

**INDIANA DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS**

GEOTECHNICAL SECTION

Aquifer Protection Guidelines

Revised October 30, 1996

The concern for the protection of our ground water natural resources and the prevention of further contamination of that resource prompted the 1987 Indiana General Assembly to pass a ground water protection bill, known as Senate Bill No. 7. This bill amended the existing Indiana Code and created a new chapter identified as IC-25-39 (also referred herein as the "code").

Although, the code specifically exempts "wells drilled for the sole purpose of evaluating the foundation characteristics of earth materials to support bridges, roadways, buildings or other engineered structures.", the INDOT is taking steps to substantially follow the intent of the Indiana Code and modify bore hole abandonment procedures for all INDOT supervised drilling.

I. General Guidelines

Prior to the commencement of all geotechnical drilling, the current master list of known and/or suspected contaminated areas, compiled by the Indiana Department of Environmental Management (IDEM), shall be consulted to determine if the project falls within one of the designed areas.

If the project does not cross one of the designated areas, the work shall commence in accordance with these guidelines.

If the project does involve one of these areas, the INDOT Chief Geotechnical Engineer shall consult with the Indiana Department of Natural Resources (DNR) - Division of Water and the IDEM to receive a written directive on how to proceed.

If during drilling on the project a sanitary landfill is encountered, or evidence of surface or subsurface contaminants is noted, the drilling shall be stopped and the INDOT Chief Geotechnical Engineer shall be notified immediately. Drilling shall not commence again without his approval.

When Indiana Code IC-25-39 is referred to in the following paragraphs the most current Indiana Administrative Code requirements are to be followed.

II. Bore hole Abandonment Procedure without Instrumentation

Unless special backfilling guidelines are required, these procedures shall be followed. All depths are determined from natural ground surface. Therefore in fill sections, the fill height will be subtracted from the total depth before applying these guidelines.

A. Bore Holes 10 feet or less (after cave-in):

Salvaged soil from the bore hole shall be used for backfilling these bore holes. Backfilling shall be accomplished by rodding or tamping the soil in 24" or thinner lifts to prevent settlement of the backfill and leakage of surface water to the bore hole.

B. Bore Holes from 10 to 30 feet deep (after cave-in):

The bore hole shall be backfilled in accordance with Section A, using salvaged soil from the bore hole, from the bottom to a depth seven (7) feet below ground surface. Five (5) feet of bentonite or neat cement shall then be placed in the bore hole in such a manner to form an effective plug against runoff water entering the bore hole. The last two (2) feet of bore hole shall be backfilled with salvaged soil from the bore hole.

C. Bore Hole greater than 30 feet (after cave-in):

Complete slurry backfill is required for these bore holes. The following procedure can be used as a guideline, but the procedure shall not be interpreted to modify or supersede the Code.

1. Equipment:

- a) Backfill pipe of 1 1/2" flush jointed PVC or suitable drill rod.
- b) Two 150 to 250 gallon stock tanks.
- c) Two "Masons" hoes or other suitable "mud" mixer.
- d) Slurry pump, Wilder Trimline type is suggested.

2. Materials:

- a) Bentonite - small granular (like "Benseal"), or Portland Cement.
- b) Polymer - anionic liquid emulsion used to retard the natural swell of bentonite.
- c) Fresh Water.

3. Bentonite Slurry Specifications:

If bentonite slurry is used, it shall have a minimum of 1.5 pounds of bentonite per gallon of water. The polymer should be mixed at the manufacturer's suggested rate, usually near 1 quart per hundred gallons of water. The polymer should be mixed with the water before introduction of the bentonite. No more than 100 gallons of water should be prepared at one time.

4. Procedure:

Regardless of the depth of the bore hole, no more than 35 feet of bore hole shall be backfilled in one batch. If necessary the procedure shall be repeated in 35 foot stages until backfilling is complete.

- a) The backfill rods shall be lowered to within 6 inches of the bottom of the hole and held in place with a rod clamp. The slurry is then pumped until it's within 2 feet from the surface or 35 feet of bentonite has been pumped, whichever occurs first. If the slurry is within 2 feet of the surface, the rods are removed while pumping the last of the slurry. As soon as the rods are clear of the hole, the pump inlet hose should be shifted to the second stock tank to pump fresh water to clear the pump and rods of slurry. The top 2 feet of the bore hole shall be enlarged to 4 inches larger than the drilled diameter (8" enlarged to 12") and a cap of concrete 3 inches thick poured. The remaining hole can then be backfilled with salvaged soil from the bore hole.
- b) If the hole is only partially filled, place the inlet tube into fresh water before withdrawing the backfill tube. Then use water to clear the tube as it is withdrawn. After the tube is withdrawn and cleared, prepare the next batch of slurry. All subsequent stages are pumped after the backfill tube is inserted 6 inches into the previous slurry plug. This insures no voids are present in the backfill and to clear all water from the bore hole. The hole backfilling shall be

stopped 2 feet below ground surface and capped with 3" of concrete, then covered with salvage soil.

III. Installation and Abandonment Procedures for Inclinator Casing and Piezometers.

A. Inclinator

1. Installation:

Inclinator casing shall be installed in accordance with AASHTO Designation T254 Standard Method for Installing, Monitoring and Processing Data of the Traveling Type Slope Inclinator, Part I, except as modified herein.

<u>Section</u>	<u>Modifications</u>
2.1.1.	Minimum bore hole diameter is 8 inches.
2.2.1.	Only round extruded aluminum guide casing with four equispaced longitudinal grooves on the inside of the casing shall be used. Other types of casing may only be used with prior written approval of the INDOT.
2.6.1.	A steel pipe with either a threaded cap or lockable hinged lid shall be used.
3.1.	The bore hole shall be 8 inches in diameter and extend a minimum of 10' into sound rock.
3.3.	Hollow stem augers and roller bits are the approved boring methods.
4.0.	Only aluminum casing shall be used without prior written approval.
4.2.2.	Each joint shall be thoroughly taped to prevent intrusion of the slurry backfill.
5.0.	Only neat cement grout consisting of 94 pounds of Portland cement mixed with no more than 6 gallons of water will be permitted. No more than 5 %, by weight, of additives to improve fluidity will be allowed.

The grout shall be pumped into the bore hole from the bottom in a continuous operation to prevent voids in the backfill.

2. Inclinometer Abandonment Procedure:

- a) If the inclinometer casing is not crushed or obstructed for its entire length, bentonite or neat cement may be used to backfill the casing to within two feet of the ground surface. At this point, the casing shall be terminated and capped with concrete.
- b) If the inclinometer casing is obstructed or crushed, the casing shall be abandoned using bentonite slurry or neat cement only. Care should be taken to ensure the lower portion of the casing is adequately grouted.

B. Piezometer Installation:

1. Installation:

Piezometers shall be installed in accordance with AASHTO Designation T252 Standard Method for Measurements of Pore Pressure in Soils, except as modified herein.

<u>Section</u>	<u>Modification</u>
2.1.1.	Open observation wells are not permitted.
2.1.2.	Standard well points are not permitted.
3.1.	Driven installation is not permitted.
3.2.1.1.	Similar hammer - cable assemblies are acceptable with prior approval.
3.2.2.2	I.D. Casing is not acceptable. The following shall be used. <ul style="list-style-type: none"> a) A minimum four (4) inch nominal diameter bore hole in soil should be strictly adhered to, since a smaller diameter hole will create problems in correctly installing the bentonite backfill material. b) A minimum three and three-quarter (3 3/4) inch diameter bore hole in bedrock should be strictly adhered to, since a smaller diameter hole will create problems in correctly installing the bentonite backfill material.

- c) The maximum number of piezometers that can be installed in any one bore hole will depend upon the diameter of the bore hole. For the minimum diameter outlined above, only two (2) piezometers can be installed. Correctly installing the bentonite can be difficult when more than two (2) piezometers are placed in the minimum diameters outlined above.

3.2.2.2. The Piezometer stone assembly shall be handled in the following manner.

The porous piezometer stone should be soaked in water for several hours prior to installation. The saturated piezometer stone shall be attached to the length of 3/8 inch (inside diameter) polyvinylchloride (PVC) standpipe tubing by means of a leakproof joint. The bottom end of the saturated piezometer shall be plugged with a rubber stopper. The piezometer stone and the standpipe tubing shall be filled with clean water and lowered to the bottom of the hole. While lowering, a small excess head shall be maintained in the tube to assure that a small amount of water is flowing out of the stone.

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Disregard these sections and replace with the following:

- a) The casing shall then be pulled one and one-half (1 1/2) feet above the elevation of the top of the piezometer stone and water saturated OTTAWA sand placed down the hole (to the elevation of the top of the piezometer stone). The layer of OTTAWA sand should not be tamped. Raise the casing one (1) foot and add one (1) foot of untamped saturated OTTAWA sand. Repeat until the OTTAWA sand is a minimum of six (6) inches below the elevation of the strata break (between the stratum being monitored and the stratum immediately above).

In the case where no strata break occurs, the untamped saturated OTTAWA sand shall be placed a minimum of one (1) foot above the elevation of the top of the piezometer stone, or as directed.

- b) The casing shall then be pulled an additional two (2) feet and a minimum one (1) foot bentonite seal is to be placed in six (6) layers two (2) inches thick. The bentonite seal should be a minimum of six (6) inches above the strata break. Use tamping hammer to insure the bentonite is in place, but do not tamp into the sand. A thin layer of fine gravel may be dropped on each layer to prevent the hammer from sticking. This completes the installation of the deepest piezometer.
- c) In the event that only one piezometer is to be installed in the hole, bentonite will be added and compacted to completely fill the remainder of the hole, as the casing is withdrawn and finished in accordance with item 14.

In the event that more than one piezometer is to be installed in the hole, bentonite will be added to a predetermined depth to permit installation of the upper piezometer at a specified depth. This compacted bentonite will be added between the bentonite seal of the lowest piezometer and will form the lower seal of the next higher piezometer.

- d) The casing shall then be pulled two (2) feet and a minimum one (1) foot bentonite seal placed in six (6) layers two (2) inches thick. Use tamping hammer to insure the bentonite is in place, but do not tamp to drive the bentonite into the sand. A thin layer of fine gravel may be dropped on each layer to prevent the hammer from sticking. The top of this bentonite seal should be one (1) foot below the elevation of the bottom of the next piezometer stone.
- e) Completion of the next piezometer stone shall be accomplished using the procedure outlined above starting at No. 7 and repeated until the uppermost piezometer stone is installed.
- f) Upon completion of the uppermost piezometer, the drill casing shall be pulled out and the remainder of the hole shall be backfilled with compacted bentonite to a depth of about three (3) feet. A protective threaded metal pipe casing about three (3) feet long shall be installed at the top of each hole, backfilled to one (1) foot depth and then cemented. The inside of the casing shall then be filled with three (3) inches of sand (this prevents losing dropped caps). A

locking steel cap shall be securely placed onto the protective casing.

- g) All piezometer standpipe tubes shall be capped and properly identified to insure accurate monitoring records.

2. Piezometer Abandonment.

Piezometers shall be abandoned by pumping a bentonite slurry down the piezometer standpipe until the stone and standpipe are full. The standpipe(s) shall be terminated two (2) feet below ground surface and capped with concrete