Champlain Hudson Power Express

Inadvertent Release Contingency
Plan for Horizontal Directional Drilling
in Segment 11 - Package 7A

Catskill to Germantown
Greene County, New York

TTR Project Number 204-3701

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1.0 INTRODUCTION

CHPE LLC proposes to design a pair of HVDC electrical transmission cables plus a telecommunications line located in upland areas of the Hudson River Valley of New York for Segments 1 through 15 from Putnam Station to Schenectady, NY. Tetra Tech Rooney, Inc. (TTR) is designing 22 Horizontal Directional Drills (HDD) in Segment 11 – Package 7A near Catskill, NY. HDD methods will be used to route the crossings below congested areas, railroads, under/around obstructions (e.g., existing infrastructure or utilities), and below wetlands and bodies of water. The portions of the cable between HDD drills will be installed in PVC casings via trenching methods. The trenching construction is addressed in a separate report.

The trenchless construction of the two HVDC electrical transmission cables is proposed to be housed in individual 8-inch SDR 17 FPVC or 10-inch diameter DR 9 HDPE casings spaced approximately 15 to 25 feet apart *(spacing dependent on depth and TR values provided by NKT)*. A third, 3-inch diameter DR 9 casing will be bundled with one of the 8 or 10-inch diameter casings for a telecommunications line. The casings are to be installed in 13 to 21-inch final ream diameter drill holes.

This Inadvertent Release Contingency Plan (IRCP) is for Segment 11 - Package 7A which includes twenty (20) HDD crossings for ten HDD locations: HDD #111.B through HDD #123.

HDD is a widely used trenchless construction method to install casings with limited disturbance to the ground around the drill alignment and minimal ground surface impacts above the alignment. The goal for using HDD methods is to install the casings while controlling and minimizing the amount of impact on water bodies, congested areas, existing underground obstructions, and to the wetlands, to the maximum extent possible.

A primary potential environmental concern associated with HDD involves the inadvertent release of drilling fluids, also referred to as drilling mud, during the drilling process. The purpose of this plan is to establish general procedures to prevent a fluid release (sometimes referred to as a frac-out) during HDD construction and to present steps to manage, control and

minimize the impacts in the event that an inadvertent release of drilling fluid occurs. The objectives of this plan are to:

- Provide an overview of the HDD process with a specific focus on the composition, management, and use of drilling fluids.
- Identify controls to be implemented during construction to minimize the potential of an inadvertent release.
- Identify the planned means of monitoring to permit early detection of inadvertent releases.
- Protect areas that are considered environmentally sensitive (streams, wetlands, other biological resources, cultural resources).
- Establish site-specific environmental protection measures to be utilized prior to, during, and following drilling and pipe installation activities to minimize and control erosion and sediment releases to adjoining wetlands or watercourses.
- Provide for the timely detection of inadvertent returns.
- Have site specific preplanned general response programs in place at the start of construction that is understood and can be implemented immediately by all field crews in the event of an inadvertent release of drilling fluid occurs; and
- Establish a chain of command for reporting and notifying, in a timely manner, the construction management team, the Certificate Holders, and the proper authorities in the event of an inadvertent release of drilling fluid and of the preplanned actions that are to be implemented.

It is important to note that the plan in this document serves as the guiding framework for confirming that the HDD Subcontractor is adhering to the specifications and provisions to be protective of the environment. Since there are a variety of potential measures listed in this document available for preventing inadvertent releases and mitigating the effects of a release should one occur, the specifications require that each HDD Subcontractor submit to the project design team, for its review and acceptance, a Subcontractor specific means and methods plan for each HDD crossing reaffirming and detailing how the Subcontractor will conform with the requirements of this plan and the project specifications to prevent inadvertent releases and to mitigate any effects of a release should one occur. The plan by the Subcontractor shall be consistent with the site conditions and constraints, and the Subcontractor's selected means,

methods, and equipment. The selected HDD Subcontractor will be responsible for incorporating specific permit conditions, applicable regulatory requirements, details from this plan, site specific environmental features and geotechnical information available at the time of submittal.

2.0 DESCRIPTION OF THE HDD PROCESS

The Horizontal Directional Drilling process begins by mechanically excavating shallow approximately 5 feet wide by 10 feet long by 4 to 5 feet deep entry and exit pits at either end of the HDD alignment. A small diameter (on the order of 6 to 9 inches in diameter) pilot hole is then drilled from the entry pit using directional drilling methods. During the pilot bore, a drilling fluid (typically bentonite and water based with selected biodegradable additives to improve and modify fluid stability, carrying capacity, and drilling properties to address site-specific ground characteristics and Subcontractor preferences) is pumped through nozzles in the drill head to support the hole and to hydraulically transport drill cuttings from the drill bit back to the entry pit. Environmentally acceptable National Sanitation Foundation (NSF) certified additives are required by specification for use on this project and those planned for use by the Subcontractor will be checked for compliance by the design team prior to their use.

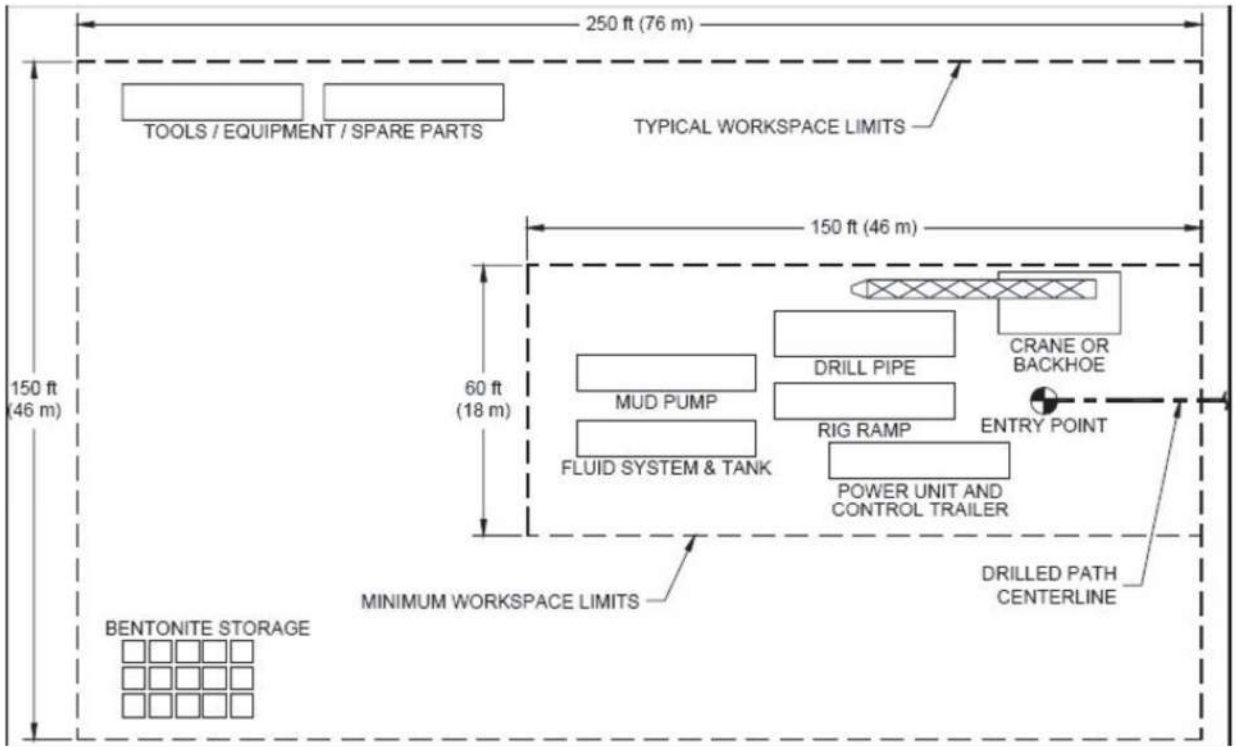


Figure A: Typical HDD Entry Workspace Area

A guidance system is mounted immediately behind the drilling head to allow the crew to track and steer the path of the drill so that it follows the preplanned alignment within the specification permitted tolerances. The drilling fluid holds the cuttings in suspension and carries the drill cuttings back through the annular space between the drill rods and the drill hole wall to the entry pit where it is collected and processed for re-use by a recycling system. The cuttings are separated from the bentonite, using screens, centrifuges, and de-sanding units which prepares the bentonite for re-use. Once the pilot hole reaches the exit pit, a larger diameter reaming head is then attached to the drill string and pulled or pushed through the pilot hole to enlarge the hole. Depending on the size of the pipe to be installed and the ground conditions, several successively larger reaming passes may be needed. Again, a bentonite and water slurry are pumped into the drill hole during reaming to remove cuttings and to stabilize the drill hole. Lastly, the drill string is pulled back through the reamed hole with the new, preassembled casing attached to it in one continuous process until the lead end of the casing emerges at the entry pit. Steps two and three may be combined, with the casing being pulled back through the drill hole immediately behind the final reaming bit or swabbing pass.

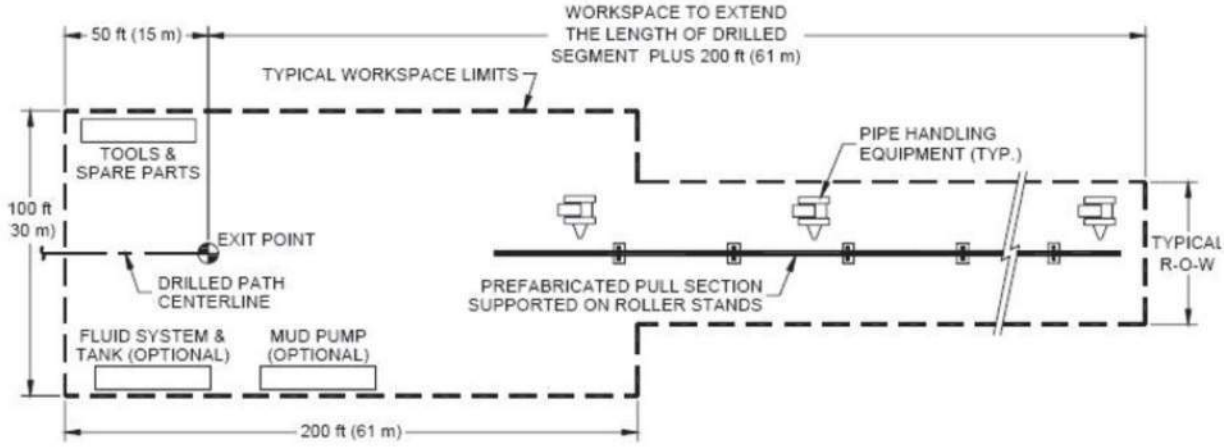


Figure B: Typical HDD Exit Workspace Area

Specific to this plan, it is important to have an awareness of the function and composition of the HDD drilling fluids. The drilling fluid composition and drilling fluid management are integral components of the HDD process with the following primary purposes:

- Support and stabilize the drill hole,

- Suspend and transport cuttings from drill bit through the drill hole annulus,
- Control fluid loss through the bore's side walls by forming a filter cake on the drill hole walls,
- Managing and modifying the drilling fluid mix to improve its cutting carrying characteristics, its pumpability, and its hole stabilization and support characteristics,
- Power the downhole cutting tools (e.g., via mud motors if required); and,
- Serve as a coolant and lubricant by reducing friction to the drill bit during the drilling process, and lubricant between the pipe and the hole wall during the pipe insertion process.
- Soil is excavated by erosion from high velocity fluid streams directed from jet nozzles on bits or reaming tools.

Table 1: Typical HDD Entry and Exit Workspace Areas

System Description	Entry Workspace	Exit Workspace
Maxi-HDD	150' x 250'	150' x 250'
Midi- HDD	100' x 150'	100' x 150'
Mini-HDD	Varies per site (20' x 60' typical)	Varies per site (20' x 60' typical)

The drilling fluids are composed primarily of potable water, which will likely be obtained from nearby sources selected and permitted by the Subcontractor. As mentioned above, the drilling fluid also contains bentonite clay as a viscosifier. Bentonite is a naturally occurring, nontoxic substance that meets NSF/ANSI 60 NSF Drinking Water Additives Standards and is frequently used for drilling potable water wells. While bentonite is non-toxic and commonly used in farming practices, it has the potential to impact plants, fish and their eggs if discharged to waterways in significant quantities. Frequently, additives are used to: amend the drilling fluid, improve its compatibility with the ground and groundwater chemical characteristics, improve its cutting suspension and carrying characteristics, improve its hole stabilization ability, and reduce seepage loss through the ground characteristics. Environmentally acceptable (i.e., biodegradable) additives are required by specification for this project and before the start of work at a specific HDD, the HDD Subcontractor is required to submit crossing, environmental, and toxicity data regarding any additives for review and acceptance by the design team.

During the HDD process and subsequent pipe insertion, the drilling fluid pumped downhole will tend to flow along the path of least resistance. Generally, this will be though the annulus between the drill string and the drill hole side wall. However, the drill alignment may encounter ground conditions where the path of least resistance is an existing fracture, fissure or hole of anthropogenic origin, areas with low overburden confinement, areas of hole collapse, or coarse gravel zones in the soil or rock substrate. When this occurs, circulation can be lost or reduced. This is a common occurrence in the HDD process but does not necessarily prevent completion of the drill or result in a release to the environment. However, the environment may be impacted if the fluid inadvertently releases to the surface at a location on a waterway's banks or within a waterway or wetland. Again, additives to amend the properties of the drilling fluid may be used as necessary to prevent and limit releases and losses through such paths of lower flow resistance. A typical HDD drilling fluid flow circuit is illustrated schematically shown in Figure C.

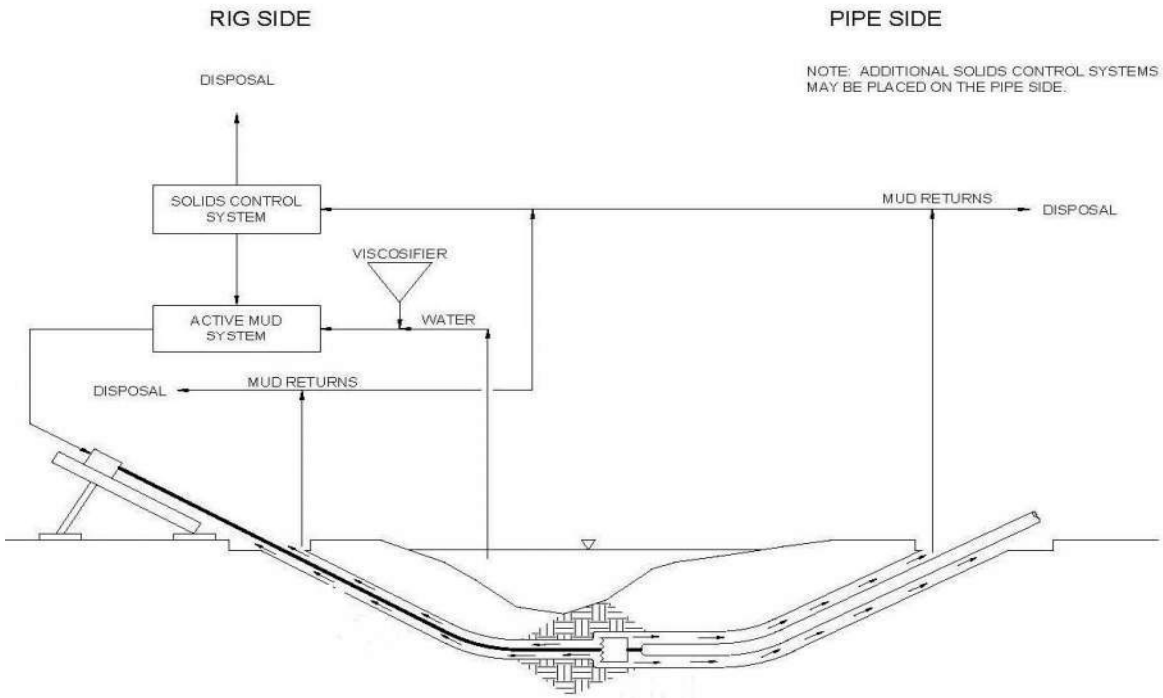


Figure C: Typical HDD Fluid Flow Circuit

3.0 FLUID RELEASE MINIMIZATION MEASURES

3.1 GEOTECHNICAL INVESTIGATION

The first steps taken to minimize the potential risk of an inadvertent release included conducting a geotechnical investigation at the site to develop an understanding of the surficial soils. Soil borings were conducted near the proposed cable alignment within or immediately adjacent to the HDD sites. We understand that each boring has been backfilled and sealed with a cement/bentonite grout to limit the risk of a release through an abandoned bore hole during the HDD construction.

3.2 HDD DESIGN INADVERTENT RETURN MINIMIZATION PRACTICES

The risk of an inadvertent return can be mitigated through profile design and implementation of specific measures throughout the installation process.

The HDD profile is designed to minimize the potential for the release of drilling fluid in sensitive areas. Cohesive soils, such as clays, dense sands, and competent rock are considered ideal materials for containment of drilling fluids. Case by case analysis of the overburden will be conducted to determine the depth of the bore necessary to provide a margin of safety against returns in a sensitive area. In non-cohesive soils, such as gravel, a greater depth of cover will be used. If substrate test bores are required during the design phase, they should be a minimum of 20 feet from the HDD centerline where practical.

Key preventive measures implemented during installation are geared toward keeping the drill fluid contained in the borehole and preventing its escape to the surface. This is accomplished through monitoring and management of drill fluid pressures and drill fluid volumes. The most effective ways of containing and controlling an inadvertent return are early detection (see section 3.6) and quick response by the HDD crew.

General design considerations for HDD include:

- Depth of cover during profile design (based on soil borings) to limit the potential inadvertent break through to the water body, road, wetlands, or ground surface.
- Typically, potential exists for releases near the entry and exit pits of a bore.

The distance where there is a potential for releases at the ends depends on the soil conditions, the slope of the ground surface and the length of the bore. Generally, the longer and deeper the drill the greater the slurry pressures required to hold the borehole open and to carry the cuttings back to the entry or exit pit.

- Specific provisions regarding exit pit design for underwater cable installation (i.e., via the use of temporary dredged cofferdams or steel casing riser pipes).

- Generally, for the formation of inadvertent releases, the more critical stage of the HDD process tends to be during the initial pilot hole drilling when the annular space between the drill sidewall and the drill string is the smallest and therefore requires large slurry pressures to overcome flow resistance to carry cuttings back to the entry pit.

- Adjusting the drill alignment to miss existing infrastructure including existing utilities, and other obstacles,

- Establishing a drill alignment line that allows for gradual angular changes to minimize pressure build-up and limit pull back stresses and bending stresses in the casing, as well as being compatible with the bending capacity of the drill steel.

- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures,

- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment, and

- Requiring that, during the performance of any HDD waterbody crossing, contractors monitor the use of biodegradable drilling solution and, in the event of a detected release of fluid, implement the procedures specified in the approved EM&CP. For any release occurring in a waterbody, the Certificate Holders shall immediately notify DPS Staff and NYSDEC of details of the release and the course of action they recommend taking.

- Requiring monitoring and controlling drilling fluid pressures with down-the-hole sensors during pilot hole drilling.

3.3 MINIMIZATION OF ENVIRONMENTAL IMPACT

The major key to minimize environmental impacts associated with HDD drilling fluids is to maintain fluid circulation to the extent practical. Maintenance of fluid circulation is the responsibility of the HDD contractor. Monitoring of drilling mud volumes, pressures, and pump

rates/returns will be monitored to assist in determining if significant drill mud loss occurs signaling a possible inadvertent return.

It should be recognized that restoration of circulation may not be practical or possible, and that environmental impact will be minimized by completing construction as soon as possible.

Drilling fluid is easily contained by standard erosion and sedimentation control measures. Drilling fluid is controlled within the boundaries of the worksite using pits at the crossing entry and exit points and typical fluid handling equipment such as vac trucks.

The environmental impacts of a release of drilling fluid into a water body include a temporary increase in local turbidity until drilling fluid dissipates with the current and/or settles to the bottom. In the immediate vicinity of a release, benthic organisms may be impacted if sufficient quantities of bentonite settle upon them.

3.4 CONTINGENCY PLAN

Prior to construction the selected Subcontractor will be required to submit a supplemental site- and Subcontractor-Specific Inadvertent Release Contingency Plan for review and approval by design team to ensure conformance with this document and any contractor specific methods. The project specifications require that the following major elements be addressed in detail in the Subcontractor's Plan:

- Work plan and detailed description of the drilling program (details for executing pilot hole, reaming, pull-back operations, and schedule), this plan shall include necessary procedures for addressing problems that are typically encountered during HDD installations through the anticipated subsurface for each drill location.
- Drilling fluid composition design and on-hand amendments to alter fluid properties to reduce pressures, potential for plugging, and seepage losses.
- Description of the planned drilling equipment and drill site layout.
- Safety Data Sheet (SDS) information for all drilling fluid products proposed for use.
- Procedures for drilling fluid pressure control, and fluid and pressure loss monitoring and management to aid in the detection of an inadvertent release (i.e., metering of makeup water, recording of drilling fluid product quantities utilized, fluid return volumes, fluid and cuttings disposal quantities, turbidity of river water, etc.).
- Contingency plans for addressing inadvertent releases into wetlands, or other

sensitive areas, which includes the specific procedures used to halt the release and then contain, clean-up, and remove materials from the release site.

- Notification procedures and chain-of-command in the event of a release.
- Criteria for evaluating the need for a drill hole abandonment and the associated plan for sealing the drill hole if abandoned.
- Drilling fluid management and disposal procedures.
- The work plan and detailed drilling program description should include documentation regarding site restoration, vegetation management, sedimentation and erosion control, and hazardous material usage (if applicable). Intended approach shall be following those measures presented in the Project EM & CP.
- Notice shall be provided to residents, businesses, and building, structure, and facility (including underground, aboveground and underwater facilities) owners and operators within one hundred (100) feet of any HDD staging area or trenching activity with an offer to inspect foundations before, during, and after construction. Additional detail regarding this notice, associated inspections, intended benefits, proof of notice, cost reimbursements and associated construction initiation schedule is included in General Condition 154.

In addition to providing a site-specific Inadvertent Release Contingency Plan, the specifications require that the Subcontractor implement the additional necessary safeguards to minimize the likelihood of a fluid release and management/control should a release occur. This includes having a readily available supply of spill response devices (containment booms, pumps, straw bales, silt fence, sediment logs, sandbags, vacuum trucks, and storage tanks) and any other materials or equipment necessary to contain and clean up inadvertent releases. To maximize protection to sensitive environmental areas these measures shall be pre-positioned at the site, readily available and operational prior to the start of any drilling. If needed, additional spill response measures shall be employed immediately, as secondary measures, in the event of a fluid release.

The workspace layout for HDD materials and equipment will be configured to reduce the likelihood of a release. Example configurations are shown in Figures A, B and C, final dimensions to be adjusted based on actual space available and shown on the drawings for each HDD crossing.

3.5 DRILLING FLUIDS MANAGEMENT

As described in the Project EM&CP document, drilling fluid (typically bentonite and water based with selected biodegradable additives) will be National Sanitation Foundation (NSF) certified and all recycling and reuse regulations will be followed where applicable. The drilling fluid management system and subsequent disposal is the responsibility of the subcontractor performing HDD. However, the drilling fluid management system and subsequent disposal will adhere to the following requirements:

- Drilling fluid will be processed through an initial clearing that separates the solid materials from the fluid.
- Solids will be sifted out by a screening apparatus/system and the solids deposited into a dump truck and periodically transported off-site and disposed of at an approved disposal facility determined by the HDD construction subcontractor.
- Drilling fluid that is deemed unacceptable to be reused during construction or left over at the end of drilling will be collected and transferred into a tanker truck for disposal at an approved disposal facility determined by the HDD construction subcontractor.
- Drilling fluid accidentally spilled during construction and operation of drilling rigs will be contained following the mitigation measures described in the SPCC (Appendix K of the EM&CP) and disposed of at an approved disposal facility as determined by the HDD construction subcontractor.
- Supply of spill containment equipment and measures shall be maintained and readily available around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system, if used, to prevent spills into the surrounding environment. Pumps, vacuum trucks, and/or storage of sufficient size will be in place to contain excess drilling fluid; and,
- No circumstances will be drilling fluid that has escaped containment be reused in the drilling system.

An overview of the drilling fluid system will be submitted to the Environmental Inspector for approval once determined and prior to any HDD installation activities. The role of the Environmental Inspector is discussed in Chapter 3 of the EM&CP.

3.6 EARLY FLUID RELEASE DETECTION

The HDD method has the potential for seepage or fluid loss into pervious geologic formations that the drill path crosses. This may occur due to the presence of fractures in the rock, low overburden confinement, or from seepage through porous soils such as coarse gravels or via prior exploratory boreholes. It is important to note that inadvertent releases of drilling fluid can occur even if the down-hole pressures are minimal. Subsurface conditions that could be conducive and lead to inadvertent releases or drill difficulties include:

- Highly permeable soil such as cobbles and gravel.
- Presence of rock joints, solution features, or other subsurface fractures.
- Considerable differences in the elevations of HDD entry and exit points (typically greater than 50 feet).
- Disturbed soil, such unconsolidated fill.
- Soft soils with low overburden capacity
- Presence of archeological resources.

Our opinions regarding the risks associated with the above conditions at specific crossings are discussed in Section 10 of this report.

An experienced drill crew is the most effective approach to detect drilling fluid seepage prior to a surface release and promptly stop the drilling and they can modify the drilling fluid composition, properties, and pressures to address indications of loss of drill fluid. The HDD Subcontractor is required to utilize experienced drill crews particularly in and adjacent to environmentally sensitive areas. The following factors can be used for identifying the potential for drill fluid release:

- The loss of pressure within the drill hole utilizing a downhole pressure monitoring system
- A substantial reduction in the volume of return fluid (loss of circulation)
- The lack of drill cuttings returning in the drill fluid

In addition to an experienced drill crew, the HDD Subcontractor will be required to perform periodic (at least twice a day) visual inspection and monitoring of the drill path, including stream channel bottom and wetlands in the vicinity of the drill bit or reaming bit for signs of an inadvertent release. Per Article VII Condition 114(n), monitoring of the status of each HDD waterbody crossing while construction activities are underway until the crossing has been

completed and the stream and stream banks have been restored. In the event of any potential or actual failure of the crossing, the Certificate Holders shall have adequate staff and equipment available to take necessary steps to prevent or avoid adverse environmental impacts. If visual monitoring indicates a potential release, additional measures such as turbidity measurements and bentonite accumulation measurements both upstream and downstream of the current active location of the drill bit are required.

3.7 CONTAINMENT & CLEAN-UP MATERIAL AND EQUIPMENT

The HDD contractor will be required to have the necessary containment and clean-up equipment on-site and/or readily available for use. At a minimum, a combination of some or all the following material and equipment should be on site and in ample supply depending on the extent of sensitive areas:

- Spill sorbent pads and booms
- Compost filter socks
- Straw bales (certified weed-free)
- Wood stakes
- Sandbags
- Silt fence
- Plastic sheeting
- Corrugated plastic pipe
- Shovels
- Push brooms
- Centrifugal, trash, sump pumps and hoses
- Vacuum truck
- Rubber tired or wide track backhoe
- Bobcat (if needed)
- Storage tanks (if needed)
- Floating turbidity curtain (may be considered for use on large streams)
- Timber Mats (enough to cross 50% of the wetland length need to be readily available)

4.0 INADVERTENT RELEASE MONITORING AND NOTIFICATIONS

The HDD Subcontractor is responsible for monitoring of the drilling operation to detect a potential inadvertent release by observing and documenting the flow characteristics of drilling fluid returns to the HDD entry/exit pits and by visual inspection along the drill path. If drilling fluid to the HDD entry/exit pits are lost, the Subcontractor shall implement the following

steps:

- The Drill Operator will monitor and document pertinent drilling parameters conditions and observe and monitor the drill path for evidence of an inadvertent release, if there is evidence (typically visual) of a release, the Subcontractor will be required to stop the drilling immediately.

- The Subcontractor shall notify the lead Environmental Inspector and construction manager of any significant loss of drilling fluid returns at the drill rig; and, in the event of a detected release of drilling fluid during the performance of any HDD waterbody crossing, implement the procedures specified in the approved EM&CP. The Certificate Holders shall immediately notify New York State Department of Public Service (NYSDPS) Staff and New York State Department of Environmental Conservation (NYSDEC) of details of the release and the course of action they recommend taking.

- The subcontractor will take steps to modify the drill fluid properties and pressures to reduce the potential of drill fluid loss or release; and

- The Drill Operator will take steps to restore drilling fluid circulation in accordance with the requirements of the 330507.13 – Horizontal Directional Drilling CHPE specification.

If a fluid release is identified, an immediate response is necessary and the Subcontractor is required to take proper corrective actions to minimize impacts, particularly to environmentally sensitive resources (e.g., watercourse, waterbodies, and wetlands). The following information will be logged and recorded:

- Name of the person reporting the incident.
- Name and location of the facility.
- Telephone where the person reporting the incident can be reached.
- Date, time, and location of the incident.
- Brief description of the incident, materials involved, and the extent.
- Estimated volume of release.
- Extent of contamination of land and/or water, if known; and
- Corrective actions taken, or to be taken.

5.0 INADVERTENT RELEASE RESPONSE (UPLAND AND ROAD AREAS)

A common reason for upward movement and release of drill fluid is from borehole collapse or blockage and a resulting increase in the pressure exerted by drill pumps. Lowering drill fluid

pressure is a first step to limiting extent of a release and can be accomplished by stopping drill rig pumps and allowing pressure to bleed off. With no pumping pressure in the hole, surface seepage will generally stop, then the Subcontractor can trip the drill stem back a selected distance and attempt to clear cuttings from the annulus to re-establish circulation.

The Subcontractor will be required to contain/isolate and remove any fluid that has emanated from the surface. On land this can be done through use of berms, straw bales, shovels as needed, or silt fence to contain the release in conjunction with excavating a small sump pit and/or use of vacuum collection equipment, if needed. Sufficient spill-absorbent material will also be required on-site.

If a release is identified in an upland area, the Subcontractor will be required to immediately respond as described above to limit the extents of the release. After containment is established, cleanup and removal can be conducted by hand, with vacuum trucks, or other equipment. The Environmental Inspector will be present during clean up and removal activities, as they may need to be conducted outside of the pre-authorized temporary workspace areas. The Environmental Inspector, Construction Manager, and the Subcontractor will work closely to determine the best course of action for inadvertent releases occurring within upland areas.

Upon containment of the release, the Subcontractor will be required to evaluate the cause of the seepage and develop mitigation strategies to limit the likelihood of recurrence. The location of the seepage and the area around the seep will be monitored upon the re-start of the HDD operations for changes in conditions. The segments of borehole nearest the entry and exit points and other areas of low overburden cover tend to be the most susceptible to surface seepage as they have the least amount of soil confinement. These locations will generally be in areas of dry land where seepage detection is easily identified and contained. If areas of substantial risk for inadvertent releases are identified during the HDD design phase, they can be protected from an uncontrolled release through use of strategically placed confinement/filter beds, straw bales, silt fence, or earth berms placed prior to the start of drilling or the use of temporary starter / conductor casings at the entry / exit locations.

6.0 INADVERTENT RELEASE RESPONSE (WETLAND, RAILROAD, AND OPEN WATER BODY AREAS)

For any release occurring in a waterbody, the Certificate Holders shall immediately notify DPS Staff and NYSDEC of details of the release and the course of action they recommend taking. During the performance of any HDD waterbody crossing, contractors monitor the use of biodegradable drilling solution and, in the event of a detected release of fluid, implement the procedures specified in the approved EM&CP. If an inadvertent release occurs when working beneath the waterway, wetland, or railroad the Subcontractor will be required to cease drilling operations and reduce pressures in borehole immediately, and notify the Environmental Inspector, the construction management team, and the Certificate Holders. The Environmental Inspector, with input from the Drill Operator, will evaluate the potential impact of the release on a site-specific basis and will determine the appropriate course of action. The Subcontractor is required to develop general in-stream or in-rail response methods and pre-place necessary materials and equipment at the site prior to construction. Specific response actions will be determined in consultation with the Environmental Inspector and Subcontractor and could include the following:

- Shutting down or slowing the drill fluid pumps.
- Modifying the drill fluid properties, add agents to reduce drilling fluid pressures and/or to plug/seal release path.
- Tripping the drill stem back a selected distance and attempt to clear cuttings from the annulus to re-establish circulation
- Stopping drilling activities for 24 hours to allow the bentonite in the subsurface pathways to gel and seal the pathways.
- Evaluate the current drill methods to identify site specific improvements to lower the risk of additional inadvertent releases and,
- Implementation of proper in-wetlands and in upland, road and railroad, hand-placed sedimentation control measures including, but not limited to hay bales, vacuum trucks, silt curtains, containment cells, turbidity curtains, or if suitable, sandbags and confinement/filter beds. These activities will require that qualified construction personnel and other support equipment, and supplies be prepositioned and readily

available at or near the site.

- Installing a temporary starter / conductor casing at the entry/exit locations.
- Use of a relief well installed at the location of the release. A well or pit equipped with a subsurface pump to control slurry pressures and future releases at that location by evacuating drilling fluid as it accumulates can also be used. The relief well can be utilized to immediately lower the borehole pressures in the event of an inadvertent release and later to control and manage the release as the drilling continues.

7.0 ORGANIZATION AND STAFFING RESPONSIBILITIES

The organizational chart shown below list the contact information of the principal organizations involved in this project. The remainder of Section 3 discusses the roles and responsibilities of these principal organizations.

Organizational Chart

Entity	Contact Information
Certificate Holders	Name, Title: TDI Phone Email
Construction Manager	TBD
HDD Construction Subcontractor	TBD
Environmental Inspector	TBD
U.S. Army Corps of Engineers, New York District Office	USACE New York District Upstate Regulatory Field Office ATTN; CENAN-OP-UR, Bldg. 10, 3rd Floor North 1 Buffington Street Watervliet, NY 12189-4000 518-266-6350 cenan.rfo@usace.army.mil
New York State Department of Public Service	Mathew Smith Department of Public Service Empire State Plz 3 Albany, NY 12223 (518) 402-5141 Mathew.smith@dps.ny.gov
New York State Department of Environmental Conservation	Regional Office(s) Information
	NYSDEC REGION 5 Sub-Office Regional Permit Administrator 232 Golf Course Rd Warrensburg, NY 12885-1172 518-623-1281 dep.r5@dec.ny.gov
New York State Department of Environmental Conservation (Spills)	NYS Spill Hotline: 1-800-457-7362

7.1 RESPONSIBILITIES OF VARIOUS ORGANIZATIONS

The principal organizations involved in this project include the Regulatory Agencies, Certificate Holders, Design Engineer, HDD Construction Subcontractor, Construction Manager, and Environmental Inspector. The roles and responsibilities of the principal organizations are discussed in the following subsections and are shown in the organizational chart included above.

7.2 REGULATORY AGENCIES

The Certificate of Conditions issued by the NY Public Service Commission is the primary regulatory agency for the requirements associated with the project. The Champlain Hudson Power Express (CHPE) Route Project also has permits from the Department of Energy, and the US Army Corps of Engineers, and the New York Water Quality Certification. Various HDDs within this package take place within or adjacent to wetlands, underneath or adjacent to bodies of water, and underneath or adjacent to railroad tracks. Measures are discussed throughout this report to control/mitigate any potential releases before environmentally sensitive boundaries are reached or impacted.

7.3 CERTIFICATE HOLDERS

The project Certificate Holders are TDI. TDI's Project Manager will have the overall responsibility to coordinate this project for TDI. The Project Manager will be responsible for correspondence and coordination among all parties and will have the authority to stop work as necessary.

7.4 DESIGN ENGINEER

The Design Engineer for Segment 11 – Package 7A HDD Design is TTR. During construction, Kiewit will be responsible for reviewing and approving required Subcontractor submittals, shop drawings, and material certificates. Kiewit will take responsibility for review and acceptance of submittals, and documenting the materials and methods used in performance of the construction work to document that the construction complies with the contract documents.

7.5 THIRD-PARTY ENGINEER

The Third-Party Engineer for the HDD inadvertent return analysis is TTR and Kiewit. During construction, Kiewit will review the Subcontractors Inadvertent Release Plan and providing technical assistance as needed with the HDD installation.

7.6 CONSTRUCTION MANAGER

The Construction Manager for this project has yet to be selected. The Construction Manager will be responsible for on-site management of the project for the Certificate Holders to ensure overall Subcontractor compliance with the EM&CP documents, environmental permits, and local and federal regulations.

7.7 HDD CONSTRUCTION SUBCONTRACTOR

The HDD Construction Subcontractors for the various HDD crossing of this project have yet to be selected. The Subcontractor will be responsible for completion of the casing pipe installation by HDD methods in accordance with the design criteria, contract documents, environmental compliance permits and federal regulations. The Subcontractor will be expected to use the appropriate construction procedures and techniques to complete the project, including supplemental site specific and means and methods specific Inadvertent Release Prevention and Contingency Plans reviewed and accepted by the design team for each crossing in accordance with the contract documents.

The HDD Drill Operator (Drill Operator) will be responsible for operating the HDD drill rig and observing and managing changes in annular fluid pressure or loss of circulation. The Drill Operator will communicate with other members of the drill crew as needed when issues arise. The Subcontractor will be responsible for developing the specific lines of communication within their organization and shall dedicate a responsible person for communicating inadvertent releases to the Construction Management team and Environmental Inspector.

7.8 ENVIRONMENTAL INSPECTOR

The Environmental Inspector for this project has not yet been determined. In general, the

Environmental Inspector will perform full-time observation and documentation during the HDD activities at a specific site. The Environmental Inspector will be responsible for coordination with all counties, state and federal resource agencies, compliance with and changes to any environmental permits.

The Environmental Inspector shall have the authority to stop work when the environmental permit conditions are not being followed or when appropriate environmental precautions are being disregarded by the Subcontractor.

7.9 LINES OF COMMUNICATION AND AUTHORITY

Formal lines of communication will generally follow the established lines of authority. However, open communications between all parties will be encouraged to facilitate more efficient communication and coordination.

7.10 TRAINING

The Subcontractor will verify and document that all construction personnel have appropriate environmental training before they begin work. The Environmental Inspector will also conduct a project orientation meeting for staff assigned with specific roles during the HDD installation and will review the site-specific environmental concerns and permit conditions. The Certificate Holders and Kiewit will also attend the orientation meeting to review the procedures that will be used to document inadvertent releases in accordance with the HDD specifications.

8.0 INADVERTENT RETURN SITE RESTORATION

Impacted areas will be restored to pre-existing conditions and contours. Impacted upland areas will be restored through normal ROW practices of seeding and mulching.

Restoration of affected wetlands will vary depending on wetland classification and extent of disturbance to the upper soil layer and vegetation during the initial return response. Residual drilling mud will be washed off vegetation to the extent practical.

Other perennial, intermittent and ephemeral streams will have as much residual drilling mud removed as practical, without resulting disturbance to the original streambed. This may include a light wash of the streambed utilizing upstream water and collection of the wash water immediately downstream. Site inspection by agency personnel may be required and would be coordinated during the notification process.

9.0 DRILL HOLE ABANDONMENT PLAN

In the event the Subcontractor must abandon the drilled hole, a plan to fill the abandoned hole will be implemented as detailed in the Subcontractor's supplemental Inadvertent Release Contingency Plan and an alternative plan/alignment for crossing shall be evaluated. If it becomes necessary to abandon a partially completed hole, the abandoned hole will be filled with a mixture of high-yield bentonite, water, and drill spoil. The first ten feet of the drill path will be compacted and filled with soil or a cement-bentonite grout mix to prevent future settlement. The Subcontractor submitted site-specific abandonment plan shall be approved by Kiewit and the Construction Manager prior to being performed in the field.

After the abandoned hole has been filled, an alternative entry and exit hole and drill path alignment will be evaluated by the Subcontractor, Construction Manager, and Kiewit. The new alignment shall be offset from the abandoned hole by at least 10 feet (except at the ends where a 5- foot offset may be used) to help limit the risk steering difficulties due to the presence of or hydraulic connection causing drill fluid loss to the abandoned hole.

10.0 CROSSING SPECIFIC DISCUSSION

10.1 HDD CROSSING #111.B

10.1.1 General Drill Crossing

HDD #111.B consists of two straight (in plan view) HDD drills, each drill is approximately 765 feet long as shown in Appendix B. Each drill will contain a 10" HDPE casing and one of the drills will be bundled with a 3" HDPE casing. The HDD drills will pass approximately 40 feet below a pond. The HDD passes under the pond at approximately latitude 42.243109N and longitude 73.859311W (Approx. STA. 70006+00) in Greene County, NY. The approximate ground surface elevation along the path of the HDD entry is El. 112.32 feet and rises in the middle to about El. 125 feet and then decrease slightly to El. 120.00 feet (reference datum NAVD 1988). The pond is present between approximate station 70005+00 and station 70006+50 (at about El. 125 feet).

The drills have no designed horizontal curve (in the plan view). The vertical curves of the drill path are designed so that the drill will pass beneath the pond. The proposed work at this location must be constructed in accordance with the Article VII Certificate and associated EM&CP.

10.1.2 Ground Conditions

At this time, no geotechnical borings are available for HDD #111.B. There are two planned Geotechnical borings that will be completed prior to construction once a construction access road is able to be constructed and landowner access permissions have been granted. For the purposes of the BoreAid analyses Geotechnical Boring KB-219.4 (from HDD #111.A) was used as it was the closest Geotechnical boring to HDD #111.B and it covered the full depth of the HDD profile. Boring KB-219.4 is located approximately 2,200 feet north of HDD #111.B. The surface elevation at the geotechnical bore was El. 120.73 feet and the total length of the bore was 80 feet. Based on the boring, the soil profile for the BoreAid analysis was divided into three (3) layers as listed out below in section 10.2.2.1. The soil profile used for the BoreAid analysis of the HDDs in this segment are shown in *Appendix A*.

10.1.2.1 Descriptions of the layers used for each HDD Crossing are summarized below:

- Layer 1 – Sandy Silt (SM): The sand silt layer extends from the ground surface at approximately El. 120.7 to 116.7 feet. This layer consists of orange and brown fill.
- Layer 2 – Silty Gravel with Sand (GM): Following the sandy silt layer is a brown silty gravel with sand layer from approximately El. 116.7 to 105.7 feet. This layer consists of medium dense to dense glacial till with occasional cobbles.
- Layer 3 – Sedimentary Rock: Following the silty gravel layer are multiple layers of weathered rock, shale, and greywacke between El. 105.7 to 40.7 feet. These layers were gray in color and very strong with good to excellent Rock Quality Designation (RQD).

10.1.3 Specific Design Considerations Include:

Preliminary analysis of the geotechnical bores, assuming typical drilling methods, indicates that the maximum allowable pressure capacity in the middle of the alignment is approximately 591 psi and the drill fluid pressure estimated to occur in the middle portion ranges from 25 to 32 psi. In the remaining section of the drill the maximum allowable pressure ranges from approximately 591 to 8 psi. The approximate minimum required drill fluid pressure needed to return cuttings ranges from 7 to 32 psi and the estimated operating drill fluid pressure can range from 9 to 40 psi. A sketch showing the maximum allowable pressure and the minimum required drill fluid pressure is provided in the BoreAid analyses in *Appendix A*.

The entry and exit workspace have a designed width of 100 feet by 150 feet long. There is also a pit 5 feet wide by 10 feet long and 5 feet deep at the entry and exit of the drill to help contain the drilling fluid when actively drilling. An approximate 770 feet-long by 20 feet-wide pipe assembly corridor will be required on the exit side of the drill within the acquired easement. Erosion and sediment control measure will be available on site as listed in section 3.7 as added precaution and preventative measures.

It appears that there is a potential for IR at the entry of the HDD. This should be relatively easily controlled through the use of a conductor casing, haybales, silt fences, erosion control measures and vacuum trucks.

In our opinion the conditions conducive to inadvertent releases that may exist at this site based on the ground conditions described in the borings at the site include:

- The sandy and silty gravel layer that is expected to be present near the entry and exit. The results of the BoreAid analysis indicate the risk for a release due to this layer is low on the entry side. Utilizing a conductor/surface casing (installed along the entry/exit tangent), monitoring the drilling pressures, and minimizing the drill fluid pressures will limit the chance for an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release due to these layers are low.
- In the general area of the pond the boring indicates that the drill will be in the Greywacke and Shale layers which combined with the depth of the drill and the results of the BoreAid analysis leads to our opinion that the risk for a release in the area of the pond is very low.

Additional design considerations and recommended IR preventative measures include:

- Drilling an 8in or larger diameter pilot hole is recommended to reduce the required drill fluid pressures *(Note: 8.75in diameter pilot hole was used in the BoreAid analysis)*
- Requiring monitoring and controlling drilling fluid pressures with downhole sensors during pilot hole and reaming operations.
- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures.
- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment.
- Increased monitoring and potential for reduced drill fluid pressures as the drill path approaches the Geotech bore locations. If a reduction in drill fluid pressures is noticed at a specific Geotech location that location can be proactively used as a strategic drill fluid containment relief well.
- If pressure is reaching the maximum allowable, the contractor can trip back as needed to clean the hole, before advancing the HDD.
- The contractor may elect to minimize drill fluid pressures as they approach the exit and/or push the drill bit over the final 30-feet.

10.2 HDD CROSSING #112

10.2.1 General Drill Crossing

HDD #112 consists of two straight (in plan view) HDD drills, each drill is approximately 960 feet long as shown in Appendix B. Each drill will contain a 10" HDPE casing and one of the drills will be bundled with a 3" HDPE casing. The HDD drills will pass approximately 25 feet below a stream, and approximately 34 feet below a pond. The approximate center of the HDD drill under the stream is at latitude 42.235041N and longitude 73.863252W (Approx. STA. 70037+00) in Greene County, NY. The approximate ground surface elevation along the path of the HDD entry is 110.55 feet and drops slightly in the middle to about 100 feet and then increases in elevation to 131.66 feet (reference datum NAVD 1988). The waterbody (pond) is present between approximate station 70037+00 and station 70041+00 (at about elevation 100 feet).

The drills have no designed horizontal curve (in the plan view). The vertical curves of the drill path are designed so that the drill will pass beneath the stream and pond. The proposed work at this location must be constructed in accordance with the Article VII Certificate and associated EM&CP.

10.2.2 Ground Conditions

Three Geotechnical bores (KB-220.5, K-220.6, and SC-5) are located along the proposed HDD #112 alignment. The full details of these Geotechnical borings, including bore log and lab testing data, can be found in Appendix B of the DSR for segment 11 package 7A. After reviewing and comparing these samples, Geotechnical boring SC-5 was selected to be used in the BoreAid analysis as it best represented the complete soil strata for the HDD alignment. Consideration was taken for the other Geotechnical borings in the design of the HDD. Geotechnical boring SC-5 is located along the proposed HDD alignment at approximately station 70042+50. The surface elevation at the geotechnical bore was El. 110.20 feet and the total length of the bore was 40 feet. Based on the boring, the soil profile for the BoreAid analysis was divided into seven (7) layers as listed out below in section 10.2.2.1. The soil profiles used for BoreAid analysis of the HDDs in this segment are shown in *Appendix A*.

10.2.2.1 Descriptions of the layers used for each HDD Crossing are summarized below:

- Layer 1 – Sand (SP): The sand layer extends from the ground surface at approximately El. 110.5 to 105.5 feet. The layer consists of mostly black fine to coarse sand. The black sand was moist and medium dense at the time of sampling.
- Layer 2 – Silt (ML): After the sand layer is a clayey silt layer from El. 105.5 to 101.5 feet. This layer contained brown, medium stiff, moist, clayey silt.
- Layer 3 – Silty Sand (SM): Following the silt layer is a silty sand layer from approximately El. 101.5 to 97.5 feet. This layer consists of red to brown, fine to course, moist dense sand with trace amounts of clay.
- Layer 4 – Silt (ML): Following the silty sand layer is a brown clayey silt from approximately El. 97.5 to 94.5 feet. This layer consists of moist, brown, clayey silt with medium stiffness.
- Layer 5 – Sandstone (Sedimentary Rock): Following the silt layer is a layer of Sandstone between El. 94.5 to 85.5 feet. This layer consists of gray, fine grained, unweathered sandstone.
- Layer 6 – Gravel (GM): Following the Sandstone layer is a layer of silty gravel from El. 85.5 to 78.5 feet. This layer consists of gray angular gravel with some silt and sand.
- Layer 7 – Shale and Sandstone (Sedimentary Rock): Following the gravel is a final layer of interbedded shale and sandstone from El. 78.5 to 70.5 feet. This layer consists of interbedded gray shale and gray sandstone.
- The chosen test bore did not reach the full depth of the drill path however, the other test bore (KB-220.5) corroborated that the sedimentary rock layer continued for the full depth of the HDD profile thus a final layer of sedimentary rock was added to complete the soil strata used in the IR analysis.
- Geotechnical boring KB-220.5 mentions “potential artesian conditions, water slowly coming out of casing the morning of 9/16/22”. It should be noted that this geotechnical boring was drilled across the RR tracks from the HDD 112 alignment and these findings were not encountered by the other borings (K-220.6 and SC-5) that were drilled closer to the HDD 112 alignment. Artesian conditions are not anticipated at this HDD; however, the contractor should be made aware that there is the potential and if any such conditions are encountered, they should proceed with the necessary precautions.

10.2.3 Specific Design Considerations Include:

Preliminary analysis of the geotechnical bores, assuming typical drilling methods, indicates that the maximum allowable pressure capacity in the middle of the alignment is approximately 943 psi and the drill fluid pressure estimated to occur in the middle portion ranges from 50 to 58 psi. In the remaining section of the drill the maximum allowable pressure ranges from approximately 942 to 5 psi. The approximate minimum required drill fluid pressure needed to return cuttings ranges from 15 to 58 psi and the estimated operating drill fluid pressure can range from 18 to 73 psi. A sketch showing the maximum allowable pressure and the minimum required drill fluid pressure is provided in the BoreAid analyses in *Appendix A.*

The entry workspaces has a designed width of 100 feet by 150 feet long and the exit workspace has a variable width. There is also a pit 5 feet wide by 10 feet long and 5 feet deep at the entry and exit of the drill to help contain the drilling fluid when actively drilling. An approximate 970 feet-long by 20 feet-wide pipe assembly corridor will be required on the exit side of the drill within the acquired easement. Erosion and sediment control measure will be available on site as listed in section 3.7 as added precaution and preventative measures.

It appears that there is a potential for releases at the entry and exit of the HDD. These should be relatively easily controlled through the use of conductor casing, haybales, silt fences, erosion control measures and vacuum trucks.

In our opinion the conditions conducive to inadvertent releases that may exist at this site based on the ground conditions described in the borings at the site include:

- The sandy layer that is expected to be present at the exit side of the drill. The results of the BoreAid analysis indicate the risk for a release due to this layer is low on the exit side. Utilizing a conductor/surface casing (installed along the entry/exit tangent), monitoring the drilling pressures, and minimizing the drill fluid pressures over the final 60-feet will limit the chance for an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release due to these layers are low.
- In the general area of the stream and pond the boring indicates that the drill will be in the sandstone layer and there is also a clayey silt layer beneath the stream and pond features. This combined with the depth of the drill and the results of the BoreAid analysis leads to our opinion that the risk for a release due to this condition is also low.

Additional design considerations and recommended IR preventative measures include:

- Drilling an 8in or larger diameter pilot hole is recommended to reduce the required drill fluid pressures *(Note: 8.75in diameter pilot hole was used in the BoreAid analysis)*
- Requiring monitoring and controlling drilling fluid pressures with downhole sensors during pilot hole and reaming operations.
- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures.
- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment.
- Increased monitoring and potential for reduced drill fluid pressures as the drill path approaches the Geotech bore locations. If a reduction in drill fluid pressures is noticed at a specific Geotech location that location can be proactively used as a strategic drill fluid containment relief well.
- If pressure is reaching the maximum allowable, the contractor can trip back as needed to clean the hole, before advancing the HDD.
- The contractor may elect to minimize drill fluid pressures as they approach the exit and/or push the drill bit over the final 60-feet.

10.3 HDD CROSSING #113

10.3.1 General Drill Crossing

HDD #113 consists of two straight (in plan view) HDD drills, each drill is approximately 610 feet long as shown in Appendix B. Each drill will contain a 10" HDPE casing and one of the drills will be bundled with a 3" HDPE casing. The HDD drills will pass approximately 40 feet below the CSX Railroad track and a bridged road crossing. The approximate center of the HDD drill under the railroad track is at latitude 42.229841N and longitude 73.865585W (Approx. STA. 70057+00) in Greene County, NY. The approximate ground surface elevation along the path of the HDD entry is 96.4 feet, then fairly flat until it exits at elevation 110.2 feet (reference datum NAVD 1988).

The drills have no designed horizontal curve (in the plan view). The vertical curves of the drill path are designed so that the drill will pass beneath the railroad. The proposed work at this location must be constructed in accordance with the Article VII Certificate and associated EM&CP.

10.3.2 Ground Conditions

Two Geotechnical borings (KB-220.9 and SC-6) are located along the proposed HDD #113 alignment. The other borings listed in *Appendix B* of the DSR (K-221.0 and B221.0-1) are located outside the extents of the HDD alignment and are provided as reference only for the geology in the area. The full details of these Geotechnical borings, including bore log and lab testing data, can be found in *Appendix B* of the DSR for segment 11 package 7A. After reviewing and comparing these samples, Geotechnical boring KB-220.9 was selected to be used in the BoreAid analysis as it best represented the complete soil strata for the HDD alignment and covered the full depth of the HDD profile. Consideration was taken for the other Geotechnical borings in the design of the HDD. Geotechnical boring KB-220.9 is located along the proposed HDD alignment at approximately station 70058+00. The surface elevation at the geotechnical bore was El. 103 feet and the total length of the bore was 57 feet. Based on the boring, the soil profile for the BoreAid analysis was divided into four (4) layers as listed out below in section 10.3.2.1. The soil profiles used for BoreAid analysis of the HDDs in this segment are shown in *Appendix A*.

10.3.2.1 Descriptions of the layers used for each HDD Crossing are summarized below:

- Layer 1 – Sand (SM): The silty sand layer extends from the ground surface at approximate El. 103 to 101 feet. This layer consists of mostly black fine to coarse sand.
- Layer 2 – Clay (CH): The next layer was a fat clay from about El. 101 to 83 feet. This layer consists of brown, medium stiff to very stiff clay.
- Layer 3 – Clay (CL): A lean clay layer follows the first fat clay layer from El. 83 to 58 feet. This layer consists of gray, very soft to soft clay.
- Layer 4 – Silt (ML): The final layer that was present in this geotechnical sample was a silt layer that was present from El. 58 to 46 feet where the boring was terminated. This layer consists of gray, very soft silt.

10.3.3 Specific Design Considerations Include:

Preliminary analysis of the geotechnical bores, assuming typical drilling methods, indicates that the maximum allowable pressure capacity in the middle of the alignment is approximately 80 psi and the drill fluid pressure estimated to occur in the middle portion ranges from 30 to 35 psi. In the remaining section of the drill the maximum allowable pressure ranges from approximately 80 to 11 psi. The approximate minimum required drill fluid pressure needed to return cuttings

ranges from 11 to 36 psi and the estimated operating drill fluid pressure can range from 14 to 45 psi. A sketch showing the maximum allowable pressure and the minimum required drill fluid pressure is provided in the BoreAid analyses in *Appendix A*.

The entry workspace is variable width and the exit workspace has a designed width of 100 feet by 150 feet long. There is also a pit 5 feet wide by 10 feet long and 5 feet deep at the entry and exit of the drill to help contain the drilling fluid when actively drilling. An approximate 617 feet-long by 20 feet-wide pipe assembly corridor will be required on the exit side of the drill within the acquired easement. Erosion and sediment control measure will be available on site as listed in section 3.7 as added precaution and preventative measures.

It appears that there is a potential for releases at the entry and exit of the HDD. These should be relatively easily controlled through the use of conductor casing, haybales, silt fences, erosion control measures and vacuum trucks.

In our opinion the conditions conducive to inadvertent releases that may exist at this site based on the ground conditions described in the borings at the site include:

- The silty sand layer that is expected to be present at the entry and exit side of the drill. The results of the BoreAid analysis indicate the risk for a release due to this layer is low on the exit side. Utilizing a conductor/surface casing (installed along the entry/exit tangent), monitoring the drilling pressures, and minimizing the drill fluid pressures over the final 60-feet will limit the chance for an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release due to these layers are low.
- In the general area of the railroad the boring indicates that the drill will be in the predominantly lean clay layer, which combined with the depth of the drill and the results of the BoreAid analysis leads to our opinion that the risk for a release due to this condition is also low.

Additional design considerations and recommended IR preventative measures include:

- Drilling an 8in or larger diameter pilot hole is recommended to reduce the required drill fluid pressures *(Note: 8.75in diameter pilot hole was used in the BoreAid analysis)*
- Requiring monitoring and controlling drilling fluid pressures with downhole sensors during pilot hole and reaming operations.

- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures.
- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment.
- Increased monitoring and potential for reduced drill fluid pressures as the drill path approaches the Geotech bore locations. If a reduction in drill fluid pressures is noticed at a specific Geotech location that location can be proactively used as a strategic drill fluid containment relief well.
- If pressure is reaching the maximum allowable, the contractor can trip back as needed to clean the hole, before advancing the HDD.
- The contractor may elect to minimize drill fluid pressures as they approach the exit and/or push the drill bit over the final 60-feet.

10.4 HDD CROSSING #115

10.4.1 General Drill Crossing

HDD #115 consists of two compound (curves in plan view and profile) HDD drills, each drill is approximately 1,350 feet long as shown in Appendix B. Each drill will contain a 8" FPVC casing and one of the drills will be bundled with a 3" HDPE casing. On average, the HDD's will pass approximately 35 feet below Catskill Creek. The approximate center of the HDD drill under the creek is at latitude 42.224442N and longitude 73.871072W in Greene County, NY. The approximate ground surface elevation along the path of the HDD entry is El. 34.1 feet and then increases at varying slopes until it exits at El. 51.1 feet (reference datum NAVD 1988). The waterbody (Catskill Creek) is present between approximate station 70091+00 to station 70096+00 and based on the bathymetric survey the bottom of Catskill Creek is at El. -2 feet.

The horizontal curve (in the plan view) is required due to the project centerline alignment and has been designed to avoid existing infrastructure as well as the Route 9W bridge. The vertical curves of the drill path are designed so that the drill will pass beneath Catskill Creek. The curves (horizontal and vertical) have been designed to be within acceptable stress parameters and verified in the BoreAid analysis. The proposed work at this location must be constructed in accordance with the Article VII Certificate and associated EM&CP.

10.4.2 Ground Conditions

Two Geotechnical bores (KB-221.3 and KB-221.4) are located along the proposed HDD #115 alignment. The other borings listed in *Appendix B* of the DSR (CU-2, B221.14-1, B221.2-1, B221.4-1, CU-2A, and B221.5-1) are located outside the extents of the HDD alignment and are provided as reference only for the geology in the area. The full details of these Geotechnical borings, including bore log and lab testing data, can be found in *Appendix B* of the DSR for segment 11 package 7A. After reviewing and comparing these samples, Geotechnical boring KB-221.3 was selected to be used in the BoreAid analysis as it best represented the deepest soil strata for the HDD alignment and covered the full depth of the HDD profile. Consideration was taken for the other Geotechnical boring in the design of the HDD. Geotechnical boring KB-221.3 is located along the proposed HDD alignment at approximate station 70090+50. The surface elevation at the geotechnical bore was El. 24.4 feet and the total length of the bore was 110 feet. Based on the boring, the soil profile for the BoreAid analysis was divided into five (5) layers as listed out below in section 10.4.2.1. The soil profiles used for BoreAid analysis of the HDDs in this segment are shown in *Appendix A*.

10.4.2.1 Descriptions of the layers used for each HDD Crossing are summarized below:

- Layer 1 – Clayey Gravel (GC): The gravel layer extends from the ground surface at approximate El. 24.4 to 22.4 feet. This layer consisted of clayey gravel with subangular to angular, course, semi-moist fill.
- Layer 2 – Sandy Clay (CL): The next layer was a sandy clay from about El. 22.4 to 18.4 feet. This sandy clay layer was mostly brown, fine to medium coarse, subangular to angular, with semi-moist gravel.
- Layer 3 – Clayey Silt (ML): Another layer of clayey silt followed from approximate El. 18.4 to 16.4 feet. The layer consists of reddish brown, low to medium plasticity, clayey silt.
- Layer 4 – Clayey Gravel (GC): The next layer was a clayey gravel from about El. 16.4 to 8.4 feet. This layer started off as reddish-brown gravel with low to medium plasticity and turned to grayish brown.
- Layer 5 – Shale (Sedimentary Rock): The final layer that was present in this geotechnical sample was a Shale from El. 8.4 to -85.6 feet. This layer was gray in color, fresh to low weathering, and very strong with good to excellent Rock Quality Designation (RQD).

10.4.3 Specific Design Considerations Include:

Preliminary analysis of the geotechnical bores, assuming typical drilling methods, indicates that the maximum allowable pressure capacity in the middle of the alignment is approximately 1353 psi and the drill fluid pressure estimated to occur in the middle portion ranges from 55 to 79 psi. In the remaining section of the drill the maximum allowable pressure ranges from approximately 1353 to 3 psi. The approximate minimum required drill fluid pressure needed to return cuttings ranges from 13 to 79 psi and the estimated operating drill fluid pressure can range from 16 to 98 psi. A sketch showing the maximum allowable pressure and the minimum required drill fluid pressure is provided in the BoreAid analyses in *Appendix A*.

The entry workspace has a designed width of approximately 100 feet by 150 feet long and the exit workspace has a variable width. There is also a pit 5 feet wide by 10 feet long and 5 feet deep at the entry and exit of the drill to help contain the drilling fluid when actively drilling. An approximate 1365 feet-long by 20 feet-wide pipe assembly corridor will be required on the exit side of the drill within the acquired easement. Erosion and sediment control measure will be available on site as listed in section 3.7 as added precaution and preventative measures.

It appears that there is a potential for releases at the entry and exit of the HDD. These should be relatively easily controlled through the use of conductor casing, haybales, silt fences, erosion control measures and vacuum trucks.

In our opinion the conditions conducive to inadvertent releases that may exist at this site based on the ground conditions described in the borings at the site include:

- The clayey gravel and sandy clay layer that is expected to be present at the entry and exit side of the drill. The results of the BoreAid analysis indicate the risk for a release due to this layer is low on the exit side. Utilizing a conductor/surface casing (installed along the entry/exit tangent), monitoring the drilling pressures, and minimizing the drill fluid pressures over the final 100-feet will limit the chance for an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release due to these layers are low.
- In the general area of the Catskill Creek the boring predicted that the drill will be in the shale layer, which combined with the depth of the drill and the results of the BoreAid analysis leads to our opinion that the risk for a release due to this condition is also low. This is because of the high RQD value rock that the drill has been designed to go

through. However, due to the environmental sensitivity of the feature being crossed the operator should monitor the drill fluid pressure and returns to ensure no IR's occur if a poor RQD value or fractured rock is encountered during drilling.

Additional design considerations and recommended IR preventative measures include:

- Drilling an 8in or larger diameter pilot hole is recommended to reduce the required drill fluid pressures *(Note: 8.75in diameter pilot hole was used in the BoreAid analysis)*
- Requiring monitoring and controlling drilling fluid pressures with downhole sensors during pilot hole and reaming operations.
- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures.
- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment.
- Increased monitoring and potential for reduced drill fluid pressures as the drill path approaches the Geotech bore locations. If a reduction in drill fluid pressures is noticed at a specific Geotech location that location can be proactively used as a strategic drill fluid containment relief well.
- If pressure is reaching the maximum allowable, the contractor can trip back as needed to clean the hole, before advancing the HDD.
- The contractor may elect to minimize drill fluid pressures as they approach the exit and/or push the drill bit over the final 100-feet.

10.5 HDD CROSSING #117

10.5.1 General Drill Crossing

HDD #117 consists of two straight (in plan view) HDD drills, each drill is approximately 735 feet long as shown in Appendix B. Each drill will contain a 10" HDPE casing and one of the drills will be bundled with a 3" HDPE casing. The HDD drills will pass approximately 40 feet below the CSX Railroad track. The approximate center of the HDD drill under the railroad track is at latitude 42.219413N and longitude 73.876200W (Approx. STA. 70116+50) in Greene County, NY. The approximate ground surface elevation along the path of the HDD entry is El. 105.2 feet, then fairly flat until it exits at El. 101.5 feet (reference datum NAVD 1988).

The drills have no designed horizontal curve (in the plan view). The vertical curves of the drill path are designed so that the drill will pass beneath the railroad. The proposed work at this location must be constructed in accordance with the Article VII Certificate and associated EM&CP.

10.5.2 Ground Conditions

Three Geotechnical bores (K-221.8, B221.8-1, and KB-221.8B) are located along the proposed HDD #117 alignment. The other boring listed in *Appendix B* of the DSR (K-221.7) is located outside the extents of the HDD alignment and is provided as reference only for the geology in the area. The full details of these Geotechnical borings, including bore log and lab testing data, can be found in *Appendix B* of the DSR for segment 11 package 7A. After reviewing and comparing these samples, Geotechnical boring KB-221.8B was selected to be used in the BoreAid analysis as it best represented the complete soil strata for the HDD alignment and covered the full depth of the HDD profile. Consideration was taken for the other Geotechnical borings in the design of the HDD. Geotechnical boring KB-221.8B is located along the proposed HDD alignment at approximately station 70117+75. The surface elevation at the geotechnical bore was El. 101.0 feet and the total length of the bore was 82 feet. Based on the boring, the soil profile for the BoreAid analysis was divided into six (6) layers as listed out below in section 10.5.2.1. The soil profiles used for BoreAid analysis of the HDDs in this segment are shown in *Appendix A*.

10.5.2.1 Descriptions of the layers used for each HDD Crossing are summarized below:

- Layer 1 – Sand with Gravel (SP): The sand layer extends from the ground surface at approximate El. 101.0 to 99.0 feet. This layer consists of mostly gray, dry, sand with gravel fill material.
- Layer 2 – Clay (CL): The clay layer follows the fill from El. 99.0 to 97.0 feet. This layer consists of mostly gray, firm, dry clay.
- Layer 3 – Silt (ML): The next layer was silt with gravel from about El. 97.0 to 95.0 feet. This layer consists of brown to gray, soft, moist silt with medium sand to fine gravel.
- Layer 4 – Silt (ML): Another silt layer follows from about El. 95.0 to 66.0 feet. This layer consists of gray, moist, soft to very soft silt.
- Layer 5 – Silt (MH): The next layer was a silt from about El. 66.0 to 56.0 feet. This layer consists of gray, moist, very soft silt.

- Layer 6 – Silt (ML): The final layer that was present in this geotechnical sample was a silt layer that extends from El. 56.0 to 19.0 feet where the boring was terminated. This layer consists of mostly gray, moist, very soft silt.

10.5.3 Specific Design Considerations Include:

Preliminary analysis of the geotechnical bores, assuming typical drilling methods, indicates that the maximum allowable pressure capacity in the middle of the alignment is approximately 65 psi and the drill fluid pressure estimated to occur in the middle portion ranges from 20 to 30 psi. In the remaining section of the drill the maximum allowable pressure ranges from approximately 65 to 3 psi. The approximate minimum required drill fluid pressure needed to return cuttings ranges from 3 to 32 psi and the estimated operating drill fluid pressure can range from 4 to 41 psi. A sketch showing the maximum allowable pressure and the minimum required drill fluid pressure is provided in the BoreAid analyses in *Appendix A*.

The entry workspace has a designed width of 100 feet by 150 feet long and the exit workspace has a variable width. There is also a pit 5 feet wide by 10 feet long and 5 feet deep at the entry and exit of the drill to help contain the drilling fluid when actively drilling. An approximate 797 feet-long by 20 feet-wide pipe assembly corridor will be required on the exit side of the drill within the acquired easement. Erosion and sediment control measure will be available on site as listed in section 3.7 as added precaution and preventative measures.

It appears that there is a potential for releases at the entry and exit of the HDD. These should be relatively easily controlled through the use of conductor casing, haybales, silt fences, erosion control measures and vacuum trucks.

In our opinion the conditions conducive to inadvertent releases that may exist at this site based on the ground conditions described in the borings at the site include:

- The sand and gravel layer that is expected to be present at the entry and exit side of the drill. The results of the BoreAid analysis indicate the risk for a release due to this layer is low on the exit side. Utilizing a conductor/surface casing (installed along the entry/exit tangent), monitoring the drilling pressures, and minimizing the drill fluid pressures over the final 30-feet will limit the chance for an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release due to these layers are low.

- In the general area of the railroad the boring indicates that the drill will be in the predominantly silt layer, which combined with the depth of the drill and the results of the BoreAid analysis leads to our opinion that the risk for a release due to this condition is also low.

Additional design considerations and recommended IR preventative measures include:

- Drilling an 8in or larger diameter pilot hole is recommended to reduce the required drill fluid pressures *(Note: 8.75in diameter pilot hole was used in the BoreAid analysis)*
- Requiring monitoring and controlling drilling fluid pressures with downhole sensors during pilot hole and reaming operations.
- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures.
- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment.
- Increased monitoring and potential for reduced drill fluid pressures as the drill path approaches the Geotech bore locations. If a reduction in drill fluid pressures is noticed at a specific Geotech location that location can be proactively used as a strategic drill fluid containment relief well.
- If pressure is reaching the maximum allowable, the contractor can trip back as needed to clean the hole, before advancing the HDD.
- The contractor may elect to minimize drill fluid pressures as they approach the exit and/or push the drill bit over the final 30-feet.

10.6 HDD CROSSING #118

10.6.1 General Drill Crossing

HDD #118 consists of two compound (curves in plan view and profile) HDD drills, each drill is approximately 850 feet long as shown in Appendix B. Each drill will contain a 10" HDPE casing and one of the drills will be bundled with a 3" HDPE casing. The HDD drills will pass an approximate average depth of 37 feet below West Bridge St (Route 9W). The approximate center of the HDD drill under Route 9W is at latitude 42.214412N and longitude 73.883666W in Greene County, NY. The approximate ground surface elevation along the path of the HDD entry is El. 134 feet and then decreases slightly until it exits at El. 123 feet (reference datum NAVD

1988). The road is present between approximate station 70143+50 to station 70144+50 (at about El. 135 feet).

The horizontal curve (in the plan view) is required due to the project centerline alignment following the CSX Railroad and has been designed to avoid existing infrastructure as well as the Route 9W bridge. The vertical curves of the drill path are designed so that the drill will pass beneath Route 9W at an acceptable depth and the existing utilities with more than the minimum separation. The curves (horizontal and vertical) have been designed to be within acceptable stress parameters and verified in the BoreAid analysis. The proposed work at this location must be constructed in accordance with the Article VII Certificate and associated EM&CP.

10.6.2 Ground Conditions

Four Geotechnical bores (KB-222.2, K-222.3, B222.34-1, and K-222.4) are located along the proposed HDD #118 alignment. The full details of these Geotechnical borings, including bore log and lab testing data, can be found in *Appendix B* of the DSR for segment 11 package 7A. After reviewing and comparing these samples, geotechnical boring KB-222.2 was selected to be used in the BoreAid analysis as it best represented the complete soil strata for the HDD alignment and covered the full depth of the HDD profile. Consideration was taken for the other Geotechnical borings in the design of the HDD. The Soils Assistant was used in BoreAid to build the complete soil strata for HDD #118 as borings K-222.3 and K-222.4 displayed very similar soil layers as KB-222.2, but at differing depths. Geotechnical boring KB-222.2 is located along the proposed HDD alignment at approximate station 70137+50. The surface elevation at the geotechnical bore was 123.1 feet and the total length of the bore was 70 feet. Based on the boring, the soil profile for the BoreAid analysis was divided into four (4) layers as listed out below in section 10.6.2.1. The soil profiles used for BoreAid analysis of the HDDs in this segment are shown in *Appendix A*.

10.6.2.1 Descriptions of the layers used for each HDD Crossing are summarized below:

- Layer 1 – Silty Sand with Gravel (GW): The silty sand with gravel layer extends from the ground surface at approximately El. 123.1 to 120.1 feet. This layer consisted of silty sand with fine to course gravel fill.
- Layer 2 – Silt (MH): Immediately below the above layer was a brown firm to stiff silt at El. 120.1 to 102.1 feet.

- Layer 3 – Lean Clay (CL): Following the silt layer was a gray, firm to very soft, medium to high plasticity clay from approximately El. 102.1 to 74.1 feet.
- Layer 4 – Graywacke (Sedimentary Rock): The final layer that was present in this geotechnical sample was a Graywacke rock from El. 74.1 to 53.1 feet where the boring was terminated. This layer was gray in color, moderately weathered, very close to moderate fracture spacing with good Rock Quality Designation (RQD).

10.6.3 Specific Design Considerations Include:

Preliminary analysis of the geotechnical bores, assuming typical drilling methods, indicates that the maximum allowable pressure capacity in the middle of the alignment is approximately 897 psi and the drill fluid pressure estimated to occur in the middle portion ranges from 20 to 30 psi. In the remaining section of the drill the maximum allowable pressure ranges from approximately 897 to 22 psi. The approximate minimum required drill fluid pressure needed to return cuttings ranges from 3 to 35 psi and the estimated operating drill fluid pressure can range from 3 to 44 psi. A sketch showing the maximum allowable pressure and the minimum required drill fluid pressure is provided in the BoreAid analyses in *Appendix A*.

The entry and exit workspace have a designed width of 150 feet by 100 feet long. There is also a pit 5 feet wide by 10 feet long and 5 feet deep at the entry and exit of the drill to help contain the drilling fluid when actively drilling. An approximate 857 feet-long by 20 feet-wide pipe assembly corridor will be required on the exit side of the drill within the acquired easement. Erosion and sediment control measure will be available on site as listed in section 3.7 as added precaution and preventative measures.

It appears that there is a potential for releases at the exit of the HDD. This should be relatively easily controlled through the use of conductor casing, haybales, silt fences, erosion control measures and vacuum trucks.

In our opinion the conditions conducive to inadvertent releases that may exist at this site based on the ground conditions described in the borings at the site include:

- The gravel, silt, and clay layers that are expected to be present at the entry and exit side of the drill. The results of the BoreAid analysis indicate the risk for a release due to this layer is moderate on the exit side. Minimizing the drill fluid pressures and/or pushing the drill bit over the final 200-feet, monitoring the drilling pressures, and electing to utilize a surface/conductor casing (installed along the entry/exit tangent) will limit the chance for

an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release due to these layers are low.

- In the general area of the road the boring indicates that the drill will be in the sedimentary rock layer. We do not anticipate any IR issues within this layer due to the high RQD value of the rock layers. The results of the BoreAid analysis combined with the depth of the drill leads to our opinion that the risk for a release due to this layer is also low.

Additional design considerations and recommended IR preventative measures include:

- Drilling an 8in or larger diameter pilot hole is recommended to reduce the required drill fluid pressures *(Note: 8.75in diameter pilot hole was used in the BoreAid analysis)*
- Requiring monitoring and controlling drilling fluid pressures with downhole sensors during pilot hole and reaming operations.
- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures.
- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment.
- Increased monitoring and potential for reduced drill fluid pressures as the drill path approaches the Geotech bore locations. If a reduction in drill fluid pressures is noticed at a specific Geotech location that location can be proactively used as a strategic drill fluid containment relief well.
- If pressure is reaching the maximum allowable, the contractor can trip back as needed to clean the hole, before advancing the HDD.

10.7 HDD CROSSING #119

10.7.1 General Drill Crossing

HDD #119 consists of two straight (in plan view) HDD drills, each drill is approximately 840 feet long as shown in Appendix B. Each drill will contain a 8" FPVC casing and one of the drills will be bundled with a 3" HDPE casing. The HDD drills will pass an approximately average depth of 35 feet below a wetland and drainage channels in Greene County, NY. The approximate ground surface elevation along the path of the HDD entry is 94.5 feet and then increases slightly until it exits at an elevation to 116 feet (reference datum NAVD 1988).

The drills have no designed horizontal curve (in the plan view). The vertical curves of the drill path are designed so that the drill will pass beneath the wetland and drainage channels. The proposed work at this location must be constructed in accordance with the Article VII Certificate and associated EM&CP.

10.7.2 Ground Conditions

Two Geotechnical bores (K-222.7 & KB-222.8) are located along the proposed HDD #119 alignment. The other borings listed in *Appendix B* of the DSR (B222.6-1, KB-222.6A and K-222.6) are located outside the extents of the HDD alignment and are provided as reference only for the geology in the area. The full details of these Geotechnical borings, including bore log and lab testing data, can be found in *Appendix B* of the DSR for segment 11 package 7A. After reviewing and comparing these samples, geotechnical boring KB-222.8 was selected to be used in the BoreAid analysis as it best represented the complete soil strata for the HDD alignment and covered the full depth of the HDD profile. Consideration was taken for the other Geotechnical boring in the design of the HDD. Geotechnical boring KB-222.8 is located along the proposed HDD alignment at approximately station 70167+75. The surface elevation at the geotechnical bore was 117.2 feet and the total length of the bore was 90 feet. Based on the boring, the soil profile for the BoreAid analysis was divided into six (6) layers as listed out below in section 10.7.2.1. The soil profiles used for BoreAid analysis of the HDDs in this segment are shown in *Appendix A*.

10.7.2.1 Descriptions of the layers used for each HDD Crossing are summarized below:

- Layer 1 – Clay (CL): The initial clay layer extends from the ground surface at approximately El. 117.2 to 115.2 feet. This layer was brown, soft, and moist.
- Layer 2 – Silt (MH): Immediately below the above layer was a moist, brown, very stiff silt at El. 115.2 to 102.2 feet.
- Layer 3 – Clay (CH): Following the silt layer was a brown, very soft to firm, moist clay from approximately El. 102.2 to 72.2 feet.
- Layer 4 – Silt (ML): The next layer was a gray, moist, very soft silt from about El. 72.2 to 52.2 feet.
- Layer 5 – Silt (MH): Another silt layer follows from about El. 52.2 to 31.2 feet. This layer consisted of gray, moist, very soft silt.

- Layer 6 – Clay (CL): The final layer that was present in this geotechnical sample was a gray, hard, moist clay with rock fragments (glacial till) from El. 31.2 to 27.2 feet where the boring was terminated.

10.7.3 Specific Design Considerations Include:

Preliminary analysis of the geotechnical bores, assuming typical drilling methods, indicates that the maximum allowable pressure capacity in the middle of the alignment is approximately 88 psi and the drill fluid pressure estimated to occur in the middle portion ranges from 50 to 55 psi. In the remaining section of the drill the maximum allowable pressure ranges from approximately 88 to 9 psi. The approximate minimum required drill fluid pressure needed to return cuttings ranges from 14 to 55 psi and the estimated operating drill fluid pressure can range from 18 to 69 psi. A sketch showing the maximum allowable pressure and the minimum required drill fluid pressure is provided in the BoreAid analyses in *Appendix A*.

The entry workspace has a designed width of 100 feet by 150 feet long and the exit workspace has been designed width of 100 feet by 150 feet long. There is also a pit 5 feet wide by 10 feet long and 5 feet deep at the entry and exit of the drill to help contain the drilling fluid when actively drilling. An approximate 851 feet-long by 20 feet-wide pipe assembly corridor will be required on the exit side of the drill within the acquired easement. Erosion and sediment control measure will be available on site as listed in section 3.7 as added precaution and preventative measures.

It appears that there is a potential for releases at the entry and exit of the HDD. These should be relatively easily controlled through the use of conductor casing, haybales, silt fences, erosion control measures and vacuum trucks.

In our opinion the conditions conducive to inadvertent releases that may exist at this site based on the ground conditions described in the borings at the site include:

- The clay layers that are expected to be present at the entry and exit side of the drill. The results of the BoreAid analysis indicate the risk for a release due to this layer is low on the exit side. Utilizing a conductor/surface casing (installed along the entry/exit tangent), monitoring the drilling pressures, and minimizing the drill fluid pressures over the final 70-feet will limit the chance for an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release due to these layers are low.

- In the general area of the drainage channel (Sta. 70166+00) the boring indicates that the drill will be in the silt layer, which combined with the depth of the drill and the results of the BoreAid analysis leads to our opinion that the risk for a release due to this condition is also low. Please note that the maximum allowable soil formation pressure is close to the minimum required drill fluid circulation pressure at this location. Minimizing the drill fluid pressures in this area and monitoring the drilling pressures will limit the chance for an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release in the area of the drainage channel will remain low.

Additional design considerations and recommended IR preventative measures include:

- Drilling an 8in or larger diameter pilot hole is recommended to reduce the required drill fluid pressures *(Note: 8.75in diameter pilot hole was used in the BoreAid analysis)*
- Requiring monitoring and controlling drilling fluid pressures with downhole sensors during pilot hole and reaming operations.
- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures.
- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment.
- Increased monitoring and potential for reduced drill fluid pressures as the drill path approaches the Geotech bore locations. If a reduction in drill fluid pressures is noticed at a specific Geotech location that location can be proactively used as a strategic drill fluid containment relief well.
- If pressure is reaching the maximum allowable, the contractor can trip back as needed to clean the hole, before advancing the HDD.
- The contractor may elect to minimize drill fluid pressures as they approach the exit and/or push the drill bit over the final 70-feet.

10.8 HDD CROSSING #120

10.8.1 General Drill Crossing

HDD #120 consists of two straight (in plan view) HDD drills, each drill is approximately 1,470 feet long as shown in Appendix B. Each drill will contain a 8" FPVC casing and one of the drills will be bundled with a 3" HDPE casing. The HDD drills will pass an approximate average depth

of 40 feet below two drainage channels. The approximate center of the HDD drill under the first drainage channel is at latitude 42.207218N and longitude 73.890447W and the second drainage channel at latitude 42.205665N and longitude 73.891841W in Greene County, NY. The approximate ground surface elevation along the path of the HDD entry is El. 120 feet and then varies in topography until it exits at El. 122 feet (reference datum NAVD 1988). The drainage channels are present at approximately station 70176+00 and station 70183+00 respectively (at about El. 86 feet and El. 100 feet).

The drills have no designed horizontal curve (in the plan view). The vertical curves of the drill path are designed so that the drill will pass beneath the drainage channels. The proposed work at this location must be constructed in accordance with the Article VII Certificate and associated EM&CP.

10.8.2 Ground Conditions

Four Geotechnical bores (B222.9-1, K-223.0, KB-223.1A, and K-223.1) are located along the proposed HDD #120 alignment. The full details of these Geotechnical borings, including bore log and lab testing data, can be found in *Appendix B* of the DSR for segment 11 package 7A. After reviewing and comparing these samples, geotechnical boring KB-223.1A was selected to be used in the BoreAid analysis as it best represented the complete soil strata for the HDD alignment covered the full depth of the HDD profile. Consideration was taken for the other Geotechnical borings in the design of the HDD. Geotechnical boring KB-223.1A is located along the proposed HDD alignment at approximate station 70181+00. The surface elevation at the geotechnical bore was El. 114.7 feet and the total length of the bore was 85 feet. Based on the boring, the soil profile for the BoreAid analysis was divided into five (5) layers as listed out below in section 10.8.2.1. The soil profiles used for BoreAid analysis of the HDDs in this segment are shown in *Appendix A*.

10.8.2.1 Descriptions of the layers used for each HDD Crossing are summarized below:

- Layer 1 – Fat Clay (CH): The clay layer extends from the ground surface at approximately El. 114.7 to 89.2 feet. This layer was light brown, soft to very stiff, and moist.
- Layer 2 – Silt (MH): Following the clay layer was a moist, gray, firm to soft silt layer that was present from about El. 89.2 to 69.7 feet.

- Layer 3 – Lean Clay (CL): Following the silt layer was a gray, stiff, wet clay that was present from about El. 69.7 to 67.7 feet.
- Layer 4 – Weathered Rock (Sedimentary Rock): The next layer was a weathered rock present from El. 67.7 to 57.2 feet.
- Layer 3 – Graywacke (Sedimentary Rock): The last layer of the sample was gray, hard, unweathered rock with fair to good Rock Quality Designation (RQD). This layer was present from about El. 57.2 feet until it terminated at El. 29.7 feet.

10.8.3 Specific Design Considerations Include:

Preliminary analysis of the geotechnical bores, assuming typical drilling methods, indicates that the maximum allowable pressure capacity in the middle of the alignment is approximately 1141 psi and the drill fluid pressure estimated to occur in the middle portion ranges from 50 to 70 psi. In the remaining section of the drill the maximum allowable pressure ranges from approximately 1141 to 32 psi. The approximate minimum required drill fluid pressure needed to return cuttings ranges from 5 to 71 psi and the estimated operating drill fluid pressure can range from 6 to 89 psi. A sketch showing the maximum allowable pressure and the minimum required drill fluid pressure is provided in the BoreAid analyses in *Appendix A*.

The entry workspace has a designed width of 100 feet by 150 feet long and the exit workspace has been designed width of 100 feet by 150 feet long. There is also a pit 5 feet wide by 10 feet long and 5 feet deep at the entry and exit of the drill to help contain the drilling fluid when actively drilling. An approximate 1485 feet-long by 20 feet-wide pipe assembly corridor will be required on the exit side of the drill within the acquired easement. Erosion and sediment control measure will be available on site as listed in section 3.7 as added precaution and preventative measures.

It appears that there is a potential for releases at the entry and exit of the HDD. These should be relatively easily controlled through the use of conductor casing, haybales, silt fences, erosion control measures and vacuum trucks.

In our opinion the conditions conducive to inadvertent releases that may exist at this site based on the ground conditions described in the borings at the site include:

- The clay layer that is expected to be present at the entry and exit side of the drill. The results of the BoreAid analysis indicate the risk for a release due to this layer is moderate

on the exit side. Minimizing the drill fluid pressures and/or pushing the drill bit over the final 250-feet, monitoring the drilling pressures, and utilizing a surface/conductor casing (installed along the entry/exit tangent) will limit the chance for an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release due to these layers are low.

- In the general area of the culvert, it is assumed the drill will be in the sedimentary rock layer, which combined with the depth of the drill and the results of the BoreAid analysis leads to our opinion that the risk for a release due to this condition is also low.

Additional design considerations and recommended IR preventative measures include:

- Drilling an 8in or larger diameter pilot hole is recommended to reduce the required drill fluid pressures *(Note: 8in diameter pilot hole was used in the BoreAid analysis)*
- Requiring monitoring and controlling drilling fluid pressures with downhole sensors during pilot hole and reaming operations.
- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures.
- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment.
- Increased monitoring and potential for reduced drill fluid pressures as the drill path approaches the Geotech bore locations. If a reduction in drill fluid pressures is noticed at a specific Geotech location that location can be proactively used as a strategic drill fluid containment relief well.
- If pressure is reaching the maximum allowable, the contractor can trip back as needed to clean the hole, before advancing the HDD.

10.9 HDD CROSSING #121

10.9.1 General Drill Crossing

HDD #121 consists of two compound (curves in plan view and profile) HDD drills, each drill is approximately 1,740 feet long as shown in Appendix B. Each drill will contain a 8" FPVC casing and one of the drills will be bundled with a 3" HDPE casing. On average, the HDD's will pass approximately 40 feet below a creek / stone box culvert. The approximate ground surface elevation along the path of the HDD entry is El. 96 feet and then varies in topography until it

exits at El. 91 feet (reference datum NAVD 1988). The stream / stone box culvert is present between approximate station 70323+00 to station 70324+00 respectively (at about El. 60 feet).

The horizontal curve (in the plan view) is required due to the project centerline alignment. The vertical curves of the drill path are designed so that the drill will pass beneath the wetlands, access road, and steep topography. The curves (horizontal and vertical) have been designed to be within acceptable stress parameters and verified in the BoreAid analysis. The proposed work at this location must be constructed in accordance with the Article VII Certificate and associated EM&CP.

10.9.2 Ground Conditions

One Geotechnical bore (CU-5) is located along the proposed HDD #121 alignment. The other borings listed in *Appendix B* of the DSR (B225.8-1 & K-225.9) are located outside the extents of the HDD alignment and are provided as reference only for the geology in the area. The full details of these Geotechnical borings, including bore log and lab testing data, can be found in *Appendix B* of the DSR for segment 11 package 7A. At this time there are two additional planned Geotechnical borings (KB-225.6 & KB-225.8) that will be completed once landowner access permissions have been granted. After reviewing and comparing these samples, geotechnical boring K-225.9 was selected to be used in the BoreAid analysis as it best represented the complete soil strata for the HDD alignment. Consideration was taken for the other geotechnical borings in the design of the HDD. Geotechnical boring K-225.9 is located at the south end of the drill location at approximately station 70332+00. The surface elevation at the geotechnical bore was El. 97.9 feet and the total length of the bore was 45 feet. Based on the boring, the soil profile for the BoreAid analysis was divided into nine (9) layers as listed out below in section 10.9.2.1. The soil profiles used for BoreAid analysis of the HDDs in this segment are shown in *Appendix A*.

10.9.2.1 Descriptions of the layers used for each HDD Crossing are summarized below:

- Layer 1 – Gravel (GM): The silty gravel layer extends from the ground surface at approximately El. 97.9 to 95.9 feet. The layer consists of moist gray, medium to coarse, dense silty gravel.
- Layer 2 – Clay (CL): After the gravel layer a clay layer was present from El. 95.9 to 93.9 feet. The layer was moist, brown, and hard with silty gravel present.

- Layer 3 – Silt (ML): Following the clay layer is a gray silt layer from El. 93.9 to 89.9 feet. This layer consists of silt with fine to medium gravel, and coarse sand.
- Layer 4 – Silt (ML): Following the silt layer is another silt layer from El. 89.9 to 87.9 feet. This layer consists of gray silt with sand and clay. A thin organic layer was found in the middle of this layer.
- Layer 5 – Clay (CH): Following the silt layer is a brown, stiff, wet, clay layer from El. 87.9 to 82.9 feet.
- Layer 6 – Clay (CH): Another clay layer is present from El. 82.9 to 72.9 feet. This layer consists of light brown, stiff to firm, and moist to dry clay with gray seams.
- Layer 7 – Clay (CL): Following the stiff clay layer is a soft clay layer from El. 72.9 to 67.9 feet. This layer consists of moist light brown, firm to soft, clay with gray seams.
- Layer 8 – Clay (CH): A final clay layer is present from El. 67.9 to 52.9 feet. This layer consists of moist gray, soft to firm clay.
- Layer 9 – Sedimentary Rock: The chosen test bore did not reach the full depth of the drill path; however, the next closest test bore KB-226.1 (from HDD #122) supported that a rock layer continued below the Clay layers. Thus, a final layer of Sedimentary Rock was added to complete the soil strata used in the IR analysis.

10.9.3 Specific Design Considerations Include:

Preliminary analysis of the geotechnical bores, assuming typical drilling methods, indicates that the maximum allowable pressure capacity in the middle of the alignment is approximately 1178 psi and the drill fluid pressure estimated to occur in the middle portion ranges from 40 to 55 psi. In the remaining section of the drill the maximum allowable pressure ranges from approximately 1178 to 16 psi. The approximate minimum required drill fluid pressure needed to return cuttings ranges from 2 to 66 psi and the estimated operating drill fluid pressure can range from 3 to 82 psi. A sketch showing the maximum allowable pressure and the minimum required drill fluid pressure is provided in the BoreAid analyses in *Appendix A*.

The entry workspace has a designed width of 100 feet by 150 feet long and the exit workspace has a variable width. There is also a pit 5 feet wide by 10 feet long and 5 feet deep at the entry and exit of the drill to help contain the drilling fluid when actively drilling. An approximate 1755 feet-long by 20 feet-wide pipe assembly corridor will be required on the exit side of the drill within the acquired easement. Erosion and sediment control measure will be available on site as listed in section 3.7 as added precaution and preventative measures.

It appears that there is a potential for releases at the exit of the HDD. This should be relatively easily controlled through the use of conductor casing, haybales, silt fences, erosion control measures and vacuum trucks.

In our opinion the conditions conducive to inadvertent releases that may exist at this site based on the ground conditions described in the borings at the site include:

- The silt and clay layer that is expected to be present at the entry and exit side of the drill. The results of the BoreAid analysis indicate the risk for a release due to this layer is low on the exit side. Minimizing the drill fluid pressures and/or pushing the drill bit over the final 100-feet, monitoring the drilling pressures, and utilizing a surface/conductor casing (installed along the entry/exit tangent) will limit the chance for an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release due to these layers are low.

Additional design considerations and recommended IR preventative measures include:

- Drilling an 8in or larger diameter pilot hole is recommended to reduce the required drill fluid pressures *(Note: 8.75in diameter pilot hole was used in the BoreAid analysis)*
- Requiring monitoring and controlling drilling fluid pressures with downhole sensors during pilot hole and reaming operations.
- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures.
- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment.
- Increased monitoring and potential for reduced drill fluid pressures as the drill path approaches the Geotech bore locations. If a reduction in drill fluid pressures is noticed at a specific Geotech location that location can be proactively used as a strategic drill fluid containment relief well.
- If pressure is reaching the maximum allowable, the contractor can trip back as needed to clean the hole, before advancing the HDD.

10.10 HDD CROSSING #122

10.10.1 General Drill Crossing

HDD #122 consists of two straight (in plan view) HDD drills, each drill is approximately 1,100 feet long as shown in Appendix B. Each drill will contain a 10" HDPE casing and one of the drills will be bundled with a 3" HDPE casing. The HDD drills will pass an approximate average depth of 55 feet below a series of out-of-service railroad tracks. The approximate center of the HDD drill under the railroad tracks is at latitude 42.165754N and longitude 73.916281W in Greene County, NY. The approximate ground surface elevation along the path of the HDD entry is El. 91 feet and then increases slightly until it exits at El. 106 feet (reference datum NAVD 1988). The railroad track is present between approximately station 70342+00 and station 70346+00 (at about El. 109 feet).

The drills have no designed horizontal curve (in the plan view). The vertical curves of the drill path are designed so that the drill will pass beneath the railroad tracks. The proposed work at this location must be constructed in accordance with the Article VII Certificate and associated EM&CP.

10.10.2 Ground Conditions

Five Geotechnical bores (KB-226.1, B226.1-1, B226.2-1, K-226.2A, and K-226.2B) are located along the proposed HDD #122 alignment. The full details of these Geotechnical borings, including bore log and lab testing data, can be found in *Appendix B* of the DSR for segment 11 package 7A. After reviewing and comparing these samples, geotechnical boring KB-226.1 was selected to be used in the BoreAid analysis as it best represented the complete soil strata for the HDD alignment and covered the full depth of the HDD profile. Consideration was taken for the other Geotechnical borings in the design of the HDD. Geotechnical boring KB-226.1 is located along the proposed HDD alignment at approximately station 70343+50. The surface elevation at the geotechnical bore was El. 107.9 feet and the total length of the bore was 60 feet. Based on the boring, the soil profile for the BoreAid analysis was divided into three (3) layers as listed out below in section 10.10.2.1. The soil profiles used for BoreAid analysis of the HDDs in this segment are shown in *Appendix A*.

10.10.2.1 Descriptions of the layers used for each HDD Crossing are summarized below:

- Layer 1 – Silt (MH): The silt layer extends from the ground surface at approximate El. 107.8 to 92.8 feet. This layer was moist, light brown, gray, and very stiff to stiff.
- Layer 2 – Fat Clay (CH): Following the silt layer was a moist, gray, stiff, clay that was present from about El. 92.8 to 70.4 feet.
- Layer 3 – Graywacke (Sedimentary Rock): The last layer of the sample was dark gray, very strong, slightly weathered rock with excellent Rock Quality Designation (RQD). This layer was present from about elevation 70.4 feet until it terminated at 47.8 feet.

10.10.3 Specific Design Considerations Include:

Preliminary analysis of the geotechnical bores, assuming typical drilling methods, indicates that the maximum allowable pressure capacity in the middle of the alignment is approximately 723 psi and the drill fluid pressure estimated to occur in the middle portion ranges from 35 to 45 psi. In the remaining section of the drill the maximum allowable pressure ranges from approximately 723 to 17 psi. The approximate minimum required drill fluid pressure needed to return cuttings ranges from 10 to 51 psi and the estimated operating drill fluid pressure can range from 13 to 64 psi. A sketch showing the maximum allowable pressure and the minimum required drill fluid pressure is provided in the BoreAid analyses in *Appendix A*.

The entry workspace has a designed width of 100 feet by 150 feet long and the exit workspace has a variable width. There is also a pit 5 feet wide by 10 feet long and 5 feet deep at the entry and exit of the drill to help contain the drilling fluid when actively drilling. An approximate 1107 feet-long by 20 feet-wide pipe assembly corridor will be required on the exit side of the drill within the acquired easement. Erosion and sediment control measure will be available on site as listed in section 3.7 as added precaution and preventative measures.

It appears that there is a potential for releases at the entry and exit of the HDD. These should be relatively easily controlled through the use of conductor casing, haybales, silt fences, erosion control measures and vacuum trucks.

In our opinion the conditions conducive to inadvertent releases that may exist at this site based on the ground conditions described in the borings at the site include:

- The silt and clay layer that is expected to be present at the entry and exit side of the drill. The results of the BoreAid analysis indicate the risk for a release due to this layer is

moderate on the exit side. Minimizing the drill fluid pressures and/or pushing the drill bit over the final 200-feet, monitoring the drilling pressures, and utilizing a surface/conductor casing (installed along the entry/exit tangent) will limit the chance for an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release due to these layers are low.

- In the general area of the railroad and road the boring indicates that the drill will be in the sedimentary rock layer, which combined with the depth of the drill and the results of the BoreAid analysis leads to our opinion that the risk for a release due to this condition is also low.

Additional design considerations and recommended IR preventative measures include:

- Drilling an 8in or larger diameter pilot hole is recommended to reduce the required drill fluid pressures *(Note: 8.75in diameter pilot hole was used in the BoreAid analysis)*
- Requiring monitoring and controlling drilling fluid pressures with downhole sensors during pilot hole and reaming operations.
- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures.
- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment.
- Increased monitoring and potential for reduced drill fluid pressures as the drill path approaches the Geotech bore locations. If a reduction in drill fluid pressures is noticed at a specific Geotech location that location can be proactively used as a strategic drill fluid containment relief well.
- If pressure is reaching the maximum allowable, the contractor can trip back as needed to clean the hole, before advancing the HDD.

10.11 HDD CROSSING #123

10.11.1 General Drill Crossing

HDD #123 consists of two straight (in plan view) HDD drills, each drill is approximately 850 feet long as shown in Appendix B. Each drill will contain a 10" HDPE casing and one of the drills will be bundled with a 3" HDPE casing. The HDD drills will pass an approximate average depth of 42 feet below a structure. The approximate center of the HDD drill under the structure

is at latitude 42.157403N and longitude 73.919075W in Greene County, NY. The approximate ground surface elevation along the path of the HDD entry is El. 108.4 feet and then increases slightly until it exits at El. 113.1 feet (reference datum NAVD 1988). The structure is present at approximate station 70377+00.

The drills have no designed horizontal curve (in the plan view). The vertical curves of the drill path are designed so that the drill will pass beneath the structure. The proposed work at this location must be constructed in accordance with the Article VII Certificate and associated EM&CP.

10.11.2 Ground Conditions

Three Geotechnical bores (B226.6-1, K-226.7, and KB-226.8A) are located along the proposed HDD #123 alignment. The other borings listed in *Appendix B* of the DSR (CU-5A, K-226.8, and K-227.0) are located outside the extents of the HDD alignment and are provided as reference only for the geology in the area. The full details of these Geotechnical borings, including bore log and lab testing data, can be found in *Appendix B* of the DSR for segment 11 package 7A. After reviewing and comparing these samples, geotechnical boring KB-226.8A was selected to be used in the BoreAid analysis as it best represented the complete soil strata for the HDD alignment and covered the full depth of the HDD profile. Consideration was taken for the other Geotechnical borings in the design of the HDD. Geotechnical boring KB-226.8A is located along the proposed HDD alignment at approximate station 70379+00. The surface elevation at the geotechnical bore was El. 108.9 feet and the total length of the bore was 60 feet. Based on the boring, the soil profile for the BoreAid analysis was divided into five (5) layers as listed out below in section 10.11.2.1. The soil profiles used for BoreAid analysis of the HDDs in this segment are shown in *Appendix A*.

10.11.2.1 Descriptions of the layers used for each HDD Crossing are summarized below:

- Layer 1 – Silty Gravel (GM): The silty gravel layer extends from the ground surface at approximate El. 108.9 to 105.9 feet. This layer consisted of dark gray, fine to course, subangular to subrounded, loose silt with railroad ballast.
- Layer 2 – Silty Clay (CL): The next layer was from about El. 105.9 to 104.9 feet. It consisted of firm, light gray silty clay.

- Layer 3 – Silt (MH): Following the silty clay layer was an olive brown and gray, very stiff to firm silt layer that was present from about El. 104.9 to 93.9 feet. This layer also contained a 2in gravel seam at a depth of 11 feet into the boring.
- Layer 4 – Clay (CH): The next layer in the bore was clay from about El. 93.9 to 83.9 feet. It was dark gray and stiff with medium to high plasticity.
- Layer 5 – Silt (MH): The last layer of the sample was a dark gray, very soft, and moist silt. This layer was present from about El. 83.9 feet until it terminated at El. 48.9 feet.

10.11.3 Specific Design Considerations Include:

Preliminary analysis of the geotechnical bores, assuming typical drilling methods, indicates that the maximum allowable pressure capacity in the middle of the alignment is approximately 55 psi and the drill fluid pressure estimated to occur in the middle portion ranges from 30 to 37 psi. In the remaining section of the drill the maximum allowable pressure ranges from approximately 55 to 9 psi. The approximate minimum required drill fluid pressure needed to return cuttings ranges from 6 to 37 psi and the estimated operating drill fluid pressure can range from 7 to 47 psi. A sketch showing the maximum allowable pressure and the minimum required drill fluid pressure is provided in the BoreAid analyses in *Appendix A*.

The entry workspace has a designed width of 100 feet by 150 feet long and the exit workspace has been designed width of 100 feet by 150 feet long. There is also a pit 5 feet wide by 10 feet long and 5 feet deep at the entry and exit of the drill to help contain the drilling fluid when actively drilling. An approximate 857 feet-long by 20 feet-wide pipe assembly corridor will be required on the exit side of the drill within the acquired easement. Erosion and sediment control measure will be available on site as listed in section 3.7 as added precaution and preventative measures.

It appears that there is a potential for releases at the entry and exit of the HDD. These should be relatively easily controlled through the use of conductor casing, haybales, silt fences, erosion control measures and vacuum trucks.

In our opinion the conditions conducive to inadvertent releases that may exist at this site based on the ground conditions described in the borings at the site include:

- The silt and clay layer that is expected to be present at the entry and exit side of the drill. The results of the BoreAid analysis indicate the risk for a release due to this layer is low

on the exit side. Utilizing a conductor/surface casing (installed along the entry/exit tangent), monitoring the drilling pressures, and minimizing the drill fluid pressures over the final 60-feet will limit the chance for an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release due to these layers are low.

- In the general area of the structure the boring indicates that the drill will be in the silt layer combined with the length of the drill and the results of the BoreAid analysis leads to our opinion that the risk for a release due to this condition is also low.

Additional design considerations and recommended IR preventative measures include:

- Drilling an 8in or larger diameter pilot hole is recommended to reduce the required drill fluid pressures *(Note: 8.75in diameter pilot hole was used in the BoreAid analysis)*
- Requiring monitoring and controlling drilling fluid pressures with downhole sensors during pilot hole and reaming operations.
- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures.
- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment.
- Increased monitoring and potential for reduced drill fluid pressures as the drill path approaches the Geotech bore locations. If a reduction in drill fluid pressures is noticed at a specific Geotech location that location can be proactively used as a strategic drill fluid containment relief well.
- If pressure is reaching the maximum allowable, the contractor can trip back as needed to clean the hole, before advancing the HDD.
- The contractor may elect to minimize drill fluid pressures as they approach the exit and/or push the drill bit over the final 60-feet.

Appendix A

BoreAid HDD Simulation Output

Generated Output

WARNING: The accuracy of the data obtained by the BoreAid® system is highly dependent upon accurate data gathering, data input and proper use of the software. Vermeer is not responsible for that information. BoreAid® data is not intended to replace the need for future on-site utility locating, measuring and verification procedures, which are essential for accurate placement of new underground installations and avoidance of existing utilities.

CALL YOUR ONE-CALL SYSTEM FIRST

WARNING: Always contact your local One-Call system before the start of your digging project. The BoreAid® system is intended to be used with other utility locating methods, such as the use of the One-Call system and the exposing of existing utilities by potholing.

Locate utilities before drilling. Call 811 (U.S. only) or 1-888-258-0808 (U.S. or Canada) or local utility companies or national regulating authority.

Before you start any digging project, do not forget to call the local One-Call system in your area and any utility company that does not subscribe to the One-Call system. For areas not represented by One-Call Systems International, contact the appropriate utility companies or national regulating authority to locate and mark the underground installations. If you do not call, you may have an accident or suffer injuries; cause interruption of services; damage the environment; or experience job delays.

OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning the excavation or underground drilling operation. When the actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If the utility cannot be precisely located, it must be shut off by the utility company.

Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 1 HDD 111.B DWG C-311.B

Input Summary

Start Coordinate	(0.00, 0.00, 112.32) ft
End Coordinate	(765.00, 0.00, 120.00) ft
Project Length	765.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

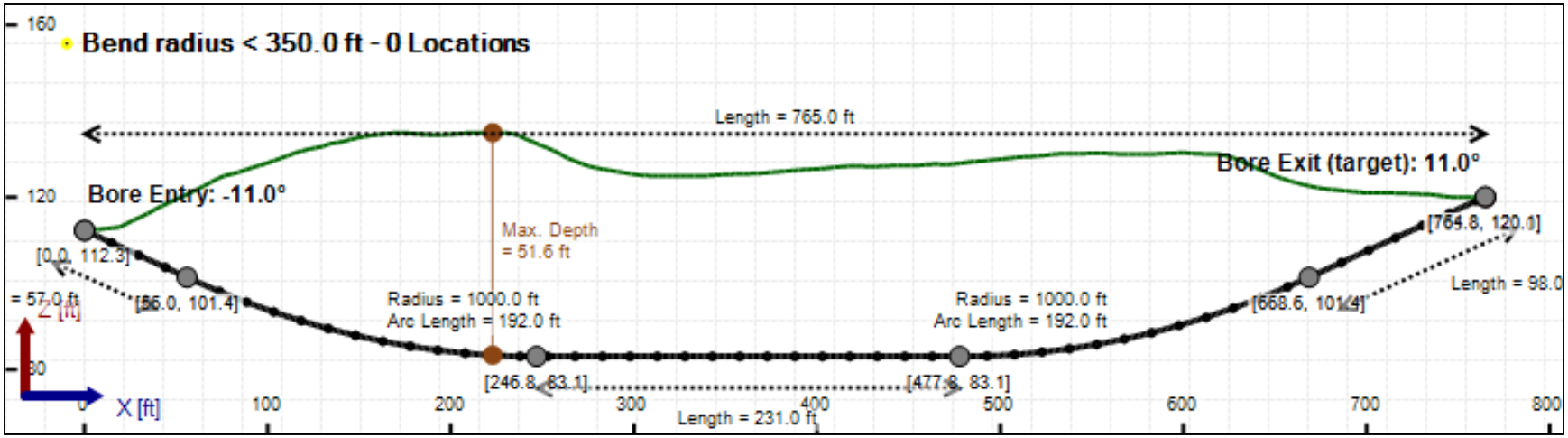
Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SM
Depth: 4.00 ft
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

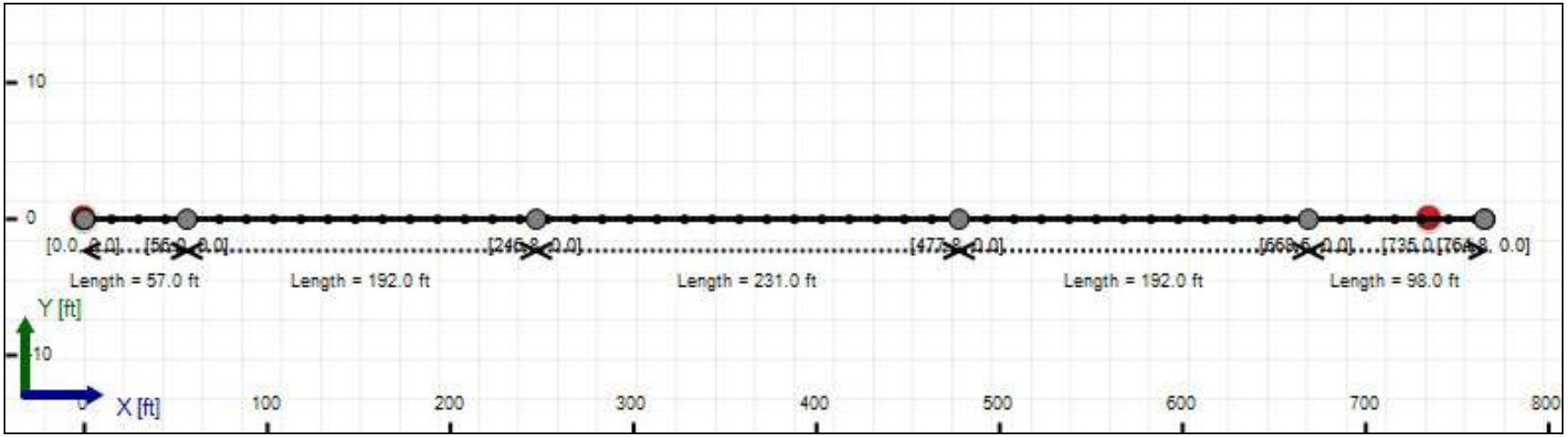
Soil Layer #2 USCS, Gravel (G), GM
Depth: 11.00 ft
Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks
Depth: 65.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 780.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	6.2	41.9
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	6.2	41.9
Deflection		
Earth Load Deflection	1.701	11.401
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.833	11.533
Compressive Stress [psi]		
Compressive Wall Stress	28.1	188.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	13656.8	13656.8
Pullback Stress [psi]	380.9	380.9
Pullback Strain	6.624E-3	6.624E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	380.9	406.2
Tensile Strain	6.624E-3	7.512E-3

Net External Pressure = 21.9 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.833	7.5	4.1	OK
Unconstrained Collapse [psi]	25.4	117.3	4.6	OK
Compressive Wall Stress [psi]	28.1	1150.0	40.9	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	35.3	233.1	6.6	OK
Tensile Stress [psi]	406.2	1200.0	3.0	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	591.142 psi	1337.413 psi
1	8.75 in	12.00 in	591.064 psi	1337.294 psi
2	12.00 in	16.13 in	590.930 psi	1337.088 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

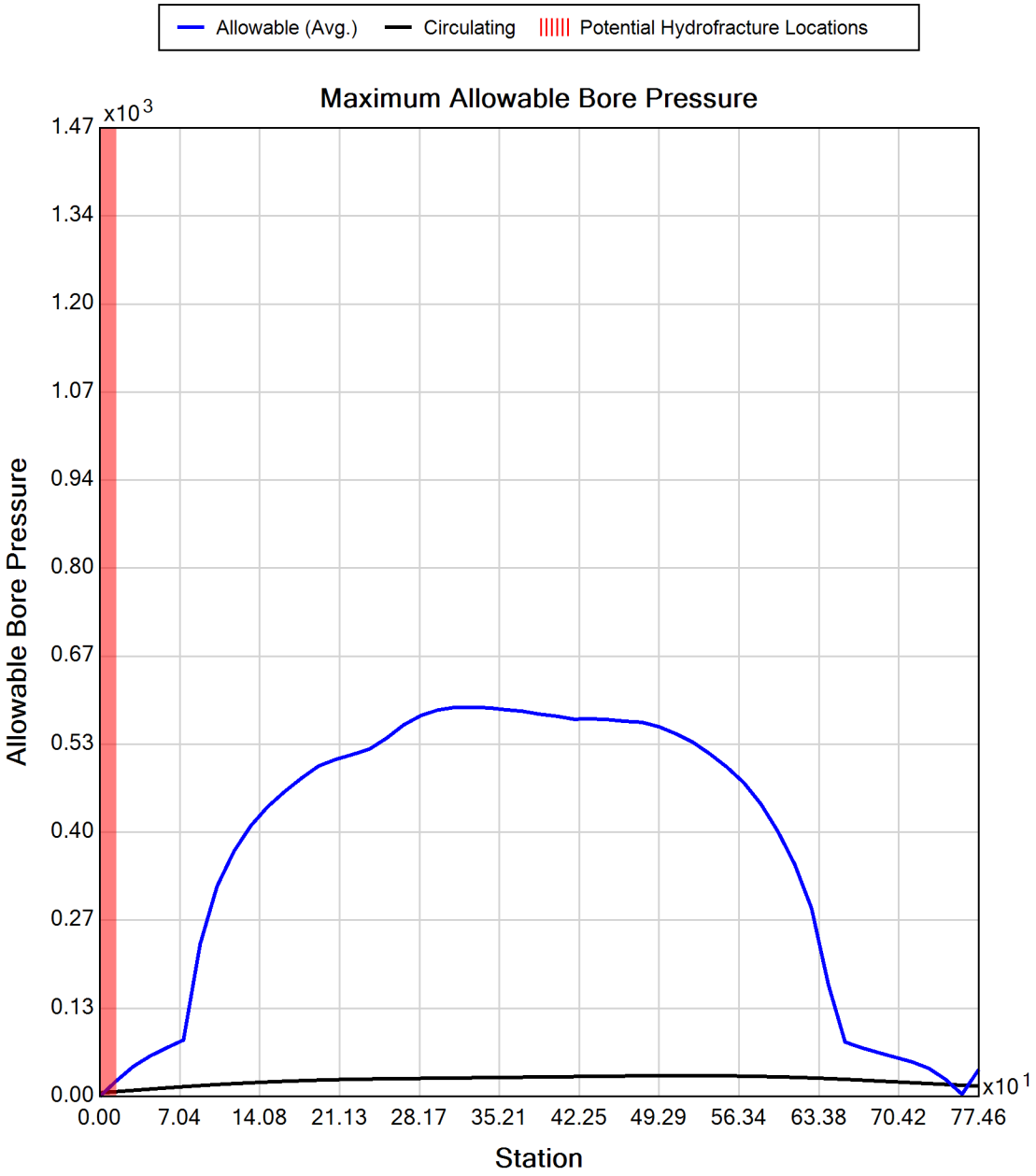
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



Generated Output

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Before you start any digging project, do not forget to call the local One-Call system in your area and any utility company that does not subscribe to the One-Call system. For areas not represented by One-Call Systems International, contact the appropriate utility companies or national regulating authority to locate and mark the underground installations. If you do not call, you may have an accident or suffer injuries; cause interruption of services; damage the environment; or experience job delays.

OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning the excavation or underground drilling operation. When the actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If the utility cannot be precisely located, it must be shut off by the utility company.

Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 HDD 111.B DWG C-311.B.2

Input Summary

Start Coordinate	(0.00, 0.00, 113.48) ft
End Coordinate	(765.00, 0.00, 120.84) ft
Project Length	765.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

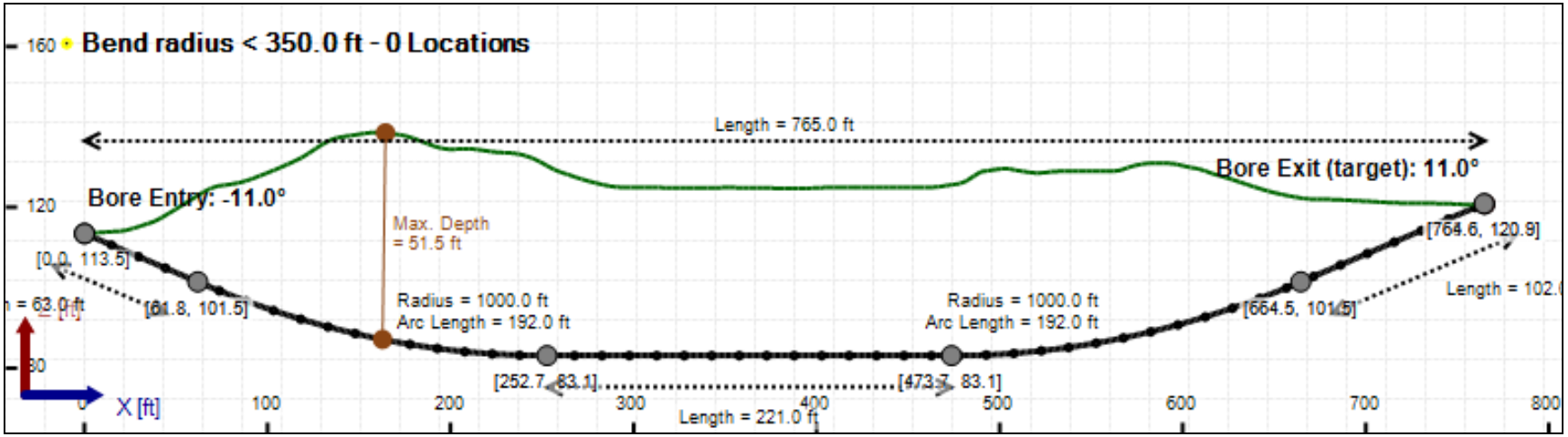
Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SM
Depth: 4.00 ft
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

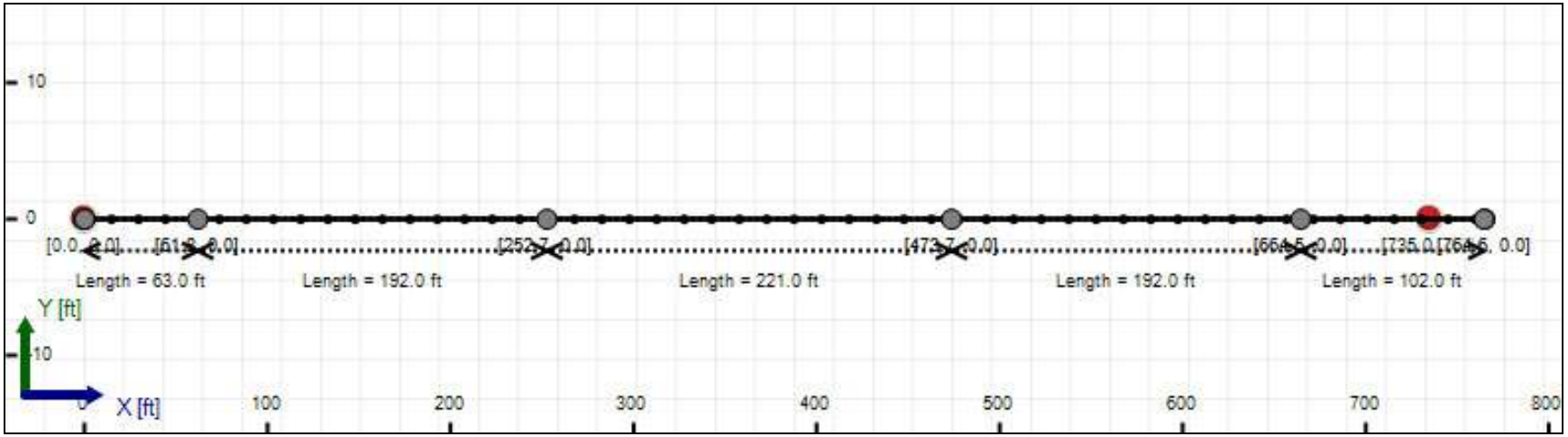
Soil Layer #2 USCS, Gravel (G), GM
Depth: 11.00 ft
Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks
Depth: 65.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 780.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	6.2	42.0
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	6.2	42.0
Deflection		
Earth Load Deflection	1.699	11.425
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.831	11.557
Compressive Stress [psi]		
Compressive Wall Stress	28.1	188.8

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	13674.3	13674.3
Pullback Stress [psi]	381.4	381.4
Pullback Strain	6.632E-3	6.632E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	381.4	405.6
Tensile Strain	6.632E-3	7.502E-3

Net External Pressure = 23.5 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.831	7.5	4.1	OK
Unconstrained Collapse [psi]	25.8	117.4	4.5	OK
Compressive Wall Stress [psi]	28.1	1150.0	41.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	35.8	232.9	6.5	OK
Tensile Stress [psi]	405.6	1200.0	3.0	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	624.836 psi	1337.485 psi
1	8.75 in	12.00 in	624.753 psi	1337.366 psi
2	12.00 in	16.13 in	624.609 psi	1337.161 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

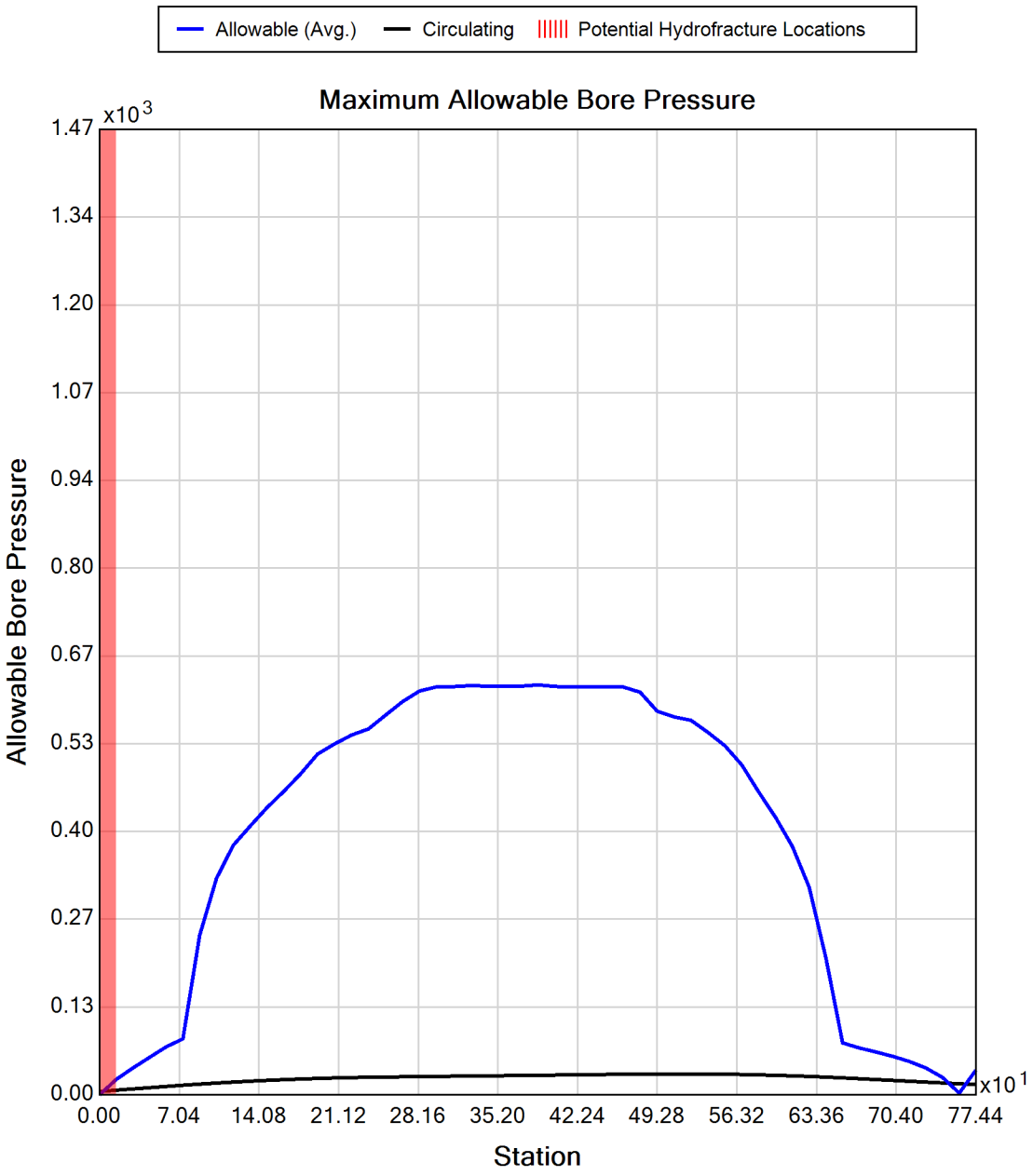
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



Generated Output

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 3 HDD 111.B DWG C-311.B.2

Input Summary

Start Coordinate	(0.00, 0.00, 113.48) ft
End Coordinate	(765.00, 0.00, 120.84) ft
Project Length	765.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	9.0
Pipe Thickness	0.39 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

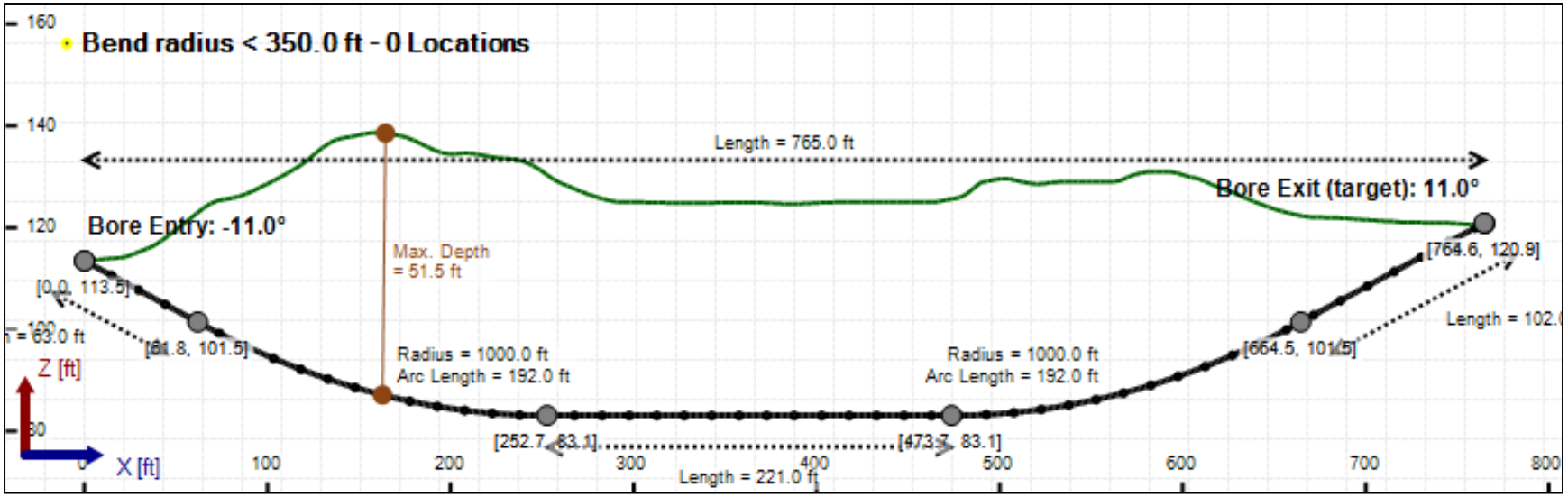
Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SM
Depth: 4.00 ft
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

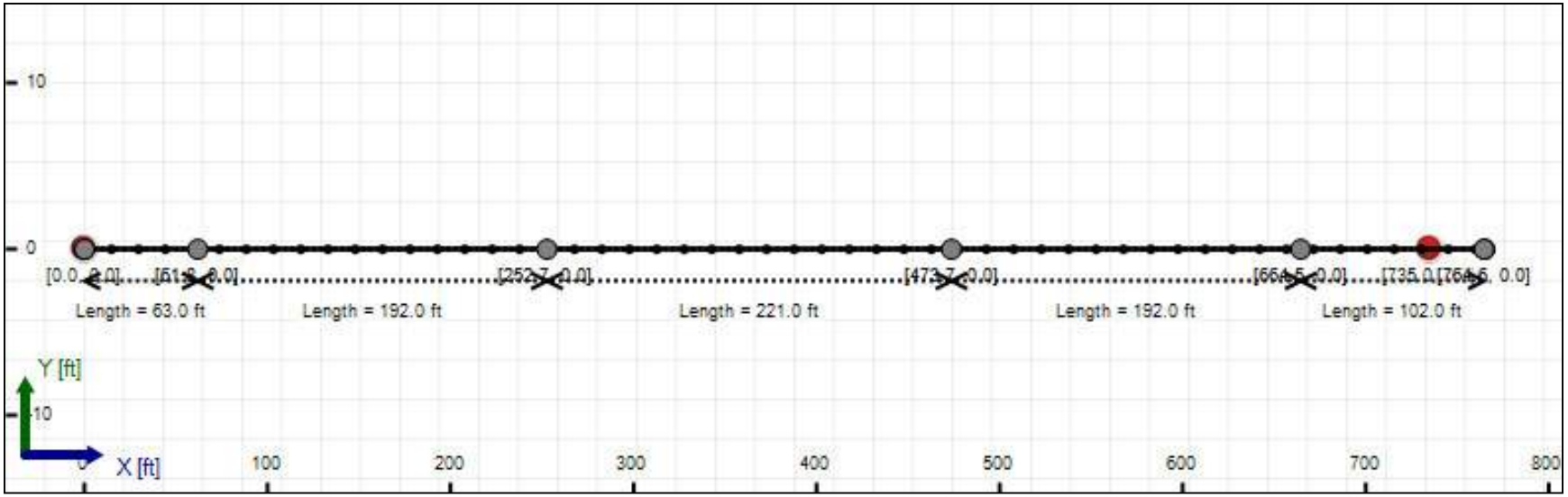
Soil Layer #2 USCS, Gravel (G), GM
Depth: 11.00 ft
Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks
Depth: 65.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 3" (3.5")

Pipe DR: 9

Pipe Length: 780.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.625 ft

Silo Width: 0.625 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.0	42.0
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	3.0	42.0
Deflection		
Earth Load Deflection	0.810	11.425
Buoyant Deflection	0.043	0.043
Reissner Effect	0	0
Net Deflection	0.853	11.468
Compressive Stress [psi]		
Compressive Wall Stress	13.4	188.8

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1562.1	1562.1
Pullback Stress [psi]	411.0	411.0
Pullback Strain	7.148E-3	7.148E-3
Bending Stress [psi]	0.0	8.4
Bending Strain	0	1.458E-4
Tensile Stress [psi]	411.0	417.9
Tensile Strain	7.148E-3	7.413E-3

Net External Pressure = 23.5 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.853	7.5	8.8	OK
Unconstrained Collapse [psi]	25.8	128.2	5.0	OK
Compressive Wall Stress [psi]	13.4	1150.0	86.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.021	7.5	355.7	OK
Unconstrained Collapse [psi]	35.8	233.0	6.5	OK
Tensile Stress [psi]	417.9	1200.0	2.9	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	624.836 psi	1337.485 psi
1	8.75 in	12.00 in	624.753 psi	1337.366 psi
2	12.00 in	16.13 in	624.609 psi	1337.161 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

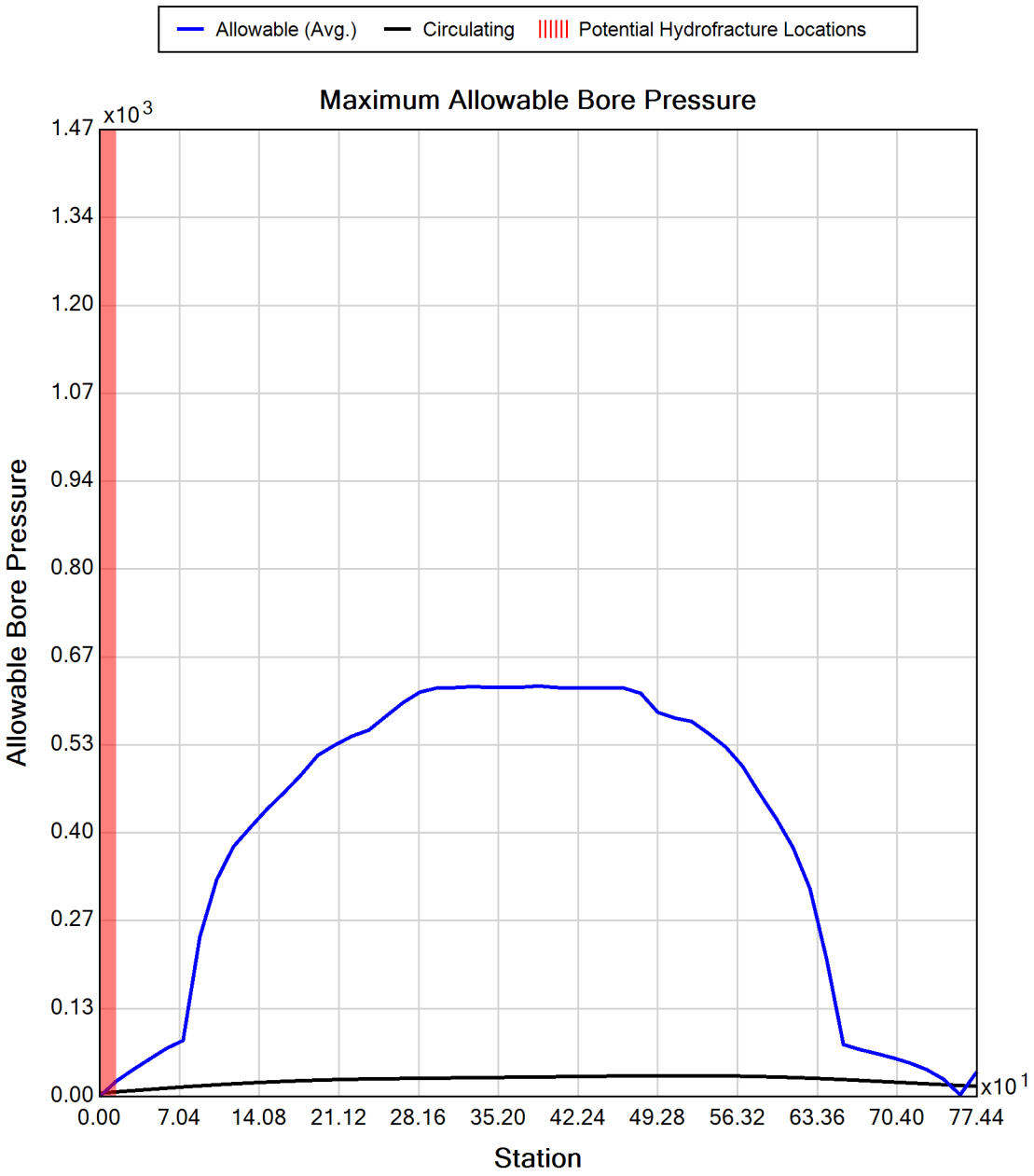
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 & 3 Equivalent Pipe Bundle HDD 111.B DWG C-311.B.2

Input Summary

Start Coordinate	(0.00, 0.00, 113.48) ft
End Coordinate	(765.00, 0.00, 120.84) ft
Project Length	765.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 780.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	8.0	42.0
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	8.0	42.0
Deflection		
Earth Load Deflection	10.061	52.497
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	10.751	53.186
Compressive Stress [psi]		
Compressive Wall Stress	57.5	299.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11427.6	11427.6
Pullback Stress [psi]	285.3	285.3
Pullback Strain	4.962E-3	4.962E-3
Bending Stress [psi]	33.5	33.5
Bending Strain	5.833E-4	5.833E-4
Tensile Stress [psi]	318.9	318.9
Tensile Strain	6.129E-3	6.129E-3

Net External Pressure = 15.1 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.338	7.5	22.2	OK
Unconstrained Collapse [psi]	18.6	50.4	2.7	OK
Tensile Stress [psi]	318.9	1200.0	3.8	OK

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 1 HDD 112 DWG C-312

Input Summary

Start Coordinate	(0.00, 0.00, 110.55) ft
End Coordinate	(960.00, 0.00, 131.68) ft
Project Length	960.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 7

Soil Layer #1 USCS, Sand (S), SP
Depth: 5.00 ft
Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), ML
Depth: 4.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Sand (S), SM
Depth: 4.00 ft
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML
Depth: 3.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks
Depth: 9.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Soil Layer #6 USCS, Gravel (G), GM
Depth: 7.00 ft
Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

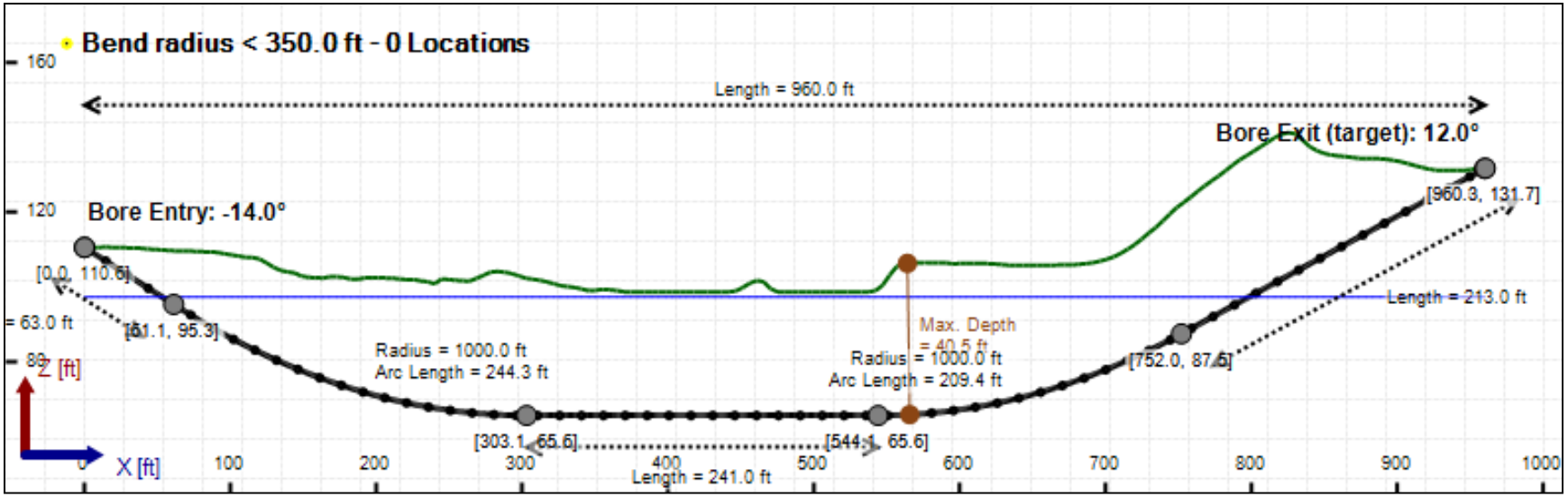
Soil Layer #7 Rock, Geological Classification, Sedimentary Rocks

Depth: 25.00 ft

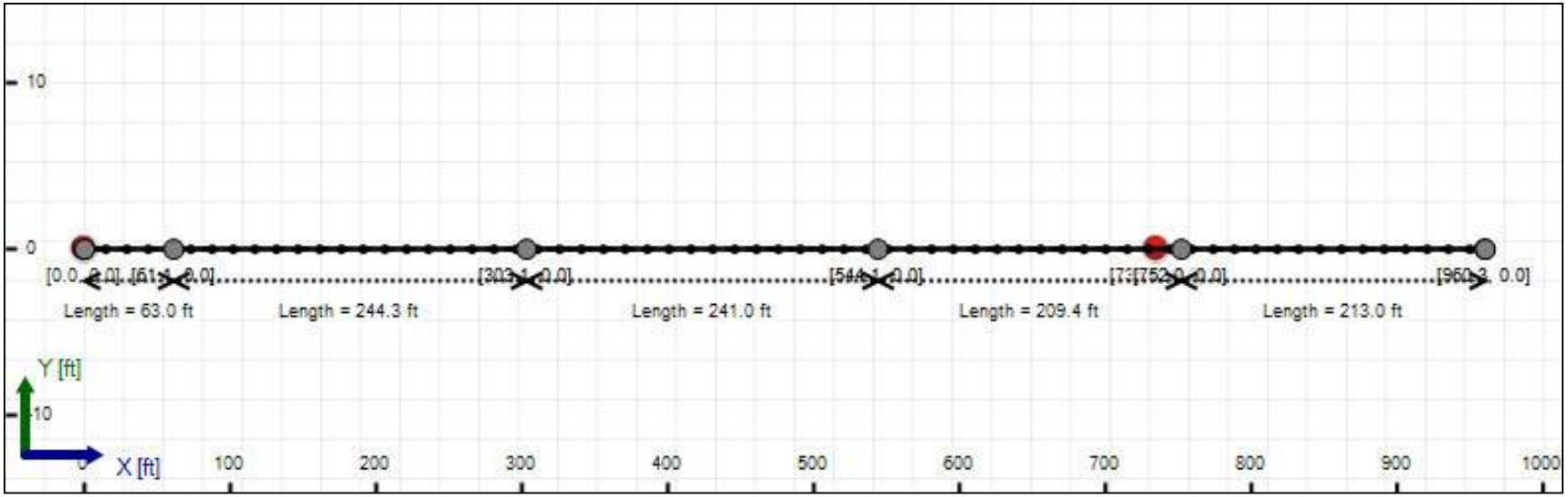
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 975.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.4	29.4
Water Pressure	13.7	13.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.2	43.0
Deflection		
Earth Load Deflection	1.541	8.025
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.673	8.157
Compressive Stress [psi]		
Compressive Wall Stress	86.2	193.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	18384.6	18384.6
Pullback Stress [psi]	512.7	512.7
Pullback Strain	8.917E-3	8.917E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	512.7	536.9
Tensile Strain	8.917E-3	9.785E-3

Net External Pressure = 33.8 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.673	7.5	4.5	OK
Unconstrained Collapse [psi]	43.6	119.5	2.7	OK
Compressive Wall Stress [psi]	86.2	1150.0	13.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	53.6	225.5	4.2	OK
Tensile Stress [psi]	536.9	1200.0	2.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	942.479 psi	1340.560 psi
1	8.75 in	12.00 in	942.273 psi	1340.367 psi
2	12.00 in	16.13 in	941.918 psi	1340.033 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

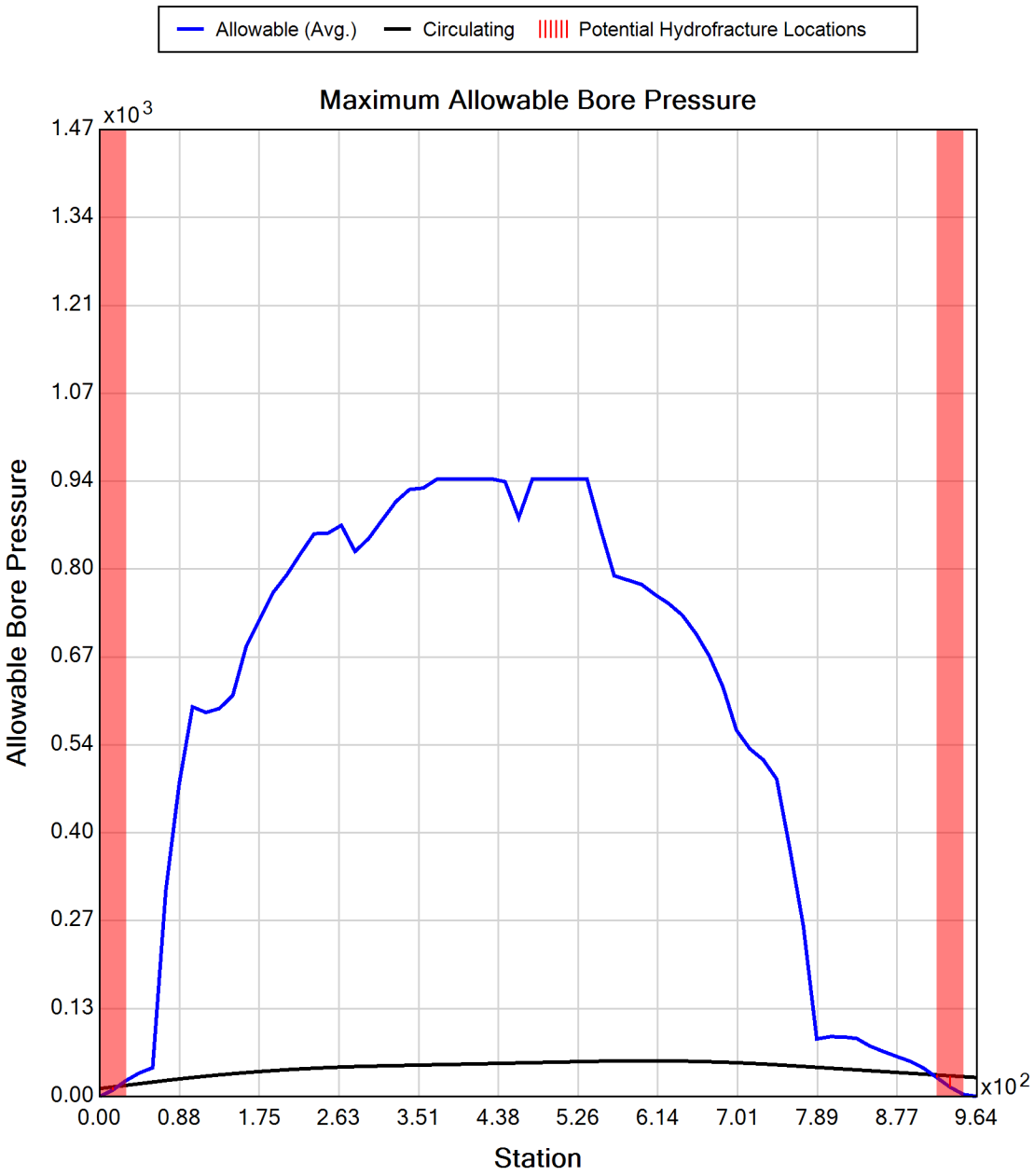
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



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Project Summary

General:

Kiewit - CHPE

Ref: New York

204-3701

Start Date: 04-29-2022

End Date: 06-19-2023

Designer:

Aaron Coady

Tetra Tech Rooney

115 Inverness Drive East, Suite 300

Englewood, Colorado

United States 80112

aaron.coady@tetratech.com

Description:

Segment 11 (Package 7A)
Conduit 2
HDD 112
DWG C-312.2

Input Summary

Start Coordinate	(0.00, 0.00, 110.99) ft
End Coordinate	(960.00, 0.00, 129.86) ft
Project Length	960.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 7

Soil Layer #1 USCS, Sand (S), SP
Depth: 5.00 ft
Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), ML
Depth: 4.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Sand (S), SM
Depth: 4.00 ft
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML
Depth: 3.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks
Depth: 9.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Soil Layer #6 USCS, Gravel (G), GM
Depth: 7.00 ft
Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

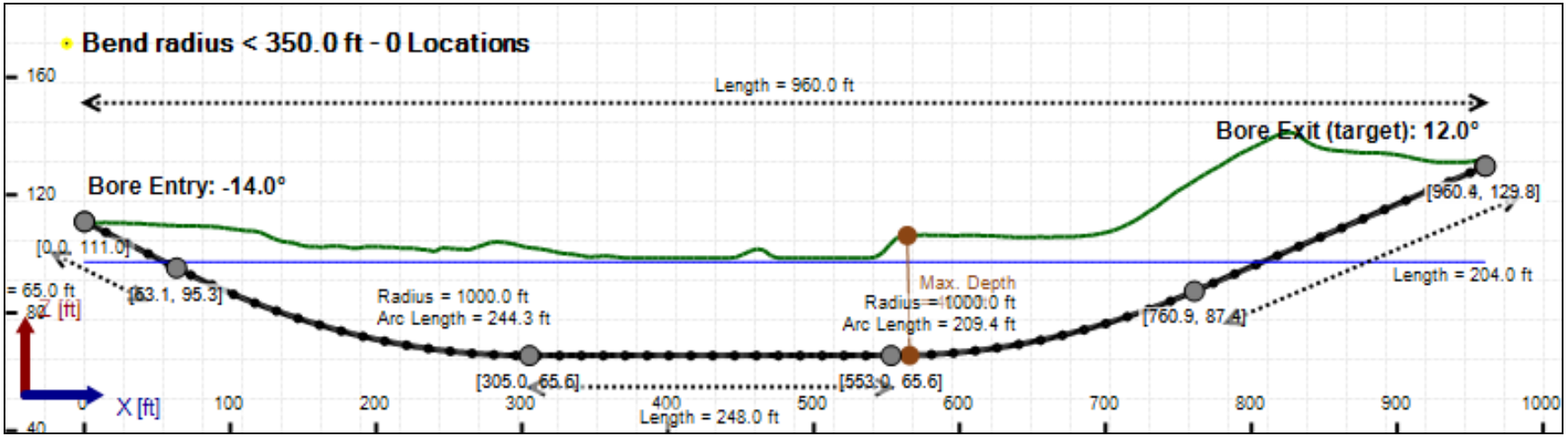
Soil Layer #7 Rock, Geological Classification, Sedimentary Rocks

Depth: 25.00 ft

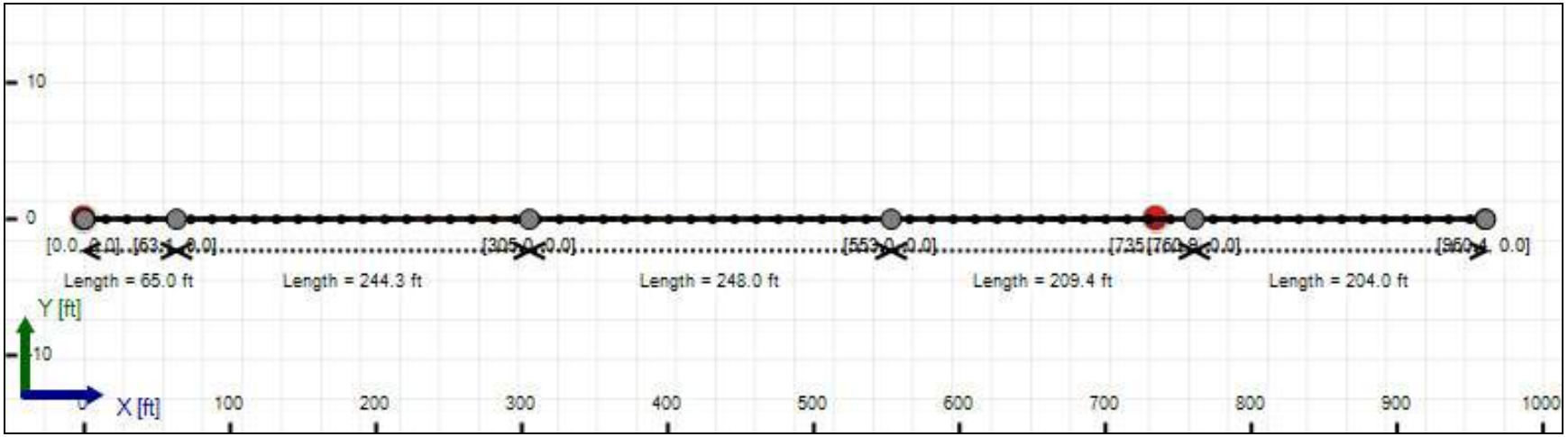
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 975.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.5	29.7
Water Pressure	13.7	13.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.2	43.4
Deflection		
Earth Load Deflection	1.541	8.460
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.673	8.592
Compressive Stress [psi]		
Compressive Wall Stress	86.5	195.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	18257.6	18257.6
Pullback Stress [psi]	509.2	509.2
Pullback Strain	8.855E-3	8.855E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	509.2	533.6
Tensile Strain	8.855E-3	9.727E-3

Net External Pressure = 32.3 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.673	7.5	4.5	OK
Unconstrained Collapse [psi]	42.4	119.4	2.8	OK
Compressive Wall Stress [psi]	86.5	1150.0	13.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	52.3	225.7	4.3	OK
Tensile Stress [psi]	533.6	1200.0	2.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	957.767 psi	1340.904 psi
1	8.75 in	12.00 in	957.558 psi	1340.712 psi
2	12.00 in	16.13 in	957.198 psi	1340.381 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

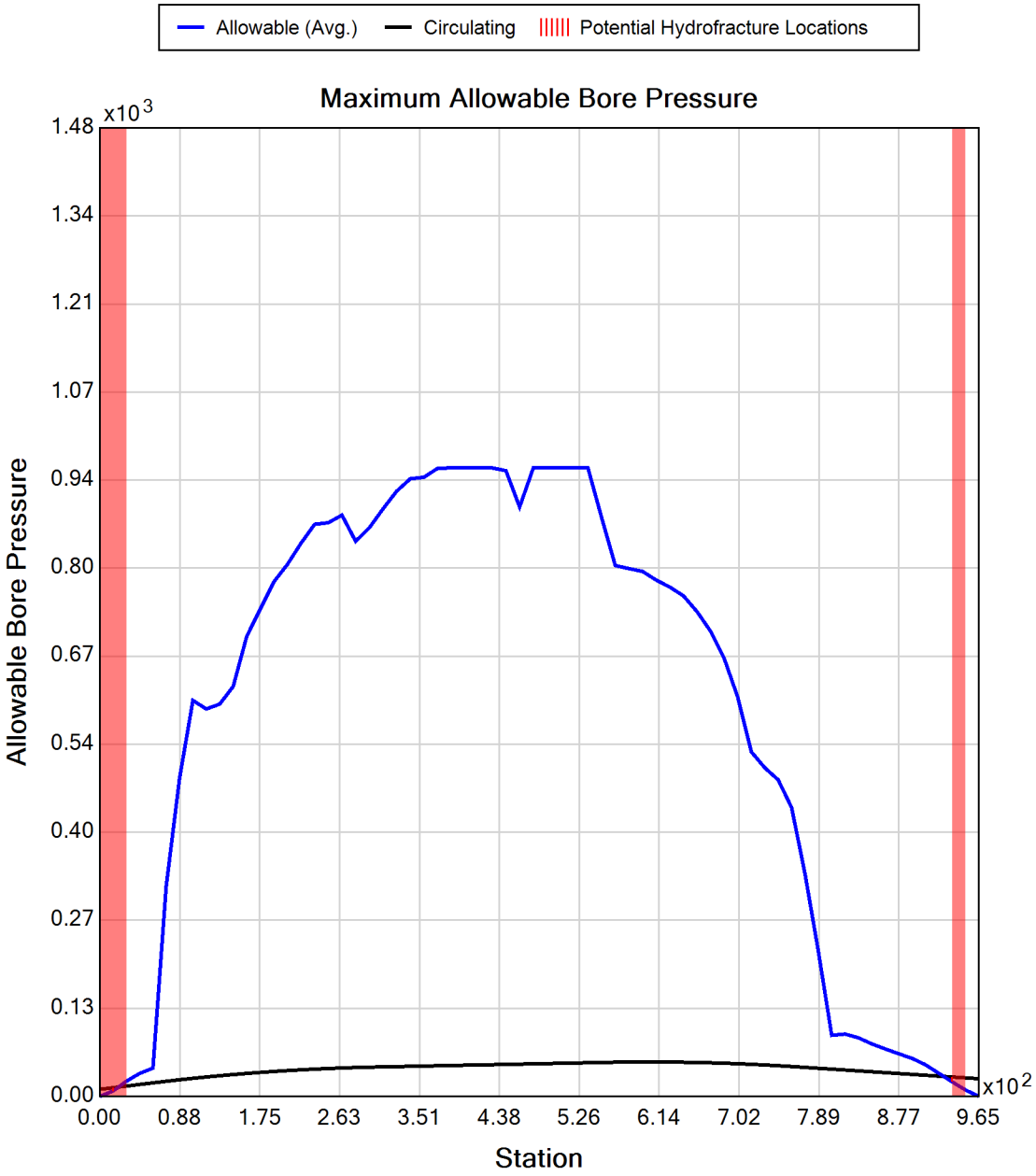
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



Generated Output

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OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning the excavation or underground drilling operation. When the actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If the utility cannot be precisely located, it must be shut off by the utility company.

Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 3 HDD 112 DWG C-312.2

Input Summary

Start Coordinate	(0.00, 0.00, 110.99) ft
End Coordinate	(960.00, 0.00, 129.86) ft
Project Length	960.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	9.0
Pipe Thickness	0.39 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 7

Soil Layer #1 USCS, Sand (S), SP
Depth: 5.00 ft
Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), ML
Depth: 4.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Sand (S), SM
Depth: 4.00 ft
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML
Depth: 3.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks
Depth: 9.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Soil Layer #6 USCS, Gravel (G), GM
Depth: 7.00 ft
Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

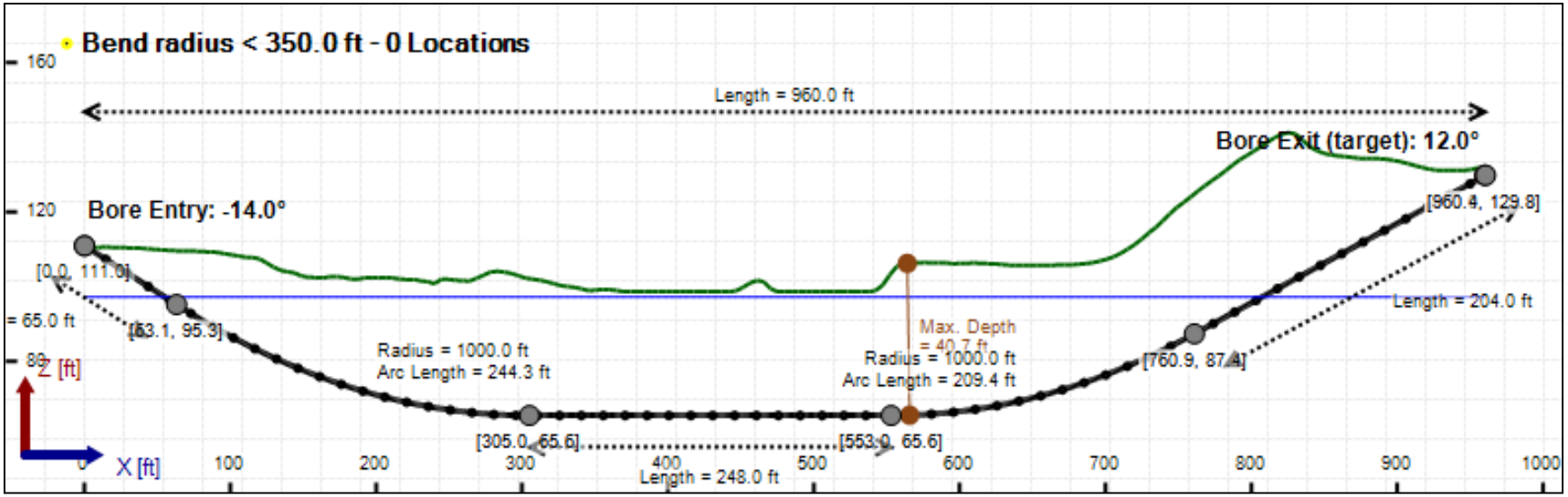
Soil Layer #7 Rock, Geological Classification, Sedimentary Rocks

Depth: 25.00 ft

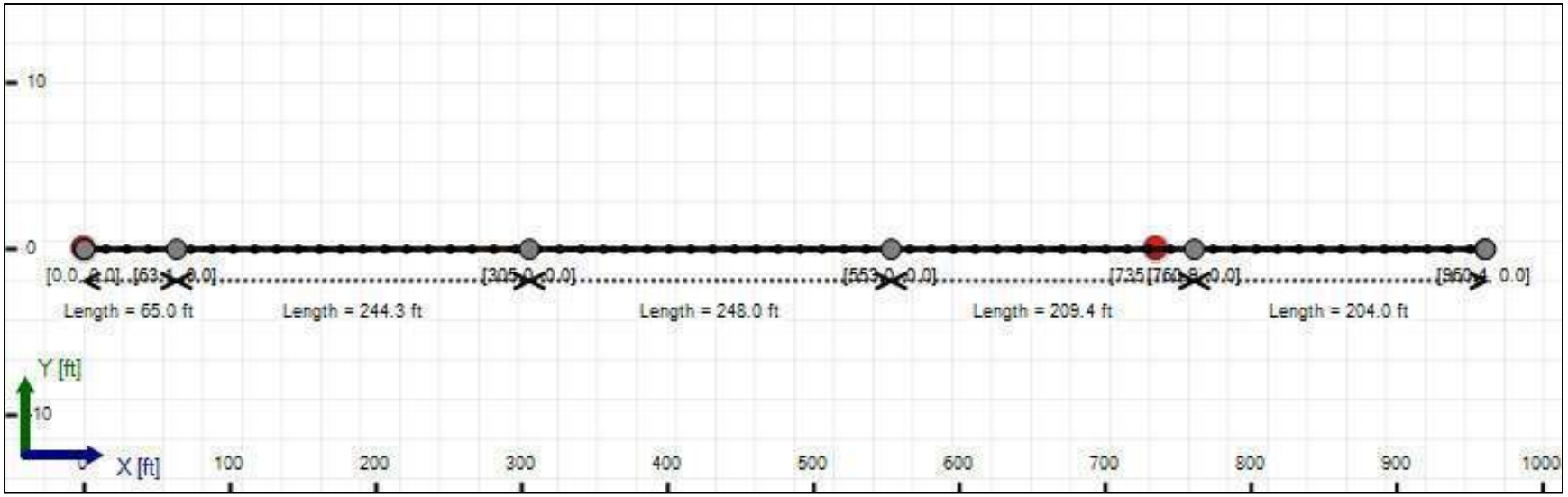
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 3" (3.5")

Pipe DR: 9

Pipe Length: 975.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.625 ft

Silo Width: 0.625 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.6	29.7
Water Pressure	13.7	13.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	16.3	43.4
Deflection		
Earth Load Deflection	0.750	8.460
Buoyant Deflection	0.043	0.043
Reissner Effect	0	0
Net Deflection	0.793	8.503
Compressive Stress [psi]		
Compressive Wall Stress	73.4	195.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	2048.0	2048.0
Pullback Stress [psi]	538.8	538.8
Pullback Strain	9.371E-3	9.371E-3
Bending Stress [psi]	0.0	8.4
Bending Strain	0	1.458E-4
Tensile Stress [psi]	538.8	545.8
Tensile Strain	9.371E-3	9.639E-3

Net External Pressure = 32.3 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.793	7.5	9.5	OK
Unconstrained Collapse [psi]	42.4	129.2	3.1	OK
Compressive Wall Stress [psi]	73.4	1150.0	15.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.021	7.5	355.7	OK
Unconstrained Collapse [psi]	52.3	225.7	4.3	OK
Tensile Stress [psi]	545.8	1200.0	2.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	957.767 psi	1340.904 psi
1	8.75 in	12.00 in	957.558 psi	1340.712 psi
2	12.00 in	16.13 in	957.198 psi	1340.381 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

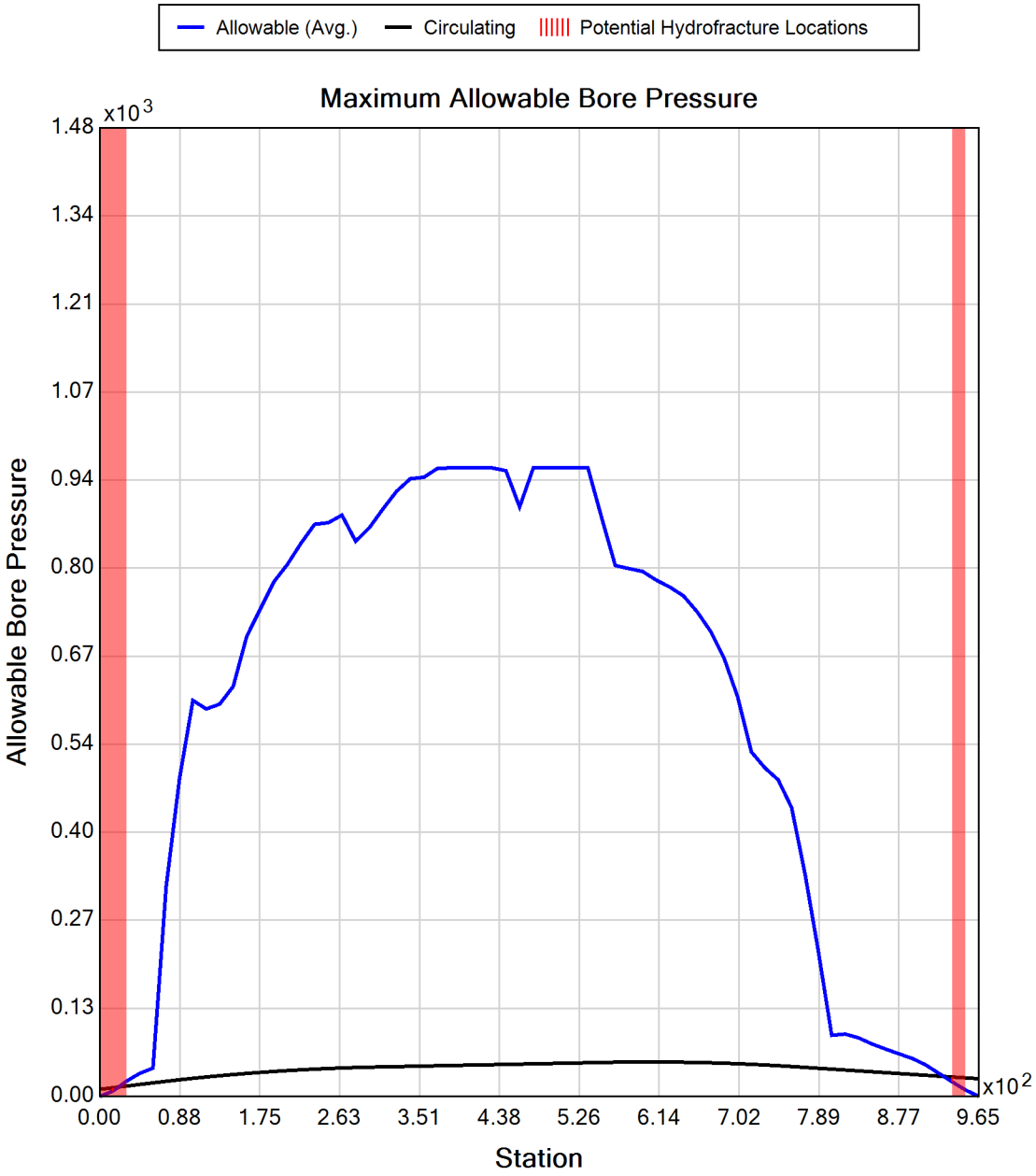
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 & 3 Equivalent Pipe Bundle HDD 112 DWG C-312.2

Input Summary

Start Coordinate	(0.00, 0.00, 110.99) ft
End Coordinate	(960.00, 0.00, 129.86) ft
Project Length	960.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 975.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	7.0	29.7
Water Pressure	13.7	13.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	20.7	43.4
Deflection		
Earth Load Deflection	9.120	38.875
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	9.810	39.565
Compressive Stress [psi]		
Compressive Wall Stress	148.4	310.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15033.1	15033.1
Pullback Stress [psi]	375.4	375.4
Pullback Strain	6.528E-3	6.528E-3
Bending Stress [psi]	33.5	33.5
Bending Strain	5.833E-4	5.833E-4
Tensile Stress [psi]	408.9	408.9
Tensile Strain	7.695E-3	7.695E-3

Net External Pressure = 18.2 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.338	7.5	22.2	OK
Unconstrained Collapse [psi]	24.1	49.3	2.0	OK
Tensile Stress [psi]	408.9	1200.0	2.9	OK

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 1 HDD 113 DWG C-313

Input Summary

Start Coordinate	(0.00, 0.00, 96.49) ft
End Coordinate	(610.00, 0.00, 110.20) ft
Project Length	610.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

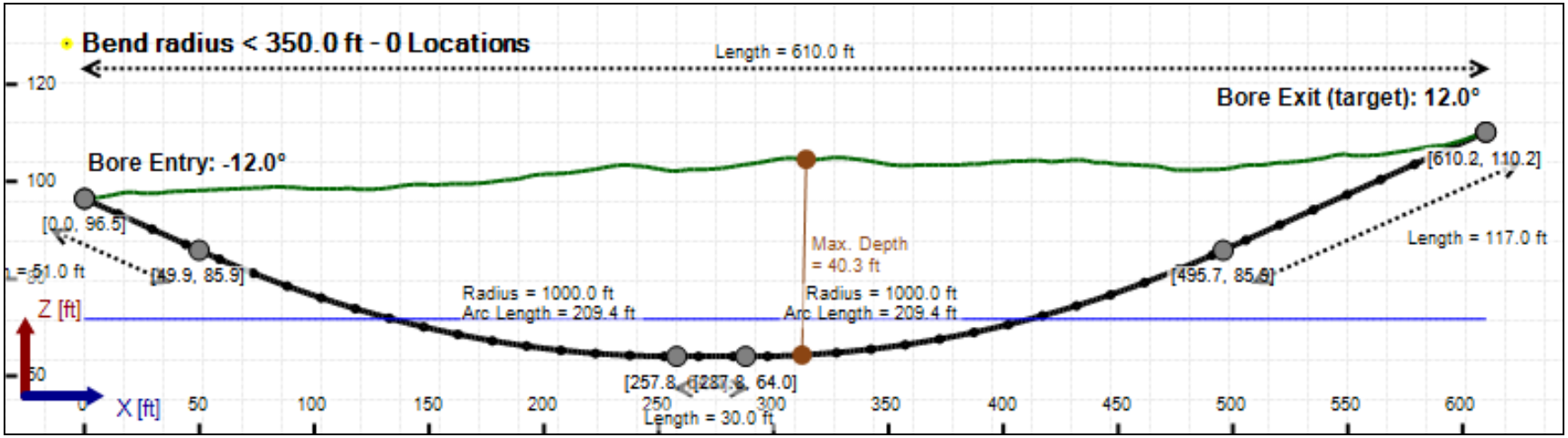
Soil Layer #1 USCS, Sand (S), SM
Depth: 2.00 ft
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #2 USCS, Clay (C), CH
Depth: 18.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

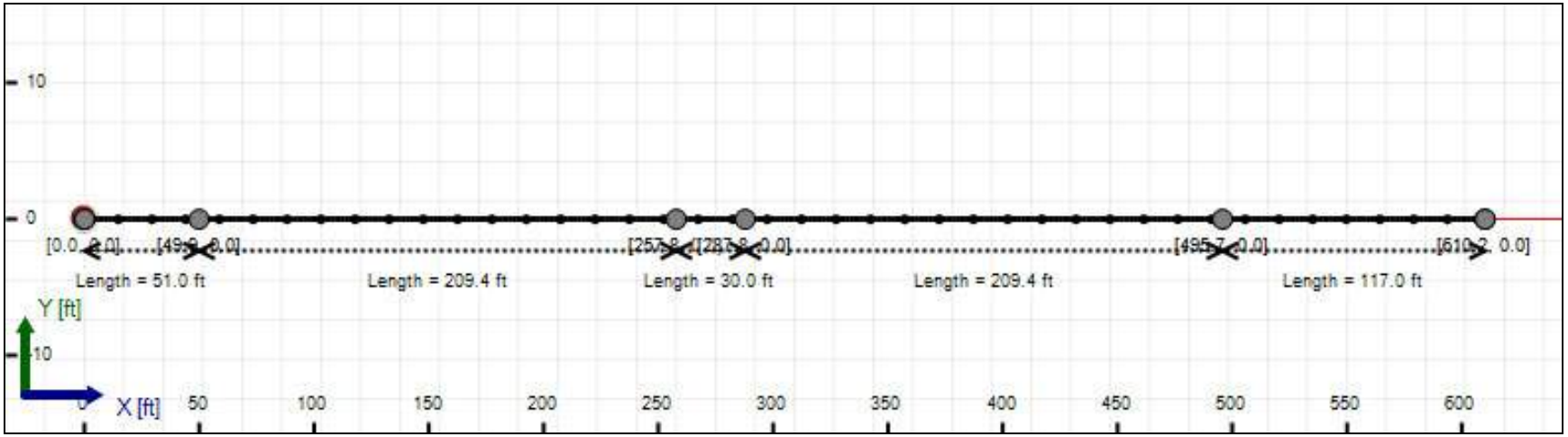
Soil Layer #3 USCS, Clay (C), CL
Depth: 25.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #4 USCS, Silt (M), ML
Depth: 12.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 630.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	9.1	26.3
Water Pressure	3.3	3.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	12.4	29.5
Deflection		
Earth Load Deflection	2.696	7.176
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.828	7.308
Compressive Stress [psi]		
Compressive Wall Stress	55.7	132.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11975.3	11975.3
Pullback Stress [psi]	334.0	334.0
Pullback Strain	5.808E-3	5.808E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	334.0	359.3
Tensile Strain	5.808E-3	6.696E-3

Net External Pressure = 26.8 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.828	7.5	2.7	OK
Unconstrained Collapse [psi]	31.8	109.4	3.4	OK
Compressive Wall Stress [psi]	55.7	1150.0	20.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	41.8	235.9	5.6	OK
Tensile Stress [psi]	359.3	1200.0	3.3	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	77.451 psi	58.806 psi
1	8.75 in	12.00 in	77.384 psi	58.562 psi
2	12.00 in	16.13 in	77.269 psi	58.157 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

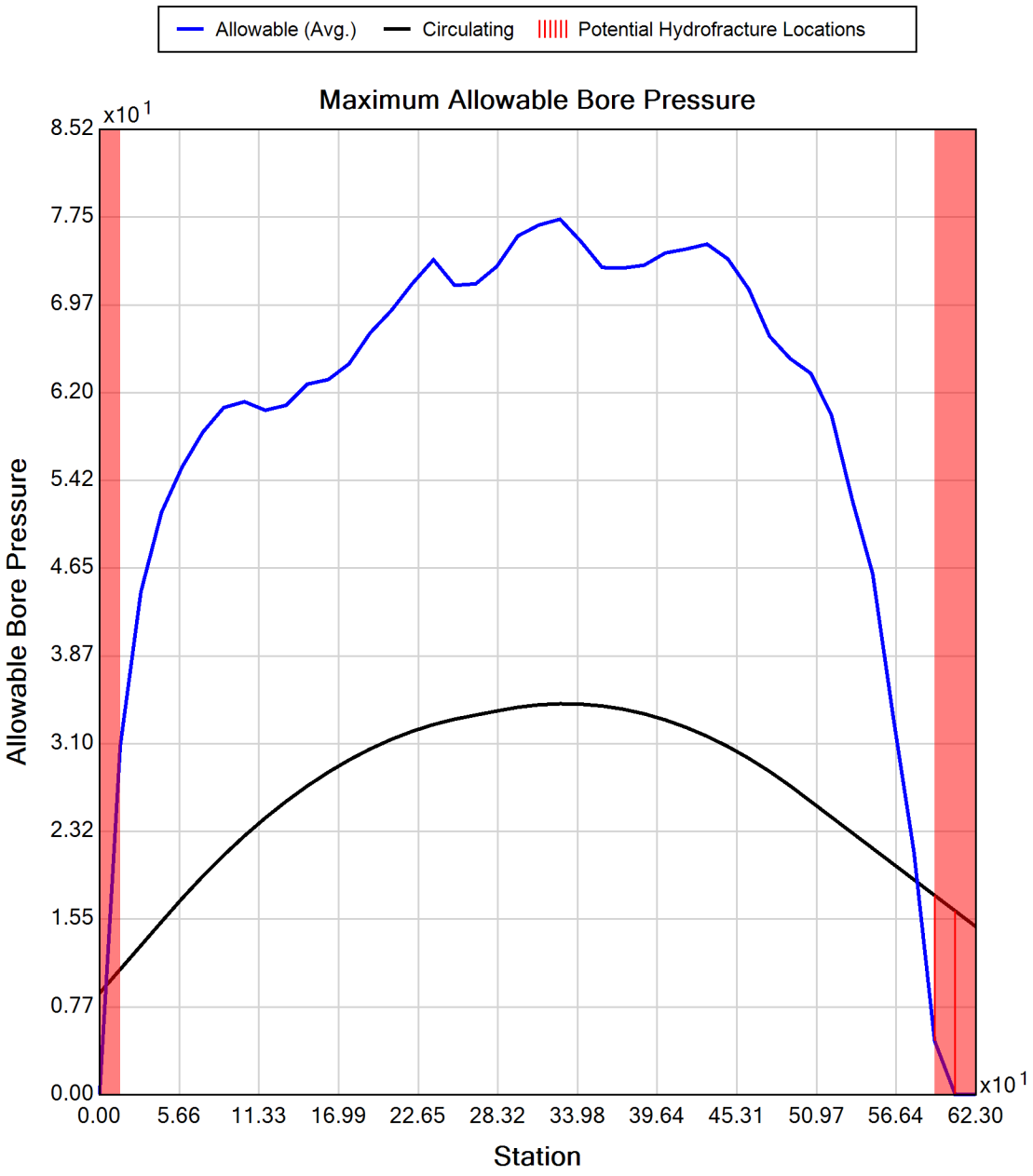
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



Generated Output

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 HDD 113 DWG C-313.2

Input Summary

Start Coordinate	(0.00, 0.00, 96.49) ft
End Coordinate	(610.00, 0.00, 109.16) ft
Project Length	610.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

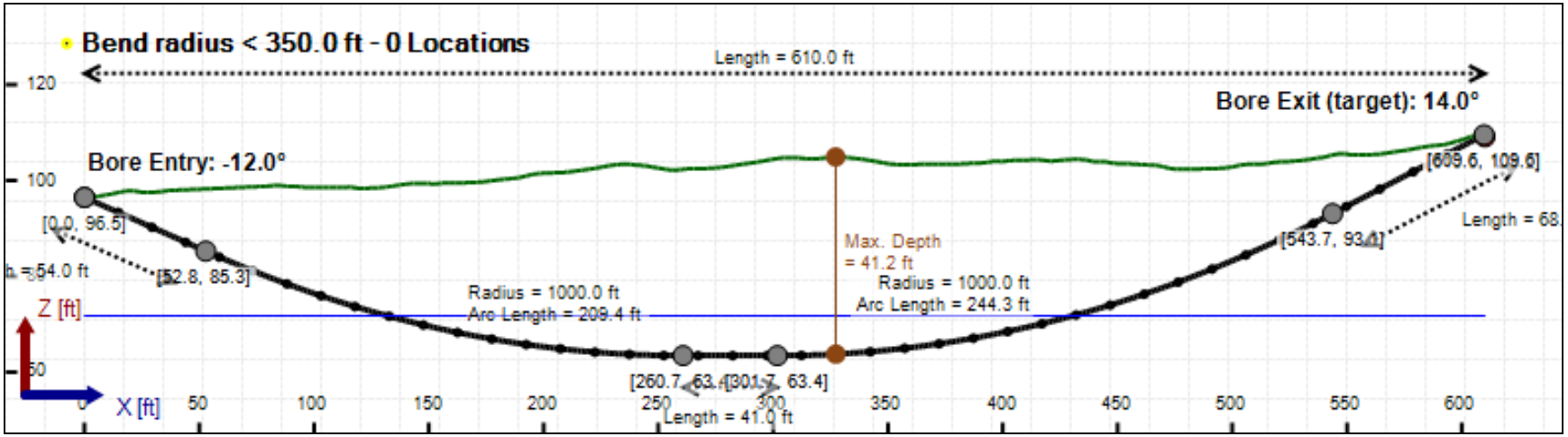
Soil Layer #1 USCS, Sand (S), SM
Depth: 2.00 ft
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #2 USCS, Clay (C), CH
Depth: 18.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

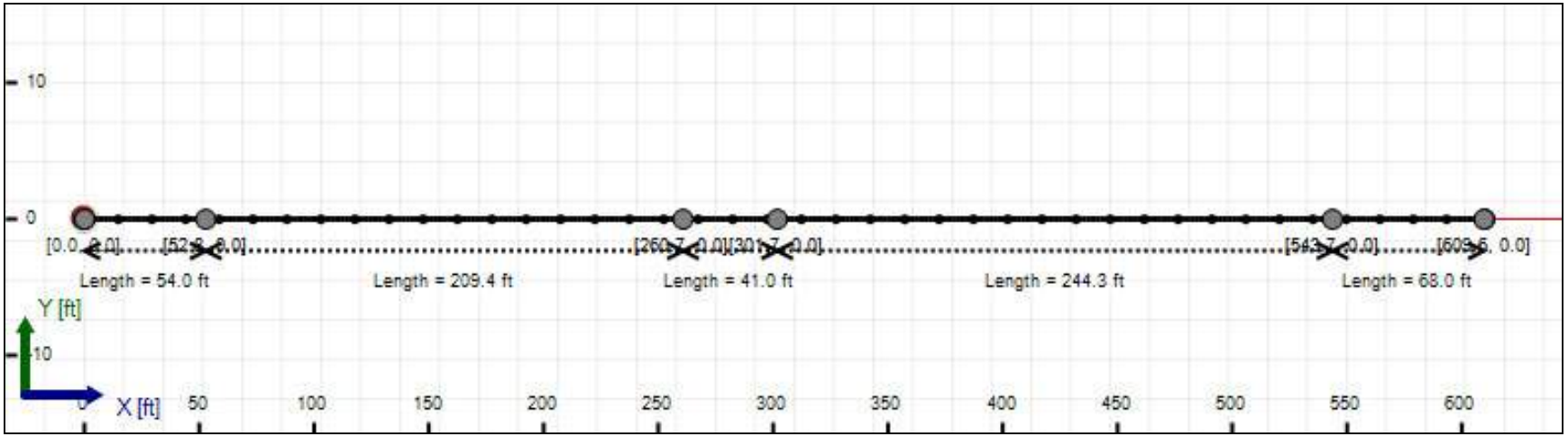
Soil Layer #3 USCS, Clay (C), CL
Depth: 25.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #4 USCS, Silt (M), ML
Depth: 12.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 630.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	9.1	26.7
Water Pressure	3.6	3.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	12.7	30.3
Deflection		
Earth Load Deflection	2.713	7.307
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.845	7.439
Compressive Stress [psi]		
Compressive Wall Stress	57.2	136.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	12100.8	12100.8
Pullback Stress [psi]	337.5	337.5
Pullback Strain	5.869E-3	5.869E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	337.5	363.2
Tensile Strain	5.869E-3	6.764E-3

Net External Pressure = 26.7 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.845	7.5	2.6	OK
Unconstrained Collapse [psi]	32.1	109.3	3.4	OK
Compressive Wall Stress [psi]	57.2	1150.0	20.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	42.1	235.5	5.6	OK
Tensile Stress [psi]	363.2	1200.0	3.3	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	77.756 psi	56.297 psi
1	8.75 in	12.00 in	77.694 psi	55.980 psi
2	12.00 in	16.13 in	77.587 psi	55.463 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

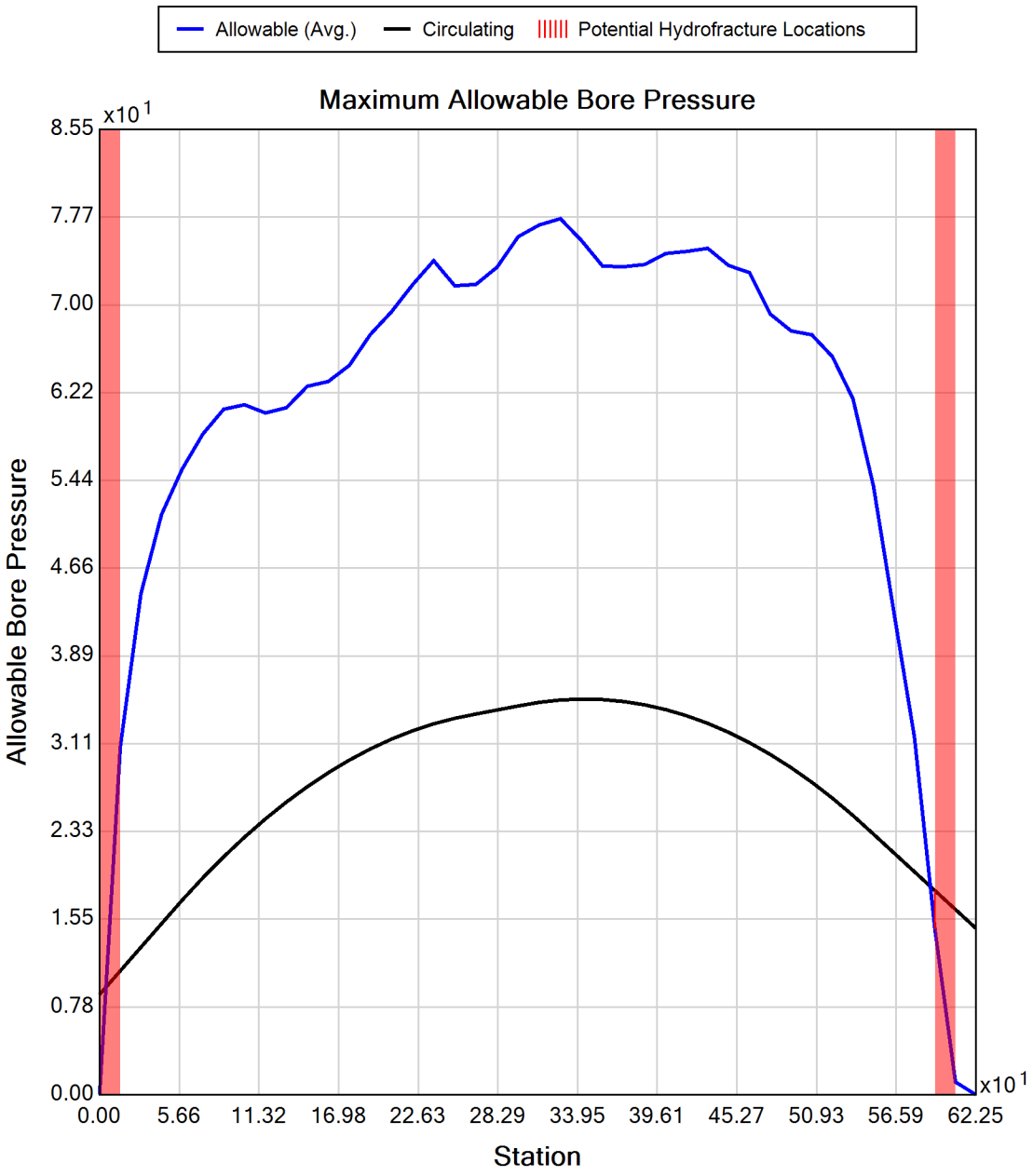
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 3 HDD 113 DWG C-313.2

Input Summary

Start Coordinate	(0.00, 0.00, 96.49) ft
End Coordinate	(610.00, 0.00, 109.16) ft
Project Length	610.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	9.0
Pipe Thickness	0.39 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

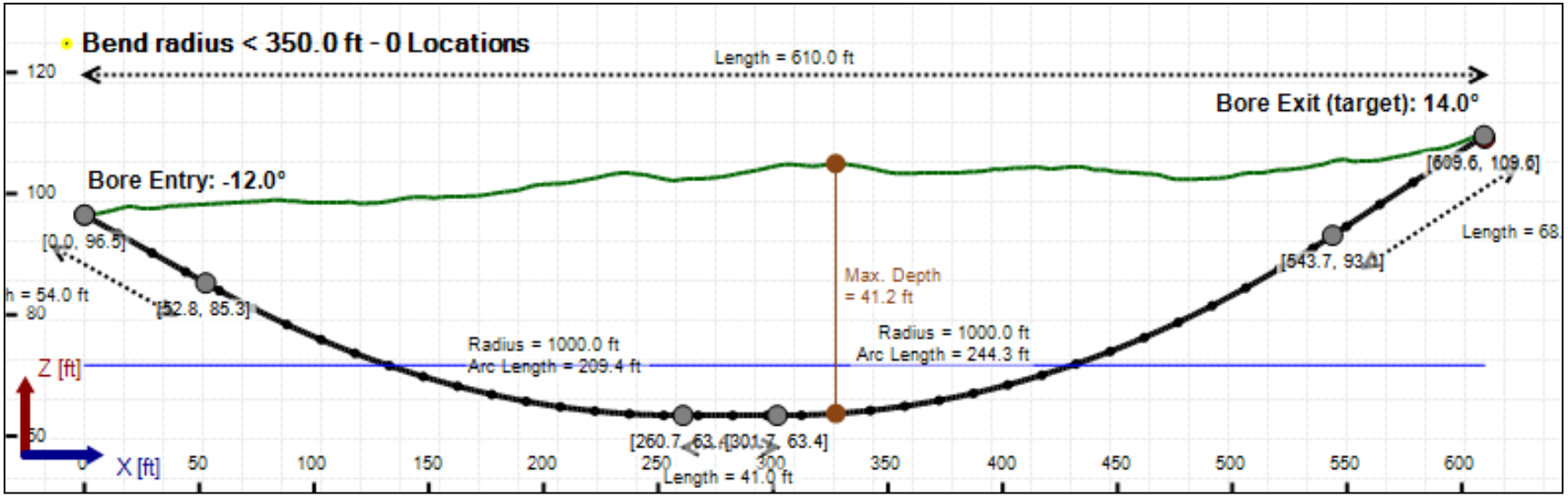
Soil Layer #1 USCS, Sand (S), SM
Depth: 2.00 ft
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #2 USCS, Clay (C), CH
Depth: 18.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

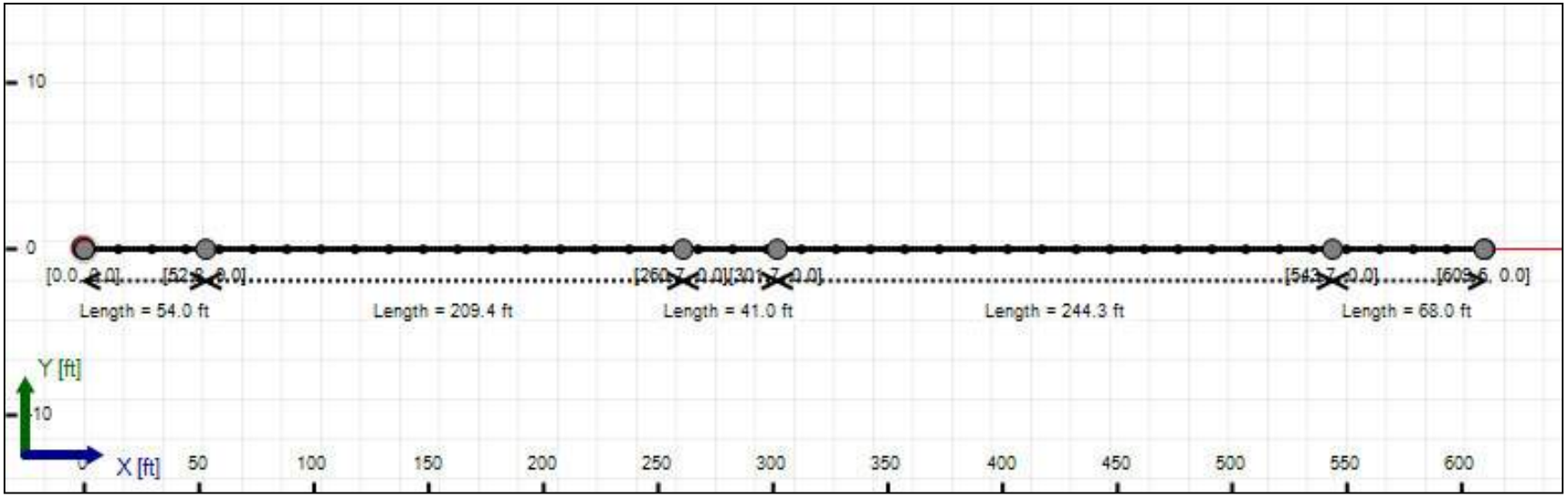
Soil Layer #3 USCS, Clay (C), CL
Depth: 25.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #4 USCS, Silt (M), ML
Depth: 12.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 3" (3.5")

Pipe DR: 9

Pipe Length: 630.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.625 ft

Silo Width: 0.625 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.6	26.7
Water Pressure	3.6	3.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	8.2	30.3
Deflection		
Earth Load Deflection	1.562	7.307
Buoyant Deflection	0.043	0.043
Reissner Effect	0	0
Net Deflection	1.605	7.350
Compressive Stress [psi]		
Compressive Wall Stress	36.9	136.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1395.3	1395.3
Pullback Stress [psi]	367.1	367.1
Pullback Strain	6.384E-3	6.384E-3
Bending Stress [psi]	0.0	8.4
Bending Strain	0	1.458E-4
Tensile Stress [psi]	367.1	375.4
Tensile Strain	6.384E-3	6.675E-3

Net External Pressure = 26.7 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.605	7.5	4.7	OK
Unconstrained Collapse [psi]	32.1	123.0	3.8	OK
Compressive Wall Stress [psi]	36.9	1150.0	31.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.021	7.5	355.7	OK
Unconstrained Collapse [psi]	42.1	235.7	5.6	OK
Tensile Stress [psi]	375.4	1200.0	3.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	77.756 psi	56.297 psi
1	8.75 in	12.00 in	77.694 psi	55.980 psi
2	12.00 in	16.13 in	77.587 psi	55.463 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

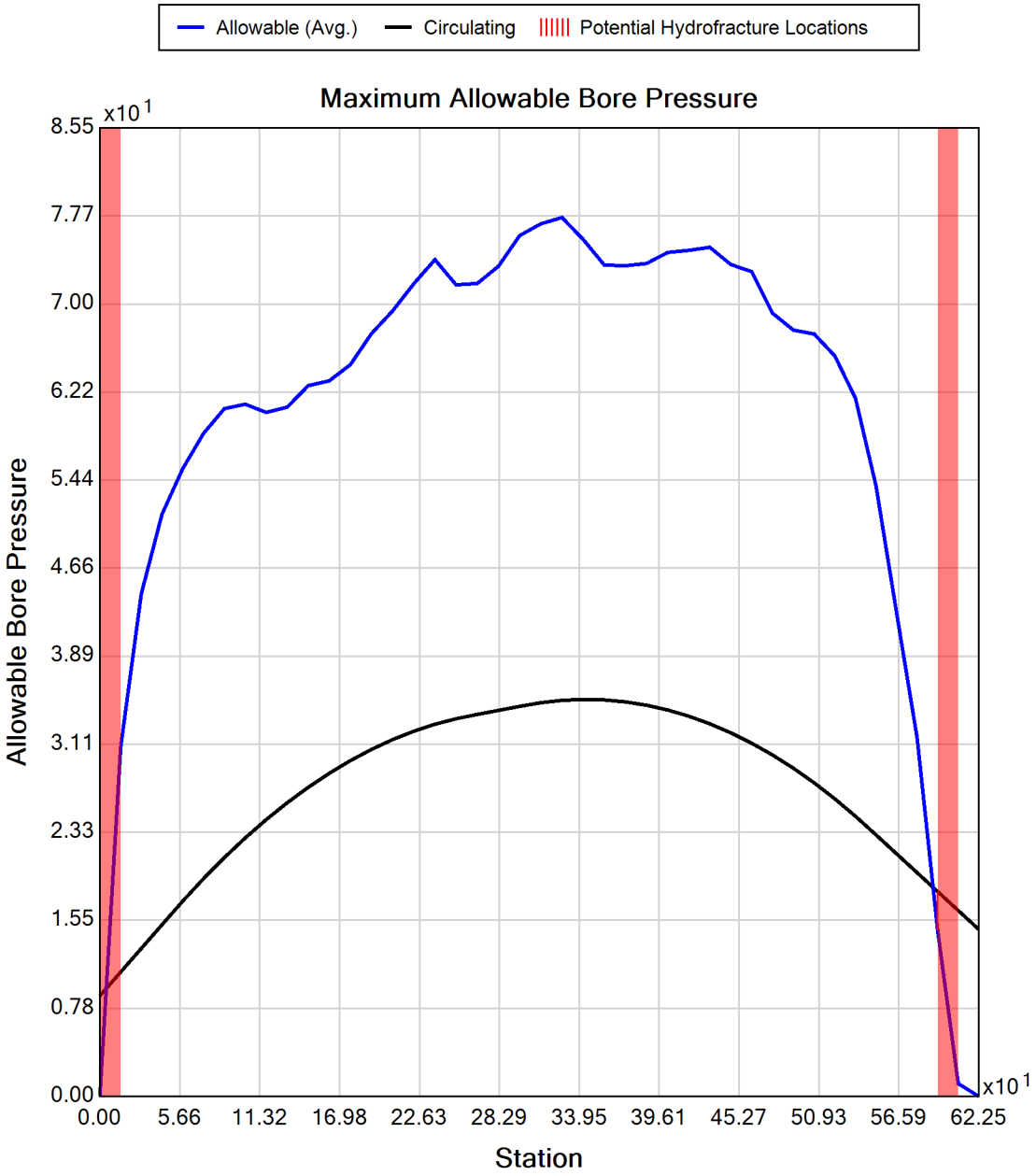
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



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Project Summary

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Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 & 3 Equivalent Pipe Bundle HDD 113 DWG C-313.2

Input Summary

Start Coordinate	(0.00, 0.00, 96.49) ft
End Coordinate	(610.00, 0.00, 109.16) ft
Project Length	610.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 630.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	11.0	26.7
Water Pressure	3.6	3.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	14.6	30.3
Deflection		
Earth Load Deflection	14.503	33.574
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	15.192	34.263
Compressive Stress [psi]		
Compressive Wall Stress	104.7	216.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10257.0	10257.0
Pullback Stress [psi]	256.1	256.1
Pullback Strain	4.454E-3	4.454E-3
Bending Stress [psi]	33.5	33.5
Bending Strain	5.833E-4	5.833E-4
Tensile Stress [psi]	289.7	289.7
Tensile Strain	5.621E-3	5.621E-3

Net External Pressure = 18.0 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.338	7.5	22.2	OK
Unconstrained Collapse [psi]	20.7	50.7	2.5	OK
Tensile Stress [psi]	289.7	1200.0	4.1	OK

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Designer:	Aaron Coady TetraTech Rooney 115 Inverness Drive, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 1 HDD 115 DWG C-315

Input Summary

Start Coordinate	(0.00, 0.00, 34.11) ft
End Coordinate	(1337.80, 0.00, 51.18) ft
Project Length	1337.80 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	8.625 in
Pipe DR	18.0
Pipe Thickness	0.48 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GC
Depth: 2.00 ft
Unit Weight: 16.3086 (dry), 18.2028 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

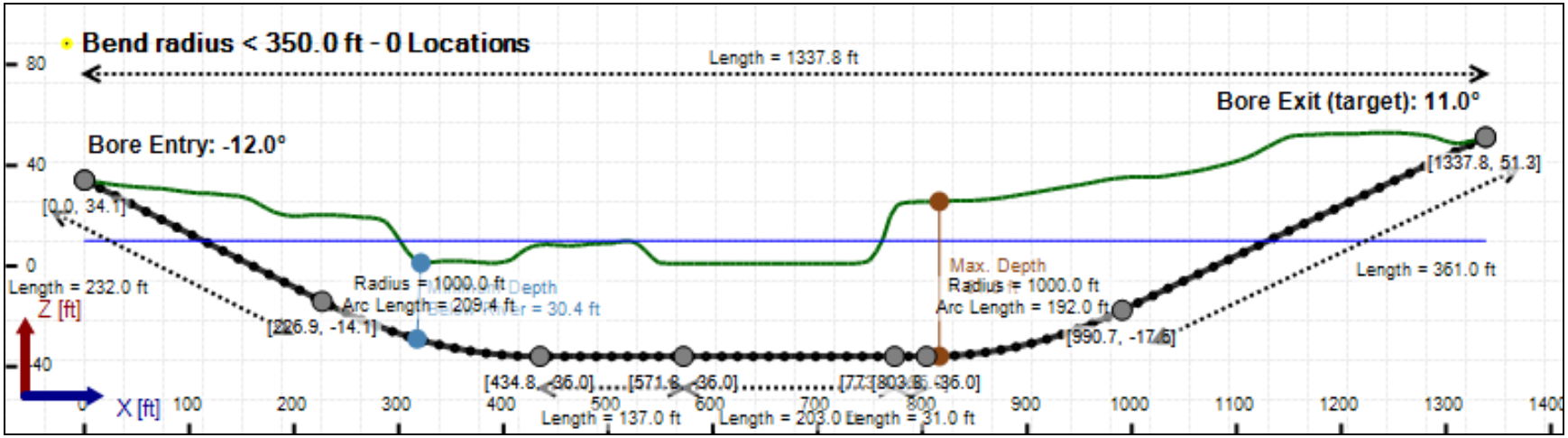
Soil Layer #2 USCS, Clay (C), CL
Depth: 4.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 7.30 [psi]

Soil Layer #3 USCS, Silt (M), ML
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

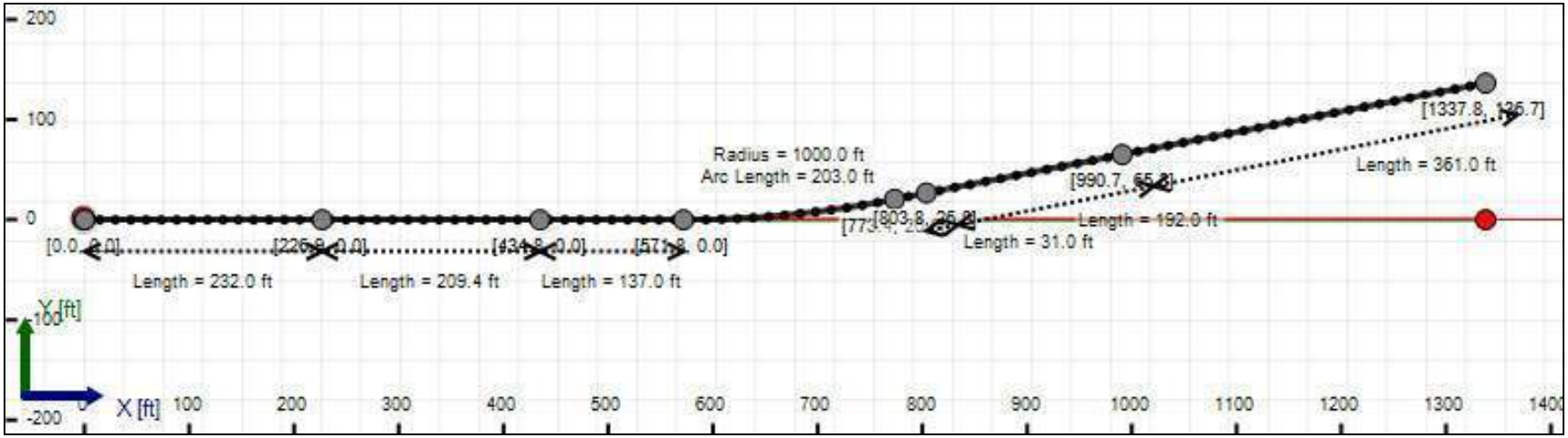
Soil Layer #4 USCS, Gravel (G), GC
Depth: 8.00 ft
Unit Weight: 16.3086 (dry), 18.2028 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks
Depth: 94.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: PVC

Classification: IPS

Pipe OD: 8" (8.625")

Pipe DR: 18

Pipe Length: 1379.99 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.07799990971883 ft

Silo Width: 1.07799990971883 ft

Surface Surcharge: 0 psi

Short Term Modulus: 400000 psi

Long Term Modulus: 400000 psi

Short Term Poisson Ratio: 0.38

Long Term Poisson Ratio: 0.38

Pipe Unit Weight: 11.68400 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 2800 psi

Allowable Tensile Stress (Long Term): 2800 psi

Allowable Compressive Stress (Short Term): 3200 psi

Allowable Compressive Stress (Long Term): 3200 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.0	49.2
Water Pressure	19.9	20.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	25.0	69.1
Deflection		
Earth Load Deflection	0.929	9.063
Buoyant Deflection	0.060	0.060
Reissner Effect	0	0
Net Deflection	0.989	9.123
Compressive Stress [psi]		
Compressive Wall Stress	224.9	622.2

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	17818.3	17818.3
Pullback Stress [psi]	1453.1	1453.1
Pullback Strain	3.633E-3	3.633E-3
Bending Stress [psi]	0.0	143.8
Bending Strain	0	3.594E-4
Tensile Stress [psi]	1453.1	1588.1
Tensile Strain	3.633E-3	4.330E-3

Net External Pressure = 53.4 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 365.0 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.989	7.5	7.6	OK
Unconstrained Collapse [psi]	58.5	174.1	3.0	OK
Compressive Wall Stress [psi]	224.9	3200.0	14.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.060	7.5	125.5	OK
Unconstrained Collapse [psi]	68.4	160.8	2.4	OK
Tensile Stress [psi]	1588.1	2800.0	1.8	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	1353.006 psi	1363.489 psi
1	8.75 in	12.00 in	1352.855 psi	1363.405 psi
2	12.00 in	12.94 in	1352.802 psi	1363.376 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

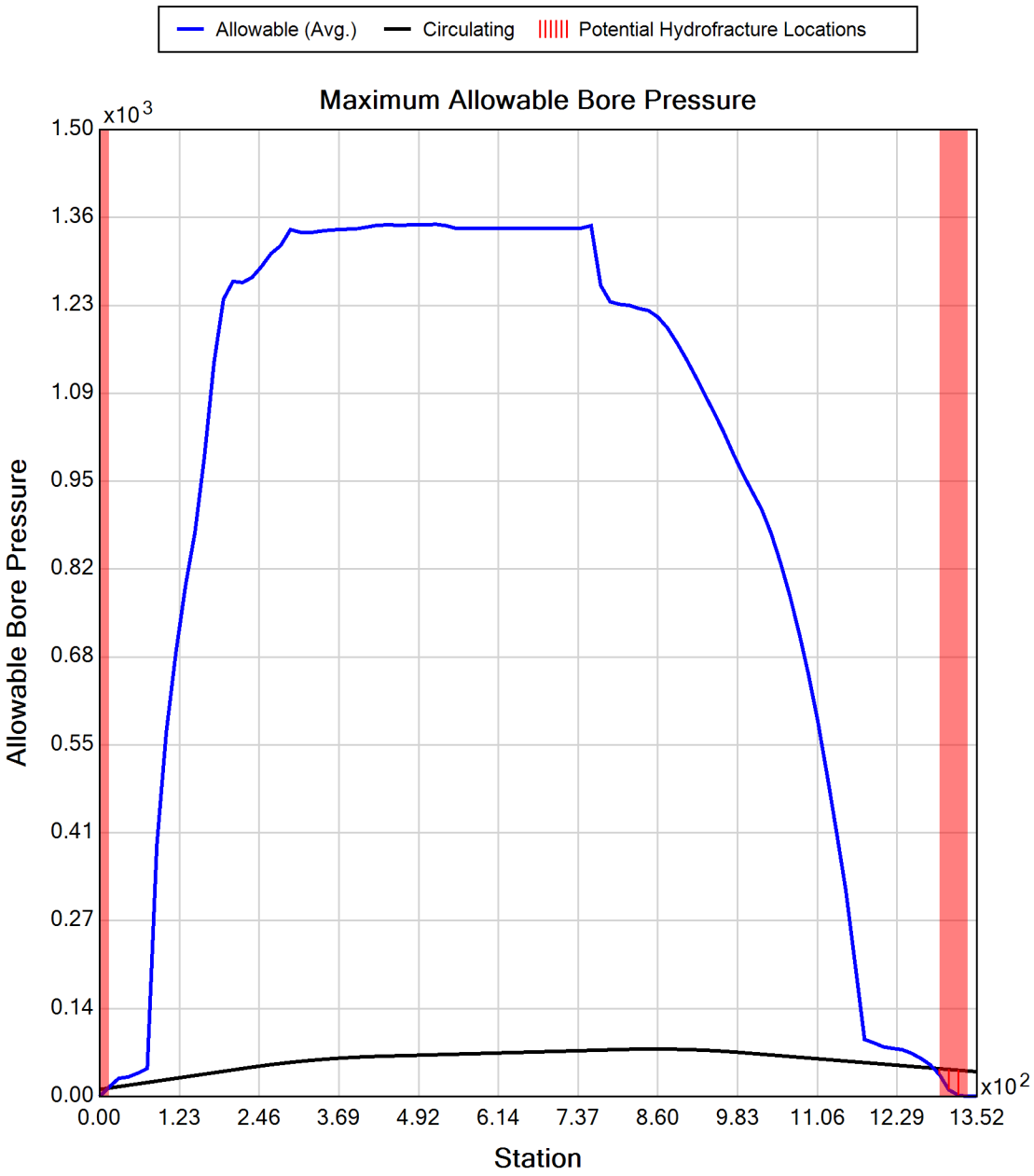
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



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Project Summary

General:	Kiewit CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 HDD 115 DWG C-315.2

Input Summary

Start Coordinate	(0.00, 0.00, 33.87) ft
End Coordinate	(1349.00, 0.00, 54.01) ft
Project Length	1349.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	8.625 in
Pipe DR	18.0
Pipe Thickness	0.48 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GC
Depth: 2.00 ft
Unit Weight: 16.3086 (dry), 18.2028 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

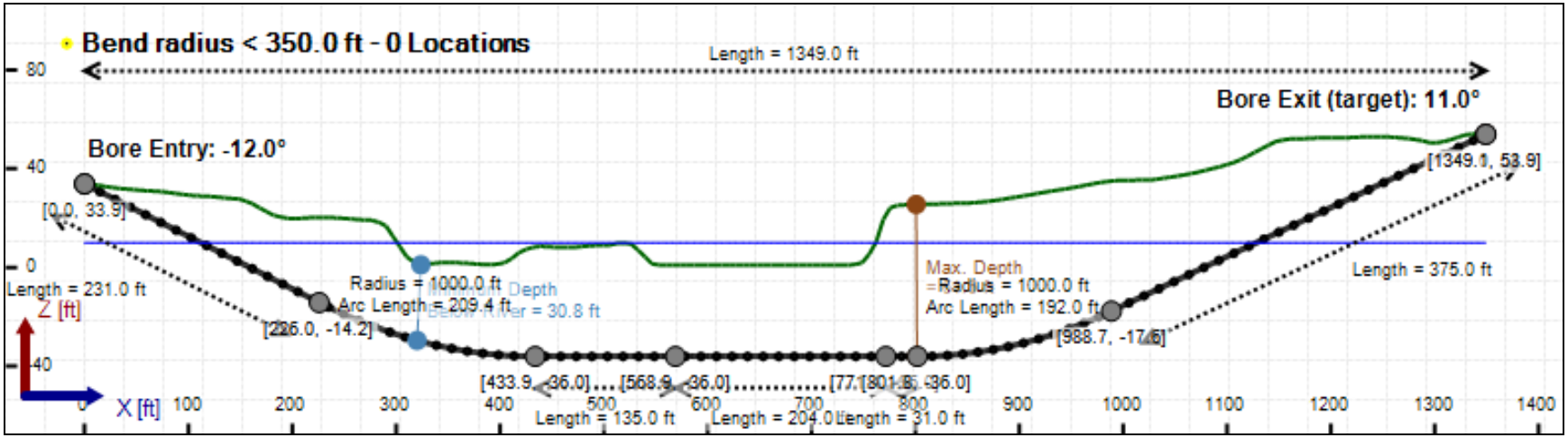
Soil Layer #2 USCS, Clay (C), CL
Depth: 4.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 7.30 [psi]

Soil Layer #3 USCS, Silt (M), ML
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

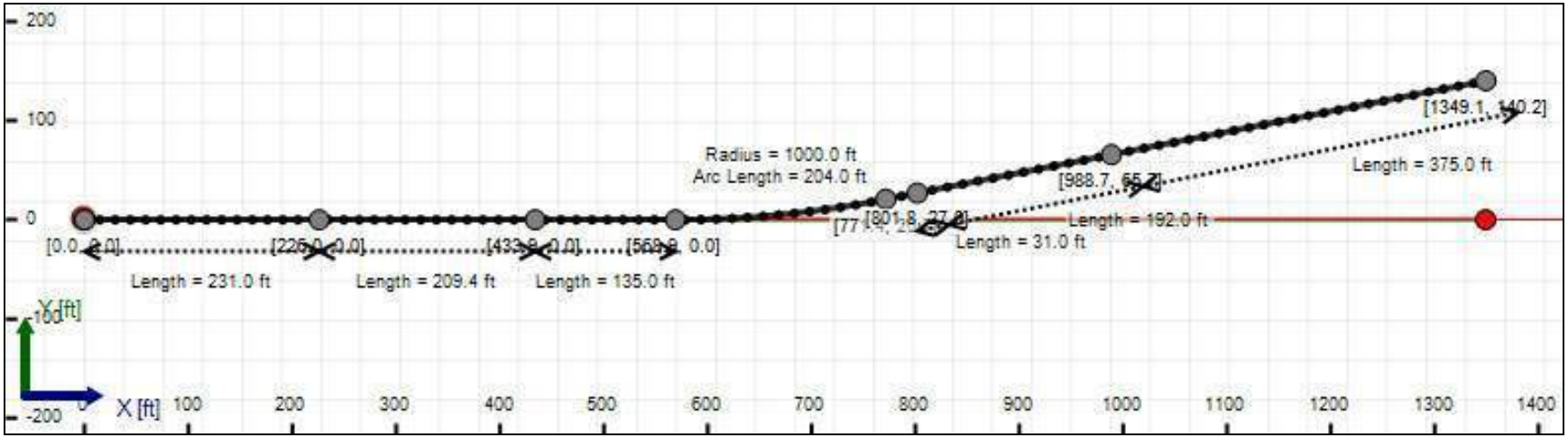
Soil Layer #4 USCS, Gravel (G), GC
Depth: 8.00 ft
Unit Weight: 16.3086 (dry), 18.2028 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks
Depth: 94.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: PVC

Classification: IPS

Pipe OD: 8" (8.625")

Pipe DR: 18

Pipe Length: 1379.99 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.07799990971883 ft

Silo Width: 1.07799990971883 ft

Surface Surcharge: 0 psi

Short Term Modulus: 400000 psi

Long Term Modulus: 400000 psi

Short Term Poisson Ratio: 0.38

Long Term Poisson Ratio: 0.38

Pipe Unit Weight: 11.68400 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 2800 psi

Allowable Tensile Stress (Long Term): 2800 psi

Allowable Compressive Stress (Short Term): 3200 psi

Allowable Compressive Stress (Long Term): 3200 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.0	49.2
Water Pressure	20.0	20.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	25.0	69.2
Deflection		
Earth Load Deflection	0.935	9.070
Buoyant Deflection	0.060	0.060
Reissner Effect	0	0
Net Deflection	0.995	9.129
Compressive Stress [psi]		
Compressive Wall Stress	225.1	622.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	17844.6	17844.6
Pullback Stress [psi]	1455.2	1455.2
Pullback Strain	3.638E-3	3.638E-3
Bending Stress [psi]	0.0	143.8
Bending Strain	0	3.594E-4
Tensile Stress [psi]	1455.2	1589.8
Tensile Strain	3.638E-3	4.334E-3

Net External Pressure = 53.8 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 365.0 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.995	7.5	7.5	OK
Unconstrained Collapse [psi]	58.8	174.1	3.0	OK
Compressive Wall Stress [psi]	225.1	3200.0	14.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.060	7.5	125.5	OK
Unconstrained Collapse [psi]	68.7	160.7	2.3	OK
Tensile Stress [psi]	1589.8	2800.0	1.8	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	1353.042 psi	1363.545 psi
1	8.75 in	12.00 in	1352.891 psi	1363.461 psi
2	12.00 in	12.94 in	1352.838 psi	1363.432 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

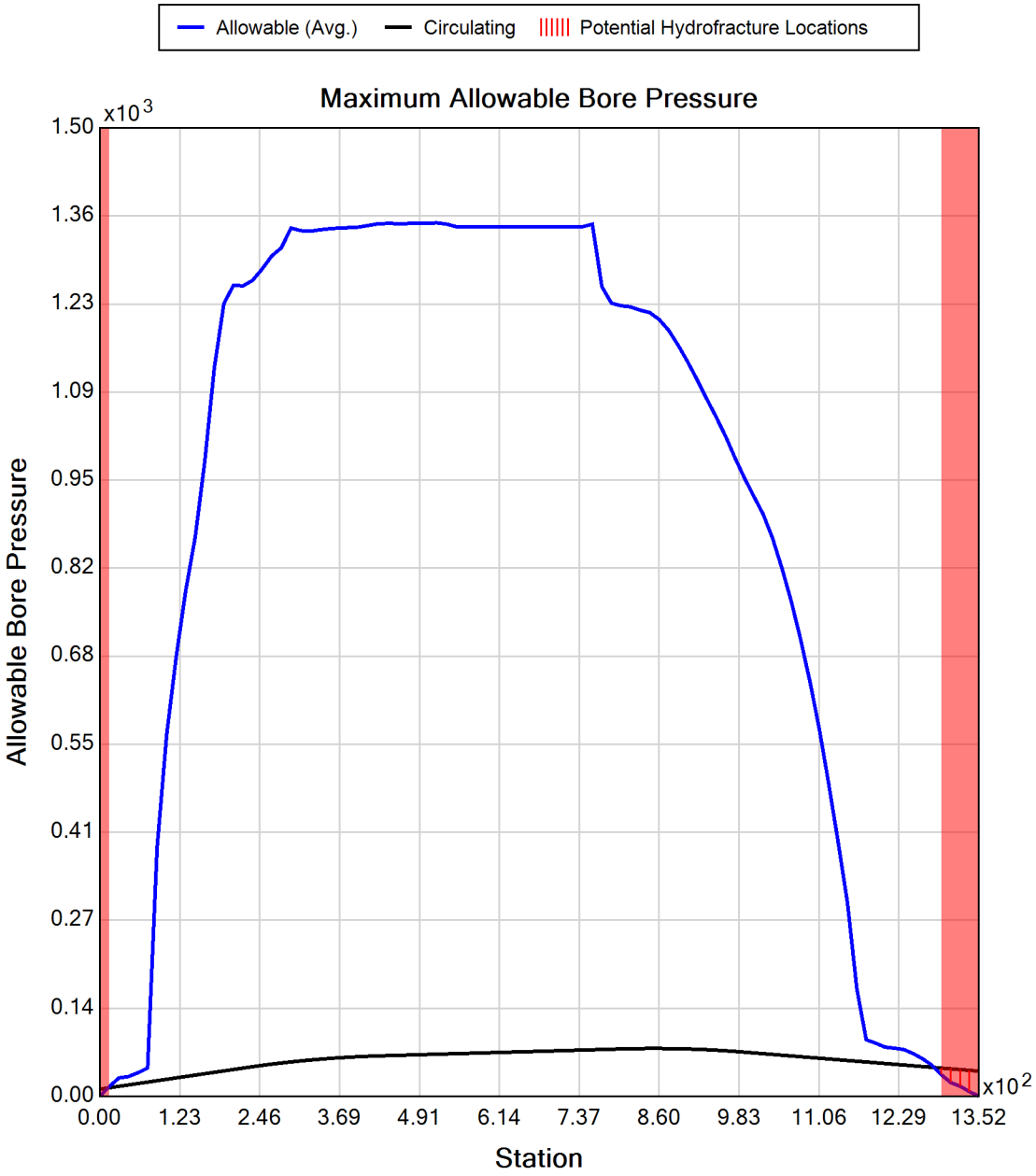
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



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Project Summary

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Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 3 HDD 115 DWG C-315.2

Input Summary

Start Coordinate	(0.00, 0.00, 33.87) ft
End Coordinate	(1349.00, 0.00, 54.01) ft
Project Length	1349.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	9.0
Pipe Thickness	0.39 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GC
Depth: 2.00 ft
Unit Weight: 16.3086 (dry), 18.2028 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

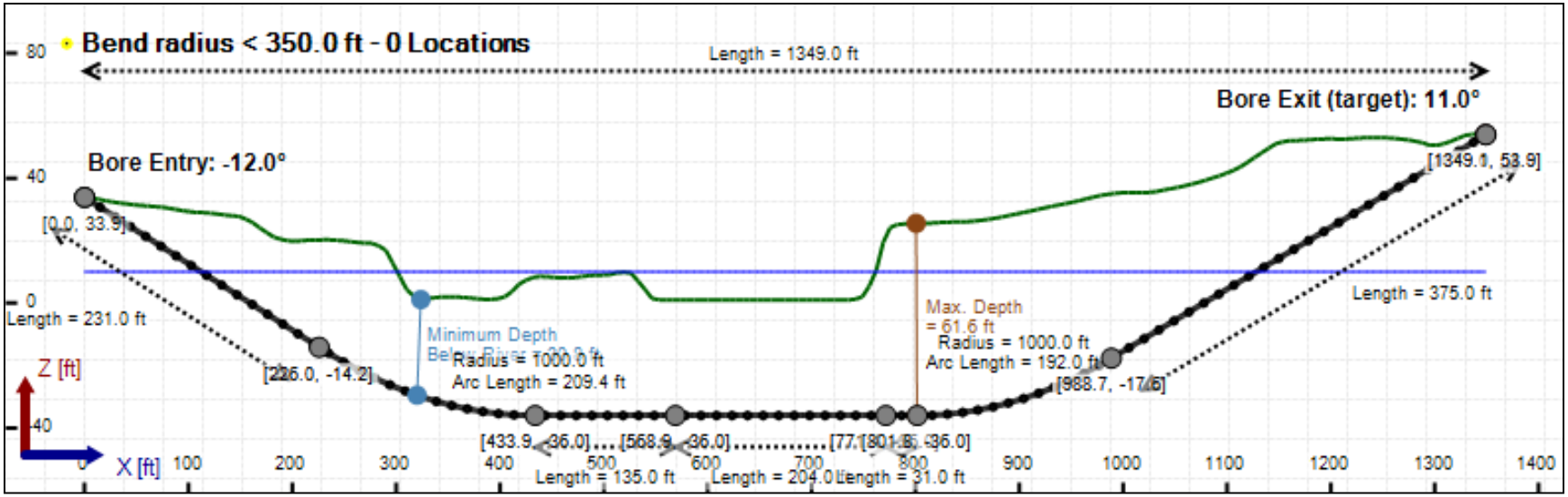
Soil Layer #2 USCS, Clay (C), CL
Depth: 4.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 7.30 [psi]

Soil Layer #3 USCS, Silt (M), ML
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

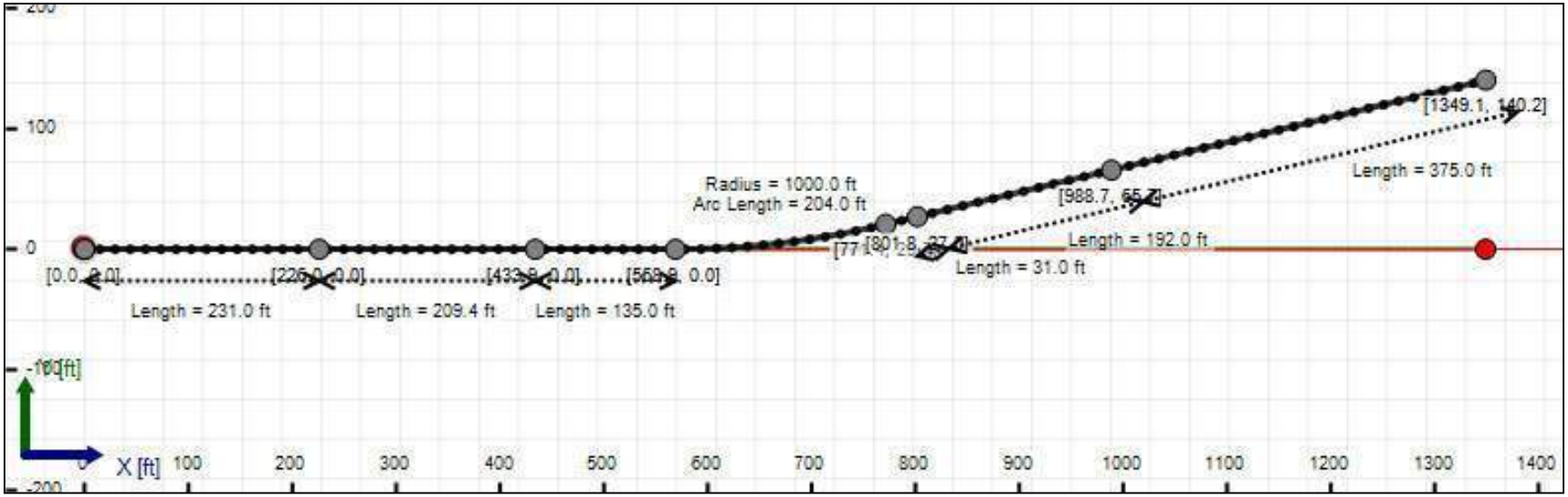
Soil Layer #4 USCS, Gravel (G), GC
Depth: 8.00 ft
Unit Weight: 16.3086 (dry), 18.2028 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks
Depth: 94.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 3" (3.5")

Pipe DR: 9

Pipe Length: 1379.99 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.625 ft

Silo Width: 0.625 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.9	49.2
Water Pressure	20.0	20.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	22.9	69.2
Deflection		
Earth Load Deflection	0.926	13.407
Buoyant Deflection	0.043	0.043
Reissner Effect	0	0
Net Deflection	0.969	13.450
Compressive Stress [psi]		
Compressive Wall Stress	103.0	311.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	2945.2	2945.2
Pullback Stress [psi]	774.9	774.9
Pullback Strain	1.348E-2	1.348E-2
Bending Stress [psi]	0.0	8.4
Bending Strain	0	1.458E-4
Tensile Stress [psi]	774.9	779.6
Tensile Strain	1.348E-2	1.370E-2

Net External Pressure = 53.8 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.969	7.5	7.7	OK
Unconstrained Collapse [psi]	58.8	128.1	2.2	OK
Compressive Wall Stress [psi]	103.0	1150.0	11.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.021	7.5	355.7	OK
Unconstrained Collapse [psi]	68.7	209.6	3.1	OK
Tensile Stress [psi]	779.6	1200.0	1.5	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	1353.042 psi	1363.545 psi
1	8.75 in	12.00 in	1352.891 psi	1363.461 psi
2	12.00 in	12.94 in	1352.838 psi	1363.432 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

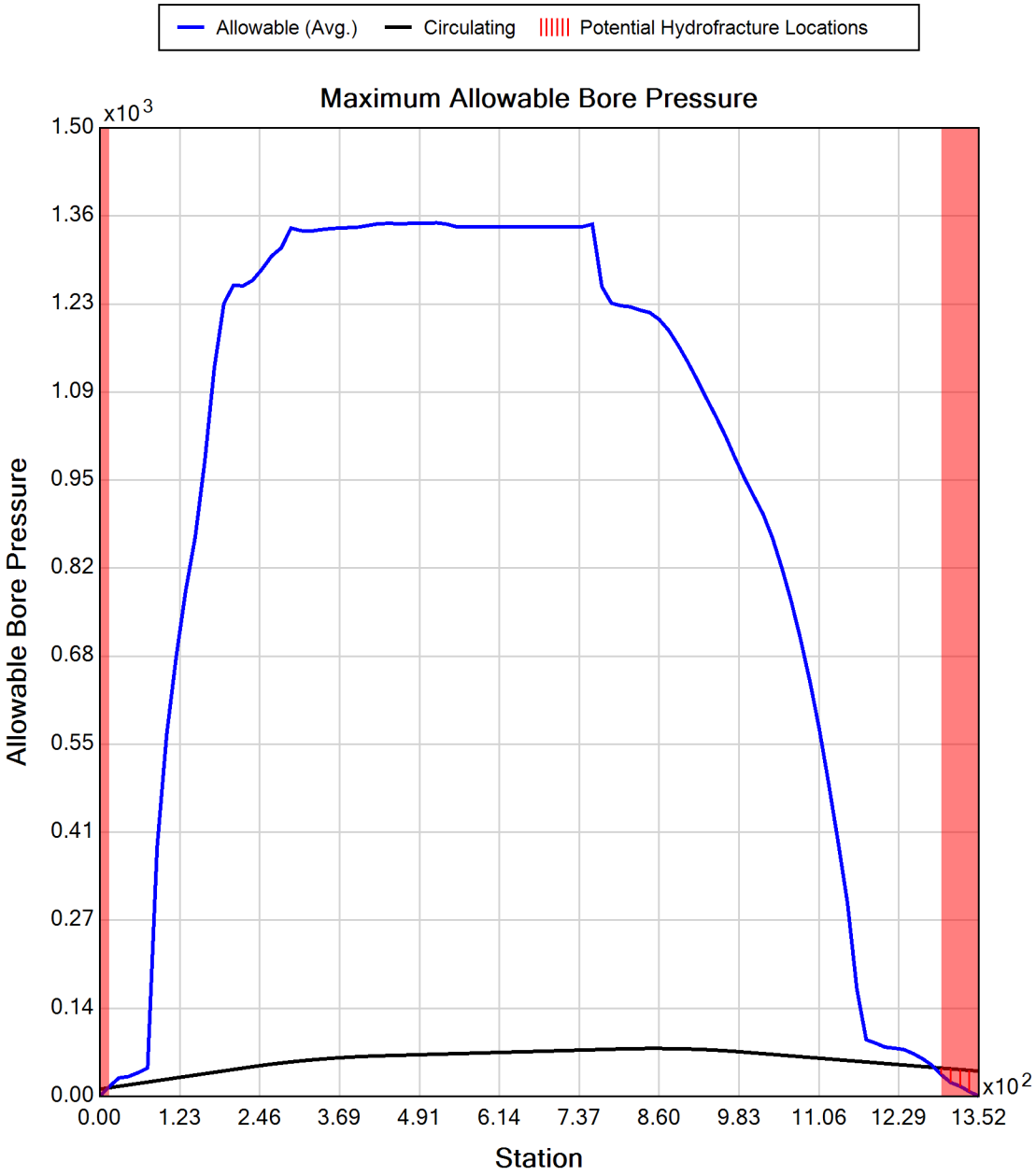
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



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Project Summary

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Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 & 3 Equivalent Pipe Bundle HDD 115 DWG C-315.2

Input Summary

Start Coordinate	(0.00, 0.00, 33.87) ft
End Coordinate	(1349.00, 0.00, 54.01) ft
Project Length	1349.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	12.750 in
Pipe DR	25.0
Pipe Thickness	0.51 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: PVC

Classification: IPS

Pipe OD: 12" (12.75")

Pipe DR: 25

Pipe Length: 1379.99 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.59400002161662 ft

Silo Width: 1.59400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 400000 psi

Long Term Modulus: 400000 psi

Short Term Poisson Ratio: 0.38

Long Term Poisson Ratio: 0.38

Pipe Unit Weight: 11.68400 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 2800 psi

Allowable Tensile Stress (Long Term): 2800 psi

Allowable Compressive Stress (Short Term): 3200 psi

Allowable Compressive Stress (Long Term): 3200 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	7.4	49.2
Water Pressure	20.0	20.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	27.4	69.2
Deflection		
Earth Load Deflection	3.855	25.520
Buoyant Deflection	0.237	0.237
Reissner Effect	0	0
Net Deflection	4.092	25.757
Compressive Stress [psi]		
Compressive Wall Stress	342.5	864.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15944.7	15944.7
Pullback Stress [psi]	813.0	813.0
Pullback Strain	2.033E-3	2.033E-3
Bending Stress [psi]	0.0	212.5
Bending Strain	0	5.313E-4
Tensile Stress [psi]	813.0	1023.4
Tensile Strain	2.033E-3	3.090E-3

Net External Pressure = 24.6 [psi]

Buoyant Deflection = 0.2

Hydrokinetic Force = 798.4 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.237	7.5	31.7	OK
Unconstrained Collapse [psi]	29.6	59.9	2.0	OK
Tensile Stress [psi]	1023.4	2800.0	2.7	OK

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Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 Package 7A Conduit 1 HDD 117 DWG C-317

Input Summary

Start Coordinate	(0.00, 0.00, 100.79) ft
End Coordinate	(735.00, 0.00, 101.29) ft
Project Length	735.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), SP
Depth: 2.00 ft
Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

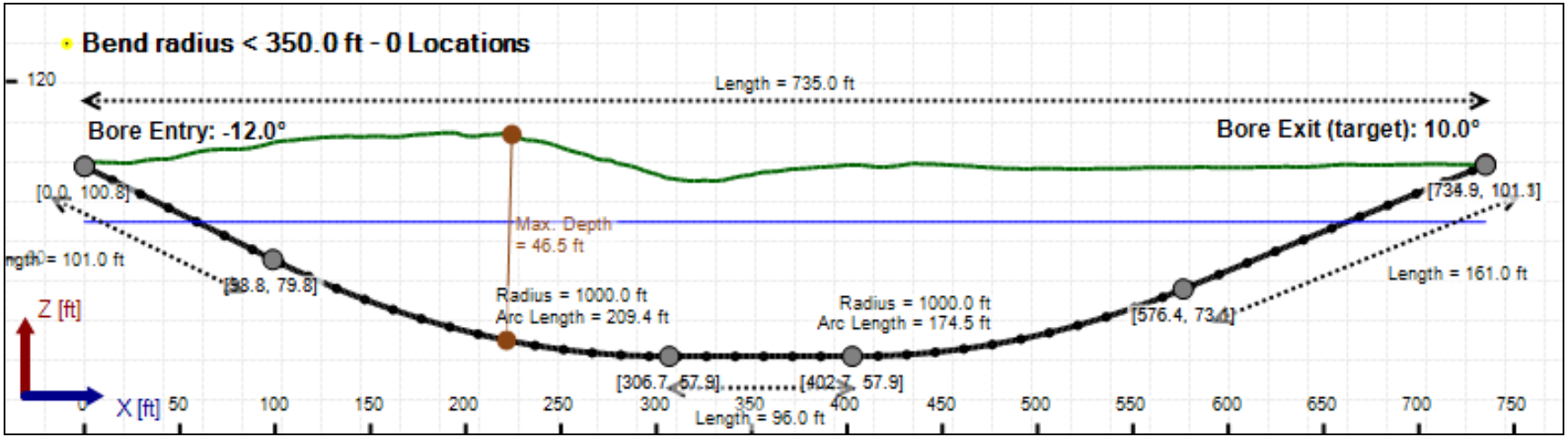
Soil Layer #3 USCS, Silt (M), ML
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML
Depth: 29.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

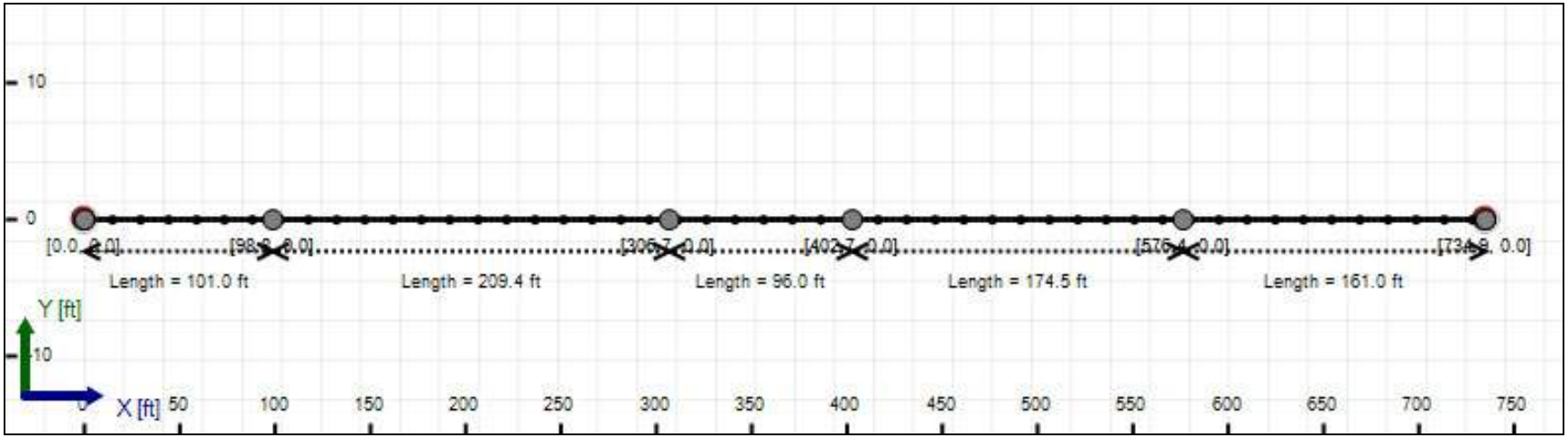
Soil Layer #5 USCS, Silt (M), MH
Depth: 10.00 ft
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #6 USCS, Silt (M), ML
Depth: 37.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 750.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	20.0	26.3
Water Pressure	13.1	11.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	33.1	37.9
Deflection		
Earth Load Deflection	5.440	7.163
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	5.572	7.295
Compressive Stress [psi]		
Compressive Wall Stress	149.0	170.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	13164.4	13164.4
Pullback Stress [psi]	367.1	367.1
Pullback Strain	6.385E-3	6.385E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	367.1	392.7
Tensile Strain	6.385E-3	7.277E-3

Net External Pressure = 23.3 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.572	7.5	1.3	OK
Unconstrained Collapse [psi]	33.1	84.0	2.5	OK
Compressive Wall Stress [psi]	149.0	1150.0	7.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	38.9	234.0	6.0	OK
Tensile Stress [psi]	392.7	1200.0	3.1	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	68.226 psi	57.625 psi
1	8.75 in	12.00 in	68.201 psi	57.594 psi
2	12.00 in	16.13 in	68.157 psi	57.541 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

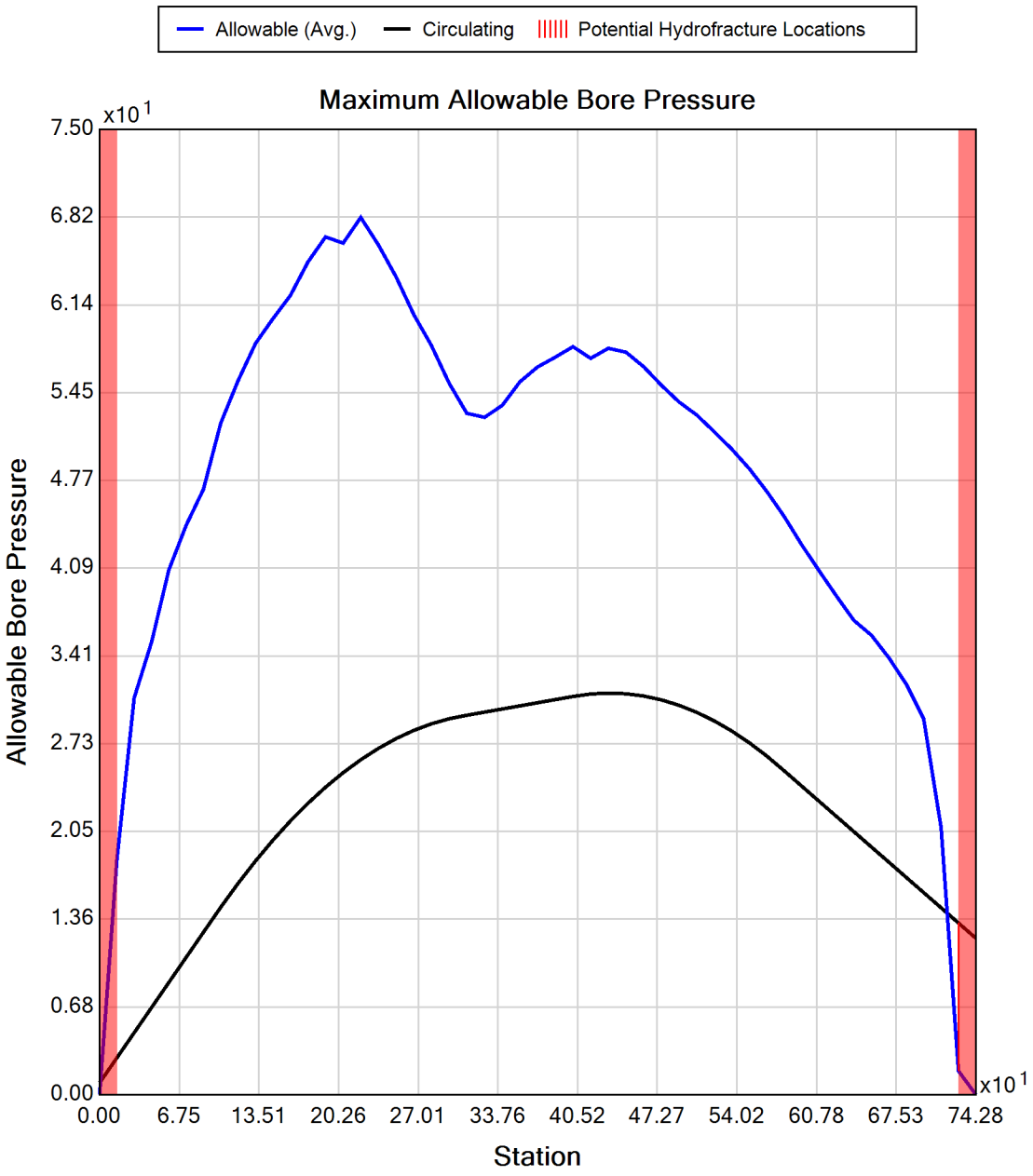
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



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OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning the excavation or underground drilling operation. When the actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If the utility cannot be precisely located, it must be shut off by the utility company.

Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 HDD 117 DWG C-317.2

Input Summary

Start Coordinate	(0.00, 0.00, 105.20) ft
End Coordinate	(790.00, 0.00, 101.50) ft
Project Length	790.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), SP
Depth: 2.00 ft
Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

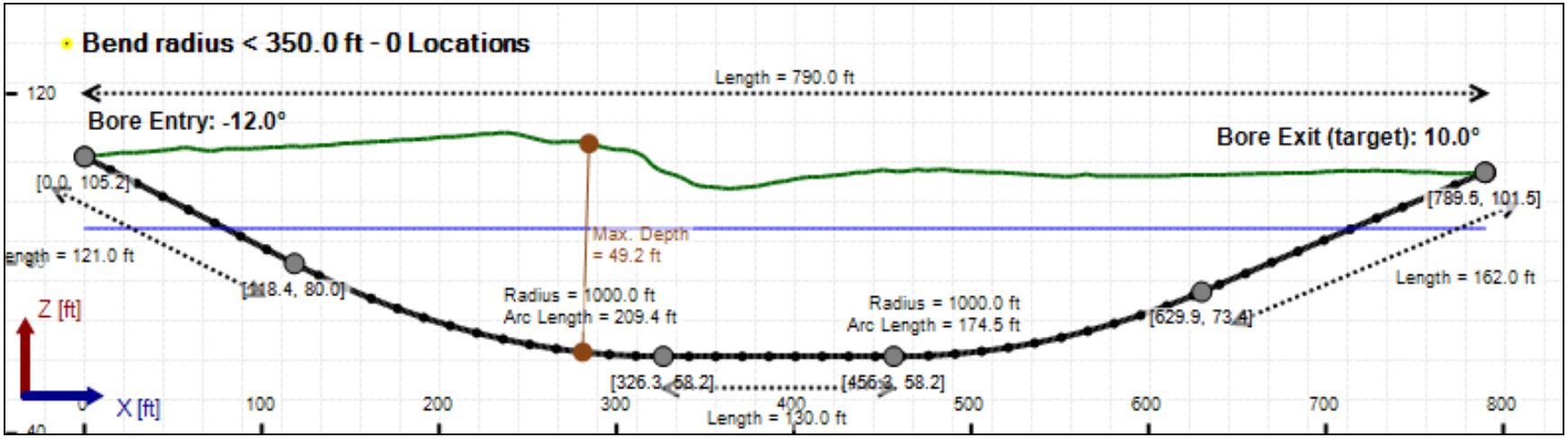
Soil Layer #3 USCS, Silt (M), ML
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML
Depth: 29.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

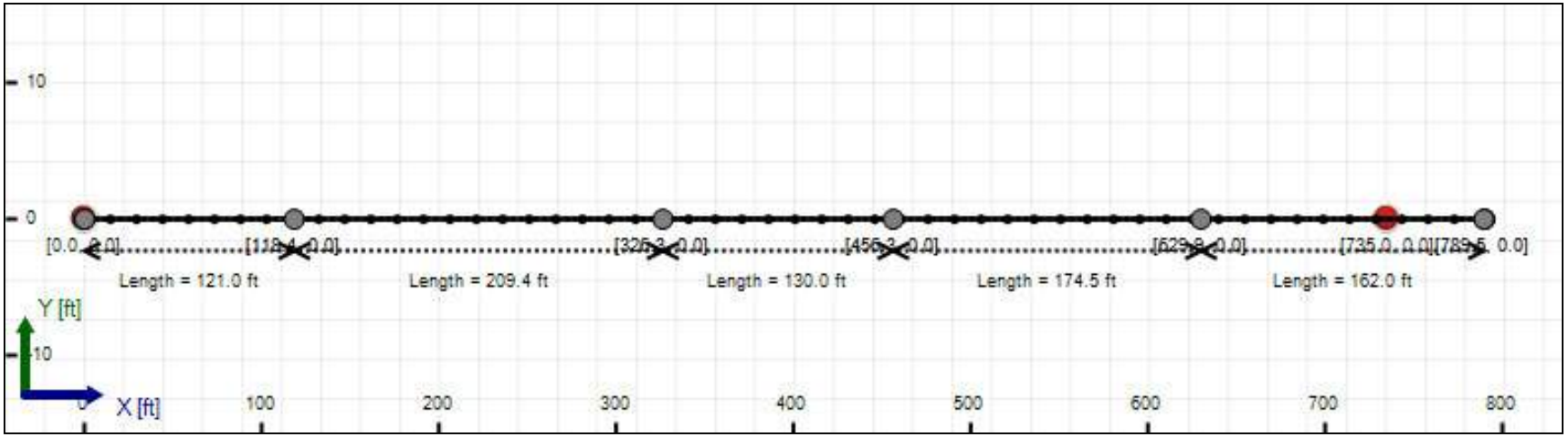
Soil Layer #5 USCS, Silt (M), MH
Depth: 10.00 ft
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #6 USCS, Silt (M), ML
Depth: 37.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 810.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	22.2	26.9
Water Pressure	13.0	12.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	35.3	39.5
Deflection		
Earth Load Deflection	6.056	7.481
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	6.188	7.613
Compressive Stress [psi]		
Compressive Wall Stress	158.7	177.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	14050.5	14050.5
Pullback Stress [psi]	391.8	391.8
Pullback Strain	6.815E-3	6.815E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	391.8	416.2
Tensile Strain	6.815E-3	7.686E-3

Net External Pressure = 26.2 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	6.188	7.5	1.2	OK
Unconstrained Collapse [psi]	35.3	79.5	2.3	OK
Compressive Wall Stress [psi]	158.7	1150.0	7.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	40.6	232.7	5.7	OK
Tensile Stress [psi]	416.2	1200.0	2.9	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	67.239 psi	59.266 psi
1	8.75 in	12.00 in	67.217 psi	59.239 psi
2	12.00 in	16.13 in	67.179 psi	59.192 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

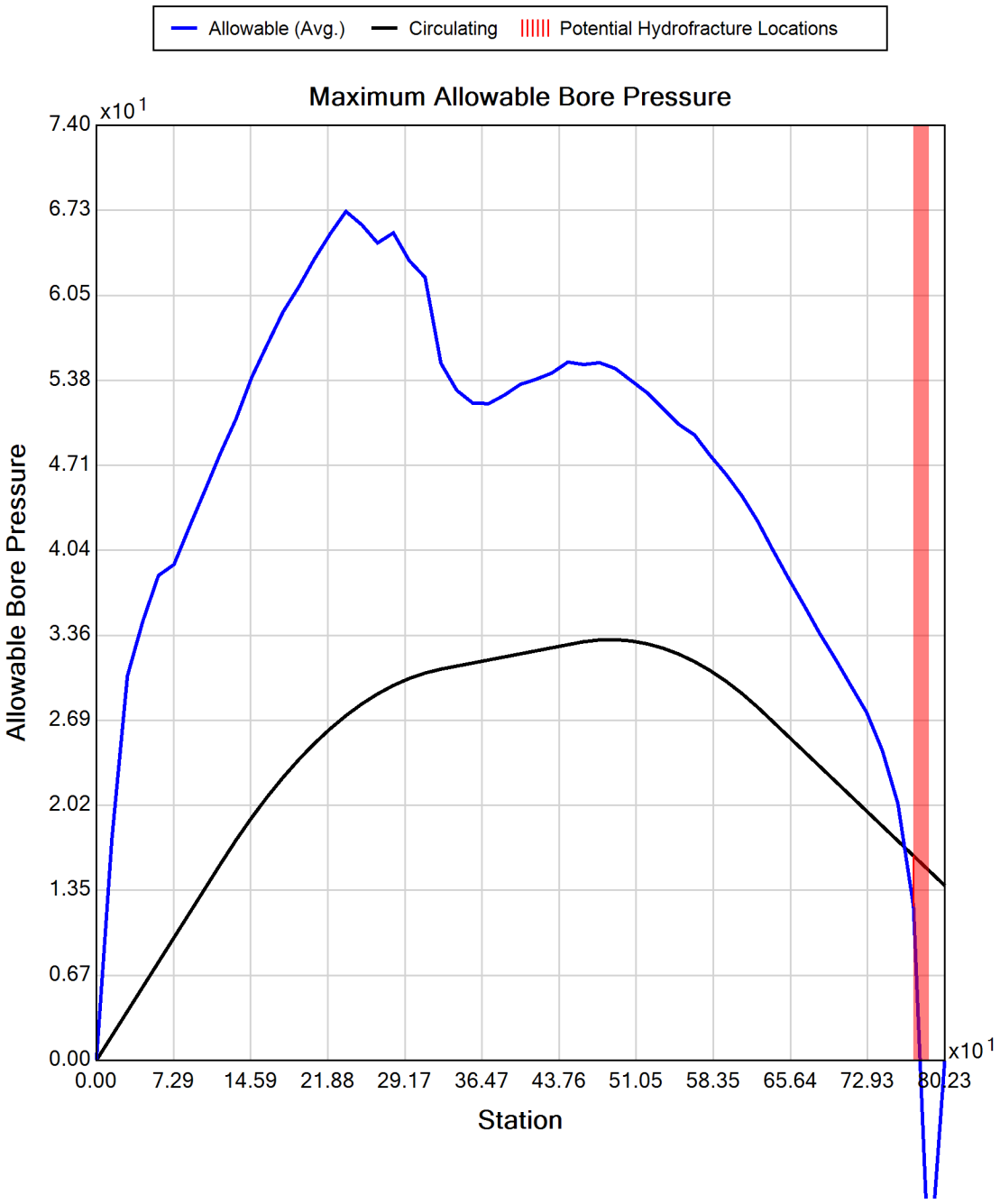
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 3 HDD 117 DWG C-317.2

Input Summary

Start Coordinate	(0.00, 0.00, 105.20) ft
End Coordinate	(790.00, 0.00, 101.50) ft
Project Length	790.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	9.0
Pipe Thickness	0.39 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), SP
Depth: 2.00 ft
Unit Weight: 14.6454 (dry), 16.9323 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

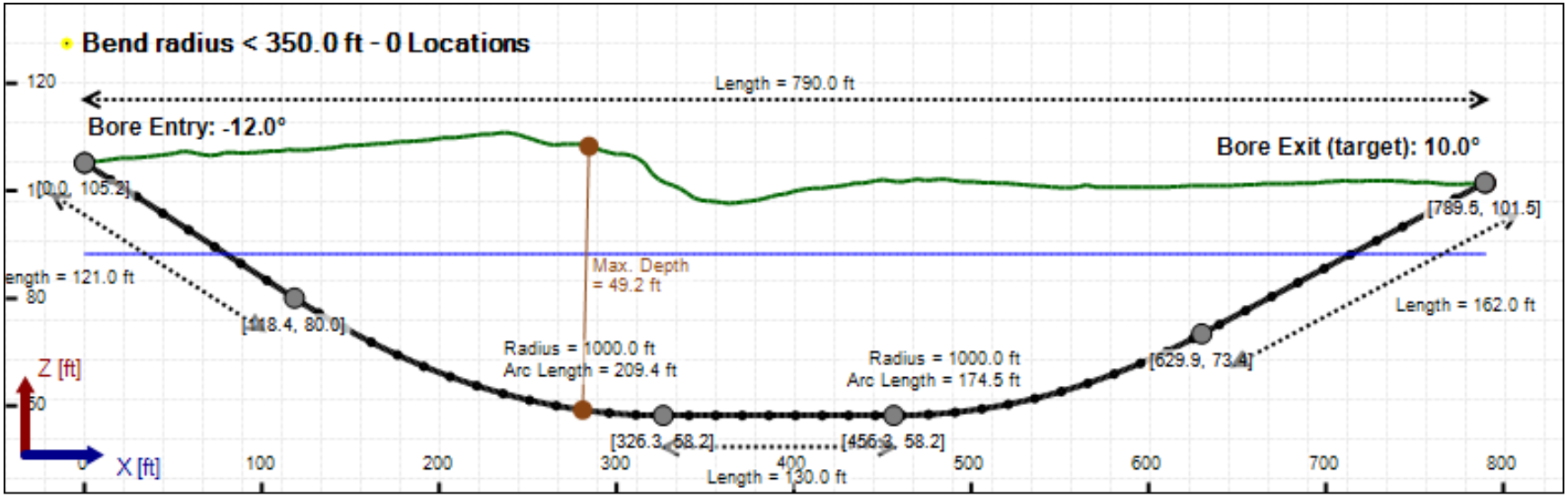
Soil Layer #3 USCS, Silt (M), ML
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML
Depth: 29.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

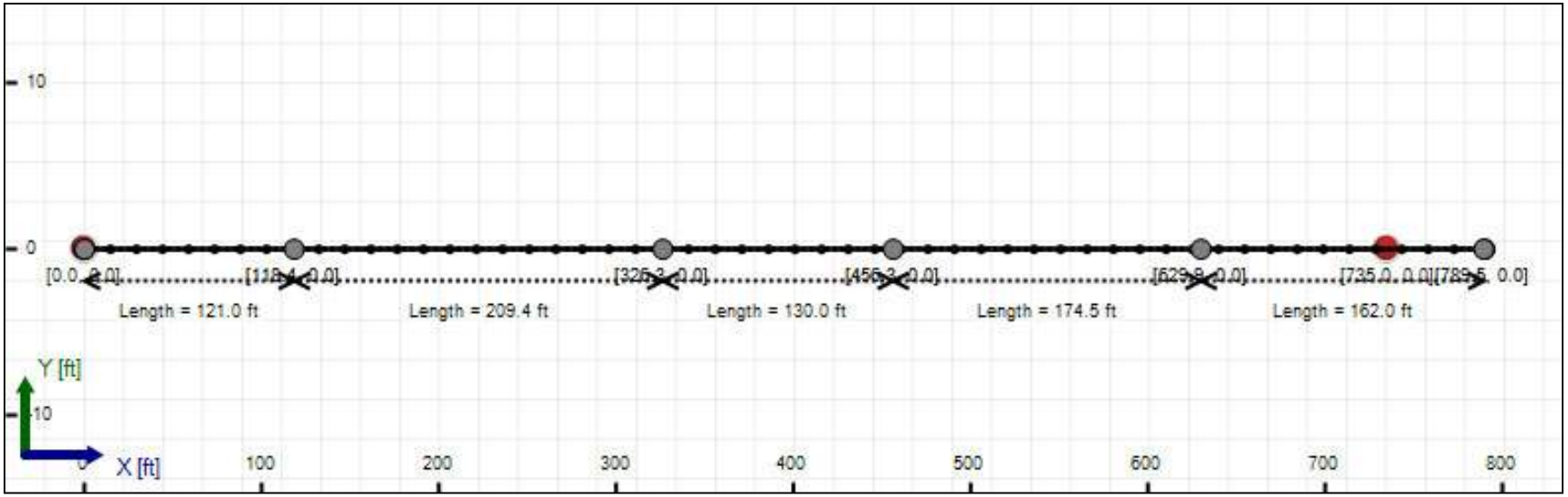
Soil Layer #5 USCS, Silt (M), MH
Depth: 10.00 ft
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #6 USCS, Silt (M), ML
Depth: 37.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 3" (3.5")

Pipe DR: 9

Pipe Length: 810.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.625 ft

Silo Width: 0.625 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	22.2	26.9
Water Pressure	13.0	12.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	35.3	39.5
Deflection		
Earth Load Deflection	6.056	7.481
Buoyant Deflection	0.043	0.043
Reissner Effect	0	0
Net Deflection	6.099	7.524
Compressive Stress [psi]		
Compressive Wall Stress	158.7	177.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1602.0	1602.0
Pullback Stress [psi]	421.5	421.5
Pullback Strain	7.330E-3	7.330E-3
Bending Stress [psi]	0.0	8.4
Bending Strain	0	1.458E-4
Tensile Stress [psi]	421.5	428.5
Tensile Strain	7.330E-3	7.597E-3

Net External Pressure = 26.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	6.099	7.5	1.2	OK
Unconstrained Collapse [psi]	35.3	80.2	2.3	OK
Compressive Wall Stress [psi]	158.7	1150.0	7.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.021	7.5	355.7	OK
Unconstrained Collapse [psi]	40.6	232.8	5.7	OK
Tensile Stress [psi]	428.5	1200.0	2.8	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	67.239 psi	59.266 psi
1	8.75 in	12.00 in	67.217 psi	59.239 psi
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Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

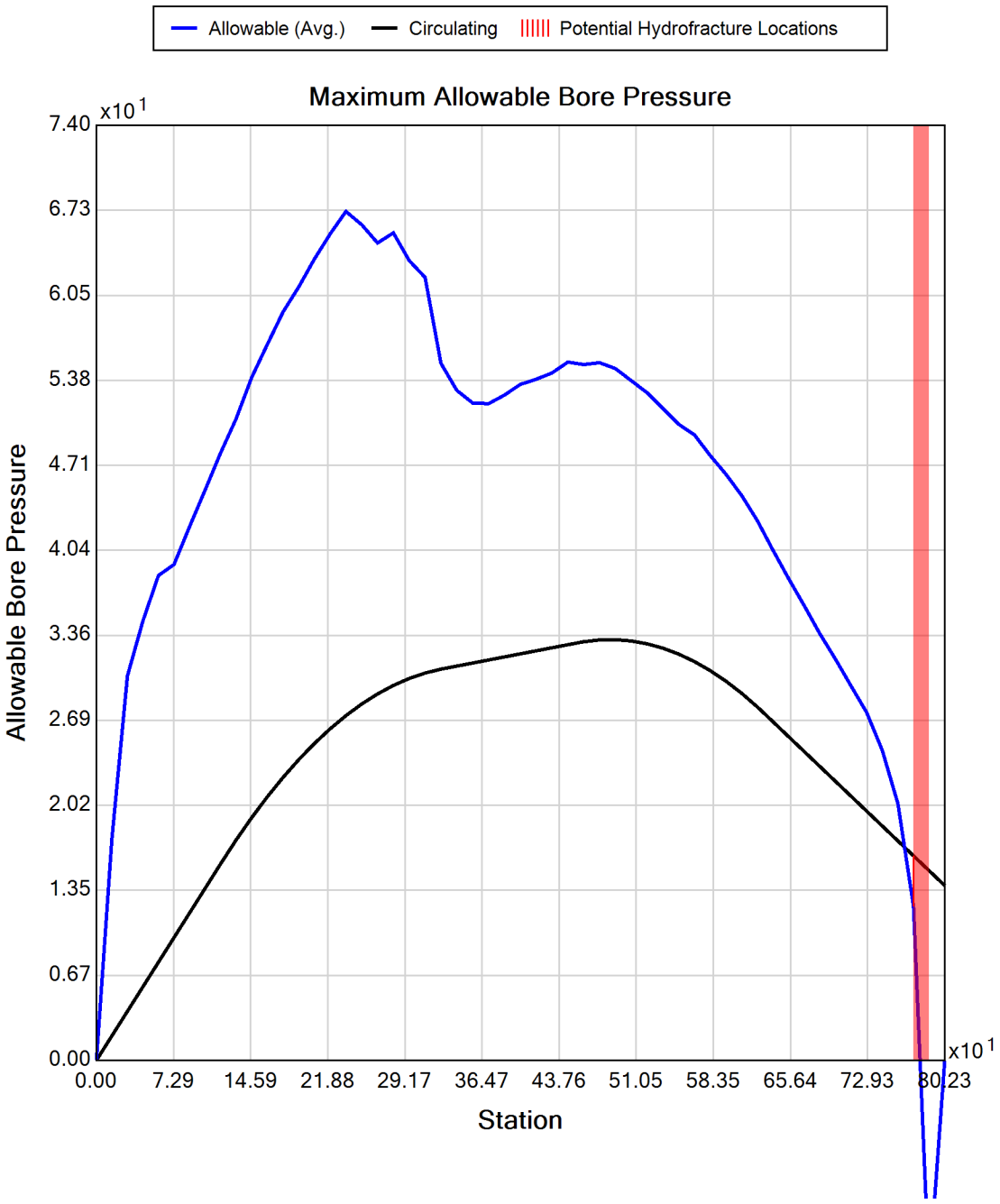
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 & 3 Equivalent Pipe Bundle HDD 117 DWG C-317.2

Input Summary

Start Coordinate	(0.00, 0.00, 105.20) ft
End Coordinate	(790.00, 0.00, 101.50) ft
Project Length	790.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 810.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	22.2	26.9
Water Pressure	13.0	12.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	35.3	39.5
Deflection		
Earth Load Deflection	27.829	34.373
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	28.519	35.063
Compressive Stress [psi]		
Compressive Wall Stress	252.2	282.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11898.2	11898.2
Pullback Stress [psi]	297.1	297.1
Pullback Strain	5.167E-3	5.167E-3
Bending Stress [psi]	33.5	33.5
Bending Strain	5.833E-4	5.833E-4
Tensile Stress [psi]	330.6	330.6
Tensile Strain	6.334E-3	6.334E-3

Net External Pressure = 16.1 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.338	7.5	22.2	OK
Unconstrained Collapse [psi]	20.2	50.2	2.5	OK
Tensile Stress [psi]	330.6	1200.0	3.6	OK

Generated Output

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 1 HDD 118 DWG C-318

Input Summary

Start Coordinate	(0.00, 0.00, 134.19) ft
End Coordinate	(850.00, 0.00, 122.96) ft
Project Length	850.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

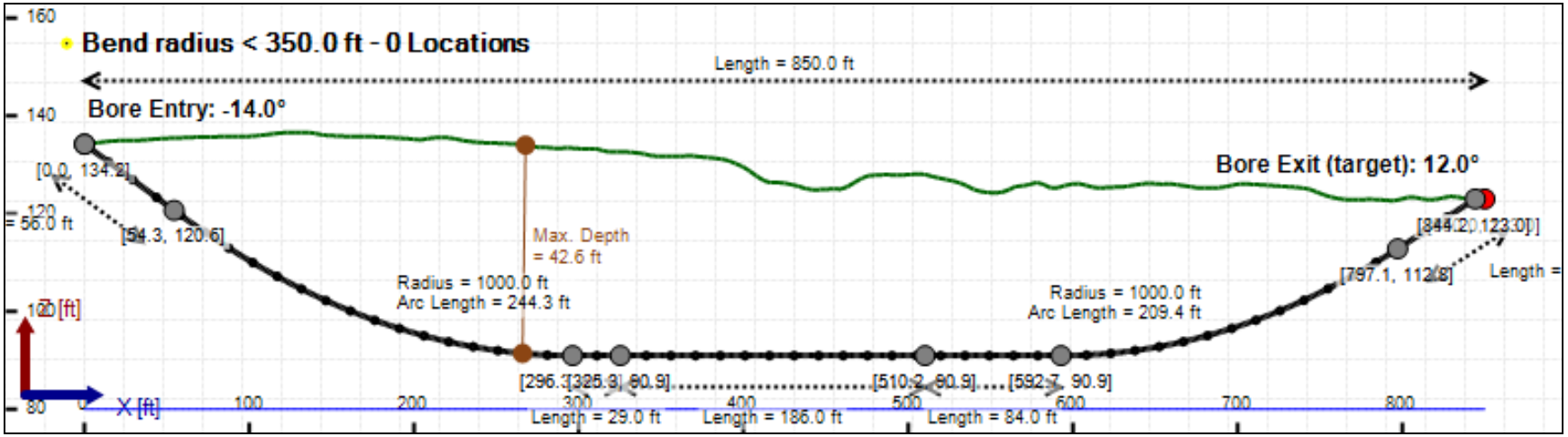
Soil Layer #1 USCS, Gravel (G), GW
From Assistant
Unit Weight: 17.3250 (dry), 18.9651 (sat) [lb/US (liquid) gallon]
Phi: 40.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), MH
From Assistant
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

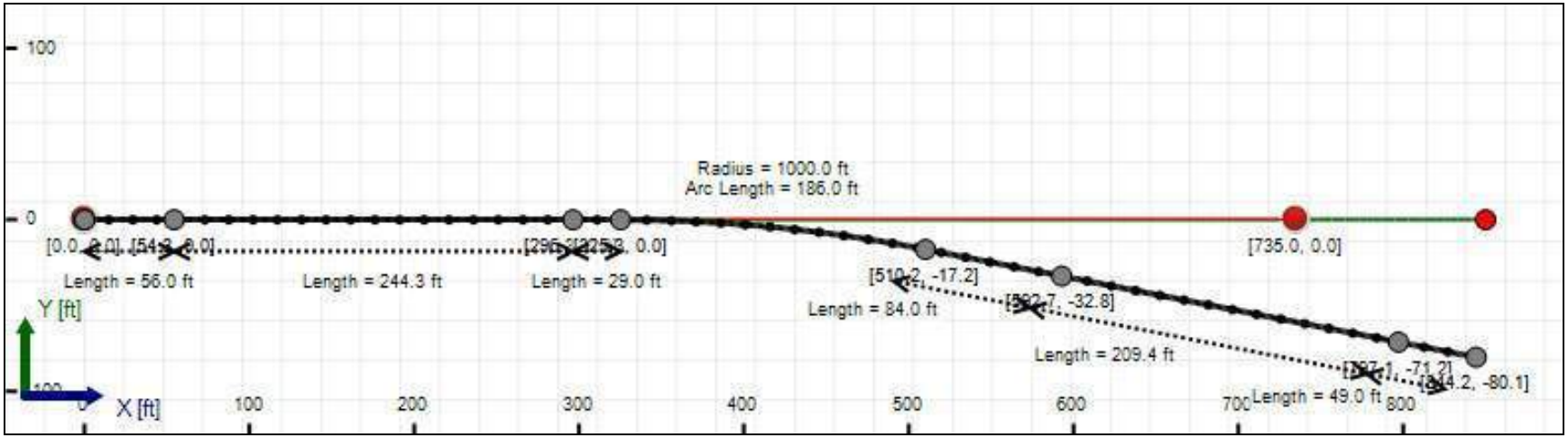
Soil Layer #3 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 869.99 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	21.0	31.9
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	21.0	31.9
Deflection		
Earth Load Deflection	5.731	8.693
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	5.863	8.825
Compressive Stress [psi]		
Compressive Wall Stress	94.7	143.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15404.2	15404.2
Pullback Stress [psi]	429.6	429.6
Pullback Strain	7.471E-3	7.471E-3
Bending Stress [psi]	25.8	25.8
Bending Strain	4.479E-4	4.479E-4
Tensile Stress [psi]	455.4	455.4
Tensile Strain	8.367E-3	8.367E-3

Net External Pressure = 19.4 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.863	7.5	1.3	OK
Unconstrained Collapse [psi]	27.8	81.9	2.9	OK
Compressive Wall Stress [psi]	94.7	1150.0	12.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	38.1	230.3	6.0	OK
Tensile Stress [psi]	455.4	1200.0	2.6	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	897.089 psi	1329.070 psi
1	8.75 in	12.00 in	896.960 psi	1328.895 psi
2	12.00 in	16.13 in	896.737 psi	1328.594 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

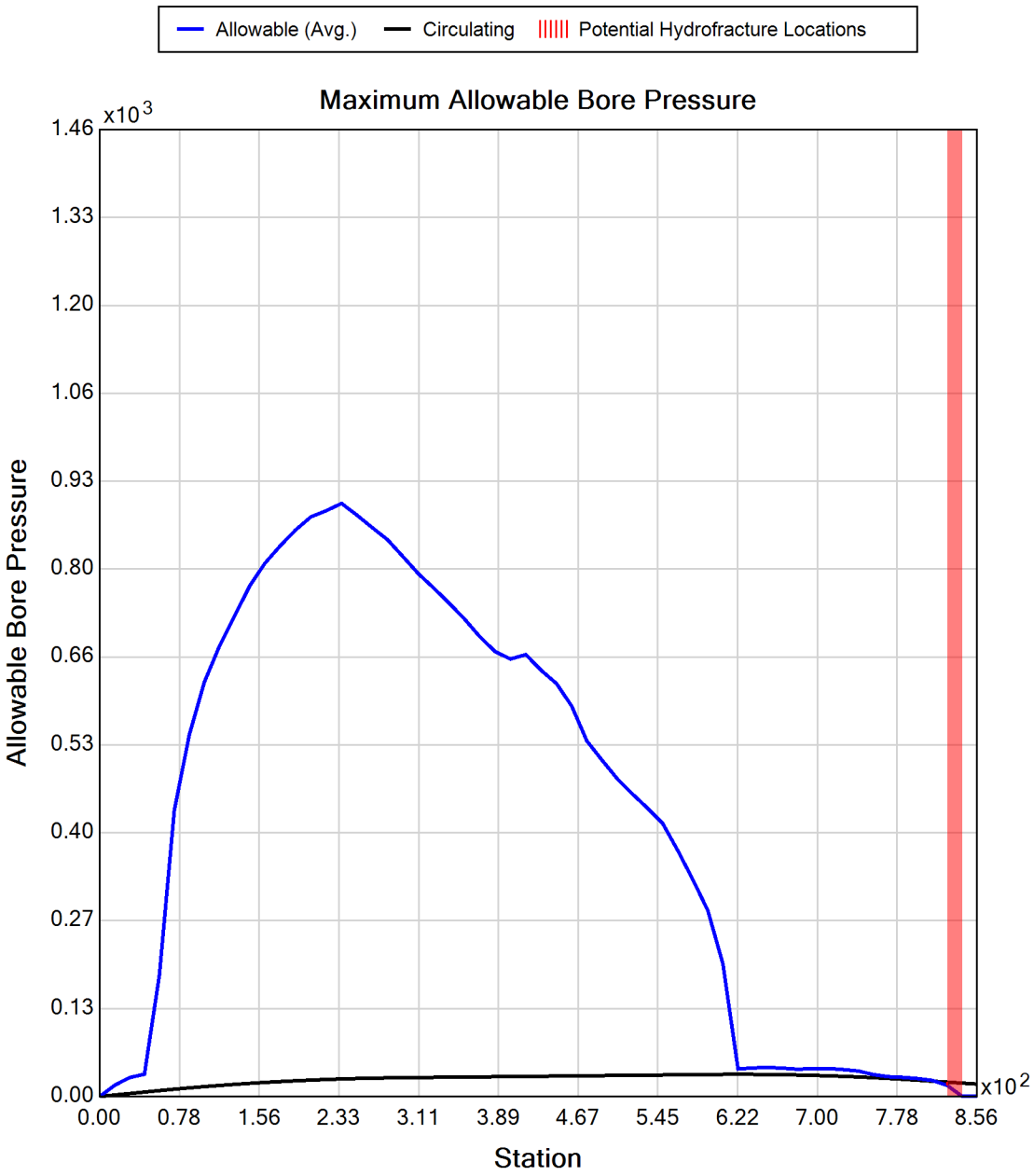
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 HDD 118 DWG C-318.2

Input Summary

Start Coordinate	(0.00, 0.00, 133.93) ft
End Coordinate	(854.50, 0.00, 121.52) ft
Project Length	854.50 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

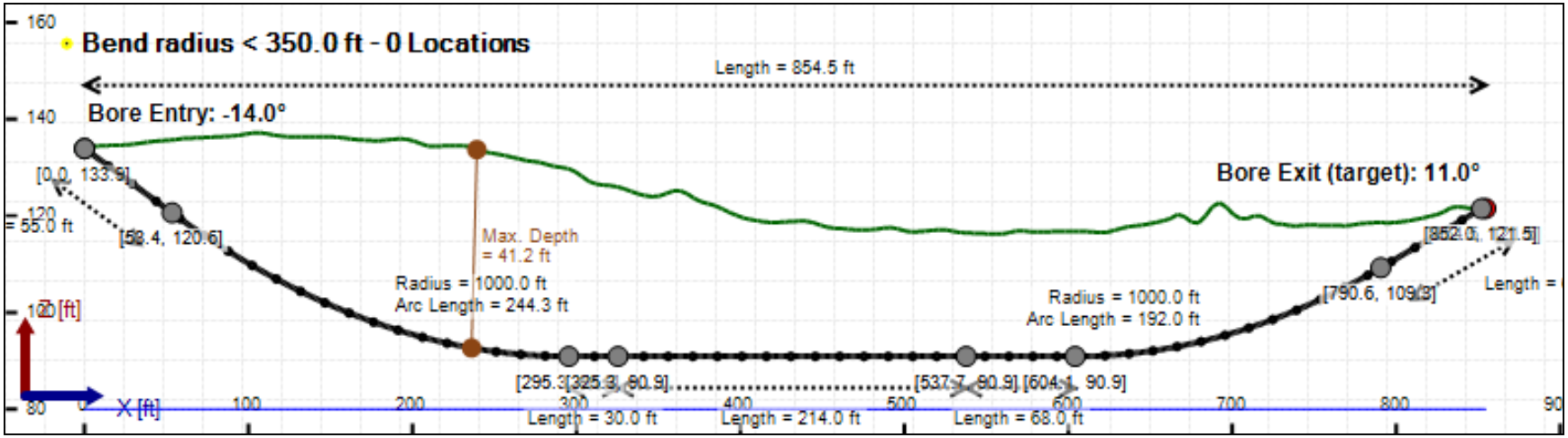
Soil Layer #1 USCS, Gravel (G), GW
From Assistant
Unit Weight: 17.3250 (dry), 18.9651 (sat) [lb/US (liquid) gallon]
Phi: 40.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), MH
From Assistant
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

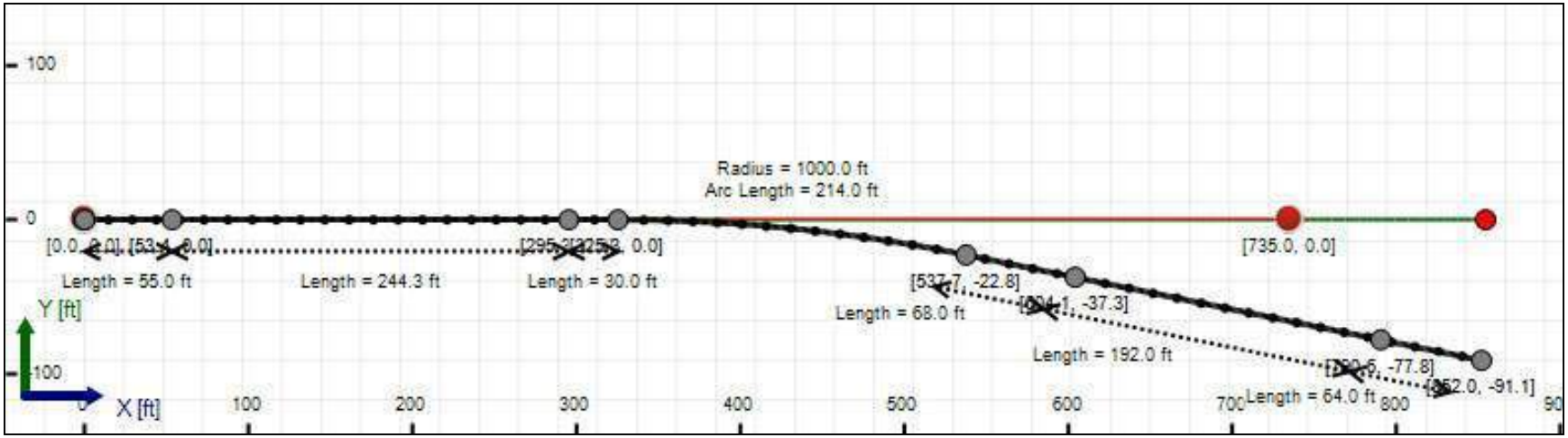
Soil Layer #3 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 869.99 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	18.8	31.2
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.8	31.2
Deflection		
Earth Load Deflection	5.112	8.492
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	5.244	8.624
Compressive Stress [psi]		
Compressive Wall Stress	84.5	140.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15189.1	15189.1
Pullback Stress [psi]	423.6	423.6
Pullback Strain	7.367E-3	7.367E-3
Bending Stress [psi]	25.8	25.8
Bending Strain	4.479E-4	4.479E-4
Tensile Stress [psi]	449.4	449.4
Tensile Strain	8.263E-3	8.263E-3

Net External Pressure = 19.4 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.244	7.5	1.4	OK
Unconstrained Collapse [psi]	27.9	87.2	3.1	OK
Compressive Wall Stress [psi]	84.5	1150.0	13.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	37.9	230.5	6.1	OK
Tensile Stress [psi]	449.4	1200.0	2.7	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	903.243 psi	1328.445 psi
1	8.75 in	12.00 in	903.110 psi	1328.261 psi
2	12.00 in	16.13 in	902.881 psi	1327.943 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

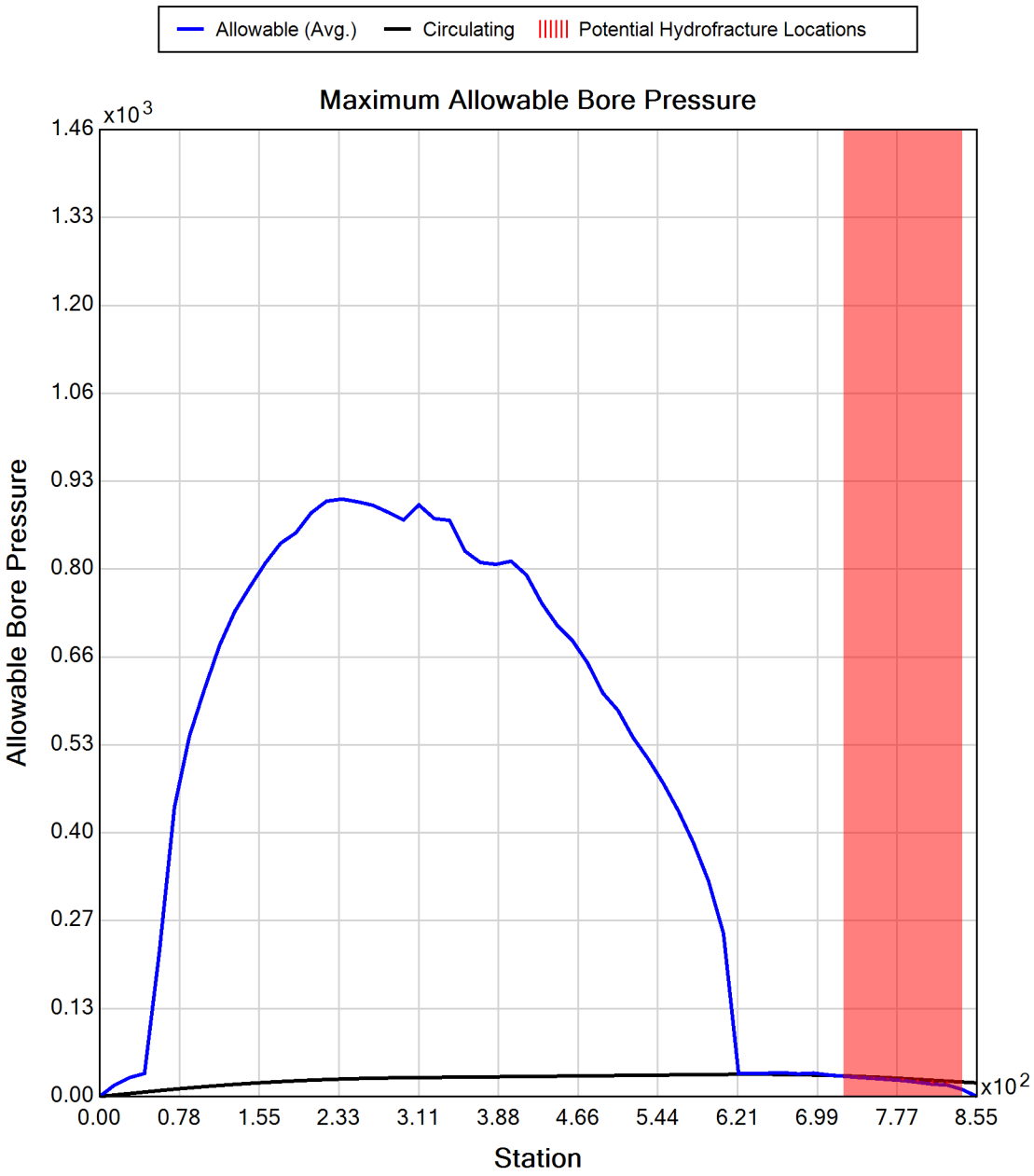
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



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Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 3 HDD 118 DWG C-318.2

Input Summary

Start Coordinate	(0.00, 0.00, 133.93) ft
End Coordinate	(854.50, 0.00, 121.52) ft
Project Length	854.50 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	9.0
Pipe Thickness	0.39 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

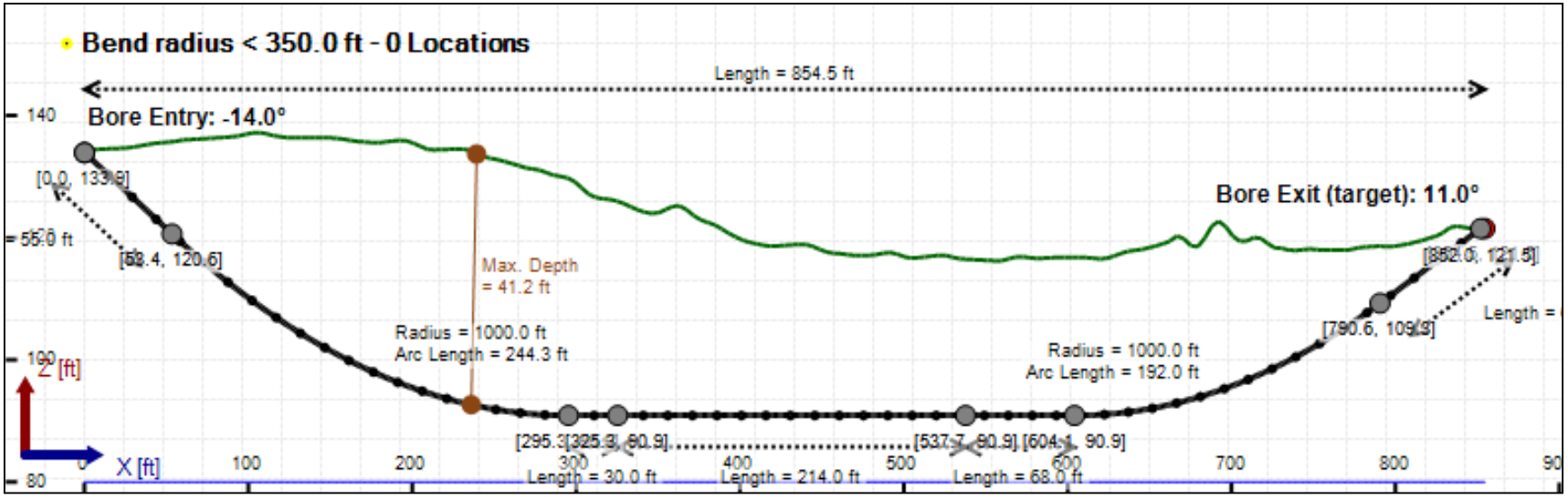
Soil Layer #1 USCS, Gravel (G), GW
From Assistant
Unit Weight: 17.3250 (dry), 18.9651 (sat) [lb/US (liquid) gallon]
Phi: 40.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), MH
From Assistant
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

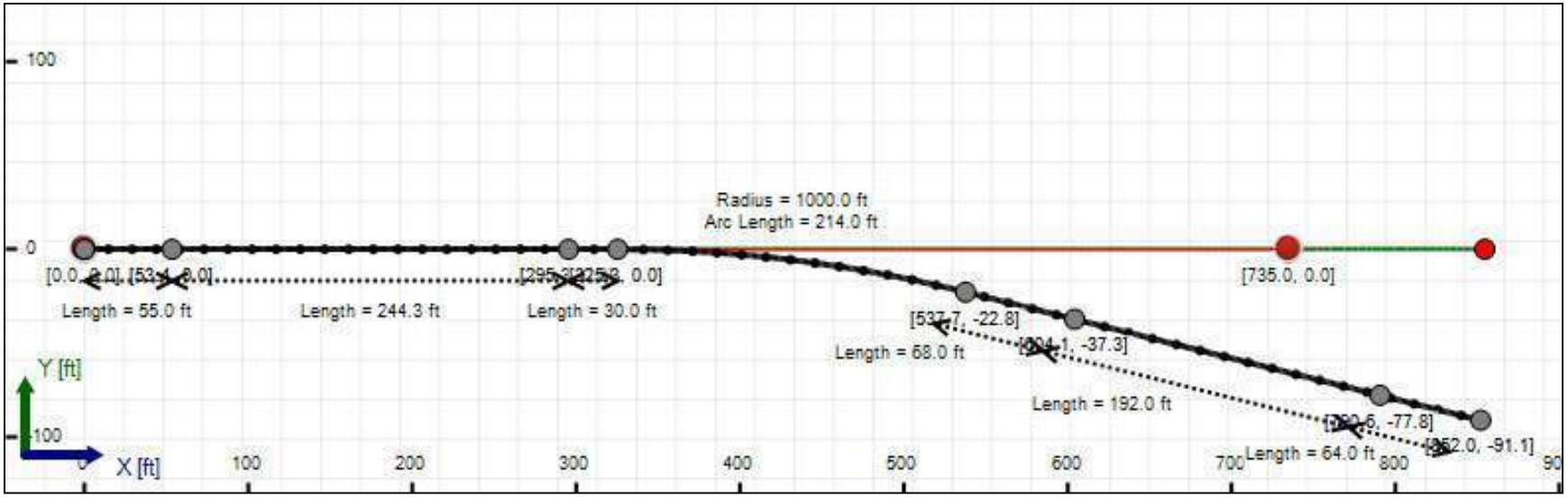
Soil Layer #3 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 3" (3.5")

Pipe DR: 9

Pipe Length: 869.99 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.625 ft

Silo Width: 0.625 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	18.8	31.2
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.8	31.2
Deflection		
Earth Load Deflection	5.112	8.492
Buoyant Deflection	0.043	0.043
Reissner Effect	0	0
Net Deflection	5.155	8.535
Compressive Stress [psi]		
Compressive Wall Stress	84.5	140.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1722.7	1722.7
Pullback Stress [psi]	453.2	453.2
Pullback Strain	7.882E-3	7.882E-3
Bending Stress [psi]	8.4	8.4
Bending Strain	1.458E-4	1.458E-4
Tensile Stress [psi]	461.6	461.6
Tensile Strain	8.174E-3	8.174E-3

Net External Pressure = 19.4 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.155	7.5	1.5	OK
Unconstrained Collapse [psi]	27.9	87.8	3.2	OK
Compressive Wall Stress [psi]	84.5	1150.0	13.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.021	7.5	355.7	OK
Unconstrained Collapse [psi]	37.9	230.5	6.1	OK
Tensile Stress [psi]	461.6	1200.0	2.6	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	903.243 psi	1328.445 psi
1	8.75 in	12.00 in	903.110 psi	1328.261 psi
2	12.00 in	16.13 in	902.881 psi	1327.943 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

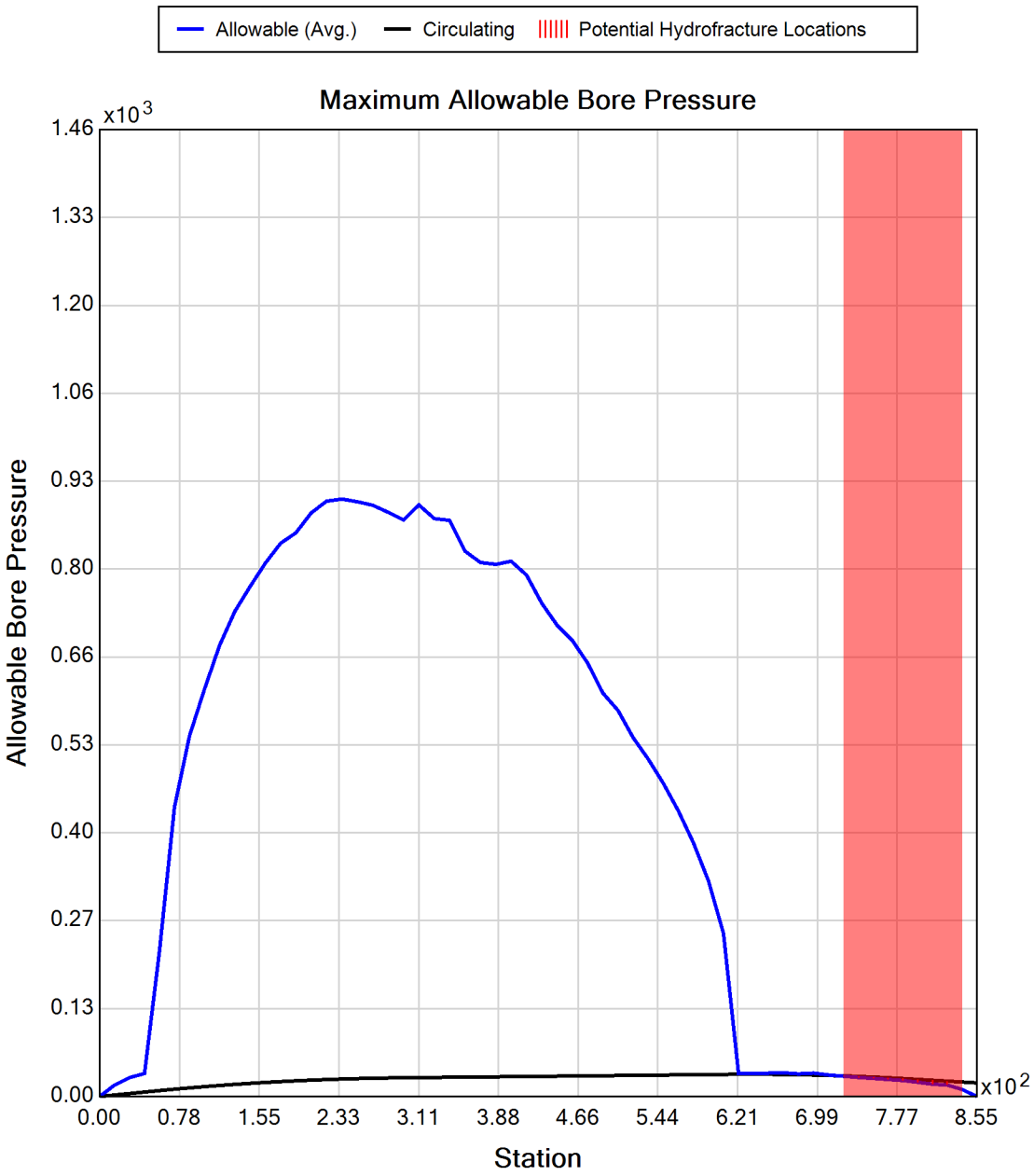
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



Generated Output

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 & 3 Equivalent Pipe Bundle HDD 118 DWG C-318.2

Input Summary

Start Coordinate	(0.00, 0.00, 133.93) ft
End Coordinate	(854.50, 0.00, 121.52) ft
Project Length	854.50 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 869.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	18.8	31.2
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.8	31.2
Deflection		
Earth Load Deflection	23.489	39.021
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	24.179	39.711
Compressive Stress [psi]		
Compressive Wall Stress	134.2	222.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	12736.8	12736.8
Pullback Stress [psi]	318.0	318.0
Pullback Strain	5.531E-3	5.531E-3
Bending Stress [psi]	33.5	33.5
Bending Strain	5.833E-4	5.833E-4
Tensile Stress [psi]	351.6	351.6
Tensile Strain	6.698E-3	6.698E-3

Net External Pressure = 15.2 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.338	7.5	22.2	OK
Unconstrained Collapse [psi]	19.3	49.9	2.6	OK
Tensile Stress [psi]	351.6	1200.0	3.4	OK

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 1 HDD 119 DWG C-319

Input Summary

Start Coordinate	(0.00, 0.00, 94.50) ft
End Coordinate	(840.00, 0.00, 116.17) ft
Project Length	840.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	8.625 in
Pipe DR	18.0
Pipe Thickness	0.48 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #2 USCS, Silt (M), MH
From Assistant
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 32.00, S.M.: 100.00, Coh: 0.00 [psi]

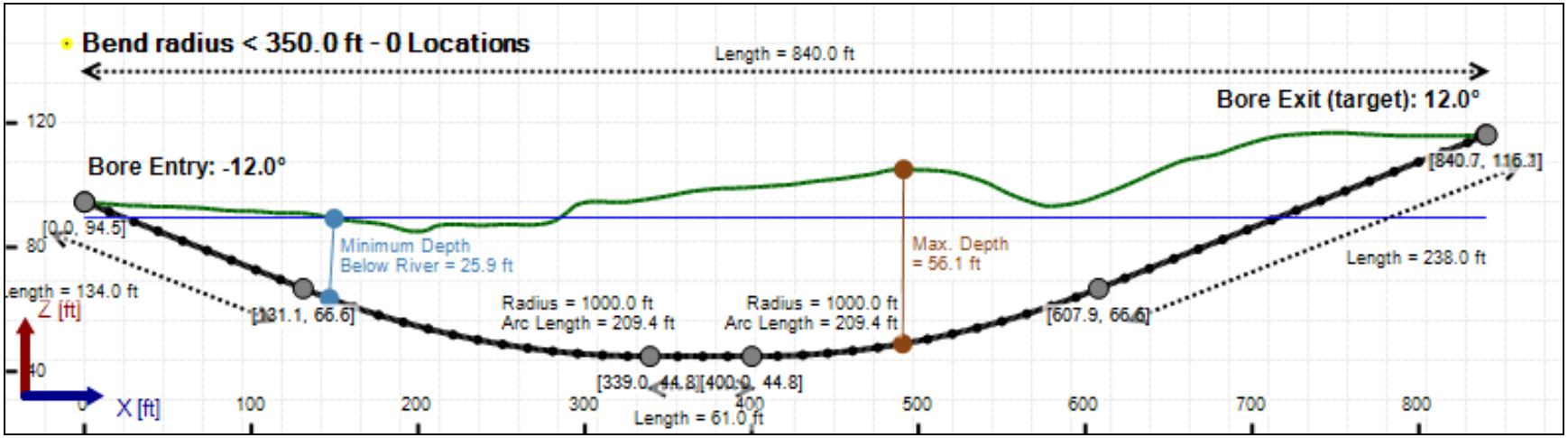
Soil Layer #3 USCS, Clay (C), CH
From Assistant
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #4 USCS, Silt (M), ML
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

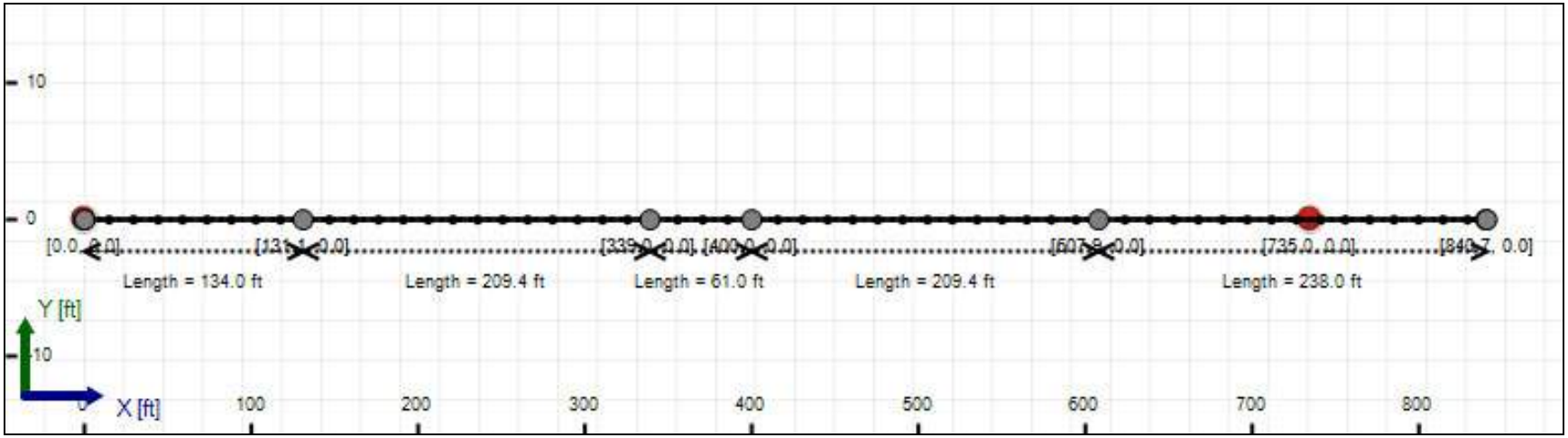
Soil Layer #5 USCS, Silt (M), MH
From Assistant
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

Soil Layer #6 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: PVC

Classification: IPS

Pipe OD: 8" (8.625")

Pipe DR: 18

Pipe Length: 855.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.07799990971883 ft

Silo Width: 1.07799990971883 ft

Surface Surcharge: 0 psi

Short Term Modulus: 400000 psi

Long Term Modulus: 400000 psi

Short Term Poisson Ratio: 0.38

Long Term Poisson Ratio: 0.38

Pipe Unit Weight: 11.68400 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 2800 psi

Allowable Tensile Stress (Long Term): 2800 psi

Allowable Compressive Stress (Short Term): 3200 psi

Allowable Compressive Stress (Long Term): 3200 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.1	24.7
Water Pressure	19.4	18.9
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	22.5	43.6
Deflection		
Earth Load Deflection	2.065	4.733
Buoyant Deflection	0.060	0.060
Reissner Effect	0	0
Net Deflection	2.125	4.793
Compressive Stress [psi]		
Compressive Wall Stress	202.3	392.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11045.4	11045.4
Pullback Stress [psi]	900.8	900.8
Pullback Strain	2.252E-3	2.252E-3
Bending Stress [psi]	0.0	143.8
Bending Strain	0	3.594E-4
Tensile Stress [psi]	900.8	1042.5
Tensile Strain	2.252E-3	2.966E-3

Net External Pressure = 40.7 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 365.0 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.125	7.5	3.5	OK
Unconstrained Collapse [psi]	46.8	179.8	3.8	OK
Compressive Wall Stress [psi]	202.3	3200.0	15.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.060	7.5	125.5	OK
Unconstrained Collapse [psi]	56.8	171.9	3.0	OK
Tensile Stress [psi]	1042.5	2800.0	2.7	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	88.204 psi	77.160 psi
1	8.75 in	12.00 in	88.177 psi	77.154 psi
2	12.00 in	12.94 in	88.167 psi	77.151 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

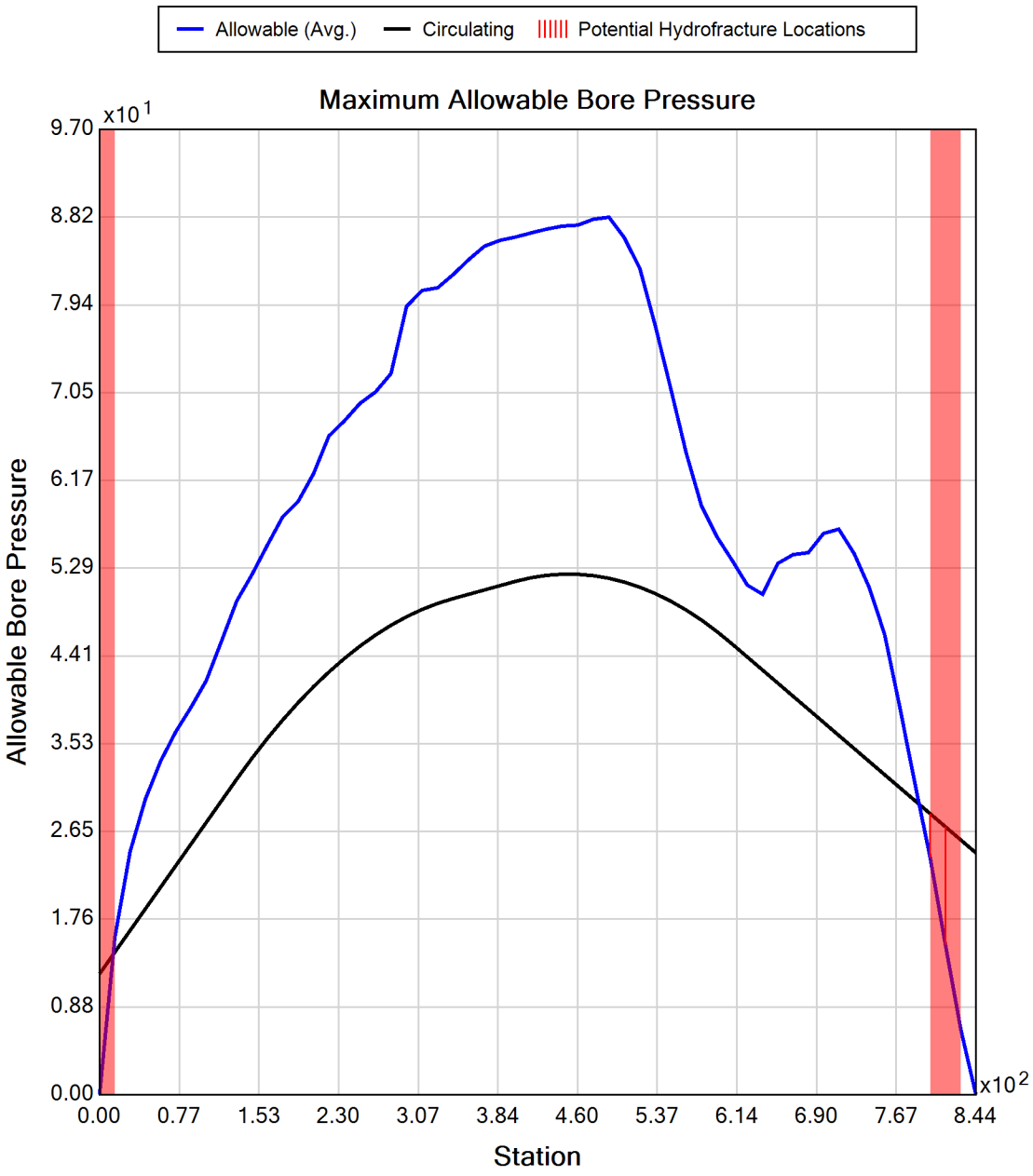
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



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Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 HDD 119 DWG C-319.2

Input Summary

Start Coordinate	(0.00, 0.00, 95.00) ft
End Coordinate	(840.00, 0.00, 116.84) ft
Project Length	840.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	8.625 in
Pipe DR	18.0
Pipe Thickness	0.48 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #2 USCS, Silt (M), MH
From Assistant
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 32.00, S.M.: 100.00, Coh: 0.00 [psi]

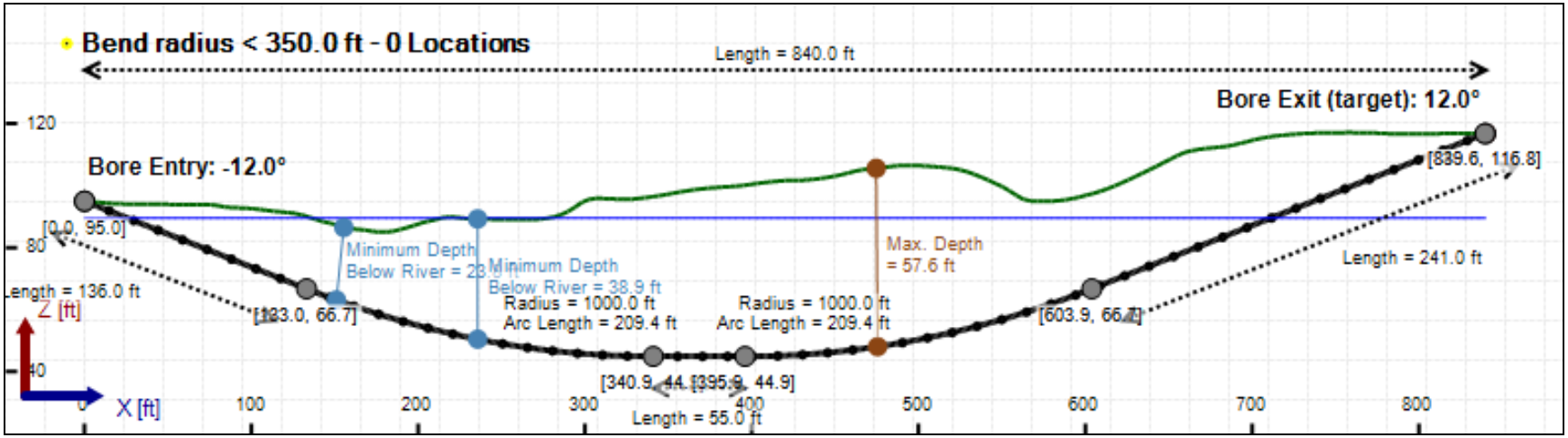
Soil Layer #3 USCS, Clay (C), CH
From Assistant
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #4 USCS, Silt (M), ML
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

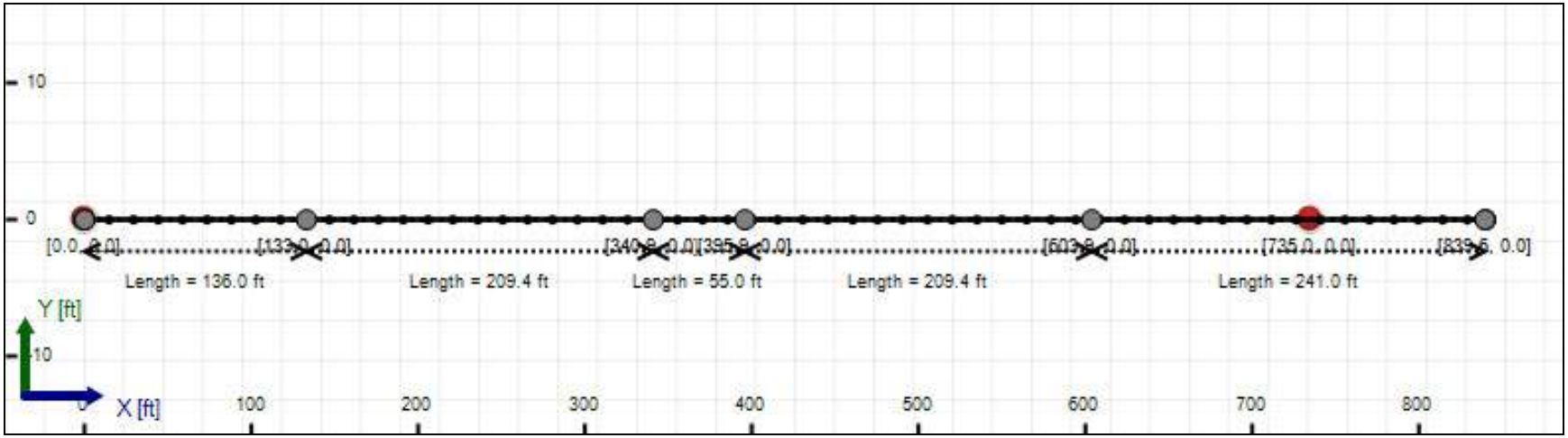
Soil Layer #5 USCS, Silt (M), MH
From Assistant
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

Soil Layer #6 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: PVC

Classification: IPS

Pipe OD: 8" (8.625")

Pipe DR: 18

Pipe Length: 855.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.07799990971883 ft

Silo Width: 1.07799990971883 ft

Surface Surcharge: 0 psi

Short Term Modulus: 400000 psi

Long Term Modulus: 400000 psi

Short Term Poisson Ratio: 0.38

Long Term Poisson Ratio: 0.38

Pipe Unit Weight: 11.68400 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 2800 psi

Allowable Tensile Stress (Long Term): 2800 psi

Allowable Compressive Stress (Short Term): 3200 psi

Allowable Compressive Stress (Long Term): 3200 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.2	26.0
Water Pressure	19.3	18.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	22.5	44.4
Deflection		
Earth Load Deflection	2.000	4.869
Buoyant Deflection	0.060	0.060
Reissner Effect	0	0
Net Deflection	2.060	4.928
Compressive Stress [psi]		
Compressive Wall Stress	202.6	400.0

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11066.5	11066.5
Pullback Stress [psi]	902.5	902.5
Pullback Strain	2.256E-3	2.256E-3
Bending Stress [psi]	0.0	143.8
Bending Strain	0	3.594E-4
Tensile Stress [psi]	902.5	1039.5
Tensile Strain	2.256E-3	2.958E-3

Net External Pressure = 41.0 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 365.0 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.060	7.5	3.6	OK
Unconstrained Collapse [psi]	47.3	179.6	3.8	OK
Compressive Wall Stress [psi]	202.6	3200.0	15.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.060	7.5	125.5	OK
Unconstrained Collapse [psi]	57.4	172.1	3.0	OK
Tensile Stress [psi]	1039.5	2800.0	2.7	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	90.150 psi	78.459 psi
1	8.75 in	12.00 in	90.124 psi	78.453 psi
2	12.00 in	12.94 in	90.115 psi	78.450 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

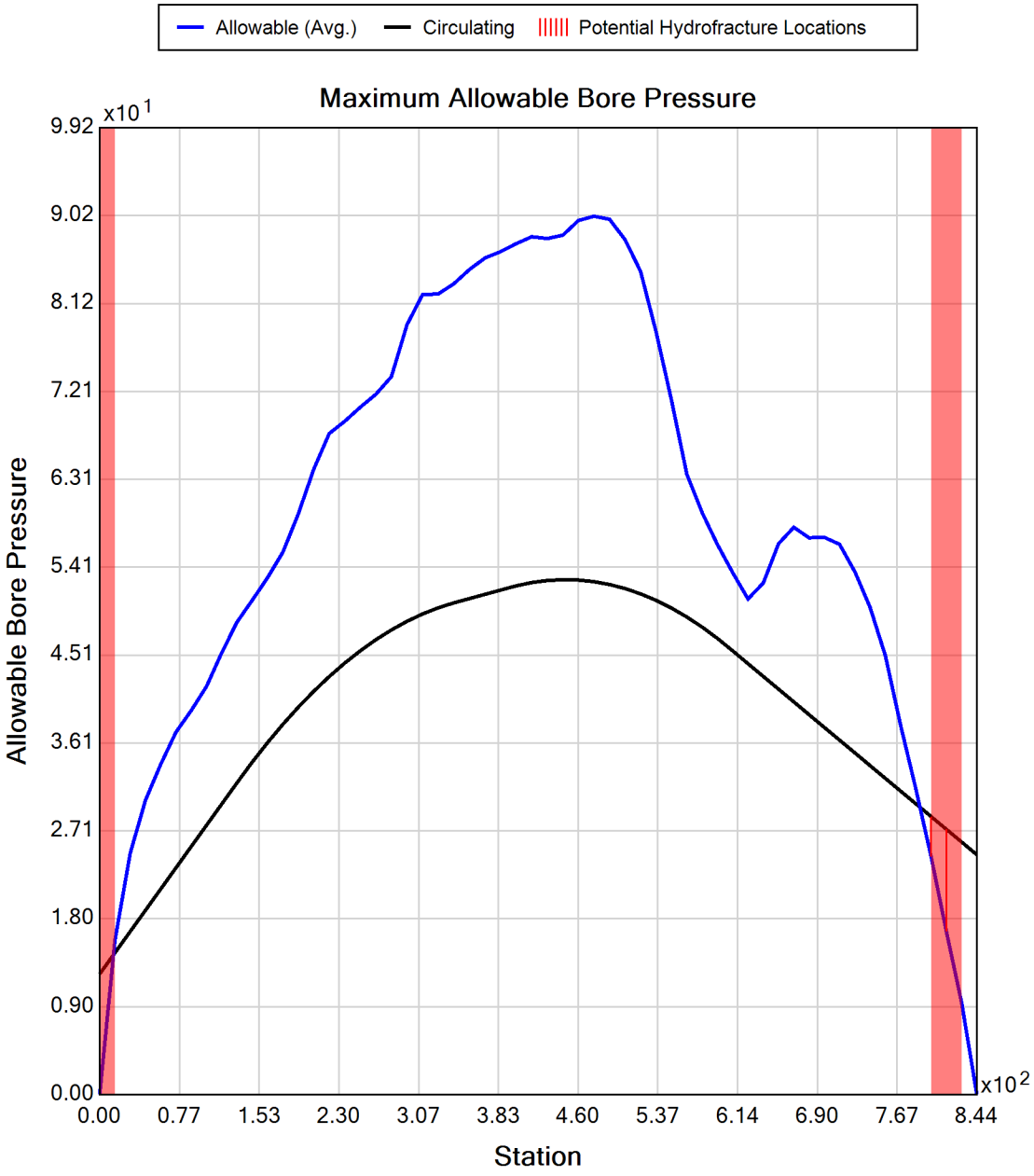
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



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Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 3 HDD 119 DWG C-319.2

Input Summary

Start Coordinate	(0.00, 0.00, 95.00) ft
End Coordinate	(840.00, 0.00, 116.84) ft
Project Length	840.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	9.0
Pipe Thickness	0.39 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #2 USCS, Silt (M), MH
From Assistant
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 32.00, S.M.: 100.00, Coh: 0.00 [psi]

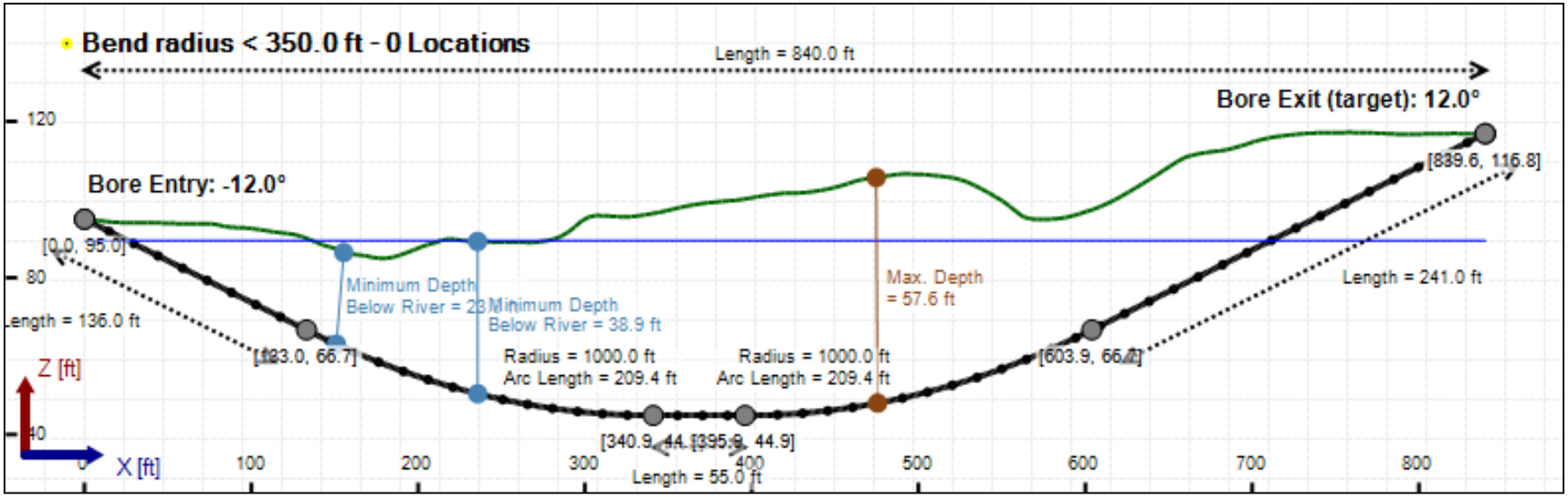
Soil Layer #3 USCS, Clay (C), CH
From Assistant
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #4 USCS, Silt (M), ML
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

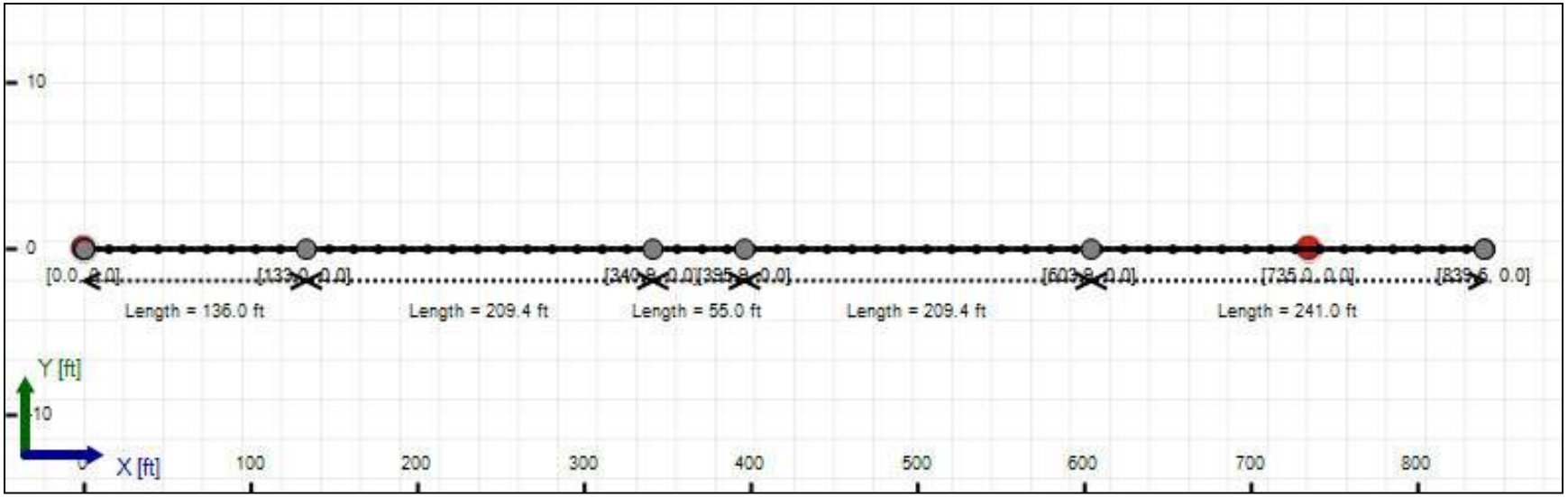
Soil Layer #5 USCS, Silt (M), MH
From Assistant
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

Soil Layer #6 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 3" (3.5")

Pipe DR: 9

Pipe Length: 855.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.625 ft

Silo Width: 0.625 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.8	26.0
Water Pressure	19.3	18.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	21.2	44.4
Deflection		
Earth Load Deflection	2.475	7.197
Buoyant Deflection	0.043	0.043
Reissner Effect	0	0
Net Deflection	2.518	7.240
Compressive Stress [psi]		
Compressive Wall Stress	95.3	200.0

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1862.3	1862.3
Pullback Stress [psi]	490.0	490.0
Pullback Strain	8.521E-3	8.521E-3
Bending Stress [psi]	0.0	8.4
Bending Strain	0	1.458E-4
Tensile Stress [psi]	490.0	496.4
Tensile Strain	8.521E-3	8.780E-3

Net External Pressure = 43.0 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.518	7.5	3.0	OK
Unconstrained Collapse [psi]	47.3	131.5	2.8	OK
Compressive Wall Stress [psi]	95.3	1150.0	12.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.021	7.5	355.7	OK
Unconstrained Collapse [psi]	57.4	228.6	4.0	OK
Tensile Stress [psi]	496.4	1200.0	2.4	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	90.150 psi	78.459 psi
1	8.75 in	12.00 in	90.124 psi	78.453 psi
2	12.00 in	12.94 in	90.115 psi	78.450 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

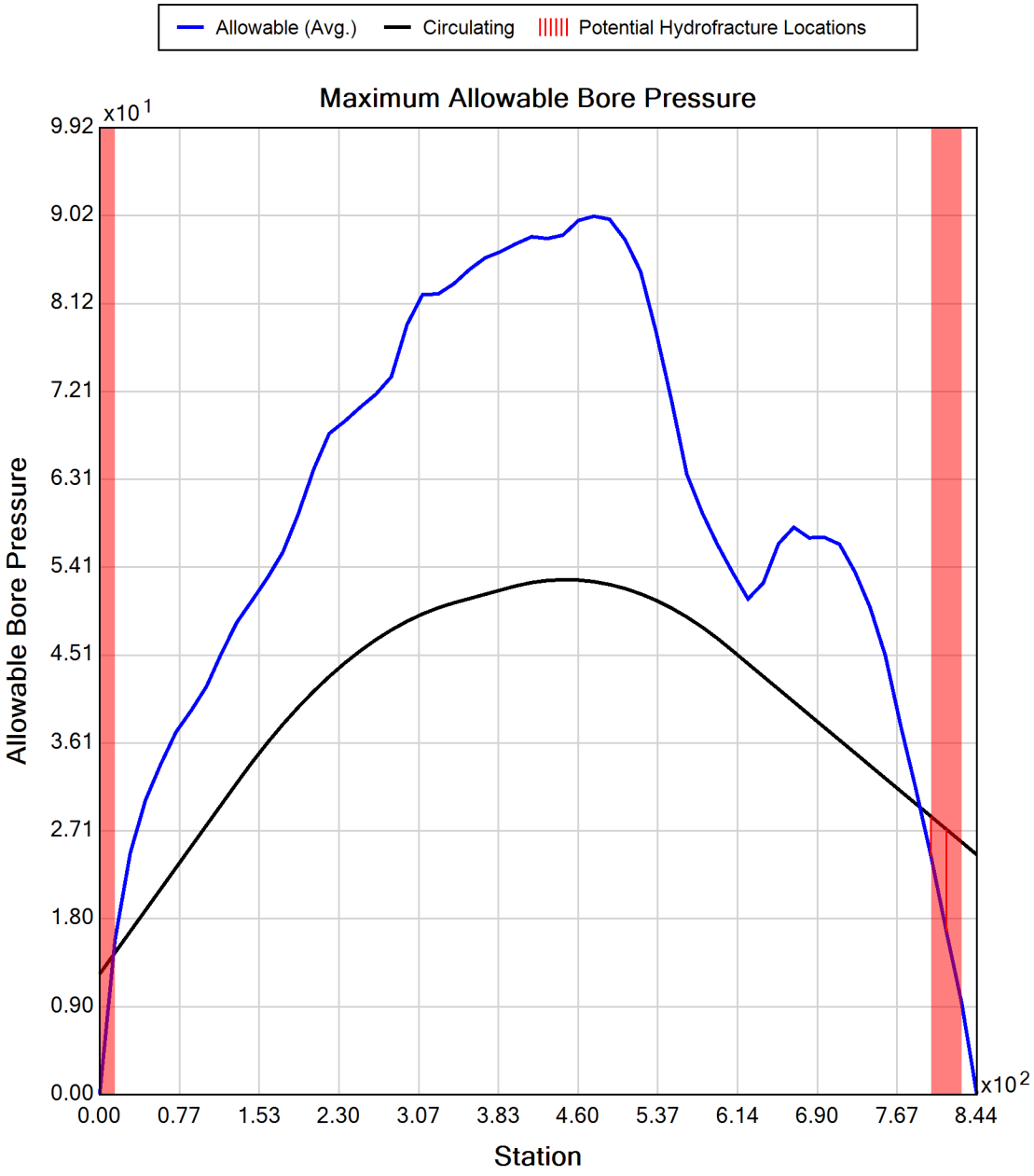
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



Generated Output

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OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning the excavation or underground drilling operation. When the actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If the utility cannot be precisely located, it must be shut off by the utility company.

Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 & 3 Equivalent Pipe Bundle HDD 119 DWG C-319.2

Input Summary

Start Coordinate	(0.00, 0.00, 95.00) ft
End Coordinate	(840.00, 0.00, 116.84) ft
Project Length	840.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	12.750 in
Pipe DR	25.0
Pipe Thickness	0.51 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: PVC

Classification: IPS

Pipe OD: 12" (12.75")

Pipe DR: 25

Pipe Length: 855.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.59400002161662 ft

Silo Width: 1.59400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 400000 psi

Long Term Modulus: 400000 psi

Short Term Poisson Ratio: 0.38

Long Term Poisson Ratio: 0.38

Pipe Unit Weight: 11.68400 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 2800 psi

Allowable Tensile Stress (Long Term): 2800 psi

Allowable Compressive Stress (Short Term): 3200 psi

Allowable Compressive Stress (Long Term): 3200 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.8	26.0
Water Pressure	19.3	18.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.0	44.4
Deflection		
Earth Load Deflection	6.121	13.699
Buoyant Deflection	0.237	0.237
Reissner Effect	0	0
Net Deflection	6.357	13.936
Compressive Stress [psi]		
Compressive Wall Stress	300.1	555.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	9974.7	9974.7
Pullback Stress [psi]	508.6	508.6
Pullback Strain	1.272E-3	1.272E-3
Bending Stress [psi]	0.0	212.5
Bending Strain	0	5.313E-4
Tensile Stress [psi]	508.6	720.8
Tensile Strain	1.272E-3	2.333E-3

Net External Pressure = 21.0 [psi]

Buoyant Deflection = 0.2

Hydrokinetic Force = 798.4 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.237	7.5	31.7	OK
Unconstrained Collapse [psi]	25.8	61.9	2.4	OK
Tensile Stress [psi]	720.8	2800.0	3.9	OK

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 1 HDD 120 DWG C-320

Input Summary

Start Coordinate	(0.00, 0.00, 119.72) ft
End Coordinate	(1470.00, 0.00, 122.35) ft
Project Length	1470.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	8.625 in
Pipe DR	18.0
Pipe Thickness	0.48 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Clay (C), CH
Depth: 25.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

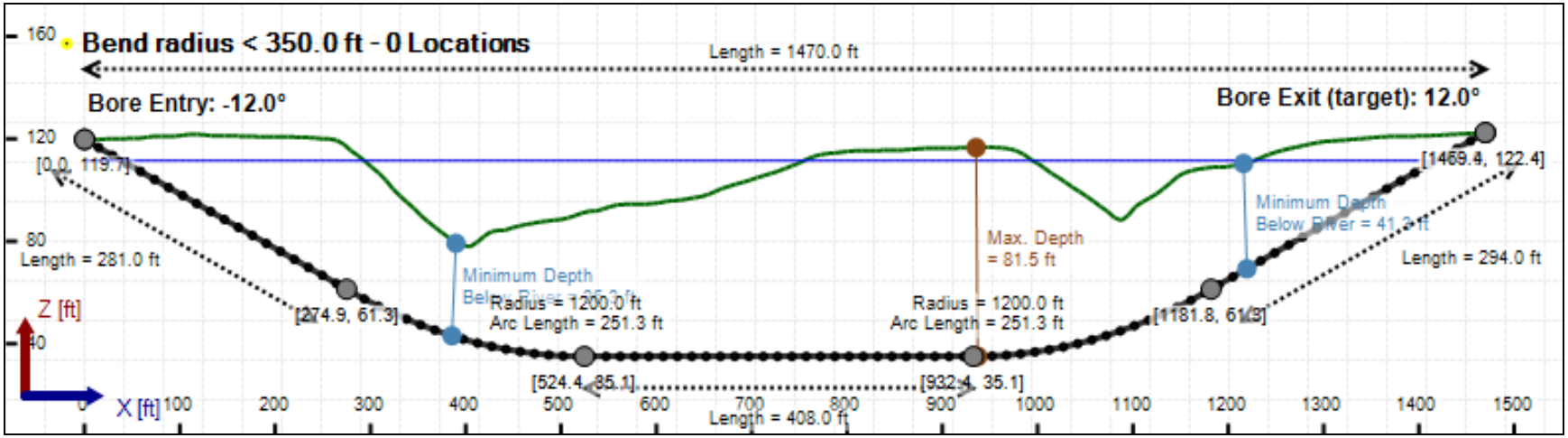
Soil Layer #2 USCS, Silt (M), MH
Depth: 20.00 ft
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Clay (C), CL
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

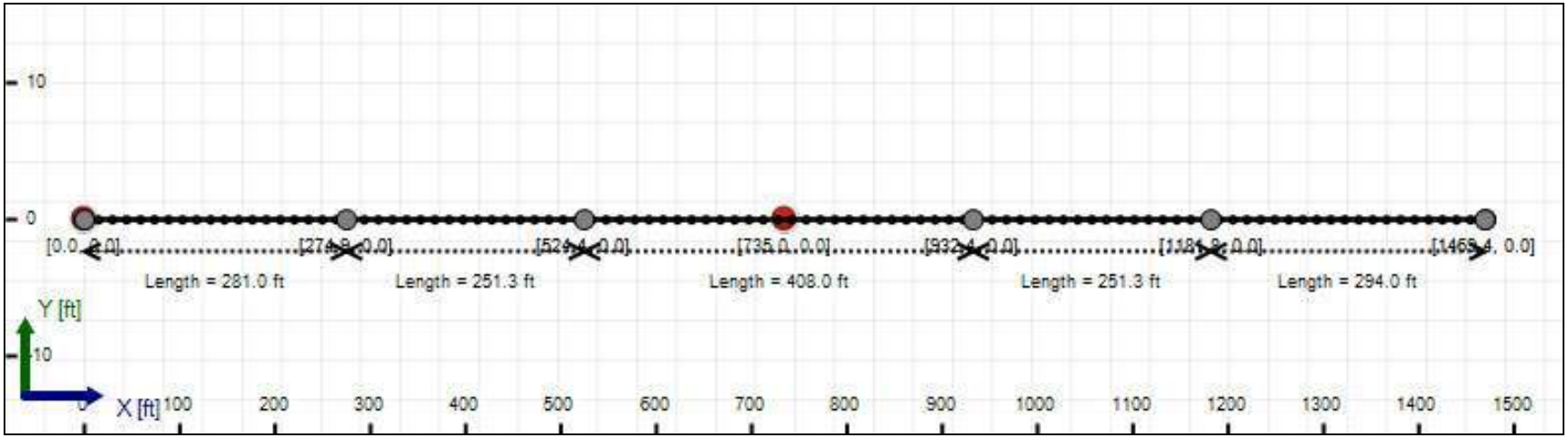
Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks
Depth: 10.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks
Depth: 38.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: PVC

Classification: IPS

Pipe OD: 8" (8.625")

Pipe DR: 18

Pipe Length: 1500.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.07799990971883 ft

Silo Width: 1.07799990971883 ft

Surface Surcharge: 0 psi

Short Term Modulus: 400000 psi

Long Term Modulus: 400000 psi

Short Term Poisson Ratio: 0.38

Long Term Poisson Ratio: 0.38

Pipe Unit Weight: 11.68400 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 2800 psi

Allowable Tensile Stress (Long Term): 2800 psi

Allowable Compressive Stress (Short Term): 3200 psi

Allowable Compressive Stress (Long Term): 3200 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.9	46.6
Water Pressure	33.1	33.1
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	37.0	79.7
Deflection		
Earth Load Deflection	3.493	8.589
Buoyant Deflection	0.060	0.060
Reissner Effect	0	0
Net Deflection	3.553	8.649
Compressive Stress [psi]		
Compressive Wall Stress	333.2	717.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	17770.9	17770.9
Pullback Stress [psi]	1449.2	1449.2
Pullback Strain	3.623E-3	3.623E-3
Bending Stress [psi]	0.0	119.8
Bending Strain	0	2.995E-4
Tensile Stress [psi]	1449.2	1563.6
Tensile Strain	3.623E-3	4.209E-3

Net External Pressure = 50.2 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 365.0 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.553	7.5	2.1	OK
Unconstrained Collapse [psi]	58.7	177.4	3.0	OK
Compressive Wall Stress [psi]	333.2	3200.0	9.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.060	7.5	125.5	OK
Unconstrained Collapse [psi]	68.6	161.6	2.4	OK
Tensile Stress [psi]	1563.6	2800.0	1.8	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	1141.125 psi	1374.555 psi
1	8.75 in	12.00 in	1140.919 psi	1374.507 psi
2	12.00 in	12.94 in	1140.848 psi	1374.491 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

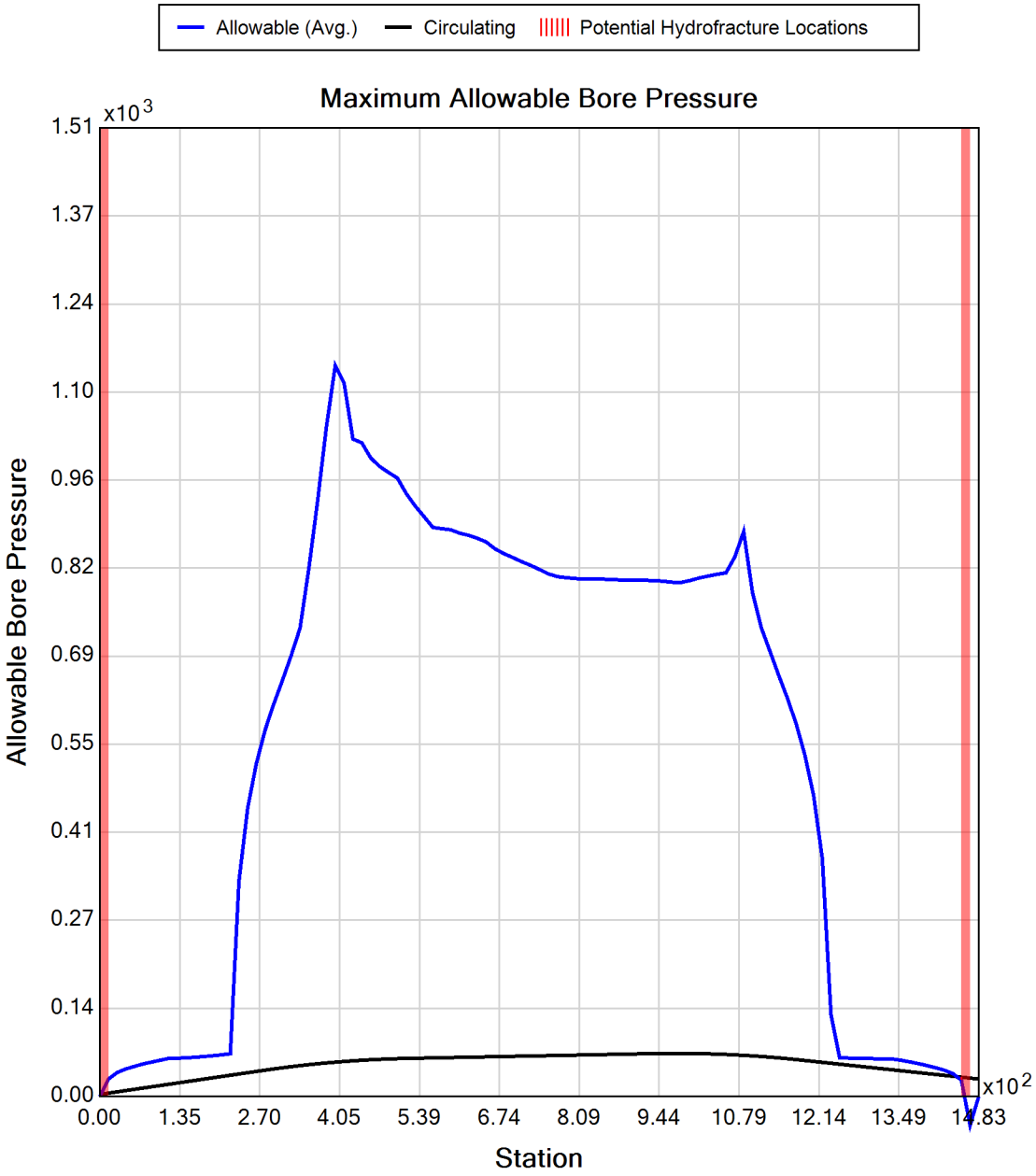
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



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General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 HDD 120 DWG C-320.2

Input Summary

Start Coordinate	(0.00, 0.00, 121.03) ft
End Coordinate	(1470.00, 0.00, 122.91) ft
Project Length	1470.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	8.625 in
Pipe DR	18.0
Pipe Thickness	0.48 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Clay (C), CH
Depth: 25.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

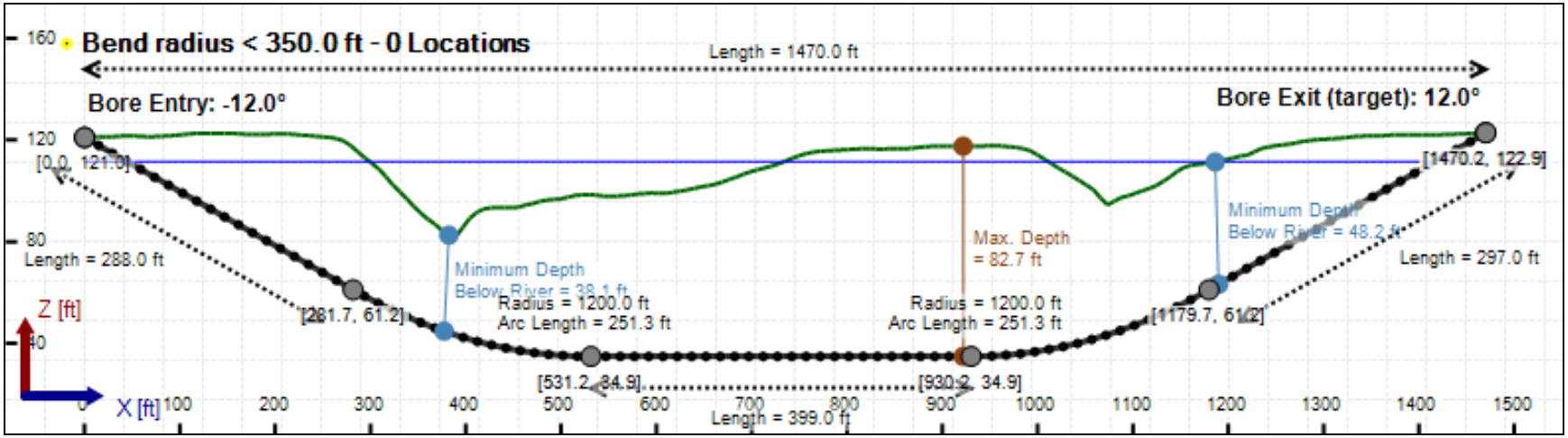
Soil Layer #2 USCS, Silt (M), MH
Depth: 20.00 ft
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Clay (C), CL
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

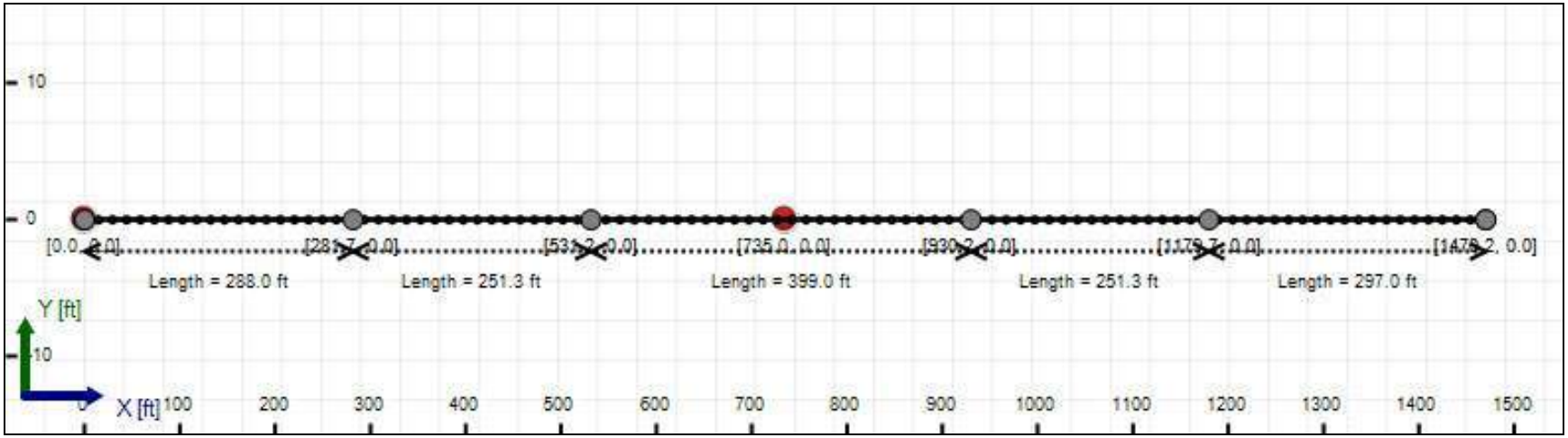
Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks
Depth: 10.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks
Depth: 38.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: PVC

Classification: IPS

Pipe OD: 8" (8.625")

Pipe DR: 18

Pipe Length: 1500.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.07799990971883 ft

Silo Width: 1.07799990971883 ft

Surface Surcharge: 0 psi

Short Term Modulus: 400000 psi

Long Term Modulus: 400000 psi

Short Term Poisson Ratio: 0.38

Long Term Poisson Ratio: 0.38

Pipe Unit Weight: 11.68400 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 2800 psi

Allowable Tensile Stress (Long Term): 2800 psi

Allowable Compressive Stress (Short Term): 3200 psi

Allowable Compressive Stress (Long Term): 3200 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.9	48.0
Water Pressure	33.2	33.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	37.0	81.2
Deflection		
Earth Load Deflection	3.588	8.842
Buoyant Deflection	0.060	0.060
Reissner Effect	0	0
Net Deflection	3.648	8.901
Compressive Stress [psi]		
Compressive Wall Stress	333.3	730.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	17741.1	17741.1
Pullback Stress [psi]	1446.8	1446.8
Pullback Strain	3.617E-3	3.617E-3
Bending Stress [psi]	0.0	119.8
Bending Strain	0	2.995E-4
Tensile Stress [psi]	1446.8	1557.5
Tensile Strain	3.617E-3	4.193E-3

Net External Pressure = 49.5 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 365.0 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.648	7.5	2.1	OK
Unconstrained Collapse [psi]	59.0	177.6	3.0	OK
Compressive Wall Stress [psi]	333.3	3200.0	9.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.060	7.5	125.5	OK
Unconstrained Collapse [psi]	69.0	161.8	2.3	OK
Tensile Stress [psi]	1557.5	2800.0	1.8	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	1050.059 psi	1375.763 psi
1	8.75 in	12.00 in	1049.885 psi	1375.717 psi
2	12.00 in	12.94 in	1049.825 psi	1375.701 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

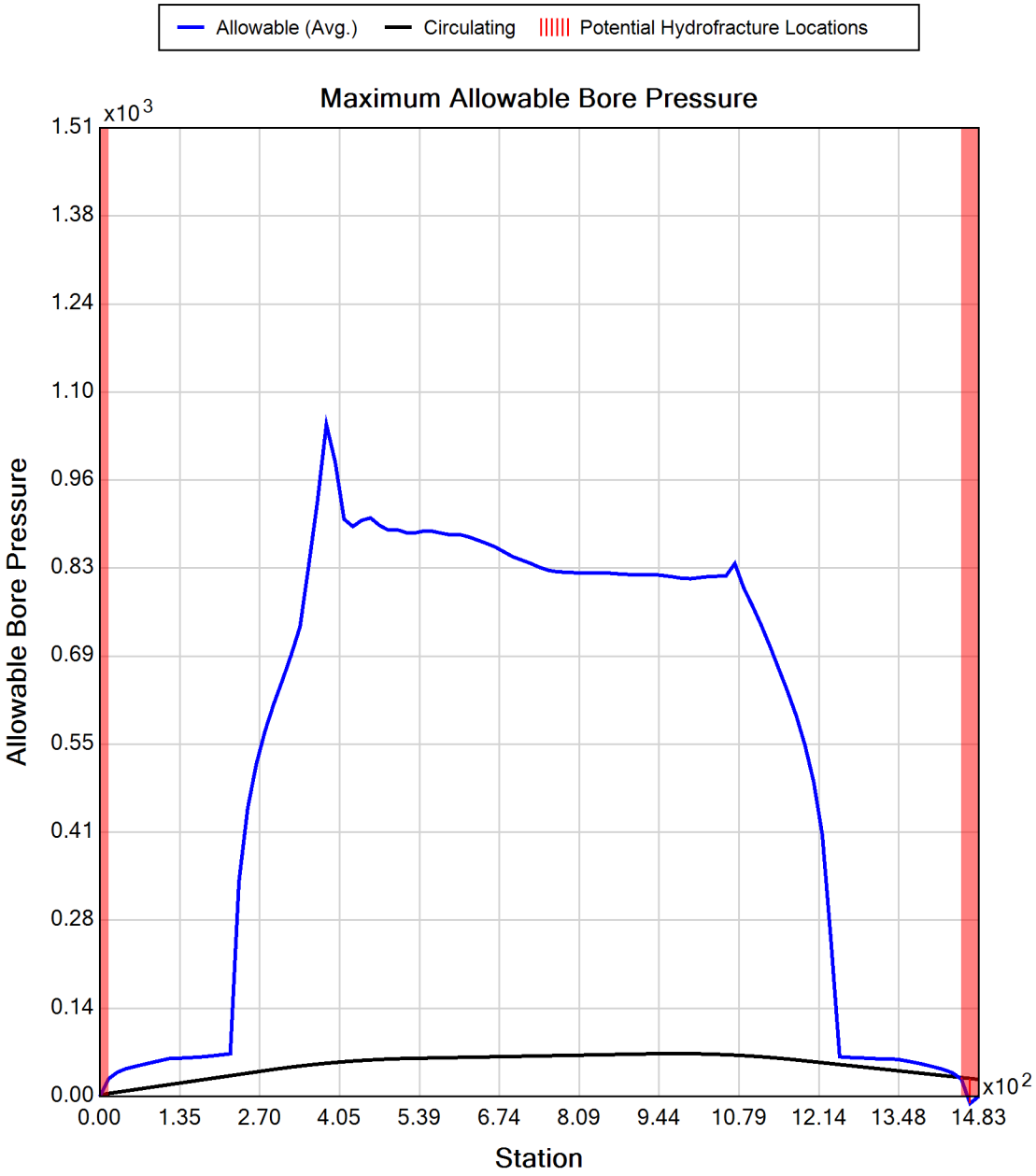
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 3 HDD 120 DWG C-320.2

Input Summary

Start Coordinate	(0.00, 0.00, 121.03) ft
End Coordinate	(1470.00, 0.00, 122.91) ft
Project Length	1470.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	9.0
Pipe Thickness	0.39 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Clay (C), CH
Depth: 25.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

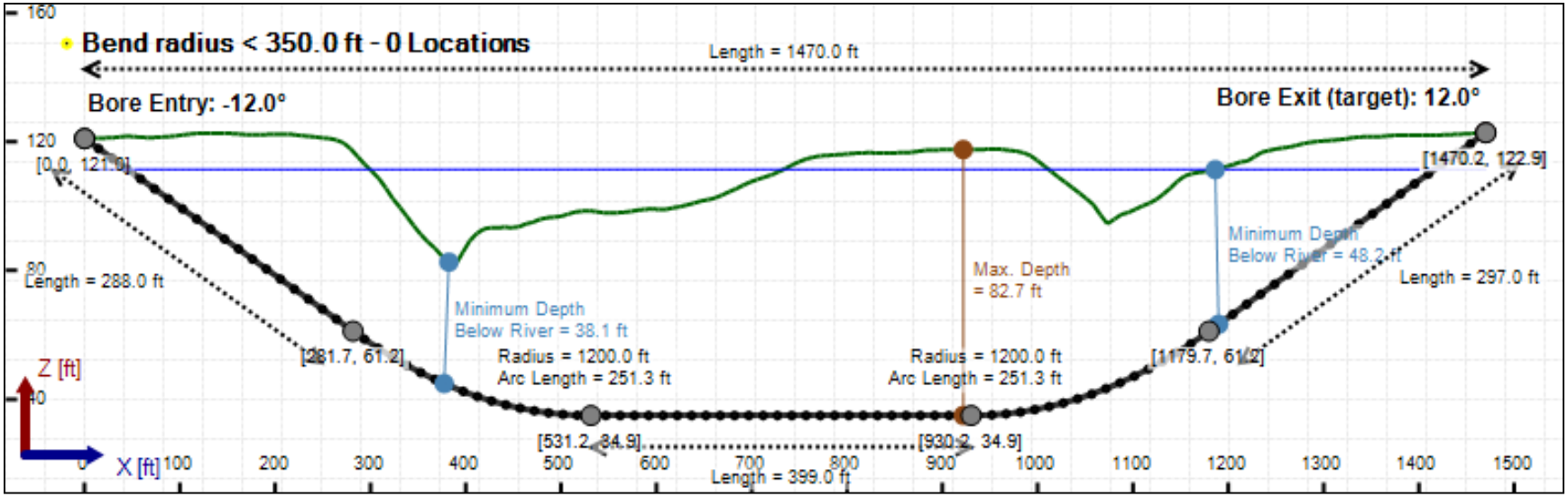
Soil Layer #2 USCS, Silt (M), MH
Depth: 20.00 ft
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Clay (C), CL
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

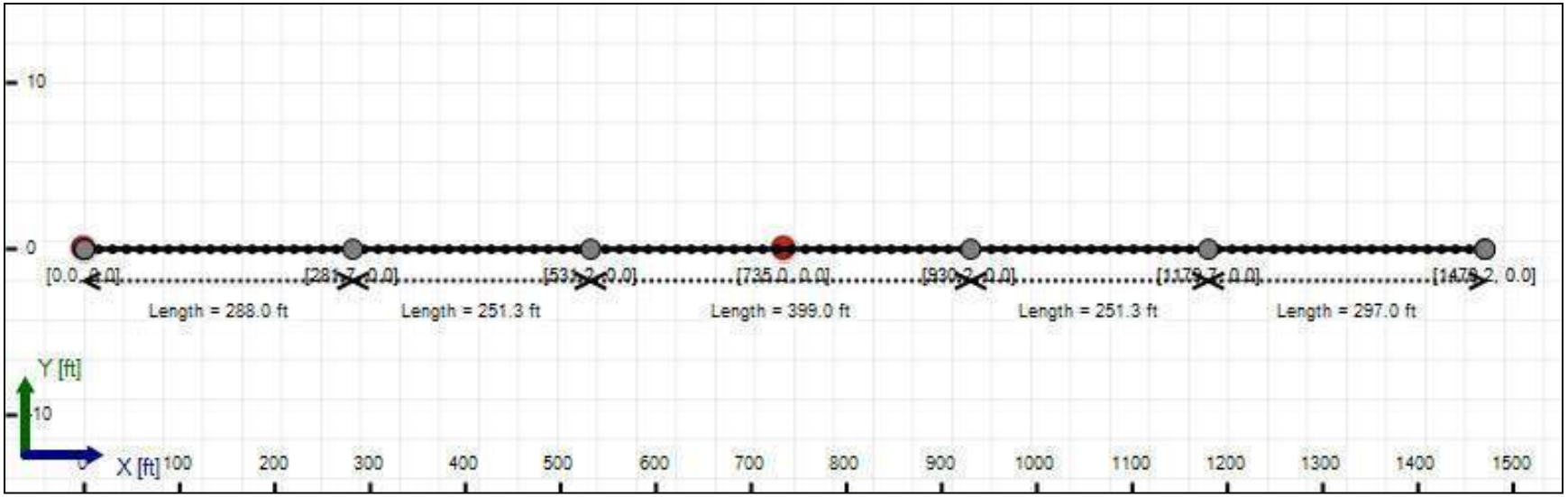
Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks
Depth: 10.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Soil Layer #5 Rock, Geological Classification, Sedimentary Rocks
Depth: 38.00 ft
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 3" (3.5")

Pipe DR: 9

Pipe Length: 1500.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.625 ft

Silo Width: 0.625 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	19.5	48.0
Water Pressure	16.1	33.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	35.6	81.2
Deflection		
Earth Load Deflection	5.304	13.070
Buoyant Deflection	0.043	0.043
Reissner Effect	0	0
Net Deflection	5.347	13.113
Compressive Stress [psi]		
Compressive Wall Stress	160.2	365.2

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	2939.3	2939.3
Pullback Stress [psi]	773.3	773.3
Pullback Strain	1.345E-2	1.345E-2
Bending Stress [psi]	0.0	7.0
Bending Strain	0	1.215E-4
Tensile Stress [psi]	773.3	777.1
Tensile Strain	1.345E-2	1.364E-2

Net External Pressure = 51.6 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.347	7.5	1.4	OK
Unconstrained Collapse [psi]	59.0	130.3	2.2	OK
Compressive Wall Stress [psi]	160.2	1150.0	7.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.021	7.5	355.7	OK
Unconstrained Collapse [psi]	69.0	210.2	3.0	OK
Tensile Stress [psi]	777.1	1200.0	1.5	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	1050.059 psi	1375.763 psi
1	8.75 in	12.00 in	1049.885 psi	1375.717 psi
2	12.00 in	12.94 in	1049.825 psi	1375.701 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

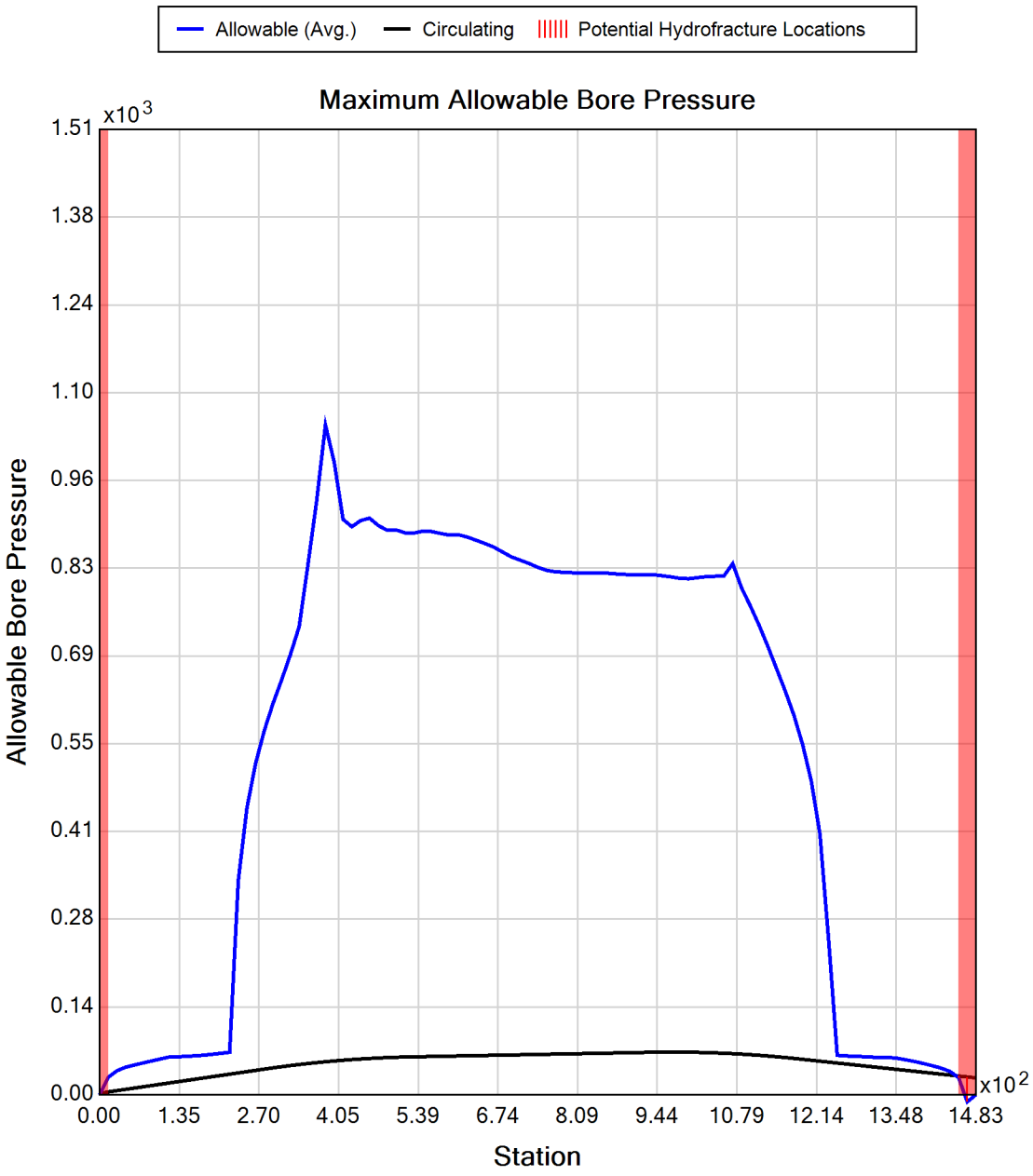
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 & 3 Equivalent Pipe Bundle HDD 120 DWG C-320.2

Input Summary

Start Coordinate	(0.00, 0.00, 121.03) ft
End Coordinate	(1470.00, 0.00, 122.91) ft
Project Length	1470.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	12.750 in
Pipe DR	25.0
Pipe Thickness	0.51 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: PVC
Classification: IPS
Pipe OD: 12" (12.75")
Pipe DR: 25
Pipe Length: 1500.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.59400002161662 ft
Silo Width: 1.59400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 400000 psi
Long Term Modulus: 400000 psi
Short Term Poisson Ratio: 0.38
Long Term Poisson Ratio: 0.38
Pipe Unit Weight: 11.68400 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 2800 psi
Allowable Tensile Stress (Long Term): 2800 psi
Allowable Compressive Stress (Short Term): 3200 psi
Allowable Compressive Stress (Long Term): 3200 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.7	48.0
Water Pressure	33.2	33.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	38.9	81.2
Deflection		
Earth Load Deflection	10.096	24.878
Buoyant Deflection	0.237	0.237
Reissner Effect	0	0
Net Deflection	10.333	25.115
Compressive Stress [psi]		
Compressive Wall Stress	486.0	1014.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	16016.5	16016.5
Pullback Stress [psi]	816.7	816.7
Pullback Strain	2.042E-3	2.042E-3
Bending Stress [psi]	0.0	177.1
Bending Strain	0	4.427E-4
Tensile Stress [psi]	816.7	992.0
Tensile Strain	2.042E-3	2.923E-3

Net External Pressure = 23.9 [psi]

Buoyant Deflection = 0.2

Hydrokinetic Force = 798.4 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.237	7.5	31.7	OK
Unconstrained Collapse [psi]	29.7	60.1	2.0	OK
Tensile Stress [psi]	992.0	2800.0	2.8	OK

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 1 HDD 121 DWG C-321

Input Summary

Start Coordinate	(0.00, 0.00, 95.95) ft
End Coordinate	(1740.00, 0.00, 90.57) ft
Project Length	1740.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	8.625 in
Pipe DR	18.0
Pipe Thickness	0.48 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 9

Soil Layer #1 USCS, Gravel (G), GM
Depth: 2.00 ft
Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 7.30 [psi]

Soil Layer #3 USCS, Silt (M), ML
Depth: 4.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 USCS, Clay (C), CH
Depth: 5.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #6 USCS, Clay (C), CH
Depth: 10.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #7 USCS, Clay (C), CL

Depth: 5.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #8 USCS, Clay (C), CH

Depth: 15.00 ft

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

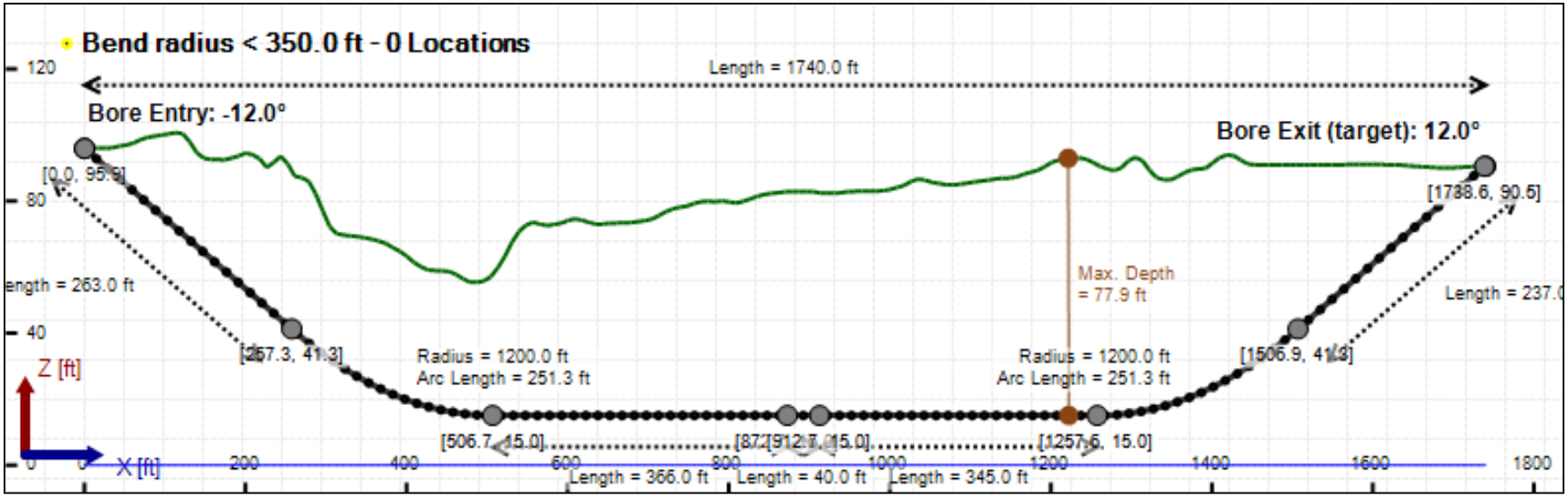
Soil Layer #9 Rock, Geological Classification, Sedimentary Rocks

Depth: 40.00 ft

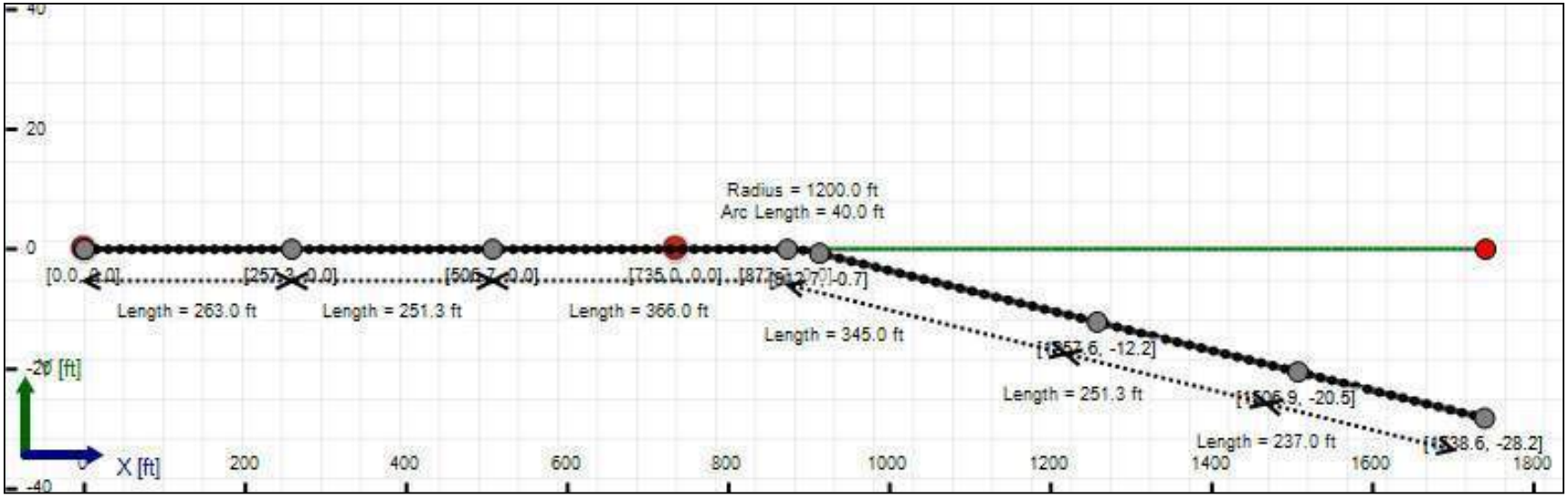
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: PVC

Classification: IPS

Pipe OD: 8" (8.625")

Pipe DR: 18

Pipe Length: 1755.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.07799990971883 ft

Silo Width: 1.07799990971883 ft

Surface Surcharge: 0 psi

Short Term Modulus: 400000 psi

Long Term Modulus: 400000 psi

Short Term Poisson Ratio: 0.38

Long Term Poisson Ratio: 0.38

Pipe Unit Weight: 11.68400 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 2800 psi

Allowable Tensile Stress (Long Term): 2800 psi

Allowable Compressive Stress (Short Term): 3200 psi

Allowable Compressive Stress (Long Term): 3200 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	25.5	54.6
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	25.5	54.6
Deflection		
Earth Load Deflection	4.706	10.066
Buoyant Deflection	0.060	0.060
Reissner Effect	0	0
Net Deflection	4.766	10.126
Compressive Stress [psi]		
Compressive Wall Stress	229.9	491.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	20139.5	20139.5
Pullback Stress [psi]	1642.4	1642.4
Pullback Strain	4.106E-3	4.106E-3
Bending Stress [psi]	0.0	119.8
Bending Strain	0	2.995E-4
Tensile Stress [psi]	1642.4	1754.2
Tensile Strain	4.106E-3	4.685E-3

Net External Pressure = 44.5 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 365.0 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	4.766	7.5	1.6	OK
Unconstrained Collapse [psi]	52.6	175.1	3.3	OK
Compressive Wall Stress [psi]	229.9	3200.0	13.9	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.060	7.5	125.5	OK
Unconstrained Collapse [psi]	62.5	157.6	2.5	OK
Tensile Stress [psi]	1754.2	2800.0	1.6	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	1178.678 psi	1348.113 psi
1	8.75 in	12.00 in	1178.499 psi	1348.061 psi
2	12.00 in	12.94 in	1178.438 psi	1348.043 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

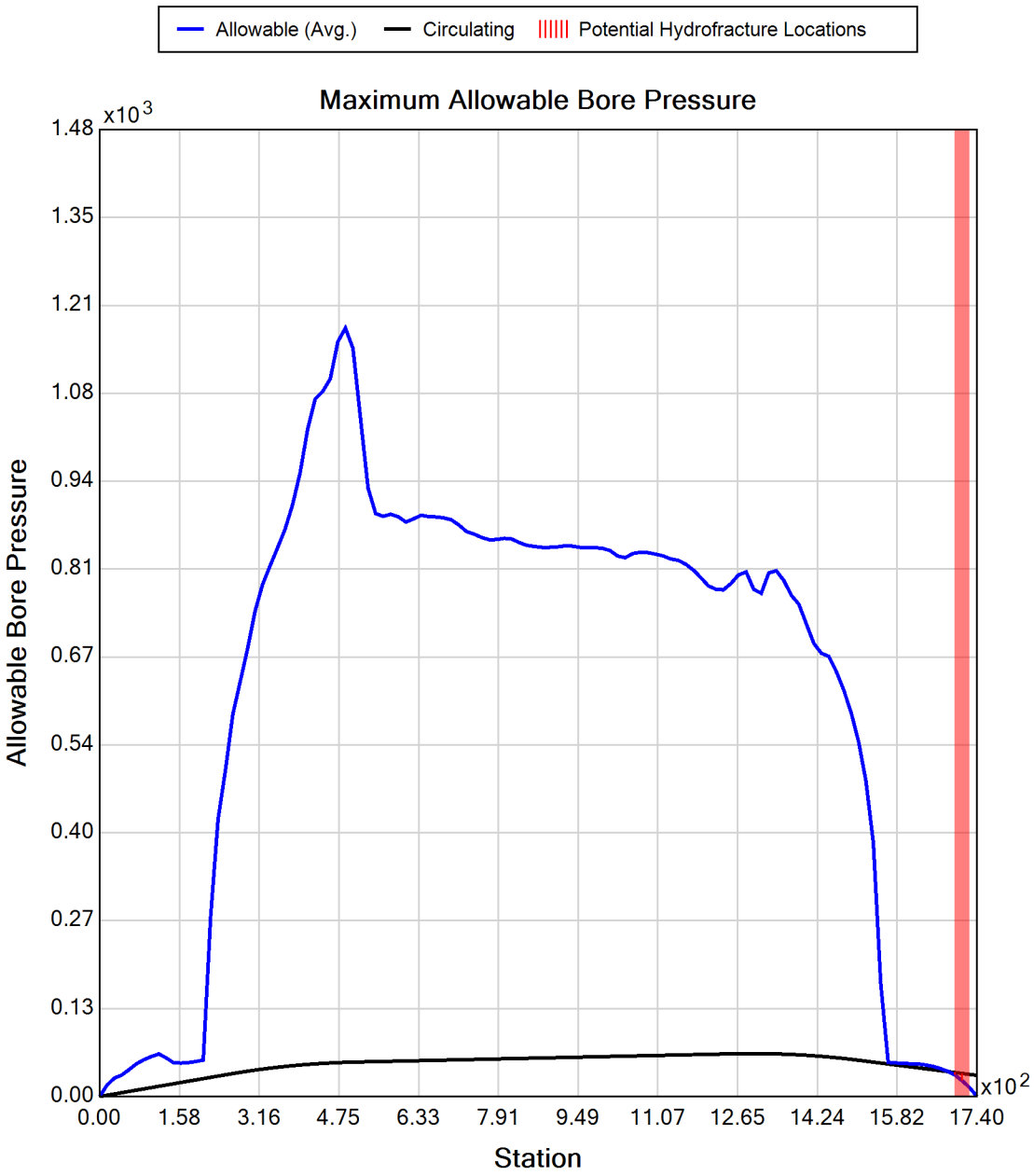
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



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Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 HDD 121 DWG C-321.2

Input Summary

Start Coordinate	(0.00, 0.00, 96.04) ft
End Coordinate	(1740.00, 0.00, 91.39) ft
Project Length	1740.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	8.625 in
Pipe DR	18.0
Pipe Thickness	0.48 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 9

Soil Layer #1 USCS, Gravel (G), GM
Depth: 2.00 ft
Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 7.30 [psi]

Soil Layer #3 USCS, Silt (M), ML
Depth: 4.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 USCS, Clay (C), CH
Depth: 5.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #6 USCS, Clay (C), CH
Depth: 10.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #7 USCS, Clay (C), CL

Depth: 5.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #8 USCS, Clay (C), CH

Depth: 15.00 ft

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

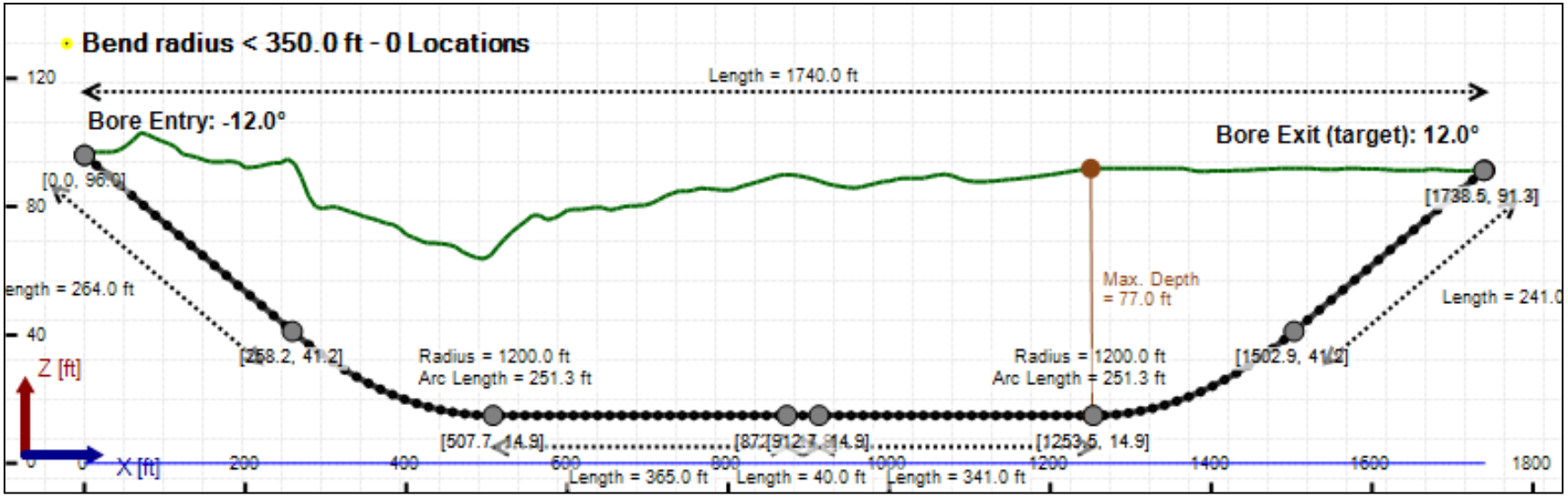
Soil Layer #9 Rock, Geological Classification, Sedimentary Rocks

Depth: 40.00 ft

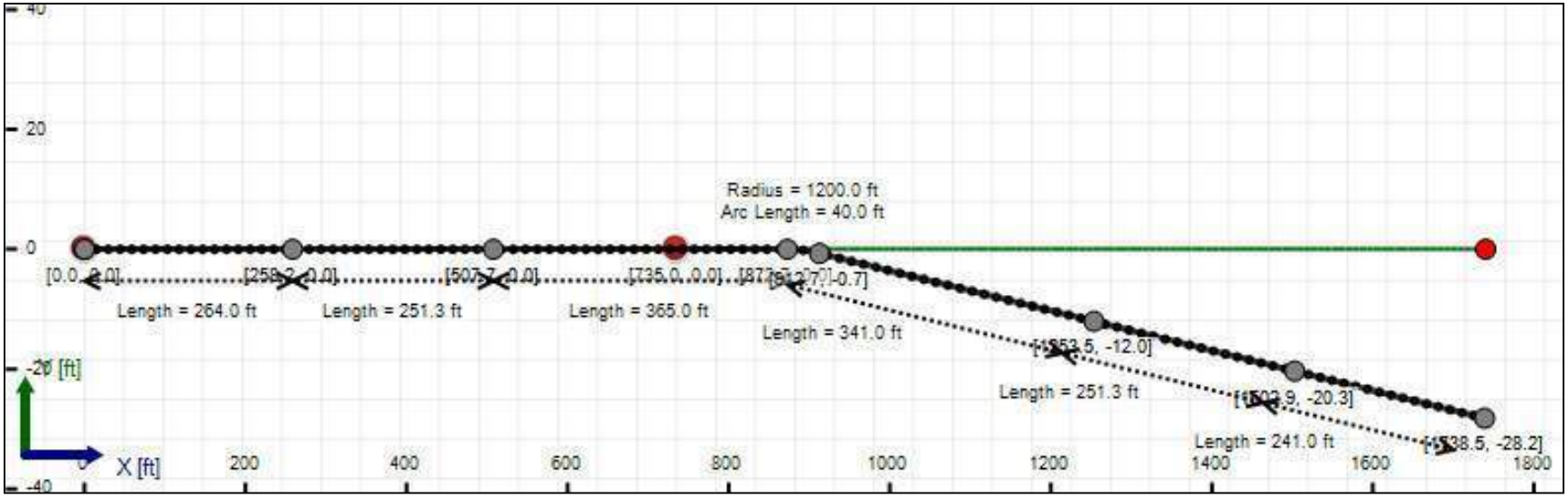
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: PVC

Classification: IPS

Pipe OD: 8" (8.625")

Pipe DR: 18

Pipe Length: 1755.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.07799990971883 ft

Silo Width: 1.07799990971883 ft

Surface Surcharge: 0 psi

Short Term Modulus: 400000 psi

Long Term Modulus: 400000 psi

Short Term Poisson Ratio: 0.38

Long Term Poisson Ratio: 0.38

Pipe Unit Weight: 11.68400 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 2800 psi

Allowable Tensile Stress (Long Term): 2800 psi

Allowable Compressive Stress (Short Term): 3200 psi

Allowable Compressive Stress (Long Term): 3200 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	26.2	53.9
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	26.2	53.9
Deflection		
Earth Load Deflection	4.835	9.923
Buoyant Deflection	0.060	0.060
Reissner Effect	0	0
Net Deflection	4.895	9.983
Compressive Stress [psi]		
Compressive Wall Stress	236.2	484.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	20172.6	20172.6
Pullback Stress [psi]	1645.1	1645.1
Pullback Strain	4.113E-3	4.113E-3
Bending Stress [psi]	0.0	119.8
Bending Strain	0	2.995E-4
Tensile Stress [psi]	1645.1	1757.4
Tensile Strain	4.113E-3	4.693E-3

Net External Pressure = 44.5 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 365.0 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	4.895	7.5	1.5	OK
Unconstrained Collapse [psi]	52.7	175.2	3.3	OK
Compressive Wall Stress [psi]	236.2	3200.0	13.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.060	7.5	125.5	OK
Unconstrained Collapse [psi]	62.6	157.5	2.5	OK
Tensile Stress [psi]	1757.4	2800.0	1.6	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	990.680 psi	1347.467 psi
1	8.75 in	12.00 in	990.576 psi	1347.414 psi
2	12.00 in	12.94 in	990.541 psi	1347.395 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 120.00 US (liquid) gallon/min

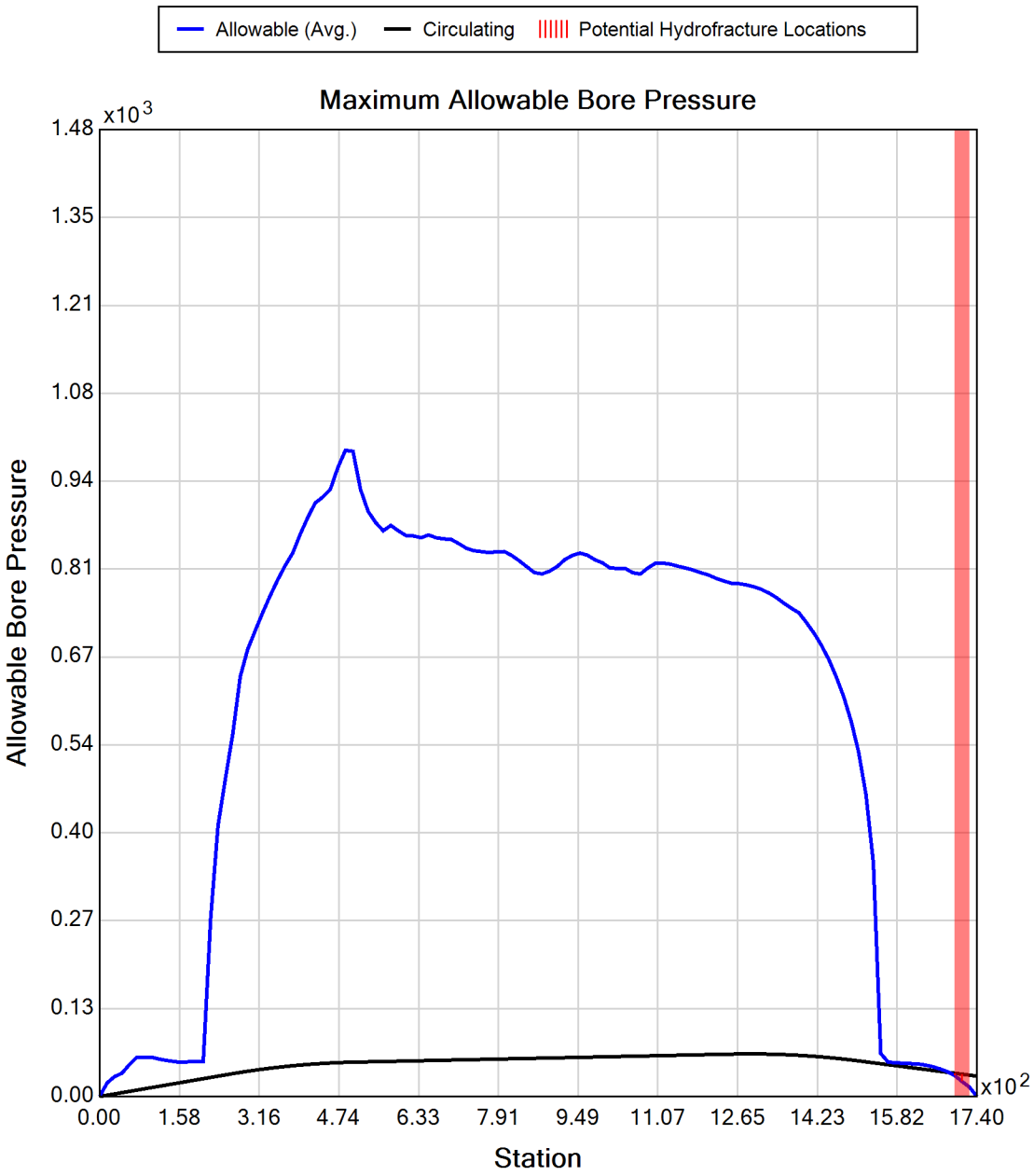
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 594.1



Generated Output

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 3 HDD 121 DWG C-321.2

Input Summary

Start Coordinate	(0.00, 0.00, 96.04) ft
End Coordinate	(1740.00, 0.00, 91.39) ft
Project Length	1740.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	9.0
Pipe Thickness	0.39 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 9

Soil Layer #1 USCS, Gravel (G), GM
Depth: 2.00 ft
Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 7.30 [psi]

Soil Layer #3 USCS, Silt (M), ML
Depth: 4.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #4 USCS, Silt (M), ML
Depth: 2.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #5 USCS, Clay (C), CH
Depth: 5.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #6 USCS, Clay (C), CH
Depth: 10.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #7 USCS, Clay (C), CL

Depth: 5.00 ft

Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #8 USCS, Clay (C), CH

Depth: 15.00 ft

Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]

Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

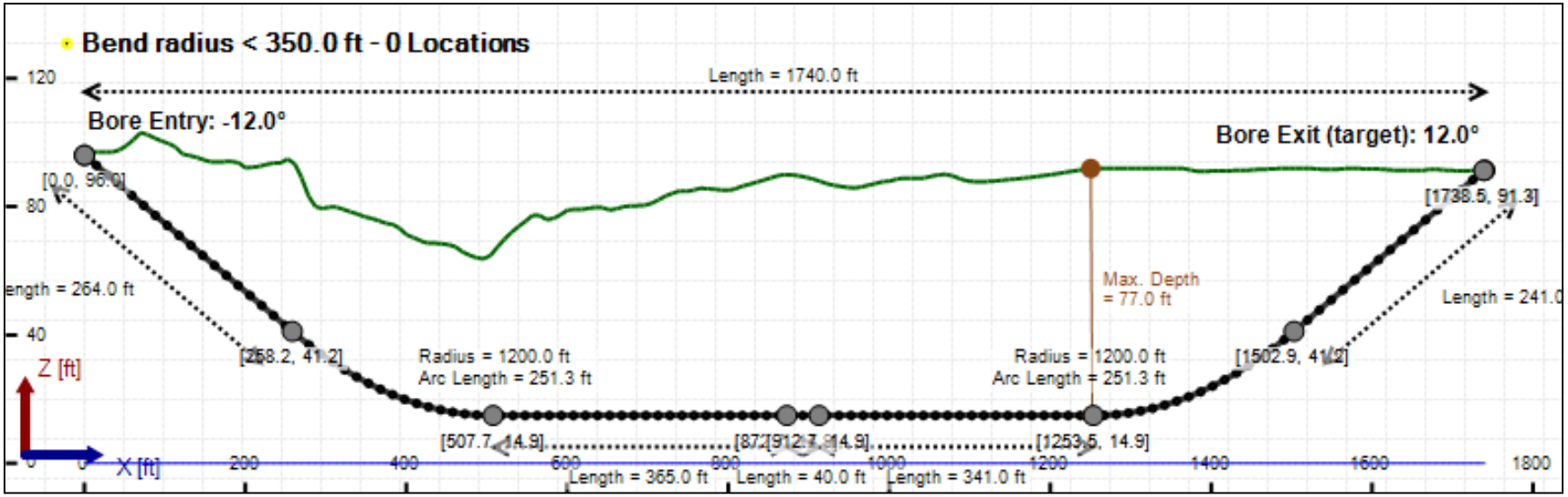
Soil Layer #9 Rock, Geological Classification, Sedimentary Rocks

Depth: 40.00 ft

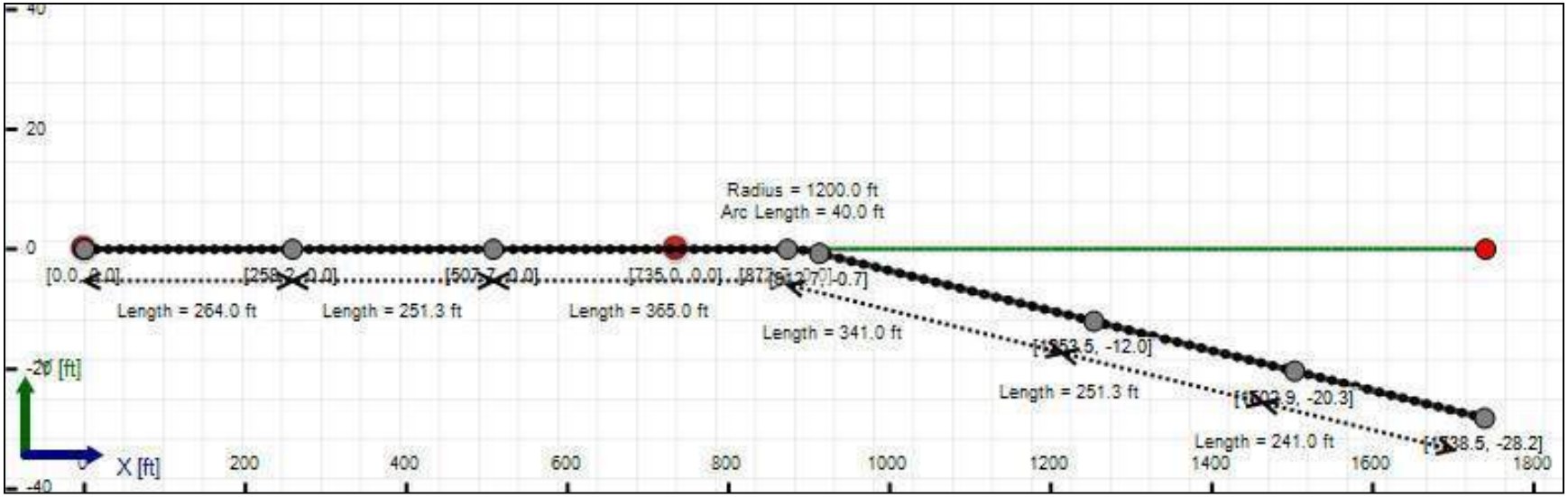
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 3" (3.5")

Pipe DR: 9

Pipe Length: 1755.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.625 ft

Silo Width: 0.625 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	26.2	53.9
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	26.2	53.9
Deflection		
Earth Load Deflection	7.133	14.668
Buoyant Deflection	0.043	0.043
Reissner Effect	0	0
Net Deflection	7.176	14.711
Compressive Stress [psi]		
Compressive Wall Stress	117.9	242.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	3314.4	3314.4
Pullback Stress [psi]	872.0	872.0
Pullback Strain	1.517E-2	1.517E-2
Bending Stress [psi]	0.0	7.0
Bending Strain	0	1.215E-4
Tensile Stress [psi]	872.0	876.1
Tensile Strain	1.517E-2	1.536E-2

Net External Pressure = 44.5 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	7.176	7.5	1.0	OK
Unconstrained Collapse [psi]	52.7	128.8	2.4	OK
Compressive Wall Stress [psi]	117.9	1150.0	9.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.021	7.5	355.7	OK
Unconstrained Collapse [psi]	62.6	203.1	3.2	OK
Tensile Stress [psi]	876.1	1200.0	1.4	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	990.680 psi	1347.467 psi
1	8.75 in	12.00 in	990.576 psi	1347.414 psi
2	12.00 in	12.94 in	990.541 psi	1347.395 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 120.00 US (liquid) gallon/min

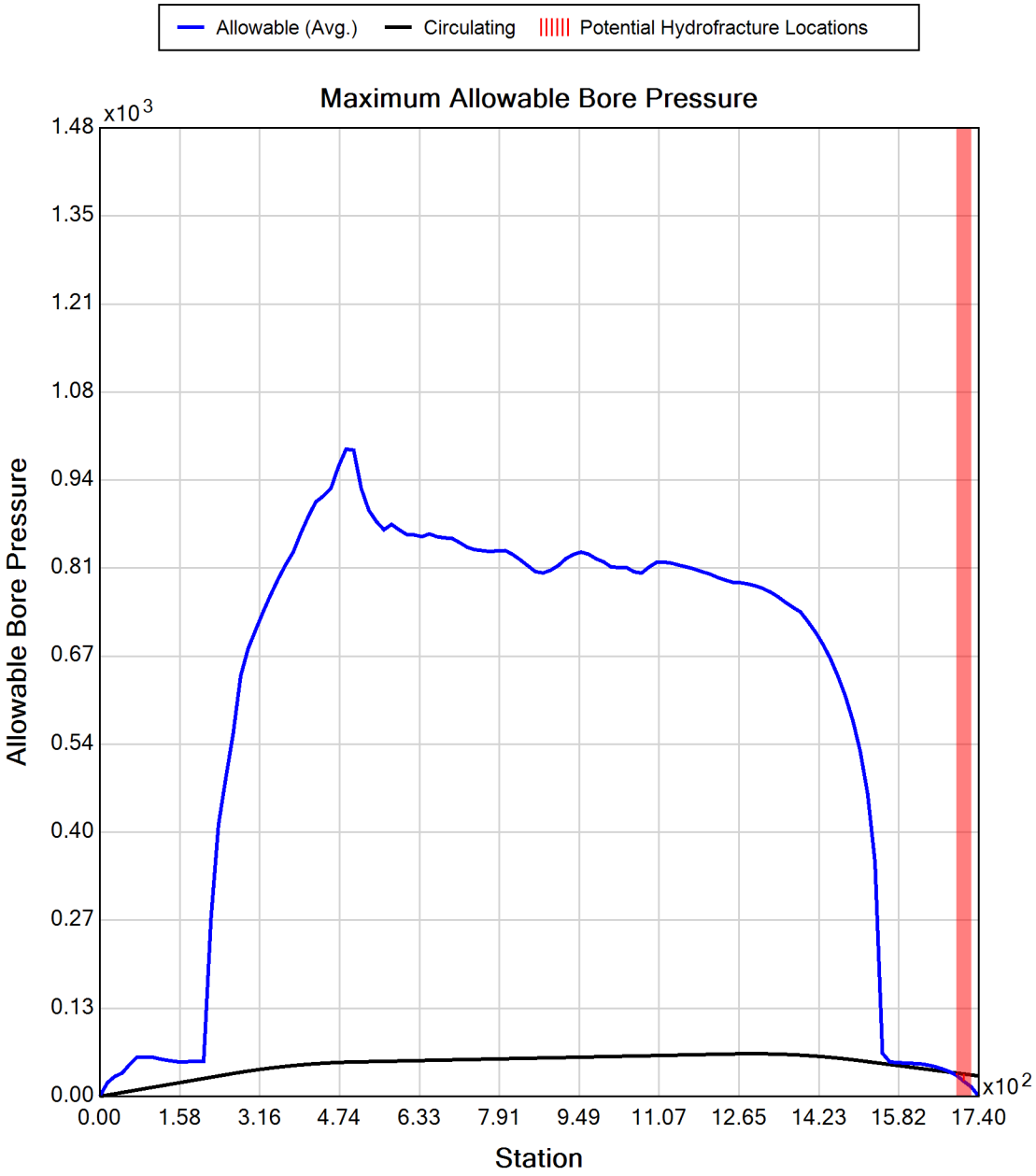
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 594.1



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 & 3 Equivalent Pipe Bundle HDD 121 DWG C-321.2

Input Summary

Start Coordinate	(0.00, 0.00, 96.04) ft
End Coordinate	(1740.00, 0.00, 91.39) ft
Project Length	1740.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	12.750 in
Pipe DR	25.0
Pipe Thickness	0.51 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: PVC

Classification: IPS

Pipe OD: 12" (12.75")

Pipe DR: 25

Pipe Length: 1755.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.59400002161662 ft

Silo Width: 1.59400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 400000 psi

Long Term Modulus: 400000 psi

Short Term Poisson Ratio: 0.38

Long Term Poisson Ratio: 0.38

Pipe Unit Weight: 11.68400 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 2800 psi

Allowable Tensile Stress (Long Term): 2800 psi

Allowable Compressive Stress (Short Term): 3200 psi

Allowable Compressive Stress (Long Term): 3200 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	26.4	53.9
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	26.4	53.9
Deflection		
Earth Load Deflection	13.662	27.921
Buoyant Deflection	0.237	0.237
Reissner Effect	0	0
Net Deflection	13.899	28.158
Compressive Stress [psi]		
Compressive Wall Stress	329.4	673.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	17956.9	17956.9
Pullback Stress [psi]	915.7	915.7
Pullback Strain	2.289E-3	2.289E-3
Bending Stress [psi]	0.0	177.1
Bending Strain	0	4.427E-4
Tensile Stress [psi]	915.7	1091.4
Tensile Strain	2.289E-3	3.171E-3

Net External Pressure = 21.5 [psi]

Buoyant Deflection = 0.2

Hydrokinetic Force = 798.4 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.237	7.5	31.7	OK
Unconstrained Collapse [psi]	27.6	59.4	2.2	OK
Tensile Stress [psi]	1091.4	2800.0	2.6	OK

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Project Summary

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Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 1 HDD 122 DWG C-322

Input Summary

Start Coordinate	(0.00, 0.00, 90.52) ft
End Coordinate	(1100.00, 0.00, 106.00) ft
Project Length	1100.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

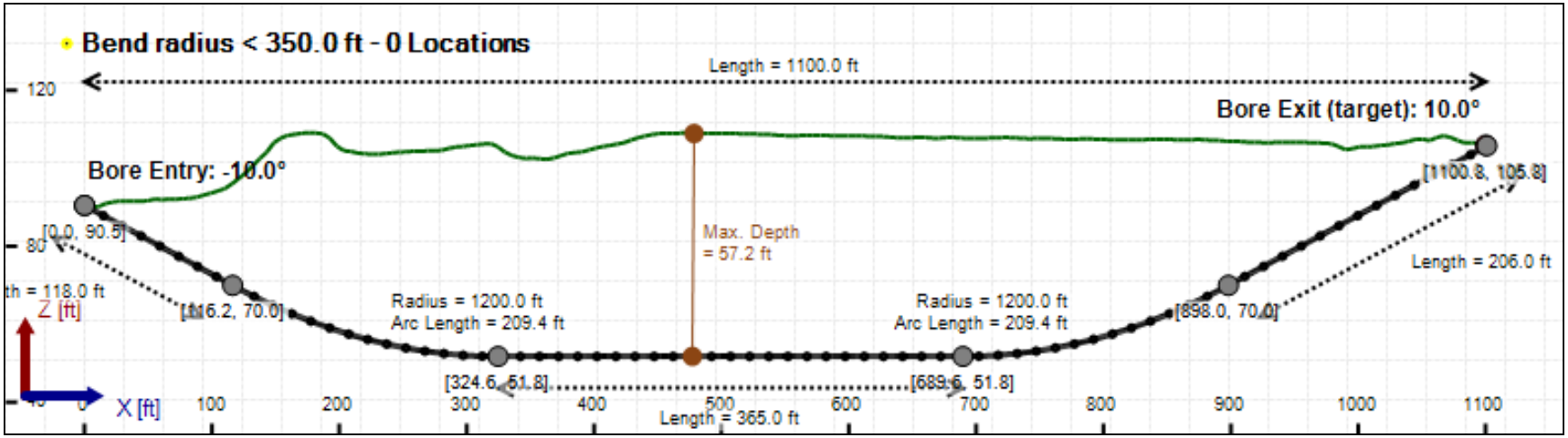
Number of Layers: 3

Soil Layer #1 USCS, Silt (M), MH
From Assistant
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

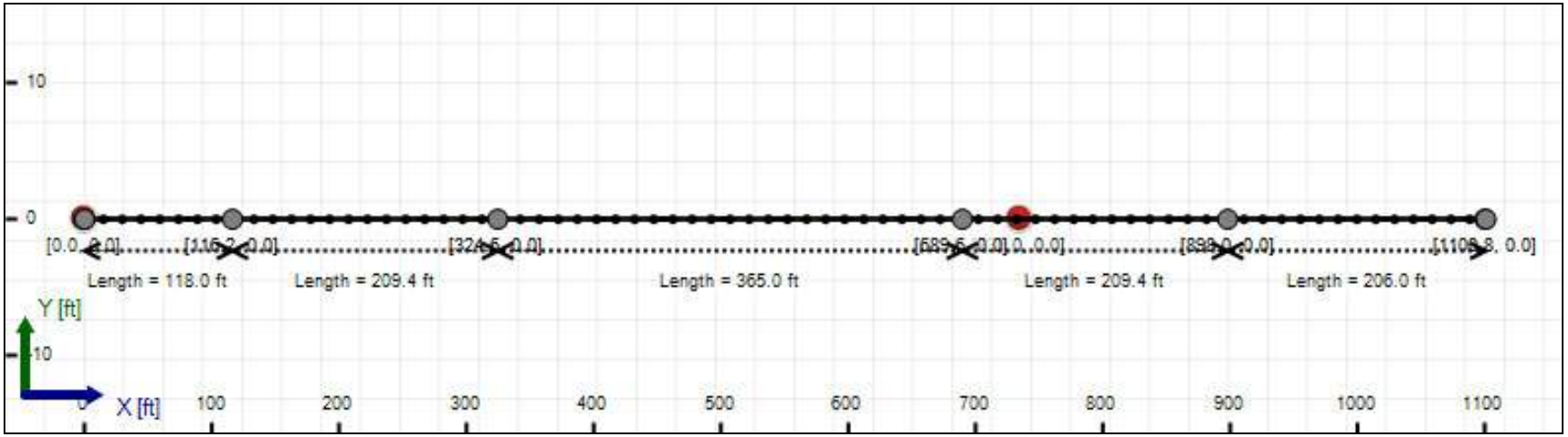
Soil Layer #2 USCS, Clay (C), CH
From Assistant
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 1110.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	20.7	37.1
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	20.7	37.1
Deflection		
Earth Load Deflection	5.651	10.115
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	5.783	10.247
Compressive Stress [psi]		
Compressive Wall Stress	93.4	167.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	19078.4	19078.4
Pullback Stress [psi]	532.1	532.1
Pullback Strain	9.253E-3	9.253E-3
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	532.1	552.5
Tensile Strain	9.253E-3	9.983E-3

Net External Pressure = 32.0 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.783	7.5	1.3	OK
Unconstrained Collapse [psi]	35.4	116.4	3.3	OK
Compressive Wall Stress [psi]	93.4	1150.0	12.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	45.3	224.0	4.9	OK
Tensile Stress [psi]	552.5	1200.0	2.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	722.692 psi	1333.508 psi
1	8.75 in	12.00 in	722.621 psi	1333.411 psi
2	12.00 in	16.13 in	722.500 psi	1333.244 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

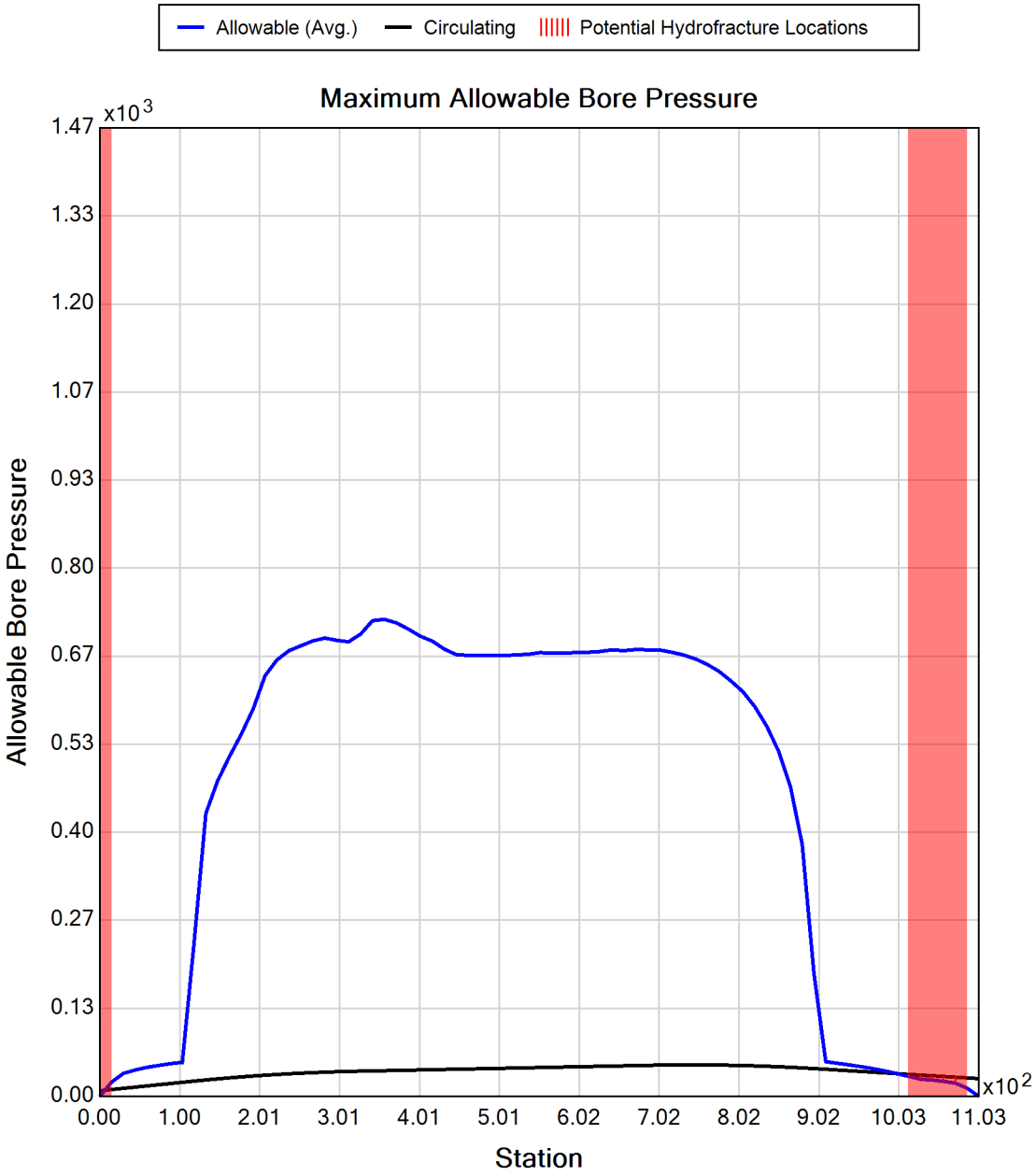
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



Generated Output

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 HDD 122 DWG C-322.2

Input Summary

Start Coordinate	(0.00, 0.00, 92.66) ft
End Coordinate	(1100.00, 0.00, 105.98) ft
Project Length	1100.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

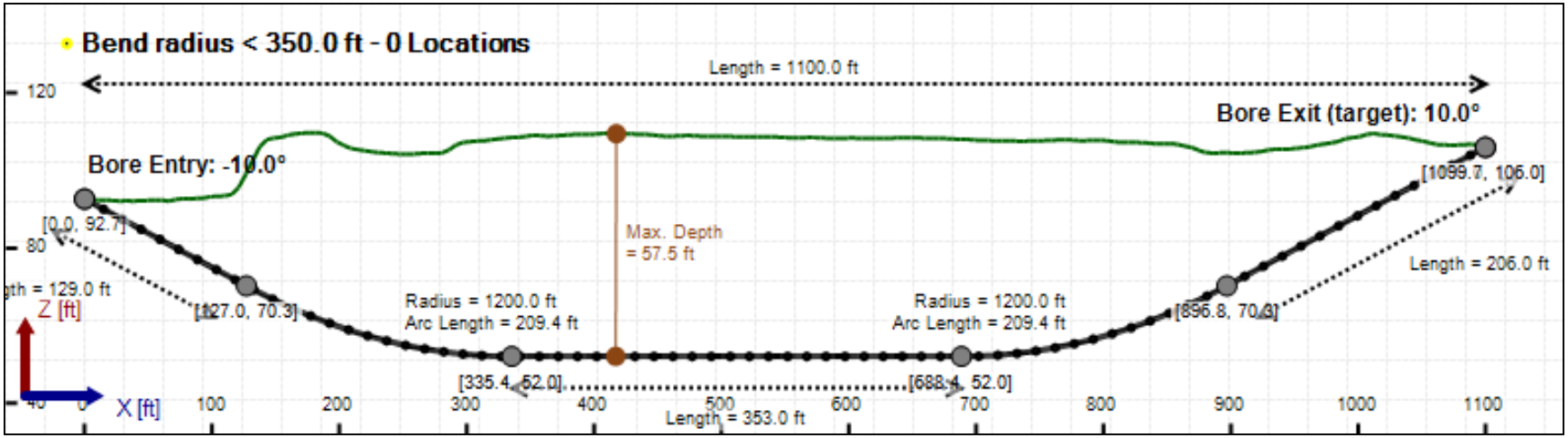
Number of Layers: 3

Soil Layer #1 USCS, Silt (M), MH
From Assistant
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

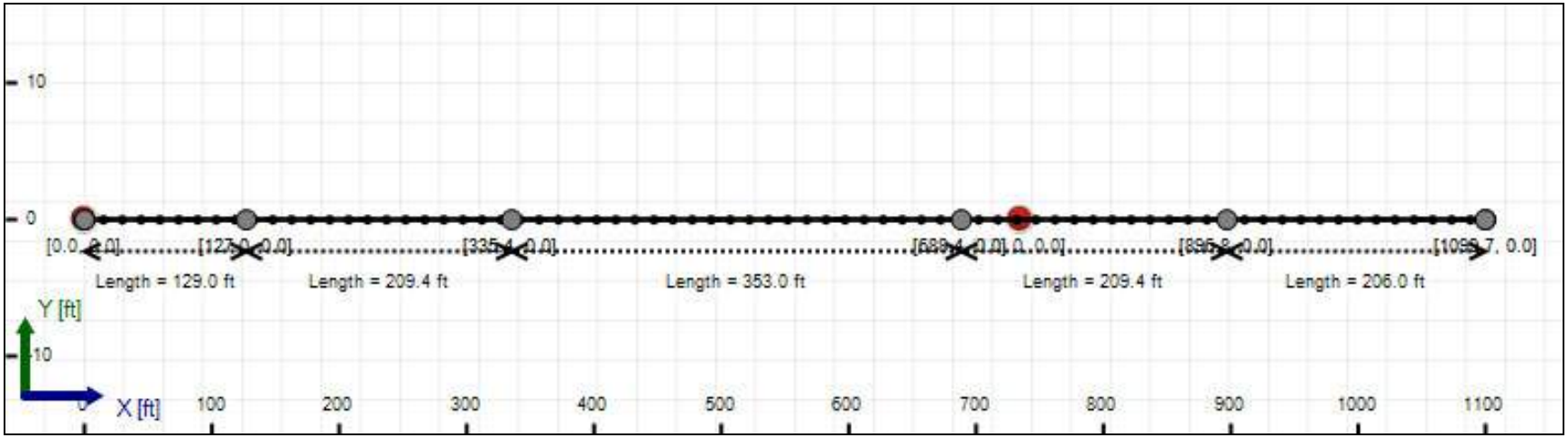
Soil Layer #2 USCS, Clay (C), CH
From Assistant
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 1110.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	19.6	37.3
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.6	37.3
Deflection		
Earth Load Deflection	5.343	10.145
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	5.475	10.277
Compressive Stress [psi]		
Compressive Wall Stress	88.3	167.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	19032.4	19032.4
Pullback Stress [psi]	530.8	530.8
Pullback Strain	9.231E-3	9.231E-3
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	530.8	550.5
Tensile Strain	9.231E-3	9.947E-3

Net External Pressure = 32.6 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.475	7.5	1.4	OK
Unconstrained Collapse [psi]	35.5	116.3	3.3	OK
Compressive Wall Stress [psi]	88.3	1150.0	13.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	45.4	224.2	4.9	OK
Tensile Stress [psi]	550.5	1200.0	2.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	688.347 psi	1333.601 psi
1	8.75 in	12.00 in	688.281 psi	1333.504 psi
2	12.00 in	16.13 in	688.169 psi	1333.339 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

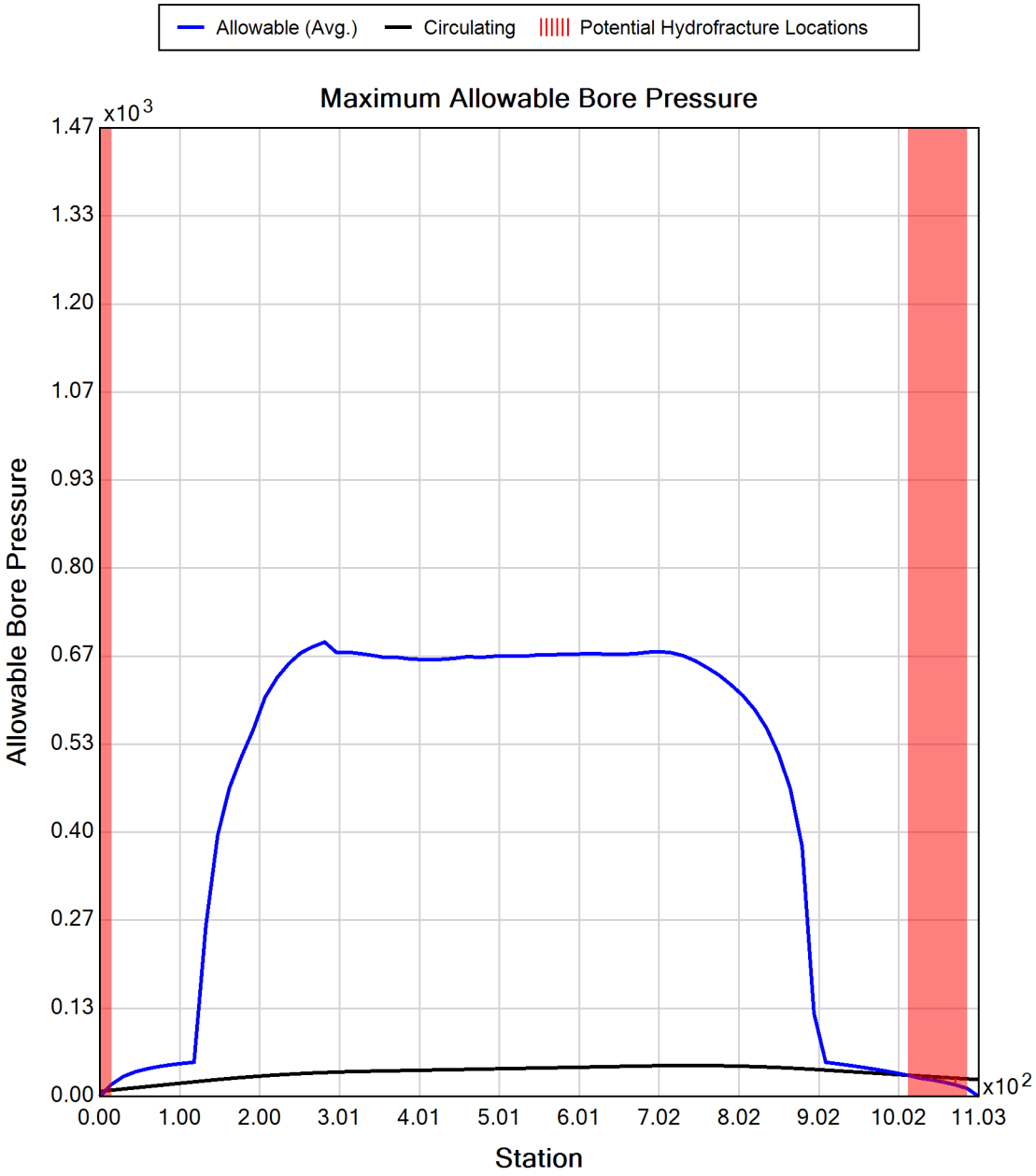
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 3 HDD 122 DWG C-322.2

Input Summary

Start Coordinate	(0.00, 0.00, 92.66) ft
End Coordinate	(1100.00, 0.00, 105.98) ft
Project Length	1100.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	9.0
Pipe Thickness	0.39 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

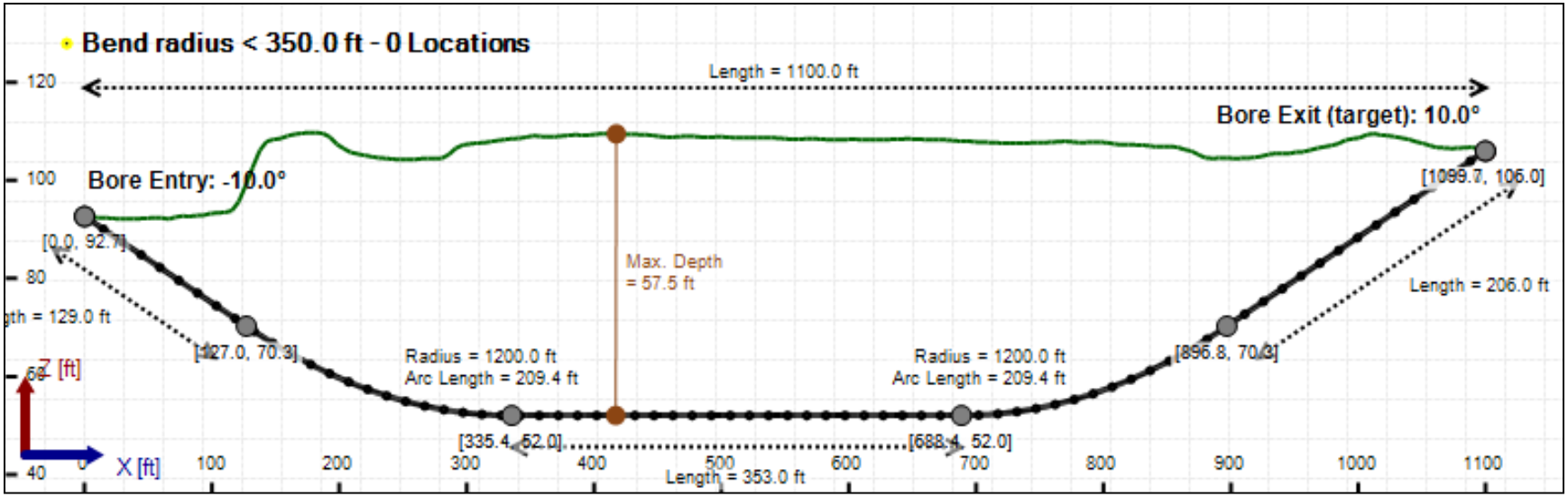
Number of Layers: 3

Soil Layer #1 USCS, Silt (M), MH
From Assistant
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 4.40 [psi]

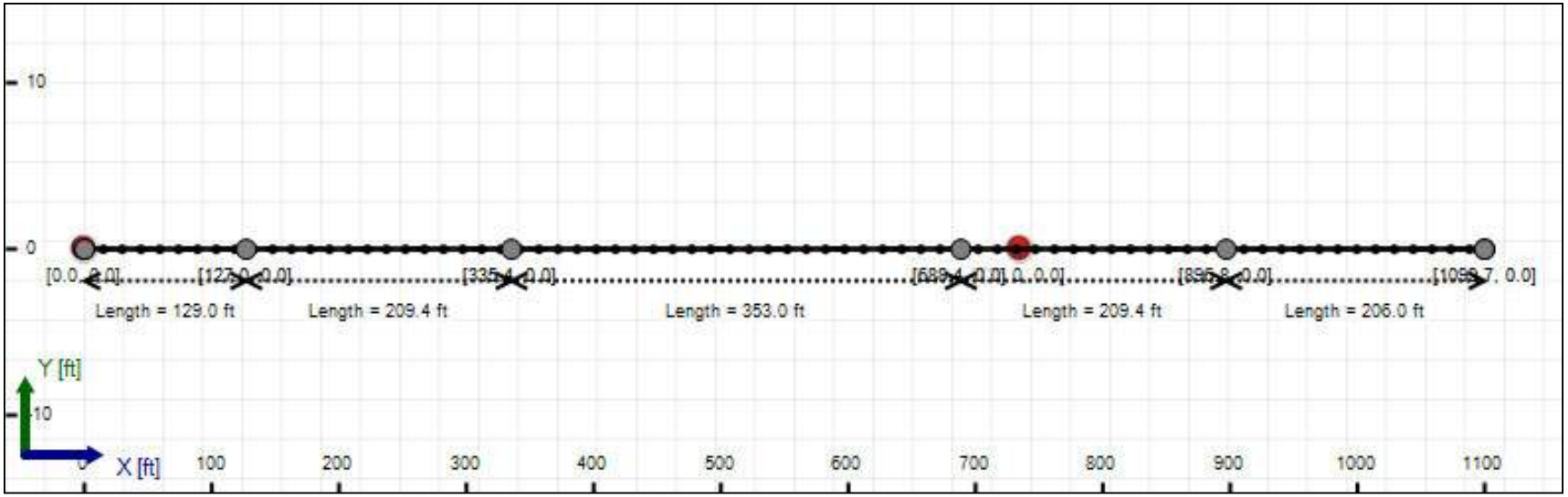
Soil Layer #2 USCS, Clay (C), CH
From Assistant
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 14.4144 (dry), 23.7468 (sat) [lb/US (liquid) gallon]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 3" (3.5")

Pipe DR: 9

Pipe Length: 1110.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.625 ft

Silo Width: 0.625 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	19.2	37.3
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.2	37.3
Deflection		
Earth Load Deflection	5.236	10.145
Buoyant Deflection	0.043	0.043
Reissner Effect	0	0
Net Deflection	5.279	10.188
Compressive Stress [psi]		
Compressive Wall Stress	86.5	167.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	2130.1	2130.1
Pullback Stress [psi]	560.4	560.4
Pullback Strain	9.746E-3	9.746E-3
Bending Stress [psi]	0.0	7.0
Bending Strain	0	1.215E-4
Tensile Stress [psi]	560.4	565.6
Tensile Strain	9.746E-3	9.959E-3

Net External Pressure = 32.6 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	5.279	7.5	1.4	OK
Unconstrained Collapse [psi]	35.5	127.7	3.6	OK
Compressive Wall Stress [psi]	86.5	1150.0	13.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.021	7.5	355.7	OK
Unconstrained Collapse [psi]	45.4	224.0	4.9	OK
Tensile Stress [psi]	565.6	1200.0	2.1	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	688.347 psi	1333.601 psi
1	8.75 in	12.00 in	688.281 psi	1333.504 psi
2	12.00 in	16.13 in	688.169 psi	1333.339 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 200.00 US (liquid) gallon/min

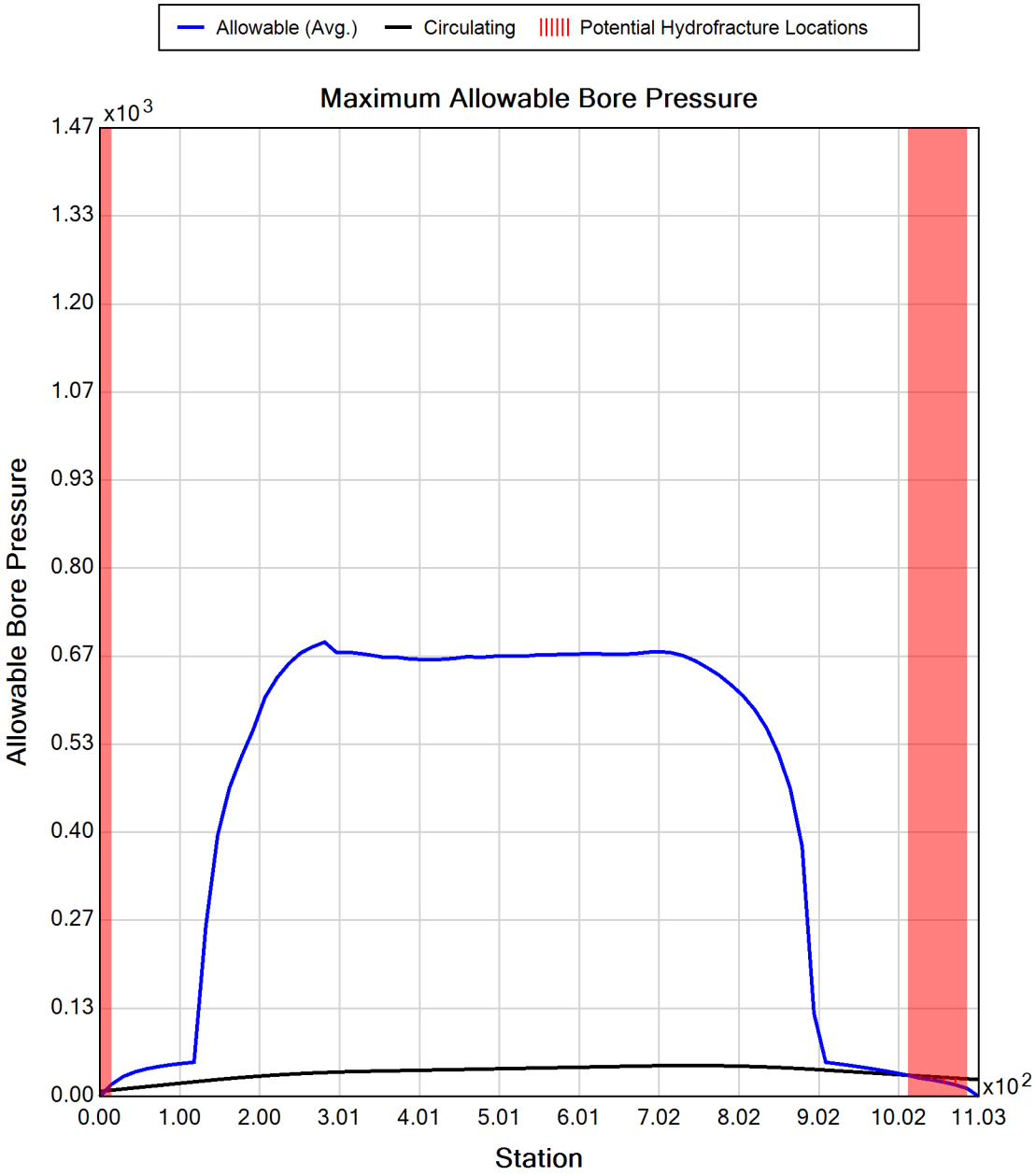
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 366.7



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 & 3 Equivalent Pipe Bundle HDD 122 DWG C-322.2

Input Summary

Start Coordinate	(0.00, 0.00, 92.66) ft
End Coordinate	(1100.00, 0.00, 105.98) ft
Project Length	1100.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 1110.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	19.9	37.3
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.9	37.3
Deflection		
Earth Load Deflection	24.921	46.617
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	25.610	47.307
Compressive Stress [psi]		
Compressive Wall Stress	142.4	266.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15785.6	15785.6
Pullback Stress [psi]	394.2	394.2
Pullback Strain	6.855E-3	6.855E-3
Bending Stress [psi]	0.0	28.0
Bending Strain	0	4.861E-4
Tensile Stress [psi]	394.2	421.9
Tensile Strain	6.855E-3	7.824E-3

Net External Pressure = 17.5 [psi]

Buoyant Deflection = 0.3

Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.338	7.5	22.2	OK
Unconstrained Collapse [psi]	21.8	49.1	2.2	OK
Tensile Stress [psi]	421.9	1200.0	2.8	OK

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Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 1 HDD 123 DWG C-323

Input Summary

Start Coordinate	(0.00, 0.00, 108.39) ft
End Coordinate	(850.00, 0.00, 113.09) ft
Project Length	850.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GM
Depth: 3.00 ft
Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

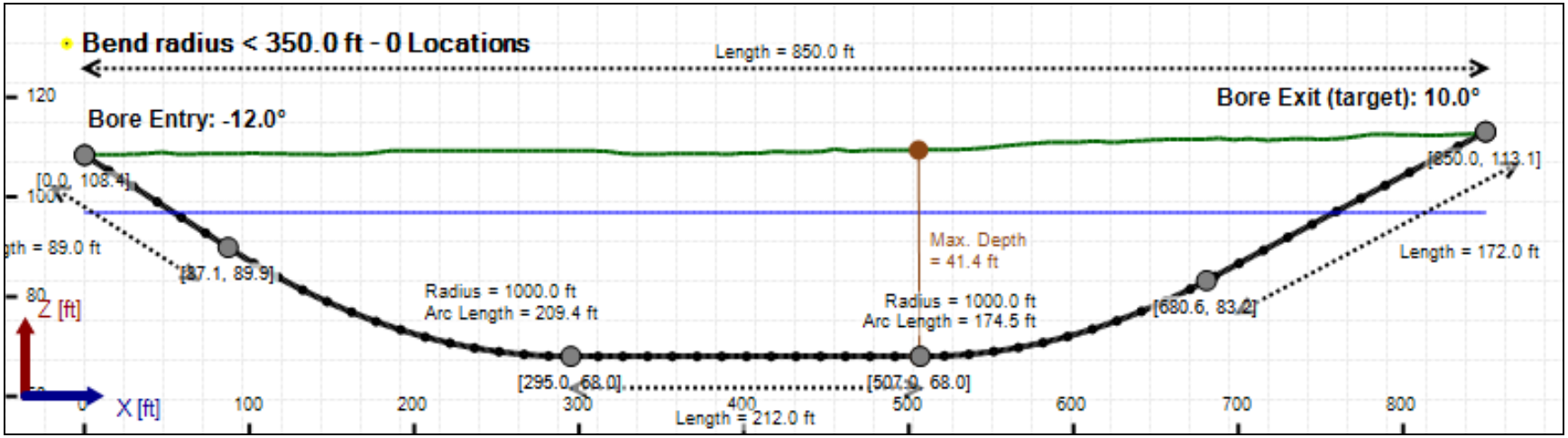
Soil Layer #2 USCS, Clay (C), CL
Depth: 1.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #3 USCS, Silt (M), MH
Depth: 11.00 ft
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 3.10 [psi]

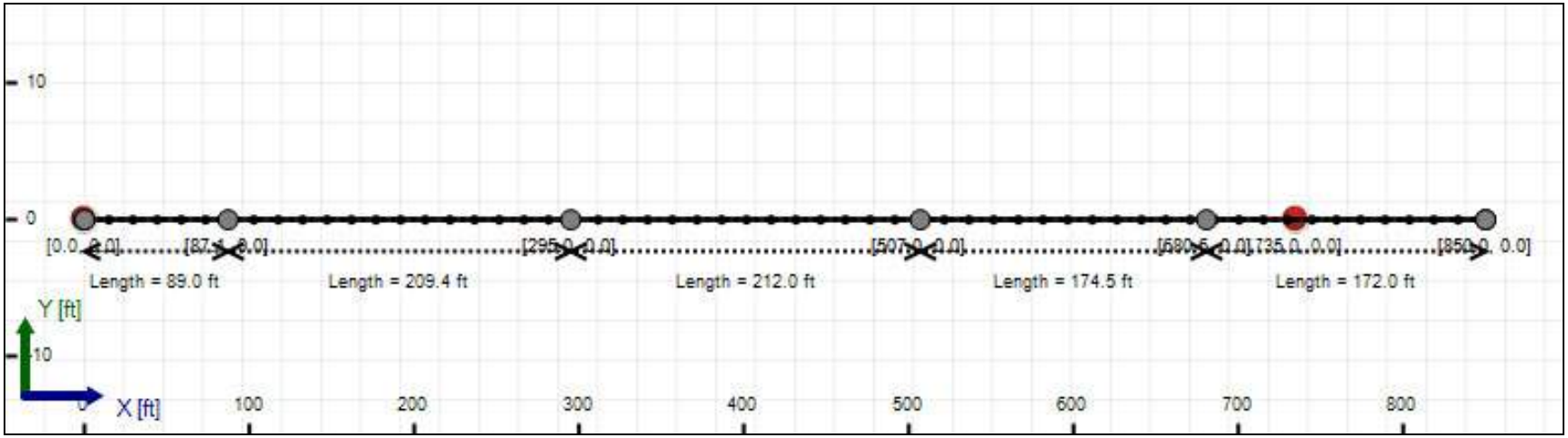
Soil Layer #4 USCS, Clay (C), CH
Depth: 10.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #5 USCS, Silt (M), MH
Depth: 35.00 ft
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 3.10 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 870.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	9.8	18.2
Water Pressure	12.5	12.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	22.3	30.7
Deflection		
Earth Load Deflection	2.677	5.070
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.809	5.202
Compressive Stress [psi]		
Compressive Wall Stress	100.5	138.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15258.9	15258.9
Pullback Stress [psi]	425.5	425.5
Pullback Strain	7.401E-3	7.401E-3
Bending Stress [psi]	25.8	25.8
Bending Strain	4.479E-4	4.479E-4
Tensile Stress [psi]	451.3	451.3
Tensile Strain	8.297E-3	8.297E-3

Net External Pressure = 26.7 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.809	7.5	2.7	OK
Unconstrained Collapse [psi]	30.8	107.4	3.5	OK
Compressive Wall Stress [psi]	100.5	1150.0	11.4	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	40.7	230.5	5.7	OK
Tensile Stress [psi]	451.3	1200.0	2.7	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	55.168 psi	48.335 psi
1	8.75 in	12.00 in	55.128 psi	48.160 psi
2	12.00 in	16.13 in	55.060 psi	47.872 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

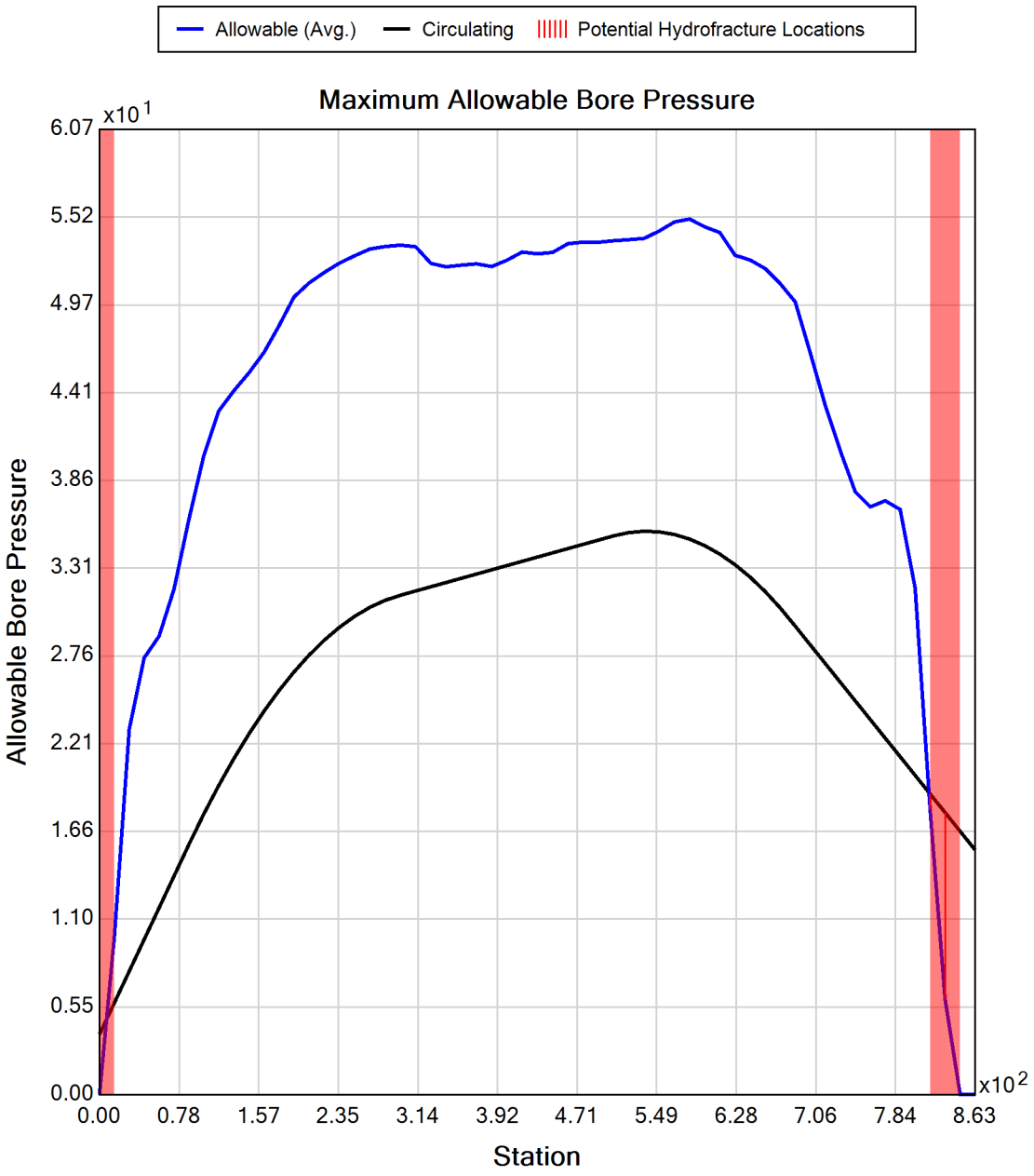
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 HDD 123 DWG C-323.2

Input Summary

Start Coordinate	(0.00, 0.00, 108.68) ft
End Coordinate	(850.00, 0.00, 112.75) ft
Project Length	850.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GM
Depth: 3.00 ft
Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

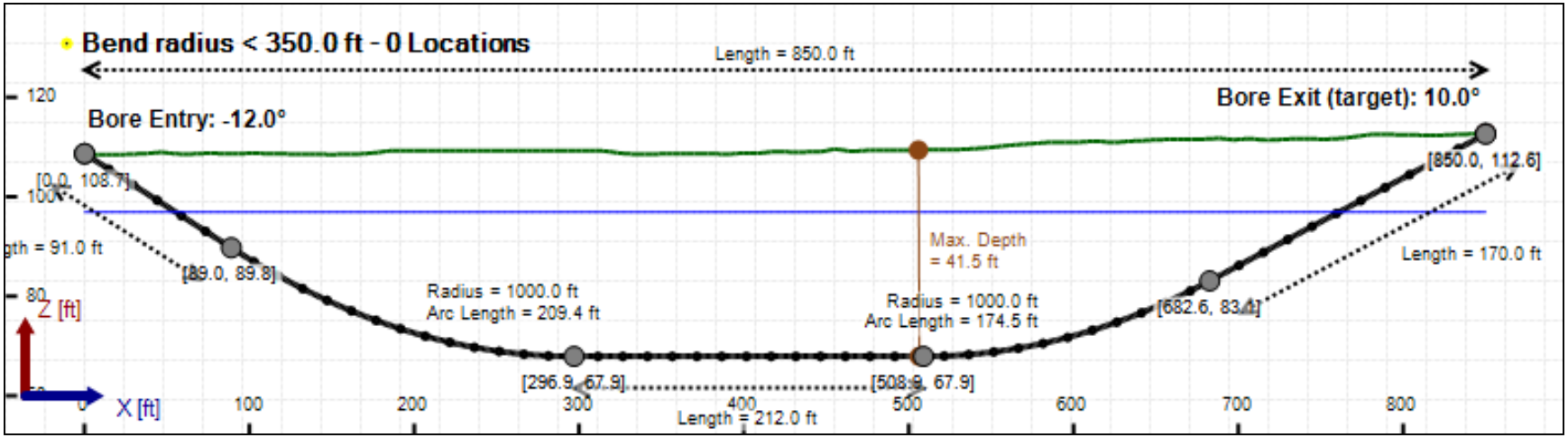
Soil Layer #2 USCS, Clay (C), CL
Depth: 1.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #3 USCS, Silt (M), MH
Depth: 11.00 ft
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 3.10 [psi]

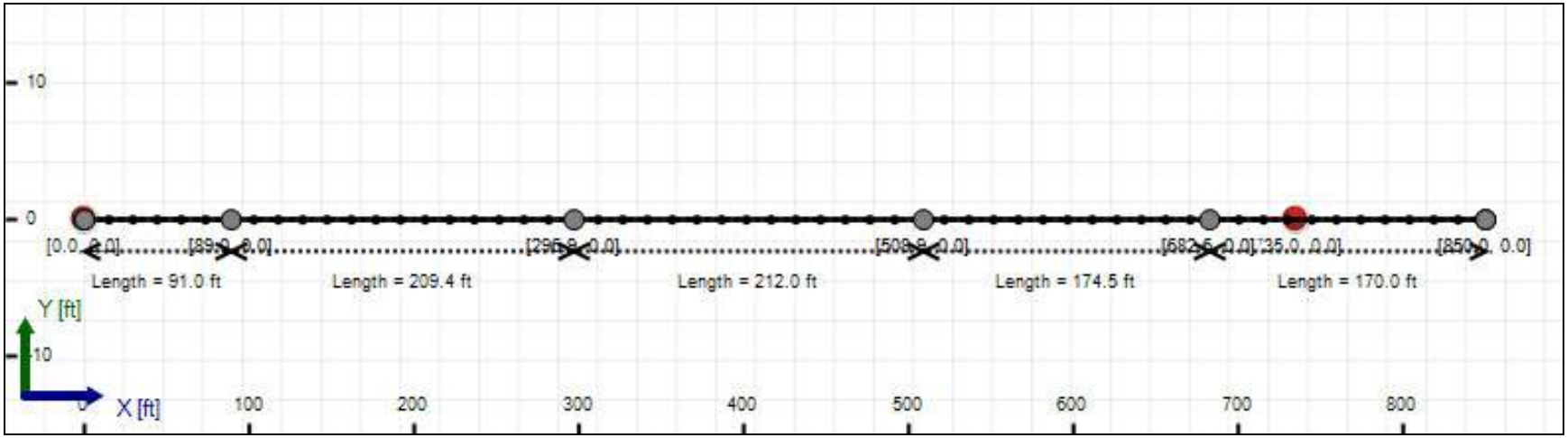
Soil Layer #4 USCS, Clay (C), CH
Depth: 10.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #5 USCS, Silt (M), MH
Depth: 35.00 ft
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 3.10 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 870.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	10.2	18.2
Water Pressure	12.6	12.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	22.8	30.7
Deflection		
Earth Load Deflection	2.785	5.069
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.917	5.201
Compressive Stress [psi]		
Compressive Wall Stress	102.6	138.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15233.9	15233.9
Pullback Stress [psi]	424.9	424.9
Pullback Strain	7.389E-3	7.389E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	424.9	448.9
Tensile Strain	7.389E-3	8.255E-3

Net External Pressure = 26.2 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.917	7.5	2.6	OK
Unconstrained Collapse [psi]	30.5	106.4	3.5	OK
Compressive Wall Stress [psi]	102.6	1150.0	11.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	40.5	230.7	5.7	OK
Tensile Stress [psi]	448.9	1200.0	2.7	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	54.849 psi	46.360 psi
1	8.75 in	12.00 in	54.810 psi	46.154 psi
2	12.00 in	16.13 in	54.744 psi	45.815 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

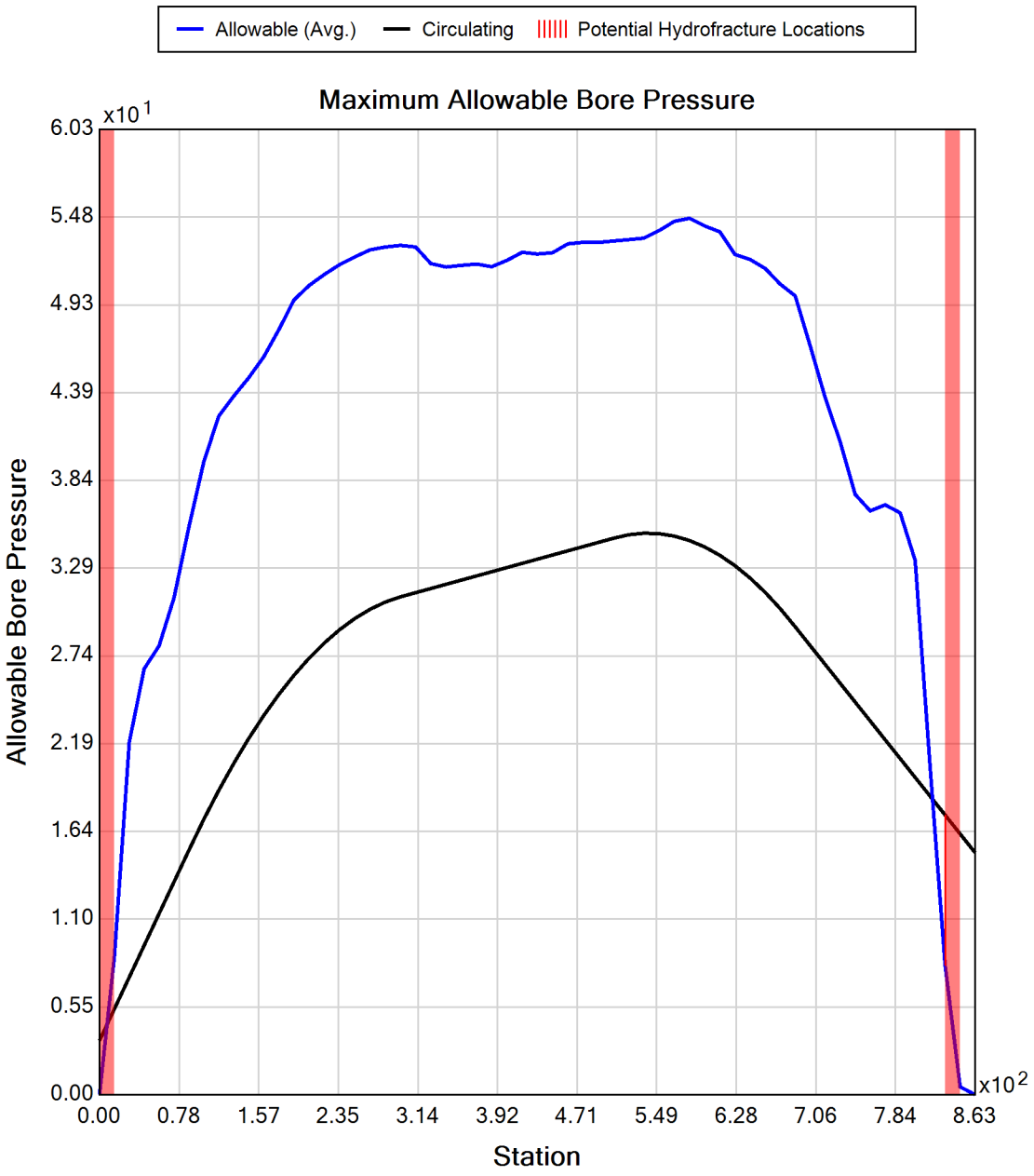
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 3 HDD 123 DWG C-323.2

Input Summary

Start Coordinate	(0.00, 0.00, 108.68) ft
End Coordinate	(850.00, 0.00, 112.75) ft
Project Length	850.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	9.0
Pipe Thickness	0.39 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GM
Depth: 3.00 ft
Unit Weight: 16.9785 (dry), 18.6879 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

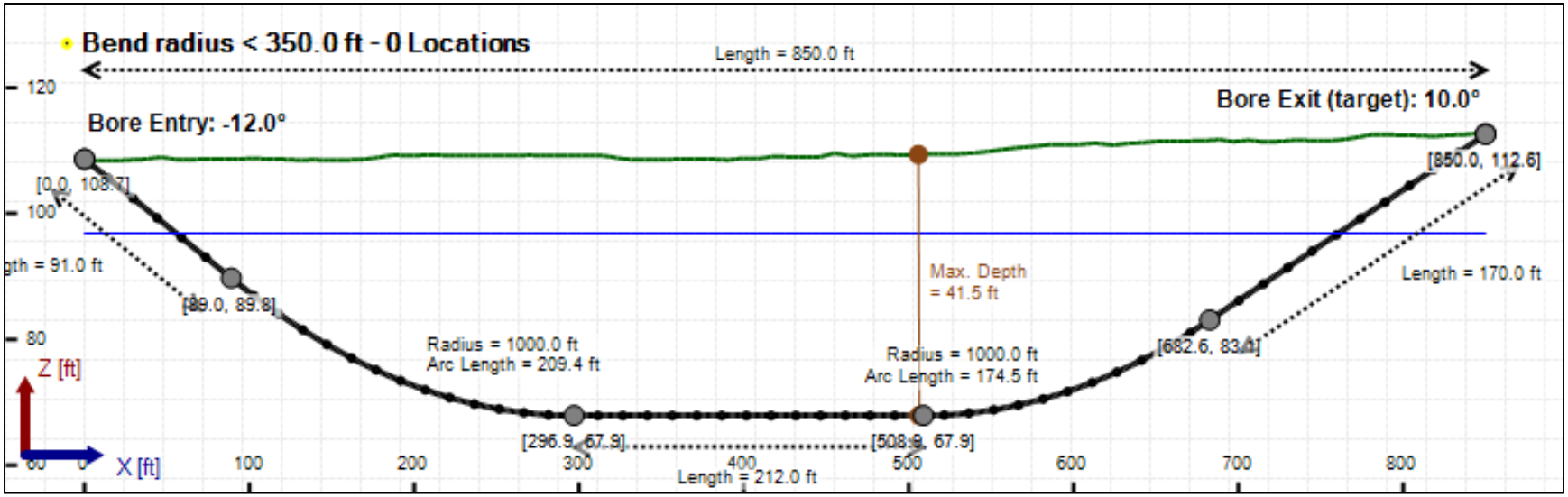
Soil Layer #2 USCS, Clay (C), CL
Depth: 1.00 ft
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #3 USCS, Silt (M), MH
Depth: 11.00 ft
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 3.10 [psi]

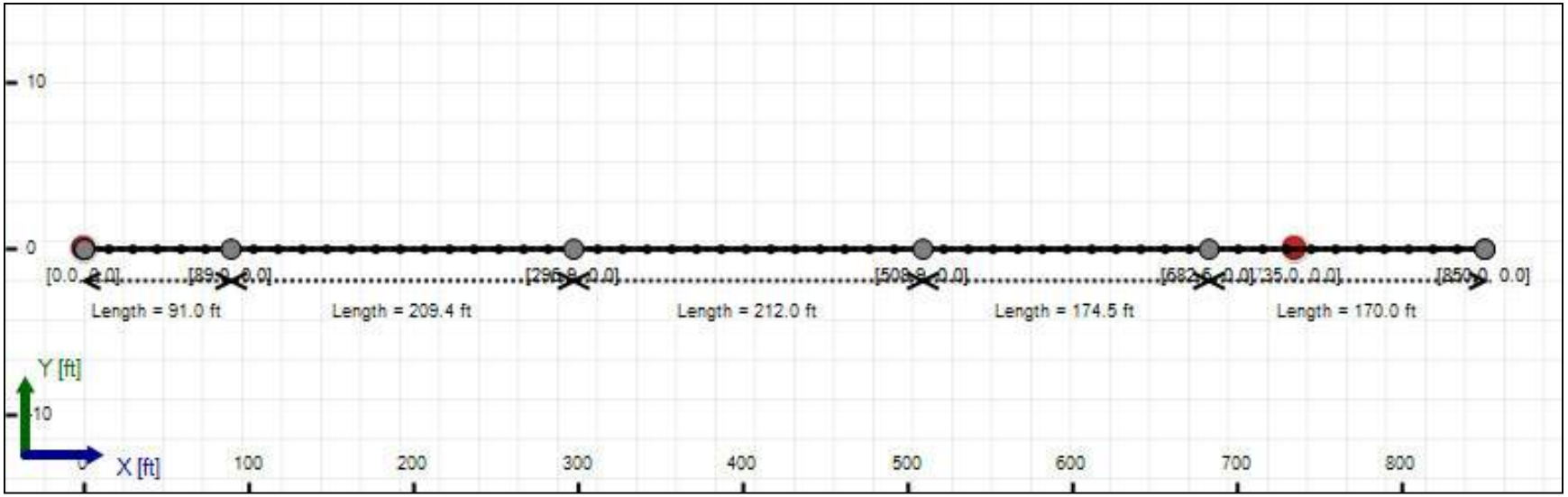
Soil Layer #4 USCS, Clay (C), CH
Depth: 10.00 ft
Unit Weight: 11.9889 (dry), 15.2922 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 300.00, Coh: 5.60 [psi]

Soil Layer #5 USCS, Silt (M), MH
Depth: 35.00 ft
Unit Weight: 10.9956 (dry), 14.5068 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 145.00, Coh: 3.10 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 3" (3.5")

Pipe DR: 9

Pipe Length: 870.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.625 ft

Silo Width: 0.625 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	6.3	18.2
Water Pressure	12.6	12.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.9	30.7
Deflection		
Earth Load Deflection	1.719	5.069
Buoyant Deflection	0.043	0.043
Reissner Effect	0	0
Net Deflection	1.762	5.112
Compressive Stress [psi]		
Compressive Wall Stress	85.0	138.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1727.5	1727.5
Pullback Stress [psi]	454.5	454.5
Pullback Strain	7.904E-3	7.904E-3
Bending Stress [psi]	0.0	8.4
Bending Strain	0	1.458E-4
Tensile Stress [psi]	454.5	461.2
Tensile Strain	7.904E-3	8.166E-3

Net External Pressure = 26.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.762	7.5	4.3	OK
Unconstrained Collapse [psi]	30.5	117.9	3.9	OK
Compressive Wall Stress [psi]	85.0	1150.0	13.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.021	7.5	355.7	OK
Unconstrained Collapse [psi]	40.5	230.8	5.7	OK
Tensile Stress [psi]	461.2	1200.0	2.6	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	54.849 psi	46.360 psi
1	8.75 in	12.00 in	54.810 psi	46.154 psi
2	12.00 in	16.13 in	54.744 psi	45.815 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 70.00 US (liquid) gallon/min

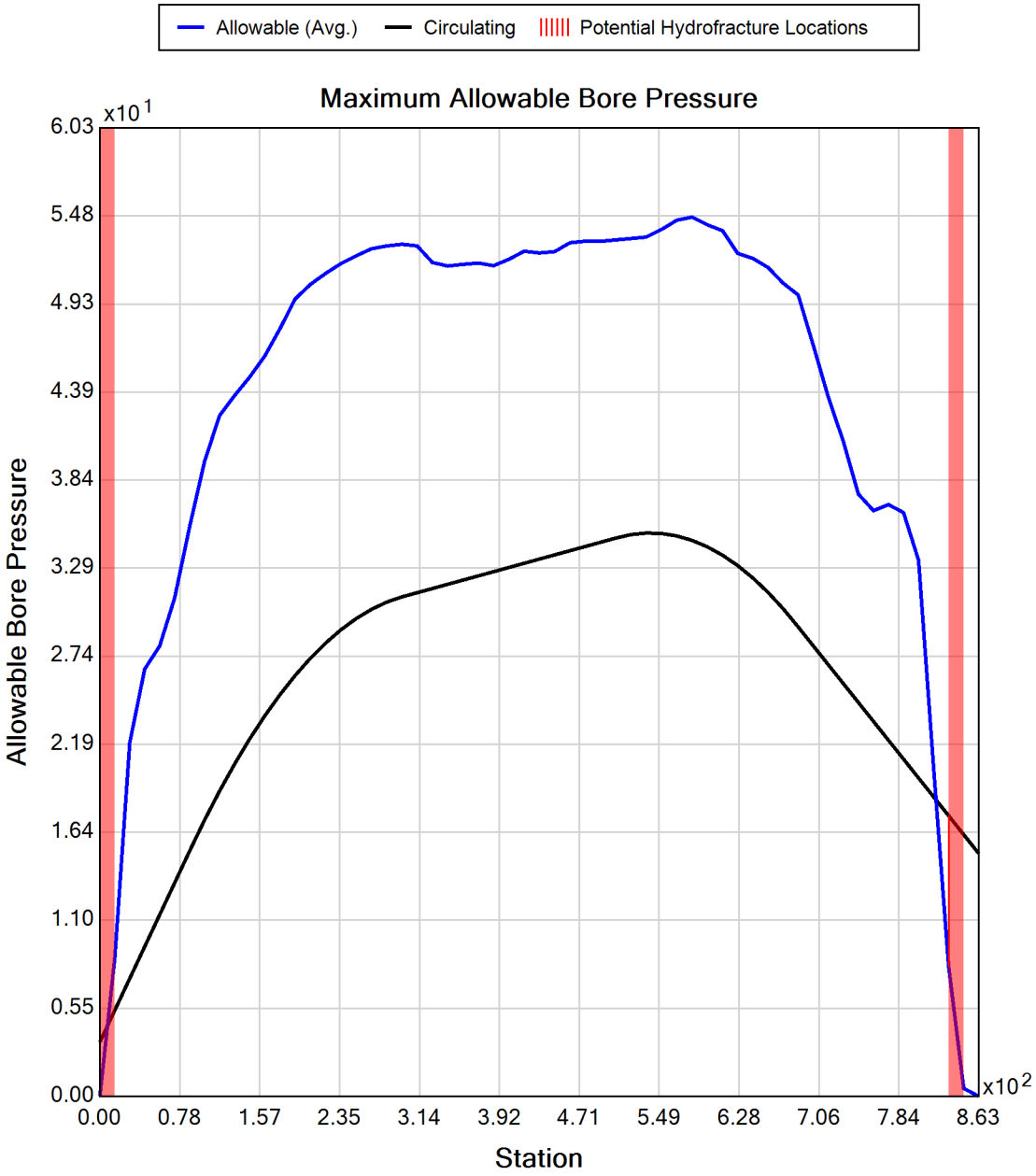
Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2



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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-19-2023
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 & 3 Equivalent Pipe Bundle HDD 123 DWG C-323.2

Input Summary

Start Coordinate	(0.00, 0.00, 108.68) ft
End Coordinate	(850.00, 0.00, 112.75) ft
Project Length	850.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	14.000 in
Pipe DR	14.3
Pipe Thickness	0.98 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 14" (14")
Pipe DR: 14.3
Pipe Length: 870.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.75 ft
Silo Width: 1.75 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 7.92790 lb/US (liquid) gallon
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 12.51801 lb/US (liquid) gallon
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	11.5	18.2
Water Pressure	12.6	12.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.0	30.7
Deflection		
Earth Load Deflection	14.339	23.290
Buoyant Deflection	0.690	0.690
Reissner Effect	0	0
Net Deflection	15.029	23.980
Compressive Stress [psi]		
Compressive Wall Stress	171.8	219.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	12724.5	12724.5
Pullback Stress [psi]	317.7	317.7
Pullback Strain	5.526E-3	5.526E-3
Bending Stress [psi]	0.0	33.5
Bending Strain	0	5.833E-4
Tensile Stress [psi]	317.7	351.1
Tensile Strain	5.526E-3	6.690E-3

Net External Pressure = 15.4 [psi]

Buoyant Deflection = 0.3

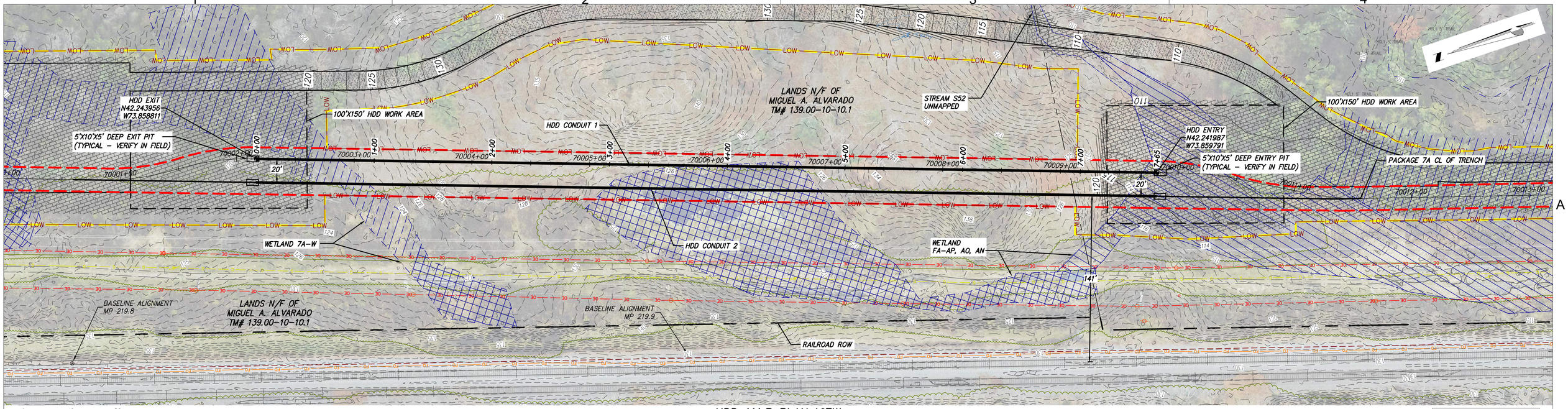
Hydrokinetic Force = 962.1 lb

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.338	7.5	22.2	OK
Unconstrained Collapse [psi]	20.2	50.0	2.5	OK
Tensile Stress [psi]	351.1	1200.0	3.4	OK

Appendix B

Design Drawings

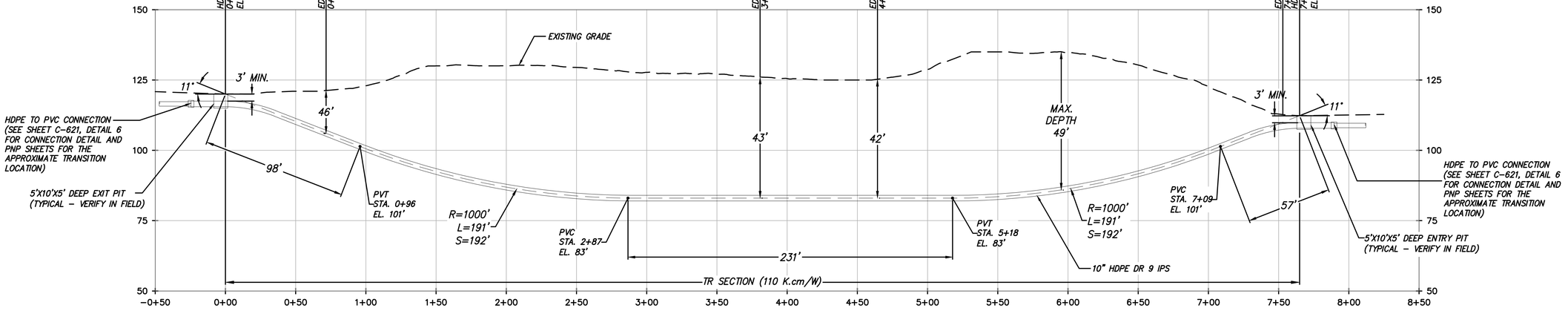


0 40 80
Scale in feet when printed on 22x34

HDD 111.B PLAN VIEW
CONDUIT 1

BORING LOG STRIP LEGEND
B101
Blow Counts per 6" = 10-10-15
Recovery %/RQD % = 90%/60%
11000psi =UCS
2D strip logs shown at 10x exaggeration
3D strip logs have no exaggeration

Legend	
ASPHALT	Asphalt
Bedrock	Bedrock
Boulder	Boulder
CH	Fat CLAY
CH-MH	SILTY Fat CLAY
CL	Lean CLAY
CL-ML	SILTY CLAY
CONCRETE	Concrete
Fill	Fill
GC	CLAYEY GRAVEL
GC-GM	SILTY CLAYEY GRAVEL
GM	SILTY GRAVEL
GP	Poorly Graded GRAVEL
GP-GC	Poorly Graded Gravel with CLAY
GP-GM	Poorly Graded GRAVEL with SILT
GW	Well Graded GRAVEL
GW-GC	Well Graded GRAVEL with CLAY
GW-GM	Well Graded GRAVEL with SILT
Limestone	Limestone
MH	Elastic SILT
ML	SILT
OH	ORGANIC Fat CLAY
OL	ORGANIC Lean CLAY
OL/OH	ORGANIC SOIL
PT	PEAT
Rock	Rock
Sandstone	Sandstone
SC	CLAYEY SAND
SC-SM	SILT, CLAYEY SAND
SHALE	Shale
SILTSTONE	Siltstone
SM	SILTY SAND
SP	Poorly Graded SAND
SP-SC	Poorly Graded SAND with CLAY
SP-SM	Poorly Graded SAND with SILT
SW	Well graded SAND
SW-SC	Well Graded SAND with CLAY
SW-SM	Well Graded SAND with SILT
Topsoil	Topsoil
USGS 601	Gravel or Conglomerate 1
USGS 654	Subgraywacke
USGS 670	Interbedded Sandstone and Shale
USGS 702	Quartzite
USGS 705	Schist
USGS 705	Schist
USGS 708	Gneiss
USGS 708	Gneiss
USGS 718	Granite 1
Void	Void
Water	Water
Weathered Rock	Undefined
Water Table	Water Table during drilling
Delayed Water Table	Water Table after drilling



0 20 40
0 40 80
Scale in feet when printed on 22x34

DESIGN AND CONSTRUCTION NOTES:

1. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL.
2. 10.750" HDPE MIN. W.T. 1.194" DR 9 IPS PIPE.
   3.500" HDPE MIN. W.T. 0.389" DR 9 IPS PIPE.
   HDD HORIZONTAL LENGTH (L): 765'
   HDD DESIGNED PIPE LENGTH (S): 770'
3. THE MINIMUM THREE JOINT (APPROX. 100 FT) COMBINED CURVE (VERTICAL + HORIZONTAL) RADIUS SHALL NOT BE LESS THAN 800 FT.
4. THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FT.
5. DRILL CONTRACTOR AND/OR GEOTECHNICAL ENGINEER TO DETERMINE LENGTH OF TEMPORARY SURFACE/CONDUCTOR CASING.
6. NO GEOTECHNICAL DATA OR REPORTS WERE AVAILABLE AT THE TIME OF DESIGN. NO OTHER GEOTECHNICAL INFORMATION WAS REFERENCED IN THE PREPARATION OF THIS DESIGN.
7. DRILL CONTRACTOR SHALL UTILIZE BUOYANCY CONTROL MEASURES (INTERNAL WATER USED FOR BALLAST) DURING PULLBACK FOR ALL BUNDLED CASINGS.

GENERAL NOTES:

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3. ALL COORDINATES ARE IN NEW YORK STATE PLANE, NAD83, EAST ZONE, US FOOT.

HDD 111.B PROFILE VIEW
CONDUIT 1

CHPE Champlain Hudson Power Express

Kiewit

TETRA TECH
TETRA TECH ENGINEERING AND SURVEYING P.C.
(A NEW YORK PROFESSIONAL CORPORATION)

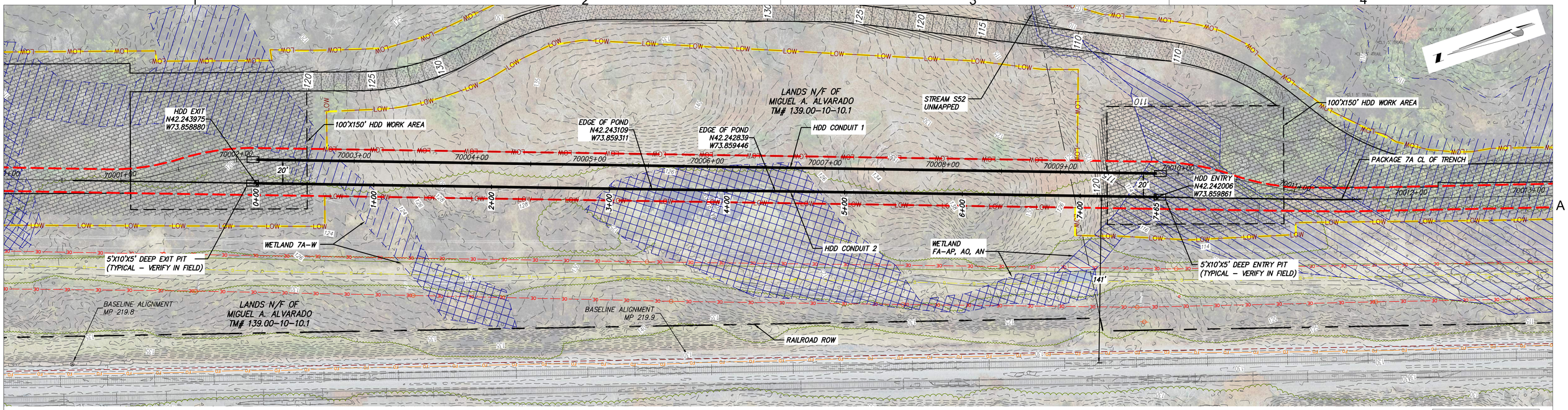
STATE OF NEW YORK · EDWARD J. KELLY · 094981 · LICENSED PROFESSIONAL ENGINEER

No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP
0	06/19/2023	ISSUED FOR CONSTRUCTION SUBMISSION	MRS	EJK

CHAMPLAIN HUDSON POWER EXPRESS
SEGMENT 11 (PACKAGE 7A) - CSX: CATSKILL
PLAN AND PROFILE - HDD 111.B
POND CROSSING - CONDUIT 1
GREENE COUNTY, NY

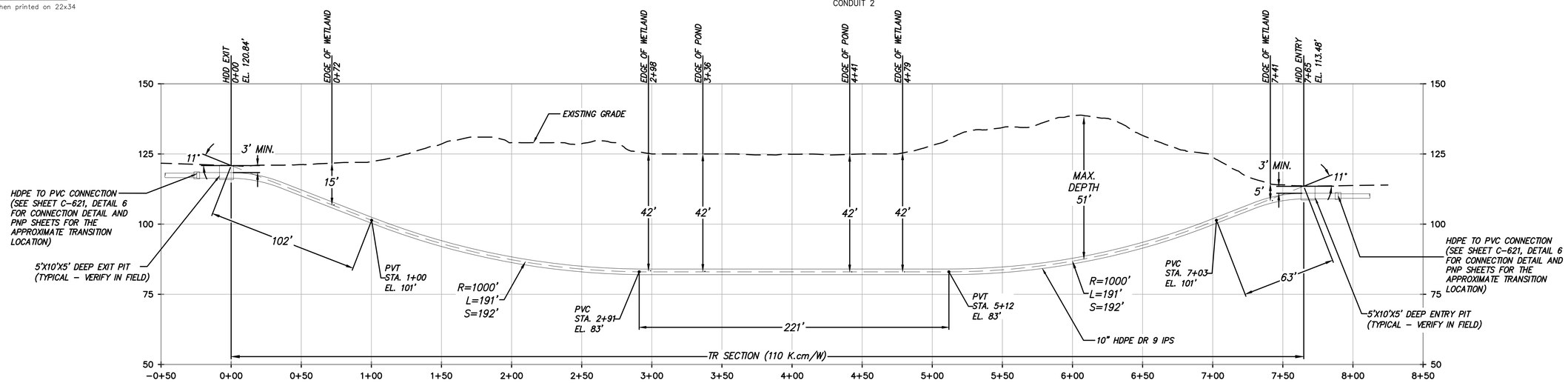
KIEWIT PROJECT NO.	21162
TT PROJECT NO.	204-3701
DRAWING NO.	**C-311.B**

DRAWN BY: MRS | DESIGNED BY: AMC | APPROVED BY: EJK | SCALE AS SHOWN | REV. NO. 0 | DATE 06/19/2023 | SH.NO. | OF



0 40 80
Scale in feet when printed on 22x34

HDD 111.B PLAN VIEW
CONDUIT 2



0 40 80
Scale in feet when printed on 22x34

HDD 111.B PROFILE VIEW
CONDUIT 2

BORING LOG STRIP LEGEND
B101
Blow Counts per 6" = 10-10-15
Recovery %/RQD % = 90%/60%
11000psi =UCS
2D strip logs shown at 10x exaggeration
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Legend	
ASPHALT	Asphalt
Bedrock	Bedrock
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CH	Fat CLAY
CH-MH	SILTY FAT CLAY
CL	Lean CLAY
CL-ML	SILTY CLAY
CONCRETE	Concrete
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ML	SILT
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OL	ORGANIC Lean CLAY
OL/OH	ORGANIC SOIL
PT	PEAT
Rock	Rock
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SC	CLAYEY SAND
SC-SM	SILT, CLAYEY SAND
SHALE	Shale
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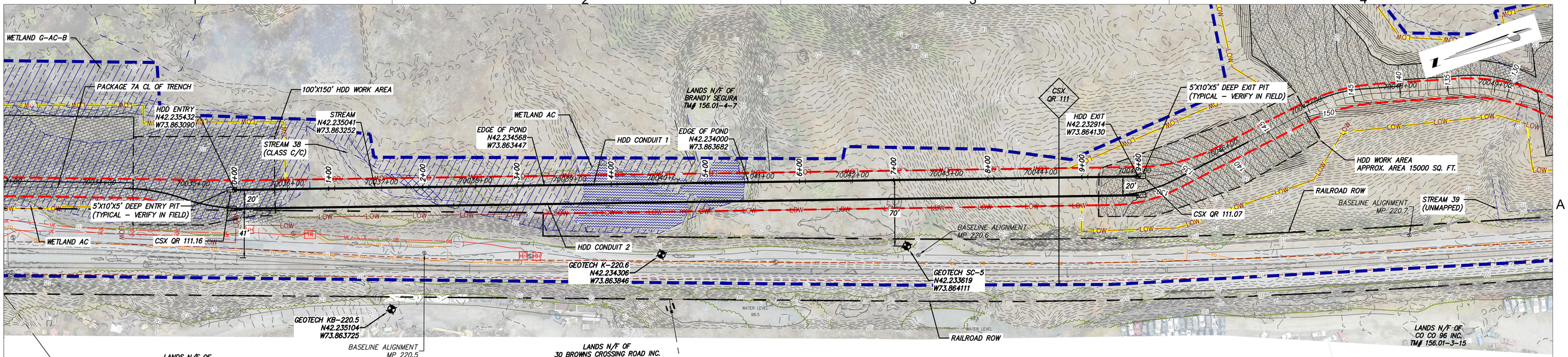
CHAMPLAIN HUDSON POWER EXPRESS
SEGMENT 11 (PACKAGE 7A) - CSX: CATSKILL
PLAN AND PROFILE - HDD 111.B
POND CROSSING - CONDUIT 2
GREENE COUNTY, NY

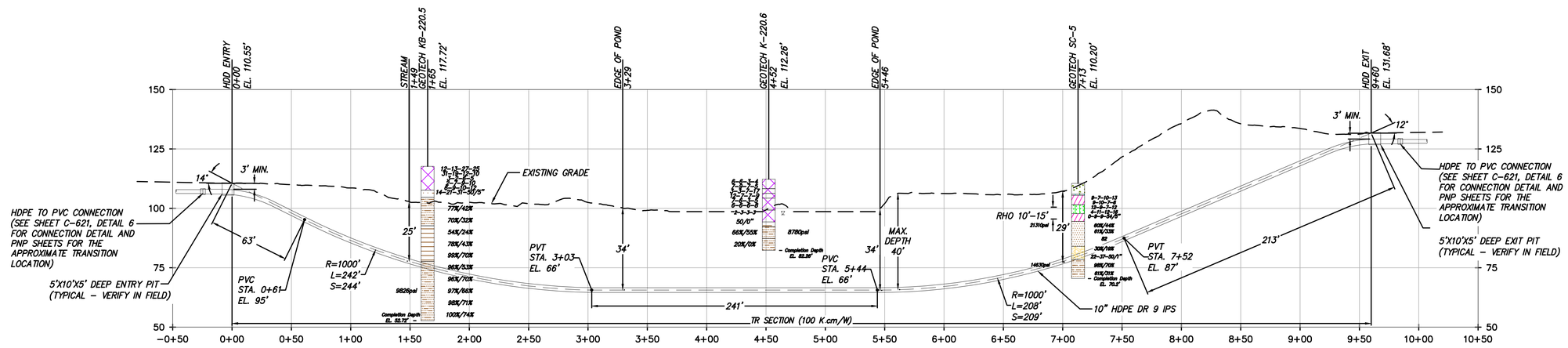
KIEWIT PROJECT NO.	21162
TT PROJECT NO.	204-3701
DRAWING NO.	**C-311.B.2**

DRAWN BY: MRS | DESIGNED BY: AMC | APPROVED BY: EJK | SCALE AS SHOWN | REV. NO. 0 | DATE 06/19/2023 | SH.NO. OF



0 50 100
Scale in feet when printed on 22x34

HDD 112 PLAN VIEW
CONDUIT 1



HDD 112 PROFILE VIEW
CONDUIT 1

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CHPE Champlain Hudson Power Express

Kiewit

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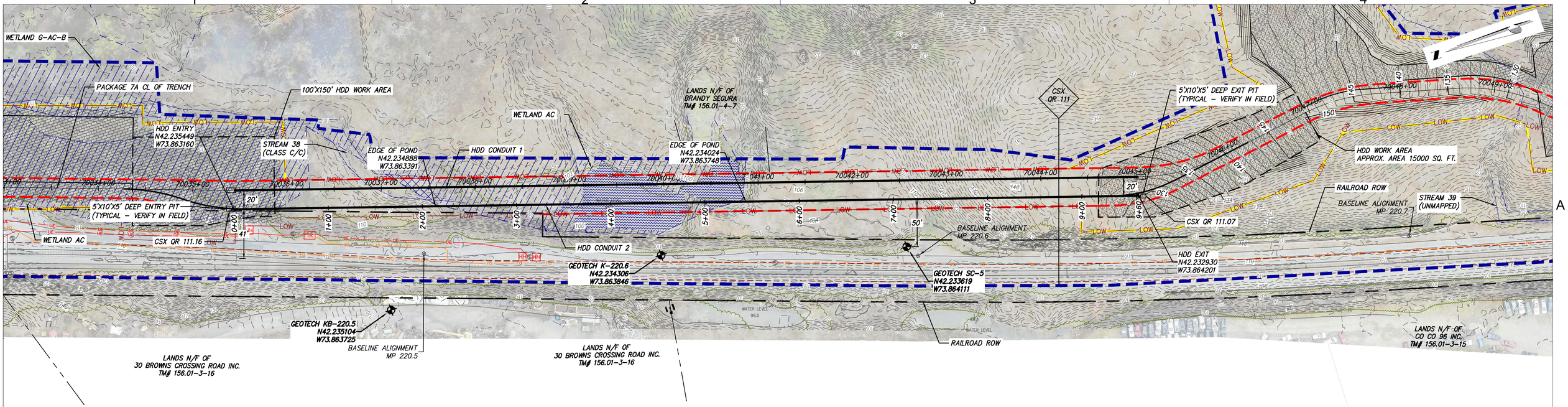
CHAMPLAIN HUDSON POWER EXPRESS
SEGMENT 11 (PACKAGE 7A) - CSX: CATSKILL
PLAN AND PROFILE - HDD 112
POND CROSSING - CONDUIT 1
GREENE COUNTY, NY

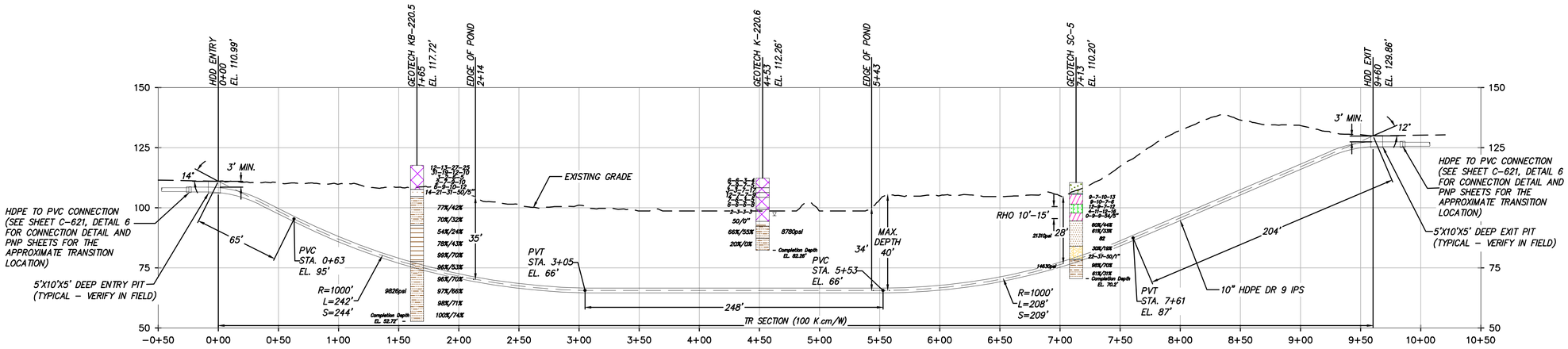
KIEWIT PROJECT NO.	21162
TT PROJECT NO.	204-3701
DRAWING NO.	**C-312**

DRAWN BY: MRS | DESIGNED BY: AMC | APPROVED BY: EJK | SCALE AS SHOWN | DATE 06/19/2023 | REV. NO. 0 | SH.NO. OF



0 50 100
Scale in feet when printed on 22x34

HDD 112 PLAN VIEW
CONDUIT 2



0 25 50
Scale in feet when printed on 22x34

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HDD 112 PROFILE VIEW
CONDUIT 2

BORING LOG STRIP LEGEND
B101
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Legend	
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CHAMPLAIN HUDSON POWER EXPRESS
SEGMENT 11 (PACKAGE 7A) - CSX: CATSKILL
PLAN AND PROFILE - HDD 112
POND CROSSING - CONDUIT 2
GREENE COUNTY, NY

KIEWIT PROJECT NO.	21162
TT PROJECT NO.	204-3701
DRAWING NO.	**C-312.2**

DRAWN BY: MRS | DESIGNED BY: AMC | APPROVED BY: EJK | SCALE AS SHOWN | DATE 06/19/2023 | REV. NO. 0 | SH.NO. OF

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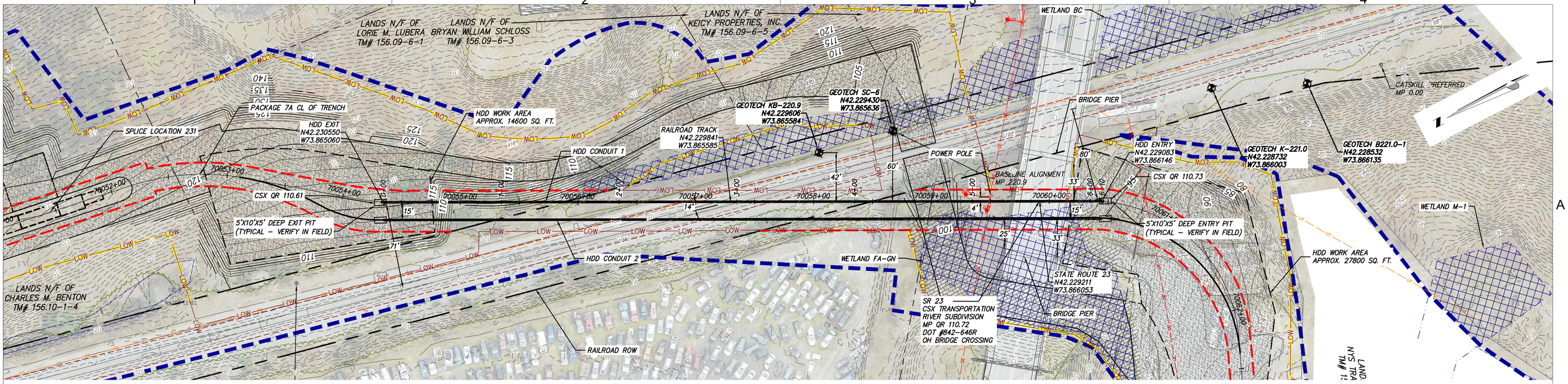

0 40 80
Scale in feet when printed on 22x34

HDD 113 PLAN VIEW
CONDUIT 1

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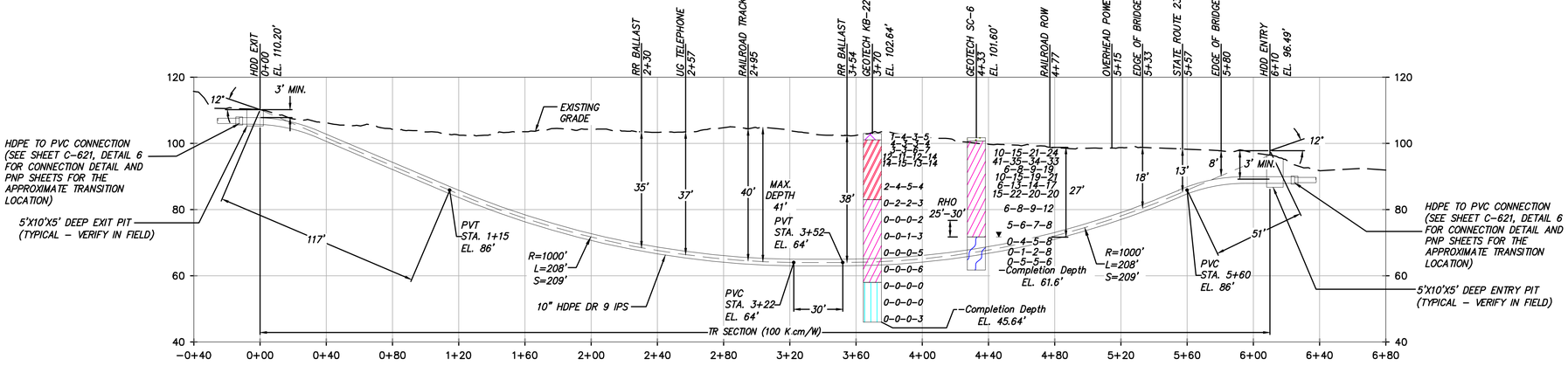

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HDD 113 PROFILE VIEW
CONDUIT 1

CHPE Champlain Hudson Power Express

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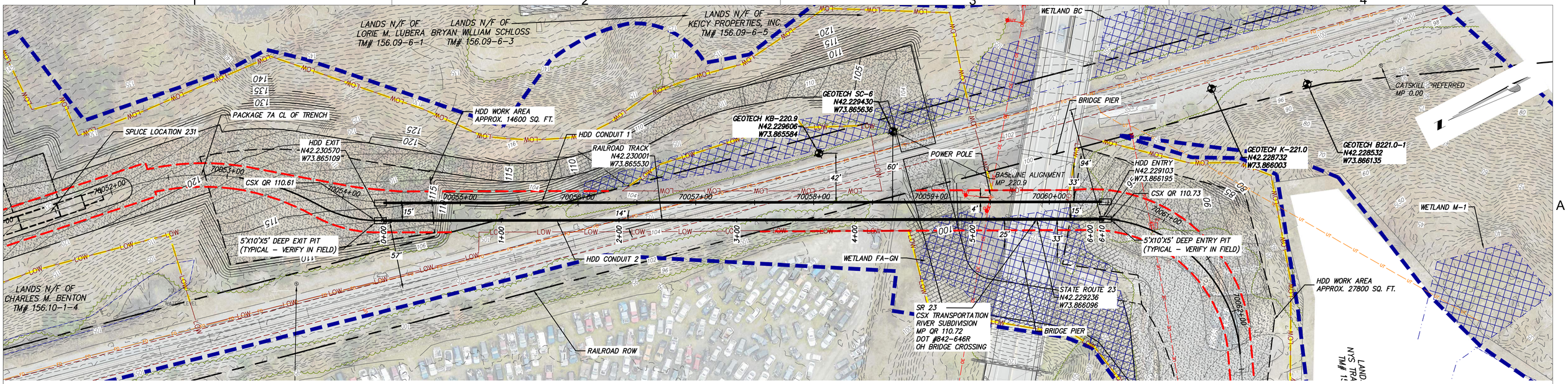
CHAMPLAIN HUDSON POWER EXPRESS
SEGMENT 11 (PACKAGE 7A) - CSX: CATSKILL
PLAN AND PROFILE - HDD 113
RAILROAD AND HWY 23 CROSSING - CONDUIT 1
GREENE COUNTY, NY

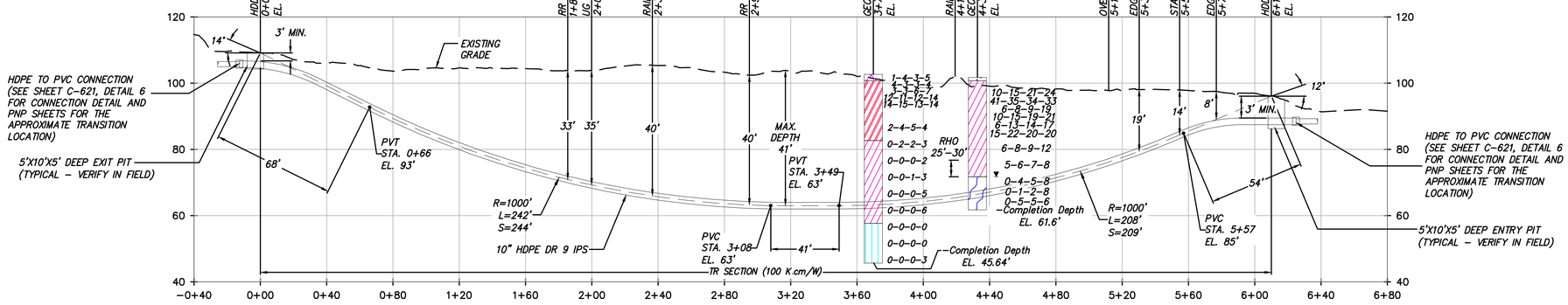
KIEWIT PROJECT NO.	21162
TT PROJECT NO.	204-3701
DRAWING NO.	C-313

DRAWN BY: MRS | DESIGNED BY: AMC | APPROVED BY: EJK | SCALE AS SHOWN | REV. NO. 0 | DATE 06/19/2023 | SH.NO. OF



0 40 80
Scale in feet when printed on 22x34

HDD 113 PLAN VIEW
CONDUIT 2



0 20 40
Scale in feet when printed on 22x34

DESIGN AND CONSTRUCTION NOTES:

1. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL.
2. 10.750" HDPE MIN. W.T. 1.194" DR 9 IPS PIPE.
   3.500" HDPE MIN. W.T. 0.389" DR 9 IPS PIPE.
   HDD HORIZONTAL LENGTH (L):610'
   HDD DESIGNED PIPE LENGTH (S): 617'
3. THE MINIMUM THREE JOINT (APPROX. 100 FT) COMBINED CURVE (VERTICAL + HORIZONTAL) RADIUS SHALL NOT BE LESS THAN 800 FT.
4. THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FT.
5. DRILL CONTRACTOR AND/OR GEOTECHNICAL ENGINEER TO DETERMINE LENGTH OF TEMPORARY SURFACE/CONDUCTOR CASING.
6. SPT N-VALUES SHOWN ON THIS DRAWING ARE NOT CORRECTED FOR SAMPLER SIZE OR HAMMER ENERGY. REFERENCE BORING LOGS AND GEOTECHNICAL REPORTS FOR ADDITIONAL SOIL INFORMATION.
7. DRILL CONTRACTOR SHALL UTILIZE BUOYANCY CONTROL MEASURES (INTERNAL WATER USED FOR BALLAST) DURING PULLBACK FOR ALL BUNDLED CASINGS.

GENERAL NOTES:

1. ALL BURIED LINE DEPTHS ARE APPROXIMATE. PRIOR TO ANY EXCAVATION OR EXPLORATORY BORING, CONTRACTOR MUST CONTACT 811 AND ABIDE BY ALL STATE EXCAVATION REQUIREMENTS. CONTRACTOR MUST CONTACT CSX WHENEVER ON RR ROW.
2. TETRA TECH ENGINEERING AND SURVEYING P.C. IS NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES IN THIS DRAWING. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF TETRA TECH ENGINEERING AND SURVEYING P.C. OR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
3. ALL COORDINATES ARE IN NEW YORK STATE PLANE, NAD83, EAST ZONE, US FOOT.

HDD 113 PROFILE VIEW
CONDUIT 2

BORING LOG STRIP LEGEND
B101
Blow Counts per 6" = 10-10-15
Recovery %/RQD % = 90%/60%
11000psi =UCS
2D strip logs shown at 10x exaggeration
3D strip logs have no exaggeration

Legend	
ASPHALT	Asphalt
Bedrock	Bedrock
Boulder	Boulder
CH	Fat CLAY
CH-MH	SILTY Fat CLAY
CL	Lean CLAY
CL-ML	SILTY CLAY
CONCRETE	Concrete
Fill	Fill
GC	CLAYEY GRAVEL
GC-GM	SILTY CLAYEY GRAVEL
GM	SILTY GRAVEL
GP	Poorly Graded GRAVEL
GP-GC	Poorly Graded Gravel with CLAY
GP-GM	Poorly Graded GRAVEL with SILT
GW	Well Graded GRAVEL
GW-GC	Well Graded GRAVEL with CLAY
GW-GM	Well Graded GRAVEL with SILT
Limestone	Limestone
MH	Elastic SILT
ML	SILT
OH	ORGANIC Fat CLAY
OL	ORGANIC Lean CLAY
OL/OH	ORGANIC SOIL
PT	PEAT
Rock	Rock
Sandstone	Sandstone
SC	CLAYEY SAND
SC-SM	SILT, CLAYEY SAND
SHALE	Shale
SILTSTONE	Siltstone
SM	SILTY SAND
SP	Poorly Graded SAND
SP-SC	Poorly Graded SAND with CLAY
SP-SM	Poorly Graded SAND with SILT
SW	Well graded SAND
SW-SC	Well Graded SAND with CLAY
SW-SM	Well Graded SAND with SILT
Topsoil	Topsoil
USGS 601	Gravel or Conglomerate 1
USGS 654	Subgraywacke
USGS 670	Interbedded Sandstone and Shale
USGS 702	Quartzite
USGS 705	Schist
USGS 705	Schist
USGS 708	Gneiss
USGS 708	Gneiss
USGS 718	Granite 1
Void	Void
Water	Water
Weathered Rock	Undefined
Water Table	Water Table during drilling
Delayed Water Table	Water Table after drilling

CHPE Champlain Hudson Power Express

Kiewit

TETRA TECH
TETRA TECH ENGINEERING AND SURVEYING P.C.
(A NEW YORK PROFESSIONAL CORPORATION)

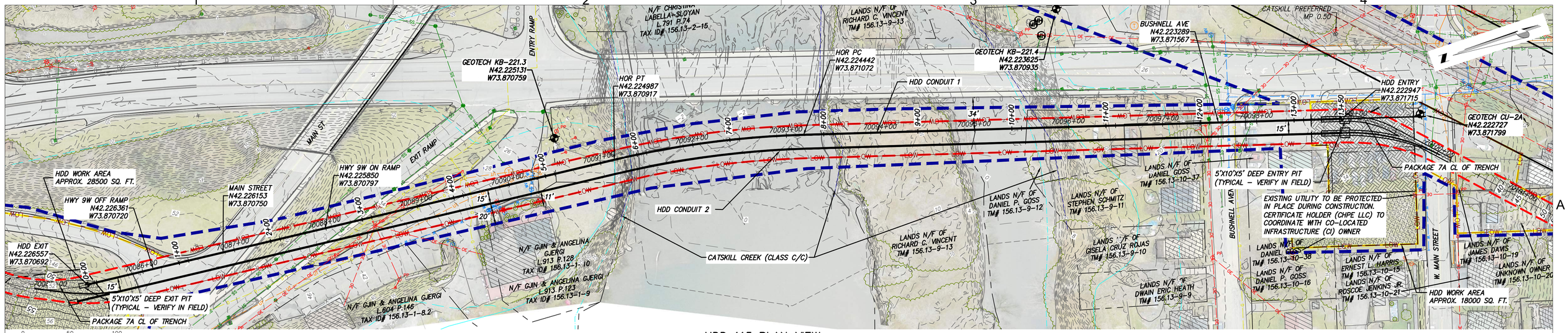
STATE OF NEW YORK · EDWARD J. KELLY · 094981 · LICENSED PROFESSIONAL ENGINEER

No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP
0	06/19/2023	ISSUED FOR CONSTRUCTION SUBMISSION	MRS	EJK

CHAMPLAIN HUDSON POWER EXPRESS
SEGMENT 11 (PACKAGE 7A) - CSX: CATSKILL
PLAN AND PROFILE - HDD 113
RAILROAD AND HWY 23 CROSSING - CONDUIT 2
GREENE COUNTY, NY

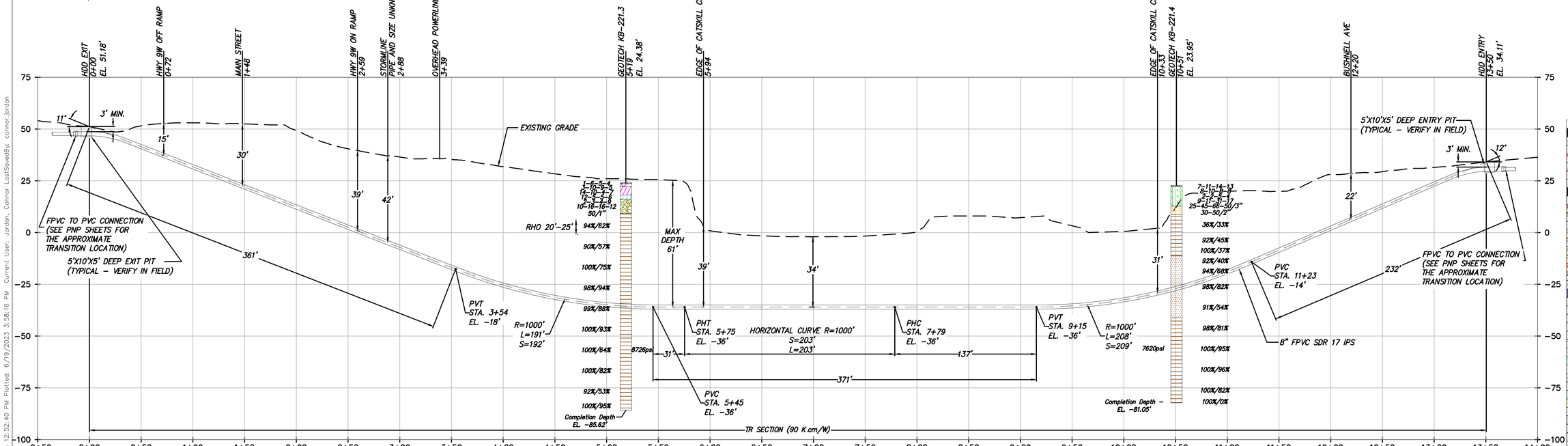
KIEWIT PROJECT NO.	21162
TT PROJECT NO.	204-3701
DRAWING NO.	**C-313.2**

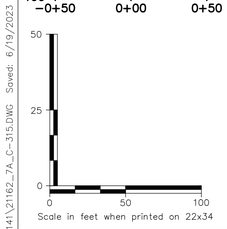
DRAWN BY: MRS | DESIGNED BY: AMC | APPROVED BY: EJK | SCALE AS SHOWN | DATE 06/19/2023 | REV. NO. 0 | SH.NO. OF



HDD 115 PLAN VIEW

CONDUIT 1





HDD 115 PROFILE VIEW

CONDUIT 1

BORING LOG STRIP LEGEND

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USGS 708	Gneiss
USGS 718	Granite 1
Void	Void
Water	Water
Weathered Rock	Undefined
Water Table	Water Table during drilling
Delayed Water Table	Water Table after drilling

DESIGN AND CONSTRUCTION NOTES:

1. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL.
2. 8.625" FPVC MIN. W.T. 0.510" SDR 17 IPS PIPE.
   3.500" HDPE MIN. W.T. 0.389" DR 9 IPS PIPE.
   HDD HORIZONTAL LENGTH (L):1350'
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CHAMPLAIN HUDSON POWER EXPRESS

SEGMENT 11 (PACKAGE 7A) - CSX: CATSKILL

HDD 115

WATER BODY CROSSING - CONDUIT 1

GREENE COUNTY, NY

KIEWIT PROJECT NO.	21162
TT PROJECT NO.	204-3701
DRAWING NO.	C-315

DRAWN BY: MRS | DESIGNED BY:AMC | APPROVED BY: EJK | SCALE AS SHOWN | DATE 06/19/2023 | REV. NO. 0 | SH.NO. OF

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