized procedures or classification schemes presented in:

- American Society of Testing and Materials (ASTM) D2487-93, D2488-93;
- NAVFAC design manual 7.01, 1986;
- EPRI EL-6800 Manual on estimating soil Properties for Foundation Design, 1990; and
- Munsell color charts, 1994.

4.2.16 Landslides shall be classified according to the criteria described in Transportation Research Board Special Report 247, and using the Field Data Sheets of Attachment 2.

4.2.17 Global Positioning System (GPS) measurements will be used to assist in locating field stations. The GPS receiver will be calibrated by locating a known benchmark in the site area at the start of each field assignment. The known coordinates of the benchmark shall be compared to the coordinates obtained from the handheld GPS receiver. Accuracy of +-20 feet will be considered acceptable for locating geologic field locations.

4.3 Collection and Storage of Samples

4.3.1 Samples may be collected from outcrops of marker beds and data points identified or recorded on geological maps. These samples would be intended for general information and descriptive purposes only, and shall not be used for quantitative or analytical purposes.

4.3.2 A sufficient amount of samples shall be taken to adequately identify the geologic unit from which the sample was taken. Samples shall be collected and stored in either canvas or plastic bags.

4.3.3 Bags shall be labeled with the project name, date, sample ID number, geological unit sampled, and initials of person(s) obtaining sample. All samples obtained shall be assigned a sample ID number that is also located on the topographic or photographic base map and recorded in a controlled field notebook. Samples should be stored upon returning from the field in a location where the samples can be easily retrieved. Samples do not need to be retained upon completion of sample review.

4.3.4 The following information shall be included in the field notebook: sample ID number and location, the conditions under which sample was taken, a sketch of outcrops from which the sample was obtained, brief description of field

classification of sample, and any special circumstances describing sample location.

4.4 Photographs

Photographs, slides or digital images may be taken of outcrop exposures, surficial deposits, geomorphic features, or other potentially significant features. A unique number shall be assigned to each roll of film. A photograph log (Attachment 3) shall be filled out in the field and kept in the WLA project file. Each photograph will be numbered and dated. Digital images shall be downloaded and provided a consistent numbering system that corresponds to the analog photo numbering system. Images shall be saved on numbered CD's, and each image shall be numbered and dated.

5.0 WLA PROJECT FILE

The following records shall be maintained in the WLA project file until directed by the Enercon Project Manager that they may be disposed of, or shall be transferred to Enercon:

- Reference Summary Forms
- Comprehensive Reference List
- Copies of Unpublished Data and Literature
- WLA Field Notebooks
- Third Party Data
- Photograph Log
- Photos and associated negatives, slides and associated negatives, and CDs containing digital images
- Index map
- Field Data Sheets.

6.0 LOST DATA

In cases where exploratory boring logs, photo logs, samples, or photographs are lost or damaged, the WLA Project Manager shall determine if interpretations can be made from existing data or if data needs to be recollected. These actions shall be documented in a memorandum to the file indicating the type and number of data lost or damaged.

7.0 TECHNICAL REVIEW

Technical review of the compilation activities shall be performed by a WLA Technical Reviewer assigned by the WLA Project Manager. The Technical Reviewer shall be a geologist competent in conducting geologic mapping for site characterization. At a minimum, the review shall

consist of reviewing the map compilation, locations of geological units or structures, and parameters estimated for input to the PSHA, and that the methodology and results are consistent with standard industry practice. The Technical Reviewer shall document his findings and recommendations in a letter report.

8.0 ATTACHMENTS

The attachments and their total page count associated with this Project Instruction are as follows:

- Attachment 1: "Reference Summary Form." (1 page)
- Attachment 2: "Field Data Sheets." (9 pages)
- Attachment 3: "Photograph Log." (1 page)

Reference Summary Form
GGNS Task 1 Data Review

Reviewer: _____ (WLA) Date: _____

Accepted By: _____ Date: _____

Circle Reference Type: Peer Reviewed Published

License Support Field Data Third Party

Complete citation (Geological Society of America format)

_____

_____

_____

Applicability (e.g. related to site conditions, tectonic setting, source model, or ground motion estimation)

_____

_____

_____

Summary of relevant information

_____

_____

_____

_____

Comment on Data Quality

_____

_____

Potential new issue

_____

_____

WLA SOIL DESCRIPTION REFERENCE SHEET 1

SOIL TYPE (USCS symbol); color; moisture condition; consistency or density; component percentages; other characteristics; additional comments (Geologic Interpretation).

SOIL TYPE: See back side of page regarding USCS soil types. List main component first in CAPITAL letters, followed by secondary components in order of decreasing abundance, separated by a comma or "with".

COLOR: Use Munsell colors when possible or use following table by default (color terms below can be prefaced with" light" or "dark").

Generalized Color Terms	gray	red	yellowish brown	olive
	greenish gray	reddish brown	reddish yellow	white
	black	brown	olive brown	yellow

Based on Munsell color charts, 1994

MOISTURE CONDITION:

Dry	Absence of moisture, dusty, dry to the touch
Damp	Slight moisture content, difficult to mold fines into ball.
Moist	Moisture evident but no visible water, fines can be molded into ball
Wet	Visible free water, soil is usually below water table

modified from ASTM 2488-93

CONSISTENCY (fine grained)

SPT blow counts	Pocket Pen. (ksf)	CONSISTENCY	Field Test
<2	<1/4	Very soft	Extruded between fingers when squeezed
2 - 4	1/4 - 1/2	Soft	Molded by light finger pressure
4 - 8	1/2 - 1	Medium stiff	Molded by strong finger pressure
8 - 15	1 - 2	Stiff	Readily indented by thumb but penetrated with great effort
15 - 30	2 - 4	Very stiff	Readily indented by thumbnail
>30	>4	Hard	Indented with difficulty with thumb nail

DENSITY(coarse grained)

SPT blow counts	DENSITY
0 to 4	Very loose
4 - 10	Loose
10 - 30	Medium dense
30 - 50	Dense
>50	Very dense

Consistency: NAVFAC Design Manual 7.01, 1986; Density: EPRI EL-6800 Manual on Estimating Soil Properties for Foundation Design, 1990.

COMPONENT PERCENTAGE: Estimate the relative percentage of coarse and fine grain material to the nearest 5%, if possible. Refer to the charts on Sheet 2 for estimating percentages in hand samples. This can also be done using the Jar Method as described in ASTM 2488: Mix the soil sample and water in a small jar with a lid (ex. a baby jar); shake thoroughly; allow to settle; coarse grain particles will settle first, sand will fall out of suspension in 20 to 30 seconds, silts will take over 30 seconds, and clays may or may not settle during the duration of test.

OTHER CHARACTERISTICS:

FINE-GRAIN COMPONENT (tests briefly described on Sheet 2 and fully explained in ASTM 2488-93):

Dry Strength		Dilatancy		Toughness		Plasticity	
None	Crumbles w/mere pressure	None	No visible change	Low	Slight pressure, thread soft&weak	Nonplastic	Thread cannot be rolled at any water content
Low	Crumbles w/some pressure	Slow	Water appears slowly on surface& disappears slowly upon squeezing	Medium	Medium pressure, thread medium stiff	Low	Thread can barely be rolled, ball cannot be formed after rolled
Medium	breaks w/cons-iderable pressure			High	Considerable pressure, thread very high stiffness	Medium	Thread easily rolled, cannot be rerolled
High	Breaks between thumb & hard surface	Rapid	Water appears quickly on surface & disappears quickly			High	Considerable time needed to roll thread, can be rerolled several times, ball can be formed without crumbling when drier than PL.
V. high	Cannot be broken						

SOIL SYMBOL	DRY STRENGTH	DILATENCY	TOUGHNESS
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

From ASTM 2488

Soil structure: Note any soil structure, blocky, prismatic, etc.

COARSE-GRAIN COMPONENT:

- Lithology: eg. quartz sand, chert gravels, gravels of varied lithologies including granite, diorite, and phyllite.
- Grading: Well graded or poorly graded
- Grain angularity (coarse sand or larger): rounded, subrounded, subangular, angular. Refer to Sheet 2 figure.
- Maximum grain size (gravels or larger)

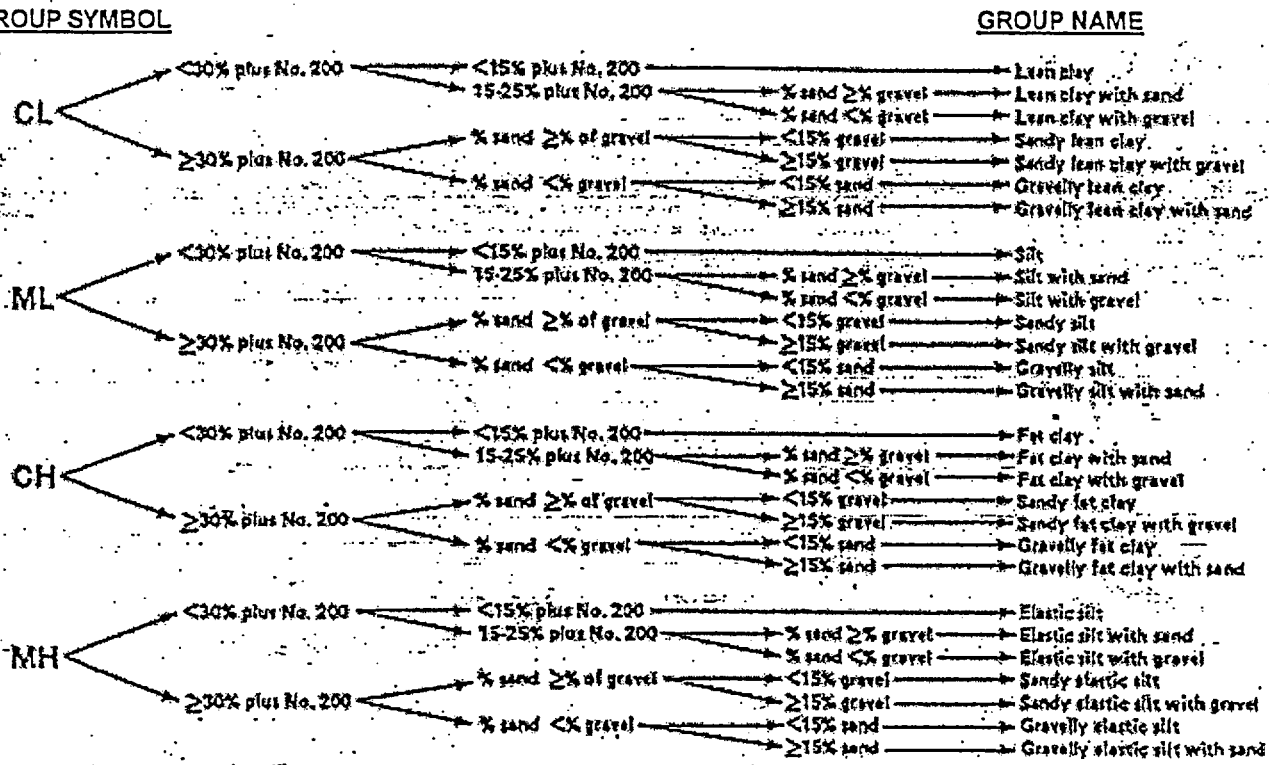
ADDITIONAL COMMENTS: presence of roots; reaction with HCl: none, weak, strong; odor; clay films; etc.

(GEOLOGIC INTERPRETATION): Alluvium, colluvium, weathered rock, landslide deposit, soil horizons, etc.

WLA MODIFIED PROCEDURES:

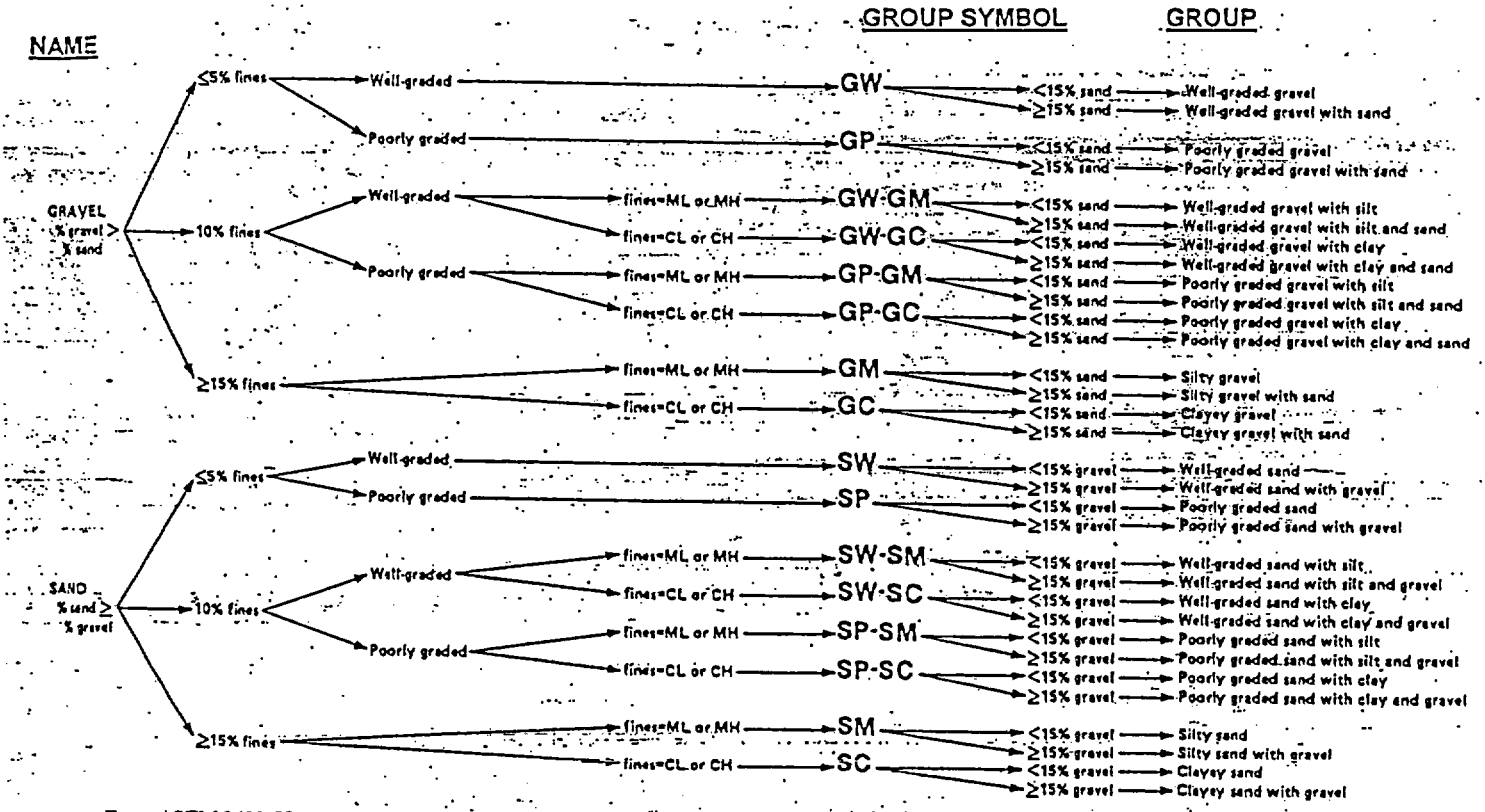
(1) Primary component should be listed first in CAPITAL letters, followed by secondary components in order of decreasing abundance separated by a comma or "with".
(2) The terms fat, lean, and elastic can be dropped from field classification and added to final logs based on basis of laboratory test results.

FINE-GRAIN SAMPLES



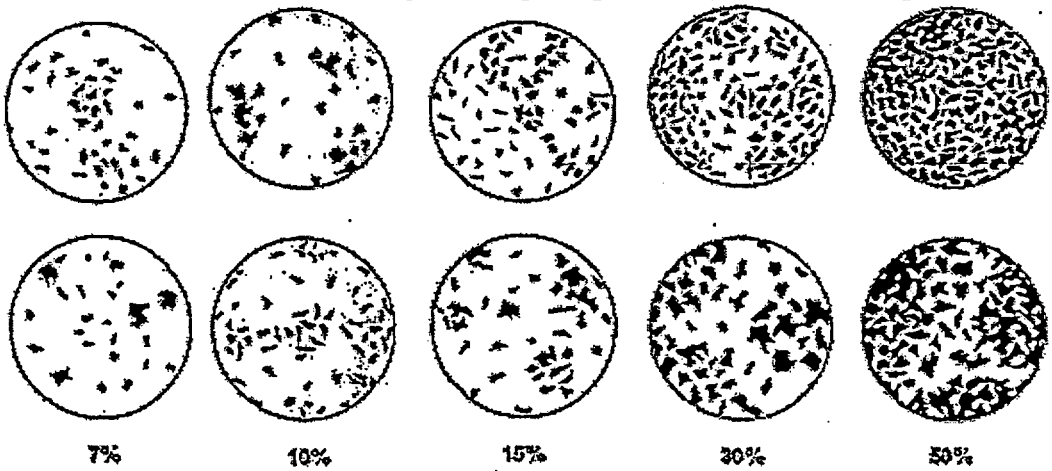
NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

COARSE-GRAIN SAMPLES



From ASTM 2488-93

PERCENT COMPOSITION: Estimating coarse grain percentage of hand samples.



From AGI Data Sheets for Geology in the Field, Laboratory, and Office, 1982.

OTHER CHARACTERISTICS:

Fine Grain Component Tests

Dry strength: None, low, medium, high, or very high. Test: Work material into putty-like consistency, adding water if necessary; mold into either ball or square (1/2 in. ø); allow to dry; crush between fingers; note strength..

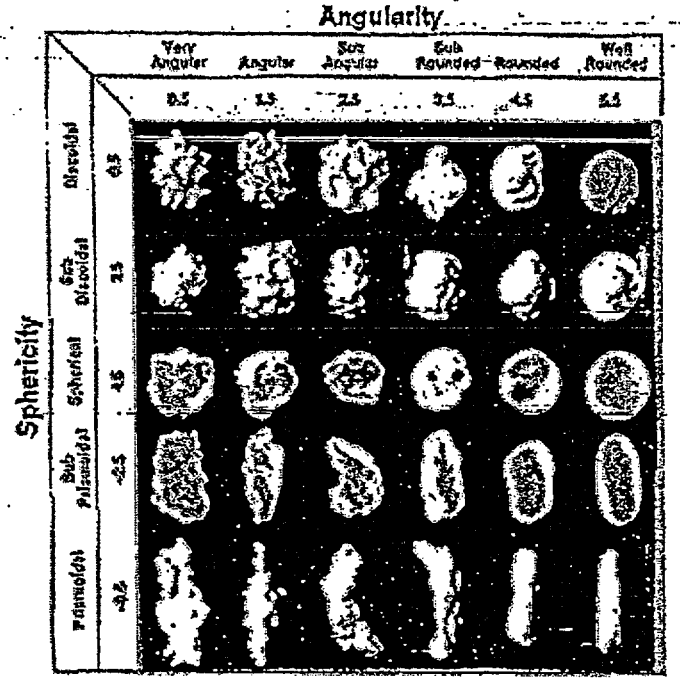
Dilatancy: None, slow, or rapid. Test: Work material into putty-like consistency, adding water if necessary; mold into either ball or square (1/2 in. ø); smooth ball into hand; shake vigorously; note reaction of water appearing on the surface of the soil; squeeze the sample; note reaction.

Toughness: Low, medium, or high. Test: Following dilatancy test; roll sample into 1/8 in. ø thread; fold thread & reroll until thread begins crumbling at 1/8 in. ø (this is near the plastic limit); note pressure required near PL.

Plasticity: Nonplastic, low, medium, or high. Test: Use same method as toughness test if sample is inorganic.

Coarse Grain Component

Grain angularity and sphericity (coarse sand or larger): rounded, subrounded, subangular, angular. Refer to figure below.



SOIL SAMPLING TECHNIQUES

Hammer Samples:

When hammer sampling, the following data should be recorded:

Delivery system: Cat-head hammer
Automatic trip hammer
Downhole hammer

Weight/drop: ASTM Standard is 140 lb w/30" drop

Sampler size:

SPT Sampler: 2:0-in. O.D., 1.375-in. I.D. split-spoon sampler, may need brass liners
2.5-inch O.D., 2.0-inch I.D. split-spoon sampler with 1 or 6-inch long brass ring liners
3.0-in. O.D., 2.5-in. I.D. split-spoon sampler with 1 or 6-inch long brass ring liners

Blow counts: Should be recorded at six inch intervals for a total of 18 inches.

Push Samples:

When push sampling, the following data should be recorded:

Sampler type: Shelby tubes, pitcher tubes, others

Downfeed pressure: This is read off of gauges on the drill rig. It should be checked throughout sampling, and a range of values should be given if appropriate. Drillers should be asked about reliability of gauges.

WLA Soil Classification based on ASTM 2488-93 Standards with minor modifications:
Primary component should be listed first in CAPITAL letters, followed by secondary components in order of decreasing abundance separated by a comma or "with".

FINE GRAINED SOIL TYPES

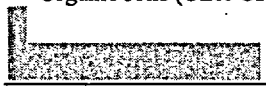
Soil Type ***	Percent composition	USCS Group Symbol
All CLAY's	Clay + Silt ≥ 50%, clay% > silt%	CL(lean) or CH (fat)
All SILT's	Clay + Silt ≥ 50%, silt% > clay%	ML(lean) or MH (fat)
CLAY or SILT	< 15% sand + gravel	clay (CL or CH), silt (ML or MH)
CLAY or SILT with sand,	15-29% sand + gravel, sand ≥ gravel	clay (CL or CH), silt (ML or MH)
CLAY or SILT with gravel	15-29% sand + gravel, gravel > sand	clay (CL or CH), silt (ML or MH)
CLAY or SILT, sandy	≥ 30% sand + gravel, sand ≥ gravel, <15% gravel	clay (CL or CH), silt (ML or MH)
CLAY or SILT, sandy with gravel	≥ 30% sand + gravel, sand ≥ gravel, ≥15% gravel	clay (CL or CH), silt (ML or MH)
CLAY or SILT, gravelly	≥ 30% sand + gravel, gravel > sand, <15% sand	clay (CL or CH), silt (ML or MH)
CLAY or SILT, gravelly with sand	≥ 30% sand + gravel, gravel > sand, ≥15% sand	clay (CL or CH), silt (ML or MH)
CLAY, silty	Clay+Silt ≥ 50%, clay%≈silt%(±5%)	CL - ML

CLAY, silty with sand	15-29% sand + gravel, sand ≥ gravel	CL - ML
CLAY, silty with gravel	15-29% sand + gravel, gravel > sand	CL - ML
CLAY, silty, sandy	≥ 30% sand + gravel,	CL - ML
CLAY, silty, sandy with gravel	≥ 30% sand + gravel, sand ≥ gravel, ≥15% gravel	CL - ML
CLAY, silty, gravelly	≥ 30% sand + gravel, gravel > sand, <15% sand	CL - ML
CLAY, silty, gravelly with sand	≥ 30% sand + gravel, gravel > sand, ≥15% sand	CL - ML

FINE GRAINED SOIL TYPES

Soil Type	Percent composition	USCS Group Symbol ***
All SAND's	Sand + Gravel ≥ 50%, sand% ≥ gavel%	SP (poorly graded)or SW (well graded)
All GRAVEL's	Sand + Gravel ≥ 50%, ravel% > sand%	GP (poorly graded)or GW (well graded)
SAND	<5% fines, <15% gravel	SW or SP
SAND with gravel	<5% fines, ≥15% gravel	SW or SP
SAND with silt	5-12% silt, <15% gravel	SW-SM or SP-SM
SAND with silt and gravel	5-12% silt, ≥15% gravel	SW-SM or SP-SM
SAND with clay	5-12% clay, <15% gravel	SW-SC or SP-SC
SAND with clay and gravel	5-12% clay, ≥15% gravel	SW-SC or SP-SC
SAND with silty clay	5-12% silty clay, <15% gravel	SW-SC or SP-SC
SAND with silty clay & gravel	5-12% silt y clay, ≥15% gravel	SW-SC or SP-SC
SAND, silty	>12% silt, <15% gravel	SM
SAND, silty with gravel	>12% silt, ≥15% gravel	SM
SAND, clayey	>12% clay, <15% gravel	SC
SAND, clayey with gravel	>12% clay, ≥15% gravel	SC
SAND, silty, clayey	>12% silty clay, <15% gravel	SC-SM
SAND, silty, clayey with gravel	>12% silty clay, ≥15% gravel	SC-SM
GRAVEL	<5% fines, <15% sand	GW or GP
GRAVELwith sand	<5% fines, ≥15% sand	GW or GP
GRAVELwith silt	5-12% silt, <15% sand	GW-GM or GP-GM
GRAVELwith silt and sand	5-12% silt, ≥15% sand	GW-GM or GP-GM
GRAVELwith clay	5-12% clay, <15% sand	GW-GC or GP-GC
GRAVELwith clay and sand	5-12% clay, ≥15% sand	GW-GC or GP-GC
GRAVELwith silty clay	5-12% silty clay, <15% sand	GW-GC or GP-GC
GRAVELwith silty clay & sand	5-12% silt y clay, ≥15% sand	GW-GC or GP-GC
GRAVEL, silty	>12% silt, <15% sand	GM
GRAVEL, silty with sand	>12% silt, ≥15% sand	GM
GRAVEL, clayey	>12% clay, <15% sand	GC
SAND, clayey with sand	>12% clay, ≥15% sand	GC
GRAVEL, silty, clayey	>12% silty clay, <15% sand	GC-GM
GRAVEL, silty, clayey with sand	>12% silty clay, ≥15% gravel	GC-GM

* The term rocky may be used for gravel-sized, angular-to-subangular rock clasts that do not appear to be fluvial in nature, but rather colluvial or related to in-situ rock weathering.
** Organic soils (OL& OH) are not included, See ASTM2488-93

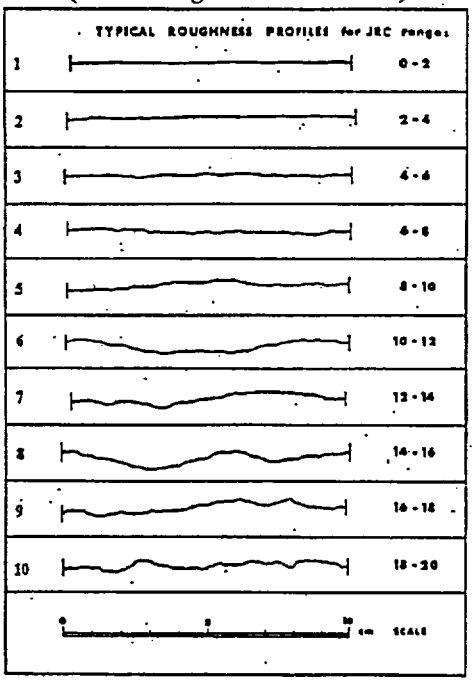


WLA ROCK STRENGTH CLASSIFICATION SCALE

Term	Hardness Designator/ Grade	Field Identification	Approximate range of uniaxial compressive strength
Extremely Weak	R0	Can be indented with difficulty by thumbnail. May be friable or moldable with finger pressure.	<150 psi
Very Weak	R1	Crumbles under firm blows with point of geologic hammer. Can be pealed by a pocket knife.	150-725 psi
Weak	R2	Can be peeled or scraped by a pocket knife with difficulty. Cannot be scratched by fingernail. Shallow indention made by firm blow of geologic hammer.	725-3,625 psi
Medium Strong	R3	Cannot be scraped or picked with a pocket knife. Specimen can be fractured with a single firm blow of a hammer/geologic pick.	3,625-7,250 psi
Strong	R4	More than one blow of geologic hammer required to fracture specimen.	7,250-14,500 psi
Very Strong	R5	Specimen requires many hard blows of hammer to fracture or chip. Hammer rebounds after impact.	14,500-36,250 psi
Extremely Strong	R6	Specimen can only be chipped by hammer.	>36,250 psi

Modified from Brown (1981), Hoek (1996).

ROCK DISCONTINUITY ROUGHNESS
JRC (Joint Roughness Coefficient)



Modified from Brown (1981)

ROCK WEATHERING CLASSIFICATION SCALE
Modified from Brown (1981)

Designation	Symbol	Field Identification	Grade
Fresh	F	No visible sign of rock material weathering: perhaps slight discoloration on major discontinuity surfaces. Rings under hammer impact	I
Slightly Weathered	SW	Rock mass is generally fresh with slight discoloration in rock fabric. Discontinuities are stained and may contai clay. Decomposition extends upto 1" into rock.	II
Moderately Weathered	MW	Less than 50% of rock is decomposed. Significant portion of rock shows discoloration and weathering effects. Crystals are dull and/or altered. Discontinuities are stained and may contain secondary minerals. Strength is significantly less than fresh rock.	III
Highly Weathered	HW	Rock mass is more than 50% decomposed. Rock can be broken by hand or scraped with knife or pick. All discontinuities exhibit secondary mineralization. Surface of core is friable and/or pitted due to washing out of highly altered minerals by drill water.	IV
Completely Weathered	CW	Rock mass is completely decomposed but rock fabric and structure may still be evident (saprolite). Specimen is easily crumbled or penetrated with pocket knife or geologic pick.	V
Residual Soil	RS	All rock material is decomposed to soil. Rock fabric and structure completely destroyed. There is a large change in volume, but soil has not been significantly transported.	VI

JOINT AND BEDDING SPACING TERMS

Spacing	Joint Spacing Term	Spacing	Bedding/Foliation Spacing Term
Less than 0.1 ft	Very close	Less than 1.5 in.	Very thin (laminated)
0.1 - 0.3 ft.	Close	1.5 in. - 4 in.	Thin
0.3 - 1.0 ft.	Moderately close	4 in. - 1 ft.	Medium
1.0 - 3.0 ft.	Wide	1 ft. - 3 ft.	Thick
3.0 - 10 ft.	Very wide	More than 3 ft.	Very thick
More than 10 ft.	Extremely wide		

Modified from Brown (1981) and Caltrans, 1996

Photograph Log

Photo Log			
			Page No. ____ of ____ pages
Camera	Roll #	Project #	ENTO002, Phase 1, Task1
Geologist			
Frame	Date	Location	Description