ENGINEERING REGULATION 1110-1-1807 UPDATED JUNE 2023

DRILLING AND INVASIVE ACTIVITIES AT DAMS AND LEVEES

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AGENDA

ER 1110-1-1807 – Drilling and Invasive Activities at Dams and Levees

- Purpose
- Applicability
- Background
- Drilling and Invasive Program Plan Requirements
- Exemptions
- Documentation
- Review Process
- Summary of Major Changes
- Questions

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PURPOSE

The primary purpose of this ER is to prevent damage to dams, levees, and their foundations from hydraulic fracturing, erosion, filter/drain contamination, heave, etc. during invasive activities such as drilling and excavation.

…drilling and other invasive activities in/on/under all USACE dams or levees, or if owned and operated by non-federal sponsors, within the real property identified and acquired for USACE dams and levees, **AND** near enough to potentially cause damage.

THESE ARE LIFE SAFETY STRUCTURES!

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APPLICABILITY

…all Major Subordinate Commands (MSCs), district commands, laboratories, and field operating activities having Civil Works and/or Military Program responsibilities. It also applies to third-party interests performing drilling or other invasive activities for all dams, levees, and their appurtenant structures with a federal interest, including non-federally owned and operated dams and levees.

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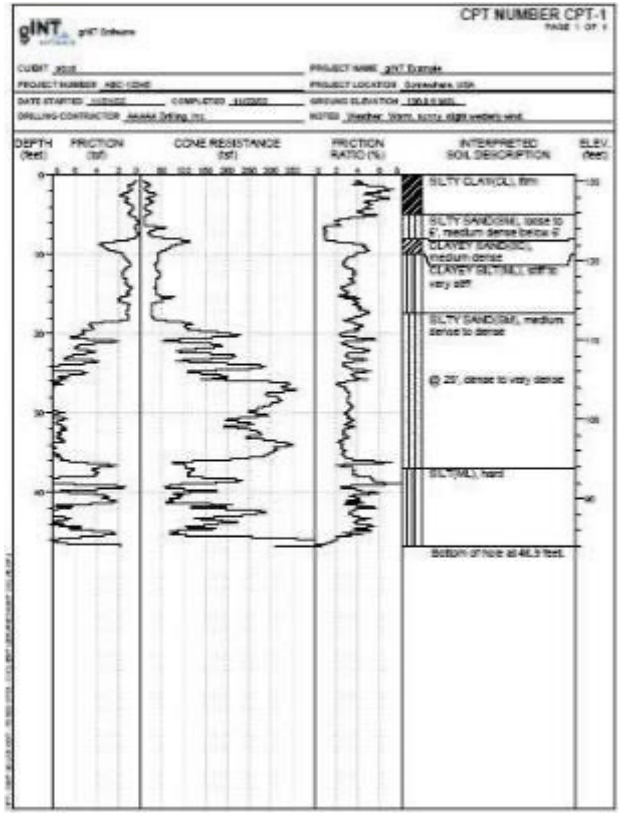
WHAT ARE INVASIVE ACTIVITIES?

Invasive activities include, but are not limited to:

- Drilling (including sampling, instrumentation installation, etc.)
- In situ testing (CPT, hydraulic conductivity, permeameter, pressure meter, etc.)
- Backfilling (casing, grouting, etc.)
- Excavation (test pit, trenching, etc.)
- Piezometer or relief well rehabilitation or redevelopment
- Anchoring or stabilization construction
- Installing seepage control features or cutoff structures (foundation grouting, cutoff walls, etc.)
- Horizontal directional drilling activities



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BACKGROUND

Grout leaking on the working platform, when grouting rock more than 100 feet below this elevation

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BACKGROUND (CONTINUED)

Grout leaks while drilling under the conduit of a dam, to the right of this photo

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Grout coming through a crack in the gallery wall

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TYPES OF HISTORICAL DAMAGE

- Creating preferential seepage paths.
- Washout of materials that creates or widens fractures or cavities.
- Filter/drain contamination, clogging, or plugging.
- Heave or increased uplift pressures.
- Hydraulic fracture or cracking a foundation grout curtain
- Damaging a utility, conduit, or other internal structure.

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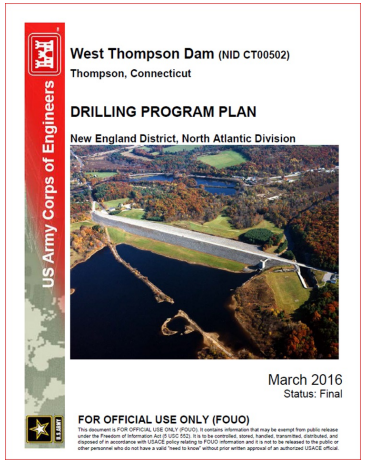
DRILLING AND INVASIVE PROGRAM PLAN

- Required prior to any drilling or invasive activities located in/on/under all USACE dams or levees, or if owned and operated by non-federal sponsors, within the real property identified and acquired for USACE dams and levees, **AND** near enough to potentially cause damage.
- Prepared and signed by a licensed PE or PG
- Justification for drilling:
  - approved recommendation from a risk assessment, or
  - routine O&M, or
  - valid engineering purpose for intrusive activities by outside entities (this includes utility crossings via horizontal directional drilling).
- List of requirements included in the ER – existing information review, team, drawings (plan, profile, cross-sections), methodology, risk evaluation.



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POTENTIAL FOR HYDRAULIC FRACTURE

- Drilling fluids should be minimized where possible
- Hydraulic fracture calculations are required at one-foot intervals along the bore path for both drilling fluids (if used) and borehole backfill
- Factors of safety (FS) should be calculated using at least two commonly used methods (e.g., Fell at al, 2018; Jaworski et al., 1981; Marchi, et al, 2014 and/or Chang and Huang, 2016).
- A minimum FS of 1.3 is required for all drilling cases
- A minimum FS of 1.5 is required for HDD applications (see EM 1110-2-2902)
- USACE developed the RMC Hydraulic Fracture Toolbox (https://www.rmc.usace.army.mil/Software/RMC-Toolboxes/RMC-Hydraulic-Fracture-Toolbox/) for hydraulic fracture calculations – now available to public

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HYDRAULIC FRACTURE TOOLBOX

Prepared by: _____ Office: _____ Date: _____
Checked by: _____ Office: _____ Date: _____
Calculation Title: _____

Hydraulic Fracture Toolbox ◄ This worksheet uses Visual Basic functions. Do not add or delete rows.

Elevation datum: ft-NAVD88 Specify datum _____

Boring and Subsurface Data Inputs

Top of Ground Elevation		ft
Depth to Groundwater		ft
Unit Weight of Water	62.4	pcf
Unit Weight of Drilling Fluid/Grout		pcf
Added Drilling Fluid/Grout Pressure		psf
Total Depth of Boring		ft

◄ Calculation table in subsequent worksheets will be limited to the input depth. Maximum depth is 200 feet.

Layer	Material Description	Material Type	Unit Weight, γ (pcf)	Effective Friction Angle, ϕ' (deg)	At Rest Earth Pressure Coefficient, K_o	Undrained Shear Strength, S_u (psf)	Rock Tensile Strength, T (psf)	Depth (ft)	
								Top of Layer	Bottom of Layer
1								0.0	
2									
3									
4									
5									
6									
7									
8									
9									
10									

◄ Use drop-down list in Column C.

Caution: Do not delete any of the following rows.

ft-NGVD29	Coarse Soil	(ft-NAVD88)
ft-NAVD88	Fine Soil	
Other	Rock	

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PERSONNEL REQUIREMENTS

- Drill rig operators must have a minimum of **three** years of experience with the type of equipment proposed, on at least two dam and/or levee projects.
- All invasive activities subject to this ER must be conducted in the presence of a licensed professional engineer or geologist who has at least **five** years of experience performing the proposed work.

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EXEMPTIONS

- Emergency response/repair, per District
- Major dam or levee modification (for example, cutoff wall installation, anchor installation, foundation grouting) that are described in design reports, plans, and specifications that have undergone Agency Technical Review
  - Note that invasive activities that are not associated with the major feature of work (for example, instrumentation, investigatory borings, drilling for in situ testing) are not exempt from the requirement to prepare a DIPP.

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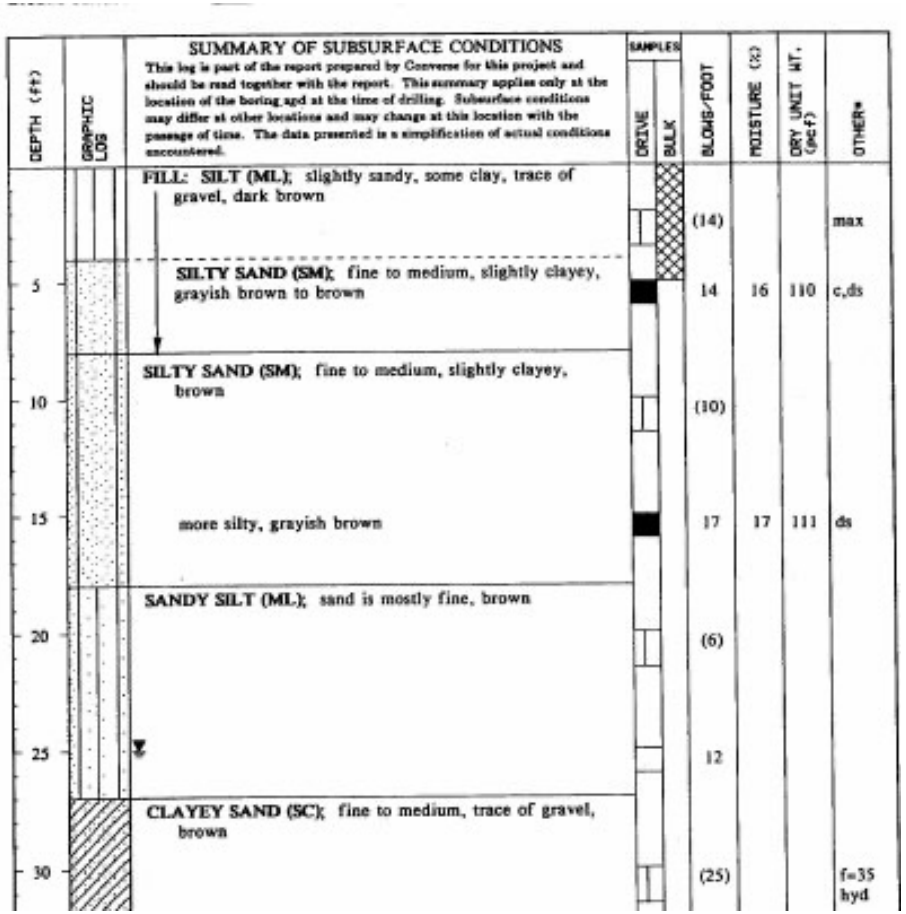
DOCUMENTATION

The District is responsible for ensuring that subsurface data generated (boring logs, CPT records, etc.) by these activities are archived in the USACE authoritative boring log database (currently OpenGround Cloud).

All boring logs generated by non-federal sponsors, or their representatives should be provided to USACE for documentation within 30 days of drilling, preferably in digital format.



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REVIEW PROCESS

- Good quality control is the best way to ensure quick approval
- DIPPs without fluid are approved by geographic District
- DIPPs with fluid are submitted for an additional review by independent committee
- Committee does not review rationale or justification but does ensure compliance with the ER and that the work is scoped to prevent damage.
- Comments are consolidated and sent back to District
- Revised plan is submitted for backcheck
- Once comments are resolved, a concurrence memo is produced and sent with the plan to District Engineering Chief for approval

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SUMMARY OF CHANGES

- Establishes a minimum Factor of Safety for hydraulic fracture of 1.3 for drilling.
- Requires two methods to calculate Factor of Safety for hydraulic fracture and provides suggested methodologies.
- Expands application to all dams and levees, not just embankments.
- Changes Drilling Program Plan to Drilling and Invasive Program Plan since this ER also applies to test pits and other non-drilling activities.
- Adds cc to regional Levee/Dam Safety Program Managers.

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SUMMARY OF CHANGES (CONT.)

- Adds a professional licensure requirement for preparer of Drilling and Invasive Program Plans.
- Clarifies experience requirements for drillers.
- Clarifies exemption for major construction projects.
- Clarifies that approval of a Drilling and Invasive Program Plan is a federal action that triggers National Environmental Policy Act.

Official Publications of USACE (https://www.publications.usace.army.mil/)
Hover on USACE Publications, choose Engineer Regulations
Search for 1807

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ANY QUESTIONS?