APPENDIX J2

CASE 10-T-0189

HDD INADVERTENT RELEASE PLAN

TABLE OF CONTENTS

1.0 Introduction

The Champlain Hudson Power Express (CHPE) project will install a pair of HVDC electrical transmission cables with an associated telecommunications line from Canada to New York City, NY. The portion of the work addressed herein is located in the upland portion of the route from the south end of Lake Champlain to New York City along the uplands of the Hudson River Valley. This work includes approximately 126 crossings under roads, railroads, wetlands water bodies, and obstructions to be installed using horizontal directional drilling (HDD) methods to minimize interference with use or impacts to the surface environment.

This Inadvertent Release Contingency Plan (IRCP) is for Segment 8 - Package 5a which includes 23 HDD crossings. A summary of the crossings is included in Table 1, below.

Table 1: HDD Locations, Lengths, and Description

HDD #	Approx. Start Station*	Approx. End Station*	Approx. HDD Length, ft	Obstruction Crossed
71	50005+00	50024+14	1,905	Railroads (2), culvert
72	50042+78	50048+32	554	Mariaville Road/Route 7 (elevated)
73	50065+00	50070+26	522	Route 159/Duansburg Rd.
73A,74	50100+15	50120+10	1,991	NYS Throughway (I-90)
75	50145+80	50153+85	798	Route 158/Guildalard Rd
75A.A	50168+45	50175+45	700	Stream, wetland
75A	50210+60	50233+02	2,241	Stream, wetland
75B	50290+65	50297+92	729	Stream, wetland
76,76A	50306+80	50327+60	2,075	Railroad, Route 20, Pond
77	50332+50	50346+30	1,380	Railroad

78	50382+60	50402+20	1,958	Route 146
79A	50409+75	50422+20	1,238	Railroad, Black Creek
80	50442+95	50461+75	1,877	Railroad, Black Creek
80A	50551+25	50571+85	2,060	Wetland
81	50578+50	50588+85	1,029	Norfolk Southern Railroad
82,83	5060-+05	50615+75	1,574	Vly Creek, Maple Ave.
83A	50673+90	50681+02	702	Stream, Culvert
84	50687+00	50697+95	1,086	New Scotland Rd/Route 85, Streams
84A	50728+75	50739+05	1,028	Route 308/New Scotland Road, Stream
84B	50777+55	50787+93	1,032	Game Farm Road, Stream
85	50808+00	50823+55	1,555	Route 443, Stream
87	50830+60	50842+60	1,215	Railroad
87A.A	50890+60	50897+02	650	Culvert

*Project stationing shown and is approximate. Each HDD has its own independent stationing.

A primary potential environmental concern associated with HDD involves the inadvertent release of drilling fluids 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;

- Identify planned means to protect areas that are considered environmentally sensitive (rivers, wetlands, other biological resources or 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;
- 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, site specific environmental features and geotechnical information not available at this time into its submittal.

This IRR Plan includes specific information for each HDD in Package 5A. The site-specific IRR plan for each HDD will be provided once available, but will not be available prior to the EM&CP Submittal. Construction of the HDDs shall not commence without NYSDPS acceptance of the site-specific IRR plan for each HDD.

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 directional bore alignment.

A small diameter (on the order of 5 to 9 inches in diameter) pilot bore is then drilled from the entry pit using directional boring methods. During the pilot bore, a drilling fluid (typically bentonite and water based with selected inert 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 inert biodegradable 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.

A guidance system is mounted immediately behind the drilling head to allow the crew to track and steer the path of the drilling 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 bore hole wall to the entry pit where it is collected and processed for re-used by a recycling system. The cuttings are separated from the bentonite, using screens, centrifuges, and desanding units which prepares the bentonite for re-use. Once the pilot bore reaches the exit pit, a larger diameter back-reaming head is then attached to the drill string and pulled back 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 is pumped into the bore hole during reaming to remove cuttings and to stabilize the bore hole. Lastly, the drill string is pulled back through the bore hole with the new, preassembled conduit attached to it in one continuous process until the lead end of the conduit emerges at the entry pit. Steps two and three may be combined, with the conduit being pulled back through the bore hole immediately behind the final reaming bit or swabbing pass.

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 bore 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 to the drill bit during the drilling process, and lubricant during the pipe insertion process.

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, inert 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 compatibility with the ground and groundwater chemical characteristics, improve cutting suspension and carrying characteristics, improve hole stabilization ability, and reduce seepage loss through the ground characteristics. Environmentally acceptable (i.e. inert biodegradable) additives are required by specification for this project.

During the HDD process and subsequent conduit 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 bore 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 bore or result in a release to the surface or adjacent 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.

3.0 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 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	TBD
New York State Department of Environmental Conservation	Regional Office(s) Information Patrick Rahm New York State Department of Environmental Conservation 625 Broadway, Albany, NY 12233 P: 518-402-6594 | patrick.rahm@dec.ny.gov
New York State Department of Environmental Conservation (Spills)	NYS Spill Hotline: 1-800-457-7362

3.1 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.

3.2 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.

3.3 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.

3.4 Design Engineer

The Design Engineer for the Package 5a HDD's Design is Brierley Associates (Brierley). During construction, the Design Engineer will be responsible for reviewing and approving required Subcontractor submittals, shop drawings, and material certificates. Brierley will also 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.

3.5 Third Party Engineer

The Third-Party Engineer for the HDD inadvertent return analysis is Brierley Associates. During construction, Brierley/Kiewit will review of the Subcontractor's Inadvertent Release Plan and provide technical assistance as needed with the HDD installation.

3.6 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.

3.7 HDD Construction Subcontractor

The HDD Construction Subcontractors (Subcontractors) for the various HDD crossings of this project have yet to be selected. The Subcontractor will be responsible for completion of the conduit 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 Inadvertent Release Prevention and Contingency Plan 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.

3.8 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 county, 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.

3.9 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.

3.10 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 Design Engineer will also attend the orientation meeting to review the procedures that will be used to document inadvertent releases in accordance with the HDD specifications.

4.0 Fluid Release Minimization Measures

4.1 Geotechnical Investigation

The first steps taken to characterize and minimize the potential risk of an inadvertent release includes conducting a geotechnical investigation at the site to develop an understanding of the surficial soils. Test 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.

4.2 HDD Design

The HDD crossings are being designed to reduce the potential risk of an inadvertent fluid release during construction. General design considerations for HDD include:

- Depth of cover during profile design (based on test borings) to limit the potential inadvertent release to the water body, road, railway, wetlands, or ground surface.
- Typically, potential exists for releases near the entry and exit pits of an HDD 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 bore the greater the slurry pressures required to hold the borehole open and to carry the cuttings back to the entry or exit pit.

- 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 bore 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 avoid 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 conduit, as well as being compatible with the bending capacity of the tool 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.
- Requiring that, during the performance of any HDD waterbody crossing, contractors monitor the use of inert 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.

4.3 Contingency Plan

As mentioned above, 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. 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 in compliance with 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 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.

4.4 Drill Fluids Management

As described in the Project EM&CP document, drilling fluid 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 the HDD work. 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 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 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,
- Under no circumstances will 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.

4.5 Early Fluid Release Detection

The HDD method has the potential for seepage or fluid loss into pervious geologic formations that the bore 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 fractures, solution features, or other subsurface fractures.
- Considerable differences in the elevations of HDD entry and exit points (typically greater than 20 feet).
- Disturbed soil, such unconsolidated fill.
- Soft soils that have the potential to squeeze.
- Soils that have the potential for collapse.
- Obstructions that require the use of a high flow mud motor.
- Soft soils with low confining capacity.
- Presence of archeological resources.

- Existing deep foundations.
- Existing below-grade utilities.

Our opinions regarding the risks associated with the above conditions at specific crossings are discussed in Section 9 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 so 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:

- Spikes or loss of pressure within the drill hole utilizing a downhole pressure monitoring system; and
- A substantial reduction in the volume of return fluid (loss of circulation)

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 ground surface 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 while construction activities are underway until the crossing has been completed. 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 (where applicable)

5.0 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 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 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 HDD technical specifications.

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).

6.0 Inadvertent Release Response (Upland and Road areas)

A common reason for upward movement and surface release (Inadvertent Return, or IR) 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 steel back a selected distance and attempt to clear cuttings from the annulus to re-establish circulation. However, it should be noted that reducing the pump rate too much may result in poor cuttings removal and clogging of the hole, which in turn can also result in an IR.

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 surface 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 high 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 place prior to the start of drilling or the use of conductor casings if at entry and exit areas.

7.0 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 inert 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:

- Slowing the drill fluid pumps.
- Modifying the advance rate and rod/tool rpm, to match pump rate.
- Modifying the drill fluid properties, adding agents to reduce drilling fluid pressures through improved carrying capacity
- Tripping the drill steel and tool back a selected distance and attempt to clear cuttings from the annulus to re-establish circulation.
- Swabbing of the borehole, to increase sidewall stability and to remove clogging or squeezing.
- 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.
- Potentially implementing a loss-control material (LCM), designed to plug fractures.
- Implementation of proper sedimentation control measures including, but not limited to hay bales, vacuum trucks, silt curtains, containment cells, turbidity curtains, or if suitable, sand bags 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.
- 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.

8.0 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 bore path will be compacted and filled with soil or a cement-bentonite mix to prevent future settlement. The Subcontractor submitted site-specific abandonment plan shall be approved by the Design Engineer 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 bore path alignment will be evaluated by the Subcontractor, Construction Manager, and the Design Engineer. 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.

9.0 Crossing Specific Conditions and IR Analysis

A generalized geologic profile and an annular pressure analysis for each crossing is included in Appendix A. In each case the results of the analysis are considered applicable to both HDD installations.

9.1 Analysis Method

The annular pressure analyses compares the anticipated range of downhole annular drill fluid pressures required to complete the pilot bore to the estimated confining capabilities of the surrounding geologic materials. This exercise can be useful in the evaluation of risk of inadvertent returns (IR's, or "fracout") during drilling. The potential for an IR may be considered greatest at locations where the anticipated range of downhole drill fluid pressures are close to or exceed the estimated confining capabilities of the surrounding materials. Note that the pilot hole (vs the reamed hole) is generally the most constrained, and presents the greatest risk of IR during the HDD construction process.

Drill fluid loss from the borehole typically occurs when the annular hydraulic pressure exceeds either the confining pressure of the formation, the pressure necessary to hydraulically jack open a plane of weakness, or the pressure necessary to exceed the resisting pressure along a leakage path. Three subsurface mechanisms lead to inadvertent returns: Leakage, Hydraulic Jacking, and Hydraulic fracturing. Analyses provided with this design addresses Hydraulic Jacking and Hydraulic Fracturing. No calculations are available to address leakage.

- Hydraulic Jacking: Hydraulic jacking occurs when there are existing cracks in the formation such as fractures within bedrock or stiff cohesive soils, or relatively high permeability zones contained within a relatively low permeability materials (e.g. a sand lense in clay). When the drill fluid pressure exceeds the weight or force restraining the materials on the sides of the fracture or higher permeability zone, the confining material will be hydraulically jacked open resulting in an enlarged opening with more fluid volume capacity and eventually, the possibility of a new flow path for the fluid. The Total Stress calculations provides a conservative method for assessment of this type of drill fluid loss.

- Hydraulic Fracturing. Hydraulic fracturing occurs when the drill fluid pressure exceeds the static stress state in the formation *plus* the strength of the formation material. The result is a fracturing of the formation providing access for the drill fluid to a path that will continue to grow until the drill fluid pressure is reduced or the formation strength increases. The stress plus strength and the Kirsch methods may be used to assess this type of drill fluid loss in rock. In soil formations the Delft may be used to model for drill fluid loss when hydraulic fracturing occurs.

- Leakage: Flow of the drill fluid into existing open space, such as open bedrock fractures and soil porosity, along manmade weak zones such as along pile shafts or other manmade construction planes of weakness.

The following should be noted :

- HDD requires drill fluid pressures sufficient to stabilize the borehole and remove cuttings. In general, it may be possible to reduce the risk of drill fluid loss through careful drilling and drill fluid management, but IR risk cannot be completely eliminated.
- The annular pressure analysis is considered to be a tool to identify areas of potential risk. *It is not considered an exact predictor of the location or degree of an IR.*
- The annular pressure analysis does not account for existing pathways or zones of weakness in the subsurface, which may be related to existing utilities, foundations, utility poles and below-grade space. Where present, these features will *increase* the risk of drill fluid loss.
- The annular pressure analysis is not an accurate predictor of borehole leakage, where drill fluid leaks to the adjacent materials through existing porosity or fractures.
- Drill fluid loss from the borehole may not migrate to the surface. In some cases, the drill fluid may escape to the surrounding formation.

The static drill fluid pressure is a function of the density of the drill fluid at a specific location and depth below the drill entry elevation. The dynamic pressure is the pressure required to move the drill fluid (and cuttings) up the borehole annulus, and is a function of pump rates, hole geometry, fluid density, fluid velocity, and fluid rheology. The estimated annular pressures included in Appendix A are based on the API-13D model to assess the dynamic pressure of a visco-plastic fluid based on a modified Hershel-Buckley fluid model.

Geotechnical parameters used in the analysis were derived through evaluation of laboratory testing and engineering judgement. The confining capability of the native materials was approximated using a variety of methods, which include the following:

- **Total Stress Model**: The Total Stress Model is based on the dead weight of the formation material above the drill path and excludes the potential strength of the formation. This method is considered *conservative* but is considered a reasonable approximation for the formation pressure capacity of bedrock and very dense soil to resist Hydraulic Jacking..

- **Cavity Expansion Model (Delft Equation)**: This method considers the strength of the formation to resist a cylindrical cavity expansion caused by annular pressure and based on Ko = 1 conditions. The initial equation was derived from the Mohr-Coulomb failure model adjusted by Delft University for low angle cylindrical cavity expansion in a host material when subjected to internal pressure. The original model was developed by Obert and Duvall in the 1960's. This method has been found more realistic in fine grained materials such as fine sand,, silt, and stiffer cohesive formations than the Total Stress Model. However the method require assumptions of a horizontal surface with homogeneous isotropic soil properties. Additionally, the equations require significant property assumptions such as the Shear Modulus, G and an assumption of whether of not the drill is being advanced under drained or undrained conditions related to the interaction of the drill bit and soil during the excavation process. *This model is not generally appropriate for most bedrock, particularly hard sedimentary bedrock, and metamorphic and igneous lithologies.*

- **Stress plus Strength Model**: This method was initially implemented by the US Corps of Engineers to assess the damage potential to levees from HDD fluids during drilling. This model is based on the minimum principal effective stress defined as Ko*σ'v then adds the strength of the formation material at the location nof the drill face. The basis of the model, like the cavity expansion model is the Mohr-Coulomb failure approach. This model is generally appropriate for any soil or may apply to some bedrock situations.

- **Kirsch Model**: This method was developed by the Shell Oil Company for oil field drilling and is is based in rock mechanics and Hooks Law for elastic material properties. This method is generally considered appropriate for bedrock, including fractured bedrock and is similar to the Total Stress approach.

Additional input assumptions included:

- Jetting tools will be used for fill, lacustrine and glaciofluvial deposits.
- A mud motor will be used to complete the pilot hole for bores encountering glacial till and bedrock.
- A drill fluid pump rate of 200 gpm for pilots using jetting and a drill fluid pump rate 400 gpm for mud motors.
- An average drill fluid density of 78 pcf, and maximum drill fluid density of 94 pcf.
- An estimated drill bit diameter of 8.16 inches and a drill rod diameter of 3.5 inches.

9.2 HDD Crossing #71

Surface conditions at HDD #71:

The HDD #71 alignments pass below Phillips Rd, two active rails operated by CSX, which are oriented approximately northwest-southeast, and a third, depressed rail operated by the Delaware & Hudson Railway Company (DHRC), which is oriented northeast-southwest. The DHRC rail passes below the CSX rails by means of box tunnel. In addition, HDD #71 passes below the Poentic Kill (stream), which is contained within a 15-ft box culvert, and Burdeck Street. The surrounding area is characterized by farmland and mixed industrial/commercial use.

The HDD entry (north) is located in Princetown Road; the HDD exit (south) is located in a wooded area to the southwest the CSX rails. Surface grades in the crossing vicinity are variable and generally range from about El. 327 to El. 349. The CSX rails are located on an elevated embankment to the north, and are at-grade to the south. The surface grade of the DHRC rails is at about El. 320.

Subsurface conditions at HDD #71:

The subsurface conditions along the HDD #71 alignment consist of Fill soils overlying glacial lake deposits consisting of interbedded sand and silt with gravel (loose to medium dense). The deltaic deposits overlie Glacial Till consisting of a heterogenous mixture of very dense silty sand with gravel, sandy silt, sand and gravel and clayey silt. Although not encountered by the test borings completed at this location, cobbles and boulders are expected within the Glacial Till.

IR Risk at HDD #71

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover.
- Existing below-grade utilities.
- Potential deep foundations associated with railroad structures.
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at end of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks. The driller will also need to be careful in the vicinity of the depressed railroad, due to the reduced cover in this area.

9.3 HDD Crossing #72

Surface conditions at HDD #72:

The HDD #72 alignments pass below Mariaville Road which is oriented approximately east-west, 50-ft wide, and located on an elevated embankment. Mariaville Road passes over two (2) active CSX rails to the immediate east by means of a concrete deck bridge. The western bridge abutment and roadway retaining walls are located to the immediate east and above the HDD alignments.

The HDD entry (northwest) is located in a landscaped area adjacent to and existing residential structure. The HDD exit (southeast) is located in a paved parking area behind the Schenectady County Dept. of Engineering and Public Works (single-story building). The CSX rails are located approximately at-grade to the east-northeast, and are oriented northwest-southeast. Portions of the HDD #72 alignments are located within the CSX right-of-way.

The surface grades in the site vicinity are relatively flat and range from about El. 346 to El. 348. The surface of Mariaville Road is at about El. 374.

Subsurface conditions at HDD #72:

In the vicinity of HDD #72, Fill soils are expected to overlie glacial lake deposits consisting of poorly graded sand with lesser amounts of silt (very loose to medium dense).

IR Risk at HDD #72

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover.
- Existing below-grade utilities.
- Potential deep foundations associated with overpass structures.
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks.

9.4 HDD Crossing #73

Surface Conditions at HDD #73:

The HDD #73 alignments pass below Route 159/Duanesburg Road which is oriented approximately northeast-southwest, 50-ft wide, and located on an elevated, sloped embankment. Utility poles are located within the southeast side of the embankment. Route 159/Duanesburg Road passes over two (2) active CSX rails to the immediate east by means of a concrete deck bridge. The western bridge abutment is located to the immediate east of the HDD alignments.

The HDD entry (northwest) is located in a paved parking area behind a single-story commercial building. The HDD exit (southeast) is located in a paved parking area behind the Golub Corporation Facility (single-story commercial building). The CSX rails are located approximately at-grade to the east-northeast, and are oriented northwest-southeast. Portions of the HDD #73 alignments are located within the CSX right-of-way.

The surface grades in the site vicinity are relatively flat fat and range from about El. 333 to El. 336. The surface of Route 159/Duanesburg Road is at about El. 370.

Subsurface conditions at HDD #73

In the vicinity of HDD #73, Fill soils are expected to overlie glacial lake deposits consisting of poorly graded sand and silty sand (very loose to medium dense).

IR Risk at HDD #73

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover, including existing adjacent detention ponds.
- Utility pole locations.
- Existing below-grade utilities.
- Potential deep foundations associated with overpass structures.
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks.

9.5 HDD Crossing #73A,74

Surface Conditions at HDD #73A,74:

HDD #73A,74 pass below an overhead electric cable easement (Niagara Mohawk) which is oriented approximately northwest-south, and about 100-ft wide. Power poles are located to the west of the HDD alignments.

The HDD #73A,74 alignments also pass below Interstate I-90 which is oriented approximately southeast-northwest, 115-ft wide, and located on an elevated embankment. Interstate I-90 passes over two (2) active CSX rails to the immediate east by means of a concrete deck bridge. The western bridge abutment is located to the immediate east of the HDD alignments. The areas to the north of I-90 and adjacent to Niagara Mohawk easements are heavily wooded.

The HDD #73A,74 entry (southeast) is located in a paved cul-de-sac at the northeast end of S Westcott Rd. The HDD #73A,74 exit (northwest) is located in a wooded area to the northwest of the Niagara Mohawk easement. The CSX rails are located approximately at-grade to the east-northeast, and are oriented northwest-southeast. The CSX rails rest on an elevated embankment which is approximately 4 to 5 feet higher than adjacent grades. Portions of the HDD #73A,74 alignments are located within the CSX right-of-way.

<u>Subsurface conditions at HDD #73A,74</u>

In the vicinity of HDD #73A,74, Fill soils are expected to overlie glacial lake deposits consisting of interbedded silt with trace to some clay, poorly graded sand and silty sand (very loose to dense) and clay (medium stiff to stiff).

<u>IR Risk at HDD #73A,74</u>

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover, including existing adjacent detention ponds.
- Utility pole locations.
- Existing below-grade utilities.
- Potential deep foundations associated with overpass structures.
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks.

9.6 HDD Crossing #75

<u>Surface Conditions at HDD #75:</u>

The HDD #75 alignments pass below Route 158/Guilderland Ave which is oriented approximately northeast-southwest, 35-ft wide, and located on an elevated, sloped embankment. Utility poles are located within the southeast side of the embankment. Route 158/Guilderland Ave passes over two (2) active CSX rails to the immediate east by means of a concrete deck bridge. The western bridge abutment is located to the immediate east of the HDD alignments.

The HDD #75 entry (northwest) and exit (southeast) are located in wooded areas adjacent to Route 158/Guilderland Road. The CSX rails are located approximately at-grade to the east-northeast, and are oriented northwest-southeast. The HDD #75 alignments are located within the CSX right-of-way.

The surface grades in the site vicinity generally slope downward to the south, from about El. 317 to El. 313. The surface of Route 158/Guilderland Road is at about El. 343.

<u>Subsurface conditions at HDD #75</u>

In the vicinity of HDD #75, Fill soils are expected to overlie glacial lake deposits consisting of silt and clay (medium stiff to stiff).

<u>IR Risk at HDD #75</u>

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover.
- Utility pole locations.
- Existing below-grade utilities.
- Soft glacial lake deposits which may squeeze during drilling.
- Potential deep foundations associated with overpass structures.
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks.

9.7 HDD Crossing #75A.A

<u>Surface Conditions at HDD #75A.A:</u>

HDD #75A.A passes below a small stream and adjacent wetland located to the southwest of two (2) active CSX rails. The CSX rails are oriented northwest-southeast and rest on an elevated embankment, about 10 to 12 feet higher than adjacent grades. The surrounding area is covered by small trees and brush. The stream is oriented approximately northeast-southwest, and flows beneath the CSX rails by means of a 30-in RCP culvert. The HDD #75A.A alignments are located within the CSX right-of-way.

The HDD #75A.A entry is located to the southeast; the exit to the northwest. The surface grades along the HDD alignment slope downward gently to the southeast, from about El. 304 to El. 299.

<u>Subsurface conditions at HDD #75A.A</u>
In the vicinity of HDD #75A.A, Fill soils are expected to overlie glacial lake deposits consisting of silt and clay (very soft), with lesser amounts of loose silty sand and sand.

<u>IR Risk at HDD #75A.A</u>
In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover.
- Existing below-grade utilities.
- Soft glacial lake deposits which may squeeze during drilling.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks.

9.8 HDD Crossing #75A

<u>Surface Conditions at HDD #75A:</u>
The HDD #75A alignments pass below two small streams to the southwest of two (2) active CSX rails, which are oriented northwest-southeast. The surrounding area is wooded. The streams are oriented approximately east-west, and flow beneath the CSX rails by means of a 42-in steel culvert (northwest) and twin 12-in RCP culverts (southeast). The HDD #75A alignments are located within the CSX right-of-way.

The HDD #75A entry is located to the northwest; the exit to the southwest. The surface grades along the HDD alignments are variable, ranging from about El. 301 to El. 316.

<u>Subsurface conditions at HDD #75A:</u>
In the vicinity of HDD #75A, Fill soils are expected to overlie glacial lake deposits consisting of silt and clay (very soft), with lesser amounts of loose silty sand and sand.

IR Risk at HDD #75A:

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover.
- Utility pole locations.
- Existing below-grade utilities.
- Soft glacial lake deposits which may squeeze during drilling.
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks.

9.9 HDD Crossing #76,76A

Surface Conditions at HDD #76,76A:

The HDD #76,76A alignments begin behind an 84 Lumber facility (HDD entry, El. 290), to the southwest of a railroad operated by CSX (single rail), and passes below Route 20, which is depressed (sunken road, El. 275) at this location. An interlocking concrete block retaining wall is located on the northeast side of Route 20. The aforementioned CSX rail is oriented northwest-southeast and passes over Route 20 to the northeast of the crossing. A second CSX rail is oriented northeast-southwest and passes over the first rail by means of a separate girder bridge. The HDD #76,76A alignments curve around both bridge structures, then passes below the second CSX rail (below an elevated embankment, El. 317), below a small pond and exits in a wooded area to the south (between the first and second rails). Portions of HDD #76,76A are located within the CSX right-of-way.

Subsurface conditions at HDD #76,76A:

In the vicinity of HDD #76,76A, Fill soils are expected to overlie glacial lake deposits consisting of silt and clay (loose to medium dense and very soft to soft), with lesser amounts of loose silty sand and sand. The density/consistency of the silt and clay appears to decrease with depth.

IR Risk at HDD #76,76A:

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover, including the depressed roadway and pond.
- Soft glacial lake deposits which may squeeze during drilling.
- Utility pole locations.
- Existing below-grade utilities.
- Potential deep foundations associated with railroad structures.
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks. There is also a potential of inadvertent release of reduced cover in the vicinity of Route 20 and the small pond. The contractor will need to be ready to respond to these areas if drill fluid appears at the surface. Temporary traffic control may be required at Route 20 if this occurs.

9.10 HDD Crossing #77

<u>Surface Conditions at HDD #77:</u>

HDD #77 is located to the immediate south of HDD #76,#76A, with an HDD exit (El. 287) located between two separate CSX rails (east and west), which are oriented approximately north-south. The HDD alignment passes below and then parallels the western CSX rail, which rests on an elevated embankment at about El. 312. Both the HDD entry (El 280) and exit (El. 290) are heavily wooded. The HDD #77 alignments are located within the CSX right-of-way.

<u>Subsurface conditions at HDD #77:</u>

In the vicinity of HDD #77, Fill soils are expected to overlie glacial lake deposits consisting of silt and clay (loose to medium dense and very soft to soft), with lesser amounts of loose silty sand and sand. The density/consistency of the silt and clay appears to decrease with depth.

<u>IR Risk at HDD #77:</u>

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.

- Areas of reduced soil cover.
- Soft glacial lake deposits which may squeeze during drilling.
- Utility pole locations.
- Existing below-grade utilities.
- Potential deep foundations associated with railroad structures.
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks.

9.11 HDD Crossing #78

Surface Conditions at HDD #78:

The HDD #78 alignments are located to the west and parallel to twin CSX rails, which are oriented northwest-southeast and at-grade with the surrounding area. In this vicinity, HDD#77 crossed below a abutment for a concrete deck bridge carrying Route 146 over the CSX rails. At this location Route 146 also passes over a single paved offramp, which is oriented north-south.

To the north of Route 146, the HDD #78 also passes below a linear pond, which is surrounded by small trees. A second pond is located to the west. Facilities operated by the Guilderland Highway Department are located to the east of this area.

We understand that an existing natural gas line owned by Northeast Utilities has been installed by HDD across (perpendicular) the proposed HDD #78 alignments, to the south of the Route 146 deck bridge. The location and depth of this installation was not available at the time of this report. Overhead utility poles are also present in this area.

Existing surface grades in this area are relatively flat, and range from about El. 318 to El. 321. The surface of Route 146 at the overpass is at about El. 347. The HDD entry is located to the south; the exit to the north. The HDD #78 alignments are located within the CSX right-of-way.

Subsurface Conditions at HDD #78:

In the vicinity of HDD #78, fill soils are expected to overlie Glacial Till consisting of dense to very dense silty sand, sandy stilt and sandy clay with cobbles and boulders. The glacial till overlies bedrock (shale of the Schenectady Formation) at a depth of about 30-ft below grade on the north end of the HDD alignment. Although not encountered by the test borings, the Schenectady Formation may also contain sandstone and siltstone.

<u>IR Risk at HDD #78:</u>
In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover, including the vicinity of the existing pond(s).
- Utility pole locations.
- Existing below-grade utilities.
- Potential deep foundations associated with overpass structures.
- The need to use a mud motor and elevated pump rates
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks. There is also a risk of drill fluid release in the vicinity of the small pond(s) on the north end of the bore.

9.12 HDD Crossing #79B

<u>Surface Conditions at HDD #79B:</u>
The HDD #79B alignments pass below a CSX siding, and Black Creek. The HDD entry is located to the north, in a paved parking area, to the west of the primary CSX rail alignment, which is oriented northwest-southeast and at grade with the surrounding area. A siding connects to the primary CSX alignment, and is oriented approximately northeast-southwest. At this location Black Creek parallels the primary CSX alignment and flows beneath the siding within a concrete culvert. A series of industrial park buildings are located to south-southwest of the siding, on the west side of Black Creek. The HDD #79B alignments terminate between these buildings.

Site grades adjacent to Black Creek are relatively flat, and range from about El. 319 to El. 321. The banks of the creek are relatively steep and covered by small trees and brush, and the channel is approximately 35-ft wide. The bottom elevation of the creek has not been established, but estimated to be at about El. 310 to El. 312. The HDD #79B entry area is located in a small depression, with a surface grade of about El. 317. A paved parking area is located to the west, and a small building to the south. Portions of the HDD #79B alignments are located within the CSX right-of-way.

Subsurface Conditions at HDD #79B:

In the vicinity of HDD #79B, Fill soils are expected to overlie glacial lake deposits consisting of silt and clay (very soft to medium stiff), with lesser amounts of fine sand. The lake deposits overlie Glacial Till consisting of very dense silty sand with gravel, with occasional cobbles and boulders

IR Risk at HDD #79B:

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover, including the vicinity of Black Creek.
- Utility pole locations.
- Existing below-grade utilities.
- Potential deep foundations associated with CSX structures.
- The need to use a mud motor and elevated pump rates
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks. There is also a risk of drill fluid release in the vicinity Black Creek due to reduced soil cover in this area. The Contractor will need to be capable of responding to and addressing a drill fluid release into this watercourse.

9.13 HDD Crossing #80

Surface Conditions at HDD #80:

HDD #80 is located to the immediate south of HDD #79B, and passes back below Black Creek. At this location Black Creek is oriented northwest-southeast, approximately 35-ft wide, and parallels the primary CSX alignment to the east-northeast (two rails and a siding). A paved parking area and industrial buildings are located to the west, accessed by Northeastern Industrial Park Road.

The HDD #80 exit is located to the in the paved parking area to the west of Black Creek. Site grades in this area are relatively flat, and range from about El. 319 to El. 320. The banks of the creek are steep and covered by small trees and brush, and the channel is approximately 35-ft wide. The bottom elevation of the creek has not been established, but estimated to be at about El. 312 to El. 313.

In the vicinity of the HDD #80 crossing the CSX rails are elevated relative to the adjacent area, at about El. 327 to El. 330. The HDD #80 entry located in a wooded area to the southeast, between the primary CSX rails and an adjacent siding. Surface grades in this area range from about El. 323 to El. 326. Portions of the HDD #80 alignments are located within the CSX right-of-way.

<u>Subsurface Conditions at HDD #80:</u>

In the vicinity of HDD #80, Fill soils are expected to overlie glacial lake deposits consisting of silt and clay (very soft to medium stiff), with lesser amounts of fine sand. The glacial lake deposits overlie Glacial Till consisting of medium dense to very dense silty sand with gravel, with occasional cobbles and boulders.

<u>IR Risk at HDD #80:</u>

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover, including the vicinity of Black Creek.
- Utility pole locations.
- Existing below-grade utilities.
- The need to use a mud motor and elevated pump rates
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks. There is also a risk of drill fluid release in the vicinity Black Creek due to reduced soil cover in this area. The Contractor will need to be capable of responding to and addressing a drill fluid release into this watercourse.

9.14 HDD Crossing #80A

Surface Conditions at HDD #80A:

The HDD #80A alignments are located immediately adjacent and parallel to the primary CSX rail alignment (2 rails) and passes below a large wetland, and a series of small ponds. The HDD exit area is located in an open field to the northwest; the entry in a wooded area between Foundry Street and the CSX rails.

Surface grades in this are slope downward to the wetland/ponds which have a surface elevation of about El. 315 to El. 325. The HDD entry area has a surface grade of about El. 326, whereas the exit has a surface grade of about El. 336. The adjacent CSX rails slope gently to the northwest adjacent to the HDD #80A alignment from about El. 329 to El. 334. The rails pass through the wetland by means of an elevated embankment. Water flows below the rails by means of a 10'x8' box culvert.

Subsurface Conditions at HDD #80A:

On the north side of the HDD alignment, Fill soils are expected to overlie medium dense to very dense sand and gravel with some silt and clay (possible glacial till).

On the south end of the HDD alignment, Fill soils overlie a layer of medium dense sand (outwash), which overlies a layer of medium stiff to stiff silt with clay (possible lacustrine deposits), which appear to overlie Glacial Till consisting of very denes silt with gravel, with occasional cobbles and boulders.

IR Risk at HDD #80A:

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover, including the wetlands and small ponds.
- Utility pole locations.
- Existing below-grade utilities.
- The need to use a mud motor and elevated pump rates

- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks. There is also a risk of drill fluid release in the vicinity of the wetlands due to reduced soil cover in this area. The Contractor will need to be capable of responding to and addressing a drill fluid release into this area.

9.15 HDD Crossing #81

Surface Conditions at HDD #81:

The HDD #81 alignments pass below the CSX rails (2 rails) at the intersection of Foundry, Main and Grove Street. The rails are oriented northwest-southeast. Foundry and Grove are oriented roughly northwest-southwest; Main northeast-southwest.

The HDD #81 entry is located in a wooded area between the CSX rails (northeast) and Foundry Street (southwest). Small residential structures are located to the west. The surface grades in this area range from about El. 310 to El. 312 and are lower than the adjacent CSX rails, which are located in an elevated embankment, with a surface grade of about El. 330. The HDD #81 exit is located to the southeast in a grassy area between Grove Street and the CSX rails.

In the vicinity of the intersection, the railroad surface is generally at-grade with the surrounding area, ranging from about El. 331 to El. 332. The intersection is also occupied by a series of railroad signal devices and overhead utility poles. We understand that a portion of the railroad easement in the vicinity of the intersection is located within Norfolk Southern Railroad (NSRR) jurisdiction.

Subsurface Conditions at HDD #81:

In the vicinity of HDD #81, Fill soils are expected to overlie loose to medium dense sand and gravel with varying amounts of silt and cobbles (probable glacial outwash).

IR Risk at HDD #81:

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Utility pole locations.
- Existing below-grade utilities.

- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks.

9.16 HDD Crossing #82,83

<u>Surface Conditions at HDD #82,83:</u>

HDD #82,83 is located to the northeast of and parallels the CSX rails (2 rails, oriented northeast-southwest), and passes below Vly Creek. The rails pass over the creek by means of a small deck bridge. At this location the creek is approximately 30 to 40 feet wide, with banks covered by small trees.

The HDD #82,83 entry is located in a wooded area to the north, where surface grades are at about El. 320. The adjacent CSX rails are located on an elevated embankment, with a surface grade of about El. 334.

Surface grades rise steeply to the south of Vly Creek, where the surround area is predominantly residential. The HDD #82,83 alignment passes below Maple road, and to the immediate southwest of two existing single-story commercial buildings located in the Vorheesville Shopping Center and exits in a paved area to the southeast, where surface grades are at about El. 341 to El. 343. In this area the adjacent CSX rails are lower (depressed) with surface grades at about El. 335 to El. 336.

<u>Subsurface Conditions at HDD #82,83:</u>

In the vicinity of HDD #82,83, Fill soils are expected to overlie loose to medium dense to dense sand and gravel with varying amounts of silt and cobbles (probable glacial outwash). Layers of loose to medium dense fine sandy silt are also present (possible lacustrine deposits).

<u>IR Risk at HDD #82,83:</u>

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover, including the creek and Grove Street.
- Utility pole locations.
- Existing below-grade utilities.
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks. There is also a risk of drill fluid release in the vicinity of the creek and Grove Street due to reduced soil cover in these areas. The Contractor will need to be capable of responding to and addressing a drill fluid release into these areas.

9.17 HDD Crossing #83A

Surface Conditions at HDD #83A:

The HDD #83A is located to the northeast of and parallels the CSX rails (2 rails, oriented northeast-southwest), and passes beneath a 60" culvert, small stream (5 to 8 feet wide) and adjacent wetland. The HDD entry is located to the southwest; the exit to the northeast. The CSX rails in this vicinity are located on an elevated embankment, with surface grades ranging from about El. 301 to El. 305. The site grades along the HDD alignment increase from southeast to northwest from about El. 286 to El. 295.

The area around the stream is covered by brush and trees. The areas to the northwest and southeast are characterized by residential landscaped lawns.

Subsurface Conditions at HDD #83A

In the vicinity of HDD #83A, Fill soils are expected to overlie loose to medium dense sand and gravel (probable glacial outwash), which overlies Glacial Till consisting of very dense silty sand with occasional cobbles and boulders. Bedrock (shale of the Schenectady Formation) was encountered at depths of about 50 feet by the test borings taken along the HDD alignment. Although not encountered by the test borings, the Schenectady Formation may also contain sandstone and siltstone.

IR Risk at HDD #83A:

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Utility pole locations.
- Existing below-grade utilities.
- Obstructions such as cobbles and boulders within the overburden soils.

There may be a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks.

9.18 HDD Crossing #84

Surface Conditions at HDD #84:

HDD #84 is located to the northeast of and parallels the CSX rails (2 rails, oriented northeast-southwest), and passes beneath two (2) separate, small streams, and Route 85/New Scotland Road, which is depressed at this location, and oriented east-west. The CSX rails pass over Route 85/New Scotland Road by means of a steel bridge with concrete wingwalls.

The HDD entry area is located on the northwest end of the alignment, in an open field with surface grades of about El. 287. The CSX rails in this vicinity are located on an elevated embankment, with surface grades ranging from about El. 299 to El. 301. Residential structures and trees are present along the HDD alignments to the northwest of Route 85/New Scotland Road.

To the southeast of Route 85/New Scotland Road the HDD #84 alignment passes between the CSX rails and timber framed storage structures associated with a lumber yard. The plan distance between the lumber yard structures and the closest CSX rail is about 40-ft.

The HDD exit is located within an unpaved portion of the lumber yard, to the southeast. Site grades in this area range from about El. 285 to El. 290. The adjacent CSX rails are located on an elevated embankment, with a surface grade of about El. 294 to El. 295. The HDD #84 alignments are located within the CSX right-of-way.

Subsurface Conditions at HDD #84

In the vicinity of HDD #84, Fill soils are expected to overlie loose to medium dense to dense sand with varying amounts of silt (probable glacial outwash). The lower portion of these materials (very dense) may represent glacial till. Bedrock (shale of the Schenectady Formation) was encountered at depths of about 20 to 23 feet by the test borings taken along the HDD alignment. Although not encountered by the test borings, the Schenectady Formation may also contain sandstone and siltstone.

IR Risk at HDD #84:

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover, including Route 85/New Scotland Road.
- Utility pole locations.
- Existing below-grade utilities.

- The need to use a mud motor and elevated pump rates to drill through the glacial till and bedrock.
- Obstructions such as cobbles and boulders within the overburden soils.

It appears that there is a potential of inadvertent release at ends of the bores (as is common). These could be controlled through the use of conductive casings, haybales, silt fences, erosion control measures and vacuum trucks. There is also a risk of drill fluid release in the vicinity of Route 85/New Scotland Road due to reduced cover in this area. The Contractor will need to be capable of responding to and addressing a drill fluid release into this area.

9.19 HDD Crossing #84A

Surface Conditions at HDD #84A:

HDD #84A is located to the northeast of and parallels the CSX rails (2 rails, oriented northeast-southwest), and passes beneath Route 308/New Scotland Road, which is at-grade with the railroad at this location, and a small stream to the south-southeast. The stream passes below the CSX rails by means of a 12'x3.5' box culvert.

The HDD entry is located in a wooded area to the northeast. The surface grades in this vicinity slope upward toward the southeast from about El. 270 to El 280. The surface grade of the adjacent CSX rails is at about El. 283. The area to the east-northeast consists of open fields.

The surface grade at the intersection of the CSX rails and Route 308/New Scotland Road is at about El. 280 to El. 282. The intersection is also occupied by a series of railroad signal devices and overhead utility poles.

Unpaved driveways, residential structures and an agricultural facility are located to the southeast of the intersection. The agricultural facility includes numerous timber-framed structures and unpaved clearings, with fill and timber stockpiles. The HDD exit is located in a partially cleared area with surface grades ranging from about El. 277 to El. 280. The adjacent CSX rails are slightly elevated, with a surface grade of about El. 281 to El. 282. Portions of the HDD #84A alignments are located within the CSX right-of-way.

Subsurface Conditions at HDD #84A

In the vicinity of HDD #84A, Fill soils are expected to overlie dense to very dense silty sand with gravel with occasional cobbles and boulders (glacial till). Bedrock (shale of the Schenectady Formation) was encountered at depths of about 20 to 23 feet by the test borings taken along the HDD alignment. Although not encountered by the test borings, the Schenectady Formation may also contain sandstone and siltstone.

IR Risk at HDD #84A:

At this time, we anticipated that the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Utility pole locations.
- Existing below-grade utilities.
- Obstructions such as cobbles and boulders within the overburden soils.

9.20 HDD Crossing #84B

Surface Conditions at HDD #84B:

The HDD #84B alignments are located to the northeast of and parallels the CSX rails (2 rails, oriented northeast-southwest), and passes beneath Game Farm Road, which is at-grade and intersects with the railroad at this location and is oriented approximately east-west. HDD #84B also passes below a small stream to the southeast, which flows below the CSX rails by means of a 72" RCP culvert.

The HDD entry is located in a wooded area to the northeast. The surface grades in this vicinity are relatively flat and range from about El. 254 to El 255. The adjacent CSX rails rest on an elevated earthen embankment with a surface grade of about El. 260 to El. 262. The area to the east-northeast consists of farmland and fields.

The surface grade at the intersection of the CSX rails and Game Farm Road is at about El. 258 to El. 261. The intersection is also occupied by a series of railroad signal devices and overhead utility poles.

The area to the southeast of the Game Farm Road is wooded, and slopes downward at moderate grades (to the southeast and east-northeast) toward the stream, where the surface grade is at about El. 225.

The HDD exit area is currently located within a National Grid utility easement to the southeast, which is occupied by numerous utility poles and overhead power lines, and is oriented northwest-southeast. The utility easement is approximately 415-ft wide (as cleared) and characterized by small brush. Surface grades in this area slope downward gently toward the east, from about El. 251 to El. 249. The adjacent

CSX rails rest on an elevated earthen embankment, with a surface grade of about El. 256. The HDD #84B alignments are located within the CSX right-of-way.

<u>Subsurface Conditions at HDD #84B:</u>

In the vicinity of HDD #84B, Fill soils are expected to overlie glacial lake deposits consisting of silt and clay (soft to hard), with lesser amounts of fine sand. The lake deposits overlie probable Glacial Till of very dense silty sand, which may contain occasional cobbles and boulders. Bedrock (shale of the Schenectady Formation) was encountered at depths of about 20 to 23 feet by the test borings taken along the HDD alignment. Although not encountered by the test borings, the Schenectady Formation may also contain sandstone and siltstone.

<u>IR Risk at HDD #84B:</u>

At this time, we anticipated that the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of limited cover in the center of the bore alignment.
- Utility pole locations.
- Existing below-grade utilities.
- Obstructions such as cobbles and boulders within the overburden soils.

9.21 HDD Crossing #85

<u>Surface Conditions at HDD #85:</u>

The HDD #85 alignments are located to the northeast of and generally parallels the CSX rails (2 rails, oriented northeast-southwest, with a parallel siding to the southeast), and passes beneath Route 443, which is depressed at this location. The CSX rails pass over Route 443 by means of a steel bridge with concrete wingwalls. Overhead utility poles are located on both sides of Route 443. The area to the north and south of Route 443 is wooded. The HDD #85 alignments are located within the CSX right-of-way.

HDD #85 also passes below two small streams to the southeast of Route 443, which flow below the CSX rails through an 18” CMP culvert (north, invert elevation of El. 216.5) and a 72” RCP culvert (south, invert elevation of El. 211.4). Moderate to steep wooded slopes border both streams.

The HDD entry is located in a wooded area on the southeast end of the alignment. Surface grades in this area range from about El. 245 to El. 250. The adjacent CSX rails are topographically lower, at about El. 238.

The HDD exit is located in an open field to the north of Route 443, to the east of the CSX rails. The surface grades in the vicinity of the HDD entry range from about El. 238 to El. 240. The adjacent rails rest on an elevated earthen embankment, with a surface elevation of about El. 246 to El. 247.

Subsurface Conditions at HDD #85:

In the vicinity of HDD #85, Fill soils are expected to overlie glacial lake deposits consisting of silt and clay (very soft to stiff), with lesser amounts of fine sand. The lake deposits decrease in consistency, becoming very soft with depth, and overlie Glacial Till consisting of medium dense to very dense silty sand with gravel, with occasional cobbles and boulders.

IR Risk at HDD #85:

In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover located along the alignment.
- Utility pole locations.
- Existing below-grade utilities.
- The very soft soils, which do not provide significant confining capacity for drill fluid containment.
- Obstructions such as cobbles and boulders within the overburden soils.

The IR analysis for this installation is preliminary, pending additional test borings. At this time it appears that there is a potential of inadvertent release along the length of the bores, due to the soft soils and variable cover, which may be limited. The Contractor will need to be capable of responding to and addressing a drill fluid release in these areas.

9.22 HDD Crossing #87

Surface Conditions at HDD #87:

HDD #87 is oriented approximately northwest-southeast, and passes below active CSX rails (2 rails, also oriented northeast-southwest, and a parallel siding to the southeast). The railroad is slightly elevated at this location, at about El 235 to El. 237. The HDD alignment also passes below a culvert, having an invert of about El. 214.5, which allows a stream to flow below the rails.

The HDD #87 entry area is located to the northeast of the rails. This area is heavily wooded, and slopes upward to the north, from about El. 235 to El. 250. Waldermater Road is located to the east-northeast.

The HDD #87 exit area is located to the southwest of the rails. This area is heavily wooded. Site survey was not available for this area at the time of this report.

<u>Subsurface Conditions at HDD #87:</u>

In the vicinity of HDD #87, Fill soils are expected to overlie glacial lake deposits consisting of silt and clay (very soft to medium stiff), with lesser amounts of fine sand. The lake deposits decrease in consistency with depth, becoming very soft. On the northern end of the HDD alignment the glacial lake deposits overlie Bedrock (shale of the Schenectady Formation). On the southern end of the alignment the glacial lake deposits overlie Glacial Till consisting of very dense silty sand with gravel, with occasional cobbles and boulders, which in turn overlies bedrock. Bedrock was encountered at depths of about 51 to 54 feet by the test borings taken along the HDD alignment.

<u>IR Risk at HDD #87:</u>

A detailed IR analysis has not been completed for this crossing pending additional test borings. In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover located along the alignment.
- Existing below-grade utilities.
- The very soft soils, which do not provide significant confining capacity for drill fluid containment.
- The need to use a mud motor and elevated pump rates to drill through the bedrock.
- Obstructions such as cobbles and boulders within the overburden soils.

9.23 HDD Crossing #87A

Surface Conditions at HDD #87A:

HDD #87A is oriented approximately northwest-southeast, and passes below an existing 3'x4' culvert, which allows water to flow beneath the adjacent, parallel CSX rails to the east. The culvert invert is at about El. 203.4. The railroad is approximately at-grade with the surrounding area, with a surface elevation of about El. 209 to El. 211. Small commercial facilities and laydown are located to the west.

The HDD #87A entry area is located to the southeast at about El. 207, and the HDD exit to the northwest at about El. 212.

Subsurface Conditions at HDD #87A:

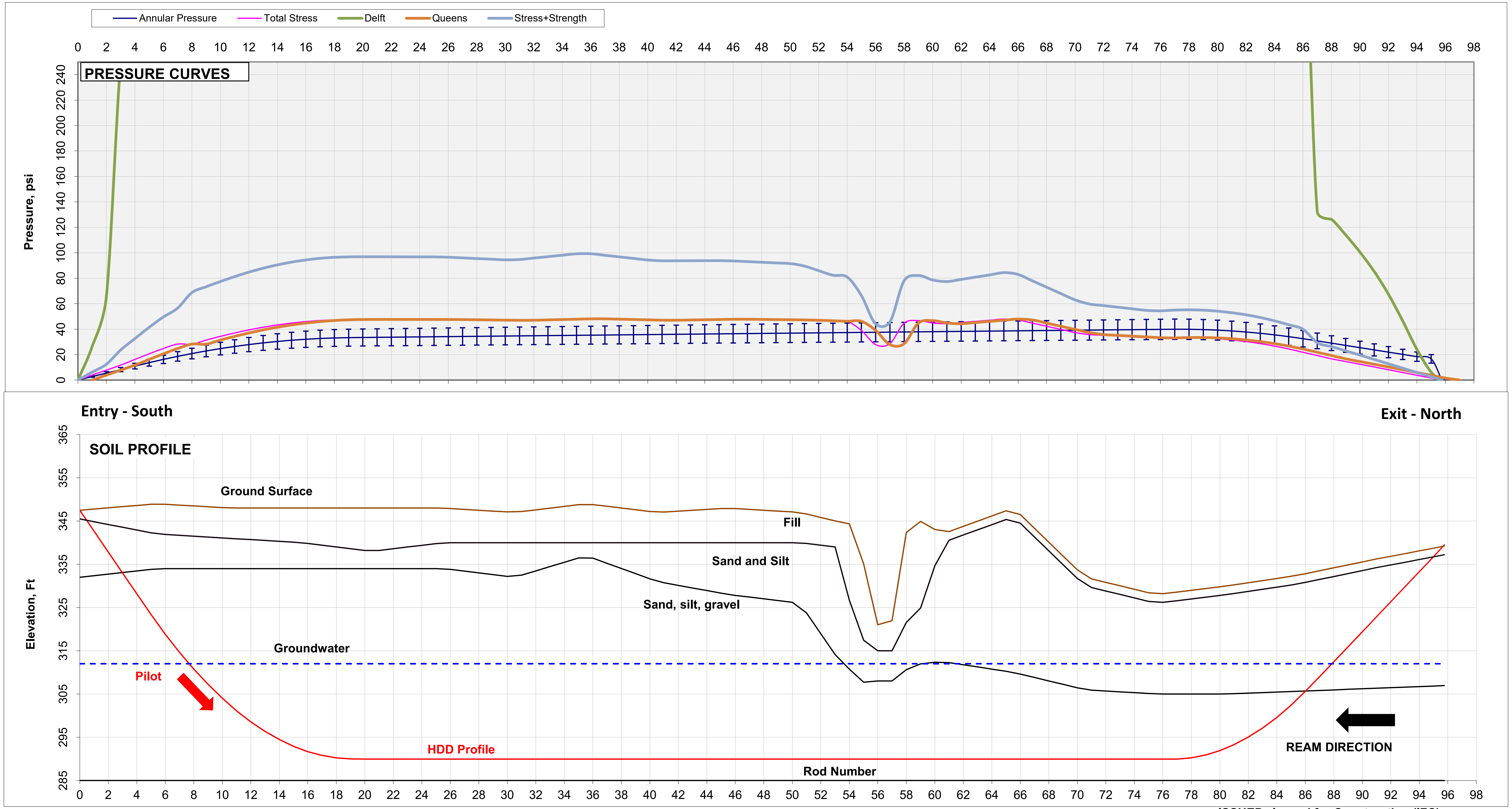
In the vicinity of HDD #87A, Fill soils are expected to overlie glacial lake deposits consisting of clay (very soft to medium stiff), with lesser amounts of fine sand. The lake deposits decrease in consistency with depth, becoming very soft. On the northern end of the HDD alignment the glacial lake deposits overlie Bedrock (shale of the Schenectady Formation) at a depth of 36 feet, which was sampled with split spoons.

IR Risk at HDD #87A:

A detailed IR analysis has not been completed for this crossing pending additional test borings. In our opinion the conditions conducive to inadvertent releases that may exist this at this site may include:

- Highly permeable soil such as cobbles and gravel in the surficial fill.
- Areas of reduced soil cover located along the alignment.
- Existing below-grade utilities.
- The very soft soils, which do not provide significant confining capacity for drill fluid containment.
- The need to use a mud motor and elevated pump rates to drill through the bedrock.
- Obstructions such as cobbles and boulders within the overburden soils.

APPENDIX A
ANNULAR PRESSURE ANALYSES



ISSUED: Issued for Construction (IFC)

Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
80 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Print Date ; 3/7/2023 14:05

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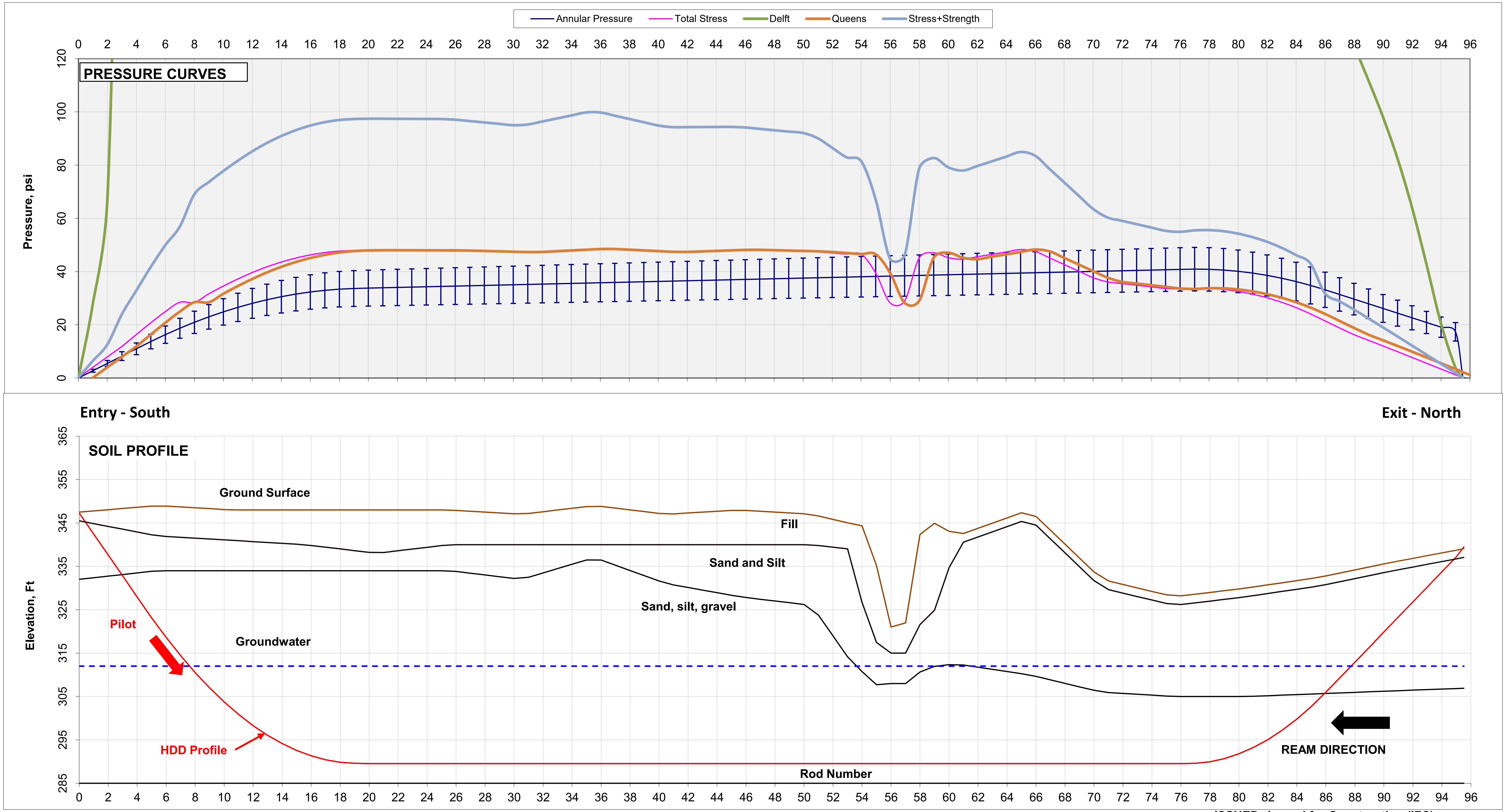
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 71 Circuit #1
CSX RR and Burdeck St.

Revision 1

FIGURE 1



ISSUED: Issued for Construction (IFC)

Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
100 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Print Date ; 3/7/2023 14:11

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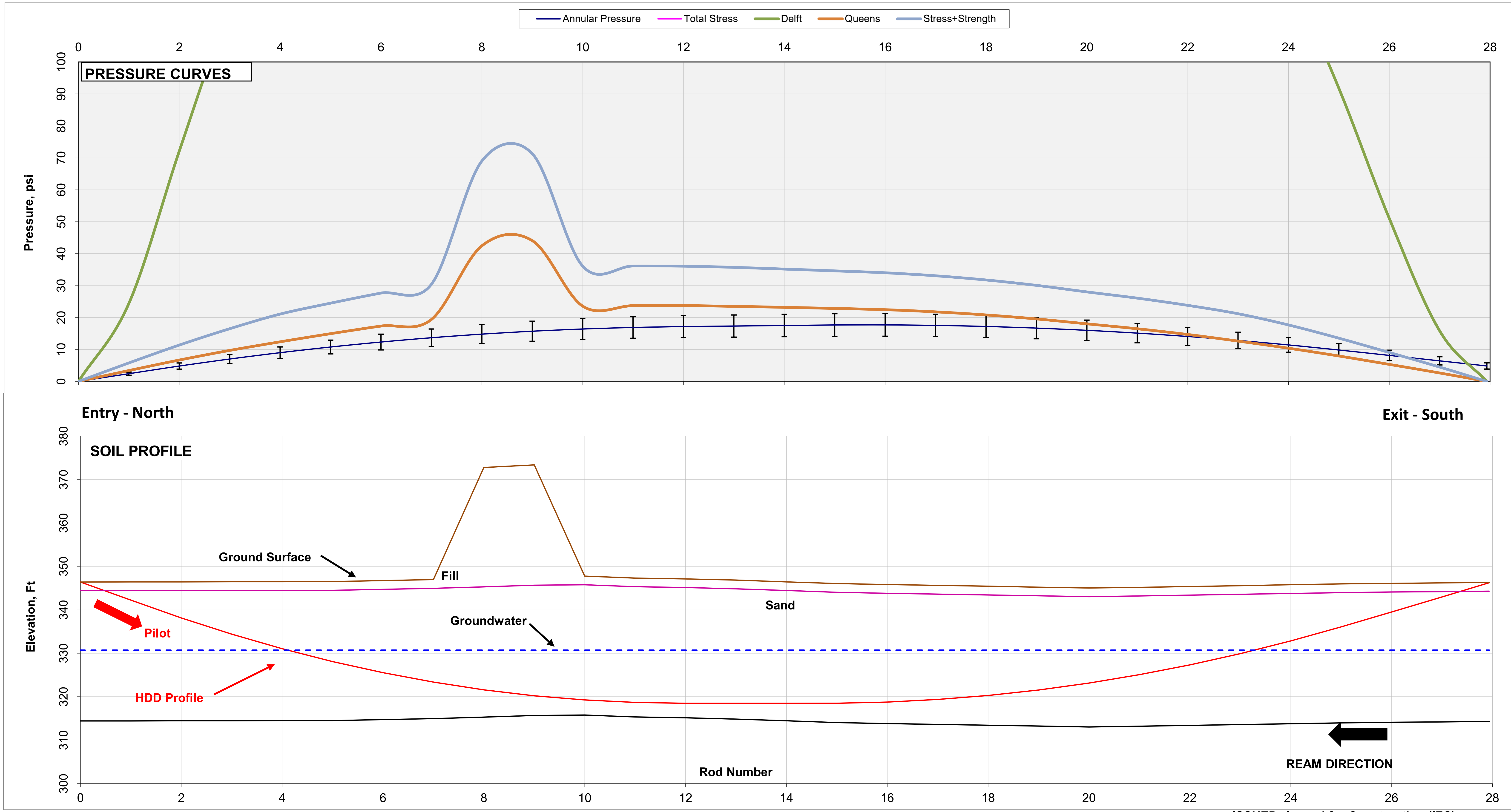
ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 71 Circuit #2
CSX RR and Burdeck St.

Revision 1

FIGURE 1



ISSUED: Issued for Construction (IFC)

Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Print Date ; 3/7/2023 14:33

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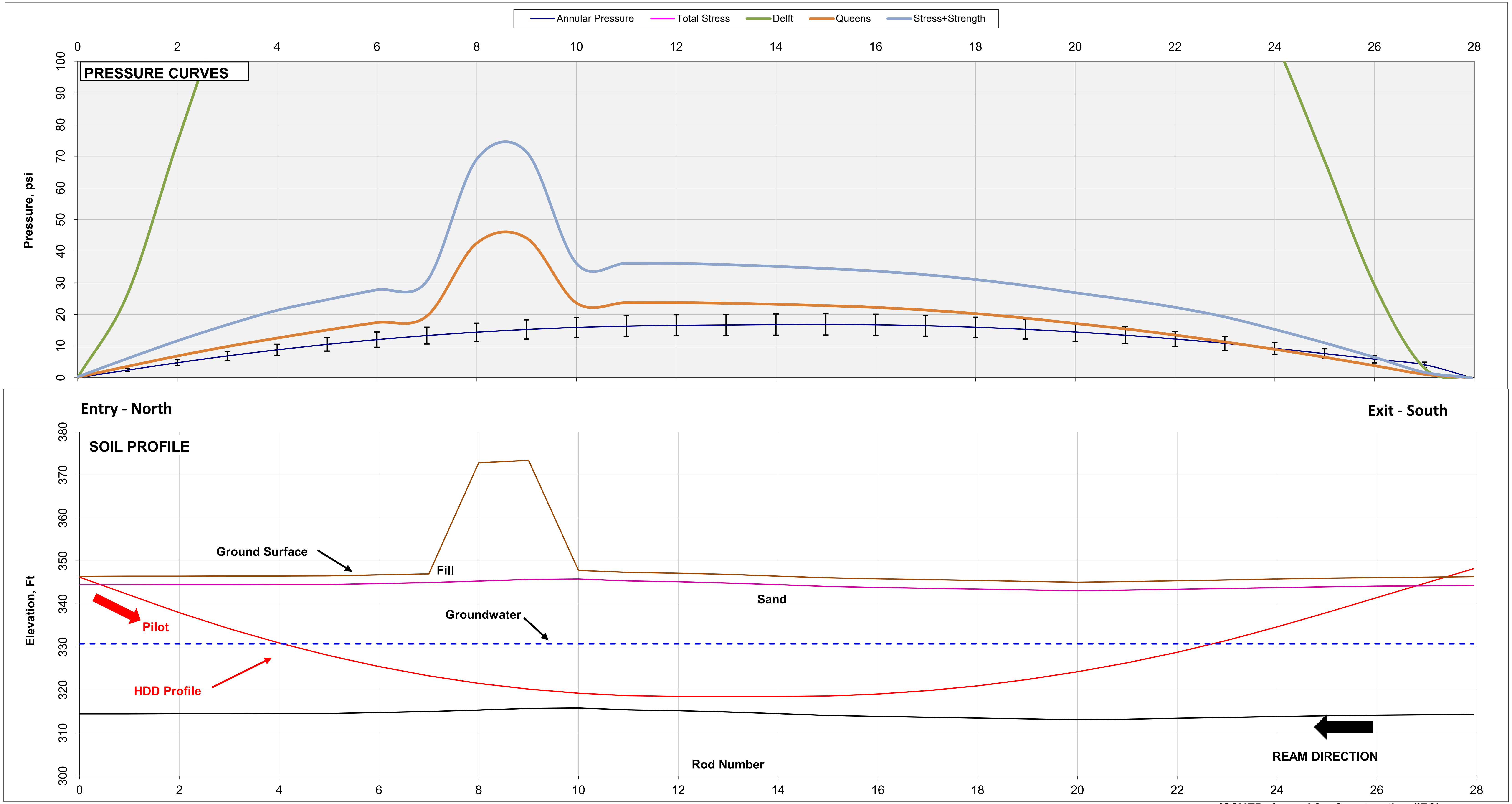
Segment 8 (Pkg. 5A) - CSX: Roterdam to Sel
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 72 Circuit #1
Mariaville Rd

Revision 1

FIGURE 1



Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
100 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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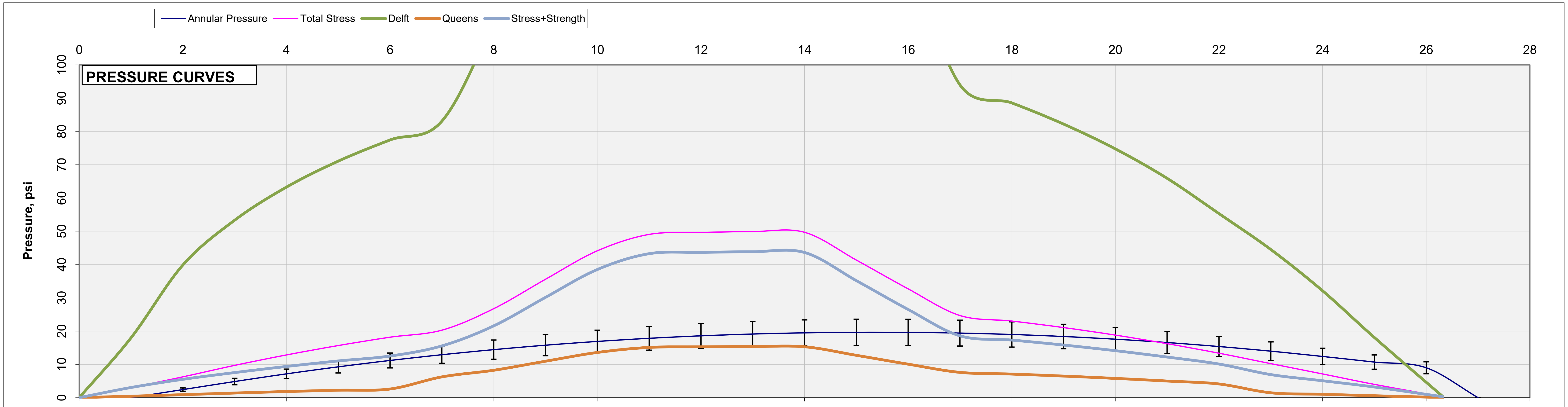
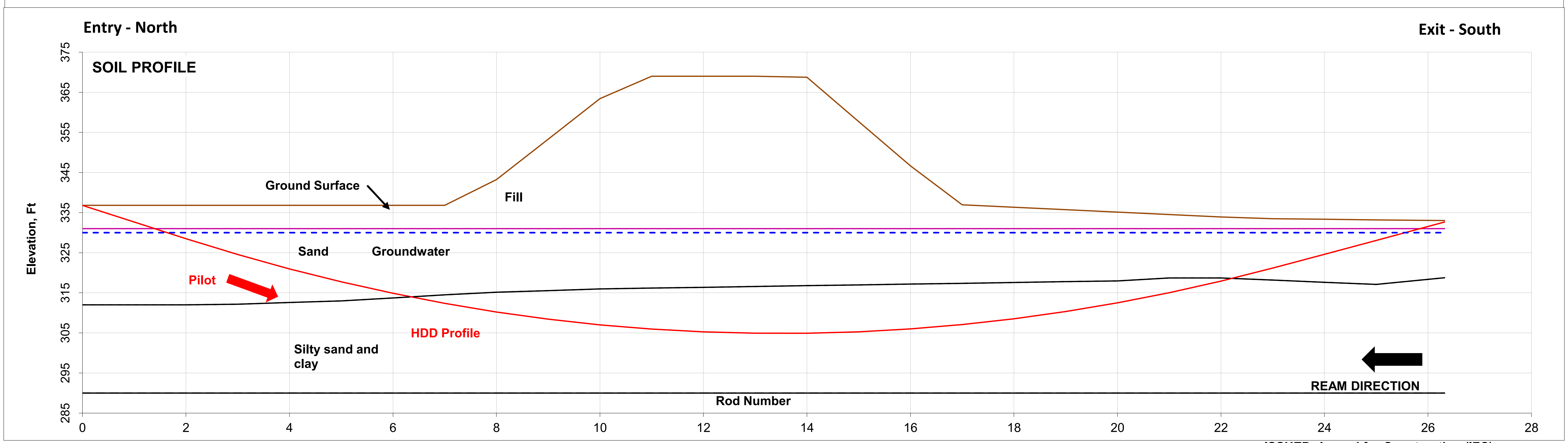
Segment 8 (Pkg. 5A) - CSX: Roterdam to Sel
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 72 Circuit #2
Mariaville Rd

Revision 1

FIGURE 1





Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Print Date : 3/17/2023 14:42

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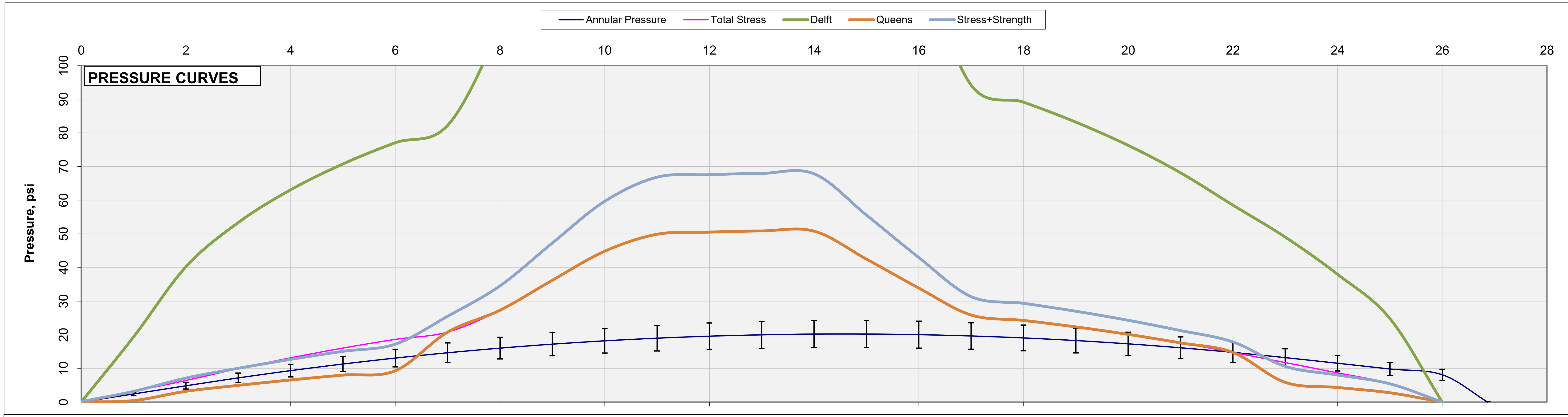
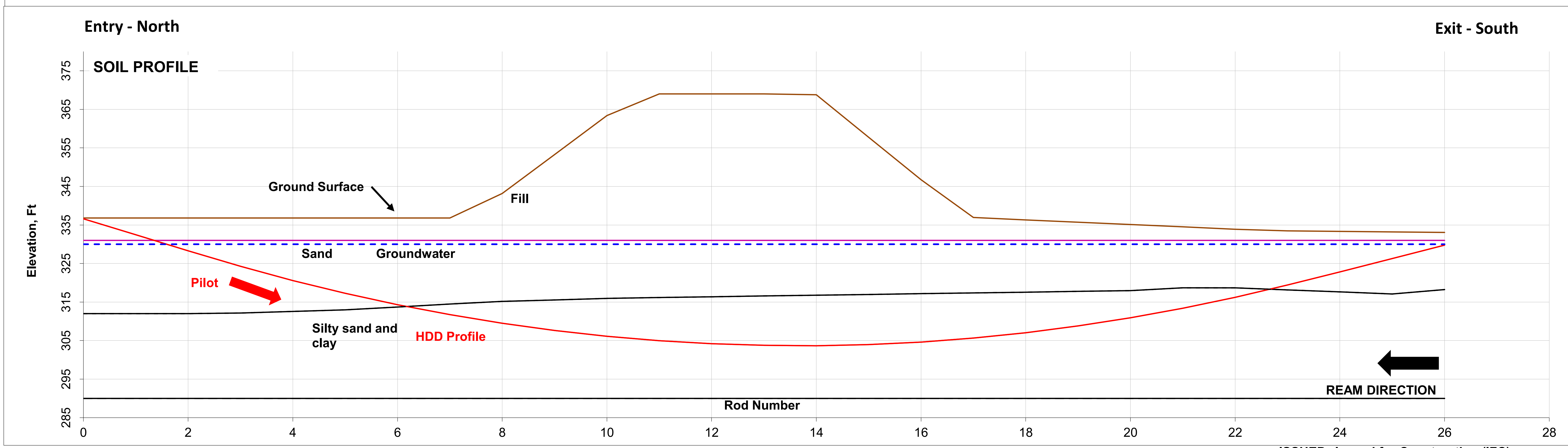
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 73 Circuit #1
Route 7

Revision 1

FIGURE 1





ISSUED: Issued for Construction (IFC)

Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annular pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Print Date ; 3/17/2023 15:02

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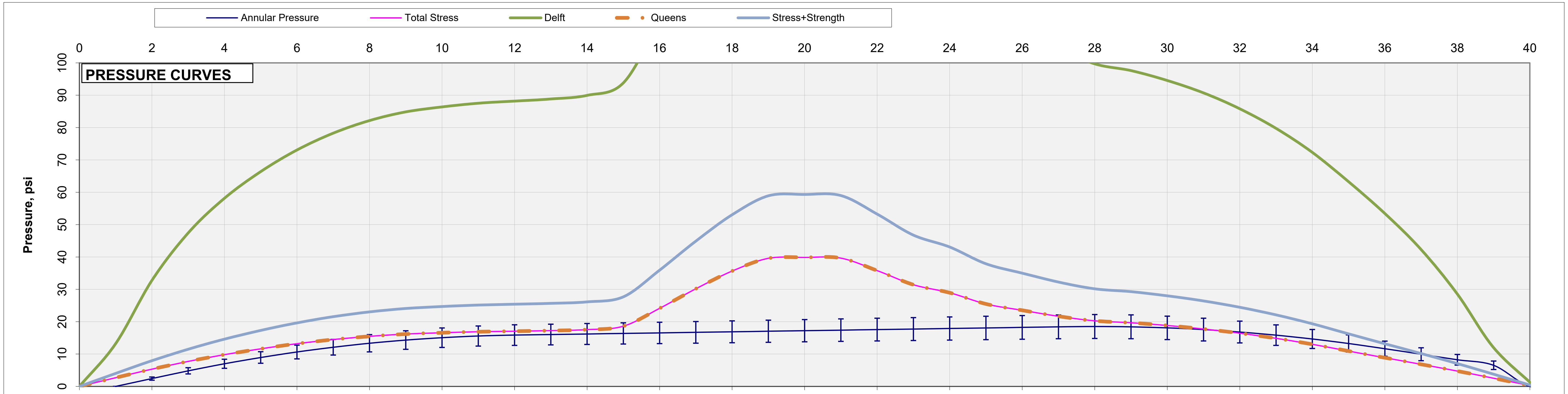
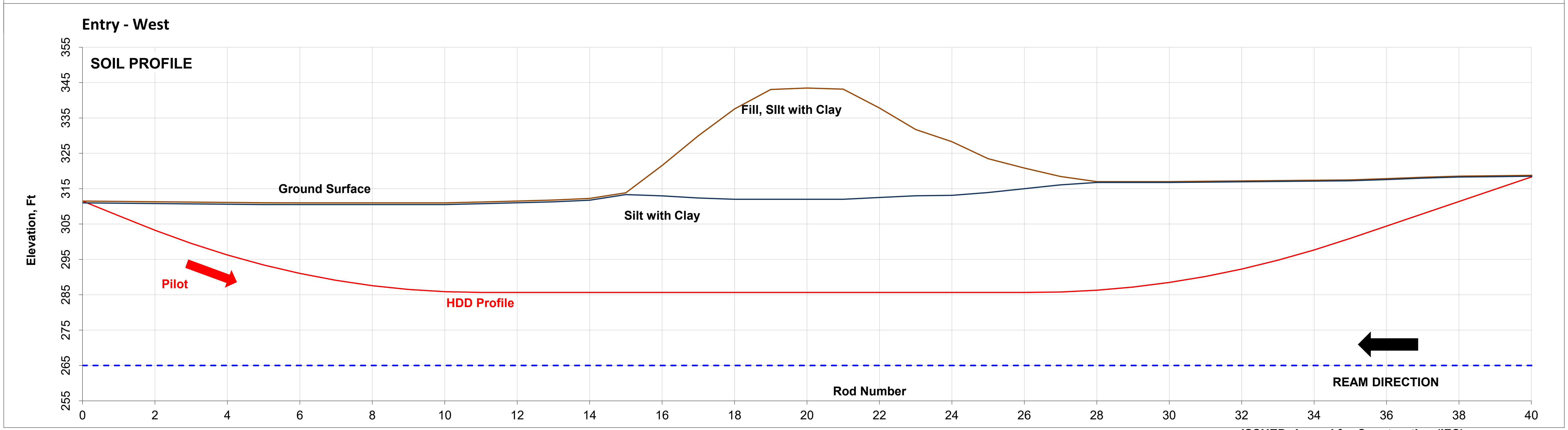
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 73 Circuit #2
Route 7

Revision 1

FIGURE 1





ISSUED: Issued for Construction (IFC)

Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annular pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Bore Logs
A179.6-1
K-179.6

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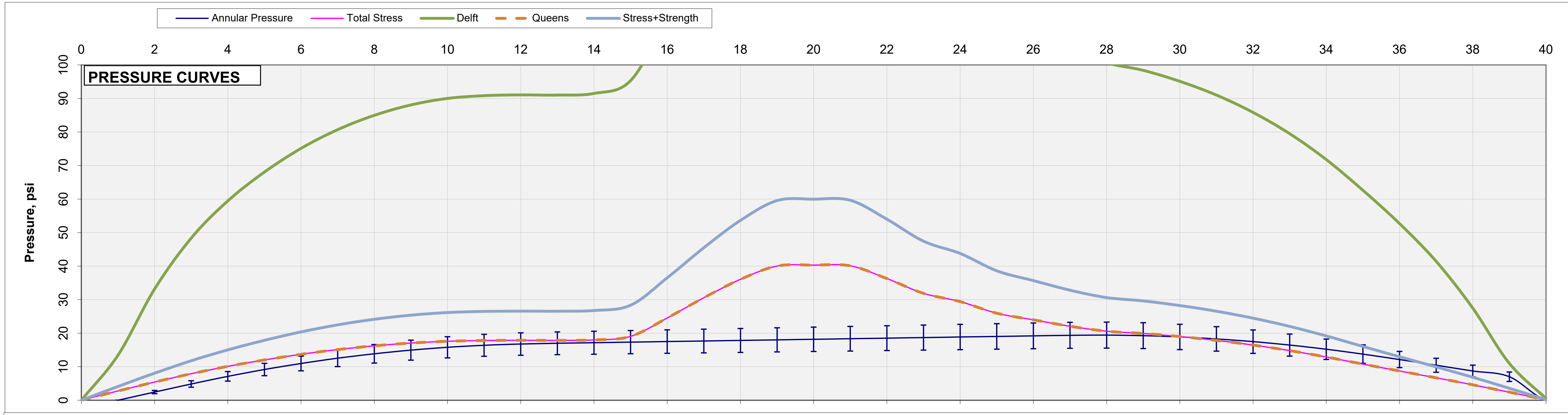
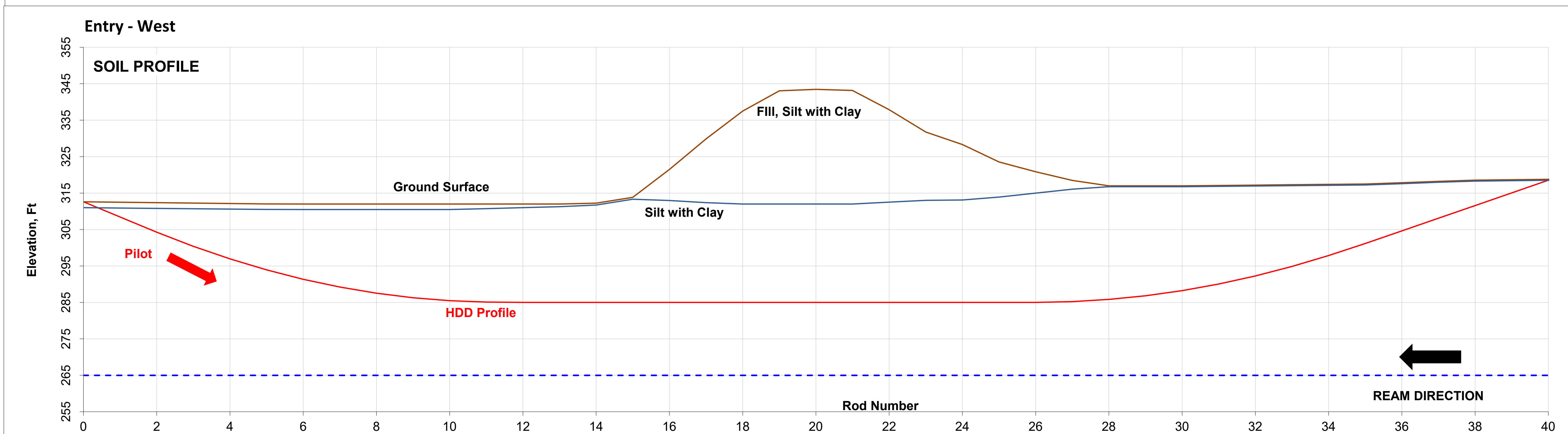
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bethlehem
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 75 Conduit #1
Guilderland Ave.

Revision 1

FIGURE 1





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Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Bore Logs
A179.6-1
K-179.6

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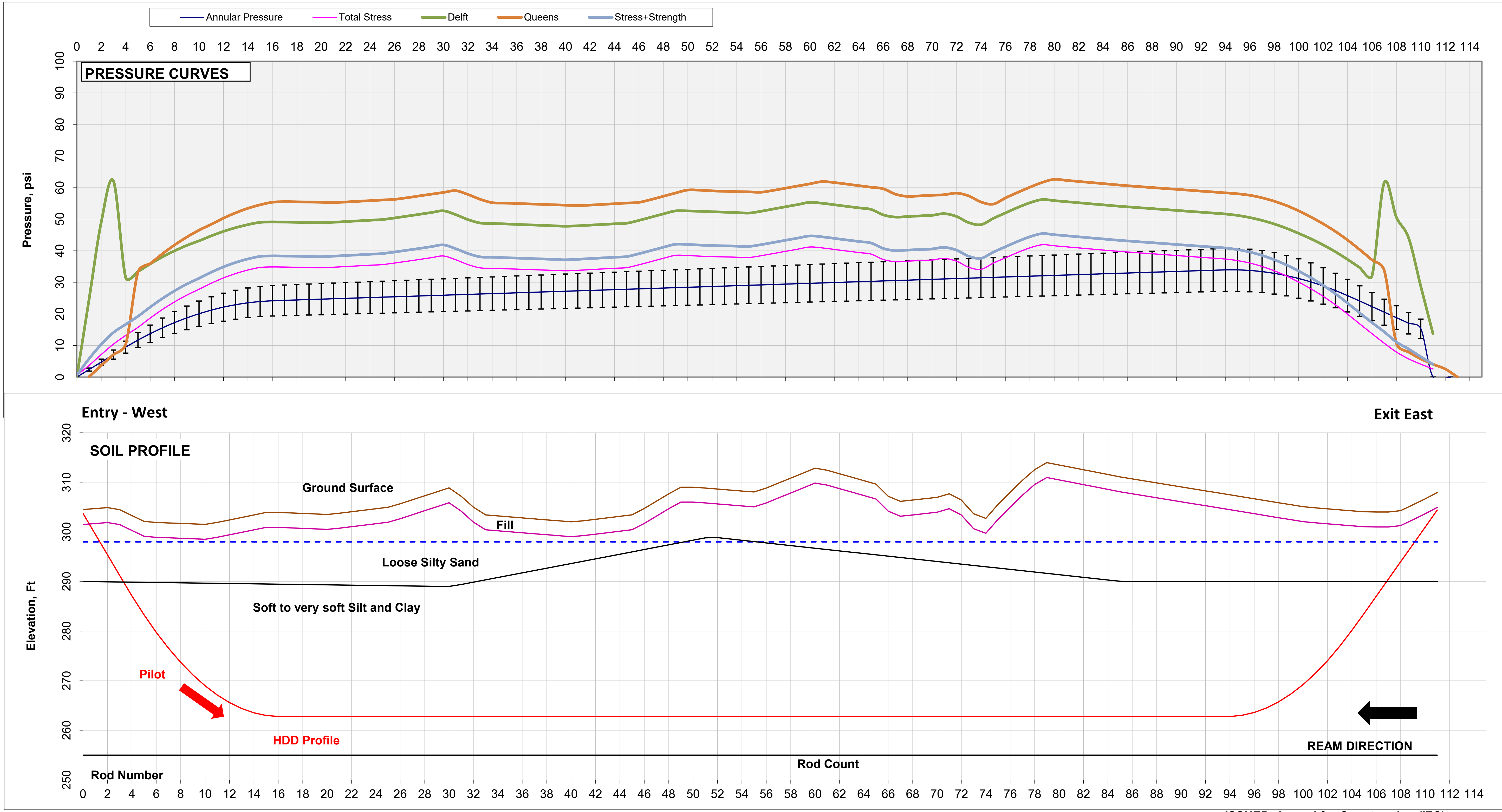
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bet
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES HDD 75 Conduit #2 Guilderland Ave.

Revision 1

FIGURE 1



ISSUED: Issued for Construction (IFC)

Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
100 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Bore Logs
K-180.8
B180.9-1
K-181.0
SCPT22-180.9
CPT22-181.1

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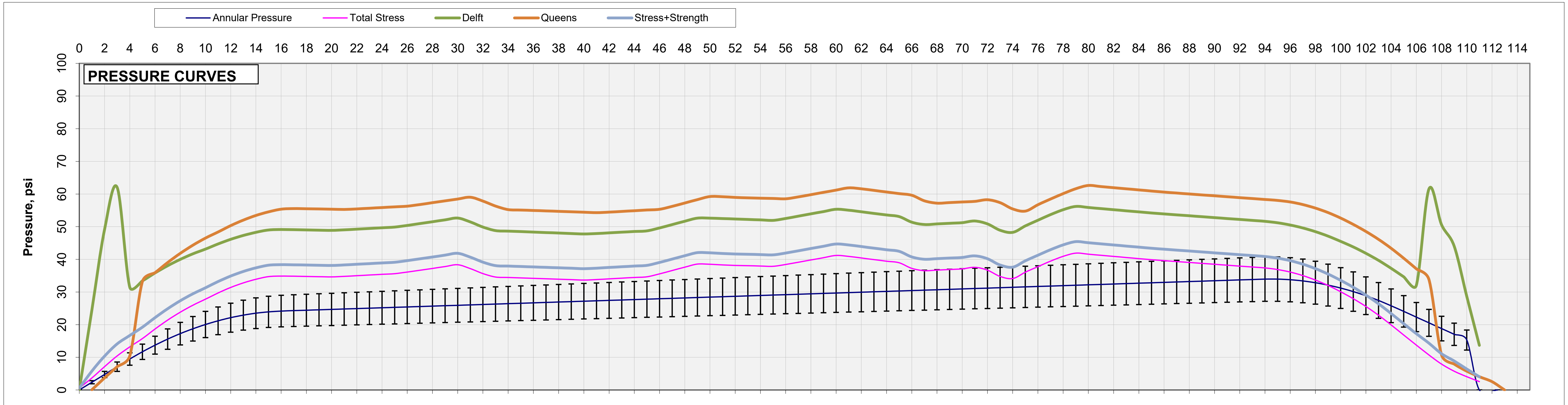
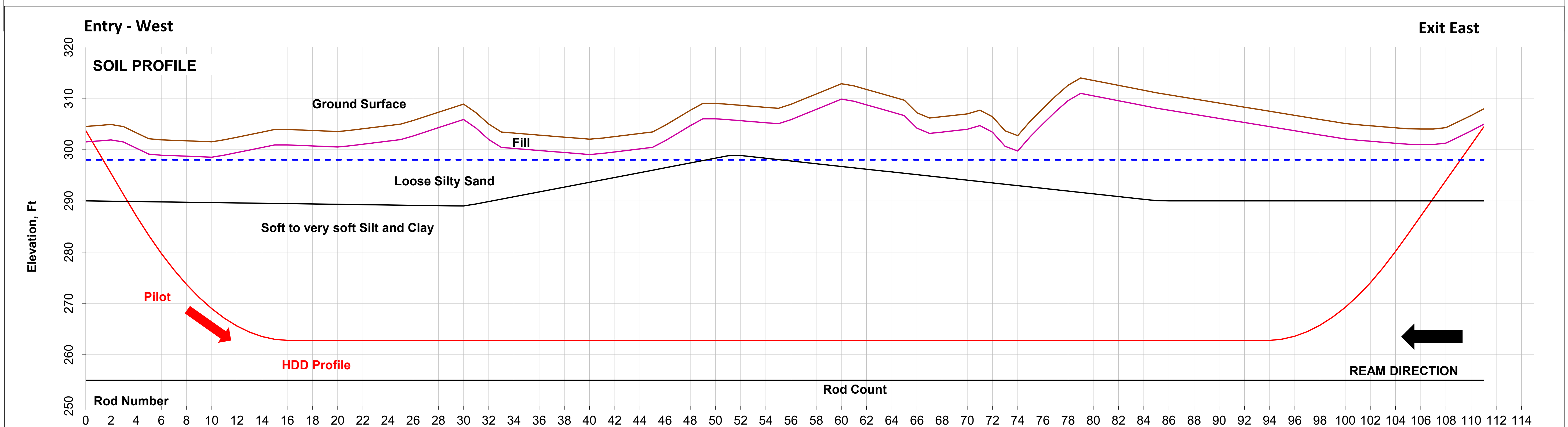
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bethlehem
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 75A Conduit #2
Stream Crossing

Revision 1

FIGURE 1





Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

ISSUED: Issued for Construction (IFC)

Basis of annular pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
100 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Bore Logs

K-180.8
B180.9-1
K-181.0
SCPT22-180.9
CPT22-181.1

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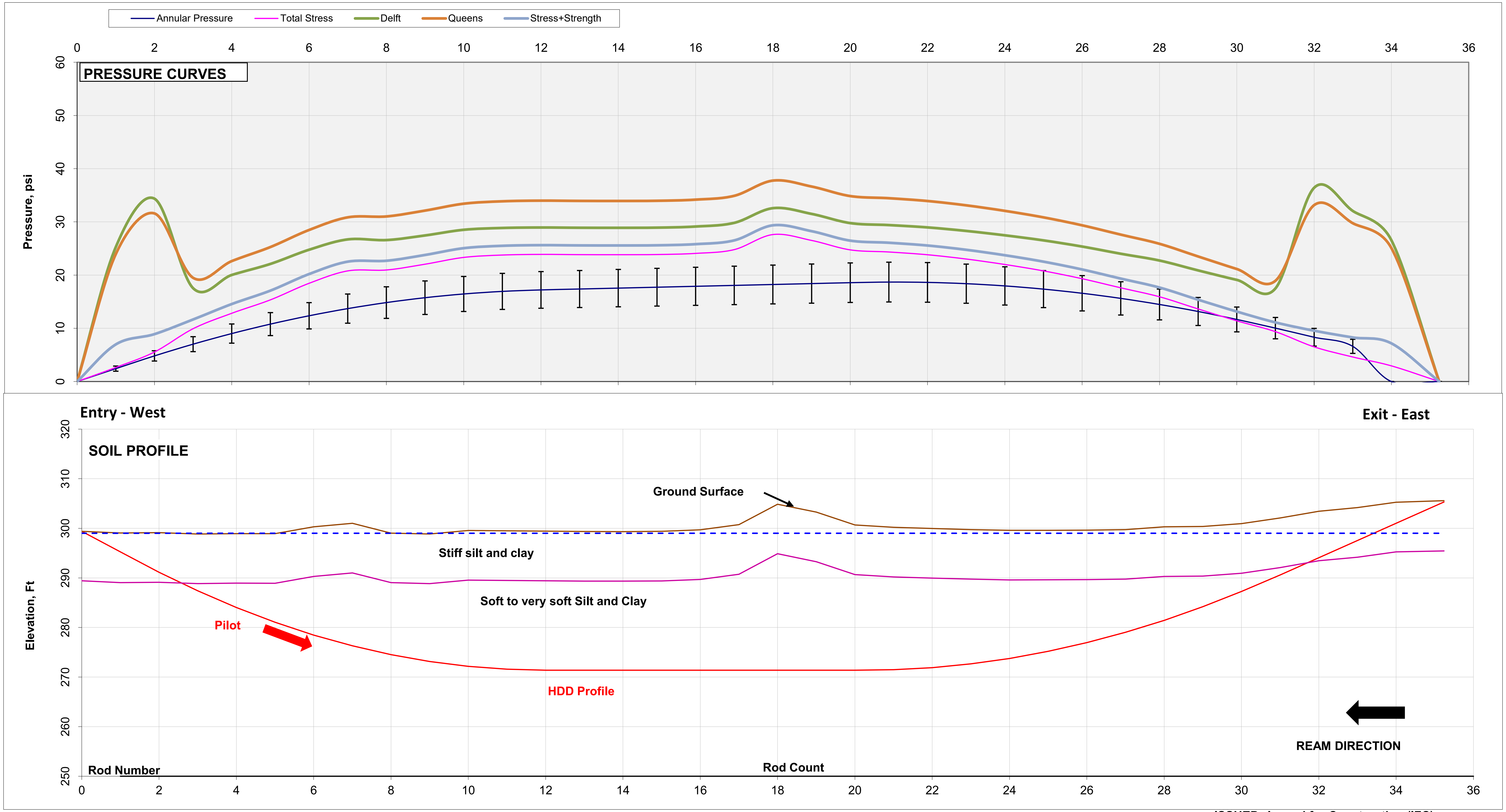
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bethlehem
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 75A Conduit #2
Stream Crossing

Revision 1

FIGURE 1



ISSUED: Issued for Construction (IFC)

Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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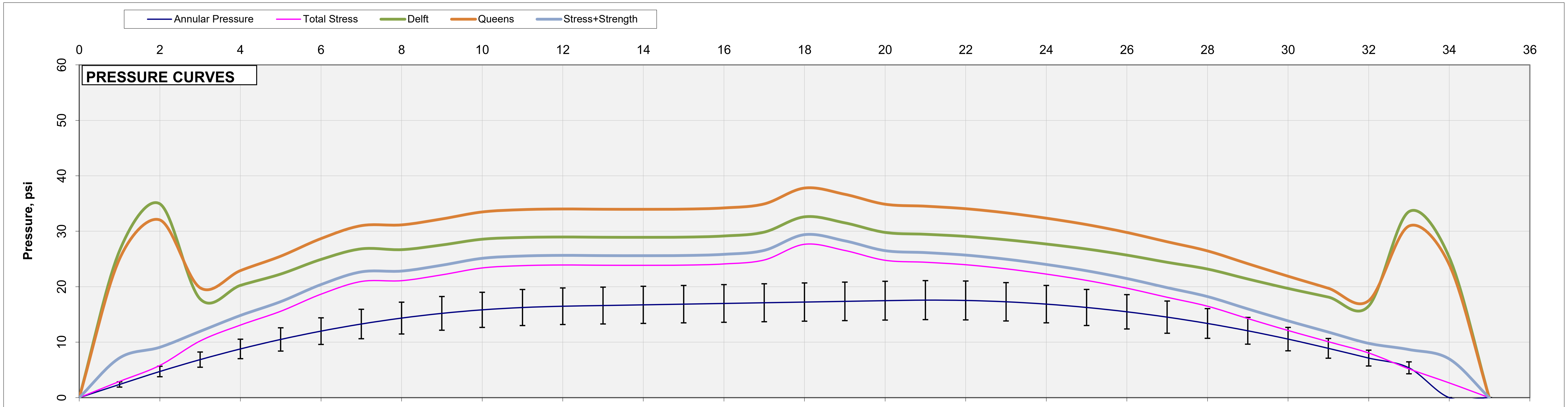
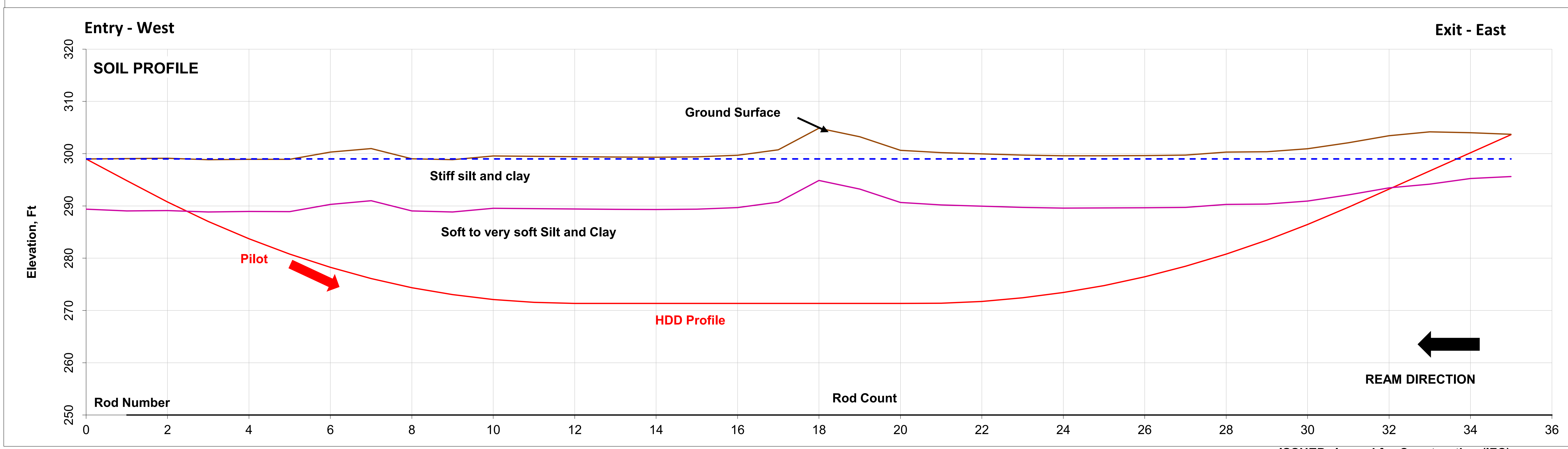
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 75A.A Circuit #1
Wetlands Crossing

Revision I

FIGURE 1





ISSUED: Issued for Construction (IFC)

Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annular pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
100 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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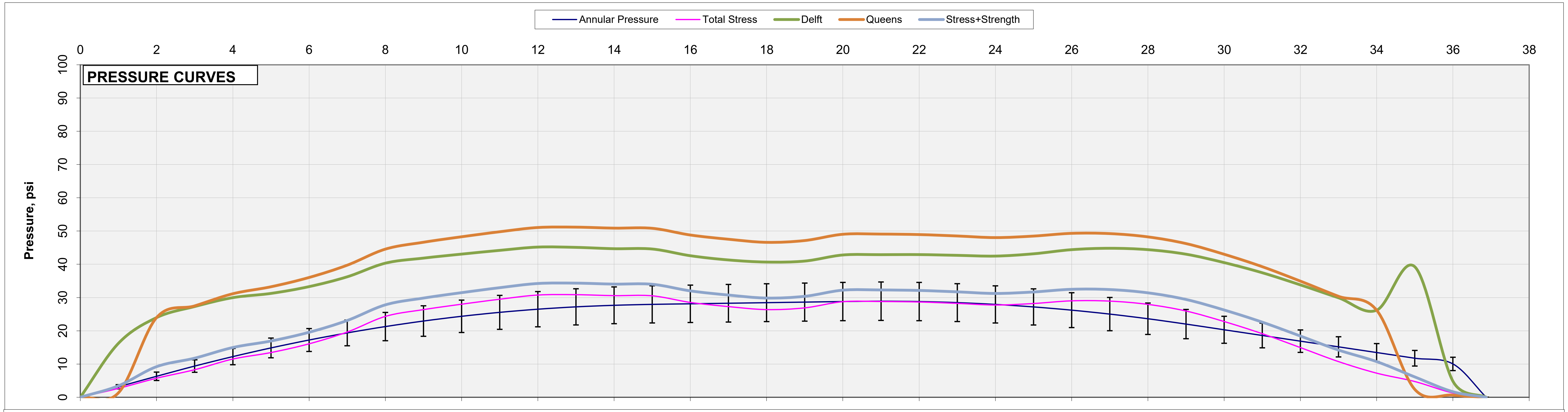
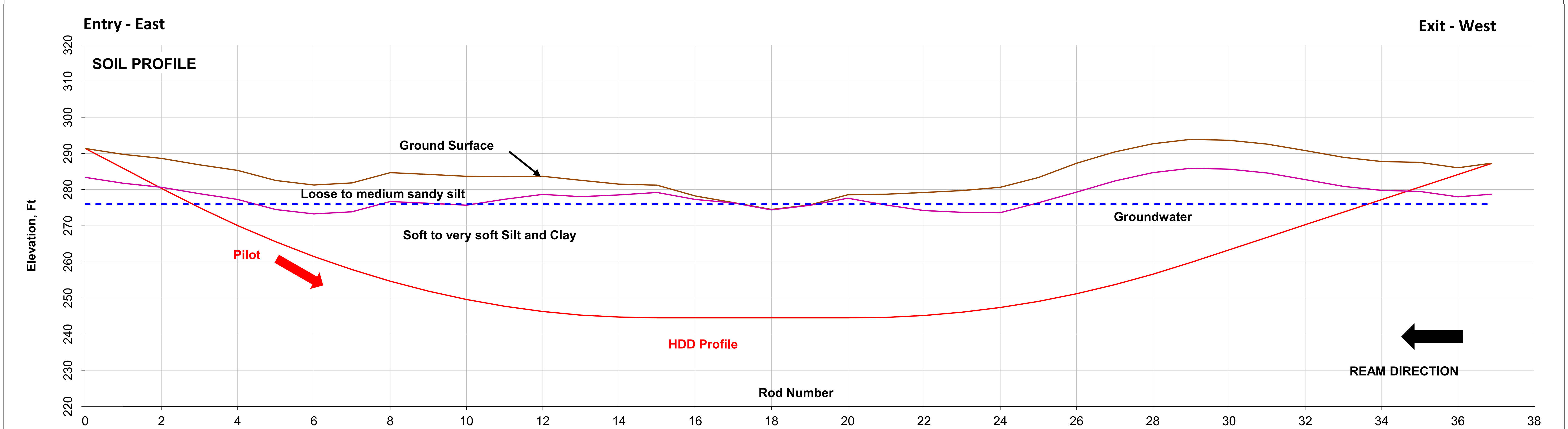
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 75A.A Circuit #2
Wetlands Crossing

Revision 1

FIGURE 1





Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annular pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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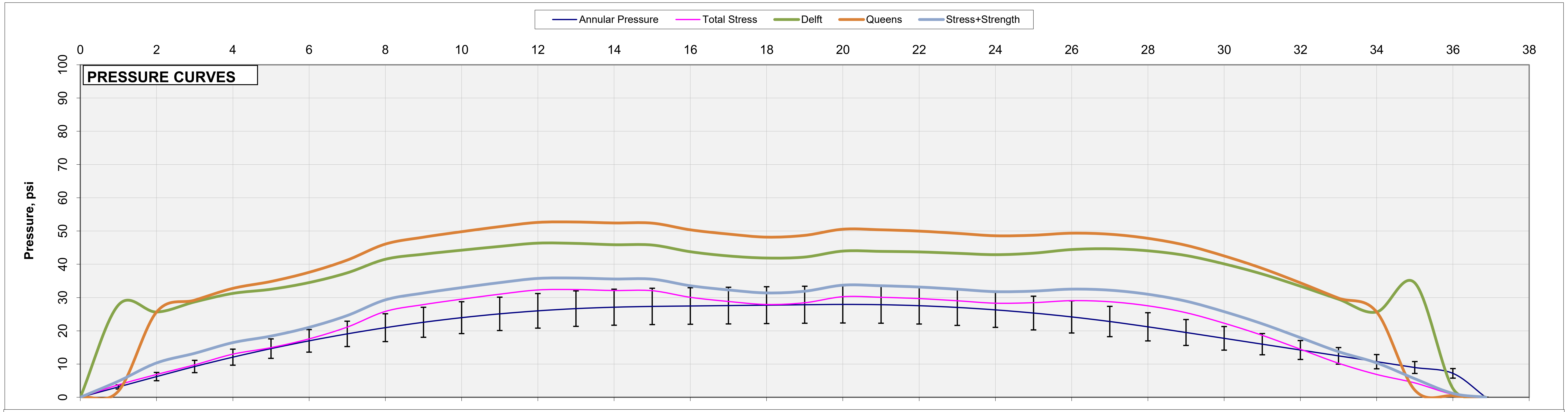
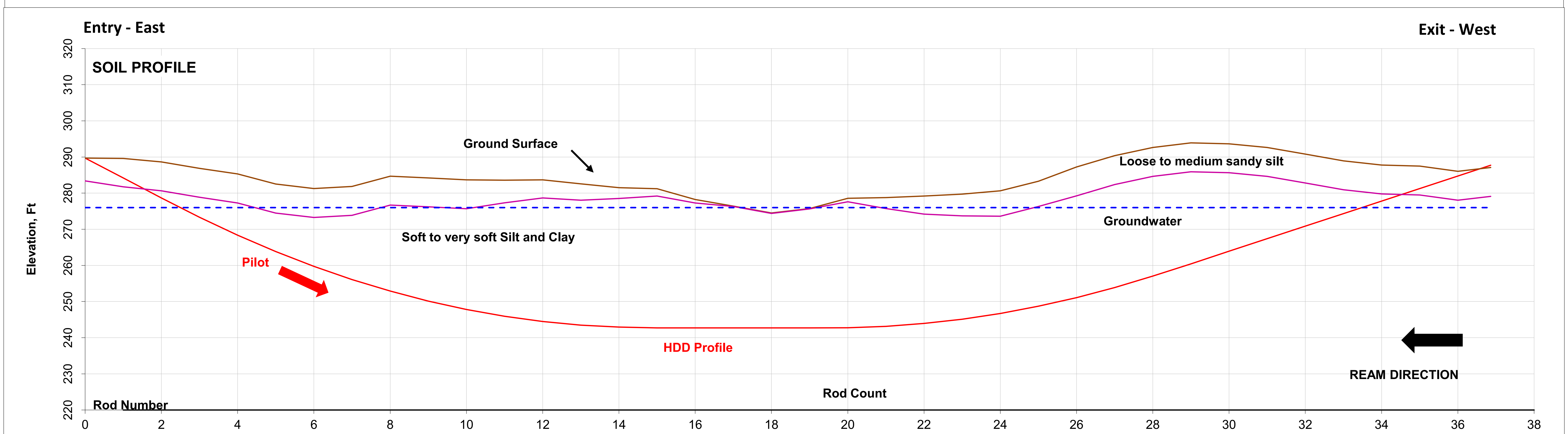
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 75B Circuit #1
Stream Crossing

Revision 1

FIGURE 1





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Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annular pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
100 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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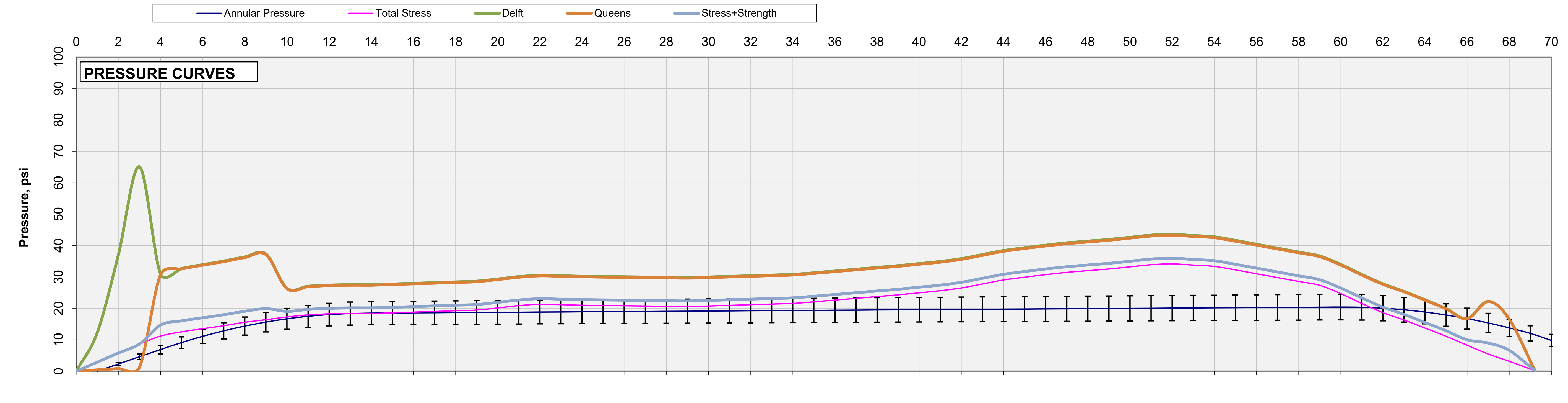
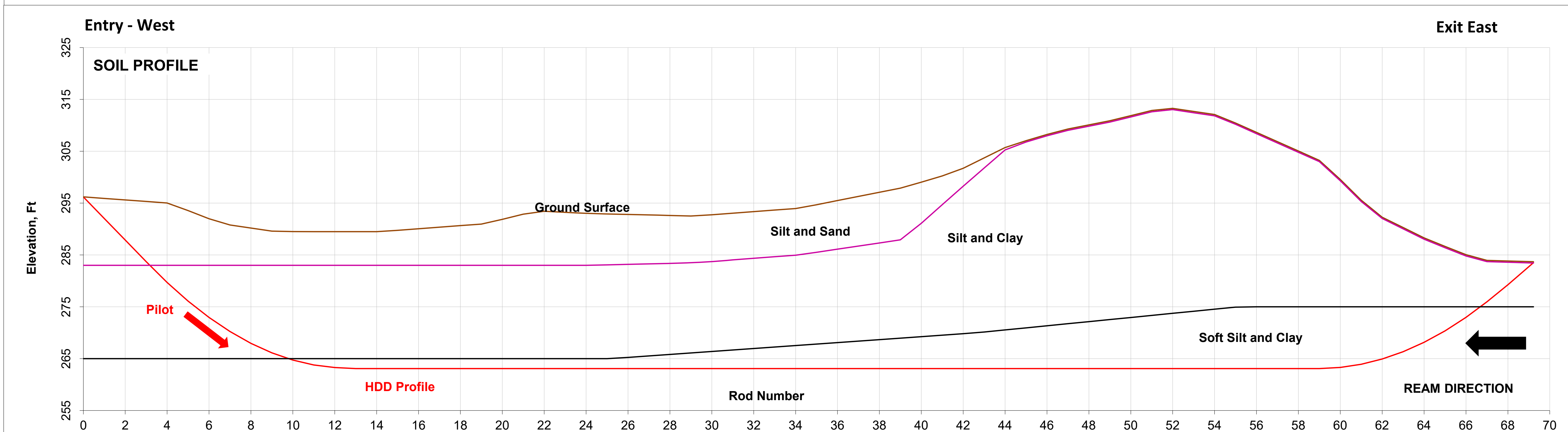
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 75B Circuit #2
Stream Crossing

Revision 1

FIGURE 1





ISSUED: Issued for Construction (IFC)

Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

12.60 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Bore Logs
B183.2-1
K183.3
K183.4

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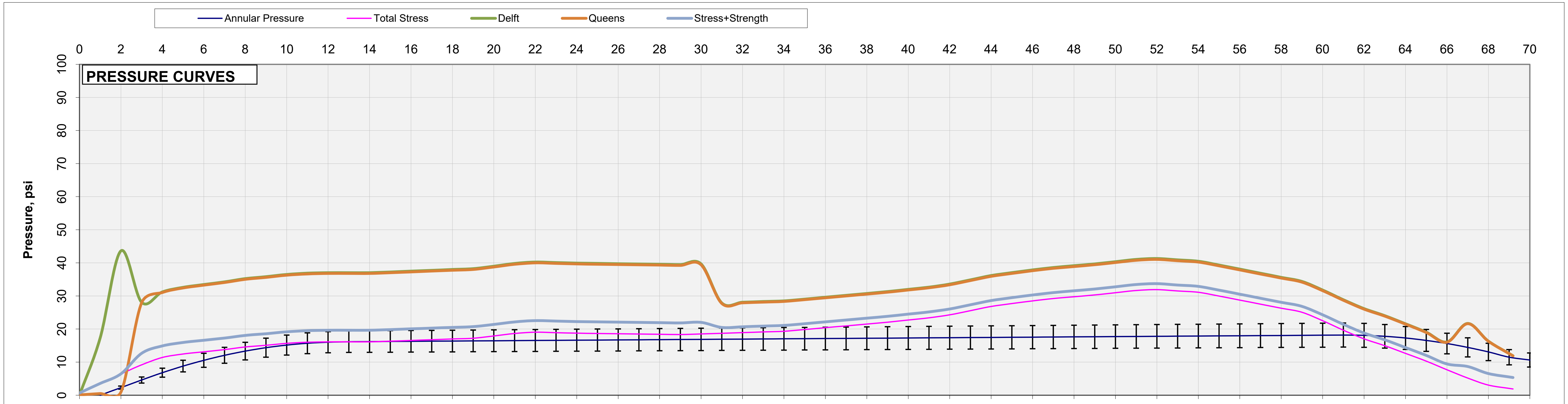
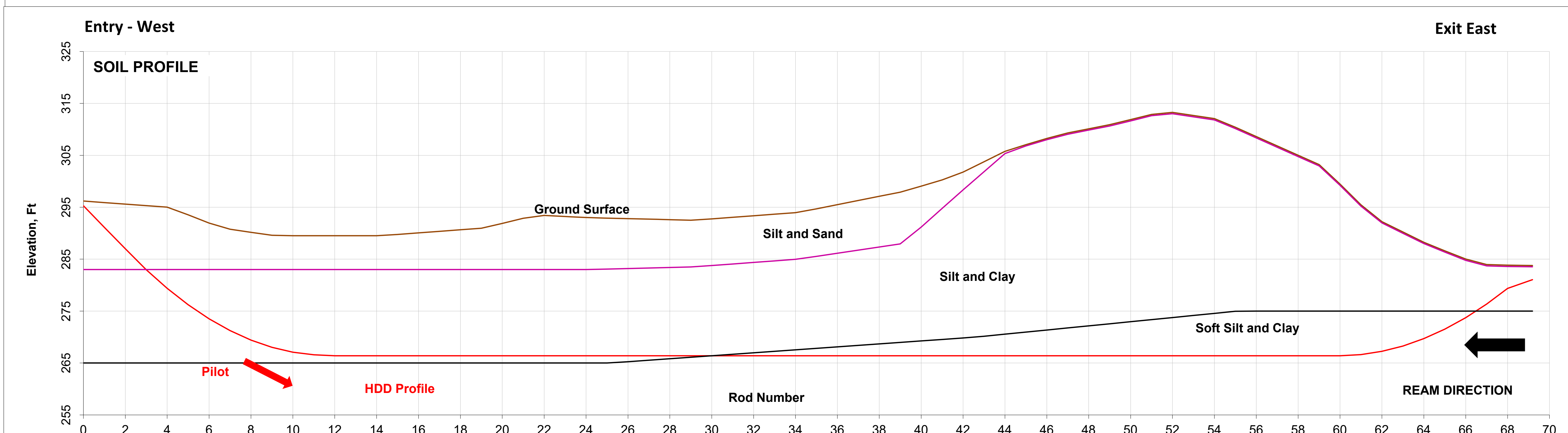
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bethlehem
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 77 Circuit #1
CSX RR Crossing

Revision 1

FIGURE 1





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Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

12.60 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Bore Logs
B183.2-1
K183.3
K183.4

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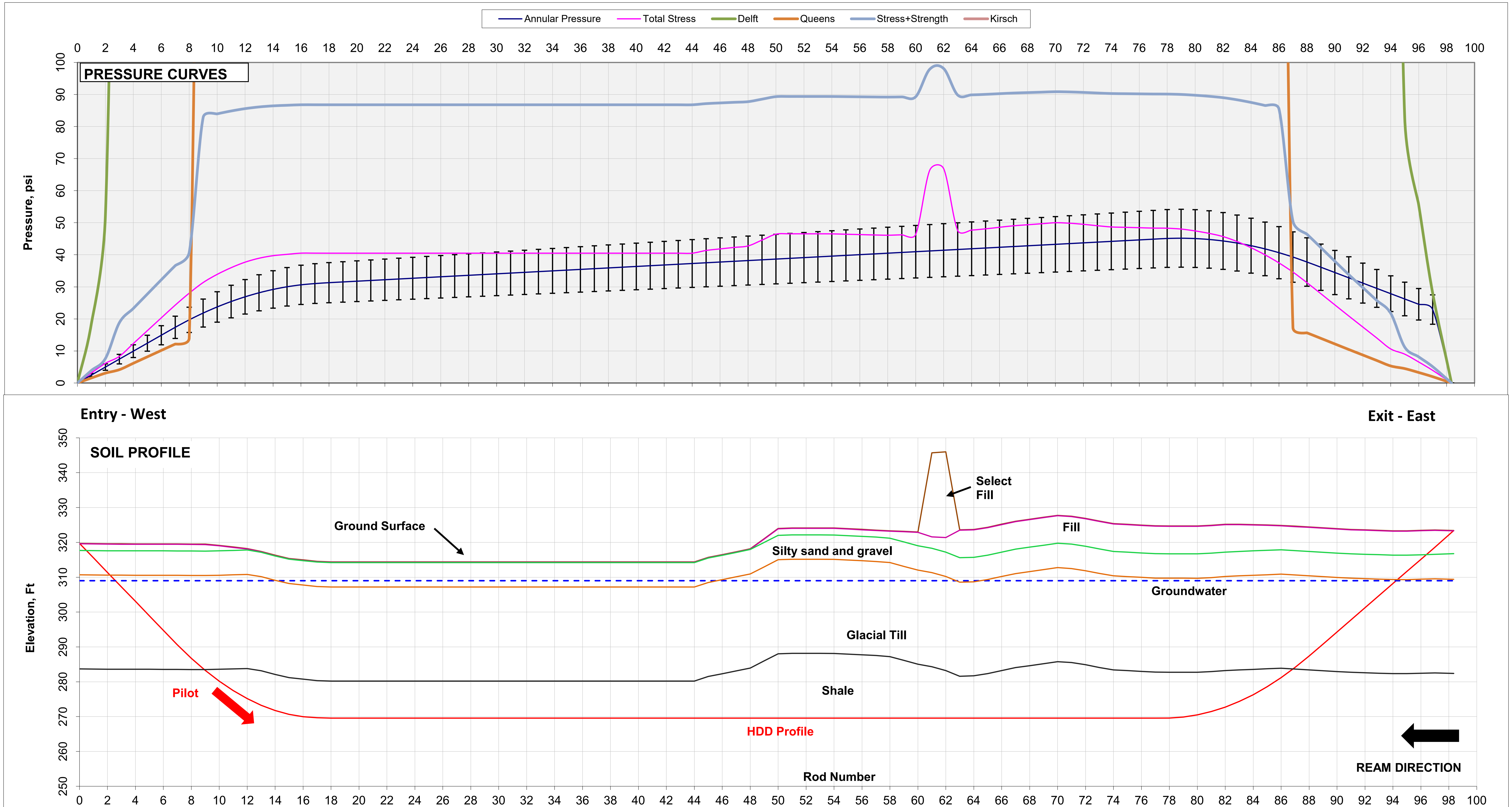
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bethlehem
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 77 Circuit #2
CSX RR Crossing

Revision 1

FIGURE 1



ISSUED: Issued for Construction (IFC)

Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annular pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
400 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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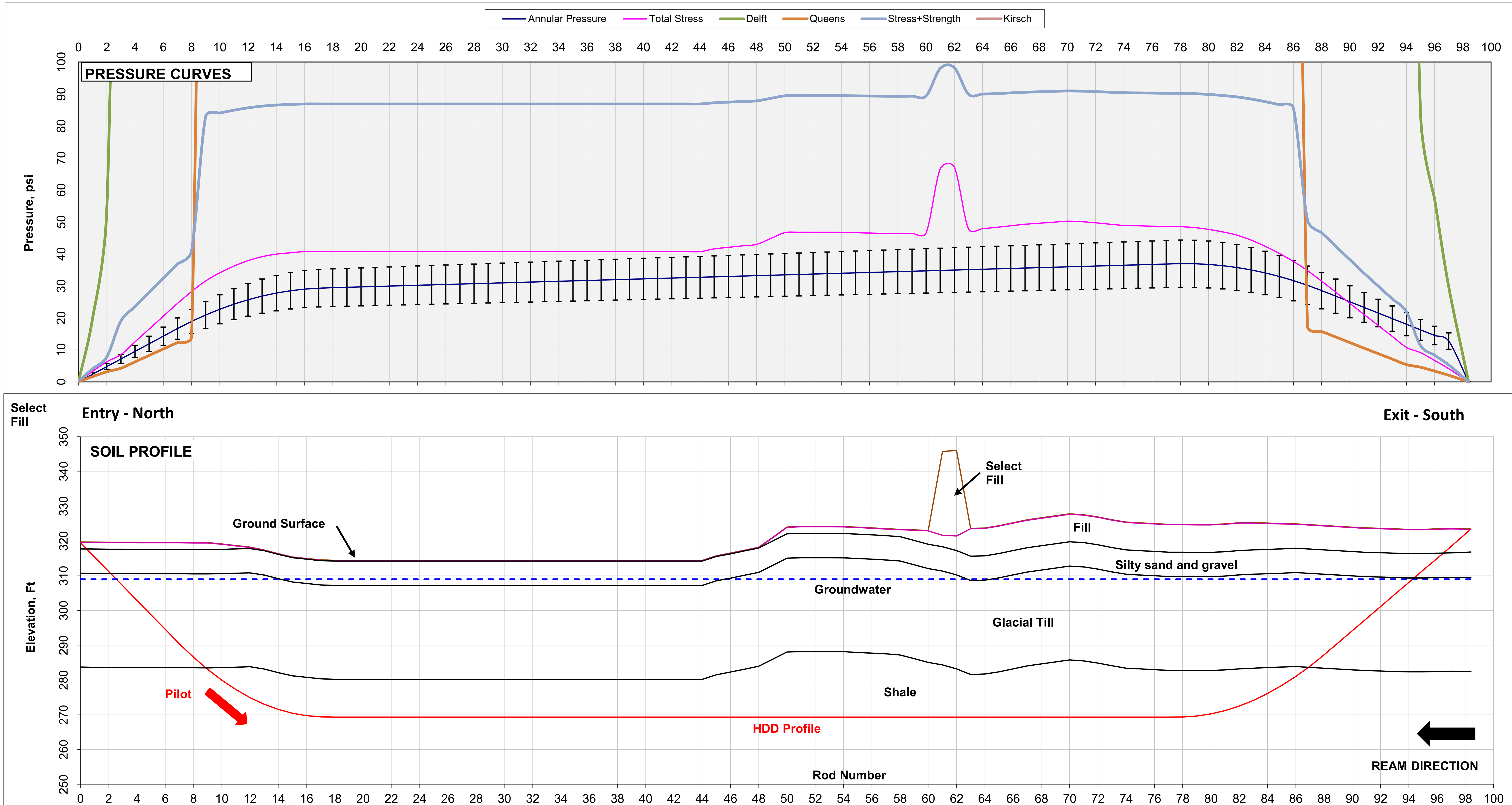
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 78 Circuit #1
CSX RR & Route 146 Crossing

Revision 1

FIGURE 1



Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

ISSUED: Issued for Construction (IFC)

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
100 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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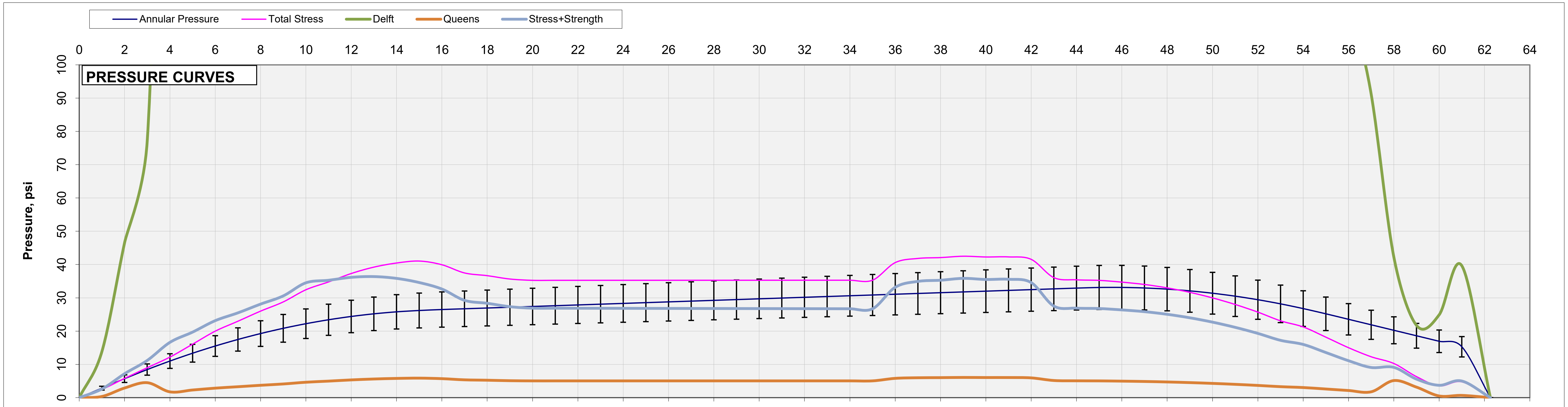
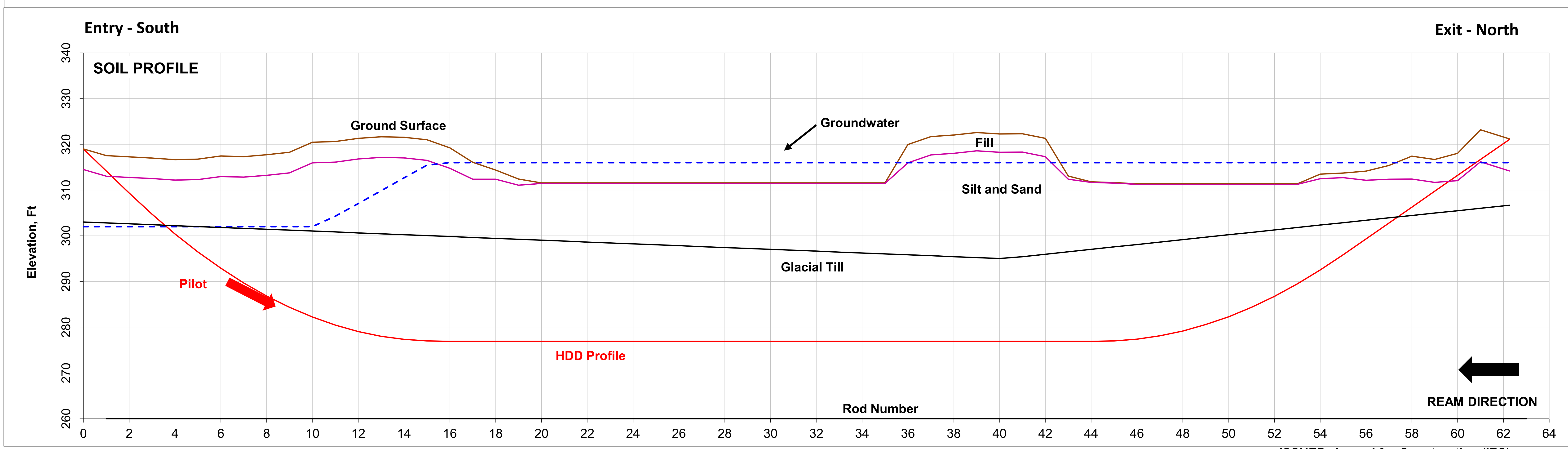
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 78 Circuit #2
CSX RR & Route 146 Crossing

Revision 1

FIGURE 1





ISSUED: Issued for Construction (IFC)

Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
400 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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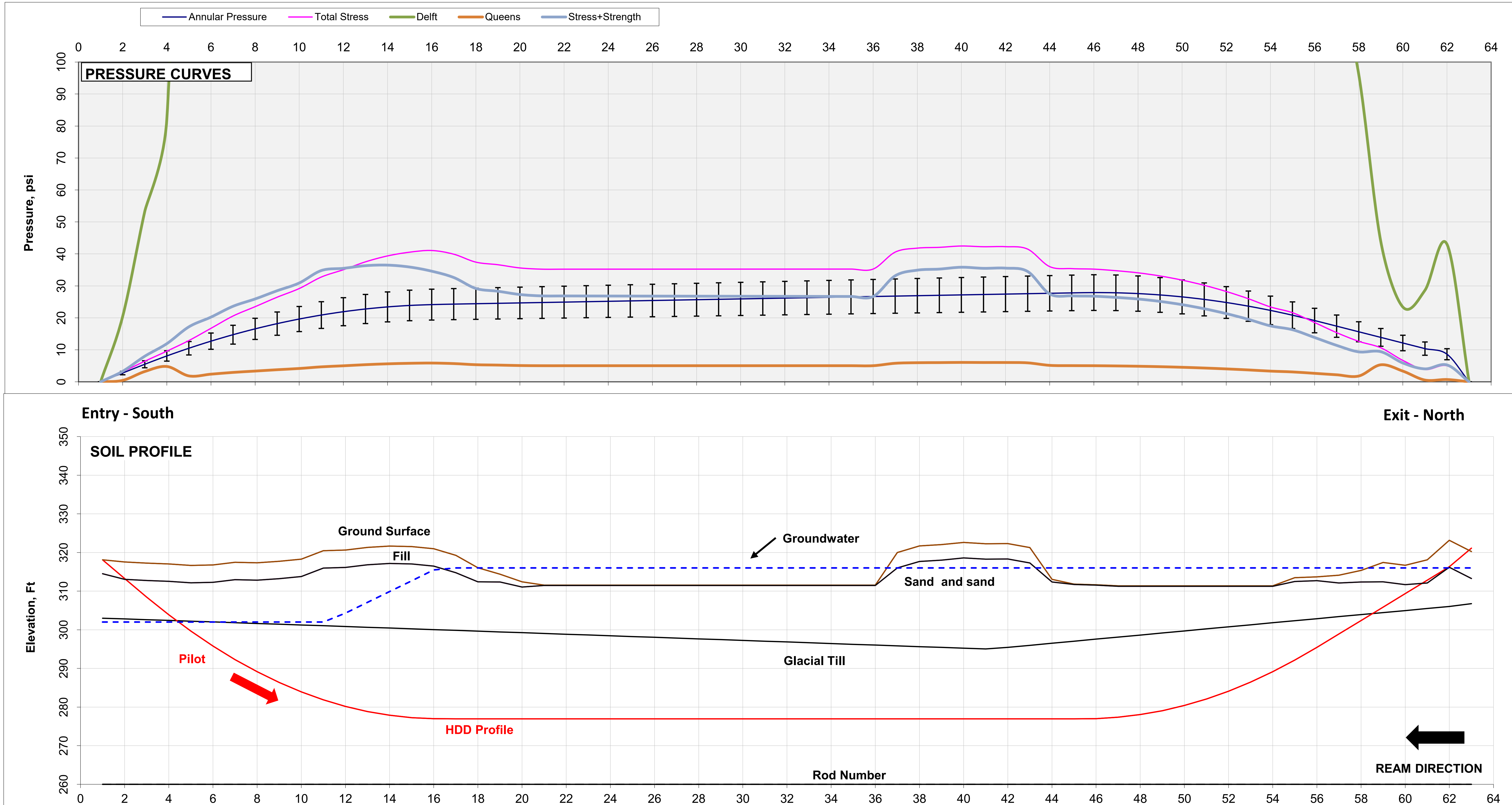
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 79B Circuit #1
CSX RR & Black Creek Crossing

Revision 1

FIGURE 1



ISSUED: Issued for Construction (IFC)

Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
100 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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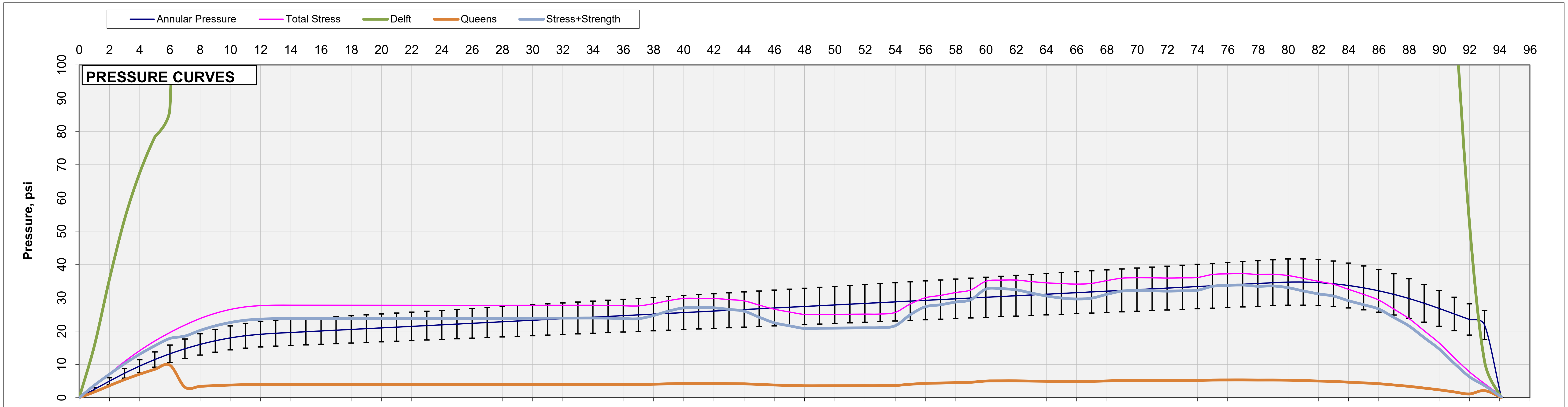
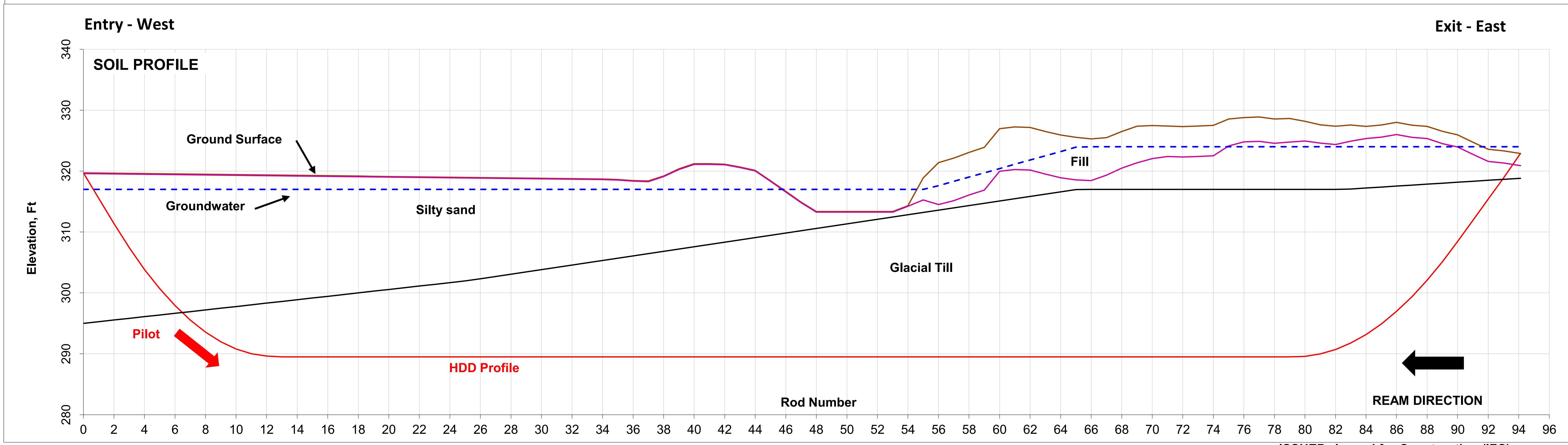
Segment 8 (Pkg. 5A) - CSX: Roterdam to Sel
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 79B Circuit #2
CSX RR & Black Creek Crossing

Revision 1

FIGURE 1





ISSUED: Issued for Construction (IFC)

Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
400 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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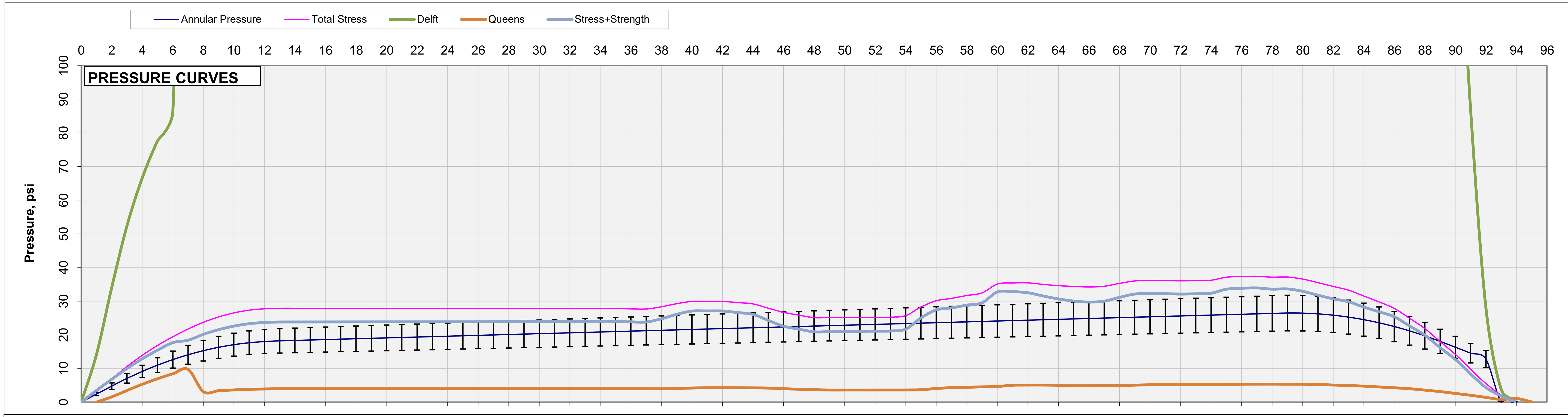
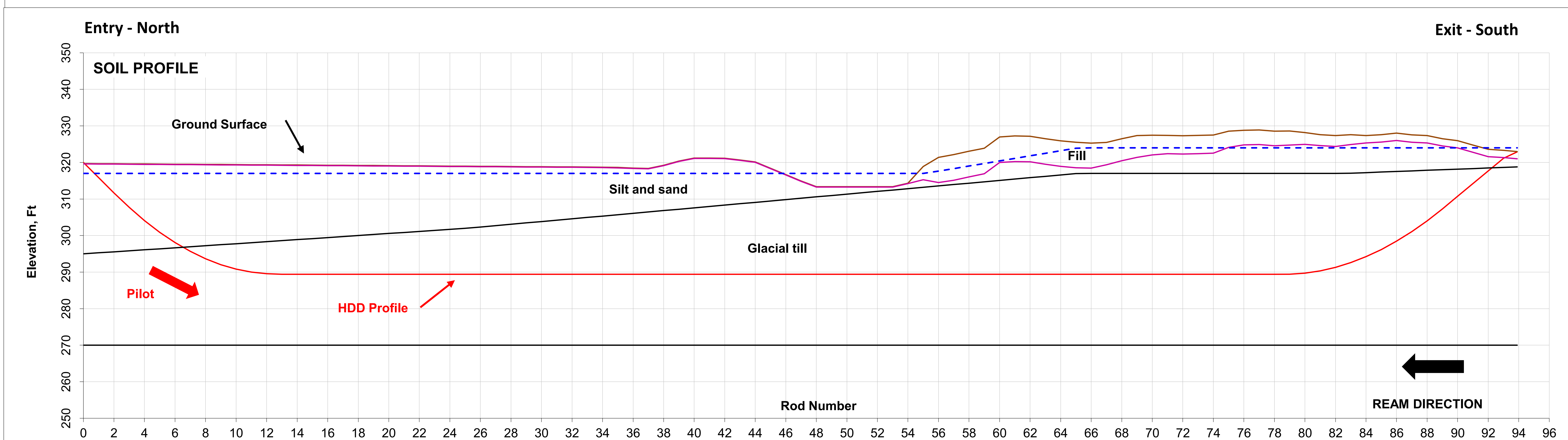
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 80 Circuit #1
CSX RR & Black Creek Crossing

Revision 1

FIGURE 1





ISSUED: Issued for Construction (IFC)

Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
100 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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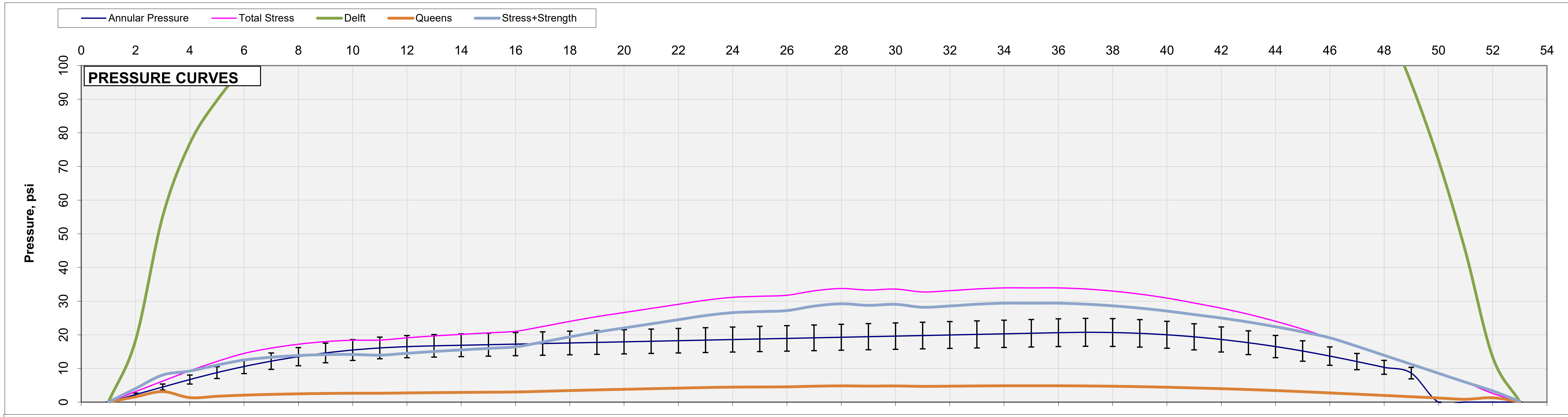
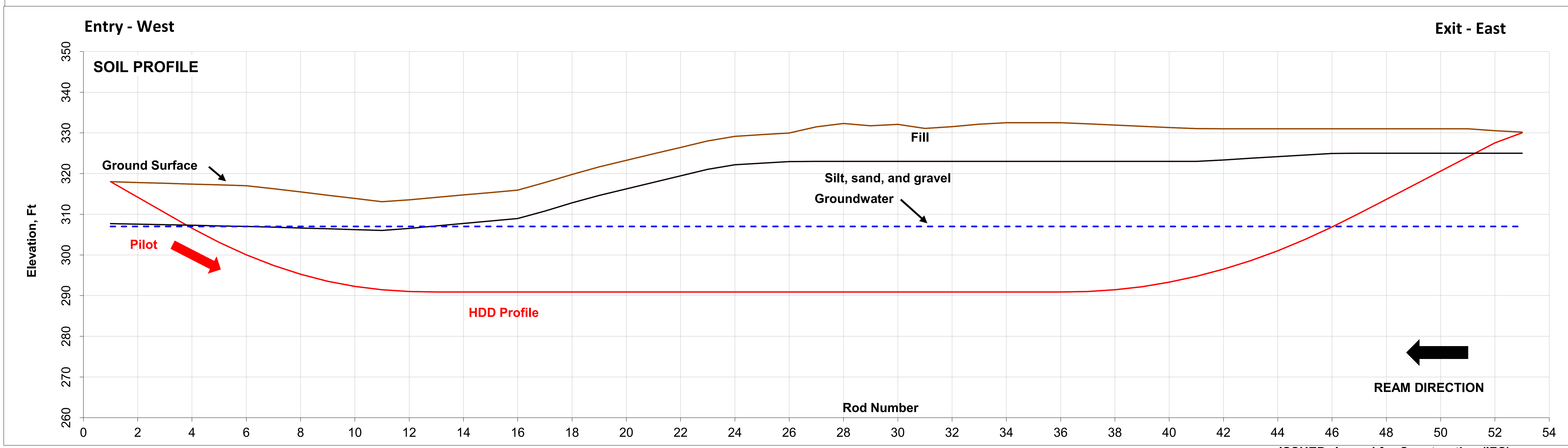
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 80 Circuit #2
CSX RR & Black Creek Crossing

Revision 1

FIGURE 1





ISSUED: Issued for Construction (IFC)

Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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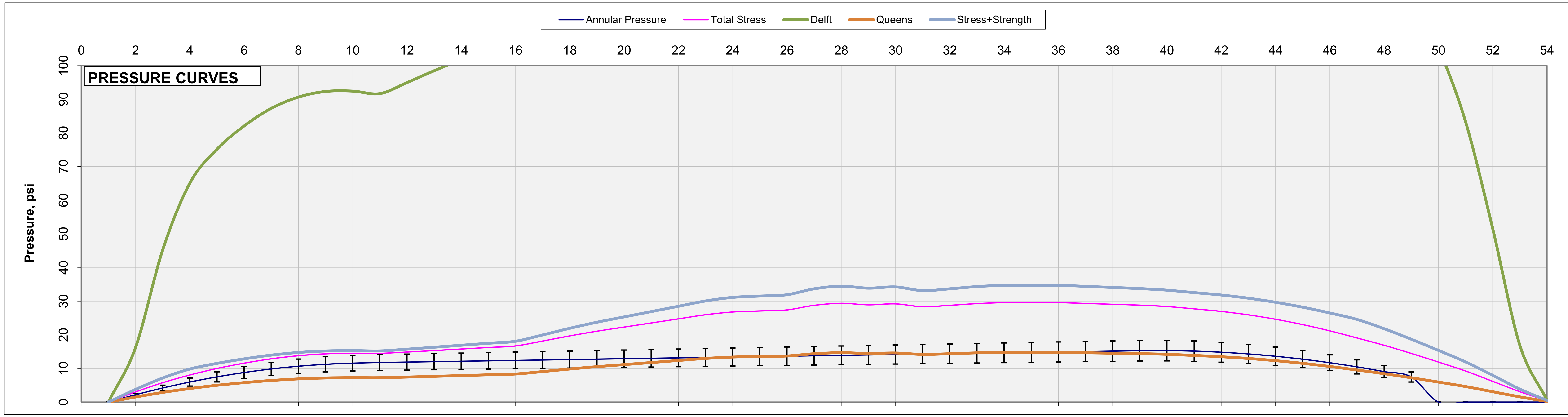
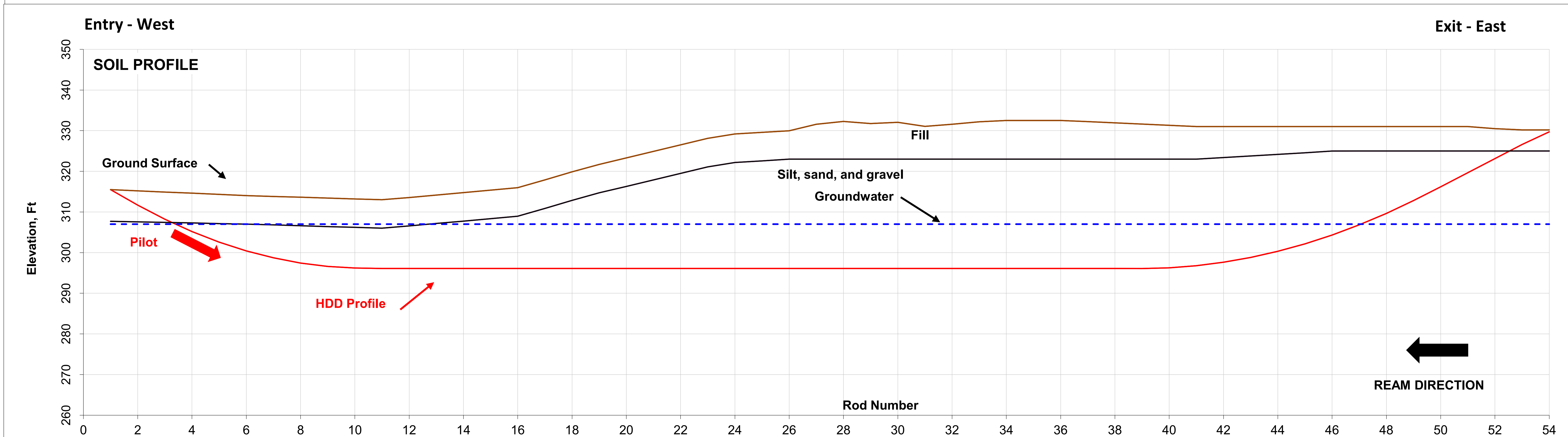
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 81 Circuit #1
S. Main St. and Grove St.

Revision 1

FIGURE 1





Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
100 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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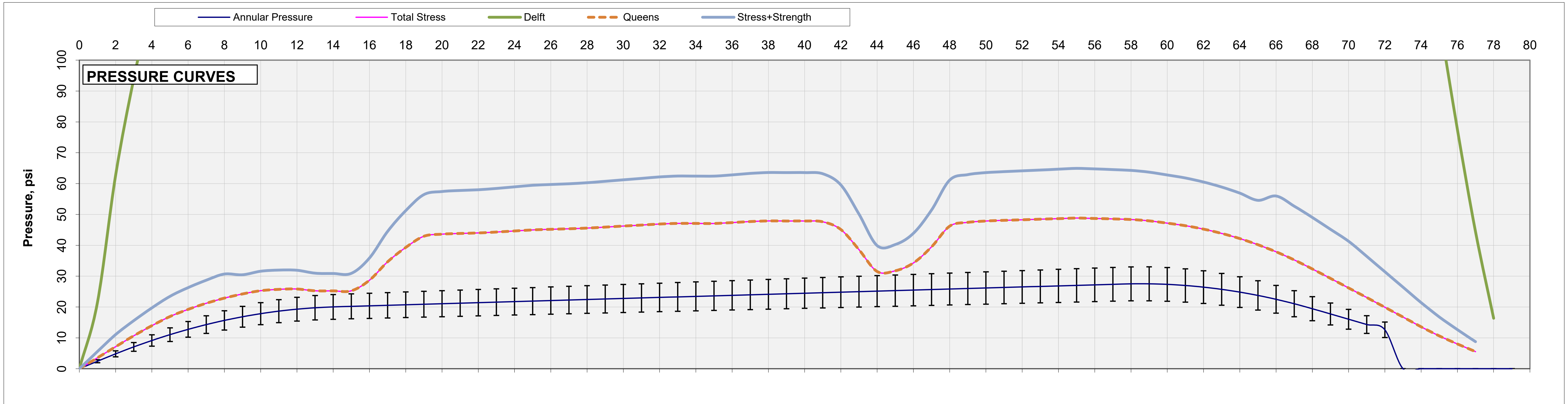
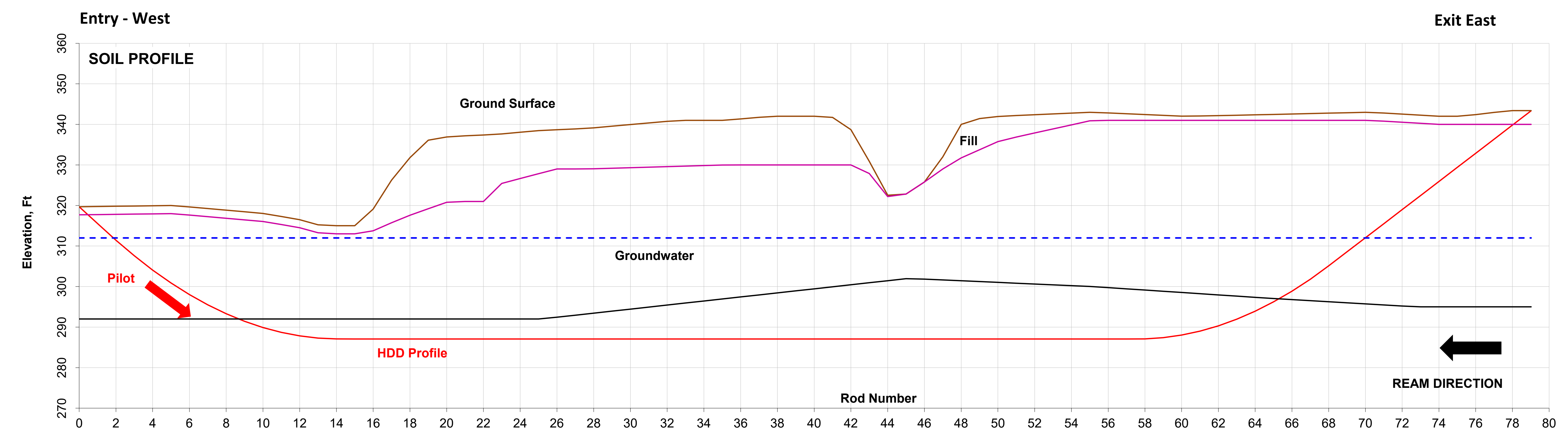
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 81 Circuit #1
S. Main St. and Grove St.

Revision I

FIGURE 1





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Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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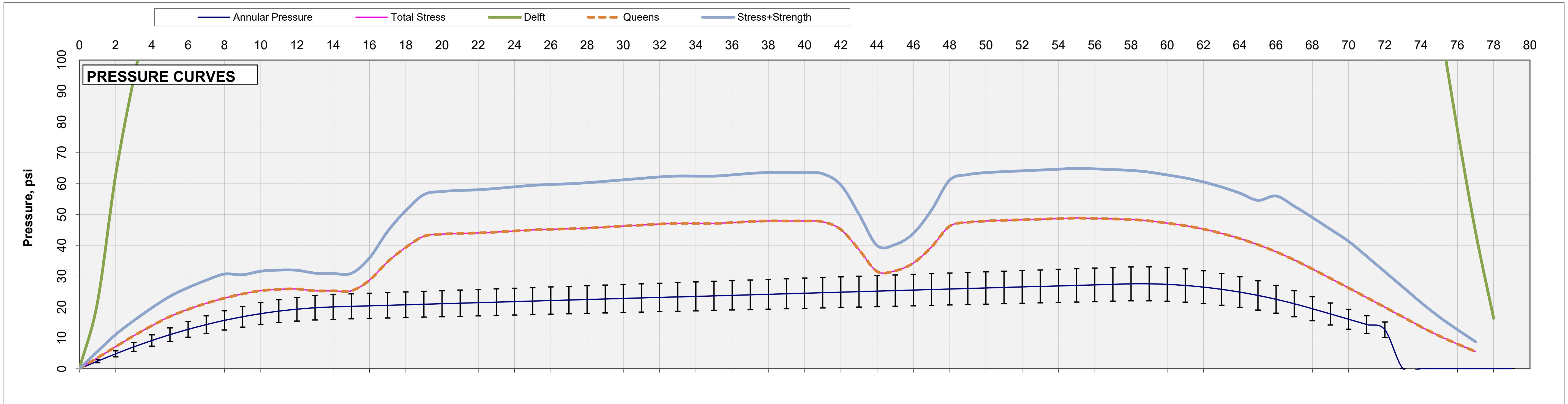
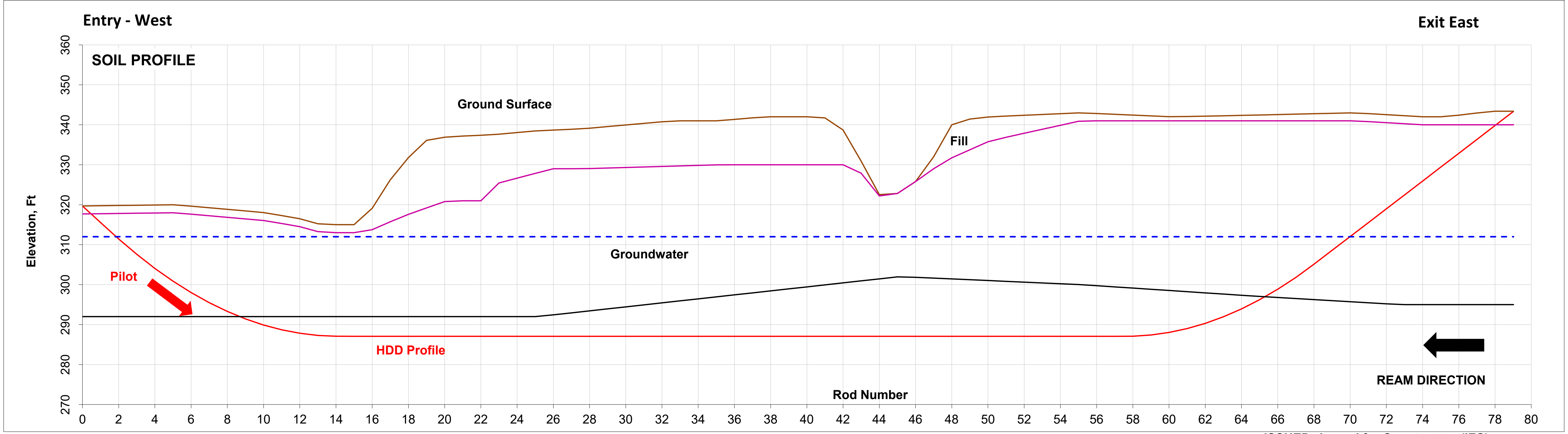
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 82-83 Conduit #1
Vly Creek/Grove Street

Revision 1

FIGURE 1





Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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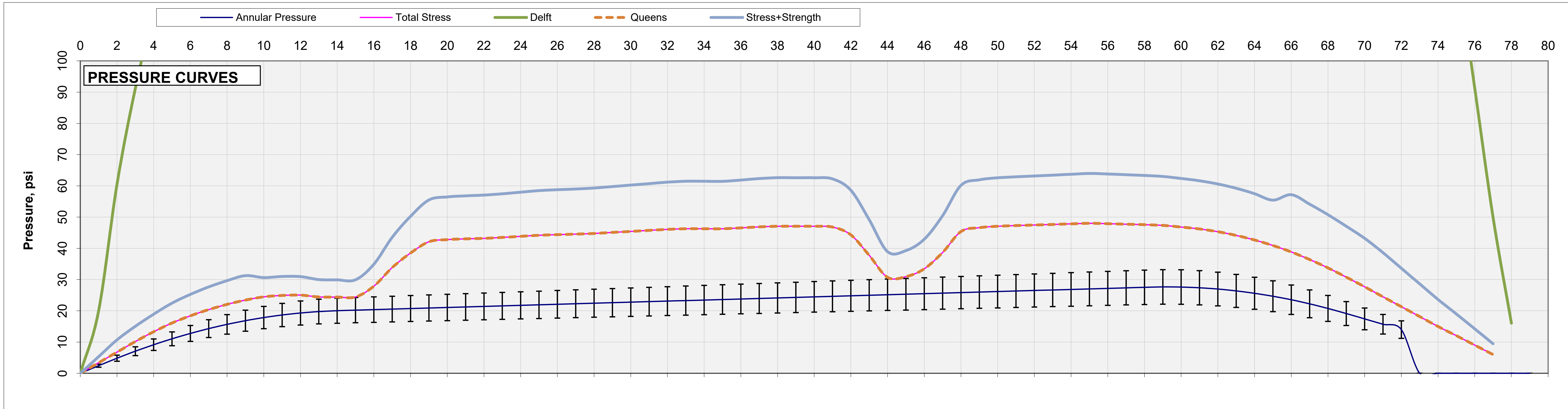
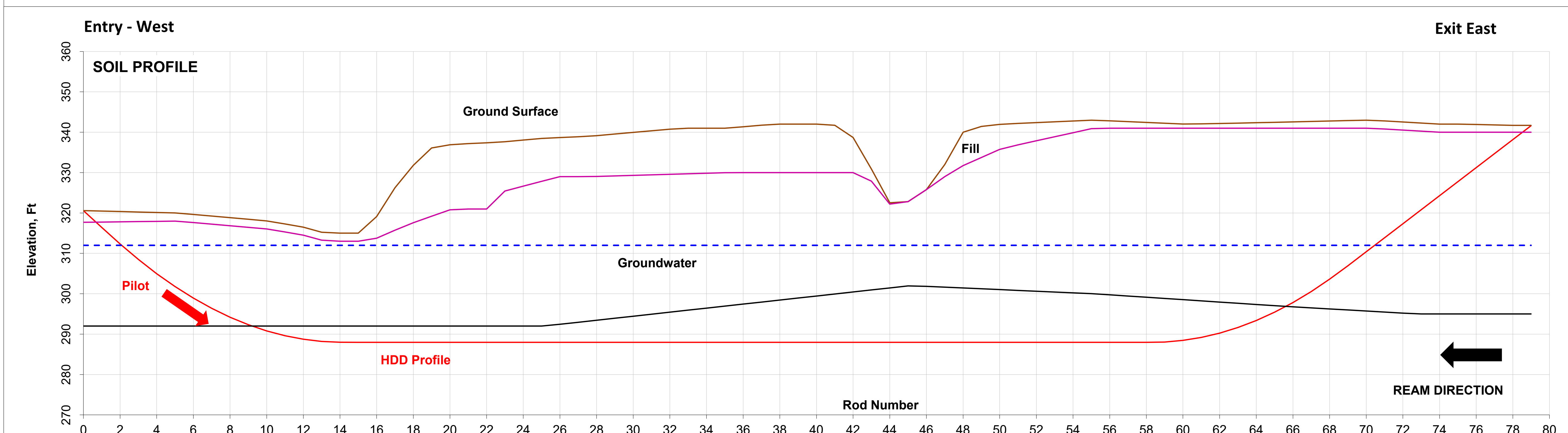
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bethlehem
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 82-83 Conduit #1
Vly Creek/Grove Street

Revision 1

FIGURE 1





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Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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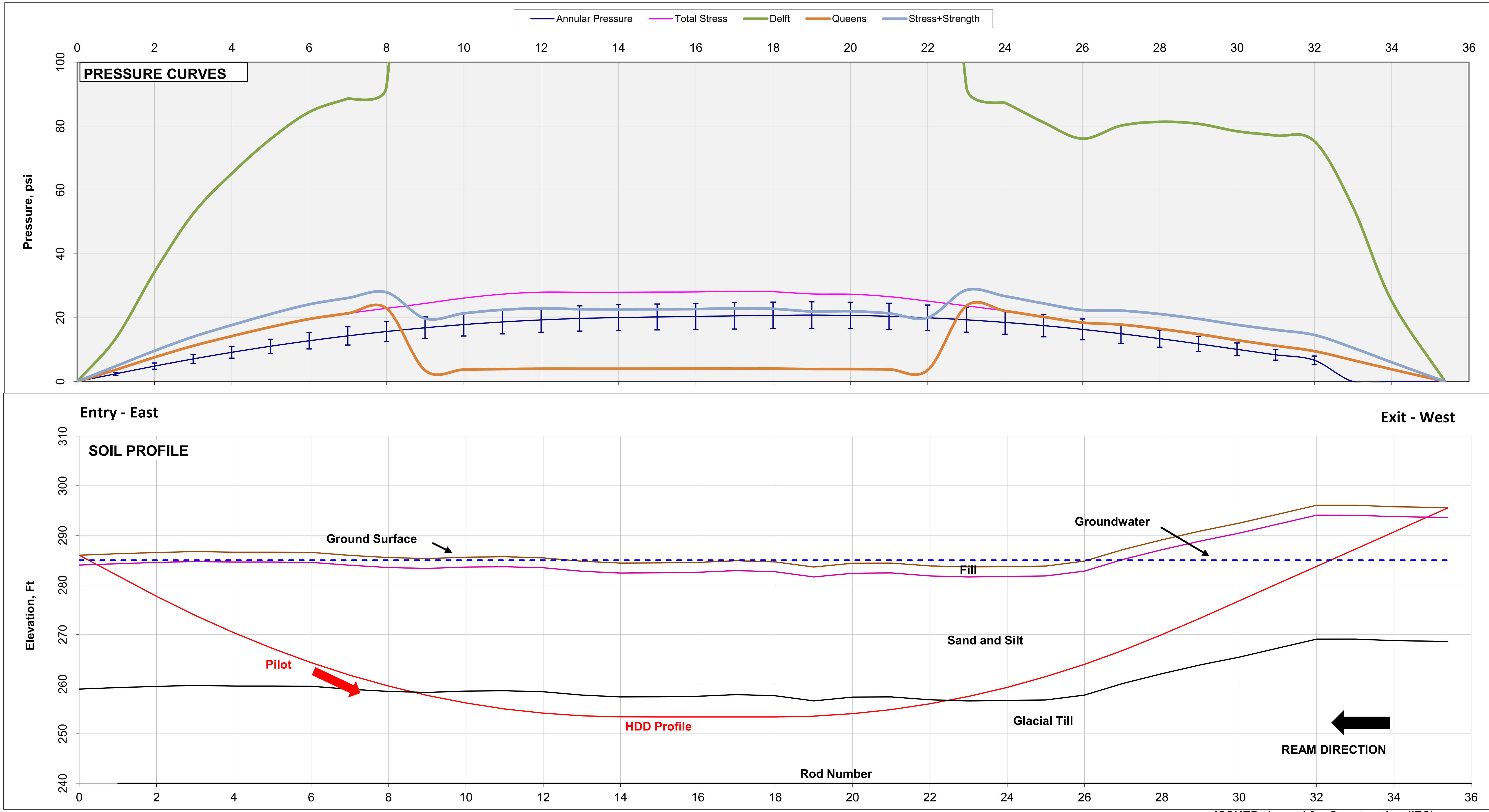
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 82-83 Conduit #2
Vly Creek/Grove Street

Revision I

FIGURE 1



ISSUED: Issued for Construction (IFC)

Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annular pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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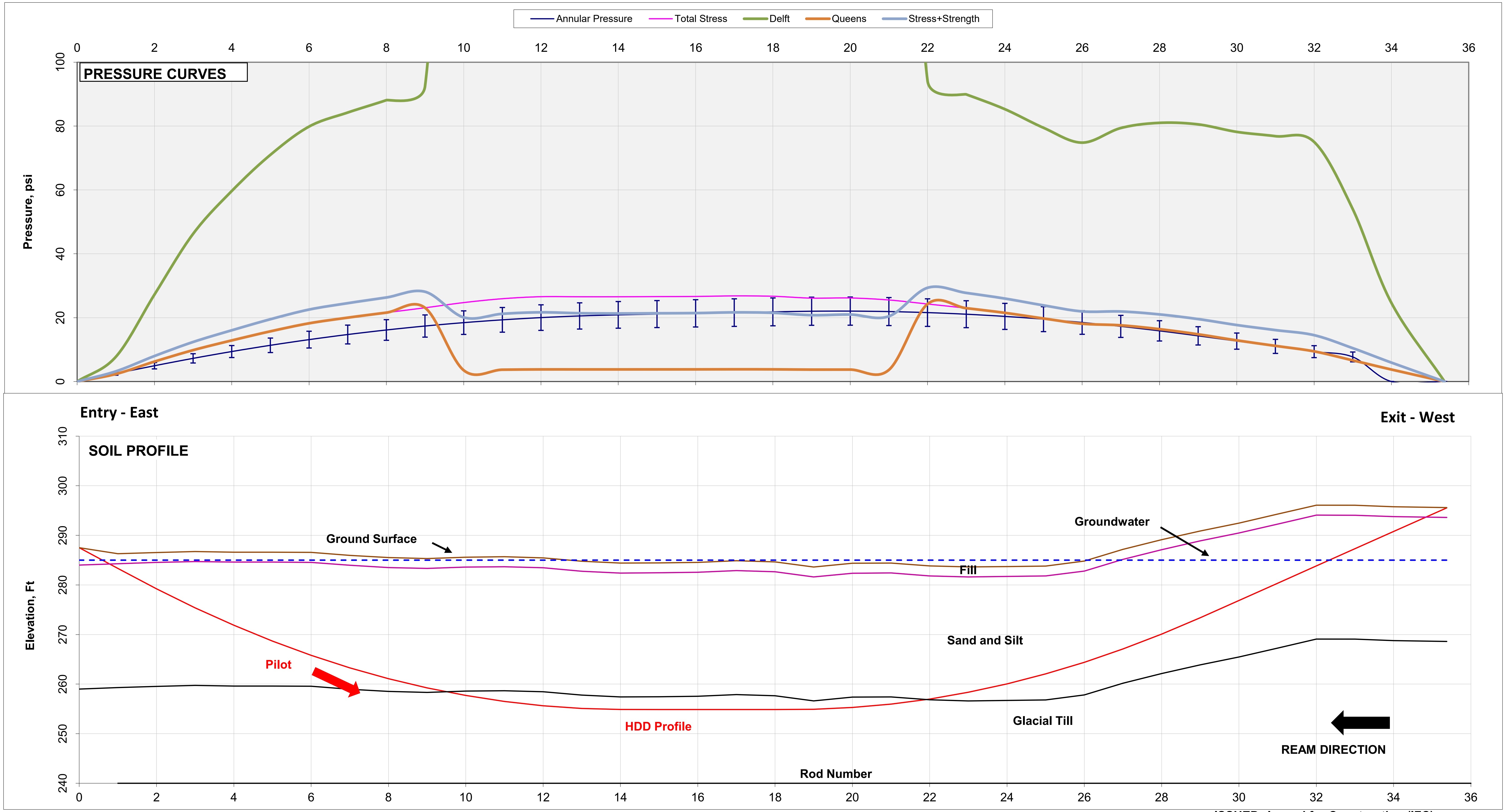
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 83A Circuit #1
Wetland FA

Revision 1

FIGURE 1



ISSUED: Issued for Construction (IFC)

Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
400 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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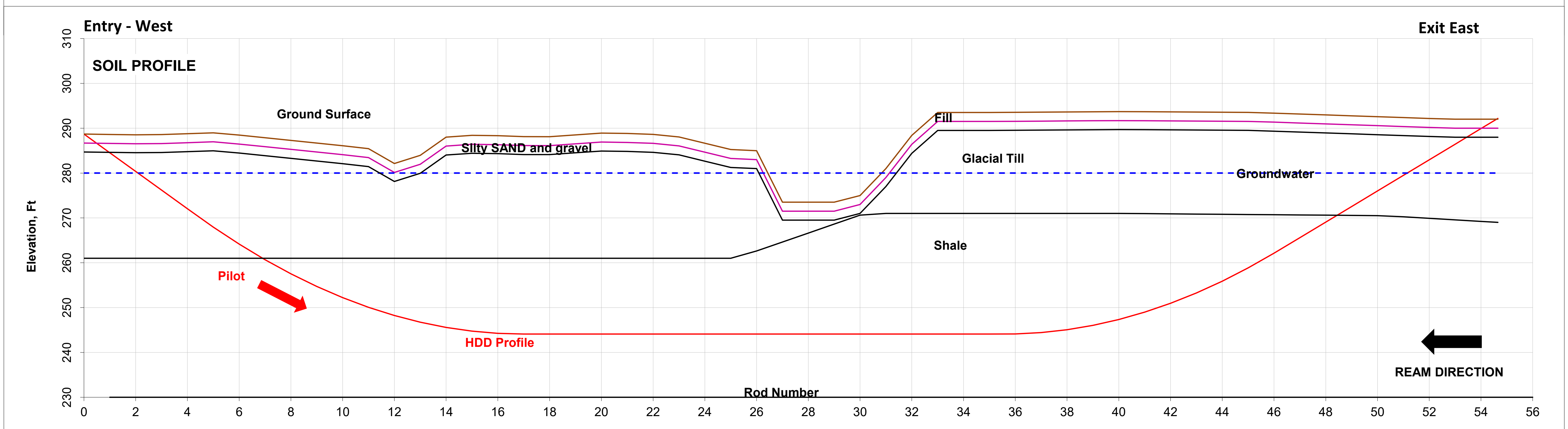
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 83A Circuit #2
Wetland FA

Revision 1

FIGURE 1



Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
400 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Bore logs

B190.0-1
K190.0
B190.1-1
KB-190.2

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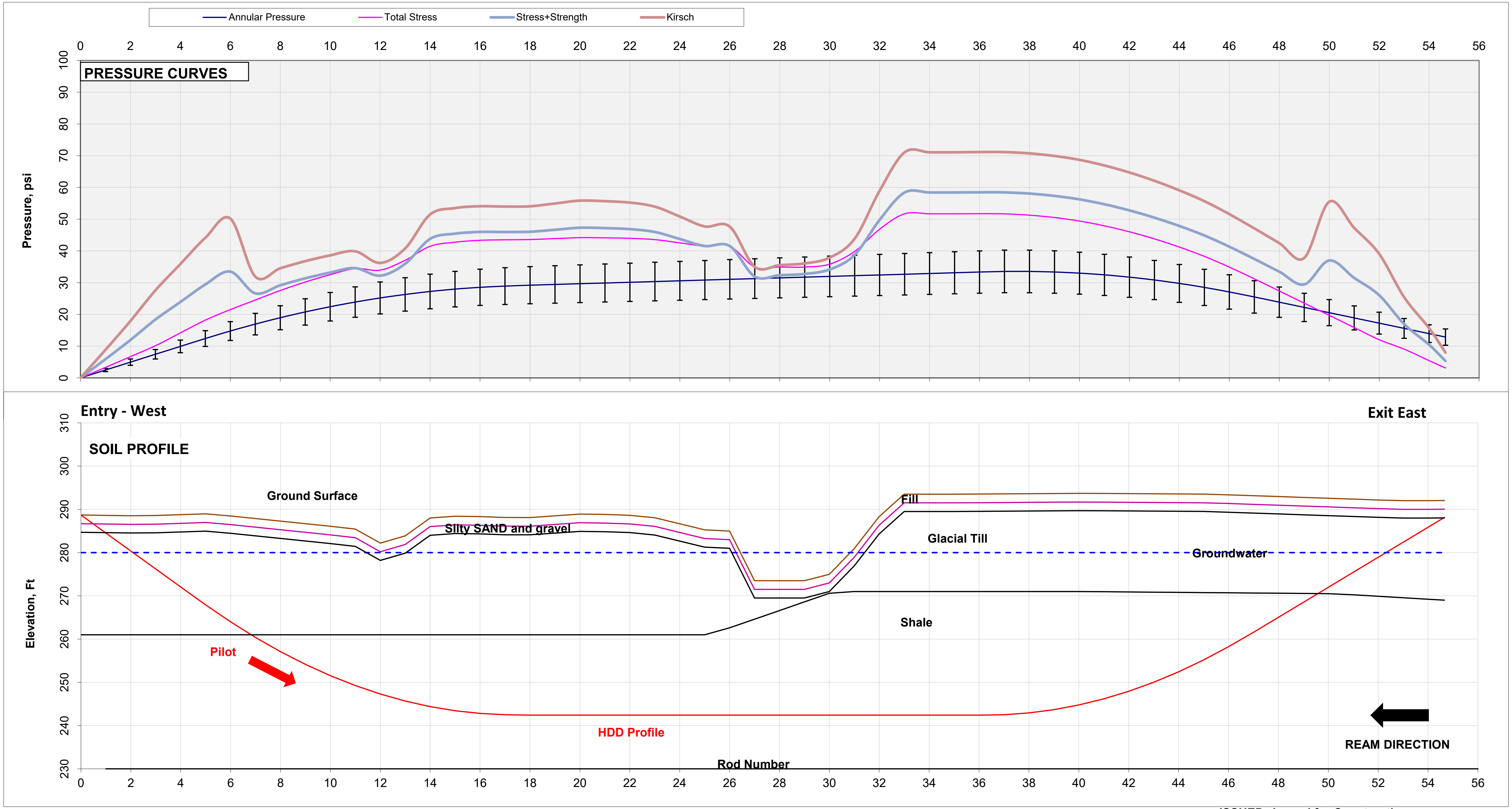
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bethlehen
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 84 Conduit #1
New Scotland Rd

Revision 1

FIGURE 1



Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
400 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Bore logs
B190.0-1
K190.0
B190.1-1
KB-190.2

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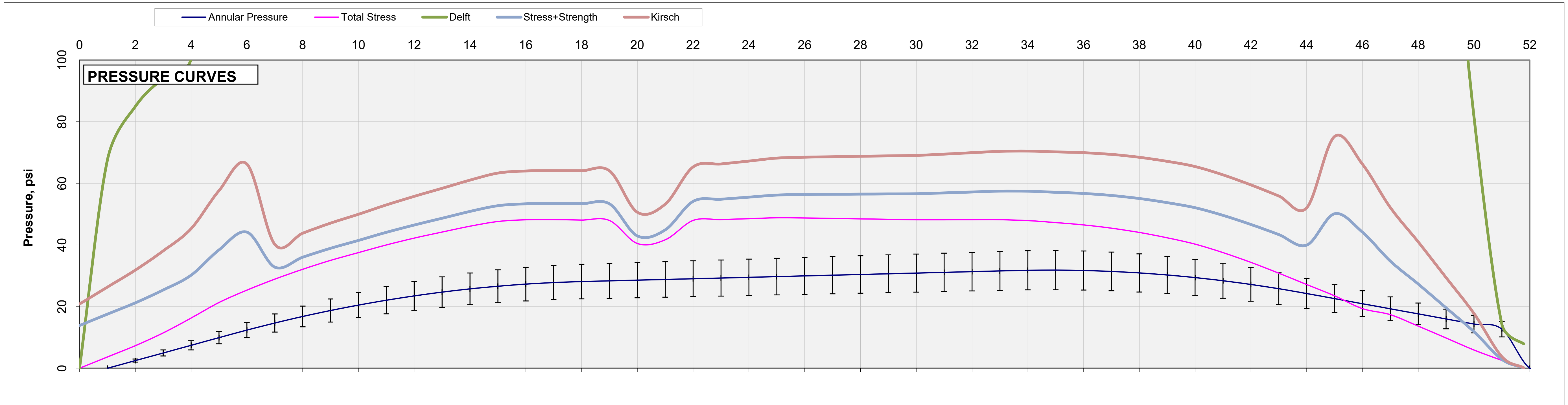
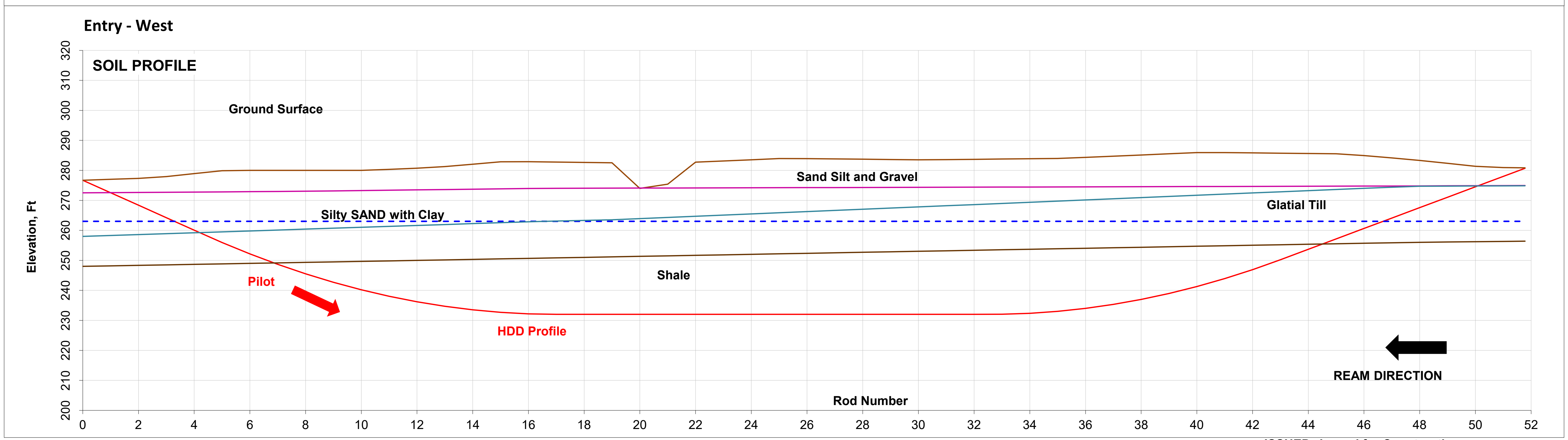
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bethlehem
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 84 Conduit #2
New Scotland Rd

Revision 1

FIGURE 1





Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

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Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
400 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Bore Logs
KB190.8
KB190.9
B190.8-1

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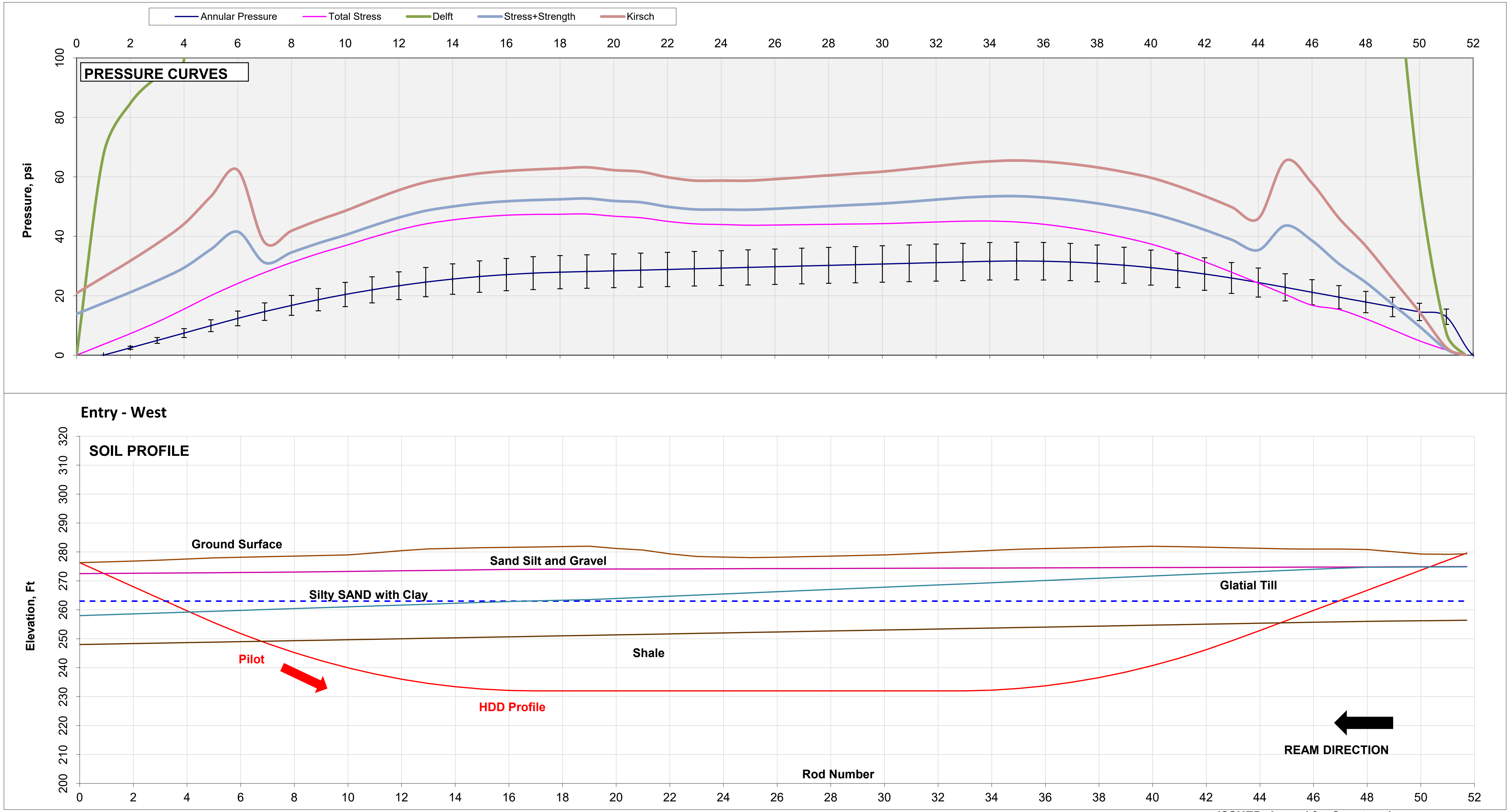
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bethlehem
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 84A Conduit #1
New Scotland South Road

Revision 1

FIGURE 1



Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

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Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
400 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Bore Logs
KB190.8
KB190.9
B190.8-1

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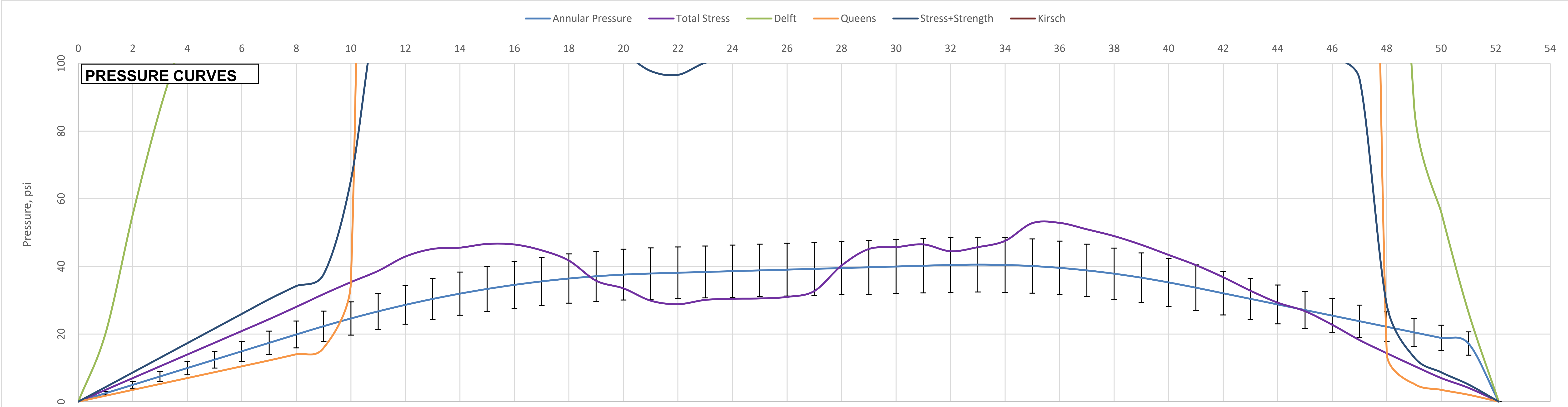
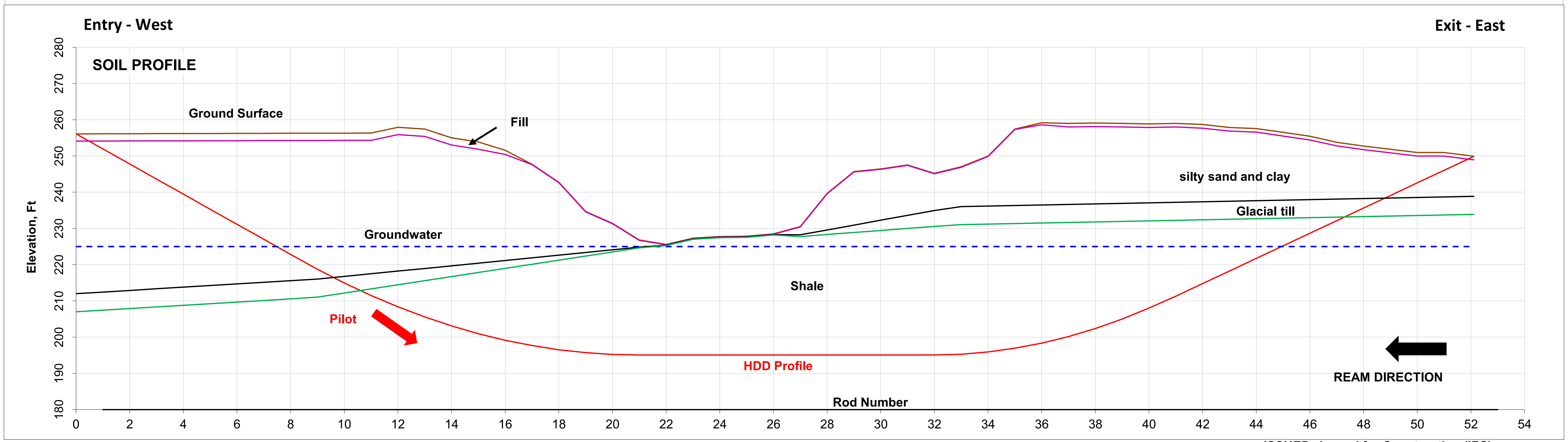
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bethlehem
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 84A Conduit #2

Revision 1

FIGURE 1





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Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
400 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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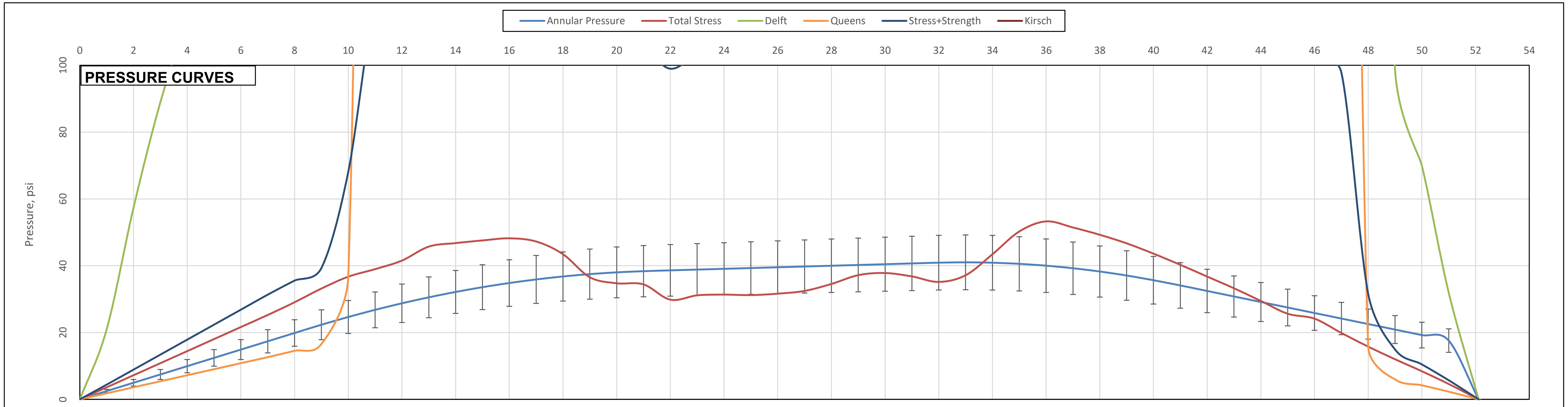
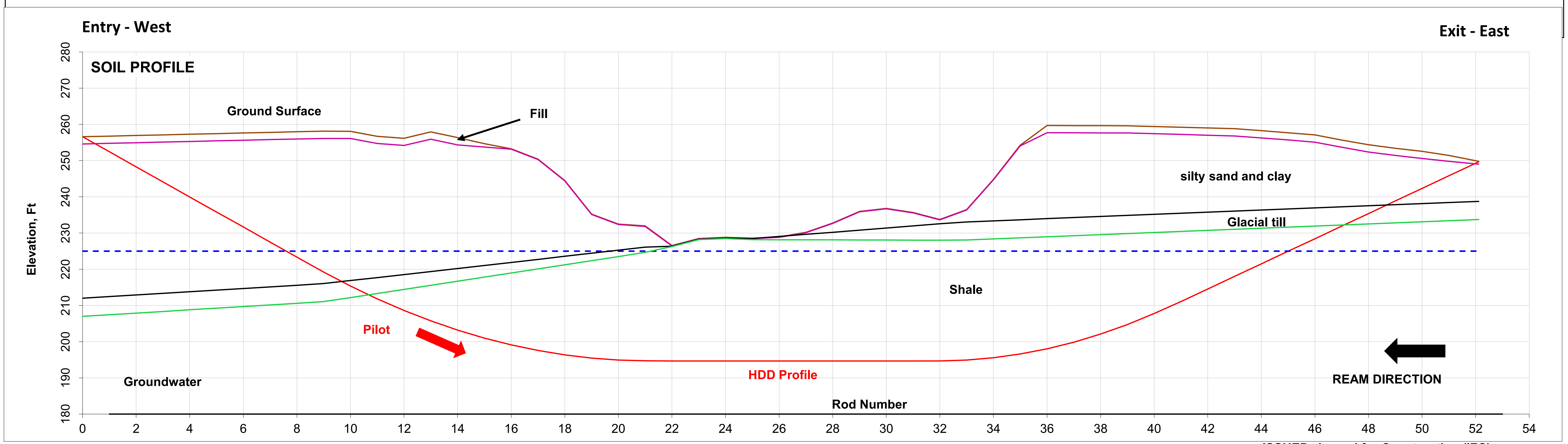
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 84B Circuit #1
Game Farm Road

Revision 1

FIGURE 1





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Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annular pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
400 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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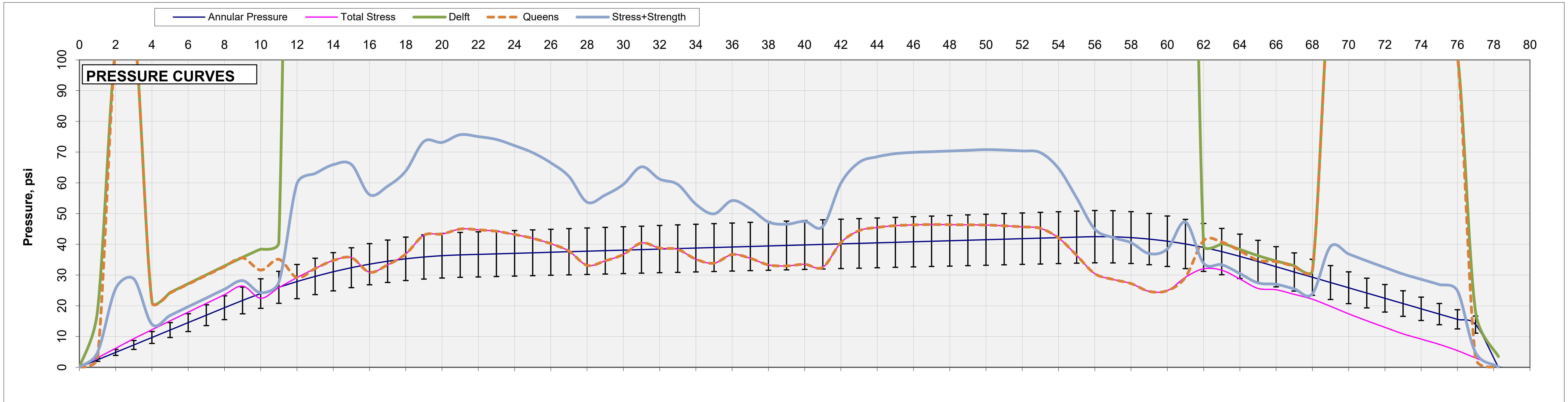
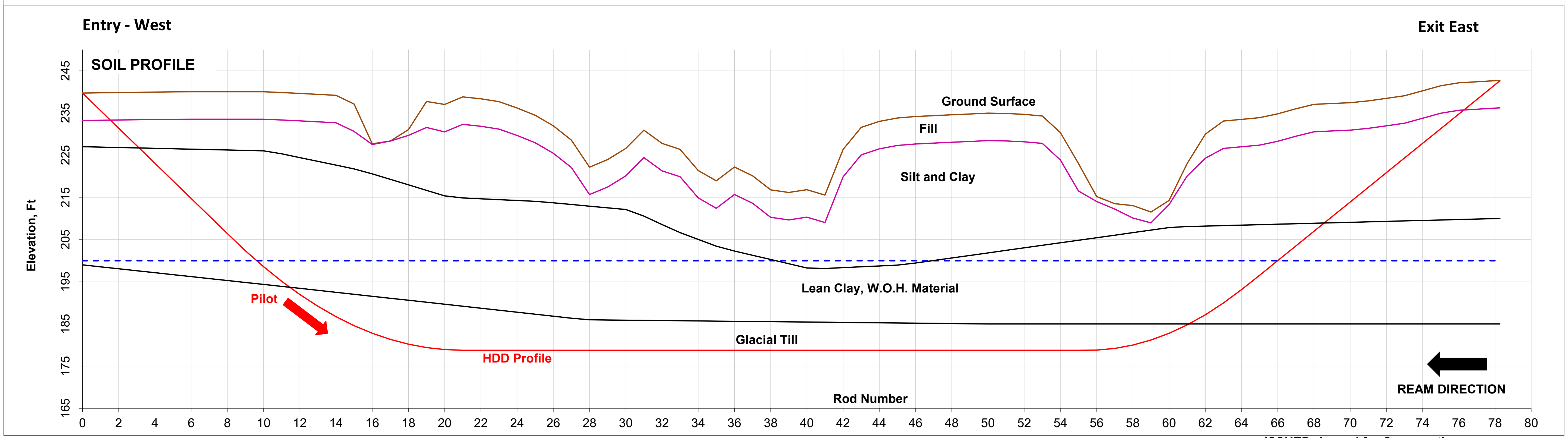
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 84B Circuit #2
Game Farm Road

Revision 1

FIGURE 1





Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

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Basis of annular pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Bore Logs

K192.3
B192.4
KB192.4-14
RS9

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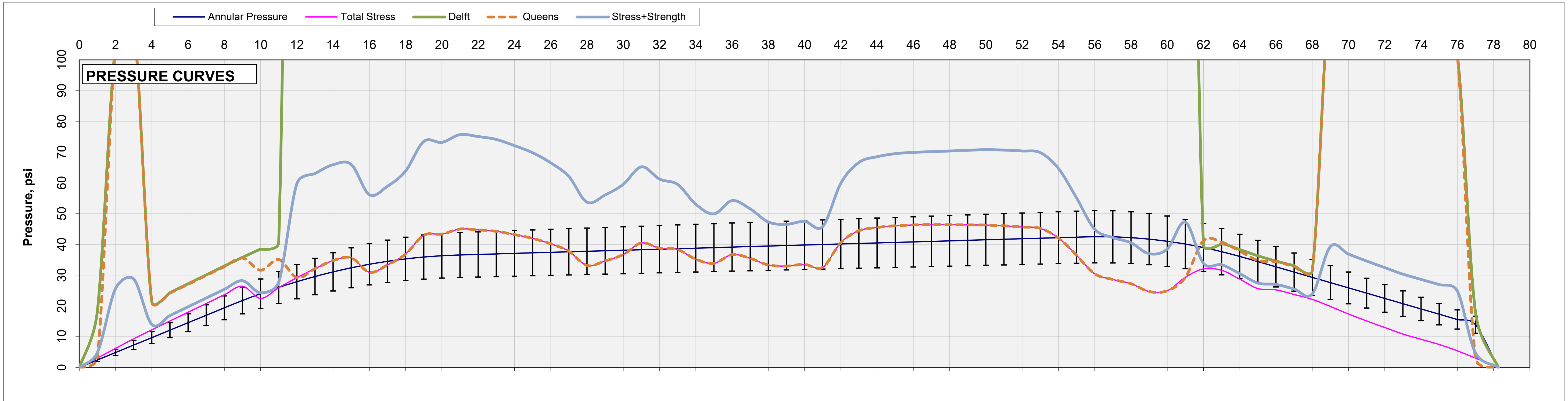
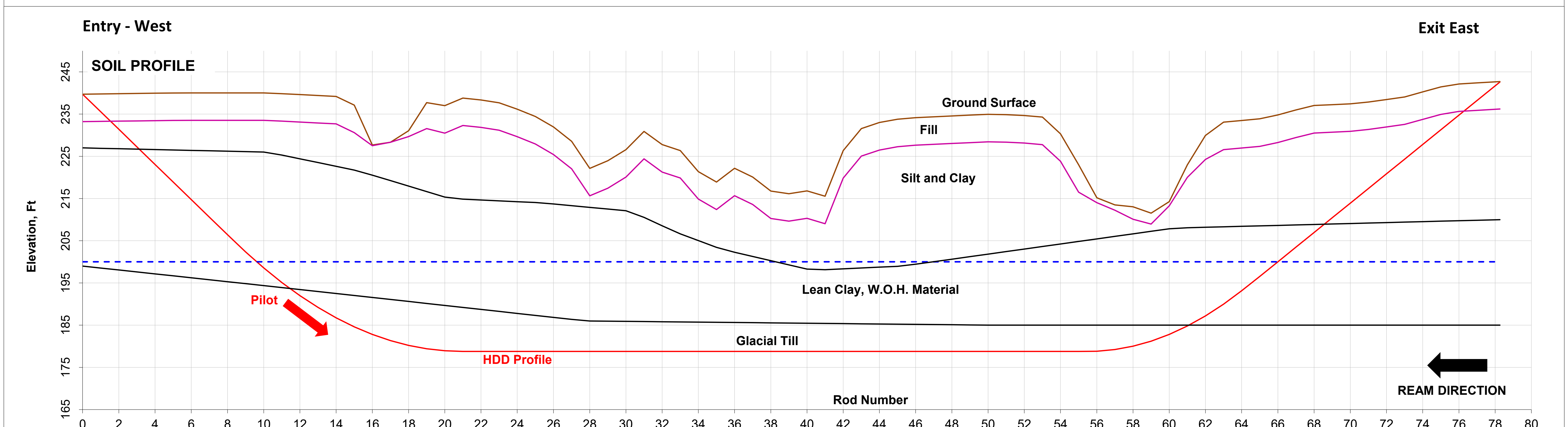
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bethlehem
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 85 Conduit #1
Delaware Turnpike

Revision 1

FIGURE 1





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Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

Bore Logs
K192.3
B192.4
KB192.4-14
RS9

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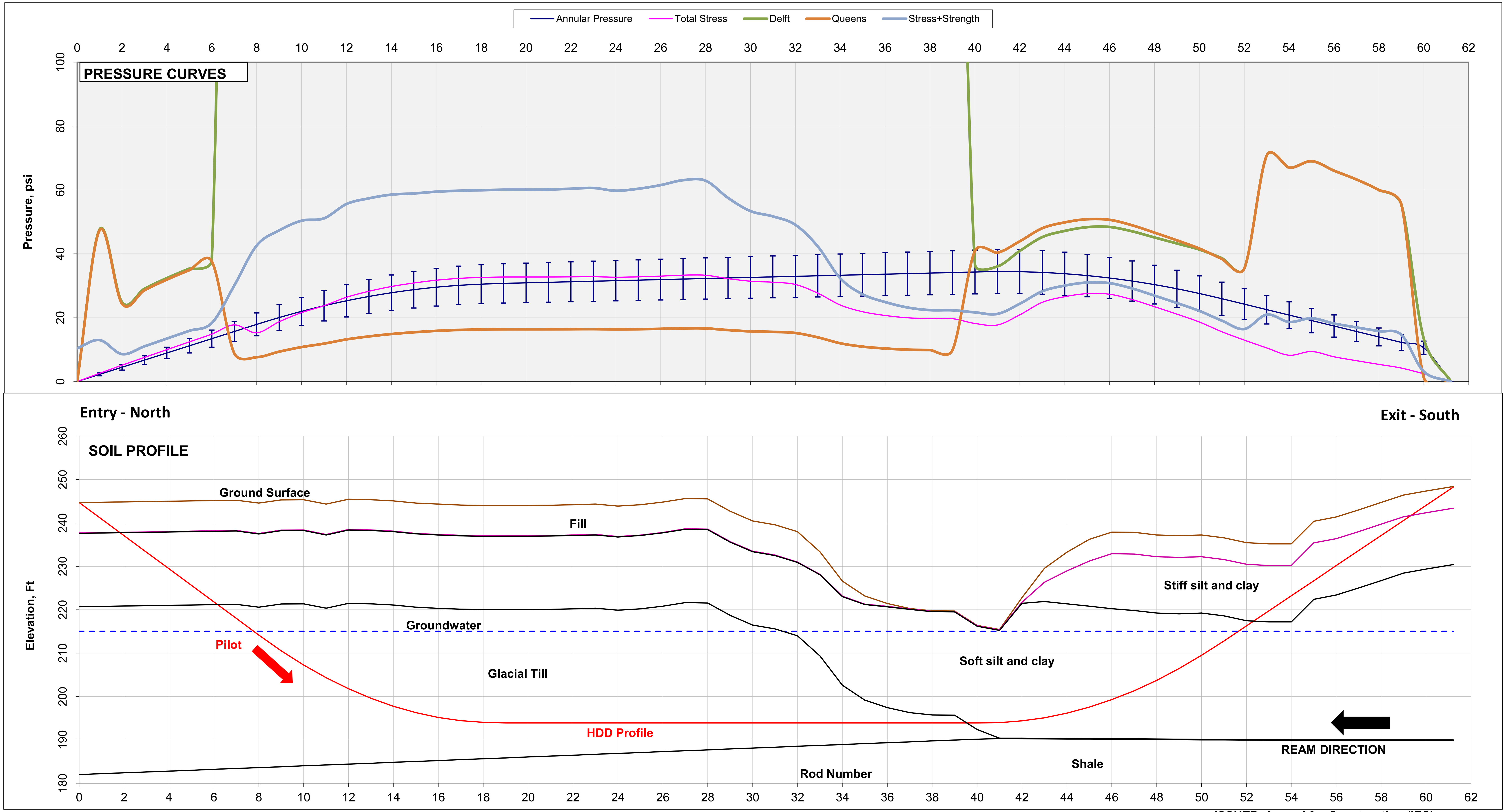
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Bethlehe
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 85 Conduit #2
Delaware Turnpike

Revision 1

FIGURE 1



ISSUED: Issued for Construction (IFC)

Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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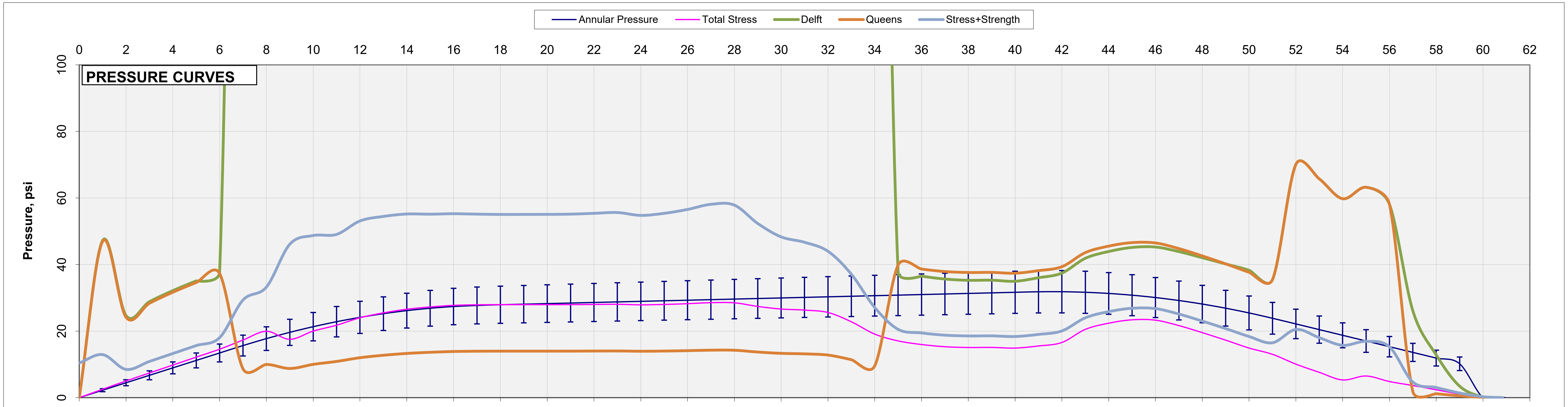
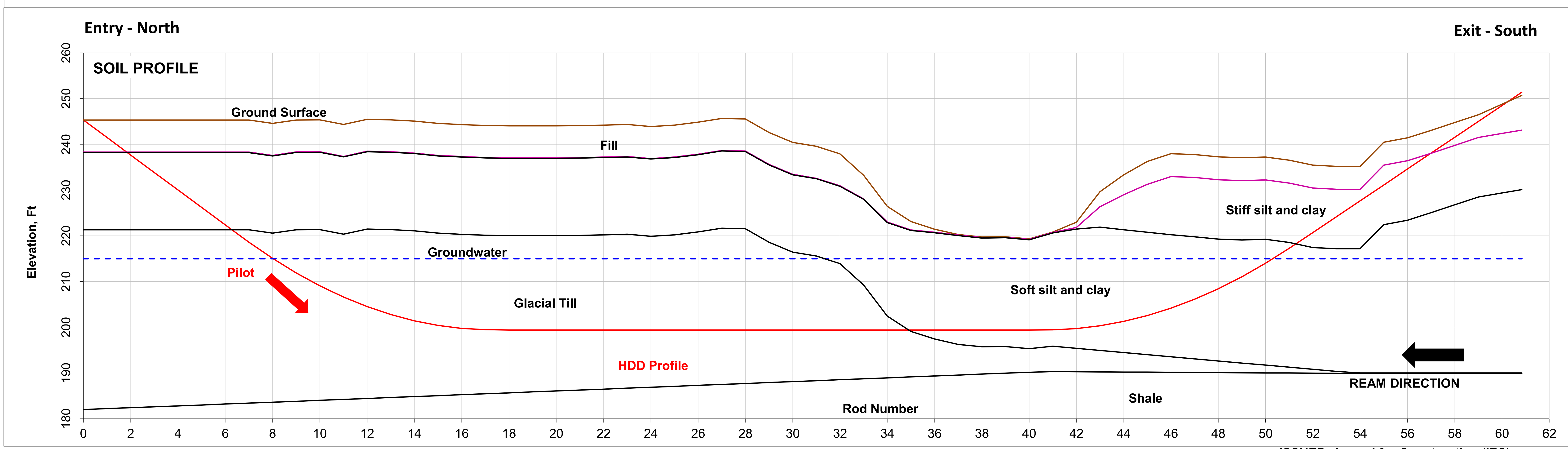
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 87 Circuit #1
CSX RR

Revision I

FIGURE 1





Notes:

1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

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Basis of annular pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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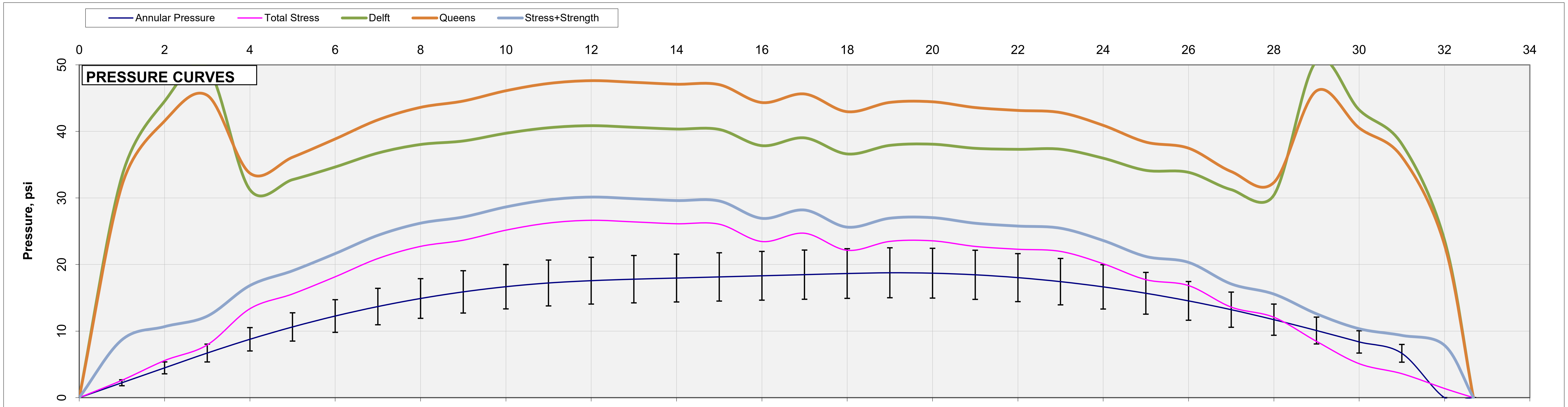
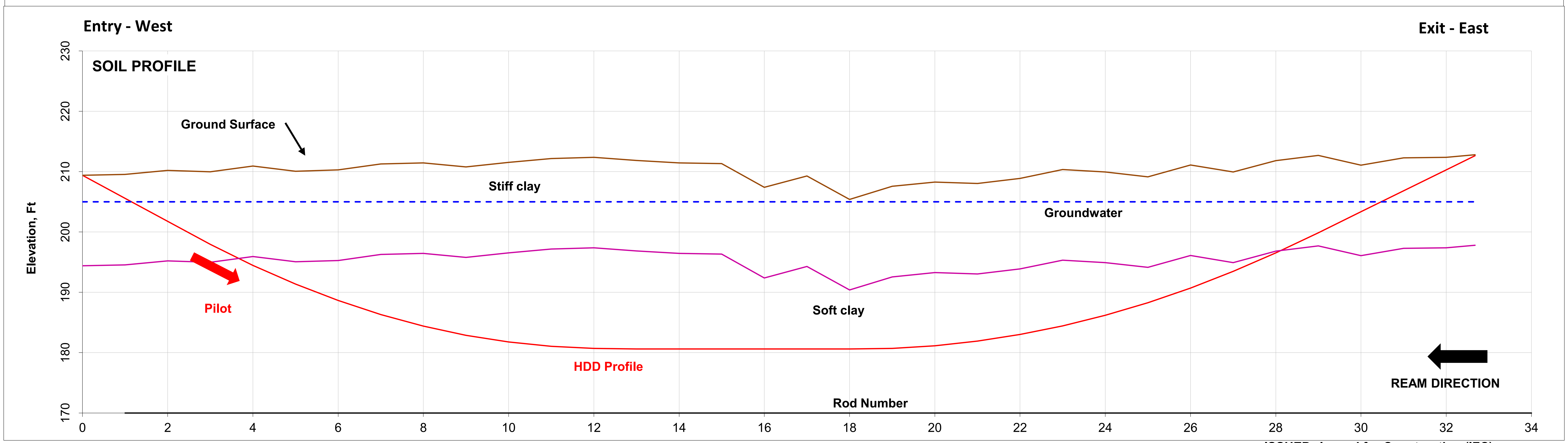
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 87 Circuit #2
CSX RR

Revision I

FIGURE 1





ISSUED: Issued for Construction (IFC)

Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annulur pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
200 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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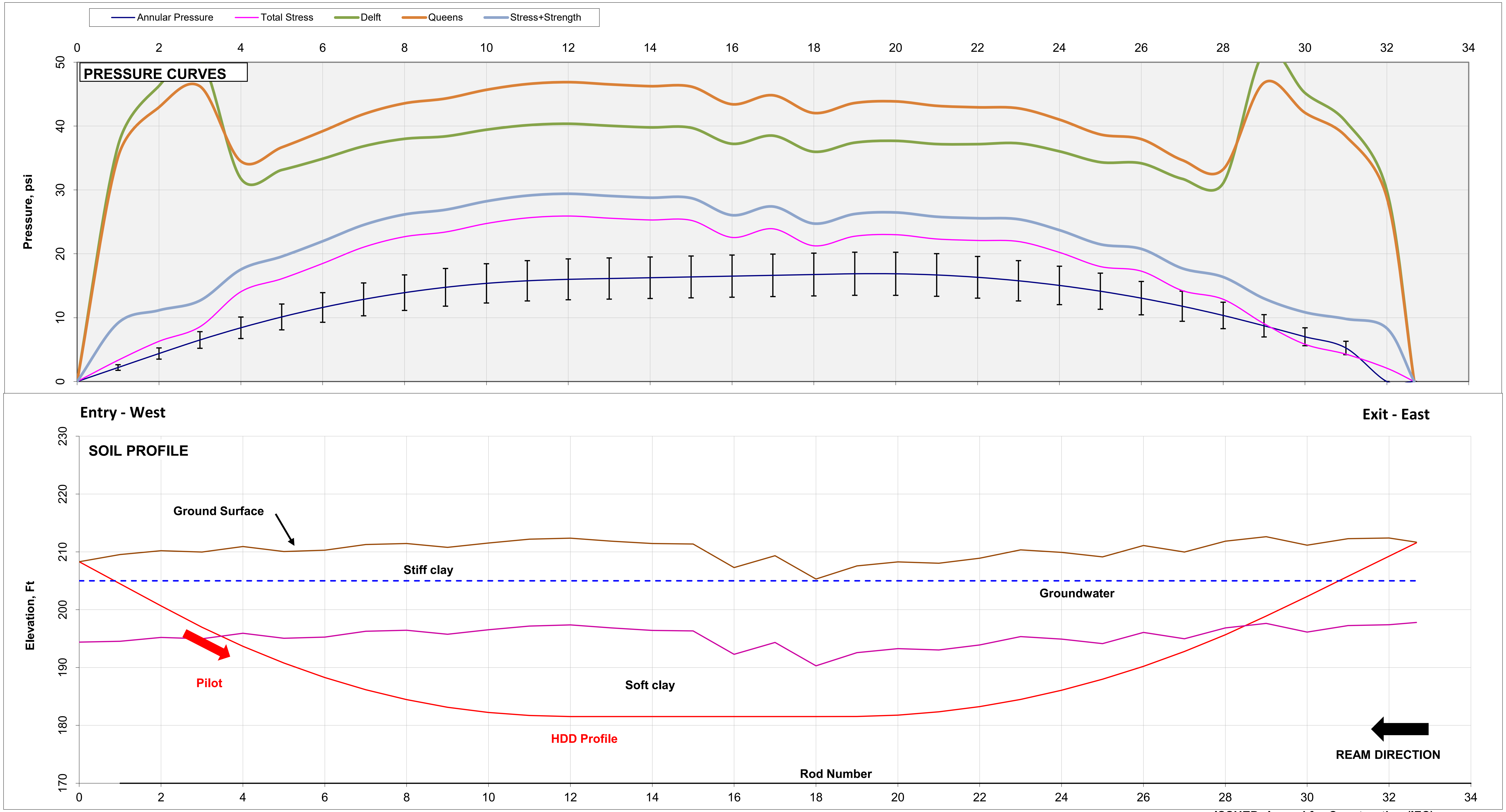
Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 87A Conduit #1
Box Culvert

Revision 1

FIGURE 1



ISSUED: Issued for Construction (IFC)

Notes:
1. Geology is interpreted from project data
2. Rod length: 20 feet
3. The error bars are at 20% and represent Drill Fluid low and high density range.
4. Ground surface data obtained from project survey data
5. Subsurface data from Geotechnical Report.

Basis of annular pressure calculations

8.16 in	Pilot Hole Diameter
78.0 pcf	Unit Weight Drill Fluid
100 gal/min	Pump Rate
3.50 in	Drill Rod Diameter
20	Ft per rod
20%	for APC curve

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Champlain Hudson Power Express
Segment 8 (Pkg. 5A) - CSX: Roterdam to Selkirk
Schenectady County, NY

ANNULAR PRESSURE AND FORMATION PRESSURE CURVES
HDD 87A Conduit #2
Box Culvert

Revision 1

FIGURE 1