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ENVIRONMENTAL CONSIDERATIONS WITH LARGE DIAMETER DIRECTIONAL DRILLING

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ABSTRACT: This paper looks at the major environmental considerations required for large diameter directional drilling. Analyzing the development of environmental regulations relating to the HDD industry in Ontario and the team centric approach to developing responsible HDD environmental practices.

Increasingly, HDD contractors are being asked to partner with designers and environmental agencies to provide solutions to infrastructure installations within environmentally sensitive areas. Many contractors have approached the prospect of working with these groups with a measure of hostility often borne from misunderstanding of the benefits of positive collaboration. The responsible contractor finds that the relationships that are built can lead to tremendous opportunities and further entrenchment of HDD as the construction solution of choice in environmental installations.

Through attention to detail, open and frank communication, education (both of the HDD contractor as relates to environmental concerns and the Environmental agencies as relates to HDD construction) and perseverance - reasonable, responsible and applicable guidelines have been established to ensure that HDD projects complete with minimal disruption to sensitive environmental projects.

This paper will illustrate the tremendous success that can be achieved in environmentally sensitive works, providing examples from projects where mitigation measures have been effectively applied and how those successes have been rolled into guidelines that all stakeholders can abide.

1. INTRODUCTION

With the proliferation of Federal and Provincial regulations concerning the environment. More attention has been focused on the means and methods of construction. In Ontario several Acts have enlisted Environmental Agencies (EA's) to serve as the stewards of the environment a task to which the agencies have addressed very well.

In certain regions of Ontario, fewer land resources are available for construction within the immediate urban areas. Developers find that 'greenfield' (outside urban area) projects are falling more within the purview of EA's as Legislation and Environmental Acts further define that role. These challenges have lead to a conflicting convergence of natural land interests. With increased attention to natural habitats and the preservation of those habitats, developers are fast learning that addressing the concerns and proactively implementing environmentally conscious solutions ensures that projects progress without delay.

In the past decade, trenchless works have seen an increased application to typical environmental crossings. These typical crossings can be characterized by the more obvious appellations, river or large stream water bodies. Where once open cut solutions proliferated the design room, trenchless methods have dominated of late. With the potential for trenchless applications to leave a smaller footprint, be less invasive to the watercourses and perceptually more appealing these solutions have become that staple design solution for aquatic crossings.

With the pervasive use of trenchless methods in water crossings, the Ontario industry has seen more and more attention from the EA's. Where once the simple go forward solution was to 'drill' a crossing, more focus, of late, has been placed on the details of drilling in particular on drilling fluids.

The initial concerns of EA's related to the actual chemistry of the drilling fluid. The visual of 'some concoction of dirty fluid' (bentonite) being pumped into the ground raised eyebrows of those unfamiliar with its chemistry and purpose. While responsible HDD companies have always utilized environmentally friendly fluids in Ontario, more agency attention was placed on fluid additives. With easy access to MSDS sheets and manufacturer letters, communication and patient education, concerns were quickly addressed that the fluids where indeed environmentally safe.

Inadvertent returns (IRs) lead to the next challenge in the evolution of HDD projects in environmental areas. While the larger HDD operators were diligently managing returns in water courses and wetlands, smaller companies were not as diligent. More and greater attention was being focused on the overall drill plan.

Many project owners have developed negative views of the environmental programs and policies. Deeming them inconsequential, inescapable, nuisances, and costly money grabs. Conversely, the attitude of employees of the EA's tend to view developers and project owners as single minded. It should be noted that not all stakeholders portray or share these stereotypical characterizations, however, the feelings exist. It is encouraging to note that both 'sides' are showing progress towards understanding towards each others mandate.

2. EDUCATION AND NEW HDD DESIGN PARADIGMS

The earliest advent of larger diameter drilling in Ontario began to open as recently as 2006. Very rarely were large diameter (24" and greater) on grade sewer and watermain HDD projects developed prior to this time. The tireless efforts of the HDD community to press the designers and educate on the merits and capabilities of constantly evolving HDD technology led to a consistent stream of 600mm and larger projects. This coupled with aging infrastructure in environmentally sensitive areas and the increased focus on environmentally sensitive construction methods led to increased design consideration of HDD methods. Where once a stream was open cut right down the lateral length, HDD options adjacent to the watercourse where under consideration. Figure 1 shows the 'laydown' area for a 600mm HDPE installation adjacent to a Rough River Tributary. Beneath this tributary a 375mm sanitary subtrunk was installed by open cut means in the 1960's. Increased development in the area warranted upgraded infrastructure. In 2006, 365m of 600mm HDPE was installed at 0.6%.

Figure 1 – 635m of 600mm HDPE Sunnybrook Subtrunk on Grade Installation 2006

The greatest challenge to construction was presented by the local conservation authorities. Without permits from this agency, construction would not be possible. The authorities limited experience with HDD had been unproductive and an early phase of HDD construction related to the overall work had been disastrous. An inexperienced drilling contractor let uncontained slurry flow into the tributary. Estimates range the slurry spill between 25,000 and 37,000 litres. The contractor was unmoved by the situation and laid blame on others.

The overall completion of the work included two additional HDD installation of 600mm HDPE on grade. The most challenging being the section adjacent to the watercourse. Several volumes of documentation was developed detailing the construction method and the environmental contingencies proposed. In addition, several hours of on site 'face to face' meetings, slowly aided in 'convincing' the EA that the method was sound and suited for the installation. In review of the work the win-win came based on the following aspects – educating the stakeholders on the method, involving the EA in the solution and inviting solution feedback, developing a realistic plan and having the materials on site prior to the work. Simply having documented locations along the bore path designated for IR material caching and actually having the materials in those locations, made a tremendous impact on the agency. In later anecdotes, the agency would relate that they never expected that the materials would be on site. The designer learned a good lesson that had they involved the EA from the start of the project, a much better relationship would have developed.

Success builds success. Immediately following the success here another opportunity arose. In the north end of the Greater Toronto Area (GTA) a failed attempt to auger bore under a stream lead the project stakeholders to seek out alternative solutions. The use of HDD would allow for the installation of 225m of 600mm HDPE of watermain well outside the immediate limits of McNair Creek on Teston Rd. The auger bore attempt required dewatering in the area immediately adjacent to the creek. Before a single auger was turned, the ground shifted causing the trench boxes to knock the heads off one of the wellpoints. The resulting flood of ground water washed one-hundred cubic meters of silt into the stream and the shaft for the auger bore operation was lost in the sinking ground. The use of directional drilling would allow the limits of equipment staging to be placed well outside the immediate influence of the watercourse. Given the soft nature of the soils the propensity for IRs was great. Working with the owner's designer, frac relief wells were developed. The attention to detail was so great that the owner had the wells added to the drawings for submission to the EA for permit approval. The frac well attempts to create an artificial fracture point in the bore path. So rather than addressing IRs in the body of a watercourse or wetland, the flow migrates to the area of least resistance, which by design are the relief wells. Figure 2 represents the actual design of the frac

relief well, intended to be installed on opposing sides of the creek bank. The design is a clear example of how some designers tend to take some license on actual needs. Earth Boring considers this design to be the Cadillac of fracture relief wells. More suitably and affordable installations simply require a 400mm hole to be installed above the bore path and perhaps bermed with soil or sand bags and managed with a vacuum truck.

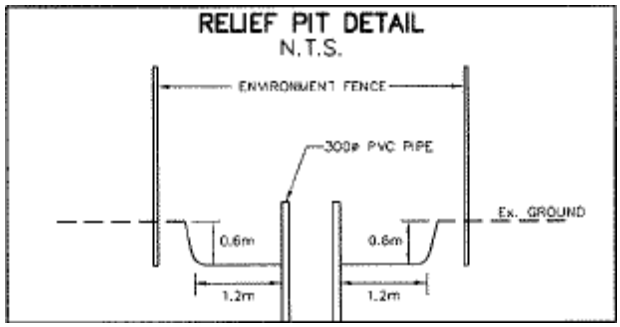

Figure 2 – Teston Rd McNair Creek 600mm HDPE Frac Relief Well Installed Adjacent to Creek Banks
Source – Project Drawings – Castlepoint Investments

Late in 2009, an installation required a crossing of a small tributary by a 762mm HDPE pipe. When construction personnel arrived on site they were advised that only three IR occurences would be allowed during the course of the bore. As the project owner and drilling crew looked dumbfounded by the project limitation, the consultant added that initially they requested that twelve frac outs be permitted and had to 'settle' on three. Carefully it was explained that it was not a matter of how many frac outs will or won't occur, but rather that when they occur how they will be addressed. Had the designer consulted HDD professionals prior to design, the limitation could have been avoided. Although the same EA had been involved in several previous HDD projects, the particular staff assigned to the project were unfamiliar with the method.

In the preceding three projects several key lessons are prevalent, communication, planning, education, involvement and following 'the plan' are critical to success in navigating environmental projects. The particular needs of any specific environmental HDD work may differ, but the fundamentals in addressing the needs are the same.

3. PARTNERING

With increasing environmental works, of increasing diameter, Earth Boring had become a regular fixture at environmental offices. Not out of calculated measure, but from necessity of procuring and championing environmental HDD work. Given the large size of the agencies, it was not often that familiar faces would appear in the environmental board rooms. With consistency and patience, the means and methods of HDD were constantly delivered to ever changing groups of people. This education would prove invaluable. This commitment to the education would lead to developing symposiums that would be delivered to local, provincial and federal EA's, giving even larger presence to the practical nature of large diameter directional drilling.

With the frequency of communication largely based on project specific initiatives, Earth Boring and several EA employees felt even greater, broader ranging dialogue would be beneficial. This communication would seek to broaden understanding of trenchless works, particularly directional drilling, to a greater level than could be achieved in a single project. These meetings are on-going and seek to develop a common understanding of the needs, goals and priorities of the various stakeholders on any given project.

Working with the mindset of 'win-win' has been particularly beneficial. While each stakeholder is striving to achieve success in their own model, understanding the needs goals and priorities of each stakeholder makes for effective partnering. In general the experience has been very positive and frustration has become a matter of the past. Out of these sessions better plans and processes where developed, albeit independent of the working group.

Some of the agencies have taken upon themselves to develop guidelines for HDD work in and around environmentally sensitive areas. They have invited feedback from HDD professionals in order to have support from

the very companies that they are requiring compliance with. The key aspect of the guideline is the absence of specific measures in general. Rather the strength of the document is in seeking development of measures suited to the particular project, or the creation of specific plans for each project. The guideline promotes a framework of compliance.

In early 2010, a federal infrastructure funding project included installation of 500mm HDPE parallel to a cold water fishery stream. Essentially, a cold water fishery means no construction work can occur in the area for the duration of the expected breeding season of the indigenous species. However, with the track record of compliance that Earth Boring had exhibited, the governing EA allowed the HDD works to proceed. This was based on the development of a site specific environmental contingency plan, the proposed mitigation strategy and past experience. This was the second of its kind to ever occur in Ontario. The first such exemption occurred in the previous month, again the same EA giving a permit to Earth Boring to perform similar work.

Figure 3 shows the longest parallel stretch of the installation. Approximately 8m separation from the waters edge to the centerline of the bore path had been designed. One perpendicular crossing is typically the norm for most environmental installations. This installation included a perpendicular crossing and approximately 150m of parallel installation.

Figure 3 – Cold Water fisheries installation Spring of 2010 – looking east to west – 500mm HDPE

During the course of the bore a single inadvertent return occurred. It occurred about 10m off the bore path and after the bore head had passed the area of fracture by about 30m. The red line in Figure 4 indicates the bore path. Near the top of the figure two frac control measures are installed to control the frac area.

Figure 4 – Bore path(red line) and frac control measures

The sensitivity and considering that permsission to construct the pipeline outside the standard fisheries window prompted more consideration to frac control measures. In addition to the supply of materials to control frac outs, Earth Boring supplied and installed silt fence in the creek to limit downstream exposure in the event of further frac outs during the course of reaming and pullback. The frac control measures were installed during the initial pilot to address a frac out that occurred at the time of pilot.

The pre-installation of the silt fence was well received by the EA who expressed appreciation that additional measures were applied in the face of potential frac outs in later in the project. The agency sent 12 employees to see the operation on the day of pullback. Progress went well until mid way thru the creek parallel when a severe frac-out occurred in the bottom of the creek. The frac-out occurred right beside the EA employees, timing could not have been 'better'. The forces on site immediately leapt to action and contained the frac-out. Figure 5 shows the crew managing the frac out. In this installation, 600mm pipe was placed over the frac point. An environmental technician swept the interior of the pipe to remove any aquatic life that may have been trapped during placement. A vacuum hose was then inserted in the top of the pipe and the slurry managed.

Figure 5 – Managing a frac out

Despite the severity of the inadvertent return, the EA was pleased with the way the forces immediately responded to the issue and mitigated further downstream migration of the slurry.

4. WIN-WIN SOLUTIONS

'Win-win' solutions cannot be achieved without mutual understanding of all stakeholders needs, goals and priorities. Simply reading a list or summary of stakeholder needs does not provide the means to understand. This understanding comes from discussion, communication and immersion in the stakeholders business. Careful cultivation of relationships and trust are the cornerstones of building 'win-win' solutions. How often has a contractor looked across the table and thought of the EA as the opponent or rather as an obstacle to be 'dealt with'. The concerns of the agencies are generally borne of the public interest. It is in responsible contracting that pre-conceived notions are eliminated. By demonstrating understanding of the environmental concern and clear communication progress can be made in developing projects that meet all expectations. In union labour circles, it is often opined that companies get the unions they deserve. This is a tongue in cheek statement that clearly notes that if you treat employees in a fashion they deem unjust, they will unionize to protect themselves. In much the same vein, years of perceived irresponsible stewardship of the environment has led to the adversarial relations prevalent today between EA's and construction stakeholders.

Breaking down the pre-conceived notions of each group is the first step in developing a 'win-win' solution for trenchless works. Education and communication are fundamental tools in strengthening the relationship. It has been Earth Boring's experience that forwarding cost effective environmental contingencies and working on compromise has led to the successes in increased large diameter HDD work under the purview of EA's. The greatest challenge has been learning when to 'push' the agencies and when to address their priorities. Responsible contractors do not attempt to 'roll over' the EA. These contractors patiently explain the work, the method and the goal and seek to incorporate the EA priorities into the work.

5. CONCLUSION – Responsible Contracting

The environmental concerns of today have been borne on the neglect of previous generations. Arguably, we endure perceived harsh environmental regulations, due to the negligence of the careless. Contractors should strive to live by the axiom of 'responsible contracting'.

1. Education, Education, Education (The Three 'E's of the Environment
    a. A well educated stakeholder will be amenable to the solutions presented
    b. Education is a two-way street, contractors are well advised to learn the needs and priorities of local environmental concerns to better advance their own needs
2. Large scale trenchless project owners and designers should seek to include participation from all stakeholders from conceptualization, to plan and design and in field resolution.
    a. When required, involve the EA's early on in design in order to understand the limitations and potential restrictions
3. Follow your environmental mitigation / contingency plan
    a. Be sure to have the material for your plan on site and ready to deploy
    b. Ensure that your forces and other stakeholders are advised of the plan and ready to act on it as may be required.
    c. Have a written copy of the plan on site at all times
4. Look to develop long term partnerships with environmental agencies
    a. EA's will increasingly become stakeholders in HDD projects
    b. Developing positive working relationships proves invaluable as agencies will drop their own preconceived prejudices of the contractor / environment relationship