

Typical Hydrotest Water Intake and Discharge Mitigation Measures

Prepared for

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Table of Contents

Executive Summary	4
1.0 Cleaning, Hydrostatic Testing, and Drying.....	5
1.1. <i>General</i>	<i>5</i>
1.1.1. <i>Intake Quantity</i>	<i>5</i>
1.1.2. <i>Intake Screening.....</i>	<i>6</i>
1.1.3. <i>Controlled Discharge</i>	<i>8</i>
1.1.4. <i>Erosion Protection</i>	<i>8</i>
1.1.5. <i>Runoff Controls</i>	<i>10</i>
1.1.6. <i>Sediment Interception</i>	<i>10</i>
1.2. <i>Pipeline Cleaning</i>	<i>12</i>
1.3. <i>Hydrostatic Testing</i>	<i>12</i>
1.3.1. <i>General</i>	<i>12</i>
1.3.2. <i>Pipeline Filling.....</i>	<i>13</i>
1.3.3. <i>Depressurization.....</i>	<i>14</i>
1.3.4. <i>Pipeline Discharge</i>	<i>14</i>
1.3.5. <i>Equipment Fueling</i>	<i>15</i>
1.4. <i>Drying.....</i>	<i>15</i>

Typical Hydrotest Water Intake and Discharge Mitigation Measures

Executive Summary

The purpose of this document is to provide general information regarding the techniques and methods commonly utilized by construction contractors to mitigate environmental impacts due to erosion, runoff, and sedimentation from the discharge of hydrostatic test water.

The document also describes some of the techniques used to protect aquatic life by minimizing impacts to fish and other species from the intake of water from a designated water body to be used for hydrostatic testing.

This document is not intended to be a complete design guide, but simply highlights some of the more recognized and utilized methods used by international companies and contractors. It should serve as a technology transfer and to provide information to support our current Preliminary Land Allocation (PLA) efforts and to defend against extraneous or impractical permit conditions.

As stated, these techniques and methods are general. Most of the data and numbers came from past Canadian Fisheries reports that have become industry norms. They are presented a guide only and are not intended to serve as a substitute for the use of qualified company personnel or consultants, nor do they represent definitive plans.

Site specific plans will be developed by the contractor according to the information collected, the Project Environmental Management Plan (EMP), applicable Russian SniPs, PSDC's and standard pipeline construction practices. Some, all or a combination of the mitigation measures outlined could be used. In addition there are numerous other, not so commonly used techniques that could be utilized, depending on the circumstances.

Due to resource limitations, no drawings or sketches have been provided. These would be very useful should this document be expanded into a full-blown report to be furnished to regulatory type agencies.

Items such as water quality sampling, hydrologic analysis, biological assessments, or any general environmental studies have not been discussed as they are covered in complete detail in various other parts of the Project documents.

Typical Hydrotest Water Intake and Discharge Mitigation Measures

1.0 Cleaning, Hydrostatic Testing, and Drying

1.1. General

Hydrostatic testing involves the filling of a pipe section with water maintained at a specified pressure for a specific period of time. This is not meant to be a hydrostatic test plan, but a general overview of the various operations that make up the hydrostatic test, with the emphasis on the explanation of the filling and discharging methods and techniques commonly used in these operations.

The pipeline will be hydrostatically tested before it is put into service to verify its integrity and to ensure its ability to withstand maximum operating pressures.

Most testing will be done in the summer. This avoids dealing with water at below freezing air temperatures and below freezing ground temperatures. In portions of the route, water availability may be a problem in the winter as well. However, there are some portions of the route that may need to be tested in the winter due to access problems. These sections should have water sources to provide sufficient quantities of test water.

Hydrostatic testing can have environmental impacts, factors to be considered include:

- Quantity of water taken from water body source
- Potential for the intake of fish from the water body source
- Erosion and sedimentation at the discharge points

The above items are covered in more detail in the following sections.

1.1.1. Intake Quantity

Required quantities are shown under 1.3.2, Pipeline Filling. However, sources for the water intake should be chosen to allow

Typical Hydrotest Water Intake and Discharge Mitigation Measures

filling to occur while maintaining adequate flow rates to protect aquatic life and to provide for downstream users, if any. Typically the intake rate should be approximately 10% of the flow rate in the water body.

In order to reduce the amount of fresh water required for the hydrostatic tests, the water from one test section could be transferred to the next test section, and so forth, thus reducing the overall fresh water quantity requirements.

1.1.2. Intake Screening

The use of screens on hydrostatic test water intakes should be used to prevent the entry of fish or the potential losses of fish due to entrainment or impingement. Entrainment occurs when a fish is drawn into a water intake and cannot escape. Impingement occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself. There are existing guidelines and calculations that deal with the sizing and design of fixed screens that are often placed at the end of a pipe used to extract water up to 125 liters per second.

Generally the design of the screens will provide protection of freshwater fish with a minimum fork length of 25 mm since most eggs and fish larvae remain in bottom substrates until they reach the fry length normally considered to be equal to or greater than 25 mm.

Information required to facilitate the design of an end of pipe intake screen intended for fish protection during freshwater withdrawal include:

- Fish presence, species and possible fish size of fish habitat conditions at the site
- Rate or ranges of rate of withdrawal from the water course
- Screen open and effective area

Typical Hydrotest Water Intake and Discharge Mitigation Measures

- Physical screen open parameters with respect to the intake and the watercourse
- Screen material, method of installation and supporting structures
- Screen maintenance, cleaning or other special requirements

The proper design of the fish screen is largely dependent upon the species and the size of the fish requiring protection.

Appropriate installation of the screen is important in keeping approach velocities low and ensuring satisfactory operation of the screen. Some of these criteria include:

- Screens should be located in areas and depths of water with low concentrations of fish throughout the year
- Screens should be located away from an man-made structures that may attract fish that are migrating, spawning, or rearing in habitat
- The screen face should be oriented in the same direction as the flow
- Screens should be located a minimum of 300 mm above the bottom of the watercourse to prevent the entrainment of sediment and aquatic organisms associated with the bottom area
- Structural support should be provided to prevent sagging or collapse of the screen

Appropriate maintenance/cleaning of the screen are also important to ensure the satisfactory operation of the screen, some of these include:

- Provision should be made for the removal, inspection, and cleaning of screens

Typical Hydrotest Water Intake and Discharge Mitigation Measures

- Pumps should be shutdown when fish screens are removed for inspection and cleaning
- Screens may be cleaned by methods such as air and water backwashing
- Flexible suction hose can be used instead of solid, fixed piping for ease of screen removal and cleaning
- Pump suction pressure can be monitored and measured to assess the need for screen cleaning.

1.1.3. Controlled Discharge

The discharge from the testing operation must be performed so that the introduction of suspended soil particles into the receiving water is minimized.

The goal of a controlled discharge is to accomplish the management of erosion and sediment. It is impossible to eliminate all erosion and hence sediment-laden runoff. This second stage of the interception of sediment before it can leave the site is critical.

A number of practices have been developed during past construction programs to address erosion and sediment control, typically these fall into 3 broad categories:

- Erosion protection
- Runoff controls
- Sediment interception

A typical hydrostatic test water discharge plan will include measures to mitigate effects from all 3 categories.

1.1.4. Erosion Protection

Typical Hydrottest Water Intake and Discharge Mitigation Measures

The initial step in controlling water discharge is erosion protection. Measures will be taken to reduce or resist sheet or rill flow. These measure are used in conjunction with measures from the other 2 above-mentioned categories.

Some common methods of erosion protection are the use of some or all of the following:

- Mulch. Mulch consists of natural or artificial material placed or sprayed onto exposed soil in order to eliminate or reduce erosion. The 2 most common types of mulch are straw (hay may be substituted) and hydraulic applied mulch.

Straw mulches are very effective and are normally applied at a rate of 4.5 tones per hectare. Mulch is generally anchored to the soil by: driving steel tracked equipment over the mulch; a mulch anchoring or crimping tool; or placing a degradable netting over the mulch.

The most common type of hydraulic mulches are made from hardwood chips.

- Erosion Control Blankets. Products are available in the form of blankets that will protect soil from erosion. A variety and type of erosion control blankets are available and are typically made from: straw/netting; straw/coconut fibre/netting; coconut fibre/polypropylene netting; coconut fibres woven into a mesh.

Erosion control blankets come in rolls of varying widths and lengths and are laid on the soil and anchored by wooden stakes, rocks, or metal staples.

- Existing vegetation. Should sufficient existing vegetation be available, it can be used as a very efficient erosion control method, sometimes used in conjunction with the other 2 methods mentioned above.
- The use of energy dissipaters installed on the discharge line

Typical Hydrotest Water Intake and Discharge Mitigation Measures

1.1.5. Runoff Controls

Since runoff is the primary cause of erosion and soil loss, measures aimed at limiting or controlling runoff are effective in reducing soil loss. The most common form of runoff control for hydrostatic test water discharge is diversion berms.

Diversion berms are commonly constructed to intercept sheet flow on exposed soil surfaces and both slow its flow rate and divert it to more stable, well-vegetated areas if they are available.

Berms should have a top width and height of at least 0.5 m and side slopes not exceeding a ratio of 2:1. A longitudinal slope of between 2% and 5% is generally used. Erosion control blankets are typically used to line the portion of the berm subject to channel flow.

1.1.6. Sediment Interception

Soil loss from slopes will occur even when slope protection measures are in place. When the potential exists, such as return of hydrostatic test water to a water body, mitigative measures should be used to intercept this material.

Several methods commonly used in water discharge situations to intercept eroded sediment include the following:

- Vegetated buffer strips. Vegetated buffer strips can be used very effectively in trapping soil particles by sheet flow. The discharge water needs to be diverted to these vegetated buffers by means of diversion berms or simply directing the discharge water directly into the buffer strips.

An example of the effectiveness is: a 20 m wide buffer strip will remove approximately 40% of suspended particles in

Typical Hydrotest Water Intake and Discharge Mitigation Measures

sheet flow. 20m - 50m will remove close to 80%, and buffer strips 50m and greater will remove virtually all sand particles.

- Silt fence. One of the most commonly used measures to trap sediment prior to entering a water body is silt fence. Silt fence is highly effective if used properly in a suitable situation.

Silt fence should only be used to intercept sheet flow. The length of sheet flow upslope of silt fence should be less than 30m.

Silt fence should be a minimum of 600 mm high and should be installed across the entire construction ROW, including affected areas adjacent to the pipeline ROW and parallel to the water body.

- Straw Bale Barriers. Straw or hay bale barriers consist of a row of entrenched or anchored bales placed along the affected area of water discharge. They are designed to intercept and retain sediment and to decrease the velocity of sheet flows. Generally, silt fence is preferable to straw bale barriers.
- Sand Bag Barriers. Sand bag barriers consist of a row of sand bags placed along the affected area of water discharge. They are designed to intercept and retain sediment and to decrease the velocity of sheet flows.

The above mitigation methods are augmented by proper placement of the measures. Normally this is accomplished by placing the discharge site back from the water body a minimum of 15 meters

The most effective methods of reducing erosion, controlling runoff, and sediment interception are to utilize natural vegetation should it be available. When sufficient amounts of undisturbed vegetation exist, many, if not all of the above mentioned mitigation measures would not be required.

Typical Hydrotest Water Intake and Discharge Mitigation Measures

1.2. Pipeline Cleaning

Before being hydrostatically tested, the pipeline will be cleaned of construction debris using a cleaning pig with wire brushes. At the ends of each test section of the pipeline, temporary low pressure launching and receiving barrels will be installed to facilitate the launching and receiving the cleaning pig runs.

The cleaning pig will be pushed through the test section with compressed air. Once the test section is determined to be free of debris, the temporary cleaning headers will be removed.

The cleaning pig run may be done at the end of the winter construction season prior to break up. This would assure that there is no obstructions in the line that will prevent successful fill pig runs in the summer. If such an obstruction were found in the winter, the pipe can still be excavated on the winter ROW, cut, the obstruction cleared and re-welded.

1.3. Hydrostatic Testing

1.3.1. General

This section will deal primarily with the uptake and discharge of the hydrostatic test water.

The uptake and discharge of test water will adhere to applicable SniPs and PSDC's. Water taken from streams, rivers and lakes will be taken in a way that minimizes damage to the ecology, fish and wildlife resources, or to the aesthetic values of the area. Water withdrawn from flowing streams will likely be restricted to a specific percentage of a lake or the flowing volume of a river and stream.

The rate, temperature and the quality of the discharge will be monitored to stay in compliance with permit requirements.

Due to the pre-cleaning of the pipe, the discharge water is expected to be of good quality. Solutions of methanol, glycol, biocide, corrosion inhibitor, leak detection fluids, etc., will not be used in the

Typical Hydrotest Water Intake and Discharge Mitigation Measures

test water except under extreme circumstances such as the requirement of winter hydrostatic testing.

When testing water is released, it will be done so as to minimize erosion or siltation by the utilization of the previously described methods.

1.3.2. Pipeline Filling

Once the pipeline section has been successfully cleaned, the pipeline will then be filled with water. Hydrostatic test water will be taken from designated water bodies crossed by the pipeline. The pipeline crosses many small rivers and it is anticipated that these water bodies will contain sufficient volumes to allow withdrawal of hydrostatic test water without downstream impact. The volume of test water needed for the 711 mm export pipeline is approximately 350 liters per meter. In terms of liters per kilometer, the water required is 350,000 liters per kilometer. In terms of cubic meters (CM), the water required is 350 CM per kilometer. There will be numerous test sections, ranging from 10 – 50 Km's depending on a number of factors, including water sources and terrain profiles.

The rate of fill and therefore withdrawal will be approximately 5,000 to 6,000 liters per minute to assure reasonable fill times. The rate will vary depending upon the equipment used and the head pressure in the line. Generally multiple 6" fill pumps at the water source feed a high volume, high head fill pump. Several light wall, 6" or 8" fill lines supply the main fill pump.

The discharge from the main pump is piped to the branch valves on the test header. There is a considerable amount of piping and welding at the source site to facilitate the filling operations. The inlet or intake of the fill pump that will be located in a river or lake will be screened so as to prevent the entrainment or impingement of fish.

The test water will be withdrawn at a controlled rate from an approved water source, and pumped into the test section behind a bi-directional fill pig. Once the test section or test sections are filled

Typical Hydrotest Water Intake and Discharge Mitigation Measures

with water, a high-pressure pump will be used to pressurize each test section to the specified design test pressure. The test pressure within the pipe section will be maintained for the time frame specified in the construction specifications.

1.3.3. Depressurization

Following the successful hydrostatic test, the test section will be depressurized. The depressurization and discharge of the water from that operation will generally take place at the lower of the two test headers on each test section. That small amount of water will be discharged on to the ground through a dissipater and straw bales and/or silt fence.

There may be instances where the preferred or the required discharge of the test water is other than the source. In such cases, precautions will be used to discharge the water into an alternate water source.

1.3.4. Pipeline Discharge

Hydrostatic test dewatering will result in the release of turbid water, therefore it is necessary that measures be taken to prevent turbid water from directly entering a water course and that erosion is mitigated at the discharge site.

Water should be discharged at least 15 m away from the watercourse. The most effective method to control the turbid water at the discharge site is to discharge the water through dissipaters into natural vegetation. When that is not available in sufficient amounts, the water can be discharged through dissipaters onto a stable spill pad constructed of rockfill, sandbags, weighted timbers, or a woven geotextile staked to the ground surface.

Beyond the spill pad, the discharged water is forced into sheetflow using staw bales or the natural topography.

Typical Hydrotest Water Intake and Discharge Mitigation Measures

More complete discussion on these as well as some of the other methods available are contained in Sections 1.13, 1.14, 1.15, and 1.16.

1.3.5. Equipment Fueling

Fueling of pumps that have to be within 30 meters of the river or lake may be necessary. Proper precautions will be taken to insure that no spills or leaks occur. These precautions include a secure impermeable berm constructed around both the pump and the fuel tank or fuel truck; and adequate spill protection equipment and materials located at the site.

1.4. Drying

Once all of the water is pigged from the test section, the test heads will be cut off and several test sections will be tied in to form a longer section that is more efficient for gauging and drying.

The running of a caliper pig or gauging plate should be done after bulk dewatering but before air-drying. This allows several test sections to be tied in to make a longer and more productive pig runs. With proper construction techniques and inspection, it is doubtful that there will be any dents.

Additional pipe joints will be welded onto one of the first test sections to provide pre-tested pipe to replace a cut out dent should one be found after hydro-testing by the caliper pig or sizing plate runs. Re-testing of the section is not necessary after replacement of the buckled pipe with pre-tested pipe and NDT acceptance of the tie in welds.

After the caliper pig or gauging plate run, multiple runs of foam swab pigs will be made using compressors and a dehydrator. The swab pigs will be run until they come out to an agreed to dryness, usually within 10% or less of their original weight. The dehydrator will continue running until the air being discharge at the other end of the line meets the dryness requirements in the specifications. No chemicals will be used to dry the pipeline following the test. When the last drying section is dried and the entire construction section is completed and tied in, the

Typical Hydrotest Water Intake and Discharge Mitigation Measures

dehydrator may be used to put a couple of pounds positive pressure on the line and the line will be shut in until start up.

To determine the number of test sections, an elevation profile of the pipeline will be performed during the centerline survey and the water sources must be known. The information is not available at this time. There is no way to determine the test section limits without this information.