SUBSURFACE UTILITY DAMAGE PREVENTION

ANI COMMON WORK INSTRUCTION

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Document History Log

Status (Baseline /Revision/ Cancelled)	Document Revision	Published Date	Description
Baseline	–	4/02/2004	Establish a procedure for subsurface utility damage prevention

1 Purpose

The purpose of this common work instruction is to describe how to perform subsurface utility damage prevention.

2 Scope and Applicability

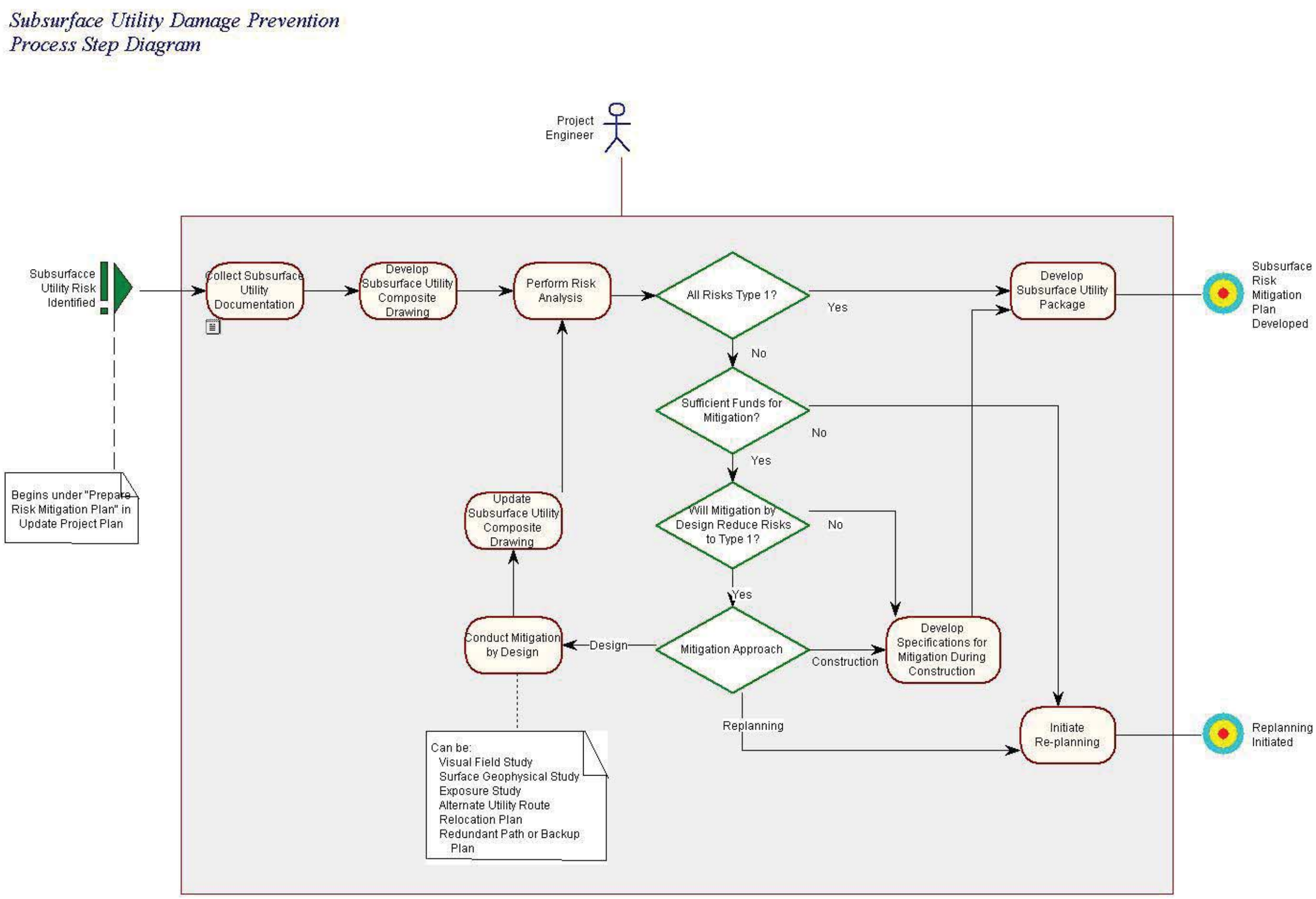
This Common Work Instruction (CWI) applies throughout ANI. Requirements within this CWI are subject to audit for ANI organizations operating under the Quality Management System (QMS).

3 Records

Record Identification	Role	Location	Record Media	Retention\Disposition\Protection
Subsurface Utilities Package	Project Engineer	Project Folder	Hardcopy	Maintain in the IC (Regional Implementation Center) for a minimum of 2 years following commissioning and then forward to the records center for the life of the facility.

4 Procedure

4.1 Process Step Diagram



4.2 Inputs

- Utility Records
- Facility Drawings
- Airport Layout Plan (ALP)

4.3 Outputs

- Subsurface Mitigation Specification (01730 OSHA Safety Requirement Specification, and, 2200 Earth Work Specification) to ANI1Q-QSOP344A - Construction
- Subsurface Risk Mitigation Plan
- Subsurface Utility Package to ANI1Q-QSOP 343 – Design

4.4 Collect Subsurface Utility Documentation

Collect documentation on existing and proposed utilities. Request drawings and other documents related to subsurface utilities in the proposed area of work from:

- FAA offices having jurisdiction over the facility:
  - ❖ Regional Office (RO)
  - ❖ Systems Management Office (SMO)
  - ❖ ANI Implementation Center (IC)
    - o Subsurface Utility Composite Drawings, if available, from prior projects
  - ❖ Local Airports District Office (ADO)
  - ❖ Local Airport Authority
    - o Obtain the latest Airport Layout Plan (ALP)
    - o Contact Local Airport Authority's engineering group
- Utility owners and operators:
  - ❖ Electrical
  - ❖ Water and sewer
  - ❖ Natural Gas
  - ❖ Telephone and cable
  - ❖ Pipeline.

From each of these sources, obtain the following information:

- Utility Owner
- Utility type
- Location (including grounding and cathodic protection)
- Surface markers or other references that aid in locating the subsurface utility
- Easements
- Abandoned or out-of-service utilities.

4.5 Develop the Subsurface Utility Composite Drawing

Create a composite drawing (or, for large areas, a series of drawings) that shows all of the utilities identified in Section 4.4.

On the drawing, mark each utility with the appropriate American Society of Civil Engineers (ASCE) Subsurface Utility Data Quality Level. The ASCE Quality Level ranks the reliability of subsurface utility data on a scale from A (verified in detail) to D (marginally reliable). Many utility owners provide ASCE Quality Levels as part of their subsurface utility data. Transfer the ASCE Quality Levels provided by utility owners to the utility composite drawing. If ASCE Quality Level information is not available, mark the utility on the drawing as Quality Level D.

For definitions of ASCE Quality Levels, see Section 6. Detailed information on Quality Levels is available in ASCE Standard CI 38-02, *Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data*.

4.6 Perform a Risk Analysis

To conduct a Subsurface Utility Risk Analysis, two Risk Factors must be evaluated:

- Probability of Subsurface Utility Damage (High, Medium, Low, Remote)
- Impact of Subsurface Utility Damage to the National Airspace System (NAS) (Catastrophic, Critical, Marginal, Negligible).

Assessing the Probability of Utility Damage

Rank the probability of subsurface utility damage as High, Medium, Low, or Remote using engineering experience and judgment. At a minimum, evaluate the following:

- Quality Level data. See Appendix B for information on the risks associated with Quality Levels.
- Level of utility protection. Utilities enclosed in rigid conduit or duct banks are less prone to damage.
- Detectability. Physical size, conductivity of materials, and proximity to the surface all influence the detectability of a buried utility.
- Proximity of new work to surface structures. The closer to a structure, the more likely subsurface utilities exist.
- Proximity of new work to known subsurface utilities. The closer the excavation is to an existing utility, the greater the risk of causing damage.

Assessing Impact of Subsurface Utility Damage to the National Airspace System (NAS)

Cutting cables or other utilities that support the NAS can have catastrophic impact. While damaging facilities on major airports almost always causes significant delays, damage to outlying facilities can also have serious consequences. Consider, for example, a Very High Frequency Omnirange Radio (VOR) facility located on a small rural airport that has no scheduled air service. An unscheduled outage would have little effect on local airport operations but the VOR might also be an arrival gate for a major airport located many miles away.

FAA personnel who are thoroughly familiar with the services provided by the facility in question are expected to assess risks to the NAS that would be caused by a facility outage. Contact the Air Traffic Requirements branch at the Regional Office for assistance in assessing the impact of utility damage on specific NAS facilities.

Each Existing Utility Requires a Separate Risk Analysis

Analyze the risk for each utility. Using the Subsurface Utility Risk Analysis Matrix (Figure 1), find the intersection of the two Risk Factors (Probability of Subsurface Utility Damage, Impact of Utility Damage to NAS) on the matrix. The intersection of Risk Factors will resolve to either a Type I Risk or a Type II Risk.

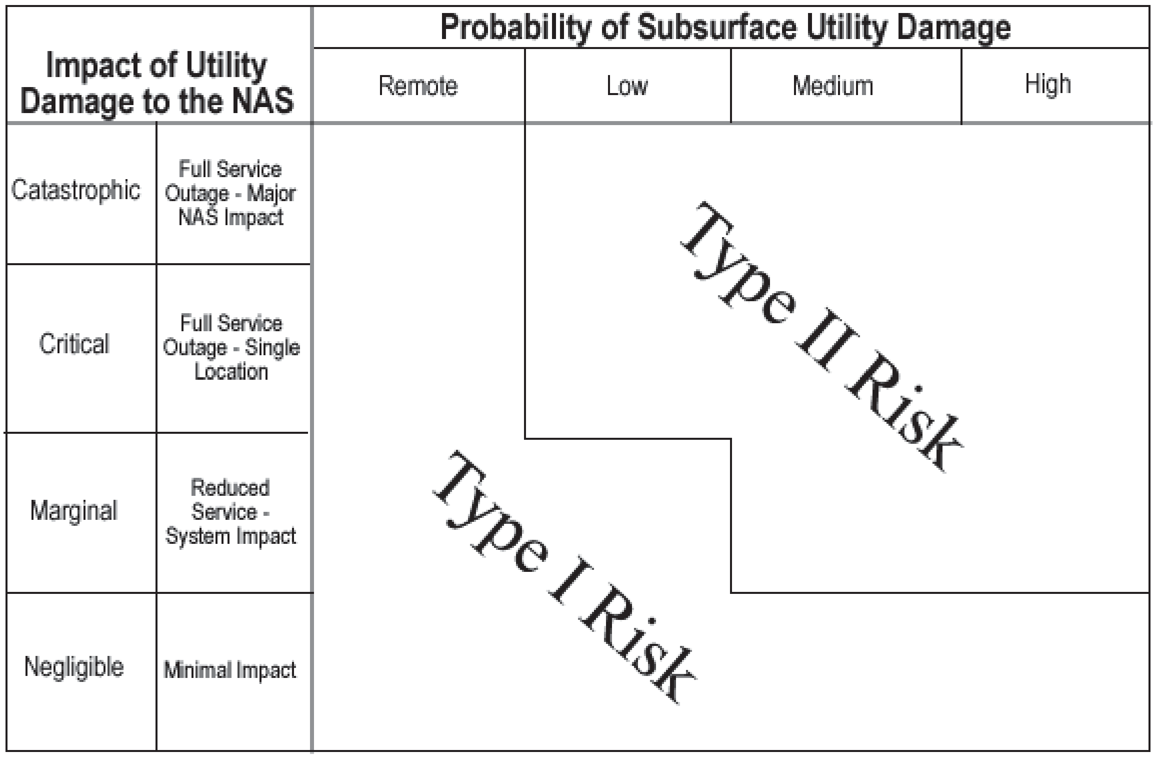


Figure 1

Subsurface Utility Risk Analysis Matrix

If any of the risks identified in the Risk Analysis are Type II Risks, mitigation is required. Mitigation by Design is explained in Section 4.11. Mitigation during Construction is explained in Section 4.14.

The objective of mitigation is to reduce risks. Given sufficient resources, mitigation will reduce all Type II Risks to Type I Risks.

4.7 Are All Risks Type I?

If all risks are Type I, neither Mitigation by Design nor Mitigation during Construction is required. Document the rationale for determining the risks and develop the Subsurface Utility Package.

If any Type II Risks are found, mitigation of the Type II Risks is required.

4.8 Are Sufficient Funds Available for Mitigation?

If sufficient funds are not available for mitigation, replanning is required.

If funding is available, two types of mitigation are possible: Mitigation by Design or Mitigation during Construction.

4.9 Will Mitigation by Design Reduce Risks to Type I?

Mitigation by Design consists of additional engineering and/or utility study. (See Section 4.11) Mitigation by Design usually results in:

- Improved design
- Reduced probability of utility damage
- Lower costs than Mitigation during Construction.

4.10 Mitigation Approach

- If sufficient design time is available, Mitigation by Design is the preferred procedure
- If sufficient design time is not available, Mitigation during Construction is the alternative mitigation approach
- If sufficient time is not available for Mitigation during Construction, replanning is required.

4.11 Conduct Mitigation by Design

Mitigation by Design reduces both expected and unexpected encounters with existing subsurface utilities, thus reducing contractor risk and effort. This often results in lower bids that more than offset the additional design costs. Mitigation by Design includes one or more of the following:

- Selecting an alternate route to reduce the likelihood of excavating near existing utilities
- Relocating existing utilities to minimize the number of crossings
- Providing for redundant utility path or backup service
- Conducting a study to acquire additional information on existing subsurface utilities (*i.e.,* improving Quality Levels). Three types of studies ranked in increasing order of quality (and cost) are:

Visual Field Survey Study

A Visual Field Survey Study is an on-site verification of surface features shown on the Subsurface Utility Composite Drawing. This study correlates applicable utility records obtained from the Subsurface Utility Composite Drawing with a site survey. When records and features do not agree, engineering judgment is required to resolve discrepancies. A Visual Field Survey Study usually yields Quality Level C data.

During a Visual Field Survey Study, field reconnaissance is performed with the subsurface utility stakeholders to verify the information on the Subsurface Utility Composite Drawing. Prior to the site visit:

- Contact federal, state, and local agencies to determine additional requirements for identifying, marking, and excavating near subsurface utilities.
- Contact the One-Call Center and subsurface utility owners/operators to designate/mark existing utilities.

At the site, compare the Subsurface Utility Composite Drawings with existing surface features including:

- Permanent signs or markers
- Manhole covers
- Vent pipes
- Pad-mounted devices
- Riser poles
- Power pedestals
- Communication pedestals
- Valve covers.

Resolve any inconsistencies between site findings and information shown on the Subsurface Utility Composite Drawings.

Surface Geophysical Study

A Surface Geophysical Study uses non-intrusive methods to reveal the presence of underground utilities. A Surface Geophysical Study identifies the existence and approximate horizontal position of subsurface utilities. This study usually leads to Quality Level B data.

Many geophysical methods currently exist to designate subsurface utilities, but there is no one known piece of equipment capable of detecting all types of utilities in a given location. A variety of equipment and properly trained staff are required; therefore, consider using a Subsurface Utility Engineering (SUE) firm to perform this study. These firms use methods such as:

- Magnetic Detection
- Radio Frequency Detection
- Terrain Conductivity
- Resistivity Measurements
- Ground Penetrating Radar (GPR)
- Optical Methods
- Infrared (Thermal) Methods.

Subsurface Utility Engineering firms may provide:

- Professional consulting
- Cost analysis
- Certified composite utility drawings
- Complete complex subsurface utility designs.

Exposure Study

An exposure study verifies the location and characteristics of subsurface utilities by exposing them using minimally intrusive excavation. This study leads to 3-dimensional data (horizontal position as well as depth) using survey and mapping standards. This study results in Quality Level A data.

In addition to providing precise position information, the Exposure Study also yields information about the physical characteristics and current condition of the utility. Use a SUE firm to perform this study.

4.12 Update the Subsurface Utility Composite Drawing

Incorporate the engineering changes and/or additional information acquired during Mitigation by Design to the Subsurface Utility Composite Drawing.

4.13 Perform (Another) Risk Analysis

This step tests the new design and/or improved utility information against the Subsurface Utility Risk Analysis Matrix. If Mitigation by Design was completely successful, all risks will now evaluate as Type I and the final step (Develop the Subsurface Utility Package) may be taken. If Type II Risks still exist, then additional mitigation is required. Use engineering judgment to determine whether additional Mitigation by Design will return added benefit. If not, proceed to Mitigation during Construction.

4.14 Mitigation during Construction

When funds are available but design time is constrained, Mitigation during Construction is the alternative method. This procedure reduces risk by designating and locating existing subsurface utilities prior to any mechanized excavation. When Mitigation during Construction is the chosen procedure, the Project Engineer must:

- Document the rationale of the decision in the project file
- Allocate necessary resources to the contract
- Include a special excavation specification as described in Section 4.16

Mitigation during Construction may result in higher contract bids, contract changes, and/or project delay due to unexpected utility relocation and/or redesign

4.15 Develop the Subsurface Utility Package

Design Considerations

- Use the Subsurface Utility Composite Drawing and field survey notes, sketches, written reports, and test hole summary sheets to develop construction drawings showing all subsurface utilities in the vicinity of the new construction.
- Use different line codes and styles to depict Quality Levels B, C, D, and new services to be installed on the plan.
- Use a distinct symbol to depict Quality Level A. Include a profile view and/or drawing notes to provide Quality Level A supplemental data, including top elevation, bottom elevation, and coordinate data.
- Use a layer/level system as specified by FAA-STD-002 to depict various utility types. Provide additional notes and/or symbols as necessary to indicate utilities ownership, date of depiction, status (active, abandoned, out of service), and condition.

- If new subsurface utilities to be installed are comprised of materials not easily detectable by non-intrusive methods (*e.g.,* plastics, fiberglass), include a means to find those utilities in the future.
- Design surface and subsurface cable markings that comply with airport authority requirements and are in accordance with the latest version of FAA-C-1391, *Installation and Splicing of Underground Cables*. Use color-coding standards applicable to the locality (federal, state, or local). If no other standard applies, use the American Public Works Association (APWA) Color Codes shown in the following table:

COLOR CODE	**TYPE OF UNDERGROUND UTILITY**
RED	Electric power lines, cables or conduits, and lighting cables
YELLOW	Gas, oil, steam, petroleum or other hazardous liquid or gaseous materials
ORANGE	Communications, cable TV, alarm or signal lines, cables, or conduits
BLUE	Water, irrigation, and slurry lines
GREEN	Sewers, storm sewer facilities and utilities, or their drain lines
WHITE	Proposed excavation
PINK	Temporary survey marking

Specifications Considerations

For subsurface utility work, contracts must include the following excavation procedures in the specifications:

- An observer, acceptable to the RE, or Superintendent, must be present to assist the equipment operator when operating excavation equipment around known subsurface utilities.
- Before conducting deep mechanized excavation of a new utility trench, make an initial earth cut along the entire centerline of the proposed utility trench. This initial cut may be made with mechanized equipment. It should be at least as wide as the proposed utility trench and no deeper than 10 inches. This initial cut should be inspected visually for utility warning tapes, sand or bedding materials, or other indication of subsurface utilities. If there is any indication of an unexpected subsurface utility, the Contractor must stop the excavation immediately and notify the RE.
- Before conducting a deep mechanized area excavation (*e.g.,* foundation or footings), make an initial earth cut five feet outside the perimeter of the proposed excavation area. This initial cut may be made with mechanized equipment. It should be at least 18 inches wide and no deeper than 10 inches. This initial cut should be inspected visually for utility warning tapes, sand or bedding materials, or other indication of subsurface utilities. If there is any indication of an unexpected subsurface utility, Contractor must stop the excavation immediately and notify the RE.
- Use only minimally intrusive excavation within 5 feet of:
  - ❖ Any pedestal, closure, riser guard, pole (with riser), meter, or other structure.
  - ❖ Any known utility that has not been exposed.
- Use only minimally intrusive excavation within 2 feet of a previously exposed utility.

- If the Contractor/Subcontractor discovers damage, causes damage, or even contacts an existing underground structure or utility, notify the RE. Discontinue excavation immediately and do not proceed until directed by the RE.
- When excavation takes place within 5 feet of a critical utility, a person capable of taking emergency action in regard to that utility must be present at the excavation site. This person must remain present until the utility is exposed. The Contractor is responsible for any costs associated with having non-FAA emergency action personnel on site. Emergency actions are of two types:
  - ❖ For water, power, petroleum and high-pressure gas lines, the ability to stop flow through the line(s)
  - ❖ If the critical utility is a NAS-related communications, control, or power line, a technician capable of restoring temporary service, must be present. (Note: If the utility is verified as a fully functional cable loop the presence of a technician is optional.)
- All existing utilities that have been exposed during exploratory potholing or excavation must be supported and protected during construction to prevent damage, stretching, kinking, etc.
- Provide for continuous temporary marking of existing utilities during excavation. Markings that are degraded by site activity or weather must be refreshed as soon as conditions permit.
- Hold the Contractor responsible for all expenses related to remarking of utilities when initial marks are not properly maintained.

4.16 Develop Specifications for Mitigation During Construction

Mitigation during Construction reduces the probability of utility damage to Remote (see Figure 1, Subsurface Utility Risk Analysis Matrix) by verifying the existence of subsurface utilities prior to any mechanized excavation.

General specifications for all types of earthwork are available in ANI1Q-QSPC01730, *OSHA Safety Requirements* and ANI1Q-QSPC02200, *Earth Work.* For subsurface utility work, contracts must use the specifications from these two documents or include the following excavation procedures in the specifications:

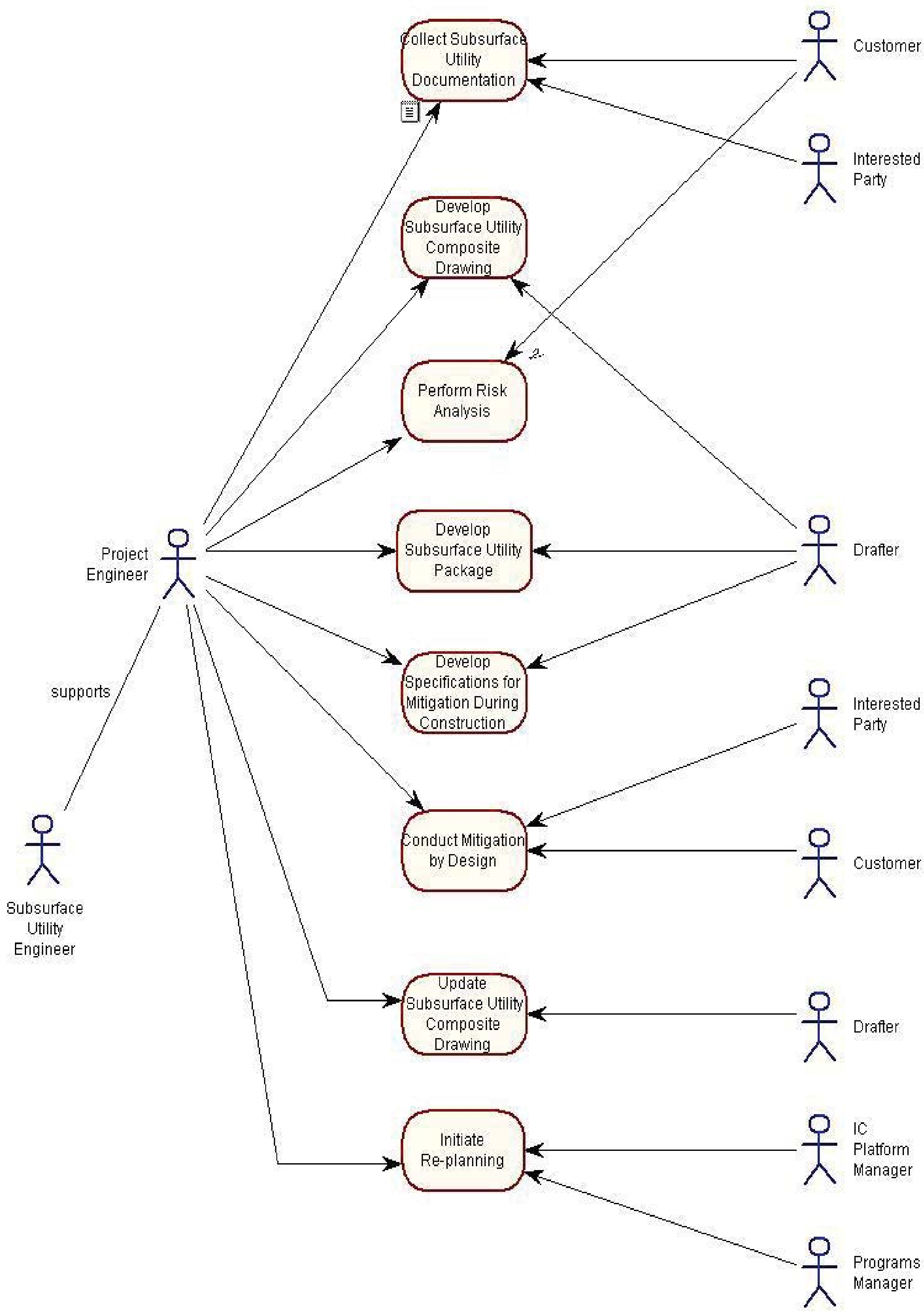
When Mitigation during Construction is chosen, the specifications must include the following additional steps:

1. In the field, mark the centerline of all proposed utilities using stakes or paint
2. Mark the limits of general excavations (*e.g.*, foundations)
3. Mark the proposed placement of grounding rods and cathodic protection
4. Identify and mark the location of existing underground utilities on contract drawings.
5. Contact airport officials, FAA technicians, One-Call System, and any other utility owners/operators, to perform utility designation/location services of existing utilities within the construction limits. The contractor is responsible for notifying relevant utility owners/operators and One-Call System in advance to ensure that delays to construction do not occur.

6. After field marking is completed, hire a professional Subsurface Utility Engineering firm to sweep the entire excavation area, including five feet outside the limits of proposed excavations. (Sweeping five feet beyond the proposed limits of excavation accommodates for the measurement errors inherent in geophysical detection methods.) Confirm the locations of the marked utilities and identify and mark any additional unidentified utilities that may be within the limits of excavation.
7. Expose all utilities at the crossing point(s) using minimally intrusive excavation.
8. If new excavation is to be done parallel to, and within 5 feet of, an existing critical utility expose the existing utility at least once every 100 feet. Also expose the existing utility at any indication of bends. Exposure must be done by minimally intrusive excavation.
9. If a previously unidentified utility is discovered, notify the RE. The RE will coordinate with the Project Engineer or utility owners/operators to determine if there is an impact on construction. Proceed only when the RE grants permission. Expose the previously unidentified utility by minimally intrusive excavation.
10. If a previously unidentified utility is discovered, it is necessary to determine whether other utilities lie nearby. Use minimally intrusive excavation to open a trench extending five (5) feet perpendicular to each side of the path of the previously unidentified utility. This trench should extend at least 1 foot below the depth of the previously unidentified utility.
11. If minimally intrusive excavation does not find a subsurface utility that was previously marked, request the owner/operator of the utility to mark it again. After the utility is located, it is necessary to determine whether other unknown utilities lie nearby. Use minimally intrusive excavation to open a trench extending five (5) feet perpendicular to each side of the path of the unknown utility. This trench should extend at least 1 foot below the depth of the unknown utility.

5 Responsibility

5.1 Roles and Responsibility Diagram



5.2 Project Engineer Responsibilities

The Project Engineer is responsible for completing all activities in this CWI and coordinating the involvement of all other parties as needed.

5.3 Subsurface Utility Engineer Responsibilities

The Subsurface Utility Engineer assists the Project Engineer in performing the utility investigation and preparing the Subsurface Utility Composite Drawings and related documents. Additional tasks may consist of selecting an economically sound solution for new utility routes, costs and benefits regarding improving data quality levels, and utility relocation and accommodation during construction.

6 Definitions

6.1 **Critical Facilities.** Facilities which, if damaged or placed out of service, may result in death, severe injury, economic loss, extensive outage to air traffic or airport operations or, if not recognized before construction, can result in significant project delay, change orders, or claims. Typical critical facilities are: power transmission equipment and NAS equipment (*e.g.,* navigational aids, radars, communications equipment).

6.2 **Critical Utilities.** Utilities which, if damaged or placed out of service, may result in death, severe injury, economic loss, extensive outage to air traffic or airport operations or, if not discovered before construction, can result in significant project delay, change orders, or claims. Typical critical utilities are: high pressure gas lines, petroleum lines, main water lines, fiber optical transmission cable, power transmission cables, and FAA control cables.

6.3 **Designating.** The process of using a surface geophysical method(s) to interpret the presence of a subsurface utility and to mark its approximate horizontal position (its designation) on the ground surface.

6.4 **Exposure Study.** Verification of the location and characteristics of subsurface utilities by exposing them using minimally intrusive excavation. This study leads to 3-dimensional data (horizontal position as well as depth) using survey and mapping standards. This study results in Quality Level A data. An Exposure Study also yields information about the physical characteristics and current condition of the utility.

6.5 **Locating.** The process of exposing and recording the precise vertical and horizontal location of a utility by exposure study.

6.6 **Minimally Intrusive Excavation.** A method of excavation that minimizes the potential for damage to the structure being uncovered. Factors such as utility material and condition may influence specific techniques. Typical techniques for utility exposure include air-entrainment/vacuum extraction systems, vacuum extraction systems, water-jet/vacuum-extraction systems, and careful hand tool usage. Water-jet systems may be used only where they are permitted by local and/or state jurisdiction and, in the Project Engineer's judgment; the risk to any subsurface utility is negligible. Removal of spoils must be considered before using water jet/vacuum extraction systems.

6.7 **One Call Notification Center.** A system for notifying utility owners/operators of proposed excavations. The One-Call center notifies member utility owners who then provide information on the location of their utilities. The nationwide One-Call referral center may be contacted at (888) 258-0808 or http://www.undergroundfocus.com/onecalldir.php

6.8 **One-Call Statute.** A local or state requirement that an excavator or designer of excavation call a central number to notify some, or all, existing utility owners of a planned excavation.

6.9 **Surface Geophysical Method.** Any of a number of methods designed to utilize and interpret ambient or applied energy fields for the purpose of identifying properties of, and structures within, the earth. Such methods include variants of electromagnetic, magnetic, elastic wave, gravitational, and chemical energies.

6.10 **Subsurface Utility Composite Drawing.** A plan that consolidates relevant utility information into one drawing (or, in the case of a large area, a series of drawings). If a profile view exists, the profile view of all utility information in a subject area along with traditional attributes and utility quality attributes must be included in the plan. Subsurface Utility Composite Drawings clearly identify known properties of a utility such as type, size, age, condition, ownership, in-service, out-of-service, and source of information. Depict the utility attributes with utility Quality Levels (A, B, C, or D) as described in section 6.7.

6.11 **Subsurface Utility Engineering (SUE).** A branch of engineering practice that involves managing certain risks associated with subsurface utilities. Typical SUE services include utility mapping at appropriate Quality Levels, utility coordination, utility relocation design, and coordination, utility condition assessment, communication of utility data to concerned parties, utility relocation cost estimates, implementation of utility accommodation policies, and utility design.

6.12 **Subsurface Utility Engineer.** A person who, by education and experience, is qualified to practice subsurface utility engineering.

6.13 **Subsurface Utility Package.** Drawings and specifications for construction relating to subsurface utilities. This package includes, but is not limited to, applicable provisions of government or industry codes, detailed procedures, methods of installation, requirements for the preservation and restoration of subsurface utilities, and limitations on the construction activities within the project area.

6.14 **Test Hole/Potholing.** A minimally intrusive excavation made to determine, measure, and record the presence of a utility structure.

6.15 **Utility.** A privately, publicly, or cooperatively owned facility or system for producing, transmitting, or distributing communications, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, or any other similar commodity.

6.16 **Utility Attribute.** A distinctive documented characteristic of a utility that may include, but is not limited to, its elevation, horizontal position, configuration, (*e.g.,* multiple non-encased pipes or cables), shape, size, material type, condition, age, quality level, and date of measurement.

6.17 **Utility Quality Level.** A professional opinion of the quality and reliability of utility information. Such reliability is determined by the means and methods of Subsurface Utility Engineering. Each of four existing utility data quality levels is established by different methods of data collection and interpretation as defined by ASCE Standard CI-38-02, *Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data.*

Quality Level D (QL D): Information derived solely from existing records or oral recollections.

Quality Level C (QL C): Information obtained by surveying and plotting visible aboveground utility features and by using professional judgment in correlating this information to Quality Level D information.

Quality Level B (QL B): Information obtained through the application of appropriate surface geophysical methods to identify the existence and approximate horizontal position of subsurface utilities. This information is surveyed to applicable tolerances and reduced onto plan documents.

Quality Level A (QL A): Information obtained by the actual exposure (or verification of previously exposed and surveyed utilities) of subsurface utilities using (typically) minimally intrusive excavation equipment to determine their precise horizontal and vertical positions, as well as other attributes. Accuracy is to within 15 mm vertical and to applicable horizontal survey and mapping standards.

6.18 **Utility Search.** The search for utilities using a level of effort in accordance with the specified Quality Level A-D within a defined area.

7 References

7.1 FAA-STD-002, *Standard Engineering Drawing Preparation & Support.*

7.2 FAA-C-1391, *Installation and Splicing of Underground Cables.*

7.3 ASCE Standard CI-38-02, *Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data*

7.4 ANI1Q-QSOP 343 – *Design*

7.5 ANI1Q-QSOP 344 – *Construction*

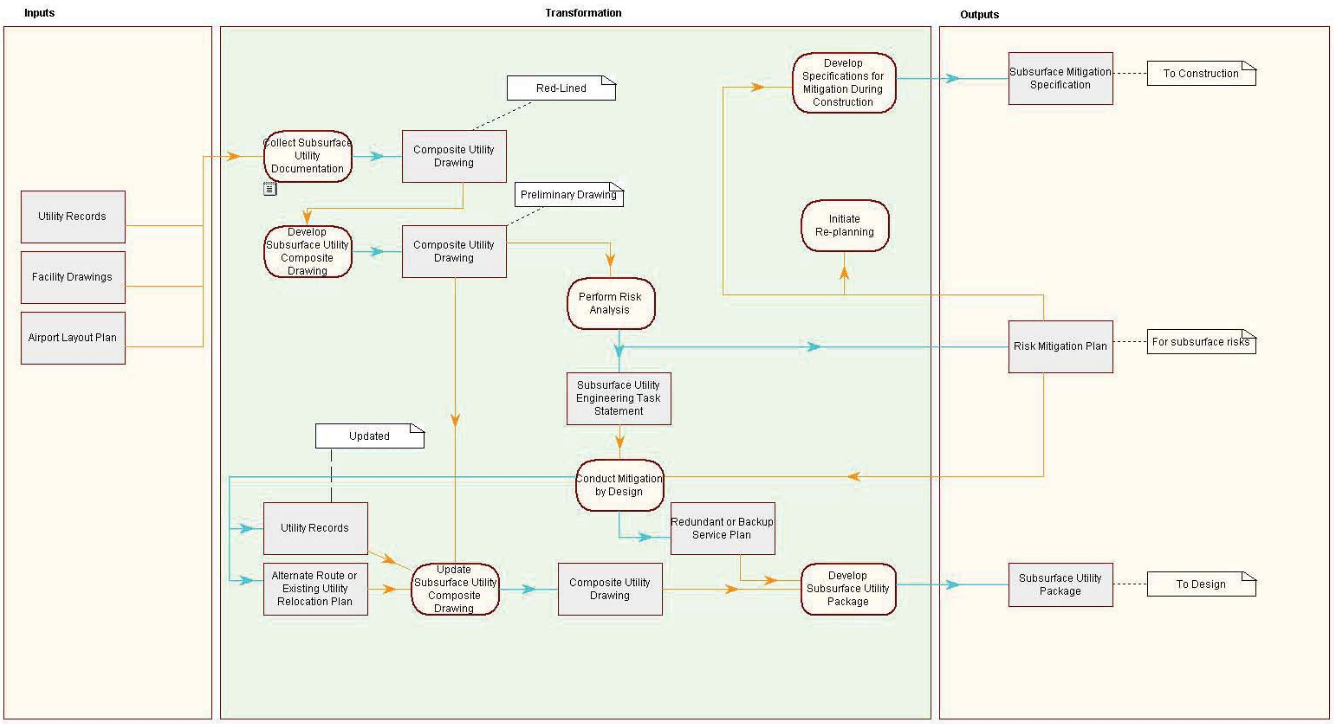
7.6 ANI1Q-QSPC01730 – *OSHA Safety Requirements*

7.7 ANI1Q-QSPC02200 – *Earth Work*

8 Resources

Not Applicable

Activity Product Diagram



Appendix B – Risks Associated with Utility Quality Levels

ASCE Subsurface Utility Quality Levels provide guidance regarding the reliability of subsurface utility data. At each level, from D to A, the quality of utility data improves and the risk of utility damage is reduced. There are certain risks associated with each quality level:

- **Quality Level D**

  Existing records of underground site conditions may be incorrect, incomplete, or otherwise inadequate because:

  - ❖ The records were not accurate in the first place. Design drawings may not incorporate "as-built" changes, or installations were "field run" and no record was made of actual locations.
  - ❖ At older sites, there often have been multiple utility owners, site owners, and contractors installing utilities and burying objects for decades. Records of these activities may not exist and are rarely found in a single file. There is seldom a composite drawing available for the site.
  - ❖ References frequently are lost. For example, current records might show something an object 28' from a building that is no longer there, or from the edge of a two-lane road that is now four-lane or is part of a parking lot.
  - ❖ Lines, pipes, and tanks are abandoned but are not indicated as such on the drawings; or, they have been physically removed but still are indicated on the drawings; or, they have been removed from the drawings but are found during construction. Any of these conditions can create questions, delays, and extra costs.
  - ❖ "As-builts" frequently lack the detail and veracity needed for design purposes in a utility-congested environment.
  - ❖ Utility depths are rarely referenced to elevation datum. The amount of cover over a utility can change without obvious visual indications because of construction activity, erosion, soil deposition, etc. This results in errors on records where "depth of cover" is the sole reference to vertical position.

- **Quality Level C**

  Information obtained by surveying and plotting visible above ground utility features improves the engineer's understanding of what is buried below the surface. However, Quality Level C data may still contain errors because:

  - ❖ The true location of the utility relative to the surface references may not be documented correctly.
  - ❖ The surface reference may have been relocated or altered.
  - ❖ Nothing in Quality Level C can confirm the configuration, type, depth, or condition of the utility.
  - ❖ The path of the utility inferred from the position of surface references may not match the true subsurface path.

- **Quality Level B**

  Information obtained through the application of appropriate surface geophysical methods results in increased confidence regarding the horizontal location of subsurface utilities. However, Quality Level B data may contain errors because:

  - Measurements of horizontal location made by geophysical methods have an inherent margin of error. Soil conditions, equipment calibration, utility depth, operator skill, and utility materials all may contribute to errors.
  - Depth data derived from geophysical equipment are only approximate.
  - Configuration and condition of the utility cannot be confirmed.
  - Geophysical methods may not differentiate multiple utilities in close proximity to one another.

- **Quality Level A**

  By physically exposing a utility, Quality Level A provides the best possible data on a subsurface utility. Risk is reduced to the absolute minimum but it is not entirely eliminated. Accidents and operator error can still cause utility damage.