HDD Training

Mitigation

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Mitigating HDD Risks

A sinkhole that formed along an HDD alignment as a result of hole instability through a dry hole section in granular soils.

HDD construction risks need to be evaluated during the design process to reduce the risk of schedule delays, damage to existing facilities and structures, impacts to sensitive areas and potential contractor claims. In order to evaluate and plan for construction risks, a comprehensive civil survey and subsurface exploration program need to be completed along with an engineer site visit.

The civil survey needs to identify any structures or buried utilities that may conflict with the planned HDD alignment or profile. The subsurface explorations need to adequately characterize the materials that will need to be drilled through.

The most common HDD construction risks include hole instability/collapse, gravelly soils, dry hole conditions, groundwater influx, inadvertent returns/frac outs, poor cuttings removal, stuck tooling or pipe.

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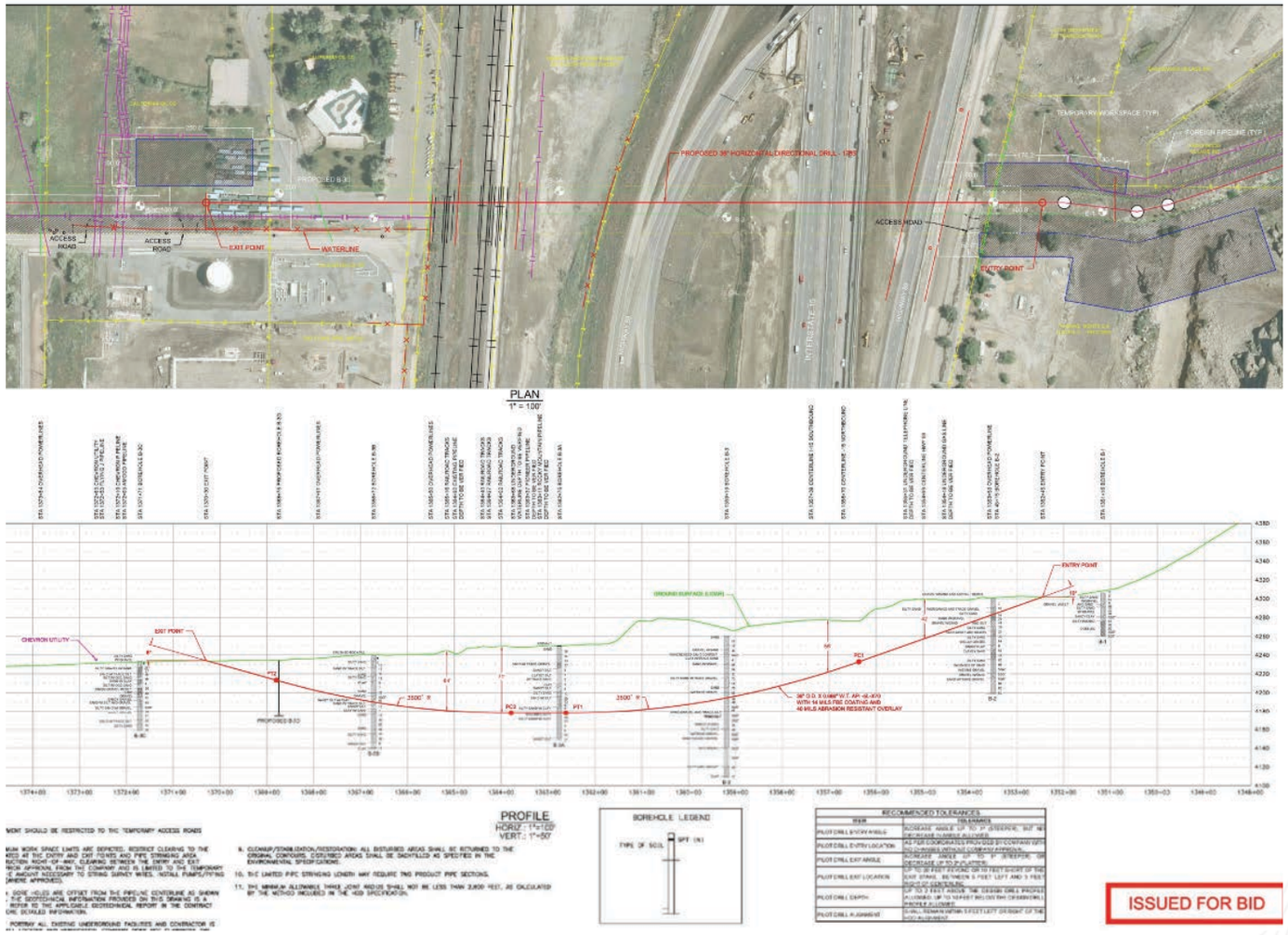
HDD Mitigation – Dry Hole

Dry hole conditions are formed as a result of elevation difference between the entry and exit points. During the design process it's best to try and avoid elevation differential between entry and exit if possible because hole instabilities and groundwater influx are much more common in these zones. The magnitude of the risk will depending on the subsurface soil/rock conditions and groundwater levels. In rock installations, hole stability is not as great a concern as for soil installations, but ground water influx into the hole can be problematic both during and after construction.

When it's not possible to eliminate elevation differential through design geometry, mitigation measures can be implemented during construction to aid in the successful installation of the pull section.



This design includes an elevation differential of about 75 feet. The resulting dry hole section is located within gravelly granular soils. The entry tangent was designed down to the fluid equilibrium point so that large diameter casing could be installed through the dry hole section.

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HDD Mitigation– Large Diameter Casing

Large diameter casing can be installed through the entry and/or exit tangents of the profile to support the hole where unstable soil conditions are anticipated or to help reduce the risk of hydraulic fracture and inadvertent drilling fluid returns. Hole instabilities may occur as a result of dry hole, gravelly soils, or groundwater influx. Large diameter casing needs to be sized to allow the hole to be reamed to its final diameter without removal which results in casing approximately 18 inches larger in diameter than the pull section. The casing can be hammered in with a pneumatic hammer and then cleaned out with a reaming tool or auger attached to the drill rig. Alternatively, the portion of the hole to be cased can be reamed out enough to accommodate the casing and then the casing can be inserted into the reamed hole.

When advancing the pilot hole through large diameter casing, a small diameter centralizer casing needs to be installed into the large diameter casing to centralize the pilot hole relative to the large casing. Depending on the situation, the large diameter casing can be removed either before or after the installation of the product pipe pull section.

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HDD Mitigation – Gravel Shield

HDD installations in gravelly soils are prone to hole collapse and the build up of gravel and larger sized particles in the hole. The drilling fluid cannot support the large gravel in the walls of the hole nor can the drilling fluid transport gravel and larger sized particles out of the hole. These complications can cause high pull forces during pullback, pipe damage and possibly stuck pipe during pullback operations.

Ideally you want to avoid designing HDD profiles in gravelly soils but in some instances this is not possible. In addition gravelly zones may be encountered at locations and depths not indicated in the borings.

One method to help prevent the pull section from getting stuck during pullback is to use a gravel shield on the pullback assembly. The gravel shield is installed on the back of the reaming tool in the pullback assembly and covers the swivel and pullhead. The gravel shield prevents gravel from getting lodged between the reamer and pullhead which reduces the risk of the pull section getting stuck in the hole.

A gravel shield welded to the pullback assembly to cover the swivel and pullhead.

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HDD Mitigation - Excavation

Where hole stability is a concern at shallow depths near the entry and exit points, the unstable overburden soils can be excavated down to the drill profile. This eliminates problems related to hole collapse either as a result of dry hole conditions or gravelly soils. In most instances, if excavations over 20 feet will be required, the installation of casing may be a better option than excavation.

The upper photo on the left is from a project in Wisconsin where the upper 20 feet of the soil profile on the exit side of the crossing consisted of gravelly sand. In an effort to eliminate concerns regarding hole instability The HDD alignment was excavated down to the drill profile and shoring boxes were used to keep the excavation open since the width of the workspace did not allow for sloped excavations. The bottom photo shows a project in new jersey where the shallow overburden consisted of a mixture of soil and boulders. Here the entry tangent of the HDD profile was excavated down to solid rock to alleviated the need to ream the hole through large boulders.

If during the design process it is determined that excavation down to the HDD profile might be necessary to prevent hole collapse or to avoid drilling or reaming through difficult soils, enough workspace should be provided in front of the entry and exit points to excavate the soils to a suitable depth.

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HDD Mitigation – Grouting

Different forms of grouting can be used to stabilize loose soil formations or highly fractured rock formations, fill subsurface voids and can also be used to cut off groundwater flow.

Grouting can be expensive to implement and the results can vary widely based on the experience and skill of the grouting contractor. If grouting is contemplated at any point during an HDD project a grouting contractor should be consulted as soon as possible so that a plan can be put in place and be implemented when needed.

Grouting can be achieved by drilling injection holes down from the surface. This is often used to stabilize formations and fill subsurface voids. To cut off groundwater flow from the hole, either drilling down from the surface or through the drilled or reamed hole.

Drilling holes above the HDD alignment in preparation for post-installation grouting. The objective here was to grout the annulus after installation of the pipe to cut off ground water flow.

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