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WP 07-EU1001

Revision 3

Geologic and Fracture Mapping of Facility Horizon Drifts

Technical Procedure

EFFECTIVE DATE: 07/21/10

Rey Carrasco

APPROVED FOR USE

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CHANGE HISTORY SUMMARY

REVISION NUMBER	ISSUE DATE	DESCRIPTION OF CHANGES
3		Added information to the Introduction on the two types of geologic mapping performed at WIPP. Added information for Stratigraphy Data Spreadsheet. Moved last 4 steps up in document and added clarification information.

INTRODUCTION [1, 2]

This procedure defines the methods used for geologic and fracture mapping of facility horizon drifts at the Waste Isolation Pilot Plant (WIPP). Mapping of geologic observations is used to document lithologic, structural, and fracture features. Selected drifts are mapped to verify stratigraphic continuity and identify geologic features. Mapping is performed by geotechnical personnel.

There are two types of geologic mapping performed at WIPP: detailed geologic mapping and stratigraphic mapping. Detailed geologic mapping examines rock type, color, texture, grain and crystal size, minor constituents, and structural features. Stratigraphic mapping is a broader generalized mapping technique used to portray geologic relationships between adjacent sedimentary strata. The focus of stratigraphic mapping is to map units that are continuous, rather than provide a detailed geologic description of individual map units.

Performance of this procedure generates the following record(s), as applicable. Any records generated are handled in accordance with departmental Records Inventory and Disposition Schedules.

- Underground Geologic Log Sheet (sample shown in Attachment 1, Sample Underground Geologic Log Sheet Template)
- Stratigraphy Data Sheet (sample shown in Attachment 2, Sample Stratigraphy Data Sheet)
- Attachment 7, Borehole Inspection Field Data Sheet

REFERENCES

BASELINE DOCUMENTS

- WP 07-1, WIPP Geotechnical Engineering Program Plan
- WP 13-1, Washington TRU Solutions LLC Quality Assurance Program Description

REFERENCED DOCUMENTS

- DOE/WIPP 93-056, *Sedimentary Textures, Structures, and Lithofacies in the Salado Formation: A Guide for Recognition, Classification, and Interpretation*

NOTE
Steps are not required to be performed sequentially.

PERFORMANCE

1.0 GEOLOGIC MAPPING

1.1. Establish vertical and horizontal survey control data.

1.2. Locate geologic mapping sections at regular intervals, maintaining a maximum of 10 feet between intervals.

1.2.1. Plot data on the Underground Geologic Log Sheet (sample see Attachment 1), or record data on a Stratigraphy Data Spreadsheet (Attachment 2) for plotting

1.3. Perform the following at each mapping section:

1.3.1. Clean rock surface as required, removing accumulations of dust and debris that could obscure geology.

1.3.2. Measure distance from floor to elevation datum to nearest tenth of a foot and plot on Underground Geologic Log Sheet or record data on a Stratigraphy Data Spreadsheet for plotting.

1.3.3. Measure distance from roof to elevation datum to nearest tenth of a foot and plot on Underground Geologic Log Sheet, or record data on a Stratigraphy Data Spreadsheet for plotting

1.3.4. Inspect section to establish geological features to be mapped. Refer to Attachment 3, Rock Types and Mapping Symbols, Attachment 4, Generalized Geologic Cross Section of Facility Geologic Units, and Attachment 5, Description of Geologic Units.

1.3.5. Plot features to scale in their relative positions on Underground Geologic Log Sheet.

1.3.6. Describe geologic features on Underground Geologic Log Sheet, noting:

- Mapping unit (if applicable)
- Rock type
- Color
- Grain/crystal size
- Minor constituents

- Structural features
- Stratigraphic contacts

1.3.7. For stratigraphy mapping, measure the distance from the top of the corresponding map unit to the floor for each respective section and record the data on a Stratigraphy Data Spreadsheet.

1.3.8. Make new lithologic descriptions or modifications to existing lithologic descriptions, as necessary.

1.3.9. Fully document new descriptions in notations on Underground Geologic Log Sheet, and by updating legends in Attachments 3 and 5.

NOTE

Steps are not required to be performed sequentially.

2.0 FRACTURE MAPPING

2.1. Establish horizontal survey control datum in area to be mapped.

NOTE

Use Attachment 3 for description and symbols of observed features. Indicate apertures and dip directions next to fractures being described.

2.2. Record fracture observations on Underground Geologic Log Sheet.

2.3. Note lithologies, ground control, and other features when appropriate. (Attachment 6, Sample Fracture Map on Underground Geologic Log Sheet)

2.4. Indicate location and condition of roof support elements on log, as necessary.

2.5. Photograph selected area when fracture pattern is too complex for accurate mapping.

NOTE

Steps are not required to be performed sequentially.

3.0 BOREHOLE OBSERVATIONS

3.1. Insert the probe rod into the borehole.

NOTE

Nail probe will catch or hang-up on borehole features such as fractures, clay seams, or separations.

3.2. Slowly pull probe away from and toward the collar while applying moderate pressure to a side of the hole.

3.3. Measure the depth of a feature, e.g., separation, hang up, or rough spot, from the collar of the borehole and record on Attachment 7.

3.4. Repeat Step 3.3 to the next observable feature until the significant borehole features have been identified.

3.5. Identify observable offsets and record the depth and magnitude of lateral displacement on Attachment 7.

3.6. Insert the probe rod into the borehole to the end of hole.

3.7. Measure depth of the borehole from the collar to end of hole.

Attachment 1 – Sample Underground Geologic Log Sheet Template

0		10		20		30		40		50		60		70		80		90		100	

DESCRIPTION AND NOTES

Mapping Units
MU 0 – Argillaceous halite
MU 1 – Orange Marker Bed (OMB) – Halite, reddish orange
MU 2 – Argillaceous halite seam above OMB
MU 3 – Halite, grading pink to grey
MU 4 – Argillaceous halite, reddish brown
MU 5 – Argillaceous halite, bluish grey
MU 6 – Halite, grading grey to pink

Floor and roof are drawn relative to horizontal datum

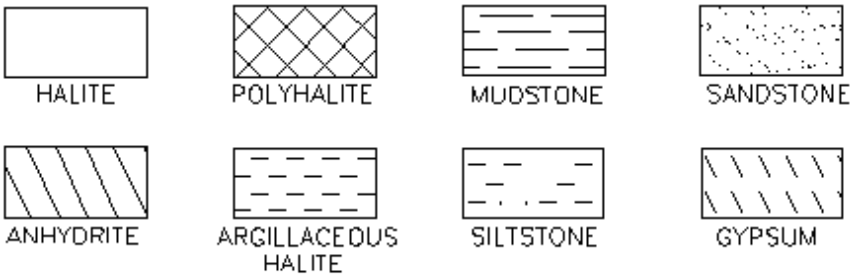
WIPP Waste Isolation Pilot Plant		UNDERGROUND GEOLOGIC LOG	
LOCATION			
SUBJECT			
HORIZONTAL AND VERTICAL SCALE		STATION	
MAPPED BY	DATE	SHEET	of

Attachment 2 – Sample Stratigraphy Data Sheet

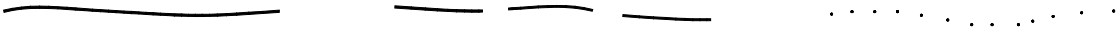
Stratigraphy Data Spreadsheet	Datum (feet)	Vertical Datum (feet)	Floor (feet)	Floor El. (feet)	Map Unit 0 (feet)	Map Unit 0 El. (feet)	Map Unit 1 (feet)	Map Unit 1 El. (feet)	Map Unit 2 (feet)	Map Unit 2 El. (feet)	Map Unit 3 (feet)	Map Unit 3 El. (feet)	Map Unit 4 (feet)	Map Unit 4 El. (feet)	Map Unit 5 (feet)	Map Unit 5 El. (feet)	Map Unit 6 (feet)	Map Unit 6 El. (feet)	Map Unit 7 (feet)	Map Unit 7 El. (feet)	Map Unit 8 (feet)	Map Unit 8 El. (feet)	Map Unit Back (feet)	Map Unit Back El. (feet)
Date:																								
Location																								
By:																								
Vertical Datum:																								
Horizontal Datum:																								
Excel File Name:																								
Description and Notes																								
MU 0 - Argillaceous halite; unit extends into floor																								
MU 1 - Orange Marker Bed (OMB) - Halite, reddish orange																								
MU 2 - Argillaceous halite seam above OMB																								
MU 3 - Halite, grading pink to gray																								
MU 4 - Argillaceous halite, reddish brown																								
MU 5 - Argillaceous halite, bluish grey																								
MU 6 - Halite, grading grey to pink																								
MU 7 - Halite, clear to reddish-brown to medium grey																								
MU 8 - Anhydrite, medium light grey																								
MU 9 - Halite, clear; unit extends into back																								

Attachment 3 – Rock Types and Mapping Symbols

Rock types:



Contacts:



Sharp contact identifiable within 0.05 feet or less:

Gradational contact between 0.05 feet and 0.2 feet:

Diffuse contact between 0.2 and 0.5 feet:

Grain/Crystal Size:

Coarse Crystalline	Medium Crystalline	Fine Crystalline
Greater than 5 mm	1-5 mm	Less than 1 mm

Clay Seams:

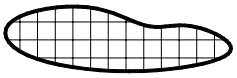
Clay seam (greater than 1/4” thick)

Clay partings (between 1/4” and 1/16” thick)

Clay breaks (less than 1/16” thick)

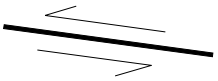
Discontinuous partings and breaks

Other Features:



Spalling Areas

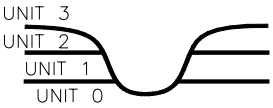
Bedding plane, joint, or fracture trace showing attitude



Fault trace showing attitude and/or relative separation

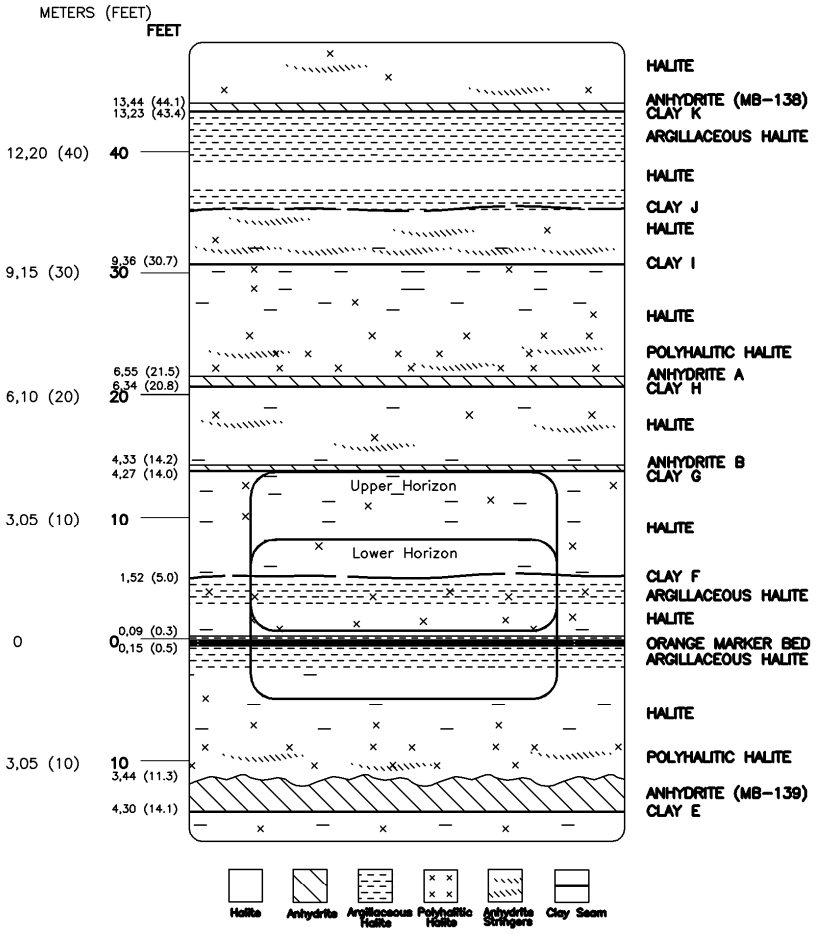
Seep or seep line

Weep or patchy damp area commonly with 1/4 to 3/4 inch diameter knobs of finely crystalline halite



Syn- or immediately post-depositional pits caused by dissolution and reprecipitation of the halite

Attachment 4 –Geologic Cross Section of Facility Geologic Units



Attachment 5 – Description of Geologic Units

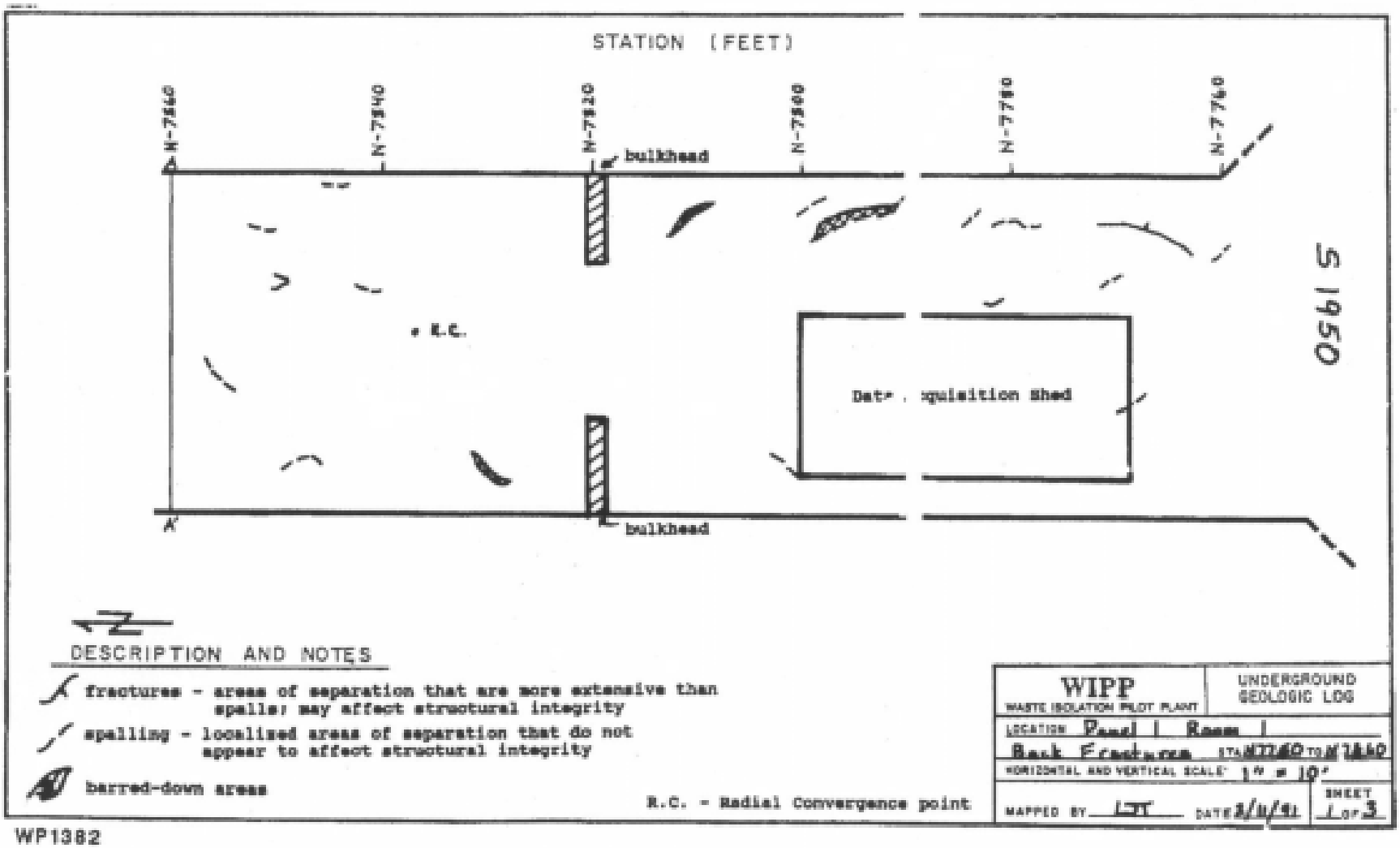
Unit*	Description
15	Halite: Clear to grayish orange-pink (10R 8/2) tint; transparent to translucent; coarsely crystalline; trace of dispersed polyhalite and intercrystalline clay; scattered white to light gray (N7) anhydrite pods; unit extends into roof; lower contact with Unit 14 is sharp based on prominent clay seam at top of Unit 14.
14	Halite: Clear to grayish orange-pink (10R 8/2) tint; transparent to translucent; coarsely crystalline; locally medium crystalline; trace of dispersed polyhalite; discontinuous stringers of medium gray (N5) clay; medium gray (N5) clay seam at top of unit; discontinuous occurrences of anhydrite along top of clay seam; lower contact with Unit 13 is diffuse and is based on increase in polyhalite content in Unit 13 and color change from grayish to reddish-brown.
13	Halite: Clear to moderate reddish-brown (10R 4/6); translucent to transparent; fine to coarsely crystalline; trace to some dispersed polyhalite and blebs; trace of gray and brown clay; continuous and discontinuous polyhalite stringers near top of unit; lower contact with Unit 12 is gradational based on increase in polyhalite content and decrease in clay content.
12	Polyhalitic halite: Clear to moderate reddish-orange (10R 6/6); translucent to transparent; coarsely crystalline; some dispersed polyhalite and polyhalite blebs; several anhydrite stringers in lower half of unit; lower contact with Unit 11 is sharp.
11	Anhydrite (anhydrite "a"): Light brownish gray (5YR 6/1), medium light gray (N6), some grayish orange-pink tint (10R 8/2); micro-crystalline; partially laminated; contains scattered halite growths; clear, coarsely crystalline halite layer up to 2-inch wide found within anhydrite.
10	Halite: Clear to moderate reddish-brown (10R 4/6); translucent to transparent; medium to coarsely crystalline; locally finely crystalline; trace to some dispersed polyhalite; discontinuous stringers of light gray clay (N7); contact with lower Unit 9 is diffuse based on absence of clay and lesser amounts of polyhalite.
9	Halite: Clear to grayish orange-pink (10R 8/2) tint; transparent to translucent; coarsely crystalline; lower contact with Unit 8 is sharp.
8	Anhydrite (anhydrite "b"): Medium light gray (N6); microcrystalline; locally in stringers separated by clear halite; underlain by medium light gray (N6) clay seam; contact with lower Unit 7 is sharp.
*	Units listed in descending order from top to bottom.

Attachment 5 – Description of Geologic Units

Unit*	Description
7	Halite: Clear to moderate reddish-brown (10R 6/6) to medium gray (N5); medium crystalline; locally finely crystalline; trace of dispersed polyhalite and intercrystalline light gray (N7) clay; discontinuous light gray (N7) clay stringers; unit extends into floor in experimental area; contact with lower Unit 6 is gradational based an absence of clay.
6	Halite: Clear, with grayish orange-pink (10R 8/2) tint; transparent to translucent; coarsely crystalline; trace of dispersed polyhalite; unit extends into the roof; lower contact with Unit 5 is gradational and/or diffuse.
5	Halite: Clear, transparent to translucent; coarsely crystalline; trace of argillaceous material; bluish-white (5B 9/1) to light-bluish-gray (5B 7/1), occurs in pods (1/2 inch diameter), discontinuous laminations and interstices; lower contact with Unit 4 is generally sharp and is based on prominent color change of argillaceous material (gray to red-brown) from Unit 5 to Unit 4.
4	Argillaceous halite: Clear and transparent, to moderate reddish-brown (10R 4/6), less frequently light-bluish-gray (5B 7/1); coarsely crystalline; trace of dispersed polyhalite; trace to abundant argillaceous material (decreasing downward) consisting of clay containing a trace of silt and fine crystals of halite; occurs as discontinuous laminations in upper half of unit, and interstitially in lower half; lower contact with Unit 3 is gradational, and is based on absence of argillaceous material in Unit 3.
3	Halite: Clear to moderate reddish-orange (10R 6/6); transparent to translucent; coarsely crystalline; trace of dispersed polyhalite; polyhalite content commonly increases downward; lower contact with Unit 2 is sharp.
2	Argillaceous halite: Moderate reddish-brown (10R 4/6), less frequently light bluish-gray (5B 7/1); medium to coarsely crystalline; argillaceous material which occurs primarily interstitially and as discontinuous laminations; lower contact with Unit 1 is generally sharp, less frequently gradational.
1	Halite: Light reddish-orange (10R 8/6) to moderate reddish-orange (10R 6/6), less frequently clear; translucent to transparent; medium to coarsely crystalline; trace of dispersed polyhalite; lower contact with Unit 0 is sharp.
0	Argillaceous halite: Clear to moderate reddish-orange (10R 6/6) and moderate reddish-brown (10R 4/6); medium to coarsely crystalline; trace of dispersed polyhalite; some argillaceous material, occurs in discontinuous lamination, blebs, and interstices (decreasing downward); contains finely crystalline halite; unit extends into the floor.

Units listed in descending order from top to bottom.

Attachment 6 – Sample Fracture Map on Underground Geologic Sheet



Attachment 7 – Borehole Inspection Field Data Sheet

Borehole Inspection Field Data Sheet

Borehole _____ GISID _____

Mine Coordinates

Diameter _____ (in)

Depth _____ (ft)

Direction _____

N

(offsets)

Inspected by _____ Date _____

Comments _____

Feature	Depth (ft)	Separation (in)	Offset (in)	Comments

Initial Data Entry: Entered by _____ Date _____

Subsequent Data Entry: Entered by _____ Date _____