NASA GLENN RESEARCH CENTER
AT LEWIS FIELD AND PLUM BROOK STATION

CIVIL SYSTEMS
PRESENTS

EXCAVATION 101
EXCAVATION 101

SYLLABUS

• DESCRIPTION
• OBJECTIVE
• TOPICS
EXCAVATION 101- SYLLABUS

• TOPICS
  • Excavation at GRC
  • GRC Excavation Permit
  • Competent Person
  • The Markings
  • Excavation Tolerance Zone
  • Reading the Underground Record Drawings
EXCAVATION 101- SYLLABUS

• OBJECTIVE
  • To ensure the safety of workers or visitors in or around excavation activities or ground penetration activities performed at the Glenn Research Center
  • ...Excavation and trenching are among the most hazardous construction operations
  • ...There are approximately 24 underground utility systems at GRC. This has caused potentially serious situations during construction and maintenance activities
  • ...It is GRC’s policy to evaluate all excavation and ground penetration activities to minimize the potential of cave-ins, environmental contamination, underground utility damage, or contact with subsurface encumbrances…”
  • This is intended as a summary of basic requirements and is not a substitute for full understanding of the requirements set forth in OSHA Standard 29 CFR 1926.651.
EXCAVATION 101- SYLLABUS

• ORGANIZATION

1. References, Acronyms and Abbreviations
2. Excavation at GRC
3. GRC Excavation Permit
   • Excavation Permit Work Area
   • Permit Part A
   • Permit Part B
   • Permit Part C
4. Competent Person
   • Excavation Competent Person
   • Excavation & Utility Competent Person
5. The Markings
   • NASA GRC Marking Standards
   • Table of Colors and Abbreviations
   • White Lining - Contractor Markings
   • Utility Markings – Locator Markings
   • Excavation Tolerance Zone
   • Undocumented Conditions
   • Emergency Repairs
6. Reading the Underground Record Drawings
   • Reading the URDs – Abbreviations
   • Reading the URDs – Drawing Symbols
   • Reading the URDs – Typical Details
EXCAVATION 101

1. REFERENCES, ACRONYMS AND ABBREVIATIONS
EXCAVATION 101

• REFERENCES, ACRONYMS AND ABBREVIATIONS

References used in this discussion include:

• **Ohio Revised Code** (ORC) 153.64
• **Ohio Revised Code** (ORC) 3781.25-3781.32
• **OSHA Standard 29 CFR 1926** Subpart P
• **Ohio Utilities Protection Service**
• **Glenn Safety Manual**, Chapter 35-Digging, Trenching and Excavating
• **Excavation Permit** NASA Form GRC927
• NASA Survey and Utility Location Service
• **NASA Contract Drawings and Specifications** that govern the execution of the work
• **NASA Underground Record Drawings (URDs)**
EXCAVATION 101

• REFERENCES, ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations used in this discussion:

APWA..................................American Public Works Association
COR.......................................Contracting Officer’s Representative
FE.................................. Energy and Environmental Management Office
FOS........................................ Facility Operations Specialist
GRC........................................ Glenn Research Center
ORC........................................ Ohio Revised Code
POC........................................ Point of Contact
SHeD......................................Safety and Health Division
SSC........................................ Support Services Contractor
URD...................................... Underground Record Drawing
OUPS.................................... Ohio Utilities Protection Service
EXCAVATION 101

2. EXCAVATION AT GRC
EXCAVATION 101

• EXCAVATION AT GRC

OHIO REVISED CODE 3781.25:

“Excavation means the use of hand tools, powered equipment or explosives to move earth, rock or other materials in order to penetrate or bore or drill into the earth, or to demolish any structure whether or not it is intended that the demolition will disturb the earth...”

NO EXCAVATION OF ANY DEPTH SHALL COMMENCE WITHOUT A COMPLETE PERMIT

Breaking the surface is considered an excavation at GRC.
EXCAVATION 101

QUIZ

QUESTION: WHEN DO YOU NEED AN EXCAVATION PERMIT AND WHAT IS ITS FORM NUMBER?

ANSWER: ANYTIME YOU BREAK THE SURFACE OF THE GROUND. FORM #GRC927
EXCAVATION 101

3. GRC EXCAVATION PERMIT
EXCAVATION 101

• GRC EXCAVATION PERMIT

A FULLY EXECUTED NASA FORM GRC927, "EXCAVATION PERMIT" IS REQUIRED PRIOR TO PERFORMING ANY EXCAVATION ACTIVITY AT THE NASA GLENN RESEARCH CENTER!
EXCAVATION 101

- GRC EXCAVATION PERMIT
  - 4 Part Fillable .pdf Form
  - Submitted Digitally to Eroom for routing
EXCAVATION 101

• GRC EXCAVATION PERMIT

• PERMIT PART A
  • Step 1 - NASA/SSC Initiator
  • Step 2 - Soil Characteristics
  • Step 3 - SHeD Notification
  • Step 4 - NASA Surveyor
  • Step 5 – Excavation and Infrastructure Approval

(NASA SIGNOFF IS DIGITAL-PDF ONLY)
EXCAVATION 101

- GRC EXCAVATION PERMIT
  - PERMIT PART A
    - Step 1 - NASA/SSC Initiator
    - Fillable .pdf form
    - Fill out all fields
    - Filled form can be saved

### PART A.

**Step 1. NASA/SSC Initiator** *(NOTE: Provide 48 hours advance notice to surveyors prior to marking.)*

<table>
<thead>
<tr>
<th>NASA/SSC Initiator</th>
<th>Telephone number</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Q. Initiator, NASA or SSC</td>
<td>216-555-5555 ext. 5</td>
<td>04/13/2021</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contract number/Project title</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FY21 Construct SMC Building, Taylor Road</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prime Contractor</th>
<th>Telephone number</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC Prime Contracting Co, Inc.</td>
<td>216-555-5555 ext. 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Excavation Contractor</th>
<th>Telephone number</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Have A Backhoe Excavation Contracting Co, llc</td>
<td>440-555-5555 ext. 9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contractor Excavation competent person</th>
<th>Telephone number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homer P. Vitruvian</td>
<td>440-781-6666</td>
</tr>
</tbody>
</table>
EXCAVATION 101

- GRC EXCAVATION PERMIT
  
  **PERMIT PART A**
  
  - Step 1 - NASA/SSC Initiator
  
  **EXCAVATION PERMIT WORK AREA**
  
  - The contractor will **attach** a (pdf) construction drawing to each **PART A** permit with the **WORK AREA** defined by dimensions.

  - A description of work activities shall be included.

  - **THE PERMIT SHALL ONLY BE APPLICABLE TO THE APPROVED DEFINED AREA.**
EXCAVATION 101

- GRC EXCAVATION PERMIT
  - PERMIT PART A
    - Step 1 - NASA/SSC Initiator
    - 48 Hours advance notice to Surveyors

(NOTE: Provide 48 hours advance notice to surveyors prior to marking.)
EXCAVATION 101

• GRC EXCAVATION PERMIT

• PERMIT PART A
  • Step 1 - NASA/SSC Initiator
    • EXCAVATION PERMIT WORK AREA
      • Limited to 400 linear foot section or approximately 1 Acre.
      • Divided/organized by street, parking lot, building location.
      • Contractor shall submit desired area for consideration.
      • Civil Systems Manager approves excavation limits
EXCAVATION 101

• GRC EXCAVATION PERMIT

• PERMIT PART A
  • Step 1 - NASA/SSC Initiator
  • EXCAVATION PERMIT WORK AREA
    • Permit will be CLOSED after 3 months or when activities in the permitted WORK AREA are complete
    • Multiple crews operating simultaneously must have individual permits for each crew
    • Contractor shall request renewal of permit every two weeks or when re-entering an area for refreshing the markings

NOTE: Permit valid 3 months after final signature.
EXCAVATION 101

• GRC EXCAVATION PERMIT

• PERMIT PART A

  • Step 1 - NASA/SSC Initiator
    • Fillable .pdf Form – all required initiator fields filled out digitally
    • Attachments scanned or electronically produced are attached in .pdf format
    • Form is submitted digitally by clicking on the “SUBMIT” button to e-mail to the appropriate location

ONCE **STEP 1** IS COMPLETE JUST CLICK **SUBMIT**! THE PERMIT WILL BE ROUTED VIA CONSTRUCTION EROOM.
EXCAVATION 101

QUIZ

QUESTION 1: WHAT ARE THE MAXIMUM LIMITS FOR WHICH ONE PERMIT CAN BE ISSUED?

ANSWER 1: APPROXIMATELY 400 LINEAR FOOT OR ONE ACRE

QUESTION 2: HOW LONG IS PERMIT GOOD FOR?

ANSWER 2: 3 MONTHS AFTER FINAL SIGNATURE
EXCAVATION 101

- GRC EXCAVATION PERMIT

- **UTILITY VERIFICATION AND MARKING LOG (PERMIT PART B1)**
  - Utility verification and remarking (if necessary) is required every two weeks if working in the same area.
  - Additional “freshening” of utility markings will be provided as requested by the contractor or as site conditions change as directed by CM/Inspector.

![Excavation Permit](image)
EXCAVATION 101

• GRC EXCAVATION PERMIT

• PERMIT PART B1

NOTE: All surveying, soil determination, and confined space entry activities shall be coordinated through the appropriate NASA CM NASA/SSC Initiator. **Excavation Contractor is responsible to maintain B1 Utility Verification and Marking Log. Contractor required to formally submit permit after permit is complete with as-built drawings.**

**EXCAVATION COMPLETION:** The NASA Surveyor must locate the new utility and confirm the location and/or changes to existing utilities prior to "backfilling." The contractor shall provide "red-line" as-built information to NASA regarding the excavation (exact location, depth, variations from existing drawings, etc.) 8 business hours (minimum) notification shall be given to allow for verification of the underground utility location before back-fill activities commence.

GRC 927 09/14 (1.0) PREVIOUS EDITIONS ARE OBSOLETE. Page 2 of 4

• Part B1 is maintained by the Contractor
• Contractor required to formally submit permit after permitted work is complete with as-built drawings.
• 8 business hour notice to Surveyor to allow verification of underground utility locations prior to backfilling
EXCAVATION 101

- GRC EXCAVATION PERMIT

- **PERMIT PART B2**
  - Contractor required to pothole all utilities prior to excavation
  - Waivers can be granted by the Civil Systems Manager.
  - Contractor to contact CM/Inspector to initiate utility verification
  - Surveyor will verify the exposed utilities match the URDs, and per spec.
  - Questions to be resolved by NASA Engineer
• **PERMIT PART B2**
  
  Part B2 is maintained by the Contractor
  
  Contractor required to formally submit permit after permitted work is complete with as-built drawings attached
EXCAVATION 101

• GRC EXCAVATION PERMIT

• PERMIT PART C
  • Daily field tag up meetings will be held between CM/Inspector and Contractor
  • The CM/Inspector shall not sign off on any daily permit without design drawings, underground record drawing, and field survey markings on-site and complete
  • The contractor may only proceed with the work scope discussed for that specific day.
EXCAVATION 101

• GRC EXCAVATION PERMIT

• PERMIT PART C

• The Daily Meeting may be held on the morning or afternoon prior to the specific day, depending upon NASA and Contractor schedules.

• If the contractor is found not working in the approved area, the Government shall immediately stop work with no financial repercussion to the Government. CM/Inspector/FOS to contact COR for direction.

---

1. On a daily basis, the NASA/SSC Initiator or designee shall hold daily meetings on-site with the Prime Contractor Superintendent, Contractor Excavation Competent Person, and the machine operator to discuss the daily excavation activities prior to commencing work to ensure safe excavation practices and daily scope.

2. All parties shall sign off in the appropriate areas on the above Daily Log form.

3. The Contractors Excavation Competent person shall be on-site at the excavation area overseeing the excavation at all times.

4. If Contractor deviates from the approved daily plan, they shall obtain approval from NASA Construction Manager/Inspector prior to commencing any additional work and document that decision on the Daily Log.

5. Permit Part C shall not be used for maintenance contractor work only if deemed necessary by Civil Systems.

6. Contractor required to formally submit permit after permit is complete with as built.
EXCAVATION 101

QUIZ

QUESTION 1: WHO MAINTAINS THE LOG SHEETS IN B1, B2, AND C?

ANSWER 1: THE CONTRACTOR.

QUESTION 2: WHEN ARE REMARKING OF UTILITIES REQUIRED?

ANSWER 2: EVERY TWO WEEKS OR AT REQUEST.
EXCAVATION 101

4. COMPETENT PERSON
EXCAVATION 101

• COMPETENT PERSON

EXCAVATOR SUPERVISION REQUIREMENTS

Contractor will provide formal submittal to Project Manager.
Contractor must provide the following:

• EXCAVATION COMPETENT PERSON (Permit Part A),

or

• EXCAVATION & UTILITY COMPETENT PERSON (Permit Part B)

to oversee each permitted excavation. This person shall be at the physical excavation site 100% of the time comparing construction documents to the URDs, auditing the excavation process, evaluating utility markings, evaluating typical symbols vs. details and to ensure the permit process is followed.
The EXCAVATION COMPETENT PERSON assigned to supervise PERMIT PART A activities shall:

1. Have a working knowledge of trenching, excavation, horizontal directional drilling, underground construction, shoring, and soil types.
2. Have the ability to assure that all underground utilities are located, field verified, and clearly marked prior to excavation.
3. Be knowledgeable in applicable excavation regulations to include OSHA 29CFR1926. Have knowledge of trench collapse prevention, ventilation and air monitoring requirements (where applicable), ground water control, personal protective equipment, and emergency procedures as they pertain to underground construction and utility work. A minimum 5 years excavating experience is required.
4. Have the ability to notify the prime contractor or government (as applicable) of any non-conformance issues and document them; and to provide any corrective actions to mitigate hazards or non-conformance issues.
EXCAVATION 101

• COMPETENT PERSON

In addition to the requirements specified in the previous list, the EXCAVATION & UTILITY COMPETENT PERSON that is assigned to supervise PERMIT PART B activities shall:

5. Have the ability to review, understand, and interpret URDs, contract drawings and specifications.

6. Have the ability to oversee and witness underground construction and utility work to ensure that established processes are followed. A minimum of 5 years utility installation experience is required.

7. Be knowledgeable in applicable rules and regulations to include 29CFR1926 and installation of utilities such as domestic water (IE fire hydrants, thrust blocks, testing, cleaning and chlorination), sewers, duct banks, natural gas, and other pressure pipes, as appropriate to the assigned task.

8. Be capable of identifying existing and predictable hazards in the surroundings of underground utility construction and understanding the corrective measures to eliminate them.
EXCAVATION 101

QUIZ

QUESTION 1: WHEN IS THE CONTRACTOR COMPETENT PERSON REQUIRED TO BE AT THE EXCAVATION SITE AND HOW MANY SITES CAN THEY OVERSEE?

ANSWER 1: AT ALL TIMES AND JUST ONE!

QUESTION 2: HOW MANY YEARS OF EXPERIENCE IS REQUIRED BY CONTRACTORS COMPETENT PERSON?

ANSWER 2: 5 YEARS MINIMUM

QUESTION 3: IS A COMPETENT PERSON REQUIRED TO INSTALL A SIGN POST AND IF SO WHAT TYPE?

ANSWER 3: YES, EXCAVATION COMPETENT PERSON.
EXCAVATION 101

5. THE MARKINGS
EXCAVATION 101

• THE MARKINGS

NASA GRC MARKING STANDARDS

- The American Public Works Association (APWA) is the source for recommended color codes for utility marking at NASA GRC. Utilities are marked using colored flags and/or paint to identify the underground service.

<table>
<thead>
<tr>
<th>Color</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PINK</td>
<td></td>
<td>Temporary Survey Markings Area of Concern</td>
</tr>
<tr>
<td>RED</td>
<td></td>
<td>Electric Power</td>
</tr>
<tr>
<td></td>
<td>Natural Gas</td>
<td>(NG)</td>
</tr>
<tr>
<td></td>
<td>Service Air</td>
<td>(SA)</td>
</tr>
<tr>
<td></td>
<td>Steam</td>
<td>(ST)</td>
</tr>
<tr>
<td></td>
<td>Combustion Air</td>
<td>(CMBA)</td>
</tr>
<tr>
<td>YELLOW</td>
<td>Fuel/Oil</td>
<td>(FO)</td>
</tr>
<tr>
<td></td>
<td>Waste Gas</td>
<td>(WG)</td>
</tr>
<tr>
<td></td>
<td>Carbon Dioxide</td>
<td>(CO2)</td>
</tr>
<tr>
<td></td>
<td>Liquid Fuel</td>
<td>(LF)</td>
</tr>
<tr>
<td></td>
<td>Hi Press. Nitrogen</td>
<td>(HPN2)</td>
</tr>
<tr>
<td>ORANGE</td>
<td>Communications</td>
<td>(TEL)</td>
</tr>
<tr>
<td></td>
<td>Domestic Water</td>
<td>(DW)</td>
</tr>
<tr>
<td></td>
<td>Cooling Tower Water</td>
<td>(CTW)</td>
</tr>
<tr>
<td></td>
<td>Chilled Water</td>
<td>(CHW)</td>
</tr>
<tr>
<td></td>
<td>Raw Water</td>
<td>(RW)</td>
</tr>
<tr>
<td></td>
<td>Clarified Water</td>
<td>(CW)</td>
</tr>
<tr>
<td></td>
<td>Hot Water</td>
<td>(HW)</td>
</tr>
<tr>
<td></td>
<td>De-Ionized Water</td>
<td>(DIW)</td>
</tr>
<tr>
<td></td>
<td>Fire Protection Water</td>
<td>(FPW)</td>
</tr>
<tr>
<td>BLUE</td>
<td>Storm Sewer</td>
<td>(S)</td>
</tr>
<tr>
<td></td>
<td>Sanitary Sewer</td>
<td>(SAN)</td>
</tr>
<tr>
<td></td>
<td>Indust. Waste Sewer</td>
<td>(IWS)</td>
</tr>
</tbody>
</table>
EXCAVATION 101

• THE MARKINGS

**NASA GRC MARKING STANDARDS**

• The Contractor shall stake the alignment of new infrastructure based upon the design drawing layout and prior to requesting utility markings. The contractor shall also delineate proposed excavation limits based upon the design requirements using white paint.
EXCAVATION 101

• THE MARKINGS

NASA GRC MARKING STANDARDS

• The NASA Surveyor or Utility Locator will identify and mark the horizontal alignment of all known underground utilities crossing or within the proposed excavation limits using the colors and symbology shown on the following pages.

• Areas of Concern, where an actual utility location may not fall within the Tolerance Zone (described later), will also be identified for further exploration.
EXCAVATION 101

THE MARKINGS

NASA GRC MARKING STANDARDS

- Excavation by Hand Digging (Pot Holing), Vacuum Excavation, or Hydro Excavation, will be required at all utilities within the Tolerance Zone, including Areas of Concern.

**THE MARKINGS**

**PINK**
Temporary Survey Markings
Area of Concern (AC!)

**RED**
Electric Power (E)
Natural Gas (NG)
Service Air (SA)
Steam (ST)
Combustion Air (CMBA)

**YELLOW**
Fuel/Oil (FO)
Waste Gas (WG)
Carbon Dioxide (CO2)
Liquid Fuel (LF)
Hi Press. Nitrogen (HPN2)

**ORANGE**
Communications (TEL)
Domestic Water (DW)
Cooling Tower Water (CTW)
Chilled Water (CHW)
Raw Water (RW)
Clarified Water (CW)
Hot Water (HW)
De-Ionized Water (DIW)
Fire Protection Water (FPW)

**BLUE**
Storm Sewer (S)
Sanitary Sewer (SAN)
Indust. Waste Sewer (IWS)

**GREEN**

---

---
EXCAVATION 101

• THE MARKINGS

CONTRACTOR MARKINGS

Excavators at NASA GRC are **REQUIRED** to pre-mark with white paint the limits of the intended excavation to clearly indicate for the Utility Locator and CM/Inspectors.

For single point excavation such as borings for soil samples, for installing sign posts or fence posts, or planting a tree, mark the location with white paint using dashes.

For continuous excavation, such as trenching, boring and trenchless excavation, mark the center line of excavation with dashes in white paint. Excavation width (in feet) shall be indicated on either side of the center line in legible numbers.

For area excavations such as grading or scraping mark the perimeter with dashes in white paint at intervals close enough to clearly establish the maximum limit of the disturbance.

White flags or stakes may be used in place of white paint. Markers used to identify the excavation area shall not be excessive or oversized.
THE FIELD MARKINGS
EXCAVATION 101

QUIZ

QUESTION 1: WHAT IS WHITE PAINT USED FOR AND WHO USES IT?

ANSWER 1: WHITE PAINT IS USED TO MARK EXCAVATION LIMITS. THE CONTRACTOR USES IT.

QUESTION 2: WHAT IS PINK PAINT USED FOR AND WHO USES IT?

ANSWER 2: AREA OF CONCERN AND THE NASA SURVEYORS.
EXCAVATION 101

• THE MARKINGS

LOCATOR MARKINGS

Markers Appropriate for the Area: Underground facilities and utilities will be marked using paint or flags in a combination appropriate for the area of proposed excavation. Marks will be placed at the beginning and end of the location area as needed to clearly identify the route of the underground utility.

All markings will be placed at the beginning and end of the Location Area and at a minimum interval of two feet but not more than fifty throughout the Location Area as needed to clearly identify the route of the underground utility.

When flags are used the identification abbreviation of the utility will be written on the flag using an indelible broad tip marking pen.

Abandoned utilities remain in place at many locations within the GRC facilities. Any abandoned utilities within the location area will be marked similar to an active utility with the addition of letters “ABAN”.

EXCAVATION 101

• THE MARKINGS

Marking Buried Cables:

A. Where a single cable or un-encased conduit is present the location will be marked by placement of a mark a minimum of 1” wide and 12” long spaced at intervals over the approximate center of the utility.

B. If multiple cables or un-encased conduit are present they will be marked by placing a single mark over the approximate center of each line. If an individual un-encased conduit has a diameter greater than 2 inches the nominal size will be noted on the line:
EXCAVATION 101

• THE MARKINGS

Marking Conduit/Duct Bank:

The term "Duct Bank" is used for a structure containing one or more conduits and encased in concrete. Multiple runs of un-encased conduit will identified as previously described in Marking Buried Cables (above).

A. All concrete encased Duct Banks less than 12” wide are identified by a single mark or line with the utility type and estimated total width of the duct bank in inches:

B. For all concrete encased Duct Banks greater than 12” wide the boundary (width) is identified by parallel marks. A diamond is placed between the marks; and the no. of ducts horizontal (H) x the no. of ducts vertical (V) is indicated within the diamond symbol:
EXCAVATION 101

• THE MARKINGS

Marking Pipe Lines:
Pipelines larger than 2 inches (nominal size): The physical location of a pipeline shall be represented by a single mark. The nominal size shall be noted:

For All Pipelines:
A. Pipelines that are inserted into casings will be marked to so indicate:

B. Marks shall be placed at the beginning and the end of the location area and at intervals throughout as needed to clearly identify the pipeline location and width (diameter).

C. All numbers identifying width shall be in inches

Marking Termination Points:
Termination points, stub outs and dead ends will be marked as shown:
At a clear distance a line parallel to the utility is marked, including a perpendicular arrow and a distance in feet to the actual location of the utility. The arrow indicates direction to the utility. The utility abbreviation and size are shown on the other side of the arrow.

**Offset Marks:**
Where marks may be subject to frequent destruction, offset marks can be used to supplement the primary marks:

At a clear distance a line parallel to the utility is marked, including a perpendicular arrow and a distance in feet to the actual location of the utility. The arrow indicates direction to the utility. The utility abbreviation and size are shown on the other side of the arrow.

**Marking Changes in Direction:**
Changes in direction of an underground utility will be marked so as to clearly define the route:

**Valve Pits / Manholes / Vaults and Structures:**
The perimeter of valve boxes, manholes, vaults and other buried obstructions will be marked with the appropriate color, abbreviation and name or type. Natural gas blow off pits and dual purge valve pits will include the location of the connecting line if known, otherwise an Area of Concern will be established and marked:
Areas of Concern
An “Area of Concern” exists when the location of a utility is not shown on record drawings but the utility is presumed to exist based upon other evidence. These situations include, but are not limited to:

- An otherwise unidentified valve box, hand-hole, manhole or other system appurtenance
- A natural gas blowoff or purge valve structure showing no connecting line on legacy record drawings
- A building foundation or pavement edge where an underdrain would normally be installed but is not shown (not normally delineated on legacy record drawings)
- Electrical ground grid at building footings (not normally delineated on legacy record drawings).
- Double parallel pavement underdrains each side of curb are common at Lewis Field
- Cathodic protection test box showing no connecting line on legacy record drawings

Contractor shall treat Areas of Concern as Tolerance Zones.
Areas of Concern

An “Area of Concern” will be marked on the ground showing the estimated maximum limits of a potential encounter. Horizontal limits of such areas may be based upon a radius around a fixture; a bounding box between a fixture and a known line; or parallel lines based upon the estimated horizontal maximum potential variation in a single line.

This Example shows a natural gas line with an associated blowoff valve identified by its hand-hole lid (yellow circle). The location of the blowoff line is not shown on the record drawings. The Area of Concern for the blowoff line falls within the triangular area between the 8”NG line and the pit location indicated by the pink lines marked !C! The entire area will be hand excavated with caution until either the line is located or the tolerance zone limits are reached. Isolation valves for the 8”NG line should also be located and prepared for closure (keys in place) prior to potholing.
EXCAVATION 101

• THE MARKINGS

ORC 3781.30 Duties of excavator:

When making excavations using traditional or trenchless technologies, the excavator shall do all of the following:

1. Maintain reasonable clearance between any underground facility and the cutting edge or point of powered equipment;

2. Protect and preserve the markings of tolerance zones of underground utility facilities until those markings are no longer required for proper and safe excavations;

3. When approaching and excavating within the tolerance zone of underground utility facilities with powered equipment, require an individual other than the equipment operator, to visually monitor the excavation activity for any indication of the underground utility facility;

4. Conduct the excavation within the tolerance zone of underground utility facilities in a careful, prudent, and nondestructive manner, when necessary, in order to prevent damage;

5. Excavate up to the total depth of the excavation to either determine the precise location of underground utility facilities or verify that the total depth of excavation is free of such facilities.
EXCAVATION TOLERANCE ZONE - REMEMBER!
The “Tolerance Zone” is the total width of the underground utility plus 18 inches on each side. The Vertical Tolerance Zone (VTZ) extends from the elevation shown on the utility profile drawing 24 inches above the top edge and 24” below the bottom edge of the utility.

Methods of Excavation within the tolerance zone are:

- Hand Digging (Pot Holing)
- Vacuum Excavation
- Hydraulic Excavation
EXCAVATION 101

• THE MARKINGS

UNDOCUMENTED CONDITIONS:
You must notify the Emergency Dispatch and your COR if an unexpected underground utility or structure is found during the activity or if an underground utility or structure is hit or broken during the activity (The requestor will notify the emergency dispatch at 911 if using a NASA internal telephone or if using a cell phone dial 216–433–8888 at Lewis Field or 419–621–3222 at Plum Brook Station.) It is the COR’s responsibility to notify SHeD.

**EMERGENCY DISPATCH**
911 (NASA Internal Phone)
216-433-8888 (Lewis Field)
419-621-3222 (Plum Brook)
EXCAVATION 101 QUIZ

QUESTION 1: WHAT IS AN AREA OF CONCERN (AOC) AND HOW WILL IT BE MARKED?

ANSWER 1: AREA WITH POSSIBLE UNKNOWN UTILITIES. THE MAXIMUM LIMITS OF THE ENCOUNTER WILL BE MARKED.

QUESTION 2: WHAT IS THE TOLERANCE ZONE?

ANSWER 2: The “Tolerance Zone” is the total width of the underground utility plus 18 inches on each side. The Vertical Tolerance Zone (VTZ) extends from the elevation shown on the utility profile drawing 24 inches above the top edge and 24” below the bottom edge of the utility.
EXCAVATION 101

6. READING THE UNDERGROUND RECORD DRAWINGS
The network of underground utilities is extremely dense in many areas at GRC. Some of the utilities are unusual. Many contain hazardous materials or are physically dangerous.

Coming into unexpected contact with even an abandoned utility can have unpleasant results.
EXCAVATION 101

• READING THE UNDERGROUND RECORD DRAWINGS

Rules and Standards for using paper plots of the URDs:

• Scaling a paper drawing should never be done for critical dimensions; even for estimating it is not good practice unless a graphic scale is shown for calibration
• Elevations are always top of utility unless noted otherwise, such as inv. or f.l. (pipe invert or flow line)
• Most utilities are shown by centerline for horizontal location. A single line width can show the location of a single direct buried wire or a 30” dia Combustion Air Line or a 48” wide Power Duct Bank
• A 48” wide duct bank that is perpendicular to a trench will have a crossing distance of 48”. At a 45 degree angle to the trench the same duct bank will have a crossing distance of 68"
• Width of some duct banks are determined by the number and diameter of conduit, the estimated space between, and to the edges (3” normal); e.g.:

  5”CND-3Hx2V on drawing calls out:
  5” Dia. CoNDuit-3Horiz x(by) 2Vert.
  H=15”(conduit)+12”(2 spaces+2x3”cover)
  H=27”(Width)
  V=10”(conduit)+9”(1space+2x3”cover)
  V=19”(Height)

• Active Utility Centerlines are shown by a solid line type and labelled by system, material, size and any appropriate known information.
• Abandoned Utility Centerlines are shown by a broken line type, fully labelled with the notation “ABAN"
# EXCAVATION 101

- **READING THE UNDERGROUND RECORD DRAWINGS**

## URD ABBREVIATION TABLE

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABAN</td>
<td>ABANDONED</td>
</tr>
<tr>
<td>BC</td>
<td>BURIED CABLE</td>
</tr>
<tr>
<td>BLDG</td>
<td>BUILDING</td>
</tr>
<tr>
<td>BM</td>
<td>BENCH MARK</td>
</tr>
<tr>
<td>BOT</td>
<td>BOTTOM</td>
</tr>
<tr>
<td>CB</td>
<td>CATCH BASIN</td>
</tr>
<tr>
<td>CHWR</td>
<td>CHILLED WATER RETURN</td>
</tr>
<tr>
<td>CHWS</td>
<td>CHILLED WATER SUPPLY</td>
</tr>
<tr>
<td>CI</td>
<td>CAST IRON</td>
</tr>
<tr>
<td>CICL</td>
<td>CAST IRON CEMENT LINED</td>
</tr>
<tr>
<td>CMP</td>
<td>CORRUGATED METAL PIPE</td>
</tr>
<tr>
<td>CND</td>
<td>CONDUIT</td>
</tr>
<tr>
<td>CO</td>
<td>CLEAN OUT</td>
</tr>
<tr>
<td>COMBA</td>
<td>COMBUSTION AIR</td>
</tr>
<tr>
<td>CONC</td>
<td>CONCRETE</td>
</tr>
<tr>
<td>CONN</td>
<td>CONNECTION</td>
</tr>
<tr>
<td>COP</td>
<td>COPPER</td>
</tr>
<tr>
<td>CPTB</td>
<td>CATHODIC PROTECT TEST BOX</td>
</tr>
<tr>
<td>CS</td>
<td>CARBON STEEL</td>
</tr>
<tr>
<td>CTWR</td>
<td>COOLING TOWER WATER RETURN</td>
</tr>
<tr>
<td>CTWS</td>
<td>COOLING TOWER WATER SUPPLY</td>
</tr>
<tr>
<td>DG</td>
<td>DEGREES</td>
</tr>
<tr>
<td>DI</td>
<td>DUCTILE IRON</td>
</tr>
<tr>
<td>DP</td>
<td>DUAL PURGE</td>
</tr>
<tr>
<td>DR</td>
<td>DRAIN</td>
</tr>
<tr>
<td>DS</td>
<td>DOWNSPOUT</td>
</tr>
<tr>
<td>DW</td>
<td>DOMESTIC WATER</td>
</tr>
<tr>
<td>EL</td>
<td>ELEVATION</td>
</tr>
<tr>
<td>ENTR</td>
<td>ENTRANCE</td>
</tr>
<tr>
<td>E/P</td>
<td>EDGE OF PAVEMENT</td>
</tr>
<tr>
<td>FD</td>
<td>FLOOR DRAIN</td>
</tr>
<tr>
<td>FDN</td>
<td>FOUNDATION</td>
</tr>
<tr>
<td>FH</td>
<td>FIRE HYDRANT</td>
</tr>
<tr>
<td>FL</td>
<td>FLOOR</td>
</tr>
<tr>
<td>FO</td>
<td>FUEL OIL</td>
</tr>
<tr>
<td>FOLQ</td>
<td>FOAM LIQUID</td>
</tr>
<tr>
<td>FTG</td>
<td>FOOTING</td>
</tr>
<tr>
<td>H</td>
<td>LETTER &quot;H&quot; IN HYDRANT</td>
</tr>
<tr>
<td>HDPE</td>
<td>HIGH DENSITY POLYETHYLENE</td>
</tr>
<tr>
<td>HH</td>
<td>HANDHOLE</td>
</tr>
<tr>
<td>HORIZ</td>
<td>HORIZONTAL</td>
</tr>
<tr>
<td>HPS</td>
<td>HIGH PRESSURE STEAM</td>
</tr>
<tr>
<td>IA</td>
<td>INSTRUMENT AIR</td>
</tr>
<tr>
<td>INST</td>
<td>INSTRUMENT</td>
</tr>
<tr>
<td>IWS</td>
<td>INDUSTRIAL WASTE SEWER</td>
</tr>
<tr>
<td>JB</td>
<td>JUNCTION BOX</td>
</tr>
<tr>
<td>LF</td>
<td>LIQUID FUEL</td>
</tr>
<tr>
<td>LPS</td>
<td>LOW PRESSURE STEAM</td>
</tr>
<tr>
<td>LT</td>
<td>LIGHT</td>
</tr>
<tr>
<td>MH</td>
<td>MANHOLE</td>
</tr>
<tr>
<td>MON</td>
<td>MONUMENT</td>
</tr>
<tr>
<td>NG</td>
<td>NATURAL GAS</td>
</tr>
<tr>
<td>NIC</td>
<td>NOT IN CONTRACT</td>
</tr>
<tr>
<td>P</td>
<td>POWER</td>
</tr>
<tr>
<td>PB</td>
<td>PULL BOX</td>
</tr>
<tr>
<td>PC</td>
<td>POINT OF CURVATURE</td>
</tr>
<tr>
<td>PERF</td>
<td>PERFORATED</td>
</tr>
<tr>
<td>PI</td>
<td>POINT OF INTERSECTION</td>
</tr>
<tr>
<td>PP</td>
<td>POLYPROPYLENE</td>
</tr>
<tr>
<td>PT</td>
<td>POINT OF TANGENCY</td>
</tr>
<tr>
<td>PVC</td>
<td>POLYVINYL CHLORIDE</td>
</tr>
<tr>
<td>RC</td>
<td>REINFORCED CONCRETE</td>
</tr>
<tr>
<td>R/W</td>
<td>RIGHT OF WAY</td>
</tr>
<tr>
<td>S</td>
<td>STORM</td>
</tr>
<tr>
<td>SA</td>
<td>SERVICE AIR</td>
</tr>
<tr>
<td>SAN</td>
<td>SANITARY</td>
</tr>
<tr>
<td>SCGR</td>
<td>STEAM COND GRAVITY RETURN</td>
</tr>
<tr>
<td>SCPR</td>
<td>STEAM COND PUMPED RETURN</td>
</tr>
<tr>
<td>ST</td>
<td>STEAM</td>
</tr>
<tr>
<td>STA</td>
<td>STATION</td>
</tr>
<tr>
<td>STL</td>
<td>STEEL</td>
</tr>
<tr>
<td>T</td>
<td>TELEPHONE</td>
</tr>
<tr>
<td>TRAN</td>
<td>TRANSFORMER</td>
</tr>
<tr>
<td>UD</td>
<td>UNDERDRAIN</td>
</tr>
<tr>
<td>VAC</td>
<td>VACUUM</td>
</tr>
<tr>
<td>VB</td>
<td>VALVE BOX</td>
</tr>
<tr>
<td>VC</td>
<td>VITRIFIED CLAY</td>
</tr>
<tr>
<td>VERT</td>
<td>VERTICAL</td>
</tr>
<tr>
<td>VLV</td>
<td>VALVE</td>
</tr>
<tr>
<td>WM</td>
<td>WATER METER</td>
</tr>
</tbody>
</table>
## EXCAVATION 101

- **READING THE UNDERGROUND RECORD DRAWINGS**

### URD SYMBOL LEGEND

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>------</td>
<td>ACTIVE UTILITY LINE</td>
</tr>
<tr>
<td>------</td>
<td>ABANDONED UTILITY LINE</td>
</tr>
<tr>
<td>------</td>
<td>GRAVITY LINE w/ FLOW DIRECTION</td>
</tr>
<tr>
<td>------</td>
<td>DUAL PURGE VALVE (NATURAL GAS)</td>
</tr>
<tr>
<td>------</td>
<td>BLOWOFF PIT (NATURAL GAS)</td>
</tr>
<tr>
<td>------</td>
<td>TYPICAL VALVE</td>
</tr>
<tr>
<td>------</td>
<td>PIPE REDUCER or INCREASER</td>
</tr>
<tr>
<td>------</td>
<td>PIPE RISER or DROP</td>
</tr>
<tr>
<td>------</td>
<td>STORM SEWER CURB CATCH BASIN</td>
</tr>
<tr>
<td>------</td>
<td>STORM STRUCTURE w/ ROUND GRATE</td>
</tr>
<tr>
<td>------</td>
<td>STORM STRUCTURE w/ SQUARE GRATE</td>
</tr>
<tr>
<td>------</td>
<td>UTILITY MANHOLE w/ SOLID LID</td>
</tr>
<tr>
<td>------</td>
<td>POWER POLE</td>
</tr>
<tr>
<td>------</td>
<td>POWER POLE WITH STREET LIGHT</td>
</tr>
<tr>
<td>------</td>
<td>STANDARD FIRE HYDRANT</td>
</tr>
<tr>
<td>------</td>
<td>GRAVITY LINE CLEANOUT</td>
</tr>
<tr>
<td>------</td>
<td>PIPE CAP OR PLUG</td>
</tr>
<tr>
<td>------</td>
<td>EXTENT OF KNOWN LOCATION</td>
</tr>
<tr>
<td>------</td>
<td>GROUNDWATER MONITOR WELL</td>
</tr>
<tr>
<td>------</td>
<td>CATHODIC PROTECTION TEST BOX</td>
</tr>
<tr>
<td>------</td>
<td>PUMP OUT FIXTURE</td>
</tr>
<tr>
<td>------</td>
<td>HEAD WALL-CULVERT- END WALL</td>
</tr>
</tbody>
</table>
EXCAVATION 101

• READING THE UNDERGROUND RECORD DRAWINGS
EXCAVATION 101

- READING THE UNDERGROUND RECORD DRAWINGS

NATURAL GAS
FIELD-FABRICATED DUAL PURGE VALVE
TYPICAL CONSTRUCTION DETAIL

NATURAL GAS
FIELD-FABRICATED DUAL PURGE VALVE
TYPICAL URD CONTEXT
EXCAVATION 101

- READING THE UNDERGROUND RECORD DRAWINGS
EXCAVATION 101

• READING THE UNDERGROUND RECORD DRAWINGS

**Diagram 1: Gravity Sewer Cleanout Typical Construction Detail**
- Gravity Sewer
- Cleanout
- Typical Construction Detail
- Depth Varies
- Concrete Collar
- Ground
- Backfill
- Corner

**Diagram 2: Double Pavement Underdrains Typical Construction Detail**
- Concrete Walk or Landscaping
- Concrete Curb
- Normal Pavement Section
- Depth Varies 24”-30” Common
- Underdrain Back of Curb
- Underdrain Front of Curb
- Stone Fill
EXCAVATION 101

• READING THE UNDERGROUND RECORD DRAWINGS

CONCRETE ENCASED DUCT BANK
TYPICAL CONSTRUCTION DETAIL

PAVEMENT CUT/REPAIR AT PIPE TRENCH
TYPICAL CONSTRUCTION DETAIL
EXCAVATION 101

• READING THE UNDERGROUND RECORD DRAWINGS
EXCAVATION 101

8. EXAMPLE IMAGES
EXCAVATION 101
FINAL EXAM

QUESTION 1: WHAT COLOR MARKINGS WILL BE USED FOR NATURAL GAS?

ANSWER 1: YELLOW

QUESTION 2: WHAT COLOR MARKINGS FOR SEWER LINES?

ANSWER 2: GREEN

QUESTION 3: WHAT DOES “BLO” STAND FOR ON THE URDS?

ANSWER 3: NATURAL GAS BLOWOFF PIT.