

**Item No. 658S**  
**Void and Water Flow Mitigation**

**658S.1 Description**

This item governs notification requirements, as well as the furnishing and installing mitigation measures, specified by the Engineer or the designated Representative, for voids and water flow features discovered in bedrock during excavation activities of a project. This item does not apply to excavations that occur below the water table or in unconsolidated earth material. It is intended to address features observed upon initial excavation or discrete discharge points that are discovered when trench backfill material is removed. The purpose of the mitigation is to preserve voids and water flow features while maintaining utility integrity and preventing pollution.

The necessary investigation, selection methods for determining mitigation measures, and site plan correction submittal requirements are presented in Section 1.12.0 of the City of Austin Environmental Criteria Manual.

Standard Details 658S-1 through S-7 shall be used in site plan correction submittals related to the implementation of this item.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text the inch-pound units are given preference followed by SI units shown within parentheses.

**658S.2 Submittals**

- A. Submittals requirements of this specification include:
1. 3 x 5 hard rock: Source, type and gradation of rock.
  2. Controlled Low Strength Material (CLSM): Mix design for CLSM and other submittals shall be as required by Standard Specification Item 402S.
  3. Low Slump Concrete: The mix design for Class I, Curb & Gutter, Hand-vibrated Concrete (3500 psi) and other submittals shall be as required by Standard Specification Item 403S.7, Table 5. The concrete shall have a maximum 3 inch (75 mm) slump.
  4. Filter Fabric: Submittals as required by Standard Specification Item 620S. The material to be used for this application shall be noted.
  5. Permanent Turf Reinforcement Mat (PTRM): Non-degradable turf reinforcement mat that meets the specification requirements of the U.S. Department of Transportation, Federal Highway Administration (FHWA) FP-03, Section 713.18. The mat shall be made of nylon or other inert plastic and not be coated with chemical, substance or film. Maximum mesh opening shall be no greater than 2.5 mm (0.1 inch).

**658S.3 Materials**

- A. 3 x 5 hard rock: Rocks shall be sound with a minimum of 3 inches (75 mm) in smallest dimension and 5 inches (125 mm) in largest dimension. Open-graded rock of the size indicated on Details and fines removed, shall be used.
- B. Controlled Low Strength Material (CLSM): This material shall meet the requirements for CLSM as specified in Standard Specification Item 402S.
- C. Filter Fabric: This material shall meet the requirements for filter fabric as specified in Standard Specification Item 620S.
- D. Low Slump Concrete: This concrete shall meet the requirements for Class I, Curb & Gutter, Hand-vibrated Concrete as specified in Standard Specification Item 403S.7, Table 5. The concrete shall have a maximum 3-inch slump.
- E. Polypropylene Bags filled with pea gravel. Pea gravel shall meet requirements of Standard Specification Item 510.2 (5).
- F. Gravel Backfill: Gravel backfill shall meet requirements of Standard Specification Item 510.2 (2) (a) for pipe bedding stone.
- G. Permanent Turf Reinforcement Mat (PTRM): Non-degradable turf reinforcement mat shall meet the specification requirements of the U.S. Department of Transportation, Federal Highway Administration (FHWA) FP-03, Section 713.18. The mat shall be made of nylon or other inert plastic and not be coated with chemical, substance or film. Maximum mesh opening shall be no greater than 2.5 mm (0.1 inch).

#### **658S.4 Procedures**

- A. The Engineer or designated representative shall select a Geologist or designate a Geologist representative to observe trench walls greater than 5 feet (1.5 meters) deep of projects located within the Edwards Aquifer Recharge Zone (as defined by the City of Austin) or within 500 feet (152.5 meters) of a spring or seep identified during the permit review. The Geologist is defined as a geoscientist licensed under the Geology discipline by the Texas Board of Professional Geoscientists (Title 22, Part 39, Chapter 850.1). The Geologist representative is defined as a person who has been trained to identify and describe the geological origin of voids in karst terrain geology by the Geologist. A Professional Engineer with geological experience in karst terrain who qualifies to practice geoscience per the Texas Board of Professional Geoscientists rules (Title 22, Part 39, Chapters 850 and 851), may serve as the Geologist. Inspections must occur at least once daily during excavation operations and prior to backfilling the trench. Contractor shall be responsible to provide 24-hour prior notice of excavation activity to the designated Geologist or Geologist representative. The Contractor shall be responsible for ensuring that the Geologist or Geologist representative has the opportunity to observe the vertical face of all excavation activities (including pre-trenching operations) prior to any initial temporary back fill operations and following backfill removal for bedding, final back fill, pipe or manhole installation.
- B. Each underground void or water flow feature shall be mitigated in accordance with one or more of the following procedures and methods:

1. The Geologist or designated Geologist representative will observe the trench wall for any voids larger than 1 cubic foot (0.023 cubic meters) or any water flow feature. The Geologist or the Owner shall call the City of Austin Environmental Inspector, the Construction Inspector or Site/Subdivision Inspector, the City of Austin geologist, as necessary, for additional observation of the anomaly. For General Permit projects, the General Permit office shall be notified. For City of Austin-constructed projects, the location of the anomaly shall be recorded in the Construction Inspector's daily progress report. The owner must also notify the Texas Commission on Environmental Quality (TCEQ) for projects located within the jurisdictional boundaries of the Edwards Aquifer Recharge Zone, as defined in Chapter 213 of Title 30 of the Texas Administrative Code.
2. Initial observation of the anomaly shall be made from the top of the trench. The Contractor shall submit an Excavation Safety System Plan (City of Austin Standard Technical Specification Item 509S) for approval and shall install all necessary safety equipment to allow direct observation of the anomaly.
3. The Contractor must stop all excavation or trenching activities within 25 feet (7.62 meters) of the outer edge of the void's interior extent.
4. In certain cases, the Geologist or designated Geologist representative may determine that the void requires protection prior to any further backfill operations. Protection preventing the backfill from entering the void may consist of plywood planking or other barricade necessary to block the backfill. Areas of flowing water may require temporary mitigation measures, as well. The Contractor shall implement all appropriate mitigation measures established by the Geologist or designated Geologist representative.
5. If a void is located at the bottom of a trench, temporary void protection per Class I, Standard Detail 658S-1, shall be provided at all times that trench excavation is halted and until Owner's geologic and biologic inspection has occurred and Contractor has been given instructions on how to proceed.
6. A second void or water flow feature inspection may be required following final excavation operations. The Contractor shall stabilize the trench to allow for observation of the anomaly from within the trench. The Contractor shall provide an Excavation Safety System Plan (City of Austin Standard Technical Specification Item 509S) and shall install all necessary safety equipment to allow direct observation of the void or water flow feature. The Contractor shall assist in the investigation by providing access to the anomaly (e.g., ladders, harness and rigging, scaffolding, etc.) and confined space safety equipment. Contractor shall install all necessary shoring and trench protection.
7. The Contractor shall provide the safety plan for allowing trench entry for anomaly inspection. The Contractor's designated safety supervisor shall ensure that all OSHA requirements are met during anomaly observation. The Contractor shall not place pipe, pipe bedding, and backfill within 25 feet (7.62 meters) of the anomaly prior to final inspection.
8. The Engineer or designated representative shall submit a site plan correction to the City of Austin for all voids and/or anomalies that require mitigation measures; except for voids that are less than 18 cubic feet (.504 cubic meters), are dry, have no airflow and are located above the top of a utility pipe. The site plan correction shall show the surveyed location of the void (s)

- and/or anomaly (ies) and shall reference mitigation measures from this specification. The corresponding detail (s) are to be included in the correction. The Contractor shall not proceed with construction of the mitigation measures, excavating, pipe placement or installing pipe bedding or backfill within 25 feet (7.62 meters) of the anomaly (ies) until an approved site plan correction is acquired.
9. Mitigation of voids that are less than 18 cubic feet (.504 cubic meters), are dry, have no airflow and are located above the top of a utility pipe may proceed following a site meeting of the Engineer, the Geologist, the City of Austin Environmental Inspector, a City of Austin geologist and concurrence of a mitigation method. The Environmental Inspector will issue a punch list that will require a site plan correction approval prior to issuing a Certificate of Occupancy on any private project or prior to a final walk-through on a subdivision project and prior to the issuance of the engineer's concurrence letter. For City of Austin General Permits office projects, a member of that office must be present at the site meeting and agree with the proposed mitigation method.
  10. The Contractor shall construct the void and/or water flow mitigation measure (s) in accordance with the approved site plan correction. Anticipated measures shall be documented within the Contract Documents and pay items. The Contractor and Construction Inspector shall record material quantities of all completed mitigation measures in accordance with the pay items in the Construction Inspector's daily progress report for each day that a specific mitigation event is undertaken.
  11. Upon completion of each void and/or water flow mitigation measure, a Geologist or designated Geologist representative shall inspect the work before the Contractor resumes construction activities within 25 feet (7.62 meters) of the anomaly.

## **658S.5 Execution**

### **A. GENERAL**

The Engineer or designated representative shall establish the appropriate permanent void and water flow mitigation measures. Void and/or water flow mitigation measures shall be constructed as herein depicted and specified for most anomalies encountered. If the Geologist or designated Geologist representative observes unusually large voids or unforeseen circumstances, other measures may be prescribed by the Engineer or designated representative once the anomaly is observed.

### **B. VOID AND WATER FLOW MITIGATION MEASURES**

1. Class I temporary void mitigation measures for a void at the bottom of a trench or along a sidewall of a trench, as indicated in Standard Detail 658S-1, generally consist of:
  - a. Temporary protection of the void shall be provided by covering the void opening with filter fabric with minimum of 3 foot (915 mm) distance from edge of void to edge of filter fabric. This action will be taken prior to covering the trench or temporary backfilling operations.

- b. The void opening shall be covered with plywood planking with a minimum of 1 foot (305 mm) distance from edge of the void to the edge of the planking. Planking is to be placed to prevent backfill from entering void. Rock (minimum weight of 5 pounds (2.3 kg)) or concrete block shall be placed over planking.
  2. Class II permanent void mitigation measures, as indicated in Standard Detail 658S-2, generally consist of:
    - a. Permanent protection of the void by hand packing with 3 to 5-inch (75 to 125 mm) rock to provide stable bearing support and covering the rock at the opening with filter fabric. Low slump concrete (3500 psi) shall be placed to cover the opening area and to seal the void at the limits of excavation. Concrete shall be a minimum of 18 inches (457 mm) thick within the void opening and shall extend a minimum of 6 inches (152 mm) beyond the edge of the void. Void openings that are less than 30 inches deep shall be sealed entirely with concrete. A form shall be used to ensure proper placement of a low slump concrete-seal over the void opening. After the void is covered, the controlled low-strength bedding and backfill material shall be placed. The controlled low-strength fill material shall extend a minimum of 5 feet (1.5 meters) beyond the edge of all voids in all directions.
    - b. For Grade 2 voids, additional measures may be specified by the Engineer or designated representative (e.g., increase thickness of concrete and placement of rebar reinforcement in the concrete, placement of a steel plate over void opening, etc.).
  3. Class III void mitigation measures, as indicated in Standard Detail 658S-3, generally consist of:
    - a. Permanent protection of the void by hand packing large areas with pea gravel-filled polypropylene bags to provide stable bearing support in order to protect a void from infiltration of backfill material. If a void is greater than 100 cubic feet (2.8 cubic meters) or is located within a rock strata that is structurally unstable, then 3 to 5-inch (75 to 125 mm) rock may be utilized behind the gravel-filled polypropylene bags to prevent ground collapse. A connector pipe may be required to maintain air or water flow within a void bisected by the trench. After a void is filled, low slump concrete (Class I, 3500 psi) shall be placed to seal the void opening. If needed, place a form to ensure a minimum thickness of concrete that extends at least 18 inches (457 mm) into the void.
    - b. Secondary containment of wastewater and stormsewer lines by outer carrier pipe or low slump concrete (Class I, 3500 psi) or CLSM encasement is required. If CLSM encasement is proposed, then the engineer must submit pipe deflection and wall crushing calculations. Low slump concrete or CLSM encasement shall be a minimum of 6 inches (152 mm) thickness on all sides of the pipe and shall extend a minimum of 5 feet (1.5 m) beyond the edge of any voids. Design of carrier pipe must be reviewed by the City of Austin for all City of Austin wastewater and stormsewer lines prior to submittal of the site plan correction. Stabilizing collars and other supports, as needed, must be provided. The engineer must modify Standard Detail 658S-3 or provide

a specific detail showing the proposed carrier pipe installation and void mitigation.

4. Class IV void mitigation measures, as indicated in Standard Detail 658S-4, are-RESERVED FOR FUTURE RULE REVISION.
5. Class V void mitigation measures, as indicated in Standard Detail 658S-5, generally consist of:
  - a. Placement of CLSM bedding material along the length of pipe as directed by the Engineer or designated representative.
  - b. Placement of gravel backfill material wrapped in PTRM one foot (.305 meters) beyond limits of void in all directions. PTRM shall be placed along areas between the gravel material and trench walls/earth backfill and shall overlap at top.
  - c. A minimum of 3 feet (.915 meters) of CLSM backfill shall be placed along the length of pipe on either side of the gravel backfill material and shall extend a minimum of 1 foot (.305 meters) above the gravel backfill material. Forms shall be used to control the placement of CLSM material.
6. For very large voids, the Engineer shall define specific mitigation measures. The Contractor will implement specific mitigation measures per the direction of the Engineer or designated representative after the site plan correction is approved by the City of Austin.

#### C. REPORTING

1. The Contractor shall provide written documentation to the Engineer or designated representative describing the void and water flow mitigation measures taken on the Project. The information shall be included in the Construction Inspector's daily progress report. The report shall include, as a minimum, the following information:
  - a. Location (line stationing, distance from permanent structure, depth in trench from adjacent surface grade, geologic strata, etc.).
  - b. Physical dimensions of void and/or description of water flow recorded on the Contractor Void Description and Documentation Log Sheet (provided as Attachment A).
  - c. Photographs, field notes, maps, sketches, and measurements.
  - d. Mitigation action taken and status. Include a copy of the plan sheet showing the location of the void and details for mitigation measures.

For City of Austin-constructed projects, also include the following:

- e. Actual agreed-upon quantities of materials used by Contractor in execution of mitigation shall be included in the Construction Inspector's daily progress report.
- f. Signature from the Contractor and Construction Inspector indicating agreement with the documented quantities and any delays associated with downtime for observation of the void.



### **658S.6 Measurement**

- A. Measurement for void and water flow mitigation measures shall be made as follows:
1. Measurement of temporary void protection (filter fabric, plywood planking, etc.) shall be per each occurrence.
  2. Measurement of controlled low strength material shall be by the cubic yard of material in place.
  3. Measurement of pea gravel-filled polypropylene bags shall be by each. Minimum size is 1 cubic foot (0.028 cubic meters).
  4. Measurement of 3 to 5-inch (75 to 125 mm) rock shall be by the cubic yard (cubic meter) of rock placed.
  5. Measurement of filter fabric shall be by the square yard of filter fabric as needed to maintain specified clearance from edge of void.
  6. Measurement of permanent turf reinforcement mat shall be by the cubic foot (cubic meter) of material in place.
  7. Measurement of low slump concrete material shall be by the cubic foot (cubic meter) of material in place.
  8. Measurement for provision of Special Trench Safety shall be per Linear Foot.
  9. Measurement for Downtime Associated with Observation of Voids and/or Flowing Water shall be per Day. This pay item shall only apply in circumstances where the Contractor's operations have been halted and Contractor cannot continue work in another area of the project. Delay time will not be allocated for time that work on a void mitigation measure is in progress, only for time associated with observation and determination of mitigation measures to be taken. Contractor must notify the City's Inspector within one hour of the beginning of the delay and document the time and cause of delay. Documentation shall also include explanation of why work could not continue. Work stoppage for one hour or less shall not be cause for delay and will not be measured, but shall be included in the unit price bid in the pipe pay items. Partial day delays shall be measured as fractions of a day calculated by half days. Delays over one hour and up to 4 hours will be counted at 0.5 DAY.

### **658S.7 Payment**

This section does not obligate the City of Austin to pay for void and water flow mitigation measures on private projects.

The work performed for "Temporary Void Protection (Plywood Planking)" and "Pea Gravel-Filled Polypropylene Bags for Void Mitigation" will be paid for at the unit price bid per each occurrence. The unit price bid items shall include full compensation for all materials and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

The work performed for "Controlled Low Strength Material," "Low Slump Concrete," and "3 To 5 Inch Rock for Void Mitigation" will be paid for at the unit price bid per cubic yard. These unit bid price items shall include full compensation for all concrete, rock, curing, finishing, and for all labor, tools, materials, equipment and incidentals necessary to complete the work.

The work performed for "Filter Fabric for Void Mitigation" and for "Permanent Turf Reinforcement Mat" will be paid for at the unit price bid per square yard. These unit bid price items shall include full compensation for all materials and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

The work performed for "Special Trench Safety Associated with Observation of Voids and/or Flowing Water" will be paid for at the unit price bid per linear foot. These unit bid price items shall include full compensation for all materials, supervision, mobilization, de-mobilization, and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

The work performed for "Downtime Associated with Observation of Voids and/or Flowing Water" will be paid for at the unit price bid per day. This unit bid price item shall include full compensation for all materials, supervision, mobilization, de-mobilization, and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment for will be made using the following bid items:

<b>Pay Item 658S-1:</b>	Temporary Void Protection (Plywood Planking)	Per Each
<b>Pay Item 658S-2:</b>	Controlled Low Strength Material for Mitigation	Per Cubic Yard
<b>Pay Item 658S-3:</b>	Pea Gravel-Filled Polypropylene Bags for Void Mitigation	Per Each
<b>Pay Item 658S-4:</b>	3 To 5 Inch Rock for Void Mitigation	Per Cubic Foot
<b>Pay Item 658S-5:</b>	Filter Fabric for Void Mitigation	Per Square Yard
<b>Pay Item 658S-6:</b>	Permanent Turf Reinforcement Mat for Void Mitigation	Per Square Yard
<b>Pay Item 658S-7:</b>	Low Slump Concrete	Per Cubic Foot
<b>Pay Item 658S-8:</b>	Special Trench Safety Associated with Observation of Voids and/or Flowing Water	Per Linear Foot
<b>Pay Item 658S-9:</b>	Downtime Associated with Observation of Voids and/or Flowing Water	Per Day

**End**



<b><u>SPECIFIC</u> CROSS REFERENCE MATERIALS</b>
<b>Specification 658S, "Void and Water Flow Mitigation"</b>

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
ECM 1.12.0	Void and Water Flow Mitigation

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
658S-1 Trench	Class I – Temporary Protection of Void at Bottom of
658S-2	Class II – Permanent Void Mitigation Measures
658S-3	Class III – Void Mitigation Measures
658S-4	Class IV – Water Flow Mitigation Measures Groundwater Within Bedding Material Depth
658S-5	Class V – Water Flow Mitigation Measures Groundwater Above Bedding Material Depth
658S-6	Class V – Combination Void and Potential Water Flow Mitigation Measures
658S-7	Modified Concrete Retard

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item 402S	Controlled Low Strength Material
Item 403S	Concrete for Structures
Item 509S	Excavation Safety Systems
Item 510.2 (2)(a)	Pipe Materials, Pipe Bedding Stone
Item 510.2 (5)	Pipe Materials, Pea Gravel
Item 620S	Filter Fabric

<b><u>RELATED</u> CROSS REFERENCE MATERIALS</b>
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U.S. Department of Transportation, federal Highway Administration

<u>Designation</u>	<u>Description</u>
FP-03, Section 713.18 specifications	Permanent Turf Reinforcement Mat

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
ECM, Appendix P-1, Note 8	Erosion and sedimentation control note requiring notification and work stoppage for voids discovered on a project.

ATTACHMENT A.

Contractor Void Description and Documentation Log Sheet

**CONTRACTOR VOID DESCRIPTION AND DOCUMENTATION LOG SHEET**

Name: \_\_\_\_\_ Project Name: \_\_\_\_\_  
Date: \_\_\_\_\_ Time: \_\_\_\_\_ COA Site Plan No.: \_\_\_\_\_  
Construction Supervisor's Name: \_\_\_\_\_ Phone Number: \_\_\_\_\_  
Project Engineer: \_\_\_\_\_

How was void intercepted? (trenching, excavating, etc.)

Depth of void from ground surface:

Location of void, as distance measured from two closest surveyed stations:

GPS Coordinates of void:  
(report as UTM State Plane Coordinate system, NAD 83 or state reference system for a handheld GPS unit)

Size of void:            width            length            height

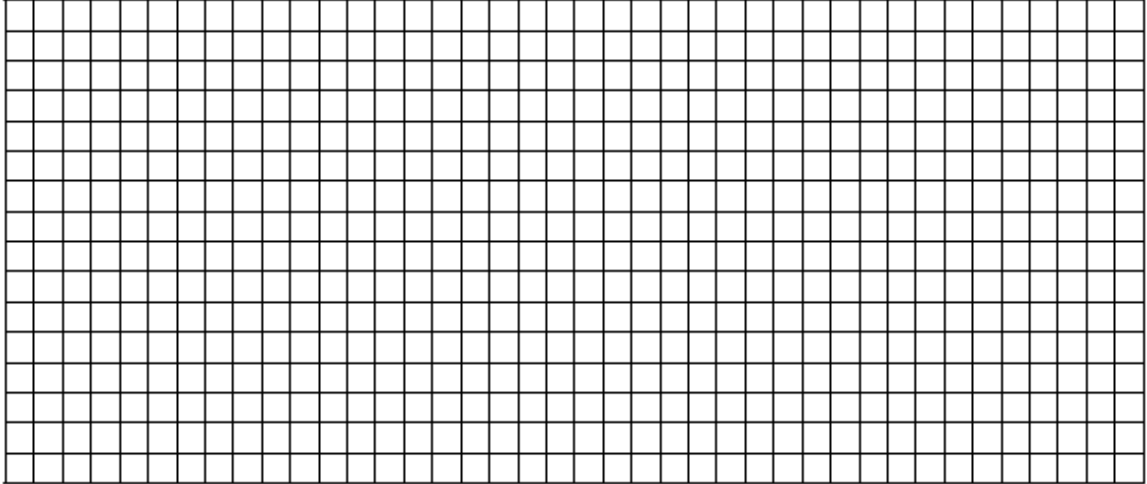
Depth extending into rock

Shape of void:        circular        Keyhole        irregular, curved shape  
                          vertical fracture  
                          fracture trend: (azimuthal degrees)  
                          horizontal fracture

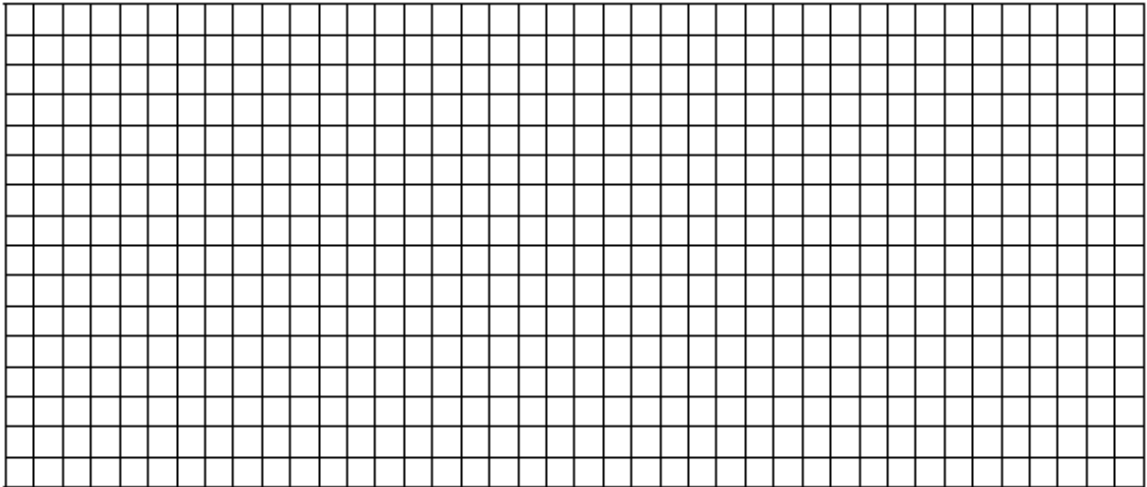
Characteristics: water flowing out? Rate or volume?  
air flow out?

Sketch a profiles of the void showing both sidewalls and the floor of the trench. Include measurements such as depth of trench, size of void (width, length, height), etc.  
TAKE PHOTOGRAPHS OF THE TRENCH WALLS AND THE INTERIOR OF THE VOID.

LEFT WALL



RIGHT WALL



TOP VIEW

