EROSION AND SEDIMENT CONTROL AT CONSTRUCTION SITES

GUIDELINES

City of Moncton
Engineering and Environmental Services

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INTRODUCTION

Erosion is the removal of soil by the action of wind, rainfall and surface runoff. The deposition of the eroded particles is called sedimentation. Construction activities can accelerate erosion dramatically, mainly by exposing large areas of soil to rain and running water. If runoff is not properly controlled and treated, the outcome can lead to sedimentation of nearby watercourses and degradation of fish and wildlife habitat.

Drainage and erosion control should be considered in the initial planning phase of a project and an erosion and sediment control plan should be developed before any earth-moving activity takes place. The intent of the erosion and sediment control plan is to reduce the impact of construction on water quality.

Erosion is primarily affected by four factors: climate, soil type, topography and vegetation. The selection of the best soil erosion and sediment control measures for your site will be based on the characteristics of the site and the nature of the construction activity. In order to select the right control measures, a site investigation must be conducted to clearly identify existing conditions. It is important that the sediment and erosion control plan be designed specifically for the subject site.

A comprehensive erosion and sediment control plan should first focus on preventing erosion by minimizing the disturbed area, stabilizing exposed soil and re-vegetating slopes. The next thing to consider is sediment control measures, which focus on intercepting sediment-laden runoff that has escaped the erosion control measures. Sediment control measures include silt fences, check dams, sediment traps and sediment basins.

The Fisheries Act prohibits the deposit or release of a deleterious substance, including sediments, to fish-bearing waters or any place where the deleterious substance may enter such water. Implementing an erosion and sediment control plan is good engineering practice and it will also reduce environmental risk and liability.

The following sections describe the information which should be included in an erosion and sediment control plan, the format in which the information should be presented, best management practices, a list of accepted erosion and sediment control measures, monitoring and maintenance requirements and runoff water quality requirements.

THE EROSION AND SEDIMENT CONTROL PLAN FORMAT

The erosion and sediment control plan must be an integral part of the site development plan and prescribe all the necessary steps, including scheduling, to assure proper erosion and sediment control during all phases of construction. The plan should include a narrative report and a site plan.

1) The narrative report must include:

- A project description;
- Scheduling of major land-disturbing activities;
- A brief analysis of local drainage factors and potential problems posed by stormwater runoff on downstream areas;
- A description of erosion and sediment control measures to be used during construction (purpose, type, location, dimensions and design considerations);
- A description of the inspection and maintenance program and schedule.

2) The erosion and sediment control plan should be an integral part of any site plan, grading plan or drainage plan or construction drawing and must include:

- Topographic features including environmentally sensitive areas located in proximity of the project area such as streams, lakes, ponds, wetlands, drainage ditches, flood plains and wells;
- Available soil information (such as major soil types and depth);
- The proposed alteration of the area including project boundary limits, limits of clearing and grubbing, areas of cut and fill, proposed slopes and location of stockpiles and excess fill;
- Erosion and sediment control measures to be used during construction (type, location, dimensions and design considerations).

EROSION AND SEDMINENT CONTROL BEST MANAGEMENT PRACTICES

The following principles should be utilized as much as possible on all construction projects.

1) Minimize the amount of disturbed soil and limit the time the disturbed area is exposed.

- Adjust the activity to natural site features (topography, soils, waterways, and natural vegetation).
- When possible, minimize the grade change on the site, which will decrease the amount of disturbed soil and the amount of erosion that can occur.
- Only clear and grub the portions of the site where it is necessary for construction and retain existing vegetation wherever feasible.

- When feasible, stage the project so that only a small portion of the site will be disturbed at any one time.
- If there are disturbed areas of the site that will not be re-disturbed for a long period, then these areas should be stabilized with temporary seeding, mulching or matting.

2) Prevent offsite runoff from flowing across disturbed areas.

- Divert surface runoff from the construction site and exposed areas using dikes, berms, drainage swales or ditches. The method of choice depends on the size of the drainage area and the steepness of the slope (further discussed in the Drainage and Sediment Control section).

3) Reduce the velocity of the runoff traveling across the site.

- Steeper slopes result in faster moving runoff, which results in greater erosion. Grade change should be as gradual as possible.
- Cover erodible soils and sloped areas with mulch, vegetation, matting or riprap. Vegetative covers increase the surface roughness, which reduces the velocity of the surface runoff.
- Runoff concentrated into swales or channels can be slowed by reducing the slope, increasing the channel width, constructing check dams and by establishing a vegetative cover.

4) Remove the sediment from onsite runoff before it leaves the site.

- Since it may take several weeks to establish a grass cover to control erosion, it is important that measures which can remove sediment from runoff before it flows off of the construction site be installed.
- Sediment control devices include check dams, gravel filter berms, sediment control fences, straw bale filter barriers, sediment traps and sediment control ponds. The selection of the best measure depends on a number of criteria including the size of the disturbed area, the type of runoff (concentrated or sheet-flow) and the volume of runoff.
- The sediment control devices must remain in place until permanent vegetation has been established or the site is otherwise stabilized.

5) Develop and implement a thorough monitoring and maintenance program.

- Conduct a routine check, including after each rain event, to ensure that all control measures are working properly for the duration of the project.
- Additional preparation may be required if heavy rain is predicted.
- Keep an inventory of erosion and sediment control materials throughout construction.

SELECTION OF EROSION AND SEDIMENT CONTROL MEASURES

Both stabilization and drainage control measures can be used to control erosion and sedimentation. Stabilization measures are used to stabilize the soil to prevent erosion. Structural drainage and sediment control measures are implemented to trap sediment-laden runoff before it leaves the site. A combination of both erosion and sediment control measures should be implemented for the plan to be effective. The selection of the best combination of measures is site specific and a site investigation must be conducted before selecting appropriate measures.

1) SURFACE STABILIZATION AND EROSION CONTROL

Surface stabilization measures will help prevent erosion of soils and should therefore be given primary attention. The following are some common accepted surface stabilization and erosion control measures:

Surface Roughening

- Surface roughening is a temporary measure and it can help reduce runoff velocity, increase infiltration and trap sediment. It helps protect exposed soil until a vegetative cover is established and should be done as soon as possible after existing vegetation has been removed.
- The soil surface can be roughened by the creation of horizontal grooves or depressions that run parallel to the contour of the land (can be created by dozer treads or other heavy equipment).
- Can be used in combination with other stabilization measures such as seeding and mulching.

Re-vegetation

Seeding

- Seeding can be a temporary or long-term erosion control measure. An immediate plant cover will not be established, unless hydroseeding is conducted.
- Seeding is most appropriate in flat areas and on slopes less than 3H:1V. It should take place as soon as possible after the land has been disturbed.
- The surface soil must be loosened for water to infiltrate and roots to penetrate. Seedbed preparation may require the application of a fertilizer.
- The selection of vegetation mixture is dependant upon site conditions. Grasses and legumes are commonly used in seed mixtures.
- Mulch should be used as it helps conserve moisture and increases the odds of successful re-vegetation.

Hydroseeding

- Hydroseeding, where a slurry of seed, fertilizer, mulch, binder and water is sprayed on a prepared surface, is an acceptable process.

- Hydroseeding should not be applied to compacted soils, eroded surfaces or areas where ponding has occurred. The soil should be loosened and free of roots, branches, weeds, rocks, ruts and ridges.
- Hydroseeding should not be neglected until the end of a project. It should be completed in stages as construction progresses. It should not be conducted during periods of heavy rain, strong winds, or immediately prior to forecasted heavy rain.

Sodding

- Sodding is appropriate for graded areas where a permanent cover is required.
- Will provide immediate cover and erosion control.
- Sodding should be done as soon as possible after the area has been cleared and should include a prepared topsoil bed.
- The sod should be rolled out horizontally across the slope with joints staggered.
- Sod should not be installed during very hot or wet weather or on frozen ground.

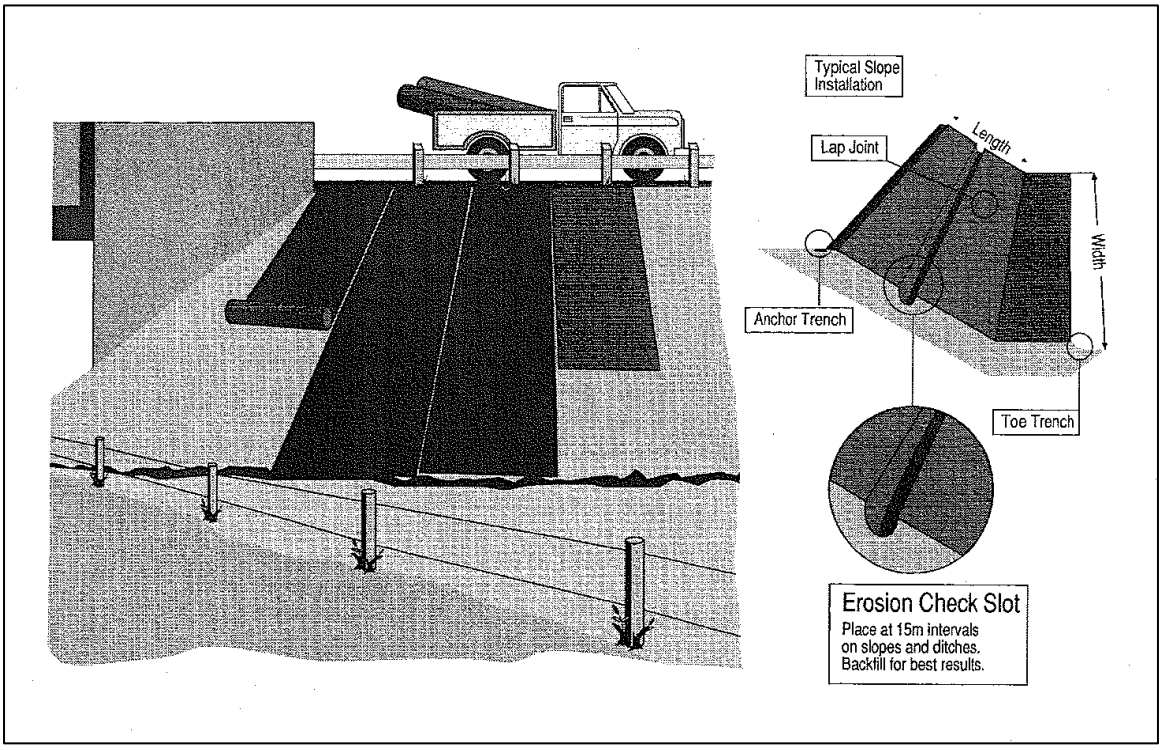
Mulching

- Mulch, commonly consisting of hay or straw, is applied to the ground surface as a temporary erosion prevention measure. It also aids in plant growth and re-vegetation as it helps conserve moisture.
- Mulching can provide immediate, effective, and inexpensive erosion control.
- Mulching can be used together with seeding or planting. Straw is the mulch most commonly used in conjunction with seeding.
- Mulch can be applied by hand or with a mulch blower.
- A tackifier, which is a bonding agent that helps secure the mulch to the soil, may be applied with the mulch. The supplier should be consulted for the application rate and ratio.
- On steep slopes and critical areas such as waterways, mulch matting should be used with netting or anchoring to hold it in place.

Matting

- Matting or erosion control blankets are used to protect slope surfaces, channels or newly seeded soil from eroding. Erosion control blankets are commonly made of mulch, wood fibre or synthetics. The selection of the mat is dependent upon the availability and the length of time protection is required.
- Most applicable for steep slopes, generally greater than 3H:1V, and where high velocity runoff or severe erosion problems are anticipated.
- The effectiveness of matting increases when used in conjunction with hydroseeding or mulching. It provides protection against surface runoff, allowing vegetation to properly establish and preventing washing away of seeds.
- The ground surface should be prepared, graded and large rocks or debris removed. It is important that the mat be in continuous contact with the underlying soil.
- The following are some important installation guidelines:
  - Fertilize and seed the area as required.

- Lay out the mats starting from the up-slope end of the site. The adjacent edges of adjoining mats shall be overlapped by a minimum of 10 cm .
- Using U-shaped wire staples, staple the upper upslope edge of the mat into a 15 cm deep trench. Then backfill and firmly pack the trench.
- If two mat lengths are used end-to-end, the down-slope mat should be overlapped a minimum of 10 cm by the up-slope length. The down-slope mat should be stapled into a trench.
- Staples should be placed 45 cm apart along overlaps and 60 cm apart along outer edges, making sure the mat is in contact with the soil.
- Erosion check slots shall be made in highly erodible areas or where slopes exceed 4H:1V to prevent water from accumulating underneath the mat. On slopes more than 15m long, there should be an erosion check slot at the midpoint. On slopes and ditches more than 30 m long, there should be a check slot at 15 m intervals. The check slots are trenches about 100 mm deep and 100 mm wide dug across the slope or ditch.
- Consider installing a diversion ditch at the top of the slope to further control the amount of stormwater that may flow over an area.



Source: Nova Scotia Department of the Environment, Erosion and Sedimentation Control Handbook for Construction Sites

Geotextiles

- A geotextile, another form of erosion protection blanket, is a porous filter fabric, usually made from synthetic materials.
- Geotextiles can be used to stabilize channel floors or to protect seeding on planted slopes until they become established. It can also be used to separate soil and riprap to prevent the soil from being eroded from beneath the riprap.

Rock Riprap

- Riprap is typically used on long steep slopes where it is difficult to establish vegetation due to high flow and surface runoff velocities. It can also be used to provide stream bank protection where vegetation alone is insufficient to prevent erosion.
- The stone gradation should be mixed so that voids between large stones are filled with smaller stones. The predominant stone size should be determined based upon the overland flow velocity.
- Filter fabric (geotextile) should be used to prevent fines from being washed out from underlying soil. To protect the fabric a layer of coarse gravel can be placed on top of the fabric, below the riprap.
- Riprap should be applied at a thickness of at least 1.5 times the maximum stone size and not less than 30 cm thick.

Buffer Zones

- A buffer zone is a strip of dense vegetation that is used to minimize the erosion potential. They are often used to delineate disturbed areas, sensitive areas and property boundaries and to protect stream banks. It is normally used as a temporary measure where the area has not been finally graded.
- The buffer zone can be an area of natural vegetation that is left undisturbed during construction or it can be newly planted or seeded.
- The buffer strip should be wider for steeper slopes or areas exhibiting excessive runoff.
- Vegetation strips should be oriented perpendicular to the flow direction.
- The selection of vegetation depends on the site conditions and the intended use of the buffer strip. May consist of grasses, legumes, shrubs and trees.

2) DRAINAGE AND SEDIMENT CONTROL STRUCTURES

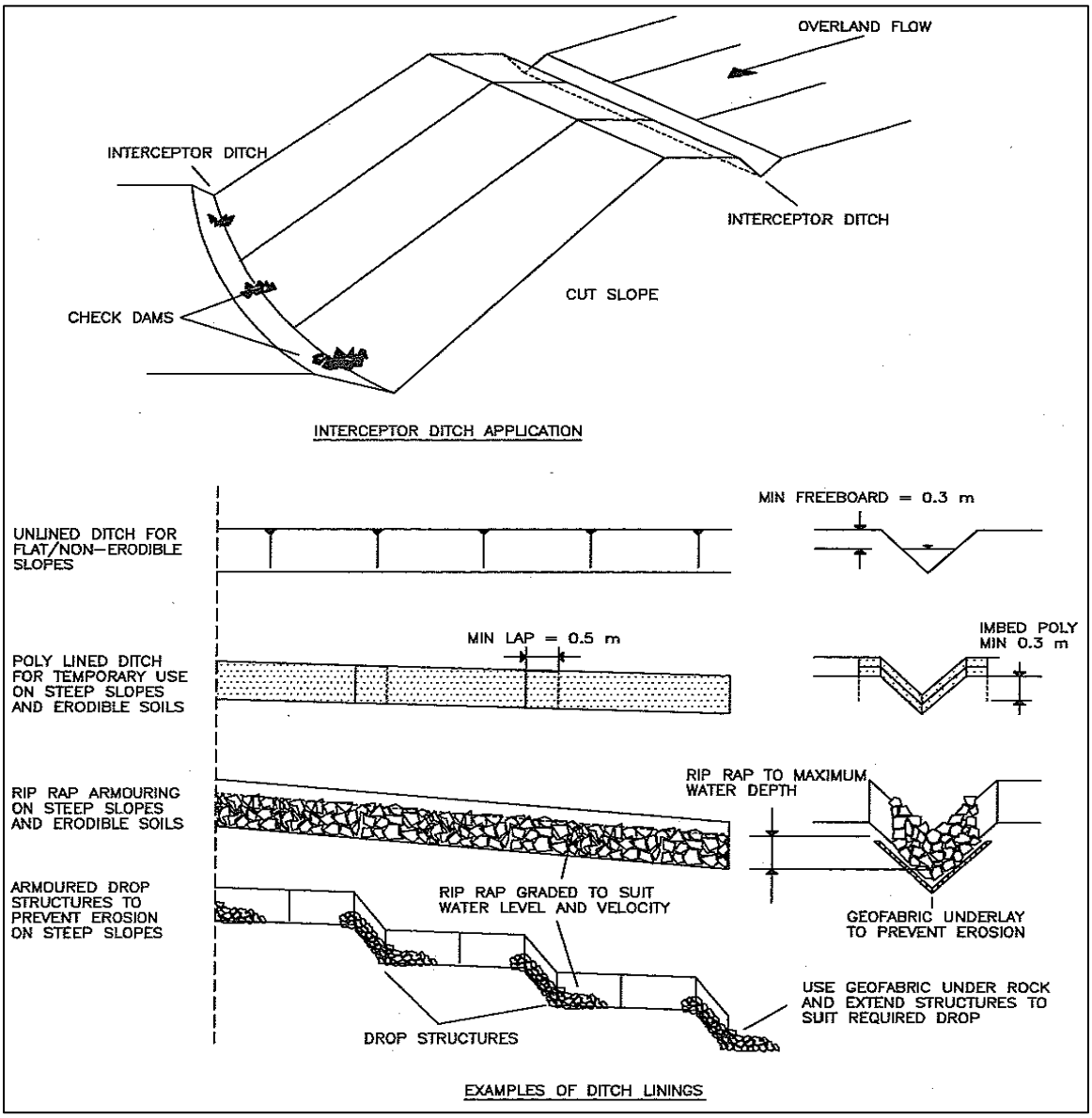
Runoff, which passes over disturbed soil, should pass through sediment control structures before it flows off of the construction site. To remove sediments from sheet-flow run-off, a filtration device such as a sediment control fence should be installed on the perimeter of the disturbed area. For concentrated flow, a diversion device such as a drainage swale or dike should be constructed and carry the runoff to a sediment basin or sediment trap. Inlet protection for catch basins and curb inlets, which receive flow from a disturbed area, should be constructed to remove the sediments from the runoff before it flows into the inlet. The following are some common sediment control measures:

Earth Dike

- An earth dike or interceptor dike is a ridge or ridge and channel combination used to divert upslope runoff from construction areas towards sediment basins or sediment traps. They can also be constructed near the perimeter of the construction area to prevent sediment-laden runoff from leaving the site.
- The dike can be constructed with compacted soil and stone, riprap, or vegetation.

Drainage Swale

- Often referred to as interceptor swale, interceptor ditch, diversion channel or diversion ditch. The swale can be parabolic, V-shaped or trapezoidal.
- They are used to reduce slope lengths and to intercept and divert water away form construction sites or other erodible areas to a suitable outlet point such as a sediment trap or sediment control pond. They are usually built around the perimeter of the site or along the upslope perimeter of a disturbed area.
- They should be built before any major soil disturbing activity takes place on site.
- Depending on the soil type and the velocity and volume of the anticipated runoff, it may be necessary to line the swale with a geotextile and/or stabilize the bottom and sides of the channel with vegetation, rock or other type of stabilization. If the soil is silt, sand, sand and gravel or organic, it is recommended to line the swale with polyethylene or other geotextile and construct a number of check dams within it. Bedrock or hard glacial till subgrade can remain unlined. Steep gradient and/or swales carrying a large volume of water may require full rock armouring to design water levels to prevent bank erosion.
- Grassed swales are broad, shallow, gently-sloping channels stabilized by suitable vegetation, which can increase infiltration of runoff and sediment removal. Until turf becomes established it will be necessary either to (i) divert runoff via an alternative route (ii) line the channel with a temporary protective lining, and mulch the shoulders thoroughly, or (iii) lay sod over the channel.
- There should be no dips or low points in the swale where storm water can collect.



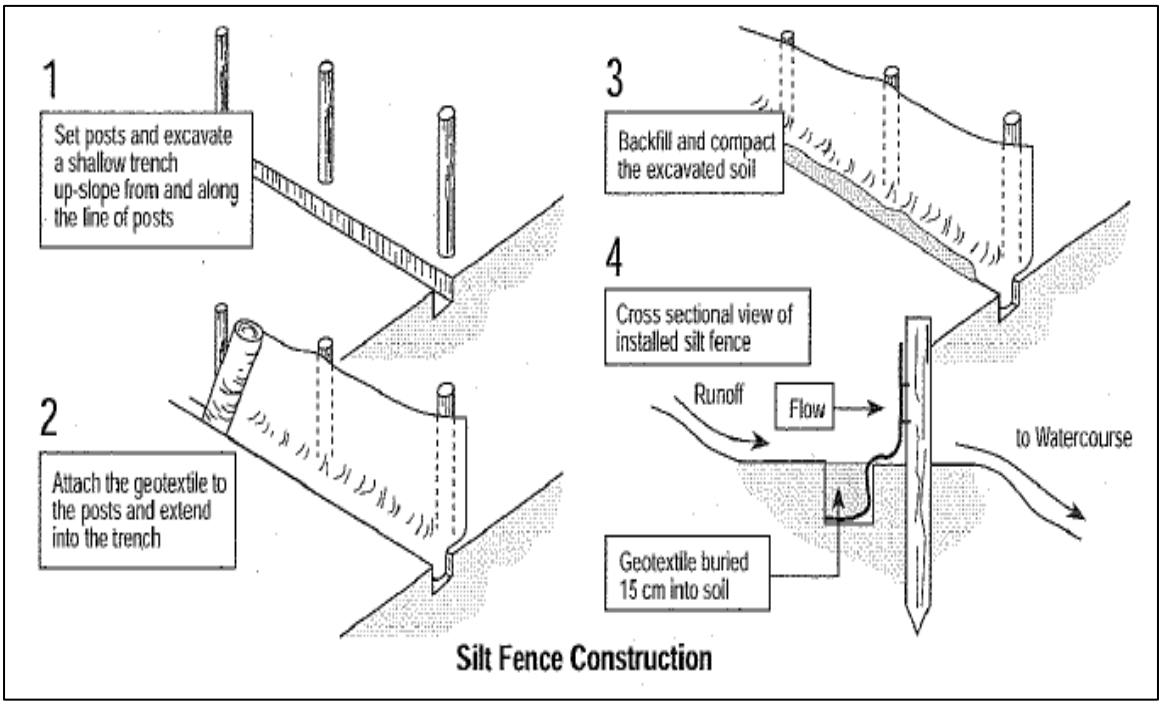
Source: Fisheries and Oceans Canada, Land Development Guidelines for the Protection of Aquatic Habitat

Gravel or Stone Filter Berm

- A filter berm is a temporary ridge constructed of loose gravel, stone, or crushed rock. It slows and filters flow, diverting it from an exposed traffic area to a stabilized outlet.
- This method is appropriate where roads and other right-of-ways under construction accommodate vehicular traffic.
- Berms should only be used in gently sloping areas. The spacing of the berms will depend on the steepness of the slope. They should be placed closer together as the slope increases.
- Berm material must be well-graded gravel or crushed rock.

Sediment Control Fences

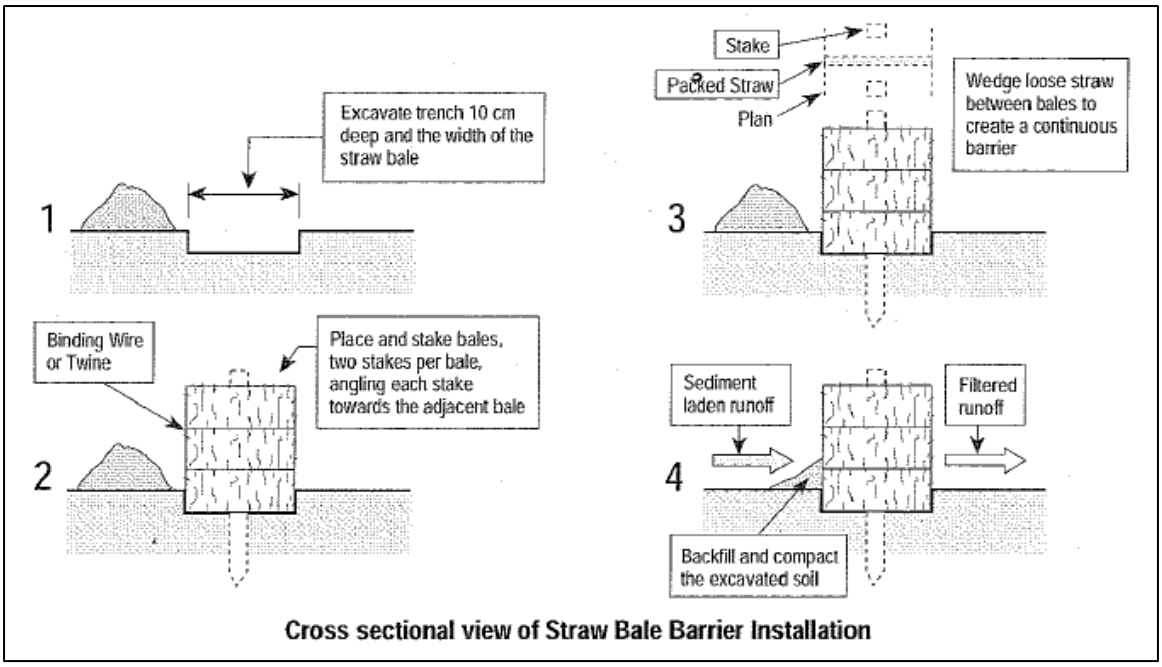
- A sediment control fence, commonly referred to as silt fence or filter fabric barrier, is used to remove sediment from overland sheet flow runoff. It is not intended to handle concentrated channel flow or high velocities.
- Sediment fences are installed perpendicular to the flow to intercept runoff, trapping the sediment. A sediment fence should be used in the following locations:
  (i) To delineate buffer zones;
  (ii) Along the contours of exposed slopes;
  (iii) At the downslope perimeter of cut or fill slopes or disturbed areas;
  (iv) Adjacent to streams and along the bank of a watercourse;
  (v) At the outer boundary of the work area.
- The fence should be erected before there is any soil disturbed on the site.
- Should be used where the size of the drainage area is not more than 0.1 ha/30 m of silt fence length or in small swales where 1 ha is the maximum contributing drainage area.
- Prefabricated sediment control fences shall be installed as per the manufacturer's instructions.
- The following are some sediment control fence installation guidelines:
  - The geotextile fabric shall be erected to a height of approximately 0.75 m above the ground surface (so that at least 0.15 m is left as a bottom flap for burying) and secured to wood or steel posts.
  - Reinforcement of the fabric, using a wire fence, may be necessary.
  - Support posts should not be over 2.5 m apart. Extra strength filter fabric may be used without wire fence backing if posts are not over 2.0 m apart.
  - Fabric joints should be lapped at least 0.15 m and stapled. The filter fabric should be stapled to the upstream side of the wooden stakes.
  - The lower edge of the fence should be buried in a trench at least 0.15 m to 0.30 m deep and covered with backfill to prevent flow under the fence.
  - The sediment control fence should be inspected frequently, especially prior to and after rain events. Sediment should be removed when it reaches about half of the height of the fence, and shall be disposed of at a location at least 30 m from any watercourse and such that it cannot wash into a watercourse.



Source: Government of New Brunswick, Department of the Environment, Watercourse Alteration Technical Guidelines

Straw Bale Filter Barriers

- Straw bale barriers can be placed around the downslope perimeter of a disturbed area or along the bank of a watercourse in order to intercept runoff, trapping the sediment before it reaches a watercourse.
- They are a short-term measure and only effective to treat runoff from small drainage areas.
- They should be bound with wire or string, placed lengthwise in a trench, staked, and backfilled. There should be at least 2 stakes per bale. The first stake in each bale should be driven toward the previously laid bale to force the bales together.
- Straw bale barriers should be checked regularly and immediately after each rainfall. Straw bales can deteriorate in 30 to 60 days. Sediment control fences are stronger and have a higher filtering capacity than straw bale barriers.



Source: Government of New Brunswick, Department of the Environment, Watercourse Alteration Technical Guidelines

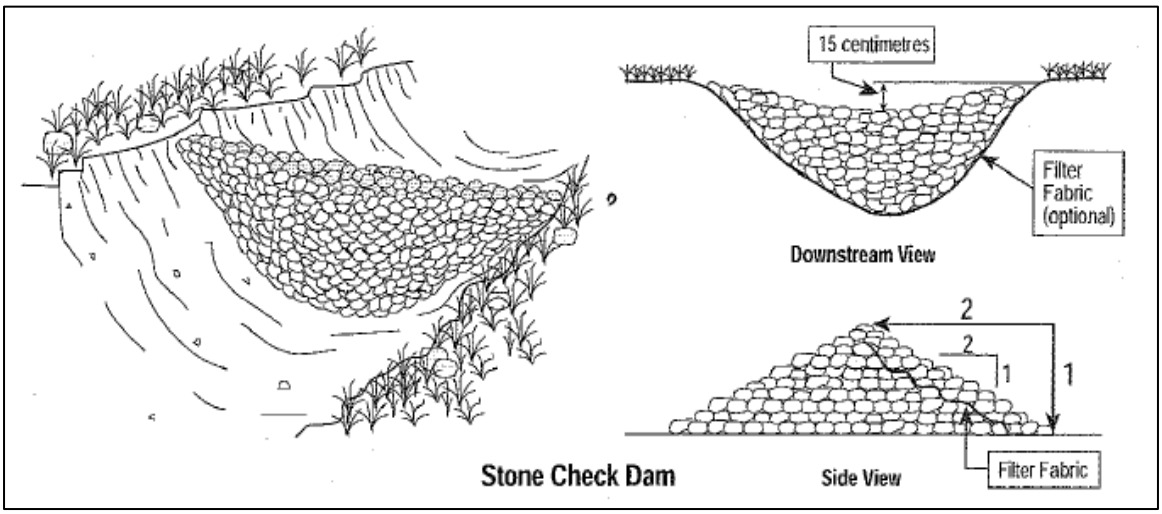
Check Dams

- A check dam is a small dam constructed across a drainage ditch, swale or channel. It is used to trap sediments by reducing the flow velocity and allowing sediments to settle out before discharge to a watercourse, to minimize channel scour and to hold moisture in underlying soil, thereby facilitating the establishment of vegetation.
- The drainage area of the ditch or swale should not be greater than 4 hectares (10 acres). The check dams should be installed before drainage is allowed to flow through the ditch.
- Several check dams, not over 40 cm high, are preferable to a few larger dams. Check dams should be placed between 15 to 200 metres apart depending on the slope of the ditch and erodibility of the soil. The top of the check dam should be as high as the base of the one upstream.
- The center of the dam should be at least 15 cm lower than the ends of the dam. This can be accomplished with a notch at the center of the dam.
- Each end of the dam should be risen by 45 cm or more to protect the bank.
- A protective apron should be placed at the foot of the dam, extending 1 m beyond the main spillway and on both banks of the ditch.
- A small area should be excavated just upstream of the check dam to provide some capacity for trapping sediment.
- Regular inspections are necessary to ensure that sediment does not accumulate to an elevation of more than half of the height of the dam at which point the accumulated sediment should be removed.

- The type of check dam used will depend on the volume and velocity of the runoff, the required life expectancy of the dam and on whether the check dam is to be temporary or permanent.

(i) Stone Check Dams

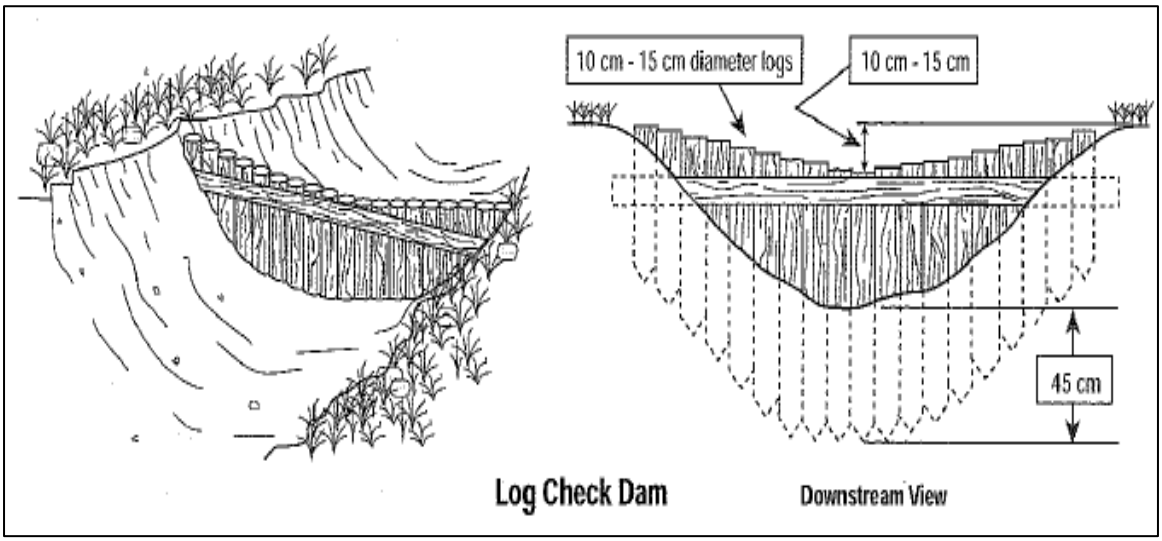
- Used in ditches of low to moderate slope (1-8^{o}), having a small drainage area.
- The size of stone should be selected base on the anticipated velocity of runoff.
- They are usually constructed with stone having a minimum size of 50 mm. If available, a gradation of stone size of at least 100-150 mm should be used. If 25-50 mm rock is used, the centre and backside of the dam should be protected with 100 mm rock.
- A geotextile filter should be placed under the stones to provide a stable foundation, to facilitate the removal of the stones and to prevent the finer soil particles from washing away.
- The side slopes should be approximately 2H:1V.
- Stone check dams vary in height up to 1.0 metre depending on the size and drainage area of the ditch and should be placed such that the elevation of the toe of the upstream dam is the same elevation as the top of the downstream dam.



Source: Government of New Brunswick, Department of the Environment, Watercourse Alteration Technical Guidelines

(ii) Log Check Dams

- Should be constructed with logs of 10 cm to 15 cm diameter salvaged from clearing operations if possible.
- The logs should be embedded at least 45 cm into the soil.
- The center of the check dam should be approximately 15 cm lower than the outer edges.



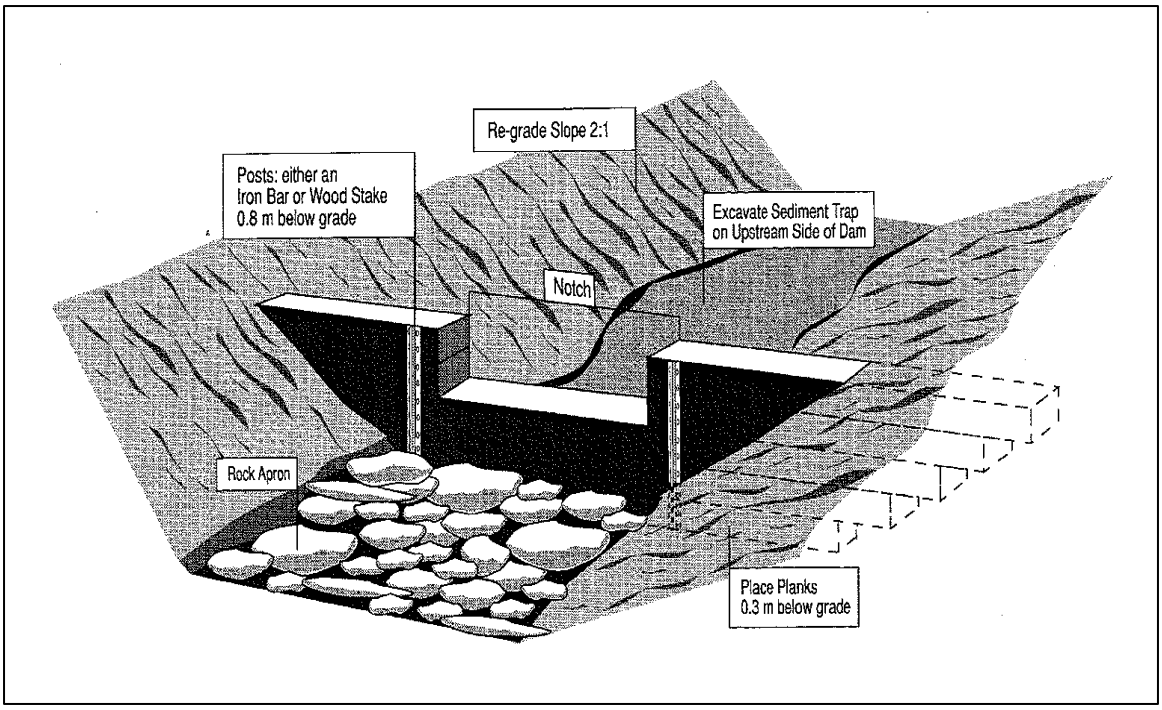
Source: Government of New Brunswick, Department of the Environment, Watercourse Alteration Technical Guidelines

(iii) Gabion Basket Check dam

- Gabion baskets are fabricated from wire mesh and filled with rock.
- May be used in channels or ditches of moderate slope, having a small to medium size drainage area, and where a source of rock is available.
- The bottom of the wire baskets should be set approximately 300 mm below the bottom of the ditch.
- Placing a layer of straw at the bottom of the gabion can improve the sediment trapping efficiency.
- A rock apron should be placed down-stream of the baskets and extend 1 m from the gabion.
- The channel sides should be stabilized by sodding, seeding, mulching or gravelling immediately after construction.

(iv) Plank Dam

- Plank dams can be used in channels with small to medium drainage areas and when a durable check dam is required.
- Posts are set at a depth of approximately 1 m in a straight line across the channel (on each side of the spillway).
- A 30 cm deep trench should be dug along the upstream side to permit placing the bottom plank and a thin layer of straw or grass as a seal. The trench should be backfilled and well compacted with earth.
- Planks are nailed to the posts with the ends of the planks set well into the banks.
- A spillway notch shall be cut in the center of the dam and a rock apron installed.



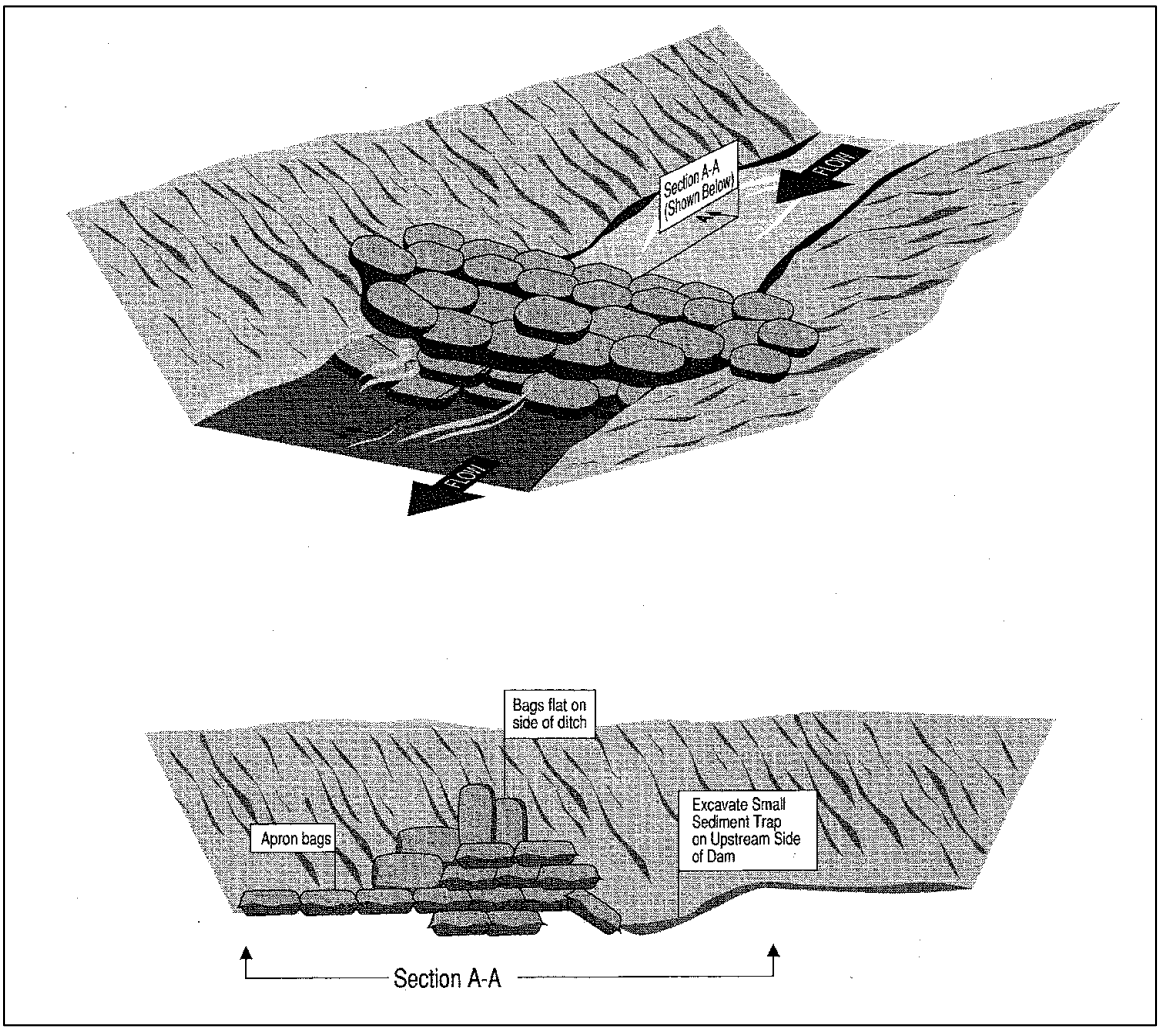
Source: Nova Scotia Department of the Environment, Erosion and Sedimentation Control Handbook for Construction Sites

(v) Straw Bale Check Dams

- Straw bales are often used as check dams in channels or ditches. They should not be used in channels with drainage areas greater than 0.8 hectares.
- Straw bales must be secured into the channel and staked with two stakes angled towards the adjacent bale.
- Additional details on straw bale check dams are provided under item (ix), Straw Bale Erosion Control Structure - NBDOT Type C.

(vi) Sandbag Dam

- Sandbag dams can be used in channels with small drainage areas and a low runoff velocity.
- A trench is excavated to a depth of 25 cm across the channel or ditch.
- Sandbags are laid in a row across the channel at least two bags high. The bags should be overlapped.
- Sandbags can be used to create an apron below the spillway. Sandbags should extend a minimum of 1 m downstream.
- The sides of the channel should be stabilized by sodding, seeding, mulching or gravelling immediately after construction.



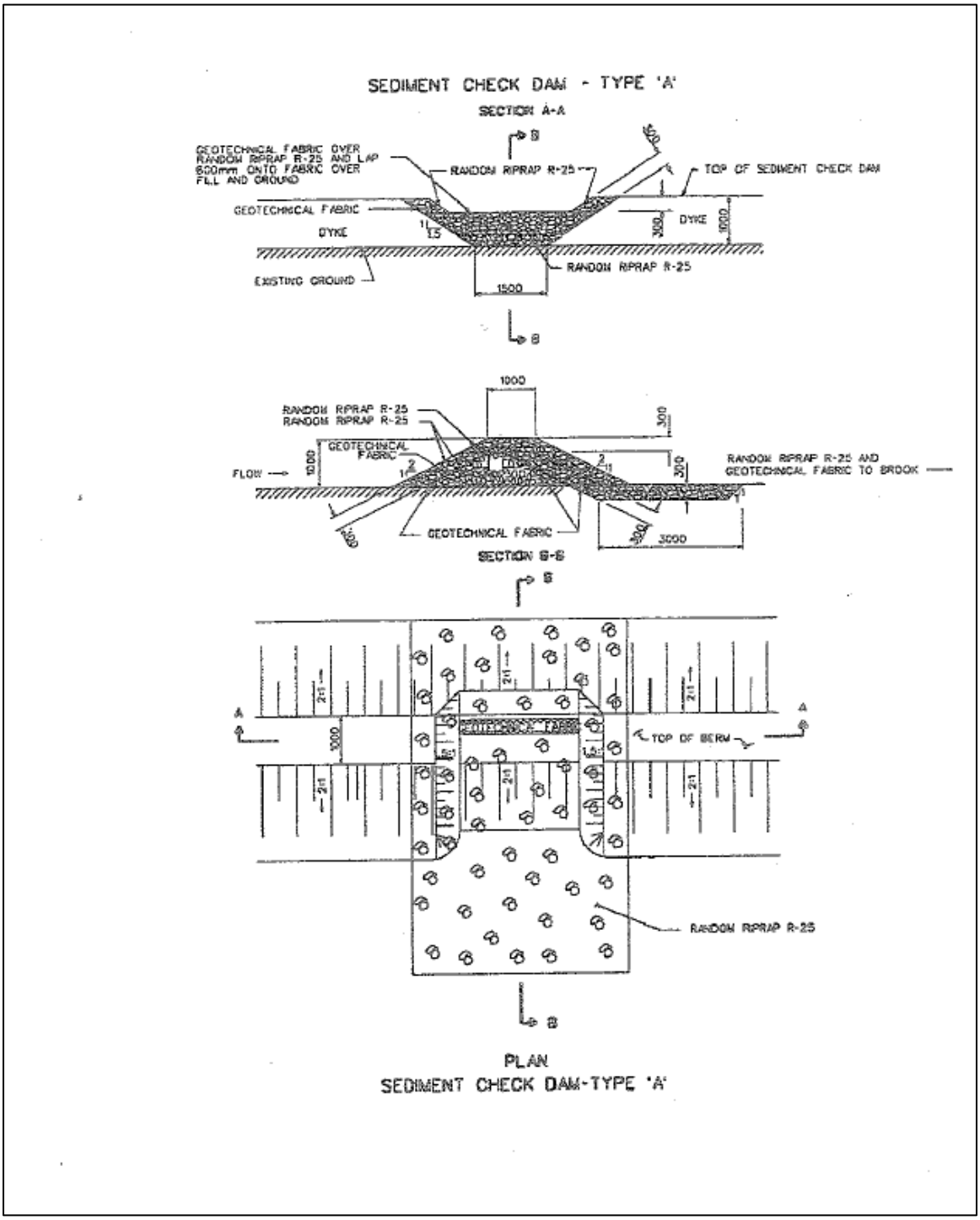
Source: Nova Scotia Department of the Environment, Erosion and Sedimentation Control Handbook for Construction Sites

The New Brunswick Department of Transportation (NBDOT) adopted standardized erosion control structures. These erosion control structures, or check dams, are categorized as Type A, Type B and Type C and are described below. Additional details can be found in NBDOT's Environmental Protection Plan (http://www.gnb.ca/0113/envpp/dotEnvPp.pdf).

(vii) Spillway Structure for Sediment Pond Dykes - NBDOT (New Brunswick Department of Transportation) Type A

- They are used in conjunction with sediment ponds to retain water and allow suspended particles to settle out. The discharge from the ponding area is filtered by riprap, which lines the outlet. They are built to pond runoff from ditches or from grubbed areas, or at the end of a cut where runoff leaves the ditch to flow down a natural slope.

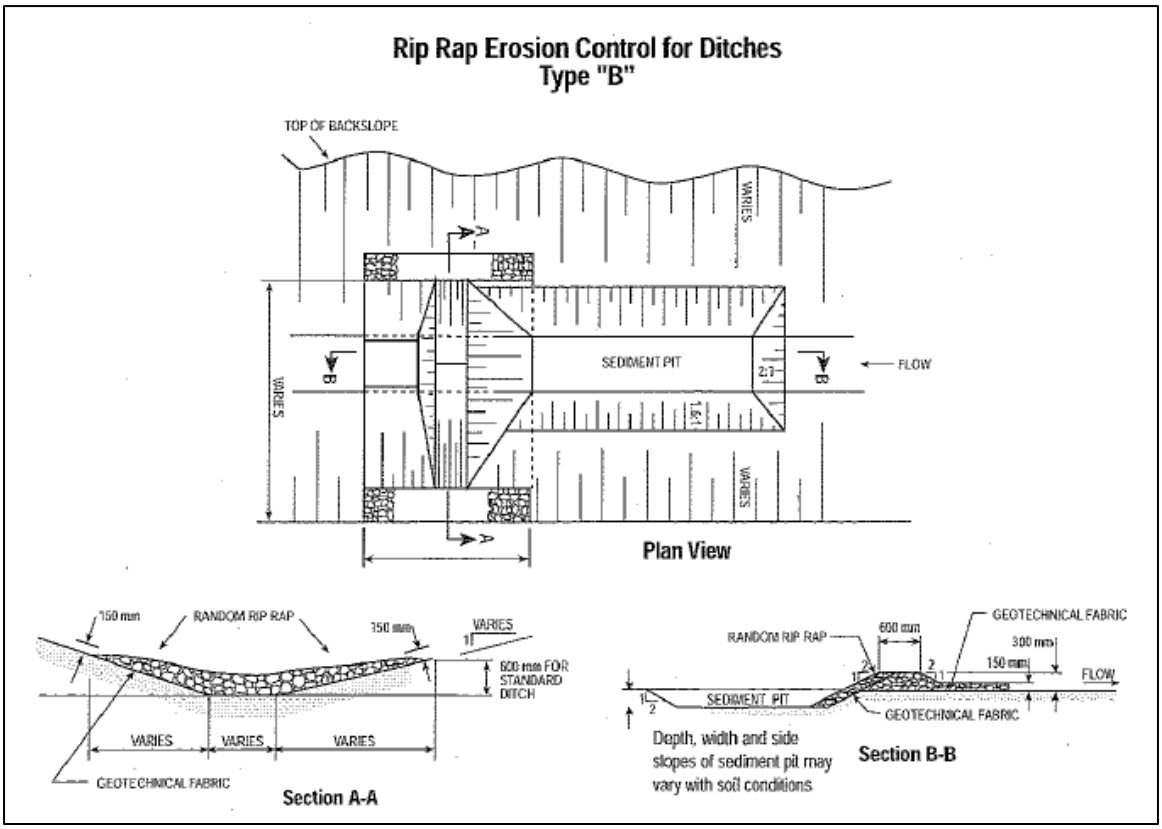
- Sediment should be removed when it accumulates to a level equal to half of the design depth of the trap or prior to the level of sedimentation reaching a point within 300 mm of the crest of the spillway.



Source: New Brunswick Department of Transportation (NBDOT), Environmental Protection Plan, May 1998.

*(viii) **Riprap Erosion Control Structure for Ditches – NBDOT Type B***

- Typically installed in rock ditches where stakes required for Type C and D structures cannot be driven.
- A small ponding area is excavated behind the dam where the runoff is detained before discharging.
- They are usually used in channels having grades steeper than 8% with heavy flows or in rock ditches where stakes cannot be driven.
- They should be constructed of geotextile fabric and random riprap "R-5". The outlet consists of rock with an impermeable membrane sandwiched between the rocks.
- Sediment deposits shall be removed when the level of sedimentation is within 100 mm of the top of the structure, or as directed by the Engineer.

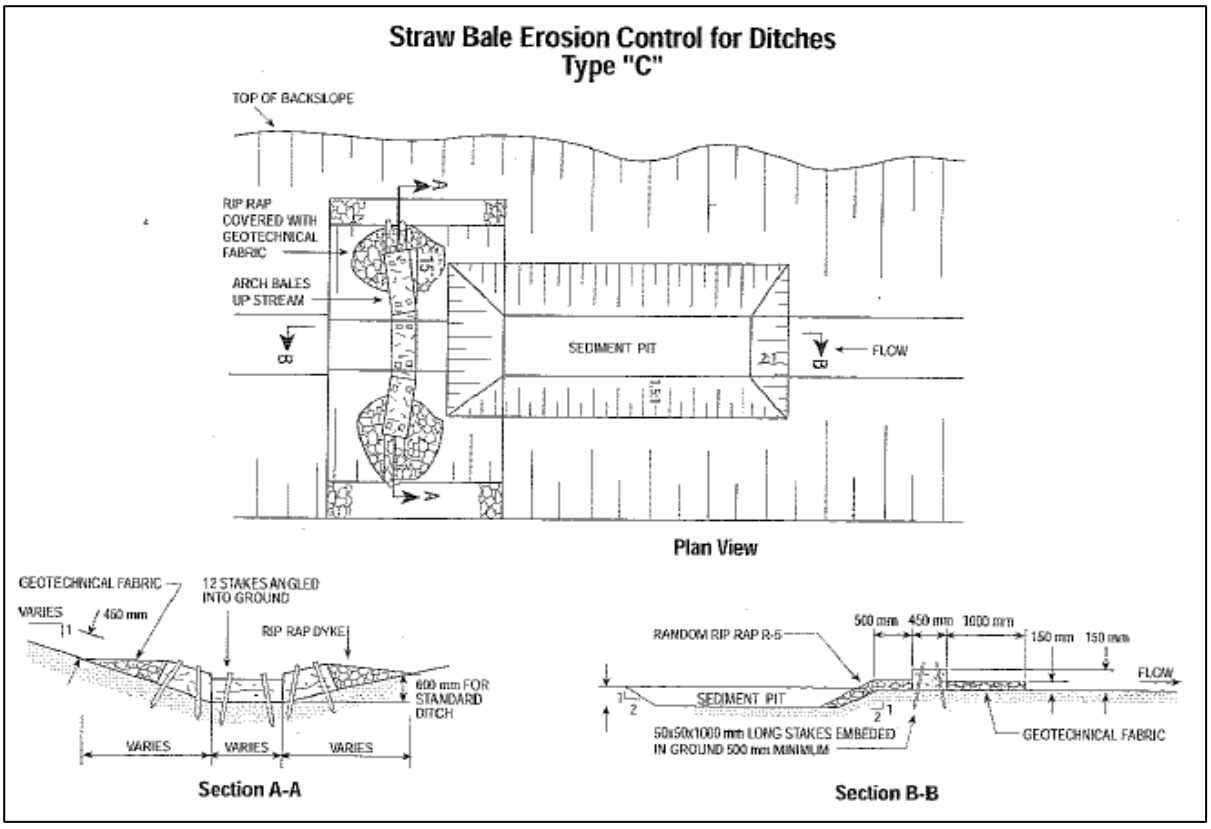


Source: Government of New Brunswick, Department of the Environment, Watercourse Alteration Technical Guidelines

*(ix) **Straw Bale Erosion Control Structure for Ditches – NBDOT Type C***

- Consists of a small dam made of geotextile fabric, straw bales and riprap constructed across a ditch. A small ponding area is excavated behind the dam where the runoff is detained before discharging.

- They can be used in channels or ditches and along side of waterways or property boundaries. They are most effective for treating small drainage areas (less than 0.6 to 0.8 hectares) for a short period of time.
- Generally used in ditches having grades up to 8 % with low to medium flows.
- A trench the width of a straw bale and the length of the proposed barrier should be excavated to a minimum depth of 100-150 mm below the surface.
- The bales are placed on their sides tightly together in the trench.
- Two wooden or steel stakes need to be driven through each bale. The first stake in each bale should be driven toward the previously laid bale to force the bales together.
- Loose straw should be wedged between any cracks to seal openings.
- The excavated soil should be backfilled and lightly compacted up to a depth of 100 mm against the upslope side of the barrier and to ground level on the down-slope side.
- A sediment trap should be excavated on the upslope side of the barrier.
- Sediment deposits shall be removed when the level of sediment is about halfway to the top of the structure or prior to the level of sedimentation reaching a point within 100 mm of the crest of the notch.
- Straw bales must be checked on a regular basis and rafter each rainstorm. Straw bales can deteriorate in 30 to 60 days.



Source: Government of New Brunswick, Department of the Environment, Watercourse Alteration Technical Guidelines

Sediment Control Ponds

- Runoff from a disturbed area can be intercepted and directed to a sediment control pond, also referred to as sediment basin or siltation pond, where runoff is detained long enough to allow most of the sediments to settle out.
- A sediment pond differs from a sediment trap with respect to the contributing drainage area it services. Ponds are generally constructed for larger disturbed areas or where the volume of water to be treated is expected to be high. They are usually designed for disturbed areas larger than 2 hectares (5 acres).
- The pond should be located at the lowest practical point in the catchment area, below construction activities, and should be large enough to handle the maximum expected amount of runoff. It should be constructed before any land disturbing activity occurs on the site. Multiple ponds may be designed for a large development.
- The pond design should include an outlet riser pipe and a spillway or gravel outlet to prevent scour. It may be necessary to use filter fabric on the spillway.
- The sediment pond should be inspected periodically and after each rain event. The pond should be cleaned out when sediment have filled about half of the volume. The accumulated sediments shall not be disposed within 30 m of a wetland or waterway or where it could re-enter the basin.
- The pond should remain in operation until the site is permanently stabilized by vegetation and/or permanent measures are in place.
- The sediment pond should be designed by a qualified engineer. The following are some design guidelines for sediment control ponds:
    - Identify the contributing drainage area, the anticipated runoff volume and the soil type. Larger ponds may be required if soil is clay or silt as they take more time to settle.
    - In general, the pond should be sized for a minimum storage volume of 250 m^3/ha.
    - The average pond depth should be at least 1.2 m to lessen the clean out frequency.
    - Average hydraulic retention time: Minimum of 40 minutes.
    - Length to width ratio should be a minimum of 2:1, preferably 4:1, in order to increase the amount of time in which settling may occur.
    - Minimum sediment storage depth: 0.5 meters
    - Minimum freeboard: 0.6 meters
    - Interior side slopes should not exceed: 2H:1V
    - Exterior side slopes should not exceed: 3H:1V

  Additional design guidelines are included in the Fisheries and Oceans Canada's Land Development Guidelines for the Protection of Aquatic Habitat: http://www.dfo-mpo.gc.ca/Library/165353.pdf.

Sediment Traps

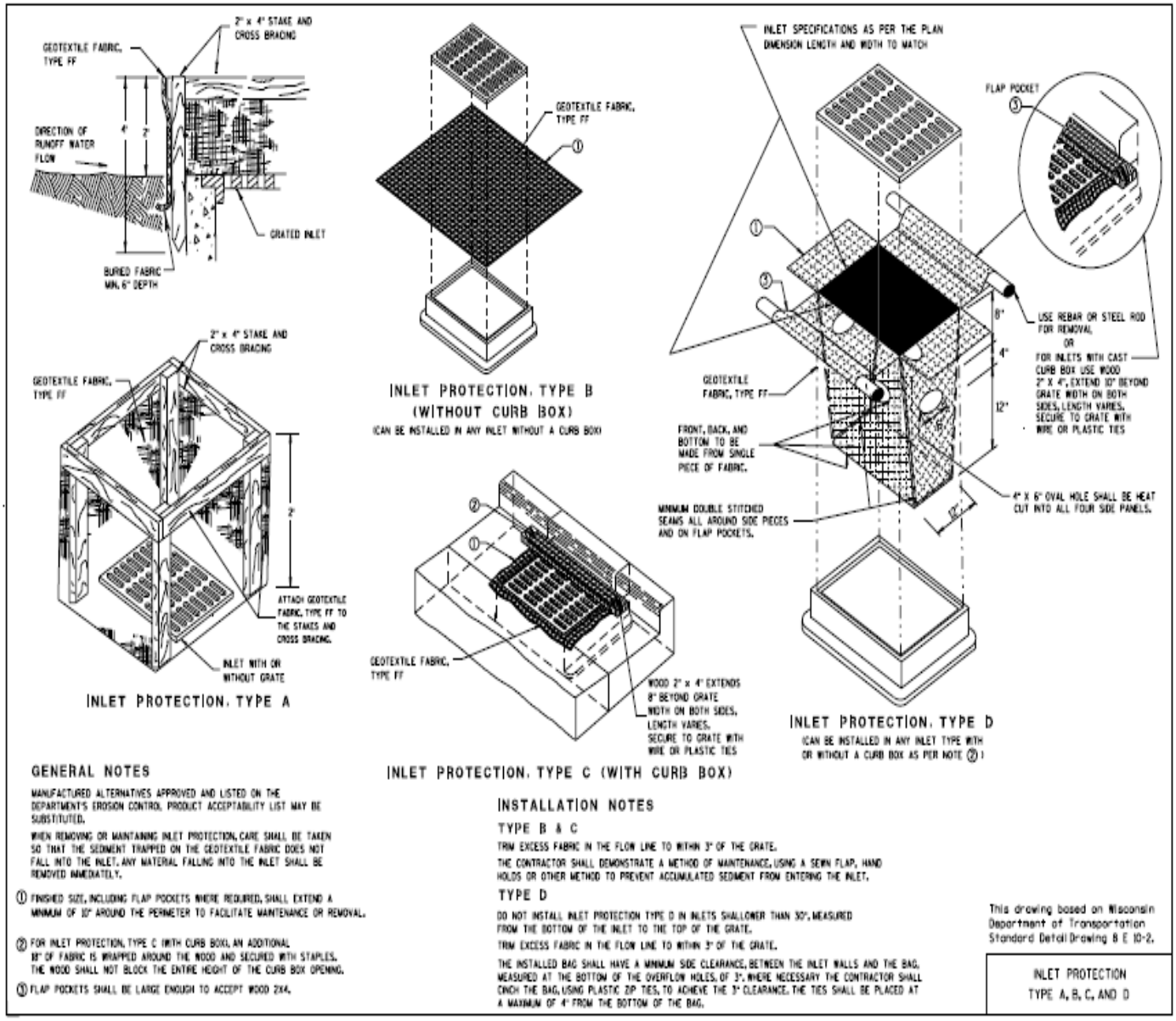
- Overland flow runoff from a disturbed area can be directed to a sediment trap, which operates like a small sediment control pond. The trap retains the runoff long enough to allow most of the sediments to settle out.

- The sediment trap is formed by excavating a pond or by placing an earthen embankment across a low area or drainage swale.
- Sediment traps are suitable for small drainage areas, usually less than 2 hectares (5 acres). The trap should be large enough to allow the sediments to settle and should have the capacity to store the sediments until removed.
- In general, sediment traps should be sized for a minimum storage volume of 150 m^3/ha over the contributing drainage area.
- Side slopes should not exceed 2H:1V.
- Traps should be inspected periodically and after each rainfall. The trap should be cleaned out when sediment have filled about half of the design volume. The trap should remain in operation until the site area is permanently stabilized by vegetation and/or other permanent measures.

Storm Drain Inlet Protection

- Drain inlet protection will prevent sediment from entering the underground storm pipe system prior to stabilization of the disturbed area. Drain or curb inlet protection should be used where storm inlets are operational prior to permanent stabilization of the disturbed area.
- Storm drain inlet protection is a filtering measure placed around any inlet or drain to trap sediment. Inlet protection can be formed using gravel or stone, sod, straw bales or filter fabric, which trap the sediment before it enters the system. Filter fabric is used when storm water flows are relatively small with low velocities. Gravel filters can be used where velocities are higher.
- This type of protection is appropriate for small drainage areas, generally not exceeding 0.4 hectares (1 acre) and where storm drain inlets will be operational prior to permanent stabilization.

The following figure illustrates some examples of storm drain inlet protection measures that can be implemented at a construction site.

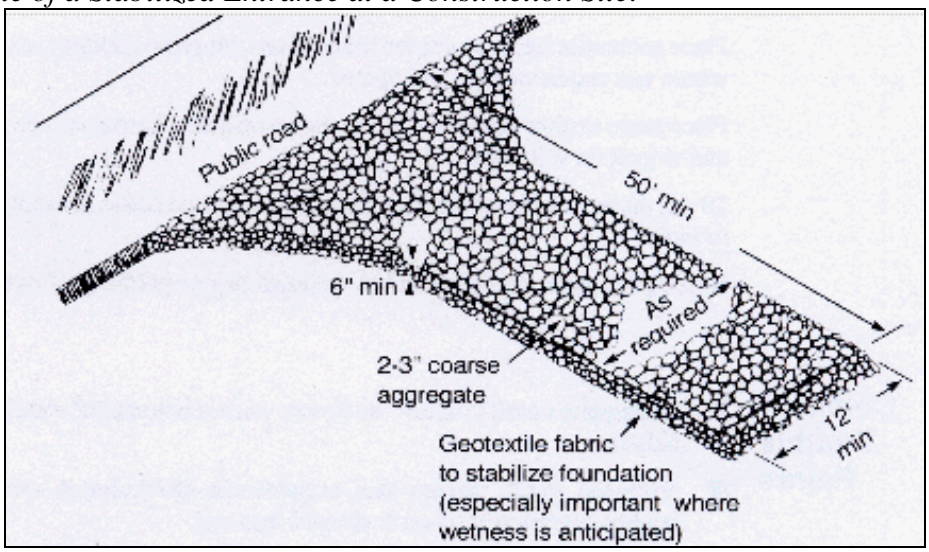


Source: Wisconsin Department of Natural Resources, Conservation Practice Standard, Storm Drain Inlet Protection for Construction Sites.

Stabilized Construction Entrance/Exit

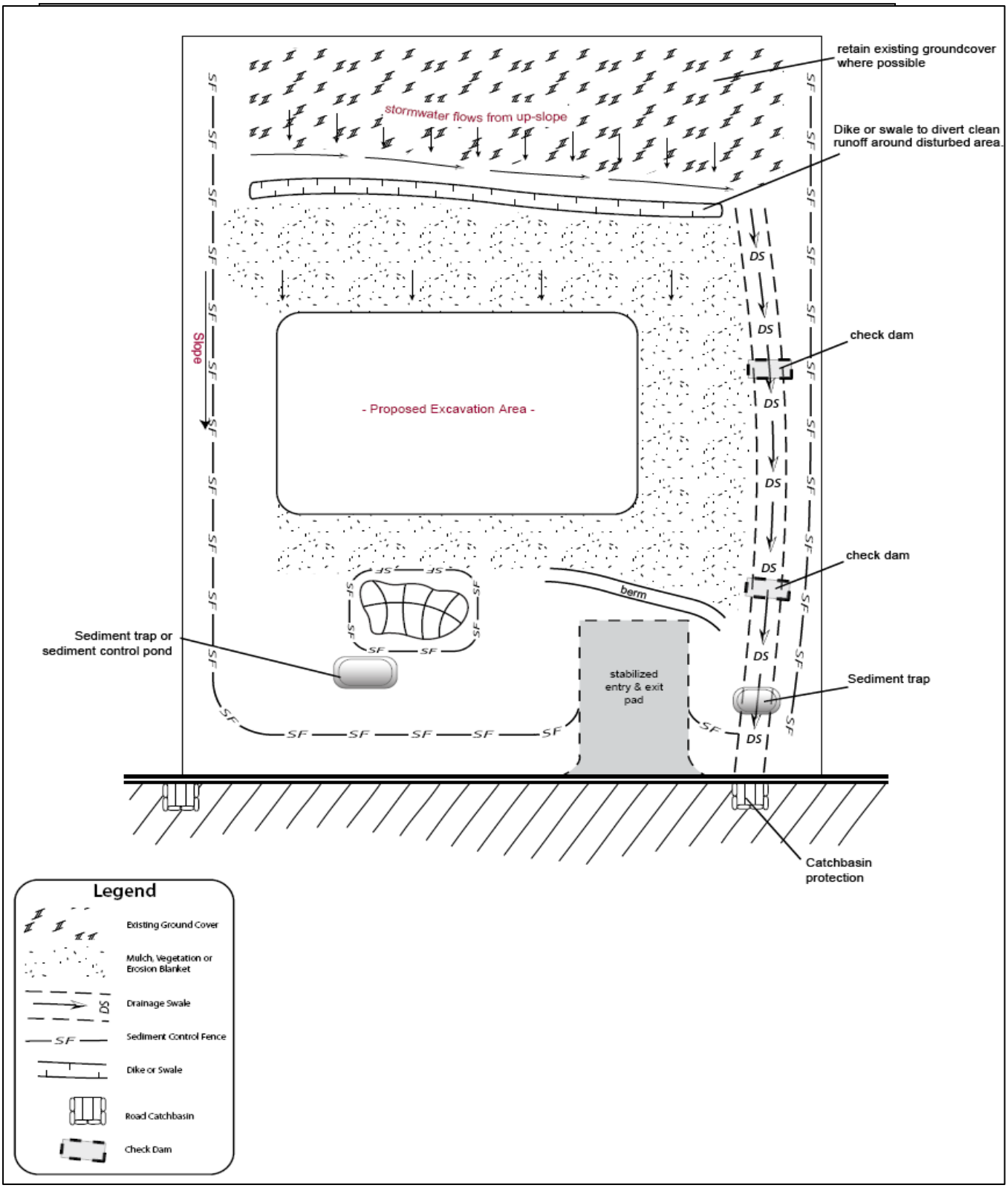
- A temporary sediment removal device can be installed at the approach from an unpaved construction site to a public roadway where there is risk of transporting mud or sediment onto paved roads.
- Installing a pad of gravel, especially over filter cloth, can help stabilize a construction entrance. Rumble strips and tire washing devices can also be added.
- Stabilize all entrances to a site before construction and further site disturbance begins. Make sure the stabilized site entrances are long and wide enough to allow the largest construction vehicle that will enter the site to fit through with room to spare.
- Install stone or gravel at a depth of at least 15 cm for the entire length and width of the stabilized construction entrance. Make sure stone and gravel are large enough so that they are not carried offsite by vehicles. Monitor and replace gravel as needed.

Example of a Stabilized Entrance at a Construction Site:



Source: Gaston County Natural Resources Department, NC.

The following figure illustrates some examples of the implementation of erosion and sediment control measures at a construction site.



MONITORING AND MAINTENANCE

A maintenance program must be implemented throughout construction activities. The maintenance program should include daily routine checks, repairs, replacements and an inventory of control materials. All control measures shall be inspected periodically and after each rainfall event.

Ensuring that erosion and sediment control structures are properly maintained will also prevent or limit mosquito breeding. Some maintenance principles include cleaning out the temporary sediment traps and basins, maintaining ditches to ensure positive drainage and removing grass cutting and other debris.

The sediment and erosion control devices must remain in place and be maintained in functional condition until permanent vegetation has been established or the site is otherwise stabilized.

Prior to winter shutdown, site conditions must be evaluated and specific requirements for erosion control to be implemented prior to spring runoff should be identified.

RUNOFF WATER QUALITY REQUIREMENTS

The Fisheries Act prohibits the deposit or release of a deleterious substance to fish-bearing waters. In high concentrations, sediment is recognized as a deleterious substance.

Fisheries and Oceans' Land Development Guidelines for the Protection of Aquatic Habitat indicate that runoff water from the development site should contain less than 25 mg/liter of suspended solids above the back-ground suspended solids levels of the receiving waters during normal dry weather operation and less than 75 mg/liter of suspended solids above background levels during design storm events. The Department of Fisheries and Oceans or the Provincial Department of the Environment should be contacted for additional questions regarding the normal dry weather storm background level.

It is also stated in the Land Development Guidelines that where spawning areas are situated in the receiving waters, the runoff water should not, at any time, increase the level of suspended solids above the background level in the receiving waters. Background suspended solids levels are the natural instream suspended solids.

APPLICABLE LEGISLATION

PROVINCIAL LEGISLATION

The New Brunswick Watercourse Alteration Regulation, which falls under the Clean Water Act, is administered by the Department of the Environment. The Regulation states that any person working within 30 metres of a watercourse is required to obtain a watercourse and wetland alteration permit. One of the mandates of the Watercourse Alteration Program is to prevent sedimentation of watercourses by requiring that control measures be taken during construction phases of the project.

The need for a Watercourse and Wetland Alteration permit should be assessed prior to any land disturbing activities taking place within 30 metres of a watercourse. Additional information on Watercourse and Wetland Alteration permits can be found in the New Brunswick Department of Environment Watercourse Alterations Technical Guidelines http://gnb.ca/0009/0371/0005/0001-e.pdf.

Relevant sections and keys points from the Clean Water Act are presented in the following table.

Legislation	Relevant Section	Key Points	Fines
Clean Water Act http://gnb.ca/0062/PDF-acts/c-06-1.pdf	Section 12(1)	No person shall directly or indirectly release a contaminant into or upon water if to do so would or could (a) affect the natural, physical, chemical or biological quality of constitution water (b) endanger the health, safety or comfort of a person or the health of animal life (c) cause damage to property or plant life or (d) interfere with visibility, the normal conduct of transport or business or the enjoyment of life or property.	-Min of $500 and max. of $50,000 (for an individual) -Min. of $1,000 and max. of $1,000,000 (for a person other than an individual)
	Section 15(1)	A person planning a hydro-electric power project, a control dam, a river diversion, a drainage diversion or another project or structure that alters a watercourse or a wetland or diverts all or part of a watercourse or the water flowing in a watercourse or a wetland, shall, before undertaking or proceeding with the project (a) provide the Minister with copies of the plans and such other documents or information as the Minister may require and (b) subject to subsection (1.1) obtain a permit issued by the Minister.	

FEDERAL LEGISLATION

As discussed in the previous section, the Fisheries Act, which is administered by Fisheries and Oceans, prohibits the deposit or release of a deleterious substance to fish-bearing waters. Relevant sections and key points found in the Act are presented in the following table.

Legislation	Relevant Sections	Key Points	Fines
Fisheries Act http://laws-lois.justice.gc.ca/eng/F-14	Section 35 (1)	No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat.	-Up to $300,000 (first offence) -Up to $300,000 and/or up to 6 months imprisonment (subsequent offences) -Up to $1,000,000 (first indictable offence) -Up to $1,000,000 and/or up to 3 years imprisonment (subsequent indictable offences)
	Section 35 (2)	No person contravenes subsection(1) by causing the alteration, disruption or destruction of fish habitat by any means or under any conditions authorized by the Minister or under regulations made by the Governor in Council under this Act.	
	Section 36 (3)	Subject to subsection (4), no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water.	
	Section 38 (4), (5) & (6)	(4) Duty to report deposits of deleterious substance, (5) Duty to take all reasonable measures to prevent the deposit of a deleterious substance (6) Inspectors may order to take remedial measures.	-Up to $200,000 (first offence) -Up to $200,000 and/or up to 6 months imprisonment (subsequent offences)
	Section 95	Releases of toxic substances must be reported, prevented and mitigated to prevent any danger to the environment or hum life or health.	

Note: Legislation is subject to change. The applicable bylaw, act or regulation should be consulted for accuracy.

REFERENCES

1) Erosion and Sedimentation Control Handbook for Construction Sites, Nova Scotia Department of the Environment, 1988. http://www.gov.ns.ca/nse/surface.water/docs/ErosionSedimentControlHandbook.Construction.pdf
2) Watercourse Alterations Technical Guidelines, Section 2 – Surface Erosion and Sedimentation Control, Province of New Brunswick, Department of the Environment and Local Government, Regional Services Branch. http://gnb.ca/0009/0371/0005/0001-e.pdf
3) Drainage and Erosion at Construction Sites, National Research Council Canada, 1976. http://www.nrc-cnrc.gc.ca/eng/ibp/irc/cbd/building-digest-183.html
4) Stormwater Management for Construction Activities, Chapter 3-Sediment and Erosion Control, US EPA, September 1992. www.epa.gov/npdes/pubs/chap03_conguide.pdf
5) Environmental Protection Plan, New Brunswick Department of Transportation, Third Edition, May 1998. http://www.gnb.ca/0113/envpp/dotEnvPp.PDF
6) Standard Specifications, New Brunswick Department of Transportation, January 2006. http://www.gnb.ca/0113/publications/2006_Standard_Specs-e.pdf
7) Land Development Guidelines for the Protection of Aquatic Habitat, Fisheries and Oceans, September 1993. http://www-heb.pac.dfo-mpo.gc.ca/publications/pdf/165353.pdf
8) Construction Entrances, U.S. Environmental Protection Agency, 2006. http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&rbutton=detail&bmp=35&minmeasure=4