

APPENDIX G

VOID AND WATER FLOW MITIGATION (COA ECM SECTION 1.12)

Immediately after deposition of the imported soils, the areas must be completely stabilized using practices recommended in this manual.

On lands where soils are added, the area must be revegetated and have at least an 80 percent vegetative ground cover prior to using the area for irrigation.

1.11.3 Delineation of Irrigation Areas

Identify and map the irrigation areas and identify slopes greater than 15 percent, Critical Environmental Features, Critical Water Quality Zones, 100 year floodplains and any other areas to be excluded from the irrigation areas.

A. **Purpose and Justification.** Areas to be included within the irrigation area must meet several criteria, as specified in the LDC, Sections 25-8-281 and 25-8-282:

"...No irrigation shall be allowed on slopes of greater than 15 percent gradient or in the Critical Water Quality Zone or the 100 year floodplain ..."

"...Wastewater disposal and irrigation areas shall never be located less than 150 feet from a critical environmental feature."

B. **Guidelines.** Delineation, mapping and calculation of the gross irrigation area required to supply the necessary 7,000 or 8,000 square feet per living unit equivalent shall exclude:

1. Areas exceeding 15 percent slope as determined by topographic map at a map scale of one (1) inch = 100 feet and a contour interval not to exceed five (5) feet;
2. Areas within 150 feet, measured horizontally, from a Critical Environmental Feature as defined in Section 25-8-1 of the Land Development Code; and
3. Areas within a Critical Water Quality Zone or a 100 year floodplain.

Verification of the exclusion of these areas, zones, and features for projects subject to the Comprehensive Watershed Regulations shall be made on the maps required as part of the general plan submission requirements. A person shall provide a map at a scale of one (1) inch = 100 feet with up to five (5) foot contour intervals, delineating the irrigation areas, slope categories, effluent holding ponds and tailwater control berms. A second map must be provided at a scale of one (1) inch = 100 feet and two (2) foot contour intervals showing locations of all Critical Environmental Features, all ground water discharge areas (including seasonal discharge areas) and any Critical Water Quality Zones and 100 year floodplains.

1.11.4 Signage

In order to protect the public health and minimize the potential for exposure of the public to pathogens, adequate signage should be provided at all irrigation areas. Signs should clearly state that the irrigation water is from a nonpotable supply in both English and Spanish and should include a red slash superimposed over the international symbol for drinking water.

1.12.0 VOID AND WATER FLOW MITIGATION

1.12.1 Description

This section describes criteria for notification requirements and guidance for furnishing and installing mitigation measures for voids and water flow features discovered in bedrock during excavation activities. This section has been developed to provide guidance for response to Note 8 of Appendix P-1 of the Environmental Criteria Manual that says:

"All work must stop if a void in the rock substrate is discovered which is; one square foot in total area; blows air from within the substrate and/or consistently receives water during any rain event. At this time it is the responsibility of the Project Manager to immediately contact a City of Austin Environmental Inspector for further investigation."

This section provides mitigation alternatives for use in addressing anomalous features or discrete discharge points that are observed upon initial excavation (e.g., trench) or 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.

This section does not apply to excavations occurring below the water table or in unconsolidated earth material. Those occurrences must be addressed on a case by case basis.

City of Austin Standard Specification Item No. 658S and Standard Details 658S-1 through 658S-7 are referenced within this document and are to be used in conjunction with this section of the Environmental Criteria Manual. Standard Specification Item No. 658S provides instructions for reporting, materials use and implementation. Standard Details 658S-1 through S-7 are to be used for site plan correction submittals.

1.12.2 Materials to be Used for Mitigation

- 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. Use only open-graded rock of the size indicated on Details, with fines removed.
- B. Controlled Low Strength Material (CLSM): Shall meet the requirements for CLSM as specified in Specification 402S.
- C. Filter Fabric: Shall meet the requirements for filter fabric as specified in Specification 620S.
- D. Low Slump Concrete: Shall meet the requirements for Class I, Curb & Gutter, Hand-vibrated Concrete (3500 psi) as specified in Specification 403S.7, Table 5.
- E. Polypropylene Bags filled with pea gravel. Pea gravel shall meet requirements of specification 510.2 (5).
- F. Gravel Backfill: Gravel backfill shall meet requirements of Specification 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).

1.12.3 Procedures for Investigating Voids and Water Flow Features

- A. The Owner or designated Representative shall provide the services of a geoscientist licensed under the Geology discipline by the Texas Board of Professional Geoscientists (Title 22, Part 39, Chapter 850.1) (Geologist), and/or a qualified person (Geologist representative) who has been trained to identify and describe the geological origin of voids in karst terrain geology and works under the direct supervision of a 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.
- B. The owner shall designate a Geologist or 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. Inspections must occur at least once daily during excavation operations and prior to backfilling the trench. The Contractor shall be responsible for providing 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 observed 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. The Contractor shall request inspection by the Geologist of any void greater than 1 square foot (0.3 meters) in total area; blows air from within the substrate and/or consistently receives water during any rain even in trenches less than 5 feet (1.5 meters) deep. The Geologist or Geologist representative will submit a record of the daily inspections on a weekly basis to the geologists in the Environmental Resources Management division, Watershed Protection and Development Review Department. The record shall include the Geologist Void Description and Documentation Log Sheet for each void or water flow feature encountered. If no voids or water flow features are observed, then the record shall consist of a description of the trenches inspected and the statement that no voids or water flow features were encountered.
- C. 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.
- D. Each underground void or water flow feature occurrence shall be mitigated in accordance with the following procedures and methods:
 - 1. The Geologist or Geologist representative will observe the trench wall for any voids larger than 1 cubic foot (0.023 cubic meters) or water flow feature. The Geologist or the Owner will call the City of Austin Environmental Inspector, the City of Austin geologist, the Construction Inspector or Site/Subdivision Inspector, 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 a void or water flow feature will be made from the top of the trench. The role of the Contractor is to provide an Excavation Safety System Plan (City of Austin Standard Technical

Specification 509S) and to install all necessary safety equipment to allow direct observation of the anomaly. The Geologist or Geologist representative shall report the location (station), size, and depth of the anomaly encountered as observed. If flowing water is encountered, the Geologist or Geologist representative shall inspect the area of flow and document the discharge. Observations are to be recorded on the Geologist Void Description and Documentation Log Sheet (provided in Attachment A).

3. If pre-trenching operations are conducted, the Geologist or Geologist representative shall note observations and the survey station location of the anomaly prior to temporary backfill operations. In certain cases, the Geologist or Geologist representative may determine that the void requires protection prior to backfill operations. Such protection would be required to prevent the interim backfill from entering the void and may consist of providing plywood planking or other barricade to block the backfill. Water flow features may require temporary mitigation measures as well. The Geologist representative or Geologist shall establish what measures to take, if any.

4. If groundwater is encountered in an area where CLSM bedding is not already specified for the section of pipe, it is anticipated that CLSM bedding will be required. If groundwater is encountered, but is at a rate of one gallon per minute or less, and the flowing water is encountered in an area where CLSM bedding is already specified for the section of pipe, no additional mitigation for the flowing water is anticipated. However, void mitigation measures may still be necessary. If the discharge rate is higher than one gallon per minute, additional water flow measures may be directed by the Owner's Representative.

5. If the void is located at the bottom of the 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 geological and biological inspections have occurred and the 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 role of the Contractor is to stabilize the trench to allow for observation of the anomaly from within the trench and to provide an Excavation Safety System Plan (City of Austin Standard Technical Specification 509S). The Contractor shall be required to install all necessary safety equipment to allow direct observation of the void or water flow feature. The role of the Contractor is to assist in the investigation by providing access to the anomaly (e.g., ladders, harness and rigging, scaffolding, etc.) and confined space safety equipment. The role of the Contractor is to install all necessary shoring and trench protection. The role of the Contractor's designated safety supervisor is to ensure that all OSHA requirements are met during anomaly observation. The role of the Contractor is to not place pipe, pipe bedding, or backfill within 25 feet (7.62 meters) of the anomaly prior to final inspection by the Geologist or Geologist representative.

7. The Geologist or Geologist representative shall observe, investigate and document the anomaly. Documentation will include the Geologist Void Description and Documentation Log Sheet (Attachment A), photos and/or sketches of the encountered void and/or water flow feature.

8. The Geologist and Owner's Representative shall confer regarding the anomaly and establish the void and/or water flow mitigation measure to be installed. The Engineer or designated representative shall verify the proposed mitigation methods and modify design drawings or site plans as necessary to direct the Contractor how to implement the void and/or water flow mitigation measures.

9. The Engineer or designated representative will submit a site plan correction to the City of Austin for all anomalies encountered 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 will show the surveyed location of the anomaly (ies) and shall reference mitigation measures from this section. The corresponding Standard Detail (s) from the 658S series shall be included in the correction. The Contractor may not proceed with construction of the mitigation measures or excavate or place pipe or pipe bedding or backfill within 25 feet (7.62 meters) of the anomaly (ies) until a site plan correction is approved.

10. 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.

11. The role of the Contractor is to construct the void and/or water flow mitigation measure in accordance with the approved site plan correction.

12. Upon completion of a void and/or water flow mitigation measure installation, a Geologist or

designated representative shall inspect the work before the Contractor resumes construction activities within 25 feet (7.62 meters) of the anomaly.

1.12.4 Selection of Appropriate Void or Water Flow Mitigation Measures

A. GENERAL

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

2. Definitions of void types.

a. Size:

1. Grade 1: An opening in rock measuring more than 1 cubic foot (.28 cubic meters) (e.g., 1 foot by 1 foot by 1 foot), but less than 18 cubic feet (.504 cubic meters) (e.g., 2 feet by 3 feet by 3 feet).
2. Grade 2: An opening in rock measuring 18 cubic feet or more (.504 cubic meters) but less than 160 cubic feet (4.48 cubic meters) (e.g., 4 feet by 4 feet by 10 feet or 2 feet by 2 feet by 20 feet).
3. Grade 3: An opening in rock measuring 160 cubic feet or more (4.48 cubic meters). A specifically designed mitigation measure will typically be required for this size void.

b. Water Flow

1. Type A: Dry.
2. Type B: Water Flow less than one gallon per minute or evidence of previous water flow.
3. Type C: Water Flow of one gallon per minute or greater that is from a discrete discharge point or horizon in bedrock. (Water flow from unconsolidated material requires additional geotechnical evaluation beyond the scope of this specification.)

c. Biological Characteristics

1. Level 1: No evidence of biological organisms (i.e., no millipedes, spiders, salamanders, etc.)
2. Level 2: Evidence of biological organisms (i.e., millipedes, spiders, salamanders, etc.)

B. MITIGATION MEASURES BASED ON TYPE OF VOID

1. Class I temporary protection measures (as indicated in Standard Detail 658S-1) shall be required for Grade 1 and Grade 2 voids located at the bottom of the trench during times that construction operations are halted. Voids occurring in the trench wall may be protected with a temporary covering, if deemed necessary by the Engineer or designated representative. Voids occurring in the trench wall may be protected with a temporary plywood covering, if deemed necessary by the Engineer or designated representative.
2. Class II permanent void mitigation measures (as indicated in Standard Detail 658S-2) shall be required for Grade 1 and Grade 2 voids located at the bottom of a trench.
3. Class III permanent void mitigation measures (as indicated in Standard Detail 658S-3) shall be required for Grade 1, Type A and Grade 2, Type A voids located along the sides of a trench.
4. Class IV permanent void mitigation measures (as indicated in Standard Detail 658S-4) RESERVED FOR FUTURE RULE REVISION.
5. Class V permanent void mitigation measures (as indicated in Standard Detail 658S-5) shall be required for Grade 1, Type B/C and Grade 2, Type B/C voids intercepted on both sides of a trench that convey flowing water and are located along the sides of a trench above the pipe bedding material zone.
6. Modified Class V permanent void mitigation measures (as indicated in Standard Detail 658S-6) shall be required for Grade 1, Type B/C and Grade 2, Type B/C voids intercepted on one side of a trench that may convey flowing water and are located above the pipe bedding material zone.

C. VOID AND WATER FLOW MITIGATION MEASURES

1. Class I temporary void mitigation measures, as indicated in Standard Detail 658S-1, generally consist

of:

- a. Void at bottom of trench or along sidewall of trench: Temporary protection of the void 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. Install prior to covering trench or temporary backfilling operations.
- b. Cover the void opening 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. Place a rock (minimum weight of 5 pounds (2.3 kg)) or concrete block 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) will be placed to cover opening area and to seal 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. Place a form to ensure proper placement of low slump concrete-seal over the void opening. After the void is covered, the controlled low-strength bedding and backfill material may 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 (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 to protect void from infiltration of backfill material. If void is greater than 100 cubic feet (2.8 cubic meters) or is 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 the void is filled, place low slump concrete (Class I, 3500 psi) to seal the void opening. If needed, place a form to ensure a minimum thickness of 18 inches (457 mm) into the void.
- b. Secondary containment of wastewater and stormsewer lines by installation of carrier pipe or low slump concrete (Class I, 3500 psi) or by CLSM encasement is required. If CLSM encasement is proposed, then the engineer must submit pipe deflection and wall crushing calculations. Encasement by low slump concrete (Class I, 3500 psi) or by CLSM 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 or required, must be provided. The engineer must modify Standard Detail 658S-3 or provide a specific detail showing 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 determined by the Engineer.
- b. Placement of gravel backfill material wrapped in PTRM. Limits of gravel backfill material placement shall extend 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. Use forms to control the placement of CLSM material.

6. For Type B and C voids or zones intercepted on one side of a trench; it is anticipated that mitigation measures will consist either of utilizing controlled low strength material (CLSM) for bedding of the pipe and/or backfill of manholes within the area of water flow, or the use of modified concrete retards. The modified Class V permanent void mitigation measures, as indicated in Standard Detail 658S-6, or the Modified Concrete Retard, as shown in Standard Detail 658S-7, shall be followed.

- 7. Modified Concrete Retards, per Standard Detail 658S-7, or manholes backfilled with CLSM should be placed when water discharge occurs along a rock horizon for a distance of 5 feet (1.5 meters) or more.
- 8. For Grade 3 voids, the Engineer will design specific mitigation measures.

D. REPORTING

- 1. The Geologist or Geologist's Representative shall provide written documentation to the Owner's Representative describing the void and water flow mitigation measures taken on the Project. This information must be submitted to the City of Austin Watershed Protection and Development Review Department with the site plan correction. The report shall include, at 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 a void and/or description of water flow recorded on the Geologist Void Description and Documentation Log Sheet (provided as Attachment A) and the TCEQ's Edwards Aquifer Protection Program Solution Cavity Forms for plan, profile and cross-section views. Obtain the most recent version of the Solution Cavity Forms from form TCEQ-0585 "Instructions to Geologists" from the TCEQ Edwards Aquifer Protection Program website.
 - c. Photographs, field notes, maps, sketches, and measurements.
 - d. The type of void and status of mitigation action taken. A copy of the plan sheet shall be included that shows the location of the void and details of mitigation measures.
 - e. The Geologist shall affix their stamp to any report (s) submitted to the City of Austin.

END

ATTACHMENT A.

Geologist Void Description and Documentation Log Sheet and TCEQ Edwards Aquifer Protection Program (EAPP) Solution Cavity Forms (Use the most recent version of the EAPP forms available. Download Form TCEQ-0585 "Instructions to Geologists" from the TCEQ Edwards Aquifer Protection Program website.)

GEOLOGIST 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?

Cave formations inside? Type:

Cave stream or pool visible?

Type of soil on floor of void: dark brown brown

Red clay light brown sand or gravel

Organic material present? (leaves, plant roots)

Fracture trend: (azimuthal degrees)

Void origin? Phreatic Vadose Collapse Fracture

Distance to closest CEF (cave, sinkhole, spring, fault):

Is the void potentially a flow path for water?

Type of void: Type A (1 cubic ft to 18 cubic feet and no hydrologic or biologic activity)

Type B (greater than 18 cubic feet and smaller than 160 cubic feet with no hydrologic or biologic activity)

Type C (greater than 18 cubic feet and smaller than 160 cubic feet with hydrologic or biologic activity)

Type D (larger than 160 cubic feet with hydrologic or biologic activity)

Life signs present? (scat, webs, animals, tracks, skeletal remains)

Distance to closest CEF (cave, sinkhole, fault, spring):

If life signs are present, conduct a biological survey for karst invertebrates and describe results here.

Suggestion for mitigation method: I _____ II _____ III _____

IV _____ (To be designed by a licensed engineer)

Note: images accompanying Appendix A are in PDF format. You must have Adobe Acrobat Reader in order to view these images.

EAPP - Soutlion Cavity Form

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