Preliminary Engineering Guidance for Environmental Clearances

What is Geotechnical Engineering?

Geotechnical Engineering is a discipline within Civil Engineering that focuses on the behavior of natural geo-materials (soils and rocks) in engineered systems. To determine the behavior of the geo-materials, a geotechnical exploration is necessary. The exploration consists of performing a variety of investigation methods that may include individually or a combination of the following: test boring, test pits, and geophysical methods. The various exploration equipment and methods described above are displayed at the end of this document.

The purpose of the geotechnical investigation is to assess the properties of the geo-materials for consideration in engineering and design.

Responsibilities

The 23 U.S.C. 101 (a)(4) defines preliminary engineering as the location, design, and related work preparatory to the advancement of a project to physical construction. Preliminary design defines the general project location and design concepts and includes activities such as surveys, geotechnical investigations, hydrologic analysis, hydraulic analysis, utility engineering, traffic studies, financial plans, revenue estimates, hazardous materials assessment, and other work needed to define the parameters for final design. These activities may all take place in advance of any NEPA approval for the project. In accordance with 23 CFR 636.103 and 23 U.S.C. 101 (a)(4), any such preliminary engineering and other activities and analyses must not materially affect the objective considerations of alternatives in the NEPA review process, such as detailed in Section 4(f) evaluations or Section 404 Individual Permits that require multiple alternatives for evaluation.

Local Public Agency (LPA) projects that have been initiated with ADOT where ground disturbing preliminary engineering activities will be undertaken in advance of the overall project NEPA approval, a State Environmental Clearance Memo will be completed. This Memo will document the preliminary engineering activities and relevant environmental mitigation to satisfy the requirements of pertinent environmental laws other than NEPA that must be considered prior to any NEPA approval.

Geotechnical Preliminary Engineering Activities

The purpose of a geotechnical investigation is to obtain information regarding the physical properties of the geo-materials for design and construction considerations.

Below are the types of geotechnical investigations that are performed by ADOT Geotechnical Services or a geotechnical consultant of ADOT.

- **Standard Geotechnical Investigations**: Performed by test borings, test pits, or hand samples. The test borings are performed by using a truck-mounted drill rig, track-mounted drill rig, or specialty-access drill rig. Drilling depths typically start at a depth of 5 feet below the ground surface and can extend to depths in excess of 100 feet. The test pits are usually performed with a backhoe and rarely a track hoe (excavator). Backhoe explorations typically start at a depth of 5 feet below the ground surface and can extend to depths of 15 feet. Track hoe exploration normally extends to depths of up to 30 feet.

- **Screening-Only Geotechnical Investigations**: Includes investigations such as pavement coring, shallow boring activities, and seismic refraction surveys. Pavement coring activities may include sampling soil to a depth no greater than 5 feet below the pavement surface in addition to basic pavement coring. Seismic refraction survey is a non-intrusive investigation similar to land surveying in terms of ground and personnel activity. Screening-only geotechnical investigations are detailed in a Standard Work document (Appendix A).

Early standard geotechnical investigations should be coordinated as early as possible with the ADOT Environmental Planner and Geotechnical group to inform scheduling, tasks, and consultant assistance. At the beginning of the design process, usually during the project kick-off meeting, the ADOT Environmental Planner will coordinate with the Project Design Team to determine if geotechnical activities will be conducted on a project, and if so, what type of geotechnical activities. For projects with complex geotechnical activities or any geotechnical activities that are planned to occur on federal or tribal lands, plan sheets or maps with the needed information are beneficial for expediting environmental review.

Standard Geotechnical Investigations

This should be expected for any project designed with structures (e.g., bridges, walls), roadway widening (e.g., cut or fill slopes, shoulders), rockfall mitigation, or any geo-hazard event (e.g., landslides, earth fissures). These types of projects are considered ground disturbing and require a review by the Environmental Planner.

For these types of projects, the geotechnical engineer (ADOT or consultant) shall provide the Environmental Planner with the following information regarding the geotechnical investigation:

- Footprint of exploration area presented on plan sheet (exact locations of test borings and/or test pits are not required)
- Access plan of equipment presented on plan sheet
- Approximate depths of test borings and/or test pits
- Types of activities (drilling and/or test pits)
- Equipment/vehicles needed for work (drill rig type and/or backhoe/track hoe)
- Temporary roads (TCE's) for access (if applicable)

Due to the fact that these projects will be designed based on the results of the geotechnical investigation and subsequent design reports, these efforts will normally require a separate environmental clearance ahead of the overall environmental clearance due to project delivery dates for submittals.

Screening-Only Geotechnical Investigation

This geotechnical work is conducted for pavement preservation/rehabilitation projects, bridge rehabilitation, and occasionally structural and/or widening projects.

Pavement coring is performed exclusively on pavement-type projects. Occasionally on pavement-type projects, the project team will request that the shallow subsurface soils (less than 5 feet) directly beneath the pavement are investigated.

Seismic refraction surveys are occasionally conducted on bridge rehabilitation projects that include scour retrofit to determine the excavability of the subsurface geo-materials. Seismic refraction surveys may also be conducted for projects with roadway/shoulder widening (cut/fill slopes) or lightly loaded structures (i.e., walls) in lieu of Standard Geotechnical Investigation methods. This usually occurs when vehicular (e.g., drill rigs) access is not practical or not possible by reasonable means.

For these activities the Environmental Planner will inform Biology and Cultural Resources as soon as these activities are known. Any concerns can be documented with emails or meeting minutes and no State Environmental Clearance Memo is required for this minimal ground disturbance activity unless it is to be combined with larger ground disturbing preliminary engineering activities.

Refer to the Geotechnical Standard Work for Screening-Only Geotechnical Events (August 2022) for further information on the information that is provided and process of these screening activities.

Preliminary Utility Engineering - Potholing

The purpose of utility potholing is to identify the location of underground utilities for consideration in design and engineering. This procedure commonly involves minimal ground disturbance using standard equipment such as hand tools and a vacuum truck to excavate a typical 1 square foot hole that is 4 feet deep into the ground. Once the utilities are identified and documented, the dirt is returned to its original location and compacted.

Similar to the environmental clearance and coordination process steps outlined for geotechnical activities, the Environmental Planner will work with the project team to determine if and when potholing activities will occur on a project. When potholing activities are needed for a project, the Environmental Planner should coordinate with the Project Design Team and request initial information on the depth, location, type of utilities, and equipment that will be used for the potholing activities.

Once the potholing information is provided by the Project Team, the Environmental Planner will inform Biology and Cultural Resources. If there are any concerns the Environmental Planner will communicate this information to the Project Design Team and Utility Coordinator. For this screening, the same process for geotechnical screening review will occur - documentation to note any concerns can be noted through emails or meeting minutes and no State Environmental Clearance Memo is required for this minimal ground disturbance activity unless it is to be combined with larger ground disturbing preliminary engineering activities.

Environmental Planning Review and Clearance Process

The Environmental Planner will coordinate with the ADOT Technical Specialists (Biology, cultural, Hazardous Materials, and Water Resources) to complete any evaluations needed. Coordination between the Project Design Team and Environmental Planner should be done to minimize and avoid sensitive environmental resources if needed. Considerations for technical evaluations include the following:

- Cultural Resources: The Historic Preservation Team (HPT) will review the geotechnical activities, identify the consultation requirements for any ground disturbing investigations, and will inform the Environmental Planner on any requirements such as monitoring or avoidance.
- Biological Resources: The Biological Resources Team will evaluate the geotechnical activities to complete the necessary documentation for any ground disturbing investigations and will provide information on any environmental concerns.
- Hazardous Materials: The Hazardous Materials Team may complete a database review of the geotechnical activities for any ground disturbing activities and identify if there are any known hazardous materials sites or issues in the project area.
- Water Resources: If there is any work in potential Waters of the United States (WOTUS), the Wetland Biologist will evaluate the geotechnical activities, complete the required documentation, and inform the Planner of any permitting requirements or mitigation requirements necessary.

The Environmental Planner should also review for any potential impacts to Section 4(f) properties. A Preliminary Initial Site Assessment (PISA) is typically not needed for geotechnical screening activities or potholing activities. Projects with new ROW or TCE's that require a project PISA should have the project PISA completed in advance of the geotechnical clearance memo if possible.

Following the evaluations, a State Environmental Clearance Memo will be issued for the footprint needed for standard Geotechnical investigations. For screening only activities (screening only geotechnical activities/potholing), documentation in the project files such as emails or meeting minutes are sufficient. For more complex geotechnical activities, a peer review of the State Environmental Clearance Memo is recommended.

PHOTOS OF DIFFERENT EXPLORATION TYPES

BACKHOE EXCAVATING TEST PIT

WHEEL-MOUNTED DRILL RIG


TRACK-MOUNTED DRILL RIG


SPECIALTY DRILL RIG


BACKHOE DRILLING WITH AUGER


SEISMIC REFRACTION SURVEY LAYOUT ALONG SLOPE

APPENDIX A

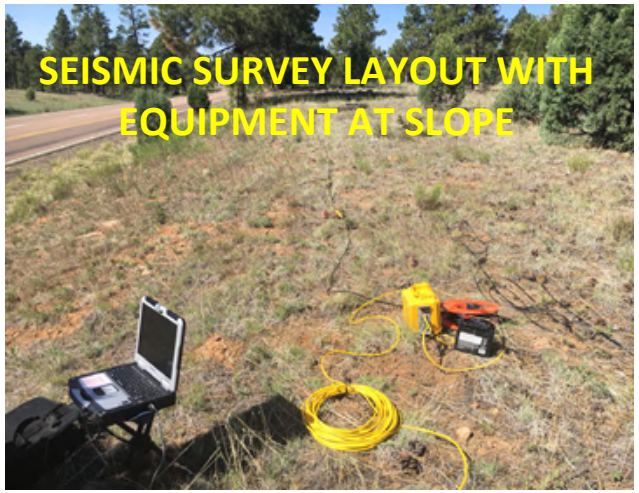
Standard Work for: Environmental Screening-Only for Geotechnical Investigation Events

Description of the task:	Provide Environmental Notification for Screening-Only Geotechnical Investigation Events	Date: 9/9/2022
Process Owner:	Patrice Brun, Manager, ADOT Geotechnical Services and Operations	Revision #: Original
Purpose:	Provide instructions and direction among work units	Document Owner: Patrice Brun and Paul O'Brien
Supplies & safety equipment required:	Standard PPE	

	WHAT? *Important Steps:* *List the critical steps of the operation that advance the work*	**HOW?** *Key Points:* *List the tasks that allow you to complete the steps successfully.*	Include a picture, a map, additional contacts or resources that are relevant for success when performing this job
1a	ADOT Geotechnical Services (or geotechnical consultant) submits notification to an ADOT EP planner for **pavement coring only** events.	ADOT Geotechnical Services (or geotechnical consultant) submits an email identifying, at a minimum, the project name, TRACS number, and project beginning and ending mileposts.	
1b	ADOT Geotechnical Services (or geotechnical consultant) submits notification to an ADOT EP planner for **pavement coring with shallow subsurface sample** (less than five feet) events.	ADOT Geotechnical Services (or geotechnical consultant) submits an email identifying, at a minimum, the project name, TRACS number, and beginning and ending mileposts in addition to the subsurface sample depths with locations provided by either a site plan, milepost, or stationing.	
1c	ADOT Geotechnical Services (or geotechnical consultant) submits notification to an ADOT EP planner for **seismic refraction survey** events.	ADOT Geotechnical Services (or geotechnical consultant) submits an email identifying, at a minimum, the project name, TRACS number, and a site plan showing the proposed survey area.	
2	Once a notification is sent by ADOT Geotechnical Services, the EP planner provides an email if there are any concerns in 5 working days for screening **pavement coring only** events, or 10 working days for screening **pavement coring with shallow subsurface sample** or **seismic refraction survey** events.	These projects will be screened exclusively by an ADOT EP planner and not an EP on-call consultant. ADOT EP will provide information on any concerns as part of the screening process	

3a	ADOT Geotechnical Operations performs all **pavement coring only** events.	1. Coordinate with District to set up traffic control and crew for pavement coring with limitations, if any and close one lane of traffic. 2. Perform pavement coring with limitations, if any. 3. Geotechnical Operations crew will have a 1-ton pickup truck which tows and positions a pavement coring rig in the traffic control work zone. 4. The coring will be performed on either the right or left wheel path (depending on the lane) or shoulder and will not be performed on any roadway paint striping. 5. Rotating core barrel (4 to 12 inches in diameter) will be pressed against pavement surface with minimum potable water to lubricate the barrel. 6. When the core barrel cuts through the pavement structure, the core barrel will be stopped and lubrication water will be cut off. 7. Core barrel will then be raised above the pavement surface and the pavement core is retrieved from the barrel. 8. Residual cuttings and/or core will be backfilled into the cored hole. Additional AC core patch material will be compacted into the core holes to bring the pavement back into service condition. 9. The pickup truck will tow the rig to the next coring location and repeat the above mentioned operations. 10. No access road is needed nor will any operations be conducted outside the paved area. 11. No water is discharged beyond the adjacent earthen shoulder. 12. No residual cuttings will remain. 13. Pavement cores will be logged and photographed and provided to the pavement design engineer. Pavement cores will be disposed of unless requested otherwise by the pavement design engineer. If that is the case, the cores will be stored at the ADOT Construction and Materials Group Central Laboratory (ADOT CML).	 

3b	ADOT Geotechnical Operations performs all **pavement coring with shallow subsurface sample** (less than 5 feet) events. ADOT Geotechnical Services representatives may also be present for observation.	1. See items 1 through 13 from pavement coring only operation above. 2. Subsurface soil samples are retrieved underneath the pavement section only (pavement and base course material if present). 3. The soil sample is retrieved by either advancing (pushing) a ring-lined barrel sampler into the subsurface soil. The sample is retrieved and the soil sample is collected and bagged. Process is repeated until the desired depth is reached. 4. Alternatively, the soil samples may be retrieved by augering by hand or by attaching an auger to a backhoe and penetrating to the desired depth. The augered soils are collected and bagged. 5. The test holes are refilled with soils previously tested at the ADOT CML. On-site soils (i.e., earthen shoulder soils, etc.) will not be used to refill the test hole. No excess soils will be disposed of or remain at the exploration site. Any remaining soils will be disposed of at the ADOT CML. 6. The soils are delivered to the ADOT CML for laboratory testing assignment. 7. ADOT Geotechnical Services will prepare a geotechnical report or memo detailing the exploration activities and recommendations.	 

3c	ADOT Geotechnical Services performs all **seismic refraction survey** events. ADOT Geotechnical Operations representatives may also be present for assistance.	1. The materials used for the seismic refraction survey consists of the following field equipment: • Seismograph • Laptop computer • 120-foot long spread cable • 300-foot trigger extension cable • 24 Geophones with clips • 16-lb sledge hammer • 6-inch by 6-inch aluminum plate • Battery: 12V 12AH • Various cables and wires to connect equipment 2. The field work is performed by transporting the above equipment by foot from a transport vehicle parked along the highway shoulder. Vehicles will remain within the roadway prism. 3. The field survey consists of extending the 120-foot spread cable along the survey area. Up to 24 geophones are clipped to the spread cable and are manually pushed in the ground at intervals ranging from 5 to 20 feet. The geophones penetrate no more than 3 inches of ground. The geophones are connected to the spread cable which is then connected to the seismograph. 4. A seismic wave is induced by striking the sledge hammer onto the aluminum plate that is placed on the ground surface. The striking of the aluminum plate is repeated multiple times. This step is typically repeated at three equally spaced points along the spread cable until satisfactory data is recorded. 5. Once the survey is completed, the equipment is collected and carried by foot to the transport vehicle.	 SEISMIC SURVEY LAYOUT WITH TRANSPORT VEHICLE ON SHOULDER  SEISMIC SURVEY LAYOUT WITH EQUIPMENT AT SLOPE  SEISMIC SURVEY LAYOUT AT BRIDGE