Preferred practices for works affecting Yukon waters

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Acknowledgements and document history

This document was originally developed in 2011 through a contract between the Government of Yukon and Yucan Environmental Planning. In 2017, the document was updated and revised through a contract between the Government of Yukon and Core Geoscience Services Inc.

About this document

Some of the updates that were made in this edition reflect significant changes made to the 2012 version of the federal *Fisheries Act* (Section 4.2.2) and the replacement of the *Navigable Waters Protection Act* with the *Navigation Protection Act* (Section 4.2.3). Many other changes reflect restructuring of roles and responsibilities of Government of Yukon departments and branches. Other changes reflect updates and improvements to preferred practices.

The natural and social environments are constantly changing. Regulatory systems and environmental practice must adapt with these environments to balance human needs and ambition with environmental protection. The preferred practices of today cannot remain static; a better method may become available.

This document is a living document that will require periodic updates in order to ensure the most current preferred practices are in place and that they reflect the current legislative and regulatory systems.

Note: at the time of finalizing this document the House of Commons had passed Bill C-68 and Bill C-69 with amendments to legislation including the *Fisheries Act* and the *Navigation Protection Act*. The Senate will study these Bills as a next step. The next version of this document will reflect such amendments once enacted.

Reviewers and contributors

Government of Yukon:

Energy, Mines & Resources: Compliance Monitoring and Inspection Branch and Mineral Resources Branch

Environment: Water Resources Branch and Environmental Programs Branch

Executive Council Office: Major Projects Yukon and Yukon Water Board Secretariat

Highways and Public Works: Transportation Engineering Branch

For information regarding this document, please contact:
Manager, environmental compliance and inspections
Government of Yukon
Department of Environment
10 Burns Road, Whitehorse, Yukon
Phone: 867-667-3227

List of acronyms

CMI: Compliance Monitoring and Inspections Branch, Department of Energy, Mines and Resources

DFO: Department of Fisheries and Oceans

EMR: Department of Energy, Mines and Resources

EC: Environment Canada

ECI: Environmental Compliance and Inspections Section, Department of Environment

HD: Horizontal distance

ML/ARD: Metal leaching and acid rock drainage

NPA: Navigation Protection Act

PPE: Personal Protective Equipment

SARA: *Species at Risk Act*

RECP: Rolled erosion control products

VD: Vertical distance

YESAA: *Yukon Environmental and Socioeconomic Assessment Act*

YESAB: Yukon Environmental and Socioeconomic Assessment Board

YWB: Yukon Water Board

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1 Introduction

1.1 Approach and layout of this guide

The "preferred practices" approach

The "preferred practices" approach is a way to help developers comply with environmental regulations and avoid or mitigate the negative environmental impacts of development activities. The preferred practices approach encourages proponents to work with stakeholders, regulators and enforcement officers to find the best, tailored solutions for each project. The premise of this document is to provide a number of key principles and preferred work practices, and encourage a proactive approach to developing work plans based upon the preferred practices outlined in the document. The focus of this guide is to provide Yukon-specific preferred practices that provide practical worksite guidelines to help planners and developers protect water resources.

While this is a document by the Government of Yukon, it includes references to federal legislation and requirements as they form part of the overall "universe" of requirements and preferred practices for works in or near water. This updated document provides examples of the latest technology and industry proven techniques and methodologies, including examples of techniques that work well, and techniques that don't work. This update also reflects significant changes in federal legislation, regulation and guidance documents, such as changes to the *Navigable Waters Protection Act* (replaced by the *Navigation Protection Act*), and changes to Department of Fisheries and Oceans' Operational Statements (replaced by "Measures to Avoid Causing Harm to Fish and Fish Habitat"). The reader should refer to the actual statutes for complete reference and interpretation of requirements.

While the types of projects that potentially affect water resources are diverse, many of their component activities are similar across a broad range of industries. For example, refuelling equipment, fording streams, constructing scratch roads, installing culverts, and cutting brush are activities that may be undertaken by a large contractor building a multi-span bridge or a farmer developing a new hay field. Consequently, the preferred practices in this guide are organized by activity type, not industry type. This approach encourages developers to break their projects down into component activities, which will help them plan work more efficiently.

Target audience

This guide was written to be useful to all members of a development team. Government agencies and regulators also may find it useful for planning infrastructure projects and conducting environmental monitoring. It is detailed enough so that planners can refer to specific preferred practices when preparing documents for the Yukon Environmental and Socio-economic Assessment Board (YESAB) and licensing agencies, or when writing environmental management plans. For planners that need more detailed prescriptions or regulatory information, the guide provides references to additional resources. Site managers and

equipment operators should find the recommendations in this guide to be concise and practical solutions to situations that will be encountered on the work site. Photos are used throughout the guide to provide examples of good work practices and site maintenance.

Layout and use of this guide

Section 1 of this guide provides background on water protection principles. The preferred practices themselves are divided into two sections. “Section 2: Preferred practices: Materials and methods” provides detailed information for basic practices that may be used across a broad range of work activities to control erosion, sedimentation, and contamination. For example, it explains how to erect structures like silt fences, check dams, and erosion control matting. “Section 3: Working in or near surface watercourses” outlines preferred practices for specific activities that occur in or around surface watercourses, such as installing culverts or fording streams. The practices prescribed in Section 3 are more general in nature, often referring back to detailed practices in Section 2 and encouraging a proactive approach to developing work plans in consultation with regulators. The reason for this is that every project will be unique and it is beyond the scope of this guide to cover every construction activity imaginable, or to be a technical how-to manual for any given activity. Instead, the intent is to provide planners and site workers with a good background in the principles and tools of water-protection measures. Section 4 includes a summary of the most relevant legislation. The appendices in this guide provide a variety of resources, including useful publications and webpages of regulators, and legal references.

This is a guide, not a regulatory manual

It is important to understand that this guide is a not a regulatory manual. The practices described here are not, strictly speaking, all dictated by statute. Some are, and we try to be clear when that is the case. Instead, the practices represent industry standards for conducting work in a manner that minimizes the risk that you will negatively impact water and potentially violate applicable legislation.

While regulatory agencies are available for advice and to provide information to assist with project planning, they may not prescribe exactly how to undertake your project and they cannot be on site to guide you through your every move. The onus to comply with applicable legislation rests with the developer. This guide should assist proponents in designing projects and conducting work in a responsible manner.

Project planning

Keep in mind that some activities and mitigative measures require planning and data collection for a year or more prior to commencement of work. This often is the case for inventories that reflect seasonal variations. Also, some specialized materials, such as rolled erosion control products, may need to be ordered months in advance.

As mentioned, this guide cannot take into account every conceivable activity that will be encountered in a work plan. Each project will have its own unique challenges, and developers may still need to consult specialists and government agencies to devise specific solutions that augment the general guidelines outlined here. This underscores the fact that when developers interact with regulators to receive information and advice, they may develop preventative and mitigative strategies for their projects with a better chance to minimize the project's effect on water and remain in compliance with the legislation.

1.2 Protecting water

The need to protect water sources from disturbance and contamination cannot be overstated. Although in some cases there is still societal debate as to what level of disturbance is considered acceptable, and what levels of certain contaminants are harmful, federal and territorial regulations are clear about the need to justify impacts before a disturbance can be permitted. For example, under the *Waters Act* (2003), it is an offence to deposit waste into water or into any area such that the waste may enter water unless the deposit is authorized by the *Waters Regulations* (2003) or a water licence. Chapter 14, Water Management, of the Yukon Umbrella Final Agreement, and individual First Nations agreements, also include water protection and water rights of Yukon First Nations (see Chapter 4.3).

The easiest solution to safeguard water resources is not to work at all in or near watercourses, and this should always be considered the default for performing work when possible. However, not all development can be planned to occur away from watercourses. Indeed, some projects must by their nature occur in or adjacent to watercourses. Most of the preferred practices in this guide emphasize ways to minimize and mitigate impacts to water resources when watercourses cannot be avoided, while other preferred practices include prescriptions for preventing unanticipated impacts even when development occurs away from watercourses. For instance, the guide includes preferred practices for controlling sediment runoff from roads because that sediment may eventually find its way to a watercourse.

From a development assessment standpoint, the potential for an activity to cause harm to water and watercourses (including groundwater, rivers, creeks, lakes, swamps, fens, bogs and other wetlands) is determined by assessing the activity's potential to do three things: 1) contaminate water (including sedimentation), or 2) restrict or alter flow, or 3) impact fish or fish habitat. The potential to cause water contamination is determined by assessing how much the activity will increase levels of sedimentation and runoff, increase influxes of pollutants and nutrients, or cause changes to water temperature. Flow restrictions or alterations occur when structures are built in streams, water is diverted, or banks and channels are disturbed. Impacts to fish and fish habitat include obvious actions such as releasing contaminants or altering flow, but also includes more subtle effects, such as disturbing spawning beds in channel sediment by fording a stream at the wrong time of year, or removing logs and other fish habitat to "clean-up" the work area.

Here are the five main mechanisms by which contamination and alterations to flow conditions can be detrimental to water quality, fish, and other aquatic life:

1. *Increased runoff* - Land alterations and disturbances frequently increase the rate and amount of runoff from a watershed entering streams. Increased flow can erode stream channels and banks, destroy in-stream habitat and increase flood potential. It is important to remember that even projects that do not occur near watercourses can cause or increase runoff that eventually will end up in waterways. In addition to the direct results of increased runoff is the potential for increased runoff to carry sediments and pollutants, and cause temperature alterations, as described below.

2. *Sedimentation* - Eroded sediment from disturbed surfaces (e.g., construction sites), or even dirt and sand on roads, driveways and parking lots, often is transported to streams with storm water runoff. Cut and fill from temporary roadways can be a large source of sediment contamination to streams, and it is important to remember that even sediment erosion that occurs far from water can quickly make its way to streams during storm events. Sedimentation causes turbidity, can smother aquatic habitat, reduces levels of dissolved oxygen, degrades aesthetic qualities, and transports nutrients and toxic contaminants.

3. *Nutrient and Contaminant Influxes* - Fertilizers on revegetation plots (including hydroseeding) or agricultural fields end up being dissolved in water and may be transported to watercourses. Failing septic systems and concentrated accumulations of animal or human waste can have similar effects. A major influx of nutrients causes eutrophication of watercourses and depleted levels of dissolved oxygen, damaging aquatic habitat and reducing aquatic diversity. Contaminants including hydrocarbons and metals can be introduced to water from sources such as spills or exposed mineralized rock material. These substances can also be transported to surface watercourses by runoff or via ground water where they can cause detrimental changes to aquatic habitats due to their toxicity. While potentially negatively affecting aquatic life, influxes of nutrients and contaminants can also harm terrestrial animals and humans depending on the impacted watercourse.

4. *Temperature Alterations* - Warming of water can be a deleterious but often overlooked effect of altering land surfaces and development activities. Sheet wash and other surface runoff water tends to be relatively warm. Any activity that increases runoff usually causes an influx of warm water into water systems. Surface watercourses can also be unintentionally warmed by removing streamside vegetation, which reduces shading, or by reducing groundwater flow, since groundwater tends to be cool. Increasing water temperatures can be harmful to cold-water species such as salmon and trout. It also can promote excessive plant growth, which chokes out still waters, reduces the level of dissolved oxygen, and has been linked to an increased incidence of disease in fish.

5. *Flow Alteration* – It is inevitable that any change to stream channels will affect flow dynamics and the stream course. Flow velocities will be decreased in some portions of

the channel and increased in others, ultimately changing the channel morphology and affecting parameters such as bank erosion and fish passage and habitat. It is important to consider that alterations to groundwater flow can also affect surface flow. Removing a portion of stream flow through pumping or diverting reduces the quantity of water flowing in the watercourse. This is particularly important for smaller streams and watercourses supporting multiple users where the cumulative effects of water withdrawal may become significant, potentially impacting aquatic habitat and downstream users.

Yukon's water legislation is based on the mechanisms and principles outlined above. Consequently, the following are the types of actions to avoid because they typically cause harm:

1. Allowing or causing sediment-laden wastewater or runoff to enter a watercourse.
2. Discharging pump water directly into a watercourse.
3. Allowing or causing a toxic material to enter a watercourse.
4. Dumping any waste into a watercourse, including sediment.
5. Infilling a portion of a watercourse.
6. Altering the bed and banks of a watercourse.
7. Altering the quantity, quality, or flow of a watercourse.
8. Modifying channel or lakebed structures.

The basic principles of the preferred practices in this guide are focussed on helping developers avoid adverse impacts to water. These principles can be summarized as:

Wherever and whenever possible:

1. Avoid working in or around watercourses.
2. Minimize the work-site footprint; only clear and excavate to the extent necessary.
3. Control for erosion and sedimentation by managing sediment-laden runoff:
    - Cover excavated and exposed surfaces, including stockpiled materials
    - Install silt fences when necessary
    - Avoid scraping (blading) down to mineral soil
    - Revegetate disturbed surfaces as soon as possible

4. When clearing vegetation, only cut down to ground level, leaving rootstock in place. This will greatly reduce erosion and sedimentation and will promote more rapid revegetation.

5. Stockpile mineral soil and organic soil separately; when spreading, spread mineral soil first and organics last. This will prevent erosion and encourage revegetation (surface stabilization).

6. Equipment should be refuelled and serviced >30m from a watercourse such that no deleterious substance enters any watercourse: all equipment must be clean and free of deleterious substances and invasive plant species before working in or near a watercourse.

7. The only fill material that ever should be placed in a watercourse, such as riprap, is coarse gravel and rock which is non-acid generating and non-metal leaching. It must be clean and free of fines. Often, this means washing rock prior to placement.

8. Never discharge water impacted by construction directly into a watercourse. Normally, it is discharged to a vegetated depression, sump or sediment trap to remove sediment and avoid erosion of the watercourse.

2 Preferred practices: Materials and methods

The preferred practices in this guide are organized into two chapters. This first chapter – *Materials and Methods* – explains in some detail procedures for controlling erosion, sedimentation and contamination, and protecting fish. These are the basic tools of the trade, and include techniques such as revegetating a site, erecting a silt fence, or designing a check dam.

The next chapter – "Working in and around surface watercourses" – lays out the preferred practices for some of the most common activities undertaken by developers in Yukon, such as installing culverts, diverting streams, fording streams or setting up barge landings. It provides notes for planners and designers, as well as preferred practices to use during the construction process. For details on how to carry out those best practices, the reader will be referred back to sections in this "Materials and methods" chapter.

2.1 Erosion and sediment control

2.1.1 General principles

The process of soil erosion involves the detachment and transport of sediment particles. Weathering or soil disturbance causes detachment, while transportation mechanisms include water, ice, wind, gravity and machinery. If suspended or trapped in water or ice, sediment particles can travel long distances. Eventually particles will precipitate out of the water column, a process referred to as sedimentation.

2.1.1-01 An unprotected stream bank that is being eroded by high water.

Sediment particles suspended in water cause turbidity and affect numerous aspects of water quality. Natural turbidity levels fluctuate seasonally in most systems with the highest levels occurring during flood events and spring melt. Natural turbidity is markedly lower in winter. While aquatic life in Yukon is adapted to

fluctuations in seasonal turbidity, increased turbidity can be very detrimental if it is sudden, excessive or occurs out of season. Turbidity blocks light from penetrating the water column proportionate to the density of suspended particles, with a reciprocal reduction in plant and algae growth (photosynthesis). This, in turn, affects the food supply for many aquatic animals. In addition, excessive amounts of sediment can cover fish eggs and clog gills, which can lead to death of eggs, fish and filter-feeding organisms.

Strategies and planning:

Preventing erosion should be the primary strategy of the erosion and sediment control plan. Moreover, it is often easier and less expensive to control erosion at the source than it is to deal with sediment after it has been mobilized. Activities which greatly increase the risk of erosion and which require planning include:

- handling and moving soil during construction
- erecting water diversions
- destabilizing slopes
- disturbing and melting permafrost
- conducting in-stream work
- building temporary roads
- clearing/grubbing vegetation

If it is not possible to eliminate erosion and sedimentation at the site, develop a control plan to minimize and manage them. Use the following principles:

2.1.1-02 The abutment and approach (not shown) of this bridge failed because surface drainage water flowed to the bridge rather than being directed away from it. This could easily have been prevented with proper grading and bridge design.

- Take into account that some erosion-control materials (e.g., geotextiles) will need to be ordered months before construction begins, so plan for them in project schedules and budgets.
- Think about whether construction can occur at a time of year that minimizes erosion.
- Time the mobilization and demobilization of equipment and camps to minimize erosion. Avoid mobilization efforts during spring runoff. During the spring and fall when temperature falls below zero at night, ground can be much more stable during the morning than during the heat of the day. If possible, time moving equipment for when the ground is frozen.
- Visit the site before the work season and identify site-specific erosion issues and sediment release problems that may arise based on work-site factors such as:
    - Slope, aspect, and elevation
    - Soil texture and percolation characteristics
    - Areas with little vegetation cover that are likely to erode
    - Local climatic factors (e.g., rain shadows)
- Take into account the expected type, intensity, and duration of the disturbance, remembering that a small disturbance in a sensitive area or at the wrong time can be just as worrisome as a major disturbance in a resilient area.

General preventative measures:

- Minimize the size of the disturbed area (i.e. project footprint).
- Use existing trails and roads as much as possible.
- Maximize retention of natural vegetation cover—it is your best and cheapest defence against erosion.
- Maintain vegetation buffers, in particular near water.
- Minimize the amount of mass grading and soil compaction at the site.
- Avoid working on unstable areas and steep slopes.
- Minimize water crossings.
- Sequence and schedule construction to take advantage of drier weather.

2.1.1-03 Rock flume. A rock flume is an erosion control measure commonly used for culvert outlets located on steep grades.

- Avoid disturbing permafrost and the overlying vegetation, or it will certainly melt.

Active erosion control measures:

- Cover and stabilize disturbed areas as soon as possible. Use appropriate erosion and sediment control products and methods (e.g. seeding, mulches, geotextiles, rolled erosion control products).
- Divert runoff around erosion-prone areas. Create durable ditches, roads and drainage structures (culverts).
- Identify vegetated natural depressions that can be used to direct runoff into for natural treatment and filtration.
- Reduce the quantity and velocity of runoff water (fast water carries more sediment): keep channel slopes low and keep drainage areas small (i.e. higher density of smaller drainages).

Active sediment control measures:

- Put sediment control measures in place before starting any work that may result in sediment mobilization. In most cases, these are: silt fences, sediment traps and dewatering basins.
- Mixing clean water with sediment-laden water simply produces a larger quantity of dirty water to manage, so keep clean water clean by:
    - Diverting sediment-laden runoff water in and around the construction site into sediment traps and dewatering basins; do not let dirty runoff water flow directly into a clean watercourse.
    - Diverting clean runoff water from undisturbed areas within the construction zone without mixing it with water from disturbed areas.

Response planning:

- Ensure that all riprap and erosion control materials are on site and ready to be deployed before construction starts.
- Have extra materials readily available in case of unforeseen need and based on site erosion risk/potential. Leftover material can always be used on the next project.
- Equipment may need to be left on the work site for longer than initially planned so that it is available for an emergency response.
- Deploying erosion control measures or responding to unforeseen erosion and sedimentation problems may mean keeping additional or specialized equipment on site.

2.1.1-04 These steps were created for easy access from a steep bank down to the river. They also avoid unnecessary erosion of the bank. Smart planning can avoid problems down the line.

2.1.2 Vegetation management and revegetation

Strategies and planning:

Retaining as much natural vegetation as possible on-site is one of the best and cheapest tools that a developer can employ to prevent erosion and sedimentation. Vegetation holds sediment in place, detains and reduces the velocity of storm water, and filters runoff water. Just as important, retaining as much natural vegetation as possible can reduce the amount and cost of reclamation work after the project is completed.

When the nature of the work requires active revegetation efforts (e.g., planting/seeding), the common practice now is to use as many native species as possible in the seed/seedling mix, preferably derived from local genetic stock. Seed and seedlings may be propagated outside of Yukon, but the original seed stock should originate from Yukon. Great care also must be taken not to introduce invasive species with seed mixes; purchased seed should be certified to be free of invasive species and other weeds. In the planning process, be aware that planting seedlings requires significant pre-planning. Cuttings should be collected in the autumn prior to planting so they can be propagated in a greenhouse over the winter in time for planting the following year.

Techniques for preserving natural vegetation:

Existing vegetation should be left undisturbed where possible unless it is determined to be invasive or otherwise harmful.

- Maintain “no-entry” vegetation buffers, particularly around watercourses, and clearly mark these before clearing starts to avoid excessive clearing. Riparian buffers are typically between 10 and 50 m wide, depending on the development activity. However, minimum buffers have been legally mandated for certain activities and industries, so check with regulators first before working directly adjacent to a watercourse.

- Only clear and blade to bare mineral soil when and where it is absolutely necessary. Instead, consider cutting trees and shrubs off at ground level and leaving the root mass in the ground. Willows in particular are very hardy and will regrow after being cut off and driven on, as long as most of the roots are kept intact.

2.1.2-01 Essentially no vegetated buffers were maintained around streams for this forestry development project. The trees left uncut are on islands and were inaccessible. Where there was access, cutting occurred right up to the streams.

- When blading to bare mineral soil must be done, stockpile and cover the scraped vegetation and organic soil and leave it in the immediate vicinity. It can be re-applied after work is complete, or applied elsewhere as needed.

Techniques to encourage natural revegetation:

- Most disturbed surfaces, natural or man-made, will eventually be recolonized by native plants, but it is important to initiate the revegetation process as soon as possible to reduce erosion. In the north, this can be a very slow process. Conditions that determine the time it takes for natural vegetative to be re-established include:
    - Proximity of viable seed sources.
    - Surface and soil conditions (suitability of soil for plant growth, including active site preparation and stabilization measures).
    - Local environmental conditions (e.g., elevation, location in Yukon, and the presence/absence of significant rains in early and mid summer).
- Natural revegetation can be greatly enhanced and accelerated by re-spreading topsoil and overburden that was previously scraped. The soil contains organics with a natural seed bank that should provide the necessary seed for revegetation. Where possible, stockpile and cover stripped surface material for later use.
- Natural recovery of vegetation in Yukon can be slow (many years to decades). In situations where more rapid plant growth or cover is required, the area should be actively seeded. A mix of perennial grasses or forbs often suffices; however, for steep slopes and other erosion-prone areas, it should include an annual grass for more rapid cover (see below).

2.1.2-02 Some sites are more challenging than others to revegetate.

Principles of revegetation through active seeding and planting:

If preserving vegetation or natural revegetation are not viable options, develop a revegetation plan for the site. Consider the following:

- Determine the revegetation objective in terms of the short and long-term goals:
    - Short-term: sediment and erosion control (e.g. stabilize the ground surface).
    - Long-term: rehabilitation to a "natural" state, creating fish/wildlife habitat, recreational use and aesthetics.
- Prior to construction, record the pre-project vegetation and site conditions. This information will help when returning the site as close as possible to its pre-existing condition. Remember to take photographs of the area to document conditions before construction begins.
- When recording pre-project vegetation types and site conditions, look beyond the immediate work site. It may help you determine what early successional habitats look like in that area, which may indicate the best colonizing plants to re-introduce. Also, since it may not be realistic to immediately re-establish the type of habitat that existed prior to construction, knowing the range of habitat types that occur locally may offer different options for revegetation. Finally, such recording will provide information about possible sources of natural seeds for re-vegetation.
- When recording site data, describe and test basic soil conditions (e.g., pH, structure, organic content, nutrient levels) to determine the need for soil amendments that would stimulate plant growth, such as organics or fertilizer.
- Determine what type of seeding/planting materials and techniques are appropriate and practical for the site. These choices are largely determined by the site's slope and stability. Steep slopes and other

2.1.2-03 Willow are very versatile shrubs. If the roots are kept intact, they will easily regrow. This mature willow bush was cut off and then transplanted to a new location.

unstable surfaces susceptible to erosion may require applications of stabilizing materials (see Section 2.1.3 *Mulching* and 2.1.4 *Rolled Erosion Control Products*). Selected seed mixes on these sites should contain rapid growing colonizing plants to quickly establish a ground cover, and may require hydroseeding (see below). Seeds usually can be applied mechanically, but seedlings and cuttings require hand planting.

- Timing: optimal seeding time is in spring (May/June) as soon after spring melt as possible. Available moisture at the site will determine when seeds germinate. Fall seeding/planting is also an option (from late September until the ground freezes up), with germination occurring after snow melt in the following next year. The advantage of fall seeding is that plants will germinate and become established earlier in the following spring. The drawback is that there may be more seed loss when seeding in fall, due to runoff and winter kill. If planting occurs too early (from mid-July until mid-September), seeds may germinate right away and many will die over winter (ungerminated seeds will survive winter, but recently germinated seeds and juvenile plants often will not).

2.1.2-04 Hydroseeding in progress. The slurry sprayed onto the slope contains a wet slurry of a fibrous mulch, seed and fertilizer. A tackifier is often included so the mixture sticks together better.

2.1.2-05 Soil preparation. The surface is loosened with a tine harrow prior to seeding. Many large seeding projects can be completed by a two-person crew using an ATV equipped with a harrow and broadcast seeding, in conjunction with hand seeding.

- Seedbed preparation: Harrowing or other means of roughening up the surface, before and after seeding, helps improve seed germination rates by scarifying compacted soil, covering seed with dirt, and creating moisture pockets.

- Seeding methods: Either hand or mechanized seeding methods – or a combination – may be appropriate, depending on the total area being seeded and nature of the terrain. When possible, use a seed drill, as it maximizes the seed-soil contact and greatly improves germination success. Unfortunately, seed drills are only practical on relatively flat, debris-free terrain. Hand and mechanized broadcast spreaders are most often used. A practical and inexpensive set-up for seeding many acres over diverse terrain is an ATV equipped with a tine harrow and a broadcast seeder. Hydroseeding is typically used for slopes that are steeper than 3HD:1VD.

2.1.2-06 A small area next to a creek is being raked in preparation of seed application.

To determine what seed mix is appropriate, consider the following:

- Seeds, seedlings, and the planting process can be expensive. So take considerable care selecting seed/seedling mixes to ensure that the plants germinate and take hold.

- A useful reference document is the *Yukon Revegetation Manual* (2012) published by Yukon College. Refer to it for seed-mixes and seeding rates that are matched to your project's site conditions. It also provides more details on reclamation and revegetation techniques than are listed here.

- You will find that only a select variety of native seeds are available commercially, but availability is always changing, so consult seed suppliers or the Government of Yukon's Agriculture Branch (EMR) when planning seed mixes.

- Avoid introducing invasive species – choose only the highest quality seed as outlined in the *Canadian Seeds Act* (1985). Ask for weed certificates from the supplier. This certificate lists results of testing for the type and percentage of weed seeds in the mix.

- Mixes of plants that are native to the site are preferred, but may be slow to establish. Consequently, it is acceptable to include an annual grass (rye, or barley) in the mix to create immediate ground cover. However, do not include more than 5-10% because

thick growth of an annual grass will impede growth of the preferred (native perennial) seed in the mix.

- For commercial production reasons, seeds and cuttings from native plants are often collected locally but propagated elsewhere, usually in Alberta and BC. When revegetating with “native plants,” ask for verification that the seeds were propagated from original Yukon stock.

- When implementing special seed/planting requirements and planting native plants, try to plan at least one year ahead so a seed producer or nursery has time to collect and grow sufficient stock. Developing a large seed supply takes many years, but nursery stock (i.e. rooted plants) can often be produced in one year from seed or small cuttings.

Monitoring:

- Monitor the revegetation progress for several years after planting, particularly along streams/erosion areas. Reseed or replant problem areas if erosion occurs or plants do not emerge.

2.1.3 Mulching

Mulching is the application of fibrous plant material, such as straw, to the soil surface. It is an effective means of controlling runoff and erosion on flat, disturbed areas and is often applied as a component of revegetation (seeding) programs because it helps retain soil moisture, promotes germination, and protects seedlings. By design, mulching is a temporary measure that protects the ground surface while seedlings germinate or while other permanent grading or cover is applied.

General principles:

- Protect mulches from wind by working them into the soil.
- When used in conjunction with seeding, apply the seed first and then the mulch.
- Water the mulched area to ensure the seeds below will germinate.
- Watch for and repair washout of mulch.
- Mulching can degrade slowly; therefore, some mulch products might need to be removed once vegetation is established.
- Avoid application where mulches may be washed from surfaces and end up clogging or polluting surface watercourses. If mulches are applied directly to stream banks, they must be well anchored with sticks, or can be hand-worked into the soil.

Straw mulch:

- Straw is a common mulch used as cover over a new seedbed. However, it is a short-lasting mulch so usually is used when the need for protecting seedlings is 3 months or less.
- When using straw in conjunction with seeding, apply the seeds first and then the straw.
- Straw should be properly cured and dried. Uncured straw may mold and damage seedlings.
- Straw should come from stalks of wheat or oats. Other baled

2.1.3-01 Straw mulch used on a stream bank to protect a seeded from erosion. This straw should have been worked into the ground surface better so it will not blow away or wash into the water body.

products, like hay and alfalfa, are an attractant to wildlife, are more prone to molding, and will break down more quickly.

- It is important that the straw is free of seeds of weeds and invasive plants. To avoid introducing invasive plants, use locally-produced straw whenever possible.
- Straw can be broken up and spread by hand or machine, but to be effective it must be applied to a uniform thickness, no less than 10cm and no greater than 20cm.
- Straw mulch needs to be anchored to the surface. This can be done mechanically by pinning, crimping, disking, or rolling it into the soil. Exercise care to avoid excessive compaction of the site when using equipment to anchor straw mulch. Compostable netting, such as jute or burlap, can be used to assist in anchoring. If the site allows for frequent (i.e., daily) watering, then the straw often can be anchored simply by keeping it moist on the surface.

Wood chip mulch:

- Chips should be relatively small to well as a mulching medium. The largest pieces should be <5cm in width and <10cm in length. The average chip should be much smaller.
- Wood chips are only suitable for areas that will not be closely mowed.
- An advantage of wood chips is that they can be obtained from trees that were cleared from the site, and thus provide inexpensive and locally derived mulch.
- Wood chips should only be applied to slopes that are <6% (16H:1V). Chips on steep slopes may be washed away by runoff and may clog drainage inlets.

Wood fibre cellulose mulch:

- A number of commercial products produced from recycled wood and paper fibers are available. Typically, these products are dyed green, and contain a variety of wood and paper fibers and may include other stability agents such as tackifiers and bonded fibers. These products are tailored for specific maximum slope angles, slope length, functional longevity, and erosional control effectiveness.
- Wood fibre cellulose mulch can be spread dry on a surface, but is usually applied wet, as a slurry using a hydromulcher. If applied dry, be sure to immediately wet the surface. Application rates depend on the specific product but are typically in the order of 11 to 14 kg per 92m^2 (25 to 30 pounds per 1,000ft^2) dry weight.

- In Yukon, wood fibre cellulose generally is not cost-effective or readily available for use as a mulch, but it is used in the slurry applied during hydroseeding, where it also functions as a flocculent and binder.

- If used in hydroseeding or other applications, be sure to purchase a type that does not contain growth-inhibiting factors, such as that found in cellulose insulation. For this reason, do not use cellulose insulation for mulch.

- Long cellulose fibre mulches provide better erosion control than short fibre mulches, but they only work well in a water/seed/mulch slurry when a tacking (binding) agent is added. Short cellulose fibres do not require a tacking agent but do not prevent erosion as well.

2.1.4 Rolled erosion control products

Rolled erosion control products (RECP) are flexible sheet materials that contain a central layer of permeable fibres sandwiched between two layers of coarse mesh. Often, both the fibres and the mesh are composed of organic materials so that the sheets decompose over time. Others are made from UV-stable synthetics (e.g., polypropylene) and are intended for longer-term use. RECPs are manufactured and purchased in rolls containing a sheet that is typically about 2m wide and 16m long.

RECPs are excellent products for covering unvegetated cut or fill slopes where erosion control or soil stabilization is needed. They are used where temporary seeding and mulching alone are inadequate or where mulch must be anchored and other methods, such as crimping or tackifying, are not feasible; for instance directly adjacent to streams.

2.1.4-01 A manufactured erosion control product composed of straw and jute mats being installed along a creek. The surface was seeded before the matting was unrolled, and later on willow cuttings were planted at the water's edge.

RECPs function best in providing a protective cover on slopes and channels where the erosion hazard is high and plant growth is likely to be slow, generally on slopes steeper than 3H:1V and with greater than 3m of vertical relief.

Planning:

- There is an array of RECP products available, composed of many different materials, each designed for a specific application. Choose one with a life expectancy appropriate for the site and application. Some of the organic fibre RECPs, such as ones made from straw and coconut fibre only last about a year before breaking down. Synthetic RECPs with UV light-resistant materials will last many years. Each has its place and application. Most often, the goal is for the RECP to persist and stabilize erodible surfaces until vegetation has developed and can provide a permanent erosion-resistant cover. At other times, the RECP functions as a semi-permanent surface treatment. RECP products are very effective, but tend to be expensive. Consequently, the most cost-effective strategy may be to use them in small or high-risk areas in conjunction with other erosion-control measures.

Installation:

- Each type of RECP has its own specific installation procedure so consult directions provided by the manufacturer.

- It is critical that RECP sheets be anchored. Special spikes, staples, and pins are available from the manufacturer, but rocks and site-made stakes can be used. Anchor spacing will need to be adjusted based on the type of material and steepness of slope.

2.1.4-02 The same site as in photo 2.1.4-01 one year later. Grass is emerging and the willow cuttings are growing along the water. The slope may look exposed and prone to erosion, but the buried erosion control project is keeping the slope stable while vegetation becomes established.

- For a RECP product to work effectively, it must be in direct, tight contact with the soil surface beneath it. Otherwise, runoff water can get between the sheet and soil and cause erosion.

- If used in conjunction with a seeding prescription, apply the seed and fertilize before installing the RECP.

Maintenance:

- Monitor the site for washouts and areas where RECP sheets may have slipped. After any damaged slope or rills have been repaired, reinstall the material and apply extra anchors.

- Periodically check that the anchors remain secure and are keeping the RECP sheets tight to the soil surface.

2.1.4-03 Coconut fibre matting reinforced with a UV resistant mesh was installed in a ditch that was prone to erosion and had a direct outlet into an adjacent river. The site was seeded prior to installation of the matting. There are two installation errors to note: the edges of the matting should have been folded into the side slopes by means of creating an anchor trench, rather than lying flat on the ground. Also, no dirt should have been put on top of the matting.

2.1.5 Surface roughening

Surface roughening, or cat-tracking, is used on slopes to provide a surface structure with small pockets that trap runoff and where water infiltrates into the ground rather than flowing downhill. The texturing also helps the revegetation process as the roughened soil and trapped moisture promote seed germination and prevent seeds from being washed away. The surface should still be graded properly and the surface should only show a light roughened texture. The process should not leave an undulating or uneven surface. Visualize a smooth soil surface that is roughened by driving over it with a tracked vehicle moving in a straight direction.

Planning:

- Surface roughening works on flat and most moderately sloped areas, except when the soil is hard pan and saturated. Instruct crews not to blade surfaces smooth or drag a flat bucket over them when grading sites, but rather to leave a rough surface and shallow cat tracks. A toothed bucket or blade works best. This will save time and money by avoiding the need to texture the surface in a separate treatment.

2.1.5-01 Slope tracking and seeding. This slope was nicely tracked with a Cat and seeded the year prior to taking this picture.

Methods:

- Run tracked machinery parallel to the fall line of the slope with the blade raised, not on the ground. Do not track parallel to the slope because it actually promotes erosion.
- Avoid excessive compaction by driving up and down the slope on the same surface only once.
- Minimize the number of turns made on the treated slope, as this causes ruts and depressions.

2.1.5-02 Extreme roughening of the surface with a ripper.

- Keep about 30 cm (1 foot) between each new track and cover the entire slope.
- Seed and mulch the slope immediately.

Maintenance:

- Check for erosion after significant rainfall events and spring runoff. If rills appear, regrade, roughen and seed again.

2.1.6 Check dams

A check dam is a structure, usually temporary, erected in narrow, erosion-susceptible drainage channels outside of watercourses that have been constructed on site to control storm water flow. They are installed to reduce flow velocity, and thus protect the channel from erosion, and also to reduce sediment loads in any channelled flows. They are placed directly in the channel and usually are positioned in series, constituting “steps”. It is not uncommon that check dams are installed as semi-permanent sediment control measures.

Planning:

Check dams can be made from a variety of materials. They are most commonly constructed of rock, logs, sandbags, or straw bales. When using rock, the material diameter should be 2 to 38 cm (1 to 15 inches). Logs should have a diameter of 15 to 20 cm (6 to 8 inches). Regardless of the material used, design the check dam carefully to ensure its effectiveness. Check dam steps need to be properly spaced so that water ponded behind the downstream check step reaches just above the base of the upstream step, like a staircase.

The following methods for constructing a rock and straw bale check dams explain the general design and application principles only. A site-specific design by an engineer may be required. Straw bale check dams may retain water more effectively than other check dam types, which can result in water building up and finding its way around the outsides. Straw bales may also fall apart, creating a large deluge of ponded water. Straw bales that are not sourced locally may also carry invasive species seeds within. The materials and design should be chosen relative to the expected lifespan of check dam, and anticipated high water flow.

Constructing a rock check dam:

- At the location of each rock check structure (step), excavate a trench key at least 15 cm deep, perpendicular to the channel.
- Place non-woven geotextile fabric over the footprint area of the rock check structure (including the trench key).
- Place the rock. The structure should extend all the way from one side of the ditch or channel to the other.
- The structure should be constructed so that centre of the crest is depressed to form a centre flow width that is a minimum of 30 cm lower than the outer edges.
- The height of the structures should be less than 80 cm to avoid impounding large volumes of runoff.
- Downstream slope of the check dam should be a minimum of 3HD:1VD.
- Upstream slope of the check dam should be a minimum of 2HD:1VD.

- The height and spacing between structures should be designed to reduce steep channel slopes to intervals of flatter gradient.
- Aggregate used should have a diameter of between 2 and 38 cm (1 to 15 inches) and must be large enough to remain in place during high velocity flow situations.
- Maximum rock diameter should not exceed 15 cm (6 inches) if the structure is to be used as a sediment trap.

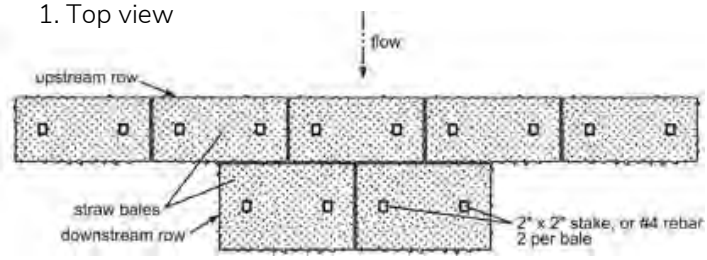
Constructing a straw bale check dam:

- At the location of each check structure (step), excavate a trench perpendicular to the channel that is approximately 15 cm deep and equal to the width of two straw bales.
- Place two rows of straw bales in each excavated trench perpendicular to flow direction, ensuring that the bales are staggered so that no joints are aligned on the upstream and downstream rows. Infill all joints with loose straw.
- The centre of the crest of the check structure should be at least 15 cm lower than the outer edges along the channel walls.
- Drive two 1.2 m long square section wooden stakes through each straw bale, ensuring each stake is embedded a minimum of 15 cm into the underlying soil.
- Backfill and compact the upstream and downstream edges of the check structure to seat the straw bales into the base of the ditch. Most local material will be suitable, but gravel is best.
- The lifespan and effectiveness of straw bale check dams is improved if each bale step is overlain with geotextile cloth prior to backfilling. The cloth should be pinned to the straw bales below grade before backfilling.
- The height and spacing between structures should be designed to reduce steep channel slopes to intervals of flatter gradient.
- To avoid impounding large volumes of runoff, check structures should be a maximum of one straw bale high.

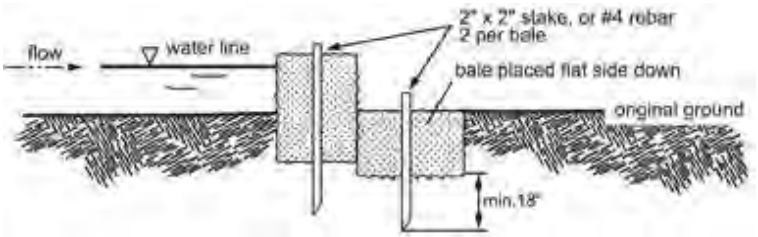
Maintenance:

- Check for erosion and integrity of check dams after significant rainfall events and spring runoff and repair where necessary
- Check that geotextile remains well fixed and that strawbales remain well anchored and re-anchor if necessary

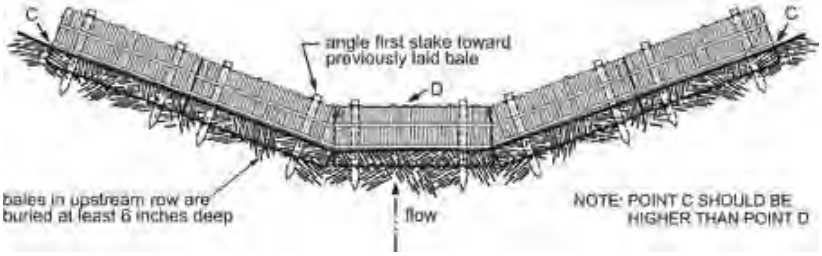
1. Top view



2. Side view



3, Upstream view



Source: US Department of Agriculture Natural Resources Conservation Service.
www.mt.nrcs.usda.gov/technical/fires/strawdam.html

2.1.7 Silt fences

Silt fences are used to pond sheet flow runoff on mildly sloped areas, thus allowing heavy sediment particles to settle out while water and lighter particles slowly pass through the fence material. When properly designed and installed, silt fences are very effective at removing sediment from runoff.

2.1.7-01 This silt fence illustrates that even an imperfectly implemented sediment control measure is better than nothing. The fence did its job, but could have been built better and it is beginning to fail. It is collapsing because of inadequate staking; metal rebar or larger wood stakes should have been used. Also, the fabric is unwoven geotextile cloth. Woven geotextile would have been a better choice, as it is stronger and will sag less. The fence will need to be cleaned out before it loses its usefulness.

In addition to creating sediment traps, another common application of silt fencing is for constructing perimeter barriers that prevent loose material from falling into watercourses.

The primary material used to construct silt fencing is geotextile cloth. Geotextile comes in two types: woven and nonwoven. Woven cloth is smooth, whereas nonwoven cloth has a rougher, woolly finish. The two products function differently, and have different applications. The woven type is stronger and allows water to seep through, but is impervious to sediment. Woven geotextile should be used for silt fencing. Nonwoven geotextile is more porous, but tends to clog up quickly with sediment and is not stiff enough to stand upright on a fence and resist water pressure (i.e., it sags and rips).

The design life of a silt fence typically is only around six months or less. Silt fences are frequently installed incorrectly. Successful performance is highly dependent on proper installation.

Installation:

- Place the fence at the bottom of a slope or on a slope bench. Install it at right angles to the slope, following the slope contour.
- The filter cloth should be keyed into the surrounding earth to hold it in place. Otherwise, runoff and sediment will flow beneath the fence. To do this, dig a shallow trench and

key the fabric in the ground. Cover the trench and compact the loose soil. Then pound the stakes into the ground.

- Posts should be spaced so that the geotextile cloth does not develop major sags and can support the weight of sediment and water. The cloth should be securely attached to posts on the uphill side, so fasteners are not pulled out by the weight of sediment and water.

2.1.7-02 This silt fence should have been installed at the bottom of the disturbed slope rather than in the undisturbed vegetation. Currently it is non-functional.

- Where a joint in the geotextile is necessary, ensure that there is sufficient overlap.

- Silt fences should not be used in locations with concentrated flow, including streams or other storm water conveyances, as they will not hold up to the flow.

2.1.7-03 This silt fence was installed along a creek as a perimeter fence to keep loose material from rolling into the water.

Maintenance:

During installation or inspection, a silt fence may appear to be adequate, but the adequacy of a fence is only tested during storm events. Installers and inspectors must ask if the fence will hold up during storms. The geotextile must be kept in good condition to maintain its function in a storm. If it is torn or frayed, replace it. If the geotextile is not keyed into the surrounding earth, it must be reinstalled. The posts should be reinstalled if they loosen. The silt fence should be cleaned when sediment accumulates and cleaned or replaced when it is covered with sediment. Here is a checklist:

- Straighten leaning fencing and secure loose posts. Fix rips in the geotextile.

- Assure that the geotextile is securely attached to the fence posts.
- Check for evidence of runoff overtopping the geotextile; correct as necessary. Clean out excess sediment.
- Check for underflow and re-key if necessary.

2.1.8 Sediment traps, sumps and detention ponds

Many development activities will generate significant amounts of sediment-laden water, either from runoff over newly exposed ground or from pumping and dewatering operations. It is standard practice to direct this wastewater into sediment traps of various sorts and sizes, depending on the types and scale of operation. Once in the trap, sediment settles out while the resulting clean water either percolates into the ground or is actively discharged. Silt fences perform a similar function. However, traps can handle larger volumes of water and sediment loads. They also function better than fences at removing fine-grained sediments such as clays or silts, as well as some chemicals.

2.1.8-01 This sediment trap contains water pumped from isolated in-stream work areas created to construct a new bridge pier. This sediment trap has a passive overflow near the top of the picture. Clear water exits the overflow and passes through vegetation before re-entering the stream.

2.1.8-02 Creative use of an old fuel tank as a sediment settling system. The upper container receives the sediment-laden water and has a passive overflow to the lower container, which has an outlet controlled by a valve.

Detention ponds function similar to sediment traps, but they are large, semi-permanent structures that require advanced engineering, whereas traps are temporary in nature and often are built on-site with minimal materials. The photographs in this section illustrate the wide range of sediment traps, sumps, and ponds that can be constructed.

Sediment traps and natural sumps:

Sediment traps usually are built on-site and often take advantages of natural sumps. However, manufactured tank systems are available and may be the best choice in some situations. Tanks

come in many forms and most often are prescribed for space-limited situations, sensitive permafrost sites, or when contaminants other than sediments need to be separated from water (it is far more effective to contain and pump contaminated sediment from a hard-lined tank than from a hole in the ground).

Site-built traps are either simple constructed containment structures or may utilize natural sumps. A simple trap can be made with straw bale walls and a lining of geotextile cloth. The main disadvantage of this system is that if the geotextile becomes clogged, the trap quickly fills, and clean water must be discharged to yet another area. The simplest and most common approach to a sediment trap is to utilize a natural, vegetated depression (sump). Vegetation helps retain sediment and slow the flow of water, and clean water either percolates into the ground or spreads further out in the depression. If only small volumes of sediment-laden water are being treated, then even a flat surface or minor depression can be used, if it is well vegetated. If an area is already disturbed and stripped of vegetation, then a pit can be excavated and used as a trap, but it should be lined with rock and should have an elevated rock-lined outlet. Excavating a vegetated area for use as a trap usually is counterproductive and may lead to more erosion and sedimentation. In almost all terrain, some form of natural depression can be found.

2.1.8-03 The size of a sediment trap depends on the volume of water that will be generated and sediment settling rate. This trap, while small, was built to contain a small volume of concrete cooling water, and was completely adequate for the job.

The size of the sediment trap is designed to match the expected sedimentation rate, which is determined by sediment size (clay precipitates out slowest, gravel fastest), water input volume, and percolation (infiltration) rate. These factors make the type and size of the trap a very site-dependent decision. For example, the amount of water being sent through a trap may be relatively small, but if the sediment load is very high and much of the sediment is fine clays, then the trap may need to be built as large as a trap that deals with large volume flood events carrying only a small load of sand.

Dewatering sediment traps:

2.1.8-04 A small excavated sump built to collect runoff from an exploration trench. Simple, but effective.

Water often accumulates in sediment traps faster than it can percolate, especially as the trap fills with sediment, and some traps are impermeable by design. In those cases, water must be properly dewatered either by pumping or via a controlled outlet. In either case, the sediment load of the discharge must be monitored and treated for sediment. If small volumes are involved, they usually are just pumped from the trap and directed onto a vegetated area for infiltration. A common mistake is to use a pump that is too large, causing the water to be pumped out too quickly or under too much pressure, which often leads to gullying and erosion. It is far better to use a small pump and run it for longer periods, or even continuously, so that the discharge occurs as a trickle. The outlet of the hose should be moved frequently to distribute water and sediment evenly. A second mistake is to pump water from too low in the trap, where there is more sediment. Floating pumps or floating suction inlets should be used so that only the cleanest water is discharged. Never pump overflow water directly into a watercourse. On traps with designed outlets, the outlet should be elevated and lined with rock. Outlet water either can be directed to a vegetated area for natural infiltration, or into a rock flume if it is permitted to be channelled towards a watercourse.

Detention ponds:

Detention ponds, also called retention ponds, are large, constructed ponds that have the capacity to accept sudden and/or large amounts of runoff or discharge water. The ponds are dewatered through elevated outlet pipes, which allow for slow discharge of clean water. The settled water leaving these pipes may either be routed to a natural watercourse or may receive further filtering and treatment if required. The volumes are generally too large to simply be discharged directly onto vegetated ground. Detention ponds can be effective for both reduction of downstream erosion (because they release slow-velocity water) and the trapping of sediment and contaminants. A number of variations on the basic design are available and such ponds can range from relatively small single basins to multiple basin systems comprised of interconnected excavations and associated wetlands. They require regular maintenance (i.e., sediment removal) to ensure that proper capacity and adequate drainage are maintained. Depending on the source of water and sediment, sediments may require special treatment if they contain contaminants. That is especially a concern in the case of urban storm water management or large construction and mine sites.

Designing and constructing detention ponds is a significant endeavor. They require the assistance of an engineer and working in collaboration with inspection and regulatory agencies, such as EMR's Compliance Monitoring and Inspections (for mining) or Department of Environment's Environmental Compliance and Inspections Section (for non-mining). Such ponds will likely trigger the need for a water license. The environmental concerns about detention ponds stem from the possible concentration of contaminants in retained sediments (and safe disposal of those sediments), concern about water quality, and concern about the safety and design of large water retaining structures.

2.1.8-05 This is a well-constructed and designed sediment trap with a passive overflow.

2.2 Contaminant control

2.2.1 Fuelling, maintaining and washing equipment, and spill kits

A small amount of fuel spilt into water can have a relatively large environmental impact compared to a spill on land, and dealing with contaminated water is expensive and difficult. For these reasons, every effort should be put forward to avoid spills in water. And while fuel spills are the main concern, there are other sources of contamination related to equipment use: stored lubricants and cleaners, leaky and greasy equipment, and contaminated water from equipment wash stations. The owner of a well-maintained piece of equipment who follows well-practiced fuelling and washing procedures will be able to avoid accidental spills better and have fewer accidents. Yet, accidents can happen and it is important to have emergency contingency plans and know how to implement them.

2.2.1-01 A generator properly set on a spill tray with roof and fabric to protect it from the weather.

The *Land Use Regulation* (2003) requires a Land Use Permit for fuel storage exceeding 4,000 liters capacity or the use of a single container with a capacity exceeding 2,000 litres. The *Storage Tank Regulations* (1996) under the *Environment Act* (2002) apply to tanks that are larger than 4,000 litres and may be permitted and inspected by the Fire Marshall's Office. Fuel storage permitting thresholds and secondary containment requirements are also listed in the Mining Land Use Regulations (both Quartz and Placer).

The following preferred practices will help reduce the chance and consequence of spills while fueling, maintaining and washing equipment:

Fuel and Chemical Storage:

- Create a designated area to store fuel, lubricants, detergents and other chemicals. It should be located well away from any watercourse, at a minimum 30 m, and often will be the same area that equipment is fuelled, stored and maintained.

- Fuel tanks should be placed in some form of secondary containment. Standard practice is to place drums in spill pans and to place immobile storage tanks (anything larger than a drum) in secondary containment with the capacity that is 110% of the fuel being stored. The idea is that the entire volume of a tank would be contained if the tank was ruptured. The most common, and most hassle-free, approach being used today is to store fuel in a double walled tank. These do not require secondary containment, as that is already built-in. However, a spill tray should be placed under the fill nozzle to contain drips.

2.2.1-02 While these drums of fuel and lubricants were placed in a spill tray, and an attempt was made to cover them, the protection is not adequate. The plastic half drum and spill tray will collect rain water. Workers will be tempted to tip the containers to dump out the water, and if they fill completely then the lighter petroleum products will be the first to overflow. Note also that they are not stored 30m away from the water body in the foreground.

- All tanks over 4,000 litres (including single tanks or aggregates over 4,000 litres) must be double-walled (i.e. secondary containment as an intrinsic part of the tank construction).

- Contained tanks and double-walled tanks must be specified and installed by a certified installer. If the tank is used as a service station, it should have some kind of secondary containment to capture spills from the tank, piping and fuel pump.

- Dyked containment systems should follow the following configuration:

    - If clay, steel or concrete materials are proposed for use in a containment system, Mining Inspections may require designs that have been sealed by a qualified professional engineer

- The entire area enclosed by the dyke must be liquid-tight, impervious to fuel, and have no openings and can be constructed of impermeable materials such as steel, concrete, clay and geomembranes. The lining can be a geomembrane, or compacted clay if the clay passes a compaction test, however, the use of clay materials is generally discouraged because it is difficult to ensure the long-term integrity of the liner, which may be subject to soil cracking and leakage
- The area must have the capacity to hold and contain 110% of the stored fuel volume.
- If constructed of earthen material (i.e., a berm), the dyke must have a flat top, not less than 1.2 m wide and covered to protect against erosion (usually, this is the same material as the liner). It also must have sides that are sloped at a stable angle (3HD:1VD).
- The dyked area must provide for the collection and removal of rainwater by sloping the entire liner at a two percent grade to a sump located at one end of the area.
- Accumulated rainwater must be separated from hydrocarbons, if spills or leaks have occurred.
- Common practice in Yukon is one of the following:
  - Construct a storage area with an earthen dyke that is lined with an impermeable geomembrane, or
  - Construct a containment area from compacted clays, or
  - Set up a commercial, manufactured rubber containment structure (pool), or
  - Use a double-walled tank, in which case a dyke is not required (except if the tank is larger than 50,000 litres).

- Keep a spill containment tray underneath fuelling nozzles. The most common form of fuel contamination occurs from drips and spills emanating from fuelling nozzles.
- Lubricants, detergents and other chemicals should be stored in weather tight containers, at least 30 m from a watercourse. If containers are kept under cover, ensure that they have adequate ventilation.

Fuelling and storing (mobile) equipment:

Probably the most common form of fuel contamination on work sites occurs from drips and spills emanating from fuelling nozzles as they are moved back and forth from the fuel tank to equipment. Therefore, the best thing a contractor can do to avoid site contamination is to implement the following strict fuelling guidelines, paying particular attention to drips from nozzles:

- Create a designated area for equipment fuelling, repair and storage located well away from any watercourse, at least 30 m. In most cases, fuel and other chemicals are stored in the same location.
- Often in small operations, a fuel truck with a tidy tank is driven up to equipment for fuelling. Use care and elevate the nozzle when transferring it to and from the equipment. If the fuel truck cannot be position immediately adjacent to the equipment, place a containment tray on the ground to catch any drips from the nozzle.
- In large operations where equipment is driven to the refuelling area, make sure that a large enough drip tray is available to contain drips from the nozzle. For some Government of Yukon projects, contractors will be required to line and/or berm refuelling areas to provide secondary containment of spills.
- At the end of the workday, park equipment at least 30 m away from any watercourse, preferably in a designated equipment storage area.
- Plan for emergencies:
    - Prepare an emergency spill plan and ensure that all employees are familiar with the plan.
    - Keep spill kits handy, fully stocked, and stored in a weather-tight container.
    - Keep adequate fire-suppression equipment on hand, including extinguishers and a dedicated water pump and water supply when warranted.
    - Have emergency phone numbers posted in the event there is a need for immediate help (Yukon Spill Line (867) 667-7244).

Using spill kits:

Spill kits of various sizes and for various applications are widely available. Typically, spill kits contain a variety of materials to deal with spills including absorbents and absorbent pads, tools and personal protective equipment (PPE), specialized reagents or neutralizers, disposal bags and instructions or clean-up procedures. The following principles should be employed:

- Ensure spill kits are readily available and accessible for when they are needed. They should be one of the first things off the truck at any construction site, not packed at the bottom of a load.

- Ensure spill kits are appropriately sized for the scale of the project. For example, “First Response” spill kits typically come in 80 litres (20 gallons) pails and are appropriate for small construction sites. Larger projects may require larger spill kits.

- Ensure spill kits contain appropriate materials for specific projects. Most spill kits contain materials for absorbing products typical for most construction sites (e.g. gas, oil, diesel, antifreeze), but projects that deal with more specific reagents or hazardous materials may require specialized materials such as reagents or neutralizers. For example, spill kits specific to cleaning up battery acid or mercury spills are available and should be available if these materials may be spilled.

- Ensure all staff are familiar and trained on how to employ and use the contents of a spill kit.

- Follow instructions or clean-up procedures provided with the spill kit. Use materials appropriate to the spill. For example, some types of absorbent pads are general purpose while others are specifically designed to absorb oil and hydrocarbons and not absorb water. Absorbents may be color coded to indicate their intended use.

- Ensure used (contaminated) spill kit materials are disposed of in an appropriate manner.

Fuelling water pumps:

Water pumps often must be placed directly adjacent to watercourses, and it usually is impractical to move them for refuelling. If the following procedures are employed, water pumps can be refuelled in-place:

- Place the pump on a fuel containment tray that is above the high water mark at all times.

- Fuel the pump by hand, using a hand-held fuel container of about 10-25 litres (2-5 gallons). This is done so that the filling process can be monitored and there is little chance of over-filling. Do not fuel with electric pumps or gravity feed unless there is an emergency shut-off switch within arm’s reach while the operator fills the tank.

- Keep sorbent pads and other spill response materials handy and stored in a weather-tight container (spill kit).

- Store the fuel container for the pump at least 30 m away from the water.

- When the pump will not be used for a long period, do not leave it stationed at the watercourse. Move and store it at least 30 m away.

Fuelling immobile equipment:

Other immobile and very large equipment (i.e. cranes) may also be fuelled without moving them to the designated fuelling site using the following procedures:

- Move the equipment out of the water, onto the shore.
- Fuel the equipment with two people: one person at the fuel tank; the other positioned at the target equipment. The purpose of this procedure is to facilitate a quick shut-off of the fuel. The two people should communicate clearly about the fuelling status (e.g., when the tank is almost full, when to slow down the flow). Practice this fuelling procedure so each person knows what to expect.
- Some fueling equipment includes automatic shutoff switches. However, these do not relieve the need to pay close attention during the fuelling process, as these devices may malfunction or will continue to pump fuel in the event that the nozzle becomes dislodged during the fueling process.
- Keep sorbent pads and other spill response materials handy and stored in a weather-tight container.

Condition of equipment:

- Leaky equipment cannot be used for work that will occur in or adjacent to water. Equipment that leaks oil, fuel or hydraulic fluid must be removed from the site immediately.
- Grease, oil and surface grime on equipment can contaminate water and need to be removed prior to use of the equipment in or near water.
- Always keep sorbent pads and/or spill kits in the equipment.

Equipment Washing:

- Designate a site well away from the watercourse as a washing area. A gravel pad is best, as it will promote the percolation and filtration of wash water.
- Pressure-wash the equipment until all dirt, grease and fuel have been removed from exposed surfaces. Minimize the use of detergents.
- If site conditions warrant, direct and contain runoff by means of berms, or natural sloping so that wash water collects in a sump that allows for percolation.
- Be aware that washing of dirty, greasy equipment has the potential to create contaminated water and soil, which the operator will be responsible to clean up. Soil remediation is expensive and time-consuming, so plan ahead to avoid this.

Emergencies:

- Prepare an emergency spill response plan. A number of documents are available to assist in preparing response plans, and a link to the Yukon Water Board's template for Fuel Spill Contingency Plan is available in "Section 7.2: Additional useful internet sites and document links".

- Train all staff in spill and emergency response practices. Procedures to be followed in the event of an emergency should be clearly posted in an appropriate location. Include the phone numbers listed below, as well as contact information for site supervisors.

- **Call the Yukon Spill Line (867) 667-7244** for all spills and equipment into water.

2.2.1-03 Emergency response. An oil spill occurred on this small lake during gravel extraction activities when a crack developed in the oil reservoir of an excavator. Booms are being deployed to contain the spill, and oil on the surface is skimmed off using absorbent pads. Ice on the lake helped contain the spill.

2.2.2 Using concrete near water

Concrete leachate and uncured cement are alkaline and highly toxic to fish and other aquatic life; it is a violation of Yukon and federal statutes to discharge alkaline materials into watercourses. The way to prevent this issue is to isolate and neutralize (bring to neutral pH) all concrete waste water and uncured cement materials before they are reintroduced to uncontaminated water. Fortunately, this is not a difficult procedure and cured concrete is very benign. Basically, concrete waste water and uncured materials are neutralized by allowing them to sit in a containment structure filled with neutral water. Over the course of a few days to weeks, the uncured cement in the solution will cure and become neutral. The alkaline water will also naturally neutralize over time. The curing process is easy to monitor by regularly checking the pH. When a pH is achieved that matches that of the surrounding natural waters (usually 6.5 to 8.5), the water is considered safe for reintroduction to natural water systems. Note, however, that the discharge of this water back into a watercourse usually requires a water license to ensure that proper discharge conditions are understood and met. This section lists the basic procedures for pouring concrete and safe handling of concrete-curing water.

Small concrete projects adjacent to watercourses (e.g., platforms for water pumps):

- Small amounts of curing water will neutralize fairly quickly, as long as they are highly diluted before contacting a watercourse. But avoid discharging this water directly into the adjacent watercourse. Instead, direct it away from watercourses into a small sump area. After the water has percolated out or evaporated, remove the concrete crust/debris that is left and take it to an approved dump site.

- When larger amounts of waste water are generated, direct the curing water/runoff away from watercourses and into a designated settling area or sump. Alternatively, construct a perimeter berm or ditch around the pouring forms to prevent curing water from entering the watercourse directly. If it is allowed to sit (cure), it will neutralize in a few days to weeks. Monitor the water by testing the pH regularly. Once the water has neutralized it can be discharged onto a rock flume or into vegetation. The concrete debris that is left needs to be removed and taken to an approved dump site.

Large concrete projects in and adjacent to watercourses (e.g., piers and dam structures):

- Completely isolate all concrete work from the watercourse and any water that enters the watercourse or storm water system. Apply techniques prescribed in Section 3.9 *Isolating In-Stream Work Areas*.

- Prevent any water that contacts uncured or partly cured concrete (during activities like washing exposed aggregate, wet curing, or rinsing equipment) from directly or indirectly entering any watercourse or storm water system.

- Erect impermeable containment facilities to collect wash-down water used to clean concrete delivery trucks, concrete pumping equipment, and other tools and equipment. After the waste water has been neutralized, it can be discharged. Remember never discharge directly into a watercourse – discharge onto a rock flume or into a vegetated ground sump.

2.2.2-01 A sturdy work platform constructed below this bridge allowed easy access to the superstructure, but it also helped catch debris and keep uncured concrete from falling in the water.

Emergency planning:

- Keep on site one or more 75L tanks (with regulator) containing CO_2, along with hose and a gas diffuser. Dissolved CO_2 in water reacts with alkaline solutions effectively reducing the pH. If a spill occurs, quickly contain it and then discharge the bottled CO_2 into the waste water.

- Because alkaline material is a contaminant, you are required to report all spills and accidental discharges of uncured materials into watercourses. Spills shall be reported to the Yukon Spill Line (867) 667-7244.

2.3 Fish specific guidelines

2.3.1 Fish screens and water pumping guidelines

Many work projects will require pumping water from a stream or lake. Be aware of the following principles when withdrawing water:

1. A water licence is not required if the withdrawal rate is below the thresholds in the *Waters Regulation*. For Industrial and Municipal undertakings this threshold is 100 m³/day or less. For placer mining, quartz mining, and all other undertaking types the threshold is 300 m³/day or less. A water licence is required if the withdrawal rate exceeds those criteria, or if below the criteria if the withdrawal could result in a significant potential adverse environmental effect or interfere with the existing rights of an authorized water user or waste depositer. Note that for any water use or waste deposit without a licence (below thresholds) a Schedule 3 (*Notice of Water Use/Waste Deposit without a License*) form is required to be submitted to the Yukon Water Board a minimum of ten days prior to the proposed withdrawal for quartz mining, placer mining, and industrial undertakings.

2. Follow fuelling procedures as outlined in Section 2.2.1

3. Fish guards must be installed over the intakes of suction hoses placed in fish-bearing waters using the following DFO criteria:

    - Screens must have maximum design openings no greater than 2.54 mm regardless of opening shape.
    - Monitor the screens to ensure they function effectively.
    - Submerge the screen so the flow distribution is uniform around the total screen area.
    - Screens should be located in areas and depths of water with low concentrations of fish throughout the year.
    - Screens should be located away from

2.3.1-01 A typical fish screen for a 4” to 5” pump, fitted with correct screen size.

natural or man-made structures that may attract fish that are migrating, spawning, or in rearing habitat.

- Stop pumping water if banks are slumping or other changes occur to the stream or channel.
- More detailed information on screen sizing and installation is given within the *Freshwater Intake End-of-Pipe Fish Screen Guideline* which is available from DFO's website at www.dfo-mpo.gc.ca.

2.3.1-02 A very large fish screen for a high velocity 8"to 10" pump.

2.3.1-03 An example of a fish screen with holes that are too large.

2.3.1-04 An unacceptable pump station. Water pumps need to be placed in spill trays and fuel must be stored >30m away from any water body.

2.3.2 Fish salvage

In-stream construction activities have the potential to (accidentally) kill fish. For instance, when a temporary isolation structure is erected in a river, fish may become trapped inside and will die when the structure is pumped dry. However, it is a violation of the *Fisheries Act* (2002) to destroy fish by any means other than sport, commercial, or subsistence fishing (except if authorized by the appropriate regulator). This requirement does not just apply to game fish; fish as small as slimy sculpins and minnows are protected as well. Thus, developers are compelled to conduct "Fish Salvage", which includes collecting and transplanting fish from the affected site and are immediately moved to an unaffected part of the stream or lake. This can be done by electroshocking, netting, or other means.

For further guidance, contact the DFO. Contact information is available in Chapter 5.

2.3.2-01 A fish salvage operation. A section of the steam was netted off and fish were collected from the isolated area by means of electroshocking. The electroshocking unit is on the back of the person on the left and the yellow pole is the shocking probe. The person on the right is helping retrieve the fish, which are only stunned for a fraction of a second so they need to be caught quickly.

2.3.2-02 Fish collected using a minnow trap.

3 Working in and around surface watercourses

This section lays out preferred practices for some of the most common activities undertaken by developers in Yukon. It provides notes for planners and designers, as well as preferred practices to use during the construction process. For details on how to carry out those practices, the reader will be referred back to specific subsections in the previous section "Materials and methods."

3.1 Working adjacent to surface watercourses: general principles

This section explains the basic operational procedures for work done within 50 m of any watercourse and along stream banks. Examples of these types of activities include general site preparation for road construction and forestry block development, as well as activities like shoreline construction and bank stabilization.

Land-based activities adjacent to a stream may require a Land Use permit from Government of Yukon. In addition, if banks are altered, authorizations from both DFO and the Yukon Water Board may be required, or these agencies may need to be notified of the proposed activity. Aquatic species at risk listed under the *Species at Risk Act* (2002) (SARA) must be considered, and their critical habitat and residences where they may be present. Contact DFO, the YWB Secretariat, Environment ECI or EMR CMI (if mining related) to get further information on licensing requirements.

3.1-01 The rock being placed in this stream is covered with sediment and is depositing silt in the stream. It should have been washed prior to careful placement in the stream.

Planning for the activity:

- Check equipment to ensure it is free of leaks and excess oil or grease. Clean it if necessary.

- Refuel equipment at least 30 m away from watercourses.
- Keep spill kits handy.
- Plan for emergencies: have a spill response plan in place that includes emergency phone numbers to call in the event of a spill such as the Yukon Spill Line (867) 667-7244.

3.1-02 A simple diversion was created to guide runoff into the vegetation, rather than the stream. Sometimes it's the little things that make a big difference.

Erosion and sediment control measures:

- Complete the work during favourable weather conditions to avoid erosion and sedimentation. In summer, avoid working near watercourses during wet periods. During other seasons, take advantage of frozen surfaces to do work that otherwise would cause additional disruption to soils.
- Take proactive measures to prevent any material from entering the watercourse, such as sediment, water, concrete, and other debris. Sometimes, this will mean building or installing containment structures such as berms and silt fencing. It may be as simple as laying down geotextiles to catch debris or protect a stream bank.
- Often, projects conducted near watercourses call for the placement of rock, riprap or other materials on banks or in river channels. These materials must be non-acid generating or metal leaching, clean (free from adhering debris), or washed if necessary, prior to their installation. Place the riprap carefully without splashing or stirring up the stream bottom

3.1-03 This stockpile of loose material should have been covered with plastic or geotextiles to avoid sediment runoff into the river. Depending on how and when the material was to be used, it also should have been stockpiled away from the river.

- If sediment, rock, or other materials will be excavated prior to work, they should be stockpiled in a stable location above the high-water mark, as far as possible/practical from the watercourse. If the stockpile is close to the water, cover it with plastic sheeting or geotextile cloth as a temporary measure to avoid sediment runoff. Scrape and stockpile organic soil layers separately from sediment and rock so it can be re-applied to the top of the work site surface at the end of the project.

- Minimize disturbance to existing vegetation. Cut brush off to ground height if needed, but without disturbing the roots. This practice will allow the vegetation to regrow from rootstocks.

- Construct temporary runoff ditches, water bars or diversions within the work area in a way that does not discharge sediment loaded water directly into the stream. Divert the ditch flow to a vegetated area where it can infiltrate into the ground.

- If operating stationary machinery next to a watercourse, position it on a stable location on the bank. Create an operating platform (with rock) if needed.

Site restoration:

- Sediments, rock and other materials that were stockpiled should be redistributed on the site or hauled away.

- Grade disturbed areas and leave slopes in stable conditions after the work is completed. Use stockpiled materials strategically to achieve this goal. Try to spread stockpiled organic soils evenly over the top of the restored surface.

- Revegetate the site and if possible use a seed mix with species native to the area. Use revegetation and other erosion control practices in this guide to augment the vegetation grown.

- When restoring stream banks, plant rooted shrubs or stakes (e.g., willows) along the bank and near the water. This is in addition to seeding the area.

- At the interface between water and a disturbed surface, it may be necessary to take additional erosion control measures, such as installing rolled erosion control products to augment seeding, shrub plantings, or riprap.

Maintenance:

- Check the site after the next heavy rain or when the snow has melted the following spring and fix slumps or erosion problems.

- Reseed or replant areas where vegetation failed to germinate or take hold.

3.2 In-stream work: General principles

This section explains preferred practices for work done with equipment positioned in or crossing a stream.

In-stream work is only possible for low-flow streams (unless an isolation structure is erected – see Section 3.9 *Isolating In-Stream Work Areas*). Typical work includes repairing or maintaining structures like weirs, culverts and bridge foundations, but may also include activities such as creating a new stream channel as part of channel restoration. Authorizations from DFO and the Yukon Water Board are typically required for any in-stream work, or these agencies may need to be notified of the proposed activity. Contact DFO, the YWB Secretariat, Department of Environment ECI (for non-mining) or EMR CMI (for mining related) to get further information on licensing requirements.

Planning for the activity:

- Check equipment to ensure it is free of leaks and excess oil or grease.
- Wash equipment prior to in-stream work (away from the water) to remove all dirt, grease and oil. Pay special attention to grease and debris lodged behind bogie wheels, tracks and undercarriage structures.

3.2-01 Pressure washing a dozer in a designated site that is lined and bermed.

- If riprap is to be placed, it must be non-metal leaching or acid generating (Non-ML/ARD) and be clean, with no debris or fine sediment. If riprap is not delivered clean, it must be washed prior to placement. Washing should be done away from the watercourse with runoff control measures in place. It may be necessary to plan for and construct a staging area for receiving and washing riprap.
- New and altered stream features, including placement of rock, should be designed to match the existing stream grade and banks heights, unless otherwise prescribed.
- When necessary, install and maintain effective sediment and erosion control measures throughout the project. Consult Section 2.1 *Erosion and Sediment Control* in this manual for guidance on those measures.

- In-stream work must be scheduled to avoid disrupting fish during sensitive life stages, (e.g., spawning). When scheduling in-stream work, consult the DFO webpage "Freshwater Timing Windows Identified for the Yukon" at http://www.dfo-mpo.gc.ca. It lists specific windows of time that in-stream work may be carried out within each Yukon river system.

- Regardless of preferred timing windows, additional mitigation measures such as sediment curtains may be required by regulatory agencies for in-stream work.

Working in the water:

- Operate the machinery from a stable location on land and only enter the water if it is not feasible to work from land. It may be a far better plan to build a temporary platform than to place equipment in the water.

- If working from land is not possible, enter the stream from a stable, gently sloped bank, and do not create multiple entry points for equipment.

- Install additional erosion control measures at the entry point. Riprap may be required.

- Minimize disturbance to existing vegetation at entry points. Cut brush off to ground height if needed, but without disturbing the roots. Avoid scraping down to bare mineral soil when unnecessary. This practice will allow the vegetation to regrow from rootstocks and keeps organic soil in place.

3.2-02 All that was available on short notice as a temporary erosion control measure on this road building project was unwoven geotextile cloth. While not the preferred material, this impromptu action on the part of the contractor was a resourceful solution, and was well-executed (note the ample staking). A week later, the permanent solution was installed that consisted of large rock (riprap) placed along the bank.

- Complete the in-stream activity as quickly as possible to minimize the time that equipment is in the water. Do not leave equipment in-stream during prolonged breaks in work activity.

- If sediment, rock, or other granular materials will be excavated prior to work, they should be stockpiled in a stable location above the high-water mark, as far as possible/practical from the watercourse. If the stockpile is close to the water, cover it with polyethylene

plastic or geotextile as a temporary measure to avoid sediment runoff. Scrape and stockpile organic soil layers separately from sediment and rock so it can be re-applied to the top of the work site surface.

Site restoration:

- Sediments, rock and other materials that were stockpiled should be redistributed on the site or hauled away.
- Grade disturbed areas and leave slopes in stable conditions after the work is completed. Use stockpiled materials strategically to achieve this goal. Try to spread stockpiled organic soils evenly over the top of the restored surface.
- Revegetate the site and if possible use a seed mix with species native to the area. Use revegetation and other erosion control practices described in Chapter 2.1 of this guide.
- When restoring stream banks, plant rooted shrubs or stakes (e.g., willows) along the bank and near the water. This is in addition to seeding the area.
- At the interface between water and a disturbed surface, it may be necessary to take additional erosion control measures, such as installing rolled erosion control products to augment seeding, shrub plantings, or riprap.

Maintenance:

- Check the site after the next heavy rain or when the snow has melted the following spring and fix slumps or erosion problems.
- Reseed or replant areas where vegetation failed to germinate or take hold.

3.3 Runoff control on roads

Properly designed and constructed roads have provisions to control runoff and avoid erosion. Avoiding erosion is important to keep sediment from entering nearby waters, but also to maintain the integrity of the road structure itself. This section describes four commonly used runoff control techniques for roads including water bars, cross ditches, slope grading and crowning. Bear in mind that the information provided here only constitutes an introduction to these techniques. Road design and construction often requires input from an engineer.

3.3-01 The lack of drainage control on this road has resulted in major washouts and has made the road barely useable.

Water bars:

A water bar is a diagonal channel constructed across the road surface to channel excess water on a temporary basis, such as during spring melt or heavy storm events. Water bars can also be used on a reclaimed/abandoned road in steep terrain as a permanent water diversion tactic to prevent erosion. Water bars allow water to cross a road in a focused channel, rather than flowing as sheet wash or riffles on top of road surfaces. They also reduce the length of the runoff path, which reduces the opportunity for water to cause erosion. Furthermore, by channelling the runoff, water can be kept out of erosion-prone portions of the road-bed and directed over more resistant sediments. Water bars are sometimes framed with boards on the sides and bottom or lined with gravel to increase their effectiveness. However, they must be left shallow enough for vehicles to drive over. Water bars find their application in situations where there is no defined ditch along the road.

3.3-02 Installation of a culvert to provide cross drainage.

Cross ditches and culverts:

A cross ditch or culvert differs from a water bar in that water is channelled beneath the road rather than being channelled across the road surface. Typically a cross ditch or culvert is located on the bottom of a slope, in a natural low area where water tends to accumulate. This type of water crossing is most commonly used for roads with defined side ditches. For details on installing culverts, see Section 3.6 *Culverts*.

Sloped grading:

Grading of a road toward (in-sloping) or away (out-sloping) from the slope of the road surface helps control runoff without ditches or cross drains. In-sloping directs runoff to remain in the road cut while out-sloping directs runoff across the road to the shoulder. This technique should only be used for roads with less than 6% grade. Furthermore, in-sloping will require a ditch in the road cut, or the construction of a much-elevated roadbed.

Crowning:

Creating a crown on a road means grading the road such that the centre is always slightly higher (10-20 cm) than the outer edges. Water that falls on the road surface is directed away from either side of the road surface into adjacent ditches or other drainage systems. Because the terrain varies along the course of a roadway, road design usually employs a combination of crowning and sloped grading. All roads should be crowned and have ditches to ensure proper runoff and maintain the integrity of the road structure.

3.3-03 Proper sloping, crowning, and ditch placement on this road is creating good drainage and a stable roadbed.

3.4 Stream fordings

Fisheries and Oceans Canada permits one-time stream fordings when there are no other means to cross a stream. However, DFO requires prior notification when a fording is going to occur. This applies to dry stream beds as well as flowing waters. DFO also has issued *Measures to Avoid Causing Harm to Fish and Fish Habitat* which can be found on DFO's webpage http://www.dfo-mpo.gc.ca. The preferred practices described here are consistent with the DFO *Measures to Avoid Causing Harm to Fish and Fish Habitat*.

Planning:

- Locate crossings at straight sections of the stream with low gradient banks; crossing should occur, perpendicular to the bank.
- The fording site must consist of stable material, such as gravel or bedrock and the stream banks must be low and stable.
- Minimize disturbance to riparian vegetation (i.e., vegetation that occurs adjacent to the watercourse). Minimize vegetation removal and prune/top it rather than grubbing, uprooting or scraping.
- Wash, refuel and service equipment and store fuel and other materials for the equipment at least 30 m away from the water.

3.4-01 This type of stream fording is a thing of the past in Yukon, and never should have reached this state. There obviously have been multiple fordings over the course of years, leaving permanent marks in a fish-bearing stream. A temporary bridge should have been installed.

- Keep an emergency spill kit on site in case of fluid leaks or spills from equipment.
- Schedule the fording to avoid disrupting fish during sensitive life stages, (e.g., spawning). When scheduling a fording, consult the DFO webpage "Freshwater Timing Windows Identified for the Yukon" at http://www.dfo-mpo.gc.ca. It lists specific windows of time that fording and in-stream work may be carried out within each Yukon river drainage system.

- If the fording will cause significant disruption of sediments, install and maintain effective sediment and erosion control measures.
- If possible, consider moving the equipment across the stream when the ground and/or stream are frozen. This could mean staging the equipment prior to the work season, or conducting a fording early in the morning in spring and fall.

Equipment washing:

- Designate a site well away from the watercourse as a washing area. Preferably, this will be a gravel pad.
- If washing equipment causes runoff, contain it by means of berms or natural slopes.
- Pressure-wash the equipment until all dirt, grease and fuel have been removed from exposed surfaces.
- Be aware that washing of dirty, greasy equipment has the potential to create contaminated water and soil, which the operator will be responsible to clean up. Soil remediation is expensive and time-consuming, so plan ahead to avoid this.

Fording:

- If there is a risk of causing rutting, deploy stream bank and bed protection materials (e.g., geogrids, logs, swamp pads, rubber tire mats), provided they do not overly-constrict flow or block fish passage. Deploy only as much matting as necessary to minimize disturbance to the streambed.
- Ford only under low flow conditions and when water depth is sufficiently shallow. Often, this is only possible during the low flow season or early in the day (streams in Yukon that are fed by glacial meltwater experience lowest flow levels early in the morning, when rates of melting are lowest).
- Crossing should be conducted at slow speeds but with a steady pace to avoid bogging down. Keep the equipment moving and do not stop midstream.
- Operate equipment in a manner that minimizes disturbance to the watercourse bed and banks. Reduced speeds will minimize wakes and bank splash.
- When fording with an excavator, set the boom bucket on the opposite shore and slightly elevate the front of the tracks. Operate the boom to gently pull the excavator while driving across. This will reduce weight on the tracks and minimize the footprint left by the excavator.
- Stabilize any surfaces that are disturbed to prevent any sediment from entering the watercourse.

Restoration:

- Ensure banks are stabilized, restored to original shape, adequately protected from erosion and revegetated with native shrub or tree species.
- If spoil piles were created when a fording site was cleared, the material should be re-spread and seeded with native grasses and shrubs.

3.5 Clear-span bridges

Small, single span (i.e., clear span) bridges that are placed above the high-water mark generally can be constructed without causing harm to fish and fish habitat, or depositing waste (i.e., sediment) into the water and may therefore not require a water licence. DFO's *Measures to Avoid Causing Harm to Fish and Fish Habitat* and online self-assessment tool provides guidance that applies to the construction of clear-span bridges.

Authorizations from DFO and the Yukon Water Board may typically be required for any in-stream work. Technically, clear-span bridges do not necessarily constitute "in-stream" work (since the bridge is spanning the stream), but it is often the case that some type of related in-stream work or bank modification will occur. While DFO may only need to be notified, and a Water License may still be required if the stream crossing is wider than 5 m. Be aware that bridge construction may interfere with the public right of navigation on navigable waters and be subject to the *Navigation Protection Act*. See Section 4.2.3 *Navigation Protection Act (NPA)* for more details.

Note: Construction of more complex, multi-span bridges and those requiring in-stream abutments, bank excavation, or pier structures will require a DFO authorization, as well as a water licence. A number of preferred practices are included in this manual to help with planning for those bridge projects (e.g., Sections 3.1 *Working adjacent to surface watercourses*; 3.8 *Stream diversions*; 3.9 *Isolating in-stream work areas*).

Planning:

- To establish the best and most stable location to place a bridge, avoid building on meander bends, braided streams, alluvial fans, or active flood plains.
- Design the bridge for expected flood levels. Depending on the design life of the bridge, typically this is for a minimum of one in 10-year flood for a temporary bridge and a minimum of one in 100-year flood for permanent structures.

3.5-01 A properly-installed temporary clear-span bridge with perimeter silt fences.

- Design and construct approaches so that they are perpendicular to the watercourse and runoff is directed away from the deck, side slopes and approaches.
- Plan and install sediment and erosion control measures before starting work.
- Wash, refuel and service equipment and store fuel and other materials for the equipment at least 30 m away from the water.

3.5-02 A properly-installed permanent clear-span bridge with riprap for bank protection.

- Keep an emergency spill kit on site in case of fluid leaks or spills from equipment.

During construction:

- If no detour options exist, a one-time fording is permitted, but DFO must be notified. See Section 3.4 *Stream Fordings* in this manual.
- Minimize disturbance to riparian vegetation. Cut brush off to ground height if needed, but without disturbing the roots. Avoid scraping down to bare mineral soil when unnecessary. This practice will allow the vegetation to regrow from rootstocks and leaves organic soil in place.

3.5-03 The abutment of this clear-span bridge should have been protected with riprap. Embankment collapse and sediment release are imminent.

- Operate equipment in a manner that minimizes disturbance to the watercourse bed and banks.
- Prevent sediment, debris, concrete and other waste materials from entering the water.
- Stabilize any surfaces that are disturbed during work to prevent any sediment from entering the watercourse.
- If spoil piles are created, they should be covered with mats or tarps until the material can be re-spread and seeded.

Restoration:

- Restore banks to original condition and slope if any disturbance occurred.
- Ensure banks and disturbed surfaces are stabilized, restored to original shape, adequately protected from erosion and revegetated with native grasses, shrubs and trees (whichever is more appropriate for the site).

3.6 Culverts

Culverts are the most common form of water crossings on small to medium-size streams. Culverts come in many shapes and forms, but in terms of construction they must be installed in isolation of the watercourse. This means they are not installed directly in a channel while there is flow. Unless the flow is seasonal, and work can occur when the channel is naturally dry, flow must be diverted into a temporary channel, so the culvert can be constructed in dry conditions. The purpose of that procedure is to avoid releasing sediment into the watercourse.

DFO's *Measures to Avoid Causing Harm to Fish and Fish Habitat*, and online self-assessment tool, provides guidance that applies to installation and maintenance of culverts. Permits from DFO and the Water Board are typically required for culverts, or at a minimum, these agencies may need to be notified of the proposed activity. Contact DFO, the YWB Secretariat, Department of Environment ECI (for non-mining) or EMR CMI (for mining related) to get further information on licensing requirements.

Other sections in this guide should be consulted when installing culverts, specifically: "3.1: Working adjacent to surface watercourses"; "3.2: In-stream work"; "3.4: Stream fordings"; "3.8: Stream diversions"; and "3.10: Infilling techniques".

Planning and Design:

- Design the culvert size and placement to handle flow during the highest expected flood levels. For a temporary culvert, design it for a minimum of a 1:10-year flood event. For a permanent culvert, design it for a minimum of a 1:100-year flood event. Many culverts fail because they are undersized.
- Ideally, the culvert diameter should be scaled so that it has the same grade, width and depth as the natural channel and does not speed up or slow down the velocity of the natural current.
- Design culvert placements so the culvert can be as short as possible. Size the length of the culvert for the width of the road/trail crossing, but with enough of the culvert protruding on each end in a manner that protects the channel from slumping sediments.

3.6-01 The site of a new culvert crossing is being prepared "in the dry", while the stream is left undisturbed. The old culvert and channel will be reclaimed after the new one is activated.

- The culvert and roadbed can be protected by installing a headwall around the culvert, or aprons, in situations where the roadbed grades steeply to the culvert inlet or outlet, and the potential of erosion is high.

- Design and construct approaches to the culvert site so that they are perpendicular to the watercourse.

- Schedule culvert installation to avoid disrupting fish during sensitive life stages, (e.g., spawning). Consult the DFO webpage "Freshwater Timing Windows Identified for the Yukon" hosted at www.dfo-mpo.gc.ca . It lists specific windows of times when in-stream work may be carried out within each Yukon river drainage system.

- Many culverts are installed improperly. The usual problems are:

    - *Culverts buried too deep.* These can quickly fill with sediment and then do not have enough capacity for high flow volume. They may even become completely blocked.

    - *Culverts buried too shallow.* These are called perched culverts. Water will either become ponded on the inlet end or flow below and around the culvert, causing erosion and culvert failure. Even if water is able to enter the inlet, if the outlet is elevated then water may discharge like a waterfall and scour the channel. Another major problem with perched culverts is that they block fish passage.

    - *Culverts are undersized.* Culverts must be sized to handle high water events, not just normal flow volumes. In undersized culverts, water velocities become too high for fish to pass through. High flows also can result in excessive scour at the culvert outlet, which can create a perched culvert.

    - *Culvert slope does not match channel slope.* When this occurs, the lowest portion of the culvert becomes filled with sediment and the highest portion can become perched.

    - *Culverts placed on a bed that had been over-excavated and then refilled, or placed on an uncompacted surface.* These culverts are prone to pitching and settling when fill is placed over them and flow is re-established.

Preferred practices on-site:

- If no detour options exist, a one-time fording is permitted. See Section 3.4 *Stream Fordings.*

- Follow Section 3.8 "*Stream diversions*" to divert the stream so the culvert can be installed in isolation of the watercourse.

- When clearing access to the culvert site, minimize disturbance to riparian vegetation. Cut brush off to ground height if needed, without disturbing the root system. Avoid scraping down to bare mineral soil, and the removal or organic soil when unnecessary. This practice will allow the vegetation to regrow from rootstocks and leaves organic soil in place.
- Wash, refuel and service equipment at least 30 m away from a watercourse.
- Store fuel and other materials for the equipment at least 30 m away from a watercourse.
- Keep a spill kit on site and have staff trained on how to use it, in case of fluid leaks or spills from equipment.
- Operate equipment in a manner that minimizes disturbance to the bed and banks of the watercourse.
- Prevent debris, concrete and other waste materials from entering the watercourse.
- Install sediment and erosion control measures prior to commencing work.
- Stabilize any waste materials removed from the work site by covering spoil piles with mats, tarps or by planting native grasses or shrubs on them.

Proper culvert installation:

- If there is flow in the channel, it must be diverted so that the culvert can be placed in isolation of the watercourse. Divert the flow following Section 3.8 *Stream diversions*.
- Culverts should be placed in the middle of the channel and maintain the same width, grade and depth as the natural channel. However, with some streams (e.g., braided streams) it may be necessary to narrow or focus the natural channel course to funnel it into the culvert. Installing

3.6-02 The attempts to keep this culvert (on left) from filling with sediment were “too little, too late” (the culvert on the right is only intended to be a high water overflow pipe). The silt fence is inadequate for the size and amount of sediment, and for high water flow velocities. Notice how the current circumvented the silt fence, anyway. The problem with two pipe system is that the lower one fills with sediment during high water events if the creek contains heavy sediment loading, such as this one. A much larger culvert should have been installed to avoid this situation.

aprons may be necessary, but it is best to avoid using them. Avoid restructuring the channel in a way that changes flow velocity.

- Excavate a shallow bed into the channel where the culvert will be placed. The depth of this bed generally should be 15-30 cm deep, and should be scaled to the diameter of the culvert within that range. The culvert should sit on compacted sediment, otherwise it could be undercut or settle when buried and flow is re-established. If the substrate it is placed on is solid and compacted, place the culvert directly in the excavated bed. If the substrate is compressible, excavate below the bed, add fine or crushed gravel and compact it. If filling and compacting, be sure to still leave a 15-30 cm deep depression.
- The slope (pitch) of the culvert should match the slope of the original streambed.
- Backfill the culvert with native materials if they do not have too much clay and will support the weight of traffic. Otherwise use crushed or fine gravel or road mix. Leave an adequate length of culvert sticking out at each end (i.e., free of backfill). The fill at the ends (headwall) should have a slope of <30%.
- Install armouring and other protection of inlets and outlets as specified by the site plan. For example, riprap, aprons, reinforced headwalls and wingwalls.
- Ice jacking is a common problem in the Yukon. Ensuring the culvert is installed at the proper depth may reduce the likelihood of this occurrence.

Restoration:

- Ensure banks are stabilized, restored to original shape, adequately protected from erosion, and revegetated with native grasses, shrubs and trees (whichever is more appropriate for the site).
- Remove from the site any excess riprap and other fill material.

Culvert cleaning and maintenance:

Even correctly sized and properly installed culverts may need occasional maintenance. The primary maintenance task is cleaning out woody debris or sediment build-up. Depending on what activities are involved; culvert cleaning or maintenance may trigger the requirement for a water license or a DFO authorization or at a minimum the agencies may need to be notified of the activity. Contact DFO, the YWB Secretariat, Environment ECI or EMR CMI (if mining related) to get further information on licensing requirements.

- If it is necessary to pump water through culverts to clear them, only use clean, sediment-free water. Capture and treat effluent water by pumping it into a sediment trap or sump (see Section 2.1.8 *Sediment traps, sumps and detention ponds*).

- Minimize disturbance to riparian vegetation when using equipment to clean/maintain culverts.
- Install effective erosion control devices to prevent sediment and debris from entering the stream.
- Minimize disturbance to the streambed by only working in the area of the culvert.
- Operate equipment and move in-stream materials slowly to reduce sedimentation.
- Schedule the work to adhere to fisheries timing windows.
- Stabilize any sediment and waste materials generated during work, and revegetate disturbed areas with native grasses and shrubs.

3.7 Ice bridges and snow fills

Ice bridges and snow fills are used as temporary winter crossing structures for creeks and rivers. Ice bridges are constructed on larger watercourses that have sufficient stream flow and water depth to allow for unrestricted flow underneath the ice. Snow fills, on the other hand are temporary stream crossings constructed by filling a stream channel with clean compacted snow.

Planning:

- Use existing trails, winter roads or cut lines wherever possible to avoid disturbance to the riparian vegetation and prevent soil compaction.
- Plan approaches and crossings perpendicular to the watercourse.
- Install erosion and sediment control measures along banks.
- Check equipment to ensure it is free of leaks and excess oil or grease.
- Refuel at least 30 m away from watercourses.

3.7-01 Working from the ice is often a preferred way to access the underside of bridges, and makes it much easier to protect water bodies. In this case, an ice bridge across the Donjek River was built to facilitate construction of a new bridge.

Construction:

- Snow and ice fill used to construct ice bridge and snow fill approaches should be clean and compacted.
- Place enough snow and ice to achieve a depth sufficient to avoid cuts to the banks of the lake, river or stream being crossed. In other words, the snow/ice bed should be built to a height that does not require vehicles to drive up or down an exposed bank to access the ice bridge. This may require the construction of snow/ice ramps at entry and exit points.
- Keep vegetation removal to a minimum.

- Operate machinery (on both land and ice) in a manner that minimizes disturbance to the banks of the lake, river or stream.
- Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.
- Water intakes need to be sized and adequately screened to prevent debris blockage and fish mortality (see Section 2.3.1 *Fish Screens and Water Pumping Guidelines*).
- Make sure crossings do not impede water flow.
- When the crossing season is over and where it is safe to do so, create a v-notch in the centre of the snow/ice fill to allow it to melt from the centre. This will minimize channel erosion and flooding and help prevent the blockage of fish passage. Compacted snow should be removed from snow fills prior to the spring freshet.
- Stabilize any waste materials removed from the work site to prevent them from entering the lake, river, or stream. This could include covering spoil piles with biodegradable mats or tarps or planting them with grass or shrubs.

Restoration:

- Restore banks to original condition if any disturbance occurred.
- Revegetate and stabilize any disturbed areas by planting and seeding. Cover such areas with mulch to prevent erosion and to help seeds germinate.
- Maintain effective sediment and erosion control measures until the site is revegetated.

3.8 Stream diversions

Occasionally, small to medium size streams will need to be diverted around work sites, in order to conduct work in isolation from the watercourse. It is a practice commonly used when installing culverts and performing other in-channel work. Stream diversions should not be taken lightly, as they have the potential to cause significant harm to aquatic life. However, there are preferred practices that can be employed to minimize the disturbance, and this section explains the basic operational procedures for the design, installation, maintenance and decommissioning of temporary stream diversions.

Most diversions are temporary – once the work is completed, the channel flow is re-initiated. However, sometimes a diversion is designed to be a permanent rerouting of the channel. For instance, for some bridge projects, the stream is left untouched while the new bridge and a new channel are constructed in isolation from the watercourse; when construction is completed, the stream is directed into the new channel followed by a decommissioning of the old bridge and old channel. Note that the prescriptions outlined here assume that the diversion is temporary, but they can be modified for permanent diversions as needed.

Authorizations from DFO and the Yukon Water Board may be required for stream diversions, or at a minimum, these agencies may need to be notified of the proposed activity. DFO may require a fish salvage plan (see Section 2.3.2 *Fish Salvage*). Contact DFO, the YWB Secretariat, Yukon's Department of Environment: ECI (for non-mining related), or Yukon's Department of EMR: CMI (for mining related), to obtain further information on licensing requirements. A useful technical resource may be the *Guidebook of Mitigation Measures for Placer Mining in the Yukon* (2008).

Planning:

- For streams that are wider than 6 m and with a flow rate greater than 2.8 m^3/sec, a stream diversion often is not practical or cannot be safely executed. Instead, work will have to be performed using in-stream isolation techniques (Section 3.9 *Isolating in-stream work areas*).

- For streams that are less than 6 m wide and with a flow rate less than 2.8 m^3/sec, a diversion can be constructed by either pumping water around the work or by excavating a temporary channel diversion. For small and intermittent streams, pumped diversions are preferred. For larger creeks, an excavated channel diversion will be more appropriate.

- When scheduling any in-stream work, consult the DFO webpage "Freshwater Timing Windows Identified for the Yukon" at http://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/yk-eng.html . It lists specific windows of time that in-stream work may be carried out within each Yukon river drainage system.

- When choosing material to block the original channel and direct flow into a temporary diversion, use a durable material that also is easy to retrieve when the main channel is reconnected. For example, aquadams and large sand bags (one-ton bags filled with gravel or sand) are better than rocks. However, for permanent diversions, rock is preferred. Place the largest and most angular rock on the upstream portion of the diversion; this will lock the rocks together and the structure will be more resistant to erosion.

- For all diversions of fish-bearing streams, DFO requires that a fish salvage plan be in place. A fish salvage operation must be completed by a qualified technician. See Section 2.3.2 *Fish Salvage* for more information, or contact DFO directly.
- Pumps that will be used on-site must be able to handle both the expected volume of the diversion and dewatering of seepage into the excavation (i.e., keeping the work site dry).

Pumped stream diversions

- Pumped diversions are not commonly used because they require very large pumps and hoses/pipes that are capable of transporting the entire stream flow. They also can be tricky and difficult to accomplish without doing harm.

3.8-01 A pumped diversion showing the water intake. Even for this small stream, pumping its entire flow across the work site required large volume pumps.

- Fish salvage: Prior to blocking off the channel and activating the new one, a fish salvage operation needs to be completed in fish-bearing streams (see *Section* 2.3.2 *Fish Salvage*).

- Place the water intake of the pump into the stream, upstream of the work area and run pipes or hoses downstream around the work site. In some cases, it may be necessary to excavate a small depression for the intake and line it with rock; this will form a pool in front of the blockage that will be placed subsequently. Alternatively, a short section of culvert with holes punched in it can be planted upright at the intake point. The pump suction hose is then placed in the culvert.

- On the downstream end, the hose/pipe outlet should not be placed directly into the stream; doing so would inevitably cause scouring and erosion when the water is pumped. Instead, construct a structure beside the stream that will dissipate the energy from the pumped water. Usually, this is a small depression with a passive overflow that

allows water to re-enter the creek. Both the depression and the overflow should be lined with rock or geotextile cloth.

- Even though the stream has not yet been blocked, start operating the pump once the inlet is established, the hose/pipe is in place, and the dissipating structure is built.

- Once the pumping and dissipations systems are working properly, block off the stream using an aquadam or large sand bag covered with plastic (held in place by rock or small sand bags).

3.8-02 Same site as above - the pumped water was released downstream of the work site in an excavated depression that was lined with rock to slow the flow velocity and trap sediment. This picture shows the pumped water bubbling up and overflowing the rock lined area. The actual creek is in the background.

- Any water left in the isolated area needs to be pumped out and deposited into a vegetated depression, sump, or other type of settling area (see *Section* 2.1.8 *Sediment Traps, Sumps and Detention Ponds*).

- To maintain this diversion, the pump will need to run continuously, so do not block off the channel until work is about to begin. Do not allow flow back into the channel until all work is finished. In other words, avoid a cycle of repeatedly pumping the channel dry and then letting water flow again.

Constructing stream diversion channels

Design Criteria:

- If the stream diversion is seasonal (i.e., less than one season) and will occur during low flow, the diversion simply needs to be designed to handle a volume at least equal to the mean annual flow.

- If the stream diversion is temporary (1-5 years), it needs to be designed to handle a 1 in 10 year event.

- If the diversion will be in place for more than five years, it is a permanent diversion and needs to be designed to handle a minimum of a 50 or 100-year flood.

- When designing diversion channels, try to match the flow and velocity gradients to those in the original channel.

- Constructing and decommissioning the diversion, as well as dewatering activities, may require additional sediment control (see Section 2.1 *Erosion and Sediment Control*).

- Develop plans to protect unvegetated banks with riprap, plastic or geotextile. This will be particularly important to protect the banks of a temporary diversion channel that was recently excavated.

- Consider if lining the entire channel (banks and stream bottom) is a better way to manage sediment release.

3.8-03 The project in the following six photos involved lengthening two existing culverts at Watson Creek. To complete the work, the creek had to be diverted so the culvert extensions could be completed in the dry. This photograph shows the diversion channel on the right and Watson Creek on the left. The banks are lined with jute fabric to protect them from erosion. The new channel is being washed and the sediment-loaded water is being pumped out into the vegetation.

Construction:

- Construct the diversion channel in isolation from the watercourse by leaving the upstream and downstream ends unexcavated – i.e., leave an upstream and downstream earthen plug in place and do not connect to the original channel (i.e., do not remove plugs) until the diversion channel is completed, including linings, riprap and sediment control.

3.8-04 Same site - the downstream earth plug is being removed.

- If a culvert, bridge or other structure is to be installed in the diversion channel, do so while the channel is dry, before initiating flow from the main channel. Often, this is the case when the diversion channel is meant to become the new permanent channel.

3.8-05 Same site - the upstream earth plug is being removed.

- In the case of temporary channels, the banks should be protected with erosion control materials, usually geotextile cloth or erosion control blankets. Permanent channel diversions require permanent armouring (such as riprap) of the banks and need to be seeded and revegetated, where applicable.

- Wash the new channel to remove loose sediment: pump wash water into the upstream end of the diversion and pump it out again when it has reached the downstream end. Do this until most of the loose sediment is washed out of the channel. Pump the waste water into a vegetated depression, sump, or other type of settling area (see Section 2.1.8 *Sediment Traps, Sumps and Detention Ponds*).

- Fish salvage: Prior to blocking off the old channel and activating the new one, a fish salvage operation needs to be completed in fish-bearing streams (see Section 2.3.2 *Fish Salvage*).

- Check the weather forecast and inspect the diversion daily for erosion and stream channel stability. Be prepared for heavy rain and possible erosion problems by having erosion control materials on-site.

Diverting the stream:

- To open the diversion channel, start by removing the downstream plug, followed by the upstream plug.

- Once the diversion channel has been activated, the main channel can be blocked off. Use aqua-dams or large sand bags (one-ton bags) covered with plastic and held in place by rock or small sand bags. Place the sandbags or other diversion material by working from both banks inward to close off the channel. Thus, the last sandbags will be placed mid-channel. This method avoids the problem of gradually focusing flow towards either bank and causing erosion and blowout as the gap is closed.

3.8-06 Same site – Watson Creek is being blocked off with large sand bags and the flow is captured by the diversion channel (foreground).

- Any water left in the old channel needs to be pumped out and deposited into a vegetated depression, sump, or other type of settling area (see Section 2.1.8 *Sediment Traps, Sumps and Detention Ponds*).

Decommissioning Temporary Stream Diversions:

Once work activities are completed in the main channel and the temporary stream diversion is no longer needed, it must be deactivated using the following procedures:

- Open the main channel. Start by removing the downstream plug, followed by the upstream plug.

- Once the main channel has been activated, the diversion channel can be blocked off using rock or solid native materials, or a combination.

- Any water left in the diversion channel needs to be pumped out and deposited into a vegetated depression, sump, or other type of settling area (see Section 2.1.8 *Sediment Traps, Sumps and Detention Ponds*). Waste water should be pumped into a vegetated sump, not into the stream.

- Backfill the channel with native sediment, most likely the material that was originally excavated, and contour to the original grade. Be sure to place mineral soil first and place organic soil on top.

- Revegetate and stabilize the disturbed areas by planting and seeding. Cover such areas with mulch to prevent erosion and to help seeds germinate.

- Maintain effective sediment and erosion control measures until the site is revegetated.

3.8-07 Same site - the sand bags are covered with plastic on the upstream side of the diversion. The plastic is anchored on the bottom with rocks to hold it in place and to seal the stream blockage.

3.8-08 Same site - the work area is dry and the culverts extensions are being attached.

3.9 Isolating in-stream work areas

Diverting a large watercourse generally is not practical or safe. Consequently, erecting a structure or conducting construction activities directly in a large watercourse requires that a portion of the streambed (or lakebed) be completely isolated from the rest of the watercourse. A common example is the use of enclosed cofferdams to construct bridge piers. This section explains the basic operational procedures for the design, installation, maintenance and decommissioning of in-stream isolation structures.

Authorizations from DFO and the Yukon Water Board may be required for in-stream isolation structures, or at a minimum these agencies may need to be notified of the proposed activity. Contact DFO, the YWB Secretariat, Yukon's Department of Environment: ECI (for non-mining related), or Yukon's Department of EMR: CMI (for mining related), to obtain further information on licensing requirements.

Planning:

3.9-01 Cofferdams used in construction of bridge piers.

- Isolation of work areas is required in streams where diversion is not feasible, and in all lakes.
- Plan work sequences so that the isolation structure is in place for the shortest time possible and during low-water levels.
- When scheduling any in-stream work, consult the DFO webpage "Freshwater Timing Windows Identified for the Yukon" at http://www.dfo-mpo.gc.ca. It lists specific windows of time that in-stream work may be carried out within each Yukon river drainage system.
- For all diversions of fish-bearing streams, DFO requires that a fish salvage plan be in place. A fish salvage operation must be completed by a qualified technician. See the Section 2.3.2 *Fish Salvage* for more information.
- Arrange to have enough pump capacity on-site to handle seepage into the work area. Be prepared to pump large volumes quickly.
- Develop an emergency plan in the event that an isolation structure is breeched.

Design criteria:

- If an isolation structure will be in place for an entire season, it should be sized to handle flow volumes and velocities of a minimum of a 10-year flood event. If it will be in place for longer, then 1:50 and 1:100-year flood event levels will need to be considered. If work is planned for a short period of time (days to weeks) and during low flow, the mean annual flow may be adequate as a design standard.

- Isolation structures should be made from a durable material that is easily retrieved from the water during decommissioning. For example, sand bags covered with heavy-duty poly sheathing or silt fences designed for in-stream application.

Construction sequence:

- Proper sediment control measures will almost certainly need to be deployed during dewatering operations, and perhaps when isolation structures are being constructed and decommissioned (see Section 2.1.8 *Sediment Traps, Sumps and Detention Ponds*).

3.9-02 Sand bags being used to protect an eroding lake shore. Note clear water in the lake and the turbid water along the shore.

- If the work will cause even temporary changes to flow volumes, velocities or turbulence, then protect nearby unvegetated banks with riprap or geotextile cloth.

- If required, complete a fish salvage operation for the area where the stream isolation structure will be installed.

- Install the isolation structure. The procedure and sequence of events should be stated in clear instructions.

- Pump out the water from the isolated area into a vegetated depression, sump, or other type of settling area to filter/collect sediment. Monitor the sediment trap and ensure that any outflow water is clear. Water should never be pumped directly into the watercourse.

- Complete the construction activity inside the isolated area promptly so that the isolation structure is in place only as long as is necessary.

- Decommission the isolation structure carefully by starting with the downstream components. Work safely, as the structure will become unstable when it is partially disassembled and water flow resumes.

Maintenance:

- Check weather forecasts and inspect the isolated area at least daily. Be prepared to deal with high water events like heavy rain by having the necessary pump capacity on hand, as well as extra erosion control materials.

3.10 Infilling techniques

Some projects require infilling portions of a stream or lake, though regulators are clamping down on the practice. Infilling is done, for example, to create permanent barge landings, bridge abutments, lakefront development, and for some types of road construction. This section is meant to provide practical guidance on how to approach this type of activity and minimize the direct impact to water, fish and fish habitat.

Any project that will place 100 m^3 or more of infill will require a water license. Even smaller infillings may require a water license, depending on their impact. Any infilling that occurs in a fish-bearing watercourse generally requires approval by DFO. Contact DFO, the YWB Secretariat, Yukon's Department of Environment: ECI (for non-mining related), or Yukon's Department of EMR: CMI (for mining related), to obtain further information on licensing requirements.

General principles and planning:

- In some cases, it will be necessary to isolate a portion of the stream or lake prior to placing the fill. See Section 3.9 *Isolating In-Stream Work Areas*.
- For all diversions of fish-bearing streams, DFO requires that a fish salvage plan be in place. A fish salvage operation must be completed by a qualified technician. See the Section 2.3.2 *Fish Salvage* for more information.

3.10-01 Careful placement of clean rock along a stream bank. A water sample is being collected to measure the turbidity caused by sediment release.

- When scheduling any in-stream work, consult the DFO webpage "Freshwater Timing Windows Identified for the Yukon" at http://www.dfo-mpo.gc.ca. It lists specific windows of time that in-stream work may be carried out within each Yukon river drainage system.

3.10-02 A temporary ramp consisting of large, clean rock infill was constructed so the excavator could access the stream and work underneath the bridge. After the work was completed, the rock was removed.

- The infill material must be non-acid generating and non-metal leaching and free of fines. This limits the infill material to clean gravel and rock.

- Because infilling usually involves large volumes of material that must be free of fines, it may be necessary to plan for a rock-washing facility. To avoid causing runoff and erosion at the washing facility, review the Erosion and Sediment Control sections of Chapter 2.

Construction guidelines:

- Create a gradual ramp from the bank down to the water using clean material. Be sure to follow best practices for erosion and sediment control (e.g., silt fences, surface stabilization, runoff control, etc. as described in Section 2).

3.10-03 For this road-widening project, the lake edge had to be infilled. The procedure involved dumping rock on the ramp and then carefully push it into the lake with a dozer.

- Infill material must be free of fines. Set up a washing station if necessary and follow best practices for erosion and sediment control (see above).

- Stockpile the clean infill material next to the watercourse, and then carefully place it into the water with an excavator such that turbulence is minimized.

- As the infill area is being built up, select large angular rock for the perimeter of the infill area, and place smaller, smoother rock in the interior. Angular rock has better cohesive properties and resistance to erosion, so this method will help stabilize the infill body.

3.11 Docks and barge landings

Docks and barge landings on the shorelines of lakes and rivers are mostly used in municipal, recreational and industrial applications. Docks come in a variety of shapes and forms. Some consist of floating platforms while others are supported by pipes, poles or cantilever arms. Barge landings are augmentations to bank structures and typically are built from wood or concrete. Some of the preferred practices discussed here are specific to docks and barge landings, but many are summaries of preferred practices found elsewhere in this guide. Those are referenced and should be consulted for more specific guidance.

Constructing docks and landings can impact fish and fish habitat. DFO permits the construction of docks and barge landings without review and pre-authorization if fish habitat (especially spawning grounds) are not negatively affected. The online self-assessment tool on DFO's website provides guidance on what activities are permissible without a DFO review. Developers are still required to notify DFO when a dock or landing is to be constructed in a fish-bearing watercourse, and DFO reserves the right to conduct inspections. Contact DFO, the YWB Secretariat, Yukon's Department of Environment: ECI (for non-mining related), or Yukon's Department of EMR: CMI (for mining related), to receive further information on licensing requirements. A water licence from the Yukon Water Board may also be required.

Planning:

- When planning approaches to docks or landings, use existing roads, trails or cut lines where possible.
- Avoid areas of known fish spawning habitat.
- Have materials on hand for the installation of erosion and sediment control measures along banks.

Construction:

- Check equipment to ensure it is free of leaks and excess oil or grease. Refuel equipment at least 30 m from the watercourse.
- Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.
- If sediment, rock, or other materials will be excavated during the work, they should be stockpiled in a stable location above the high-water mark, as far away as practical from the watercourse. If runoff from the stockpile has the potential to enter the watercourse, cover the stockpile with plastic sheeting or geotextile cloth.
- Minimize disturbance to existing vegetation. Cut brush off to ground height if needed, but without disturbing the roots. This practice will allow the vegetation to regrow from rootstocks.

- Construct temporary runoff ditches, water bars or diversions within the work area in a way that does not discharge sediment loaded water directly into the stream. Divert the ditch flow to a vegetated depression (sediment trap) where it can infiltrate into the ground.

- Operate machinery on land in a manner that minimizes disturbance to the banks of the lake, river or stream. If operating stationary machinery next to the watercourse, position it on a stable location on the bank. Create an operating platform (with rock) if needed.

- Often, it is best to build the structure from a floating platform, rather than from shore.

- Do not take materials from the shoreline to build docks or landings. Bring in clean materials from land (see Section 3.10 *Infilling Techniques*).

- If logs and other bottom structures must be disturbed, move them elsewhere in the watercourse so they remain functional as fish habitat.

- Prevent deleterious substances such as uncured concrete, grout, paint, sediment and preservatives from entering the watercourses.

- Use untreated materials (e.g. cedar, tamarack, hemlock, rocks, plastic, etc.) to construct submerged supports for dock structures.

- Treated materials can be used for above-water structures (e.g., decking), but only when treated with an approved material. Alkaline Copper Quaternary (ACQ) and Copper Azole (CA) are approved treatments as of this time. Creosote treated wood should not be used in or near water.

- If plastic barrel floats are used, ensure they are free of chemicals, and avoid the use of rubber tires, as they are known to leach toxins.

3.11-01 Little Atlin Lake boat ramp is being expanded. Infill area in the lake has been isolated with a silt curtain to contain sediment. Note the turbid water inside of the silt curtain compared to the remainder of the lake which is clear.

- Concrete leachate and uncured cement are alkaline and highly toxic to fish and other aquatic life. If using concrete for portions of the dock or landing:
    - Try to use precast material and ensure that it is fully cured before placing it in the watercourse.
    - If concrete will be poured on-site, the preferred method is to cast the concrete in component forms away from the watercourse and allow the concrete to cure for 30 days before placing components in the watercourse.
    - If concrete must be poured directly in place, that portion of the watercourse will have to be isolated. See Sections 3.9 *Isolating In-Stream Work Areas* and 2.2.2 *Using Concrete near Water*.

Restoration:

- Restore banks to original condition if any disturbance occurred during work.
- Reposition temporary stockpiles of soil and other materials and grade back into the site.
- Vegetate and stabilize any disturbed areas by planting and seeding. Cover such areas with mulch to prevent erosion and to help seeds germinate.
- Maintain effective sediment and erosion control measures until the site is revegetated.
- Review Sections 2.1.1 to 2.1.5 in the chapter on Erosion and Sediment Control.

3.12 Exploration activities: trenching, drilling and the use of explosives

Trenching drilling and the use of explosives are often used in mineral exploration. Sometimes these activities occur in the immediate vicinity of a watercourse and have high potential to negatively impact water. Keep in mind that construction of roads and trails to the explorations sites may have as much impact on water as the actual trenching, drilling and explosives use (see Section 3.3 *Runoff control on Roads*).

Trenching in particular can expose significant ground area to erosion and runoff. Because trenching often occurs on hillsides (sloped ground), runoff from trenches has high potential to turn into gullies and transport significant amounts of sediment and contaminants to watercourses.

Some types of drilling require large amounts of water for cooling. Consequently, drill pads are often constructed near watercourses. It also means that a Water License often is required if there will be any deposit of waste or if water use is above the threshold of 300 m^3 per day, and that if below threshold with not deposit of waste the proponent must file a *Notice of Water Use/Waste Deposit Without a License* with the Water Board at least 10 days prior to commencing work. The slurry ("mud") created from rock cuttings and cooling water during diamond drilling, as well as rock chips from reverse circulation drilling, often contain metal sulphides and can lead to metal leaching (ML) and acid rock drainage (ARD). ML and ARD are two distinct are frequently related, and are often referred to together as ML/ARD. Rocks with a potential for ML/ARD and the associated leachate must be kept out of watercourses. The potential for ML/ARD, especially in proximity to watercourses, means that it is critical to follow preferred practices when drilling. ML/ARD can also be a concern when trenching, blasting, conducting excavations or any other disturbance of bedrock. The chemical reactions that are related to ML/ARD are accelerated by crushing or breaking rocks and exposing them to water and/or oxygen.

The use of explosives may result in a number of adverse impacts on fish and freshwater mammals and their habitats. The detonation of explosives in or near water produces shock waves that can harm fish and their eggs. Explosives use in and near fish habitat may also result in the physical and/or chemical alteration of that habitat. For example, sedimentation resulting from the use of explosives may cover spawning areas or may reduce or eliminate bottom-dwelling life forms that fish use for food. By-products from the detonation of explosives may include ammonia or similar compounds and may be toxic to fish and other aquatic biota. The manufacture, storage and use (blasting) of explosives is regulated under the federal *Explosives Act* (1985) and the territorial *Occupational Health and Safety Act* (2002).

Complete best practices for exploration trenching and drilling (beyond just those protecting water resources) are covered in the Yukon Chamber of Mines' 2010 *Yukon Mineral and Coal Exploration Best Management Practices and Regulatory Guide*. DFO's *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters* provide additional information on blasting and

explosives use. The preferred practices presented here merely underscore those that specifically relate to protecting water.

3.12.1 Exploration trenching

Planning and construction:

- Maintain vegetated buffers of at least 30 m between trenches and watercourses.
- Orient trenches along slope contours as much as possible. That way, trenches are less likely to become drainage channels for sediment-laden runoff.
- Contain runoff by means of berms and natural sloping. If runoff has the potential to reach a watercourse and cause sedimentation, then exposed surfaces also should be covered and stabilized.

3.12-01 Large-scale trenching. In Yukon, many projects are multifaceted, include construction of access roads or trails, and are never very far from a watercourse. Planning and the application of preferred practices are key to erosion and sediment control.

- When excavating, stockpile organic soil and vegetative debris separately from mineral soil and rock. The latter especially should be kept away from watercourses and may need to be covered to avoid contaminated runoff. Other temporary erosion/sedimentation control measures, such as silt fences, may need to be deployed.
- Create a berm at the downhill end of the trench to contain water and thus prevent gullying beyond the trench.

Reclamation

- Fill in a trench with stockpiled material as soon as possible after the exploration program has been completed.
- Re-contour the area to the original slope, or use 2:1 as the default slope.
- Backfill mineral soil first and lightly compact it. Then apply the stockpiled organic soil.

- Stockpiled vegetation debris and other organic material should be scattered over the area to help reduce erosion.

- Backfilled trenches may require further erosion control measures, especially if on steep slopes or near watercourses. See sections in "Chapter 2: Erosion and sediment control". They may even require seeding in areas where rates of natural revegetation is expected to be slow.

3.12-02 This exploration trench is cause for concern. The runoff is not being controlled and the colour indicates it may be contaminated with heavy metals. The straight downhill run and slope grade mean that the trench should have been reclaimed, or at least stabilized (i.e., backfilled and vegetated).

3.12.2 Exploration drilling

Planning and construction:

- Locate drill pads on relatively flat terrain with stable slopes, and as far away from watercourses as possible.

- Do not store cores, core boxes or rock chip bags near watercourses. The minimum distance is 30 m; farther is better. Cover cores and bags with a tarp or store in a shed.

- Keep the drill pad area as small as possible.

- Maintain equipment and check for leaks daily. Use sorbent pads to capture small leaks.

- When clearing for drill pads and trails, clear only as much vegetation as is absolutely necessary and cut only to ground level, leaving root stock in place when possible.

- If the drill pad site or trails must be scraped, stockpile organic soil and vegetation debris separately from mineral soil and rock. The latter especially should be kept away from watercourses and may need to be covered to avoid contaminated runoff. When decommissioning the site and re-spreading material, spread the mineral soil fist and cover it with organic soil followed by organic debris from vegetation clearing.

- Additives to drill cooling water often are toxic. Minimize the use of additives, choose non-toxic additives, and follow preferred practices below for handling of cooling water and "mud". Whenever possible, reuse and recirculate cooling water.

- Water pumps:
    - Place the water pump on a fuel containment tray (at all times) above the high water mark.
    - Fuel the pump by hand, using a hand-held fuel container (Jerrycan).
    - Keep sorbent pads and other spill response materials handy.
    - Store the fuel container at least 30 m away from the water and in secondary containment.
    - Fish screens must be installed over water intakes when placed in fish bearing water. See Section 2.3.1 *Fish Screens and Water Pumping Guidelines*.
- Do not discharge any water directly into a watercourse. Runoff and other water that contains surface sediment only can be directed to ground sumps for filtering. Sumps can be natural, vegetated depressions, or man made excavations that are lined with geotextile cloth.
- Drill water (cooling water and "mud") can be very harmful and cannot be discharged into ground sumps. It must be collected and retained in tanks or treated in approved settling ponds.

3.12-03 Decommission of this drilling pad is nearly complete. The sump remains and the site still needs to be reclaimed. Note the pile of organic material piled along the edge of the vegetation. This will be spread over the mineral soil and the site will be seeded.

Reclamation:

- Drill holes must be plugged using commercial plugs, grout, or rocks.
- Remove any contaminated soil, oily pads, fuel drums etc., and dispose of appropriately.
- Haul out and treat contaminated water that was collected in tanks. Settling ponds will need to be monitored and possibly covered until they can be reclaimed, to ensure contaminated water does not enter the environment.

- Fill in sumps and ditches; remove any geotextile or plastic material used to control runoff from site. The sediment retained by lining materials will need to be properly disposed of, and may contain contaminants.
- Scarify compacted soil and replace the salvaged organic topsoil layer. Spread vegetation debris from clearing over the site.
- Revegetate the site if there is a lack of organic material, or high erosion potential.

3.12.3 Blasting and use of explosives

- If blasting near water bodies contact DFO prior to start-up.
- Blasting plans should use the minimum amount of explosives to complete the job.
- Blasting mats should be placed on top of holes to reduce debris from scattering over the area.
- Ammonium nitrate based explosives must not be used in or near water.
- For blasting set-back distances from water bodies check the *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters*.
- After the blast is complete collect all debris and reclaim as required.

3.13 Procedures for emergency works in and around water

If unforeseen or unpreventable circumstances call for immediate action, emergency works are permitted under the various water-protection acts if they are in the interest of public/personal safety or prevent larger environmental damage. This includes emergencies that develop as a result of flooding, unforeseen critical damage to vital structures in or near water due to human error or extreme weather events, equipment that has fallen in the water, or fuel and hazardous materials spills.

Special measures are allowed for emergency works. For instance, the *Waters Act* (2003) allows for pumping of water without a Water License "…on an emergency basis…" and for "…controlling and preventing floods…" Prohibitions on other activities, such as stream fordings, are temporarily waved, as well. All emergency-based actions should be conducted in a responsible manner that can be justified at a later date.

The *Yukon Environmental and Socio-economic Assessment Act* allows for activities to be taken without a prior assessment in response to a national emergency under the federal *Emergencies Act* (1985), or in response to an emergency in the interest of public welfare, health or safety or of protecting property or the environment. As soon as practicable after any such activity is completed, the person who undertook it shall send a written report to the applicable Designated Office describing the nature, extent and duration of the activity and any work required in order to restore or rehabilitate the area affected by it.

This section provides guidance to complete emergency work while minimizing any further harm.

Immediate Action:

Before starting the emergency repair works, you must contact these regulatory agencies:

- DFO: 1-866-845-6776
- YG EMR-CMI: 867-667-3137, for mining-related undertakings
- YG Environment-ECI: 867-667-3227, for non-mining undertakings
- The Yukon Spill Line: 867-667-7244 for spills and equipment into water
- If it concerns a "navigable" water, also contact the Navigation Protection Program: 780-495-8215

Emergency preparedness and prevention:

The effectiveness of response to an emergency often is a reflection of the level of preparedness. Likewise, collateral environmental harm caused by an emergency response

reflects the level of training and preparedness. To be ready for a proper and measured response:

- Keep equipment that is on the work site free of leaks and excess oil or grease so that if it must be deployed for an emergency response that it will not contaminate water.
- Keep spill kits in handy and nearby locations. Quick and effective response to a spill may actually prevent an emergency.
- It is always a good idea to keep extra erosion control material on-site. This includes rolls of poly and geotextile cloth and stakes for erecting sediment fencing.
- Ensure that all workers are well versed in emergency response procedures, especially spill response.
- Post procedures to be followed in the event of an emergency. Include the phone numbers listed above, as well as contact information for site supervisors.
- Consider keeping an inexpensive camera and extra batteries in your response kit or location where you post emergency procedures. Pictures will help document the emergency when a review is conducted. Inspectors may only visit the site after the emergency and your response are over; they will only see the end results of the event. Having photos of the emergency situation will help justify the extent of your response and the results.

Actions during an emergency response:

- Even though it is an emergency, actions should be carried out in a calm, professional manner. Act promptly, but don't be hasty – take a minute to talk over your plan of action. Ensure that your response does not make the situation worse.
- The first course of action should be to ensure everyone's safety.
- The next step should be to safeguard and stabilize fuels so they do enter watercourses. This may mean quickly erecting berms or moving fuel storage containers.
- Even though it is an emergency, all equipment still should be refuelled >30 m from the watercourse.
- You still must make every effort to avoid and control erosion and sedimentation during your actions. Prevent any unnecessary material from entering the watercourse, such as dirt, dirty water, concrete, debris, etc. by building or installing structures like berms, containments, sediment fences, etc. Study the erosion and sediment control measures in this guide so you are familiar with these actions.

- If a bank or structure is in risk of collapsing, place oversized rock, riprap or other non-erodible materials as necessary to provide stabilization.

- When possible operate equipment from the banks. Only enter the water with equipment as a last resort or to save life.

- In flooding situations, construct temporary runoff ditches, water bars or diversions to divert flow from the main channel so the main structure can be repaired or to avoid damage to it.

- If there is time and it is warranted, reposition excavated material and debris from the site in a stable location above the high-water mark, as far as possible/practical from the watercourse. If the stockpile is close to the water and cannot be moved, cover it with poly or geotextile cloth as a temporary measure to avoid sediment runoff.

3.13-01 Accidents happen. Be prepared to deal with them!

Site restoration and follow-up:

- If ground was excavated or disturbed, grade it back to the original slope. Then, employ standard measures outlined earlier in this guide to stabilize and revegetate the surface. This likely means installing erosion control products and silt fences in combination with mulching and seeding.

- If rock or riprap had to be placed, plan to remove it in a manner that minimizes erosion and sedimentation.

- Provide a report along with pictures to DFO, to YG EMR-CMI (for mining activities) and to YG Environment-ECI (for non-mining activities).

- Follow-up after the next heavy rain or winter snow melt to fix slumps or erosion problems.
- Design and install permanent fixes and obtain necessary approvals for these works.

3.14 Report a spill

A person that causes or discovers a spill of a hazardous substance must report it as soon as possible to the Yukon Spill Line at 867-667-7244. It is monitored 24 hours per day, seven days per week.

A person required to report a spill shall, if they have knowledge of the information or can readily obtain it, provide the following information:

- the location and time of the spill;
- a description of the circumstances leading up to the spill;
- the type and quantity of the material or substance which has spilled;
- the details of any action taken at the site of the spill;
- a description of the location of the spill and the immediately surrounding area; and
- any additional information in respect of the spill that the Minister, environmental protection officer, or person designated by the regulations requires.:

The person responsible for a spill is required to:

- make efforts to notify the owner or person in charge of the spilled substance, and any members of the public that may be adversely affected by the spill;
- take all reasonable measures to confine, repair and remedy the effects of the spill;
- remove the substance spilled to reduce the danger to human health and the environment; and
- restore or rehabilitate the natural environment to a condition reasonably equivalent to the condition that existed immediately before the spill occurred.

4 Acts, Regulations, and Agreements

This section provides an overview of the regulatory framework that has been developed to protect water resources. It provides a very general overview of the legislation most commonly associated with maintaining and protecting water in Yukon. This overview is provided for introductory purposes only and the reader should not rely on these summaries alone. The reader must familiarize themselves with the detailed requirements of each applicable act, regulation and agreement.

It should be noted that the following discussion only touches on legislation and regulations that specifically address water protection. There are numerous industry-specific acts and regulations stemming for mining, land development, forestry, pesticide-use, hazardous materials handling and others industrial activities that include measures to safeguard water. It is beyond the scope of this document to address those acts, most of which are subordinate to or draw from the various water-related legislation. An example of a document that thoroughly discusses regulatory requirements (and best management practices) within an industry-specific context is the *Yukon Mineral and Coal Exploration Best Management Practices and Regulatory Guide* (Yukon Chamber of Mines, 2010). It also must be considered that additional requirements may apply in traditional territories of First Nations. This is particularly important to consider if working on Settlement Land, in which case the relevant First Nation government will be involved in the licensing process.

When considering the water-related permitting and licensing requirements for a project, a developer should address the following six questions:

1. Will this project require a review under YESAA? (see section 4.2.1 below "*Yukon Environmental and Socio-Economic Assessment Act*")

2. Will this project require a Water Licence? (see section 4.1.1 below "*Waters Act*")

3. Will this project require a Land Use Authorization? (see section 4.1.2 below "*Territorial Lands (Yukon) Act*" or 4.1.3 "*Placer Mining Act and Quartz Mining Act*")

4. Will this project require DFO authorizations or notifications? (see 4.2.2 below "*Fisheries Act*")

5. Will this project require a Navigable Waters Approval? (see 4.2.3 below "*Navigation Protection Act*")

6. Will this project require a permit from a First Nation government, or compensation under chapter 14 of the Umbrella Final Agreement ("UFA") or the *Waters Act* (2003)?

4.1 Territorial legislation

4.1.1 Waters Act

The *Waters Act* (2003) regulates water use from watercourses in Yukon. It also regulates alterations to watercourses and deposition of waste into water. The definition of watercourse includes surface and ground water.

Many development activities that may adversely affect a watercourse will require a water license. Schedules 5 through 10, and section 4 of the *Waters Regulation*, define the activities and uses, or deposits of waste, that may trigger the need to obtain a water license. In summary, they are:

- Direct water use of 100 or 300 m^3/day or more, depending on the type of undertaking
- Watercourse crossings, including pipelines, bridges and roads, if the watercourse is over 5 m in width at ordinary high water mark at the point of construction (unless it is placer mining, in which case all construction of watercourse crossings require a licence)
- Altering the flow or direction ("watercourse training") of a non-intermittent watercourse over 5 m in width by making changes to the channel or bank, or by placement of infill, docks, culverts, or erosion control materials (unless it is placer mining, in which case all alterations require a licence)
- Alteration of flow or storage of a watercourse by constructing dams or dikes (when they exceed a certain size)
- Depositing waste into water
- Constructing permanent flood control devices (some temporary devices also require a water license)
- Diverting a watercourse that is 2 m in width or greater than at ordinary high water mark (unless it is placer mining, in which case all diversions require a licence)
- Any other use or deposition of waste that has the potential for significant adverse environmental effects
- Any use or deposit of waste that would interfere with the rights of other licensed water users

Water licenses according to undertaking type (agricultural, miscellaneous, conservation, municipal, power, recreational, quartz mining, placer mining, and industrial) are issued by the Yukon Water Board. This Board is an arms-length, government-appointed regulatory board

with First Nation, territorial and federally nominated members. Licenses are issued with terms and conditions of use (e.g., maximum amount of water that may be pumped per day; season that activity is permitted/prohibited) and a list of monitoring and reporting requirements incumbent upon the license holder (e.g., monitoring daily water use and submitting an annual report). For every granted or denied license application, the Water Board also will issue a document that explains the reasons for its decision.

The thresholds and activities listed above require a Water Licence. However, this does not mean that activities below those thresholds are unregulated. *Any* water use or deposit of waste (even those below the thresholds) conducted in the pursuit of an industrial, placer mining or quartz (hard rock) mining activity requires the developer to file a *Notification of Water Use/Waste Deposit Without a Licence* form with the Yukon Water Board 10 days prior to the start of the activity. According to the *Waters Act* (2003), agricultural, municipal, power generation and miscellaneous activities do not require notification in this situation.

The duty of enforcing conditions of a Water Licence is shared by Yukon's Department of EMR-CMI (for mining undertakings) and the Yukon's Department of Environment-ECI for all other license types. The Government of Yukon is responsible for inspection and administrative enforcement, and are also available to provide advice on how to comply with conditions of a licence or legislation.

Both the Yukon Water Board, and the main offices of the ECI and CMI are located in Whitehorse. CMI also has regional offices in various communities throughout Yukon. Office locations and further contact information are included in Chapter 4.

4.1.2 Territorial Lands (Yukon) Act

Government of Yukon's Lands Management Branch, Department of Energy Mines & Resources, manages the majority of public land under the *Territorial Lands (Yukon) Act* (2003), other than mineral rights and mining land use. Pursuant to this legislation, the branch regulates the disposition of land in Yukon, including sales, leases, and grants of rights-of-way or easements, as well as temporary use or work on public land. A land use permit is required for activities such as: site clearing or earth work (unless by hand); constructing a new road, trail or access (unless less than 1.5 m wide); clearing or installing a utility right-of-way; establishing quarries; and conducting geo-technical or hydrological studies. This legislation also applies for land-based activities that may affect water and imposes requirements in these situations.

The Government of Yukon Lands Management Branch is located in Whitehorse (see Chapter 4).

4.1.3 Placer Mining Act and Quartz Mining Act

Government of Yukon's Mineral Resources Branch, Department of Energy Mines & Resources, manages land use for placer mining and quartz mining activity under the *Placer Mining Act* (2003), the *Quartz Mining Act* (2003) and associated regulations. Pursuant to this legislation, the branch regulates and issues mining land use authorizations for these activities, of which some include works affecting Yukon waters. Mining land use authorizations of various classes

are issued according to specific project criteria (for example, number of person days in camp, quantity of fuel storage, etc.). Class 4 placer mining land use authorizations (requiring a water licence) are issued by the Yukon Water Board.

The Government of Yukon Mineral Resources Branch has offices in Dawson, Mayo, Watson Lake and Whitehorse (see Chapter 5).

4.2 Federal legislation

Note: the Government of Yukon is not responsible for federal legislation, however we have included brief summaries to inform the reader that these federal statutes may also impose requirements for a project proponent working in or near water. For greater certainty, the reader should check with the appropriate agency or office to determine the applicable requirements for their particular project.

4.2.1 Yukon Environmental and Socio-Economic Assessment Act (YESAA)

The *Yukon Environmental and Socio-economic Assessment Act* (2015) (YESAA) is a federal statute that applies to all land in Yukon including federal, territorial, settlement and private land. It provides a process to identify and mitigate potential adverse environmental and socio-economic effects of development projects in Yukon before projects are carried out.

An assessment under YESAA is required, generally speaking, when an activity is listed in the regulations and requires an authorization or a grant of an interest in land. The assessment process is initiated when an individual or organization submits a project proposal to either a designated office or the Executive Committee, the two primary types of assessment bodies established in YESAA. Once the proposal is received, the assessor ensures that the proposal contains the information necessary to commence an assessment.

Assessors consider the potential environmental and socio-economic effects of proposed activities by gathering and analyzing relevant views and information from various sources (federal, territorial and First Nation governments, experts in the field, and the public) to allow for a complete and thorough assessment. Once the appropriate views and information has been collected and considered through the assessment, the assessor recommends whether the project should proceed, proceed with terms and conditions, or not proceed.

When an assessment is complete, the recommendation is sent to the relevant "decision-maker", the Decision Body(ies), which can be federal, territorial and First Nation governments. The Decision Body(ies) will then decide whether to accept, reject or vary the recommendation of the assessor and issue a Decision Document. These documents are placed on the YESAB Online Registry and available to the public.

The six YESAB designated offices are located in Dawson, Mayo, Haines Junction, Teslin, Watson Lake and Whitehorse. YESAB's main headquarters are located in Whitehorse. Detailed contact information is provided in Chapter 5.

4.2.2 Fisheries Act

The federal *Fisheries Act* (1985) regulates and manages threats to sustainability and ongoing productivity of Canada's commercial, recreational, and Aboriginal fisheries and prohibits carrying out work that causes "serious harm to fish". Under the *Yukon Territory Fishery Regulations* (*Fisheries Act*), and in accordance with an agreement with Canada, the Government of Yukon is responsible for the management of Yukon freshwater fish and fisheries, while the federal government retains responsibility for managing fish habitat, marine fisheries, and any deposition of harmful substances into waters that may affect fish or fisheries. Government of Yukon (CMI) has been delegated responsibility to enforce the *Fisheries Act* (1985) in relation to placer mining. In all other matters, the Department of Fisheries and Oceans (DFO) is responsible for administering and enforcing the Act, which includes authorizing work that affects fish and fish habitat. However, Environment Canada (EC) is responsible for pollution prevention and deposition of harmful substances. Contact information or DFO and EC is included in Chapter 4 of this guide.

Note: at the time of finalizing this document the House of Commons had passed Bill C-68 and Bill C-69 with amendments to the *Fisheries Act*. The Senate will study these Bills as a next step. The next version of this document will reflect such amendments once enacted.

4.2.3 Navigation Protection Act

The *Navigation Protection Act* (NPA) came into force on April 1, 2014 and replaced the *Navigable Waters Protection Act* (NWPA). The NPA regulates and protects the public's right to marine navigation on all navigable waterways in Canada. All construction of works built or placed in, over, through or across navigable waterways must be licensed.

Yukon is part of the Prairie and Northern Region (Alberta, Saskatchewan, Manitoba, and all of the Northern Territories) of the NPA, whose office is in Edmonton, Alberta. Contact information is included in Chapter 5 of this guide.

Note: at the time of finalizing this document the House of Commons had passed Bill C-68 and Bill C-69 with amendments to legislation including the Navigation Protection Act. The Senate

will study these Bills as a next step. The next version of this document will reflect such amendments once enacted.

4.3 Yukon First Nations

Note: the Government of Yukon is not responsible for Yukon First Nations legislation and requirements, however we have included brief summaries to inform the reader that they may also impose requirements for a project proponent working in or near water. For greater certainty, the reader should check with the appropriate First Nations government office to determine any applicable requirements for their particular project.

The 1993 Umbrella Final Agreement between Canada, Yukon, and the Council of Yukon First Nations is the overall agreement of the Yukon Land Claims package and provides for the general agreement made by the three parties in a number of areas. One of those areas is Chapter 14, Water Management. The objective of this chapter is to maintain the water of the Yukon in a natural condition while providing for its sustainable use. This Chapter contains provisions regarding the Yukon Water Board, and water rights of Yukon First Nations. It also states that laws of general application apply.

In addition, the majority of Yukon First Nations have also finalized their respective land claims agreement, and their agreements usually also contains a chapter on water management.

4.3.1 Permission or permit from a First Nation government

Activities on Settlement Land (under a Yukon First Nation Final Agreement) may require permission or a permit from the First Nation.

Please check with the First Nation in the area where your project is proposed to find out more about permission or permit requirements. Even when a permit is not required, the Government of Yukon encourages all those planning to undertake activities on Settlement Land to communicate their plans in advance to the relevant First Nation.

5 Important contact information

Environment and Climate Change Canada
Yukon Office
91782 Alaska Highway
Whitehorse, Yukon Y1A 5B7
Phone: 867-667-3400
Fax: 867-667-7962
Email: enviroinfo@ec.gc.ca
http://www.ec.gc.ca/pollution

Fisheries and Oceans Canada (DFO)
Yukon/Trans-boundary Main Office
100 – 419 Range Road
Whitehorse, Yukon Y1A 3V1
Phone: 867-393-6722 or 1-866-676-6722 (toll-free)
Fax: 867-393-6738
Email: WhitehorseA@pac.dfo-mpo.gc.ca
http://www.pac.dfo-mpo.gc.ca/yukon/default_e.htm

Navigation Protection Program – Prairie and Northern Region
Transport Canada
1100-9700 Jasper Avenue
Edmonton, AB T5J 4E6
Phone: 780-495-8215
Fax: 780-495-8607
E-mail: NPPPNR-PPNRPN@tc.gc.ca
https://www.tc.gc.ca

Yukon Environmental and Socio-economic Assessment Board
YESAB headquarters:
200-309 Strickland Street
Whitehorse, YT Y1A 2J9
Phone: 867-668-6420; toll Free - 1-866-322-4040
Fax: 867-668-6425
Email: yesab@yesab.ca
http://www.yesab.ca

Dawson City Designated Office
Bag 6050, Dawson City, Y0B 1G0
Phone: 867-993-4040
Fax: 867-993-4049

Haines Junction Designated Office
PO Box 2126, Haines Junction, Y0B 1L0
Phone: 867-634-4040
Fax: 867-634-4049

Mayo Designated Office
PO Box 297, Mayo, Y0B 1M0
Phone: 867-996-4040
Fax: 867-996-4049

Teslin Designated Office
PO Box 137, Teslin, Y0A 1B0
Phone: 867-390-4040
Fax: 867-390-4049

Watson Lake Designated Office
PO Box 294, Watson Lake, Y0A 1C0
Phone: 867-536-4040
Fax - 867-536-4049

Whitehorse Designated Office
7209B-7th Avenue, Whitehorse, Y1A 1R8
Phone: 867-456-3200
Fax: 867-456-3209

Government of Yukon Community Services – Fire Marshall's Office
Box 2703 (C-20)
91790 Alaska Highway
Whitehorse, Yukon Y1A 2C6
Phone: 867-667-3731
Email: cs.fmo@gov.yk.ca
http://www.community.gov.yk.ca/protectiveservices/about-yukon-fire-marshals-office.html

Government of Yukon Energy Mines and Resources – Compliance Monitoring and Inspections
Box 2703 (K-325)
Room 330 Elijah Smith Building, 300 Main Street
Whitehorse, Yukon Y1A 2C6
Phone: 867-667-3137
Toll free (in Yukon): 1-800-661-0408 ext. 3137
Fax: 867-667-3199
Email: CMI-Mining@gov.yk.ca
http://www.emr.gov.yk.ca/cmi

Government of Yukon Energy Mines & Resources – Land Management Branch
Box 2703 (K-320)
Room 320 Elijah Smith Building, 300 Main Street
Whitehorse, Yukon Y1A 2C6
Phone: 867-667-5215
Fax: 867-393-6340
Email: land.use@gov.yk.ca
http://www.emr.gov.yk.ca/landmanagement

Government of Yukon Environment – Environmental Compliance and Inspections Section
Box 2730 (V-8)
Whitehorse, Yukon Y1A 2C6
Phone : 867-667-3227
Toll Free (in Yukon) 1-800-661-0408 ext. 3227
Fax: 867-393-6205
http://www.env.gov.yk.ca/air-water-waste/waterinspections.php

Government of Yukon Environment – Water Resources Branch
Box 2730 (V-310)
Whitehorse, Yukon Y1A 2C6
Phone: 867-667-3171
Toll Free (in Yukon) 1-800-661-0408 ext. 3171
Fax: 867-667-3195
https://yukon.ca/en/water-quality-monitoring

Yukon Placer Secretariat
Box 2703 (PS-206)
Whitehorse, Yukon Y1A 2C6
Phone: 867-393-7437
Fax: 867-667-3632
Email: yps@gov.yk.ca
http://www.yukonplacersecretariat.ca

Yukon Spill Line
Phone: (867) 667-7244

Yukon Water Board
Suite 106, 419 Range Road
Whitehorse, Yukon Y1A 3V1
Phone: 867-456-3980
Fax: 867-456-3890
Email: ywb@yukonwaterboard.ca
http://www.yukonwaterboard.ca/index.htm

6 Definitions

Developer or development: A developer is a person or organization that is engaged in the creation or improvement of facilities, infrastructure, land or resources development. The actions of a developer are considered to be the development. For the purposes of this guide, a "development" activity can range from road construction and maintenance to farming and mining.

Eutrophication: The phenomenon caused by adding substances to water that function as nutrients to phytoplankton (algae). Usually these substances are high in nitrates and phosphates, and most often derive from fertilizers or sewage. The resulting "bloom" of algae negatively impacts water because there is rapid turnover of algae and as algae die they provide organic matter for decomposing microbes to feed on. As these microbes decompose dead algae, they consume oxygen in the water and severely deplete the level of oxygen available for fish and other aquatic life. The result of eutrophication is a sharp reduction in higher aquatic life and diversity.

High water mark or ordinary high water mark: The highest water level reached by a body of water in the course of a year is the high water mark. In Yukon, it almost always is reached in spring. If high water has been measured for some period of time, it is customary to refer to the "normal" high water level as the "Ordinary High Water Mark." These are distinguished from "flood" levels, which are the water levels achieved in unusual high water years. Evidence of ordinary high water can be seen in vegetation and soil along stream banks. These include presence of scour marks on trees or debris deposits (e.g., leaves and twigs). High water also is marked by the point at which natural vegetation shifts from predominately water-dependent or flood-tolerant species (e.g., willows) to terrestrial species (e.g., spruce).

Navigable water: For purposes of the *Navigation Protection Act* (1985), a navigable water includes a canal and any other body of water created or altered as a result of the construction of any work. The only navigable water identified at the time of finalizing was the Yukon River - from the rapids near the dam in Whitehorse to the Canada–U.S. border.

Non-metal leaching and non-acid generating (Non-ML/ARD): Riprap and infill materials used in or near watercourses must be non-metal leaching and non-acid generating. These materials must conform to the latest Yukon Water Board standards, which include the following criteria: paste pH ≥5, Neutralizing Potential:Acid Generating Potential Ratio (NPR) ≥3, and total sulphur of ≤0.3%. Making these determinations requires the sampling and the analyses of these samples at an accredited laboratory. The collection of samples and the interpretation of these results should be conducted by a qualified person.

Riparian zone or riparian area: These terms refer to the area and vegetation immediately adjacent to a river, stream or wetland. The zone can be anywhere from a few meters to a few hundreds of meters wide. The vegetation type and structure in a riparian zone is distinct from vegetation away from the watercourse. It will contain more willows, alder, sedges, and other

plants that are adapted to living in wet and flood prone soils. Relative to other (non-riparian) habitats, riparian zones are important for many reasons. First, plant and animal diversity and productivity are very high in riparian zones. Second, some plant and animal species are highly dependent on riparian zones. Third, riparian habitat is very limited in extent, relative to other habitat types. In other words, riparian habitat is very productive but relatively uncommon. Just as important, riparian vegetation provides natural erosion control, buffers storm water runoff, builds bank stability, and offers stream cover (shade, fish habitat).

Sedimentation: Sedimentation is the tendency for particles in suspension to settle out of the fluid in which they are entrained, and come to rest against a barrier. In geology sedimentation is often used as the opposite of erosion, i.e., the terminal end of sediment transport. Settling is the falling of suspended particles through the liquid, whereas sedimentation is the termination of the settling process.

Turbidity: turbidity is the cloudiness or haziness of a fluid caused by entrained or suspended particles that are generally invisible to the naked eye. Turbidity in water is analogous to smoke in air. The measurement of turbidity is a key test of water quality.

Waste: Waste is defined in the *Waters Act* as "any substance that, if added to water, would degrade or alter, or form part of a process of degradation or alteration of, the quality of the water to an extent that is detrimental to its use by people or by any animal, fish or plants...."

Water use or waste deposit without a license: Under Section 4.(1) of the *Waters Regulations*, notice must be given to the Yukon Water Board of any water use or deposition of a waste into a watercourse that occurs in the course of placer mining, quartz mining, or any industrial undertaking.

Watercourse: As defined in the *Waters Regulations***,** means a natural watercourse, body of water or water supply, whether usually containing water or not, and includes groundwater, springs, swamps, and gulches.

Wetland: Land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, water dependent vegetation and other biological activities which are facilitated by a wet environment. Five wetland classes include bog, fen, swamp, marsh and shallow water. Note that areas do not need to be "wet" all year to be considered "wetlands."

Working "in the dry": This term refers to work that in conducted in watercourses whereby the water is first diverted or excluded from the work area for the duration of the construction period. For instance, to replace a culvert, the stream channel is diverted into a temporary channel so that work on the culvert can occur in dry conditions. The purpose of working in the dry is to avoid sedimentation and contamination of water that would be caused by equipment and work activities.

7 Resources

7.1 Publications

Alberta Transportation. 2003. Field Guide for Erosion and Sediment Control for Highways.

BC Government. 2000. Fact Sheet – Culverts and Fish Passage. British Columbia Ministry of Transportation and Highways.

BC Government. Date Unknown. Standards and Best Practices for Instream Works. British Columbia Ministry of Water, Land and Air Protection. Version 1. http://www.env.gov.bc.ca/wld/instreamworks/downloads/Bridges.pdf

Caltrans. 2003. Strom Water Quality Handbooks. Construction Site Best Management Practices Manual. California Department of Transportation.

Department of Fisheries and Oceans. 1995. Freshwater Intake End-of-Pipe Fish Screen Guidelines. By Communications Directorate Department of Fisheries and Oceans, Ottawa. ISBN 0-662-23168. Catalogue no. Fs 23-270/1995E.

Fisheries and Oceans Canada – Measures to avoid causing harm to fish and fish habitat including aquatic species at risk. Available at http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html

FP Innovations –Feric. 2007. Erosion and Sediment Control Practices for Forest Roads and Stream Crossings.

Department of Fisheries and Oceans. 1998. Guidelines for the use of Explosives in or near Canadian Fisheries Waters. http://www.dfo-mpo.gc.ca/Library/232046.pdf

Kennedy, C.E. 1993. Guidelines for Reclamation/Revegetation in the Yukon. Yukon Renewable Resources. ISBN1-55018-519-5

Nener, J. et al. Water Stewardship – a Guide for Agriculture. This publication is part of the Stewardship Series. Published by the Government of British Columbia. ISBN 0-7726-3174-3

Transportation Association Canada. 2005. National Guide to Erosion and Sediment Control on Roadway Projects. By: Transportation Association of Canada ISBN 978-1-55187-204-8

Transportation Association Canada. 1999. Synthesis of Practice No. 5 - Transportation Construction and Maintenance and Protection of Fish Habitat. http://www.tac-atc.ca/sites/tac-atc.ca/files/site/pts-fishh.pdf

Wright, S. 2008. A Revegetation Manual for Alaska. Alaska Plant Materials Center, Division of Agriculture, Alaska Department of Natural Resources, Palmer, Alaska.

Yukon Chamber of Mines. 2010. Yukon Mineral and Coal Exploration Best Management Practices and Regulatory Guide.

Yukon Environment Fish and Wildlife Branch. 2010. Status of Yukon Fisheries 2010. An overview of the state of Yukon fisheries and the health of fish stocks, with special reference to fisheries management programs. Publication No. MR-10-01
http://www.env.gov.yk.ca/publications-maps/documents/status_yukon_fisheries2010.pdf

Yukon Placer Secretariat. 2008. Guidebook of Mitigation Measures for Placer Mining in the Yukon.

http://www.yukonplacersecretariat.ca/pdf/guidebook_chapters_1_2_11apr08.pdf

7.2 Additional useful internet sites and document links

Alberta Transportation: Field Guide for Erosion and Sediment Control for Highways – April, 2003 (Revised June, 2003).http://www.transportation.alberta.ca/2620.htm

Ducks Unlimited Canada – Conserving Canada's Wetlands http://www.ducks.ca/

Government of Canada – Environment and Climate Change Canada https://www.ec.gc.ca

Government of Canada – Fisheries and Oceans Canada (DFO) http://www.dfo-mpo.gc.ca

Government of Canada Transport Canada – Navigation Protection Program
https://www.tc.gc.ca

Government of Yukon Department of Environment

- Environmental Programs Branch – Spill Response Plans:
- http://www.env.gov.yk.ca/environment-you/documents/spills2_spill_response_plans.pdf
- Environmental Programs Branch Sample – (Sample) Spill Response Plan:
  http://www.env.gov.yk.ca/air-water-waste/documents/SpillResponsePlanSample.pdf
- Yukon Ecological & Landscape Classification Program
  https://yukon.ca/ecological-landscape-classification

US Department of Agriculture – Natural Resources Conservation Service

https://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home

Yukon Chamber of Mines http://www.yukonminers.ca/

Yukon Water Board: Template for Fuel Spill Contingency Plan
http://www.yukonwaterboard.ca/forms/fuel_spill_contingency_plan.pdf

7.3 Legal references

Emergencies Act, RSC 1985, c 22 (4th Supp)

Environment Act, RSY 2002, c 76

Explosives Act, RSC 1985, c E-17

Fisheries Act, RSC 1985, c F-14

Land Use Regulation, YOIC 2003/51

Navigation Protection Act, RSC 1985, c N-22

Occupational Health and Safety Act, RSY 2002, c 159

Placer Mining Act, SY 2003, c 13

Placer Mining Land Use Regulation, YOIC 2003/59

Quartz Mining Act, SY 2003, c 14

Quartz Mining Land Use Regulation, YOIC 2003/64

Seeds Act, RSC 1985, c S-8

Species at Risk Act, SC 2002, c 29

Storage Tank Regulations, YOIC 1996/194

Territorial Lands (Yukon) Act, SY 2003, c 17

Waters Act, SY 2003, c.19

Waters Regulation, YOIC 2003/58

Yukon Environmental and Socio-economic Assessment Act, SC 2003, c 7

Yukon Territory Fishery Regulations, CRC, c 854