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ENVIRONMENTAL ASSESSMENT OF MAINTENANCE PRACTICES ALONG YUKON HIGHWAY RIGHTS-OF-WAY

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by

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ABSTRACT

An environmental assessment of maintenance practices along Yukon highway rights-of-way was undertaken by the Environmental Protection Service during the summer of 1983. Mainenance practices which were compatible with environmental quality, as well as those which presented environmental concerns were documented.

The environmental concern noted most frequently was the impact that maintenance practices had on water quality. This impact is discussed in relation to the roadway embankment, backslopes, drainage controls, and stream crossings. Other maintenance practices discussed include the calcium chloride and vegetation control programs.

A comprehensive set of photographs showing good and bad maintenance practices are presented.

RESUME

Une évaluation environnementale des pratiques d'entretien des corridors routiers du Yukon fut entreprise par le Service de Protection de l'Environnement durant l'été 1983. Les pratiques d'entretien compatibles avec la qualité de l'environnement, de même que celles présentant certains problèmes environnementaux, fut documentées.

Le problème environnemental noté le plus fréquemment fut l'impact que les pratiques d'entretien ont sur la qualité de l'eau. Cet impact est discuté en relation aux remblais routiers, pentes arrières, contrôles d'écoulement et des traverses de rivières. Les programmes de contrôle de la végétation et du chlorure de calcium, sont aussi inclus.

Une série extensive de photographies montrant les bonnes et mauvaises pratiques d'entretien est presentée.

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1 INTRODUCTION

Current federal government policy in the Yukon Territory requires that highway construction projects receive an environmental review. This requirement has heightened awareness of environmental concerns among highway planning and construction personnel. However, during the operations phase, personnel involved with maintenance have infrequent contact with environmental agencies. In view of the vast highway network in the Yukon, and of the manpower and equipment resources of the YTG Highway Maintenance Branch, a lack of dialogue with these personnel presents the potential for environmentally adverse practices to occur.

In order to initiate broad environmental input into highway maintenance programs, the Environmental Protection Service undertook an environmental survey of maintenance practices in the highway corridors during the summer and fall of 1983. The purpose of the survey was to document maintenance practices used which are compatible with environmental quality, as well as those which presented environmental concerns. All Yukon highways, excepting the North and South Canol Roads, were examined once during the survey.

The report is a summary of the most salient observations made during this survey. A more extensive report, in the form of a complete photographic record of specific observations, is on file at the Whitehorse office of the Environmental Protection Service.

The report is divided into sections, each dealing with a specific component of the highway right-of-way, such as backslopes or stream crossings. Throughout the report, photographs are used to illustrate the environmental consideration being discussed. It is important to remember that these observations have a 'cause and effect' relationship. The cause aspect will be visible while the effect to the environment will be implied. For example, where there is erosion of the road embankment above a stream crossing, the environmental concern is sedimentation of the stream. This can only be observed during periods of runoff, but is suggested by the erosional scour in close proximity to the watercourse.

The term unstable is used frequently throughout the report to describe a condition of a backslope or foreslope. Its use is meant to identify the current surficial appearance of the slope and does not necessarily refer to its structural integrity.

The report is not intended to function as a guidelines manual or to present overall recommendations for proper maintenance practices. Its purpose is to identify those maintenance practices which are, or are potentially, a concern from an environmental perspective, and to identify environmentally sound maintenance practices. There is a need to involve maintenance personnel and their practical experience with the information presented in this report to formulate practical and environmentally sound highway maintenance procedures.

As the reader progresses through the report, one generalization should become apparent; good environmental practice is also good highway maintenance practice.

2 ENVIRONMENTAL IMPACTS

Road development is a very environmentally disturbing activity in the forested regions of Canada. It is a form of development which permanently displaces the natural environment and transforms a former multiple use area into a corridor primarily managed for transportation purposes. Some of the environmental impacts associated with highway rights-of-way can be minimized or eliminated through the proper planning of construction and maintenance programs, but the prevailing impacts inherent in the highway's presence must be accepted.

For the purpose of this report, maintenance practices or an absence of proper maintenance, becomes a concern when the natural environment outside the highway right-of-way is affected. This is distinguished from the environmental disturbances which are confined to the highway corridor, such as terrain instability or aesthetics. For example, an unstable backslope depositing sediment into a stream, which crosses the right-of-way and continues beyond, is clearly an environmental concern. However, it is not considered to be an environmental concern, if the sediment remains within the right-of-way. In this latter situation, the decision to stabilize the backslope would be at the discretion of the Highway Manager.

The environmental concern noted most frequently during the survey was the degradation of water quality, primarily from eroded mineral sediments. The very design of highway transportation systems increase erosion by exposing vast amounts of soil material and interrupting natural drainage patterns. Accelerated erosion and sedimentation can be a dramatic and long term problem which adversely affects the water quality, fisheries potential, and aquatic environment of watersheds.

Sedimentation affects the aquatic environment in many ways: by reducing plant growth due to lower light transmission, by dislodging plants and invertebrates from the substrate through abrasive action, through damage to feeding and breathing apparatus of invertebrates, by reduction of habitat diversity through filling intergravel spaces, by damaging gill membranes of fish, and by plugging the intergravel spaces

which restricts oxygen supply to fish eggs. The cumulative impact of these effects is known to reduce overall stream productivity.

Other observed impacts to the aquatic environment included blockage to fish migration at stream crossings and destruction of riparian habitat.

Impact to the terrestrial environment was not noted to be a significant concern, except where it indirectly affected water quality or damaged off-right-of-way vegetation. Although highway corridors cause physical alteration to terrestrial habitats, in the context of this survey, i.e. maintenance practices, these impacts were recognized as a consequence of initial highway development.

The most frequent terrestrial impact noted was impairment of the natural scenic quality along the right-of-way. This is mentioned as an aesthetic concern, considered to be separate from the strictly ecological concerns, and beyond the purview of the Environmental Protection Service. Maintaining or enhancing aesthetic values along the right-of-way is indirectly a good environmental practice however, and is encouraged.

3 ROADWAY EMBANKMENT

The roadway embankment presents an extensive, exposed surface which traffic and weathering elements continually wear away. The road surface is also a source of deleterious substances including road salts and oil, as well as the soil aggregate travelling surface. These materials adversely affect environmental quality when allowed to enter a watercourse.

3.1 Environmental Concerns

i) Road surface runoff transports deleterious substances into a watercourse.

ii) Road embankment adjacent to watercourses are unstable or consist of erodable material.

3.2 Discussion

Road surfaces, by design, are impervious, and therefore shed water rapidly. When road surface runoff is permitted to accummulate, it can cause serious erosion of the roadway and embankment. Concentration of road surface runoff in this manner was observed on grades where the fall line exceeded the crown slope (Plate 1) or when a berm did not permit runoff to disperse (Plate 2). This results in an environmental problem when the sediment laden runoff enters a watercourse.

Another environmental concern associated with the control of road surface runoff occured when runoff traversed embankments consisting of erodable material (Plate 3). Depending upon the amount of runoff and the stability of the embankment material, this caused rill erosion (Plate 4), gully erosion (Plate 5), and often contributed to slumping (Plate 6). These situations result in direct sedimentation to watercourses during periods of runoff.

The proper control of road surface runoff is also an engineering concern, as it causes material loss of the road embankment and clogs the drainage system (Plate 7). Crowning is an effective maintenance practice currently used on all gravel-surfaced highways in

PLATE 1 - Road surface runoff tends to accummulate down steep grades. The point of discharge can cause erosion to the embankment if this area is not prepared to receive concentrated runoff (km 382.8, Hwy. 2).

PLATE 2 - The roadside berm has concentrated road surface runoff and resulted in erosion to the embankment. The eroded sediments have been carried into the adjacent watercourse (km 551.4, Hwy. 4).

PLATE 3 - Unprotected road embankments above watercourses are long term sources of stream sedimentation (km 77, Hwy. 4).

PLATE 4 - Road surface runoff is eroding the finer sediment material and depositing this into the adjacent watercourse (km 462.6, Hwy. 4).

PLATE 5 - Concentrated road surface runoff has eroded a deep gully into the road embankment and transported the eroded material into a nearby watercourse (km 1815, Hwy. 1).

PLATE 6 - Road surface runoff combined with an unstable embankment resulted in material slumping directly into the watercourse (km 136.3, Hwy. 2).

PLATE 7 - Erosion of embankment material can also interfere with drainage systems by plugging culverts and drainage ditches (km 486.7, Hwy. 4).

PLATE 8 - Maintaining adequate crown on the roadway and permitting vegetation growth along the embankment are effective in preventing embankment erosion caused by road surface runoff (km 1342.9, Hwy. 1).

the Yukon. Many potential problem situations were prevented through maintaining sufficient crown on the road surface (Plate 8). However, crowning is not appropriate in all situations, such as on particularly steep grades and curves or where the embankment consists of erodable material. Site specific maintenance practices will be required in these instances to minimize the environmental impact and decrease long term maintenance costs.

Encouraging revegetation on embankments is effective in preventing surface erosion and is aesthetically pleasing (Plate 9), but is inadequate protection against concentrated runoff. Controlling road surface runoff in problem situations has been accomplished using a permanent berm (Plate 10) in conjunction with a half section culvert, to transport the concentrated runoff across the erodable embankment (Plate 11). A method useful in situations where it is impractical to control road surface runoff is to protect the embankment with a coarse aggregate material (Plate 12). This latter practice would be directly applicable in preventing sedimentation from embankment erosion above stream crossings such as shown in Plate 3.

Embankments were frequently too steep to be stable and presented an environmental concern when located adjacent to a watercourse (Plate 13). This situation was also aggravated by uncontrolled road surface runoff (Plate 14). This concern was normally associated with fine textured soils, but can also occur on granular slopes that are too steep (Plate 15). When adjacent to watercourses, these unstable slopes can be long term sources of massive amounts of sediment, as well as being a road maintenance problem.

Unstable foreslopes are an environmental concern that require an engineering solution. Some general measures which minimized the problem at some sites were lessening the slope angle, controlling road surface runoff, and encouraging revegetation. There are, of course, more complex situations which require site specific treatment.

Some river encroachments were noted to be inadequately protected from hydraulic erosion. The most serious sections of potential river erosion have already been armoured with riprap. However, there are still several segments which are insufficiently

PLATE 9 - Establishing vegetation cover along the embankment minimizes surface erosion problems and complements the natural scenery (km 1391.7, Hwy. 1).

PLATE 10 - Road surface runoff is collected using a permanent berm and discharged onto an area prepared to receive concentrated runoff (km 5.3, Hwy. 4).

PLATE 11 - Concentrated runoff is transported across the embankment fill in a half section culvert (flume) (km 1376.4, Hwy. 1).

PLATE 12 - Embankments consisting of coarse material were not susceptible to erosion, even on steep grades such as this (km 102, Hwy 9).

PLATE 13 - This unstable embankment is slumping material directly into the watercourse (km 104.7, Hwy. 2).

PLATE 14 - Unstable embankments above culverts contribute large amounts of sediment into watercourses (km 22.4, Hwy. 11).

PLATE 15 - This unstable embankment will be a long term source of sediment into the watercourse (km 1128.5, Hwy. 1).

PLATE 16 - Unprotected embankments alongside rivers are susceptible to erosion (Ogilvie River, Hwy. 5).

protected (Plate 16). These sites showed a gradual loss of embankment material into the watercourse (Plate 17).

Unprotected river encroachments are a long term source of sedimentation and a road maintenance problem. The most common solution is to place appropriately-sized rock along the river edge. In addition, the practices of directing road surface runoff into the drainage ditch, and encouraging the establishment of vegetation (Plate 18) are good environmental procedures which should be encouraged.

Another form of encroachment on waterbodies occured with road widening projects. Normally, these projects were small in scale, but caused significant environmental impact through the physical loss of aquatic habitat (Plate 19). This can be reconciled where widening is necessary and the impact minimized by proper construction procedures. However, this should never be used as a convenient method of waste disposal. The sidecast material is frequently unstable and can cause direct sedimentation to the watercourse.

PLATE 17

This embankment shows instability caused by road surface runoff and river erosion. It is perceived as both an environmental and maintenance problem (km 1794.5, Hwy 1).

PLATE 18 Embankments will naturally revegetate providing the substrate is stable. The vegetation cover will in turn minimize sediment loss through surface and river erosion (km 554.6, Hwy. 4)

PLATE 19 - The sidecast material is interfering with a drainage course and is partially blocking the culvert inlet. Care must be exercised with maintenance programs which directly involve watercourses (km 1543.6, Hwy. 1).

4 BACKSLOPES

Backslopes are another component of the highway right-of-way which present a large exposed surface area to weathering elements. From an environmental point of view, the backslopes which contribute to stream sedimentation are of primary concern. It is important to keep this separate from aesthetics, which is treated as a secondary concern in this report.

4.1 Environmental Concerns

i) Unstable backslopes can be a source of sedimentation to watercourses.

4.2 Discussion

There are an immense number of exposed backslopes along Yukon highways. There are probably as many unstable backslopes as there are stable ones. Fortunately, only a fraction of these present any serious environmental concern due to their juxtaposition with a watercourse.

Every unstable backslope presents a different set of reasons for its instability, requiring site specific examination to determine the appropriate corrective measures. The discussion that follows will present some of the common problem types and illustrate treatments already used on other highway segments.

A common cause of long term instability was from cutting the backslope too sharply. Backslopes should be sloped to their natural angle of repose in order to provide a stable substrate for natural revegetation to occur. Backslopes in granular soil types show signs of instability and surface erosion when cut too steep (Plate 20).

Backslopes through fine textured soil types can be stable at steep angles, but are highly susceptible to surface erosion when not protected (Plate 21 & 22). These backslopes are effectively protected from surface erosion by revegetation programs, currently used on new construction projects (Plate 23). Revegetation cannot, however, protect backslopes from gully erosion (Plate 24 & 25). Drainage

PLATE 20 - Backslopes that are cut too sharp will show long term instability and be a chronic source of stream sedimentation and maintenance (km 76.6, Hwy. 4).

PLATE 21 - Backslopes through fine textured soils are highly susceptible to surface erosion (km 1345.3, Hwy. 1).

PLATE 22 - Large volumes of sediment can be eroded from unprotected backslopes consisting of fine textured material (km 1179.6, Hwy. 1).

PLATE 23 - Revegetation programs are successful in protecting backslopes from surface erosion (km 1346.5, Hwy. 1).

PLATE 24 - Revegetation programs are ineffective against gully erosion caused by concentrated runoff (km 1346.7, Hwy. 1).

PLATE 25 - Allowing natural drainage courses to cross a back-slope can cause serious gully erosion and negate the benefits of a revegetation program (km 1443.9, Hwy. 1).

courses must be intercepted above the backslope or the erosional scour backfilled with a more durable substrate (Plate 26). Another method of protecting these backslopes from surface erosion was facing the entire slope with a blanket of coarse granular material (Plate 27).

On large cuts, installing a bench cut at midslope is effective in breaking surface runoff and providing a stable substrate for vegetation to establish (Plate 28). Careful design is required to prevent runoff from accummulating on the bench and causing gully erosion to the lower slope (Plate 29).

Slopes combining fine textured soils with a high moisture content were very unstable and slumped readily (Plate 30). A good maintenance practice was to intercept the subsurface water above the backslope (Plate 31) and facing the backslope and drainage ditch with granular material (Plate 32). However, the normal maintenance practice in this situation was to clean the drainage ditch and not address the source of the problem.

The reasons for backslope instability are varied and complex, but the environmental impact is always the same. Unstable backslopes are massive sources of sediment and when transported to watercourses (Plate 33) can adversely affect water quality.

The immediate cost of stabilizing a backslope may seem excessive, however the incremental and ongoing costs of ditch maintenance should be recognized. Also, mitigating environmental impact from an unstable slope does not necessarily mean that the slope must be stabilized. Other methods can be used which prevent the eroded sediments from contaminating a watercourse. This can be accomplished with drainage controls and will be discussed in the subsequent section.

PLATE 26

Erosional scours in fine textured soils can be back-filled with coarse granular material to minimize further erosion and sedimentation (km 136.3, Hwy. 2)

PLATE 27 A blanket of coarse granular material is also effective in protecting fine textured backslopes from surface erosion (Mountainview Road).

PLATE 28 - Benches installed on large cuts provide a stable base in which vegetation can establish and gradually expand across the slope (km 1390.1, Hwy. 1).

PLATE 29 - Benches must be carefully constructed to prevent gully erosion below the bench (km 1380.7, Hwy. 1).

PLATE 30 - Backslopes that have a high moisture content are very unstable and will be a long term environmental and maintenance problem (km 1388, Hwy. 1).

PLATE 31 - This ditch was constructed to intercept surface and subsurface water above an unstable backslope (km 1386.7, Hwy. 1).

PLATE 32 - Unstable backslopes with a high moisture content can also be faced with granular material to increase stability (km 1386.7, Hwy. 1).

PLATE 33 - Unstable backslopes are massive sources of sediment and present an environmental concern when the sediment is transported into a watercourse (km 38, Hwy. 4).

5 DRAINAGE CONTROLS

Drainage controls include all the facilities which collect and transport runoff within the right-of-way. Their maintenance is of concern as it directly involves water, which is the principal carrier of sediment to watercourses.

5.1 Environmental Concerns

i) Drainage ditches transport sediment laden runoff from the right-of-way directly into watercourses.

ii) Cross drainages not properly maintained can cause flooding of terrestrial habitats or divert water onto areas not prepared to receive concentrated runoff.

iii) Ditch maintenance practices inadvertently dispose waste material in a manner by which sediment can enter a watercourse.

5.2 Discussion

The designed purpose of drainage ditches is to efficiently collect and transport runoff in the right-of-way. This is a worthy environmental practice except when the runoff also carries sediment into watercourses (Plate 34,). The source of sediment is frequently an unstable backslope, but can also be the ditch itself, if not properly prepared to receive concentrated runoff (Plate 35). In some situations, drainage ditches through erodable soil types have been lined with a blanket of coarse material (Plate 36). The drainage ditch may also be directed around the erodable soil type by being cross drained further upslope or directed into natural vegetation. A maintenance practice which only aggravates the erosion/sedimentation problem is to groom or blade the drainage ditch (Plate 37).

In contrast to ditch erosion were ditches that filled with sediment from unstable backslopes (Plate 38). An environmental concern was noted when ditch maintenance programs deposited waste materials in locations where sediment could enter a watercourse (Plate 39). Normally, the waste material is extremely unstable and can flow into

PLATE 34 - During periods of runoff, this drainage ditch carries large amounts of sediment directly into a watercourse (km 74.8, Hwy. 10).

PLATE 35 - Drainage ditches not only transport sediment, but can be the source of sedimentation when not properly prepared to receive concentrated runoff (km 382.7, Hwy. 2).

PLATE 36 - Drainage ditch through erodable soil types can be lined with coarse material to prevent an environmental and maintenance problem (Mountainview Road).

PLATE 37 - Grooming drainage ditches through erosion-prone material does little to prevent the reoccurence of the erosion/sedimentation problem (km 1334.9, Hwy. 1).

PLATE 38 - Eroded sediments from unstable backslopes can plug drainage ditches, necessitating the need for ditch maintenance. Waste material from ditch cleaning should be disposed in a stable location away from a watercourse (km 539.6, Hwy. 4).

PLATE 39 - Ditch cleaning operations deposited waste material in a location where sediment can enter a watercourse (km 81.4, Hwy. 2).

areas outside the right-of-way. Improper waste disposal practices were also seen to encourage instability on a steep, but stable embankment directly above a watercourse (Plate 40). These concerns can easily be avoided by the careful selection of waste disposal sites.

Controlling ditch drainage down sections of long grade can be a problem (Plate 41). However, the frequent spacing of cross drains in conjunction with ditch blocks appears to be a common practice along Yukon highways (Plate 42).

An environmental concern was noted when slope grooming programs did not prepare a drainage ditch to transport runoff (Plate 43). Slopes groomed in previous years showed gully erosion resulting in large volumes of sediment transported into watercourses (Plate 44). This maintenance activity should include measures to control runoff in an environmentally compatible manner.

Ensuring that cross drains function properly is an important aspect of highway maintenance. Cross drainage is impaired when culverts become clogged with sediment and debris or develop a raised inlet (Plate 45). Inefficient cross drains become environmentally damaging when vegetation beyond the right-of-way boundaries are flooded (Plate 46). At one location, the impounded water was percolating through the road embankment, threatening its stability. Another plugged culvert diverted runoff onto an unstable soil type, causing gully erosion, which in turn resulted in sedimentation to a downstream watercourse (Plate 47). Partially plugged culverts can also lead to road washouts during periods of high runoff.

Outlets of cross drains can cause environmental problems when not properly prepared to receive concentrated runoff. Severe gully erosion can occur where runoff is discharged onto fine textured soils (Plate 48). Culverts discharging onto permafrost can cause subsidence (Plate 49). Situations like these examples were prevented when half section culverts carried the runoff across the unstable material (Plate 50). However, environmental problems can still occur if the discharge outlets are not prepared against erosion (Plate 51) with the use of energy dissipators.

PLATE 40 - Waste material is creating instability on a previous stable slope. Surface runoff can transport sediment directly into the adjacent watercourse (km 539.6, Hwy. 4).

PLATE 41 - Sections of long grade should be frequently cross-drained to prevent runoff accummulation which may exceed the capacity of the ditch during periods of high runoff (km 1175.3, Hwy. 1).

PLATE 42 - Ditch blocks are used to effectively cross-drain ditch runoff on steep grades (km 1346.7, Hwy. 1).

PLATE 43 - Slope grooming programs should provide drainage ditches to prevent erosion and sedimentation problems (km 97.7, Hwy. 4).

PLATE 44 - Serious sedimentation to this watercourse is occuring through the absence of any erosion control measures (km 112, Hwy. 4).

PLATE 45 - Culverts which develop an inverted inlet are ineffective in providing proper cross-drainage (km 86.8, Hwy. 11).

PLATE 46 - A plugged culvert is causing extensive flood damage to off-right-of-way vegetation. The hydrostatic pressure from the ponded water is threatening the stability of the road embankment which could cause additional environmental impact (km 525.7, Hwy. 4).

PLATE 47 - Serious erosion at this site was caused when a plugged culvert diverted runoff into the area. The eroded sediment was carried into a nearby watercourse (km 548.5, Hwy. 4).

PLATE 48

Severe gully erosion was caused when ditch drainage was directed onto a steep slope consisting of fine textured soil (km 1446, Hwy. 1).

PLATE 49 Discharging concentrated runoff onto permafrost areas can cause subsidence (km 249, Hwy. 5).

PLATE 50

Concentrated runoff can be safely transported across erodable soils using flumes (km 1376.4, Hwy. 1).

PLATE 51 The outlets of flumes should be prepared to receive concentrated runoff (km 1373.9, Hwy. 1).

There are situations in which runoff cannot be prevented from contacting erodable soils. Under these circumstances, the runoff should be directed into a settling basin to prevent sedimentation to the watercourse. Plate 48 shows serious erosion; however the environmental impact was minimized since the runoff was directed into a natural settling basin (Plate 52) and the impact contained within the depression.

PLATE 52 This natural depression acted as a settling basin and prevented a large volume of sediment from entering a watercourse. The source of erosion is shown in Plate 48 (km 1446, Hwy. 1).

6 STREAM CROSSINGS

Stream crossings represent the interface between the highway and the watercourse. Therefore, the manner in which stream crossing structures are maintained will have a direct bearing on environment quality.

A long standing dispute between fishery managers and highway engineers concerns the relative merits of using a bridge or a culvert for a stream crossing. It is agreed that culverts can be designed and constructed to be compatible with environmental values. However, it is interesting to note that this survey recognized numerous environmental problems associated with culverts, but none with bridges.

6.1 Environmental Concerns

i) Inadequately protected embankments and berms are sources of chronic sedimentation and may cause further impact if left unprotected.

ii) Stream crossings can present a physical barrier to fish migration through excessive velocity, outfall drops, and debris blockages.

iii) Watercourses can experience extensive habitat disturbance through river training practices.

6.2 Discussion

A common environmental concern noted at stream crossings was with unprotected road embankments which resulted in the direct release of sediment into the watercourse. Although it is current construction practice to armour the embankment with rock rip rap (Plate 53), there are still many stream crossings with noticeable erosional scour at the inlets (Plate 54) and often the outlets (Plate 55). Significantly more scour can occur by the backeddy in the outlet pool (Plate 56). An environmentally good maintenance practice is to backfill the scours with coarse material to arrest further erosion and sedimentation.

PLATE 53 - Protecting road embankments from erosion is both a good environmental and engineering practice (km 243.1, Hwy. 3).

PLATE 54 - Unprotected embankments show evidence of erosional scour. Loss of embankment material is an environmental concern and a maintenance problem (km 74.8, Hwy. 10).

PLATE 55 - This watercourse is gradually eroding the unprotected embankment. In addition, the scouring of streambed material has developed an outfall barrier to fish migration (km 453.2, Hwy. 4).

PLATE 56 - Larger scoured areas can develop from the backeddy of high velocity streams (km 52, Hwy. 5).

There are a number of culverts which appeared to be of insufficient length for the roadway width (Plate 57). This caused direct sedimentation through embankment erosion and material sidecast during road surface blading. These sites also presented a driving hazard by the sudden decrease in roadway width. This situation could be prevented by extending the culvert length combined with embankment protection.

A maintenance problem already discussed under Drainage Control, but occassionally present at stream crossings, was raised culvert inlets. This occured frequently along the eastern segment of the Robert Campbell Highway. At one particular site, the stream undermined the road embankment causing a large slump, restricting traffic to one lane (Plate 58). This resulted in a large quantity of sediment entering the watercourse. Raised culvert inlets are a serious highway maintenance problem as well as an environmental concern and should be repaired to perform their intended purpose.

On streams with steeper gradients, wing berms are used to control the stream alignment. These were of concern when constructed of local streambed or pit run material and showed signs of erosion (Plate 59). In addition to prolonged sedimentation, this can cause serious environmental problems if the stream escapes the berm and creates a new stream channel (Plate 60); road washouts may also occur. Inadequate protection on the downstream side can also cause chronic erosion and sedimentation. Conversely, berms constructed of rock rip rap require minimal maintenance and present no environmental concerns (Plate 61).

An environmentally good practice along stream channels is to encourage vegetation growth (Plate 62). This can be accomplished by providing a stable streambank to allow natural revegetation. Streambank vegetation is beneficial to the stream ecosystem by filtering sediment from runoff, providing stability to the streambank, and providing overhead cover which increases stream productivity through leaf fall and insect drop. This should be encouraged as a general practice, but especially at sites where the former and present highways converge and present an excessive exposed reach of stream (Plate 63).

PLATE 57 - Culverts of insufficient length are an environmental concern and a driving hazard due to the sudden decrease in roadway width (km 176.4, Hwy. 3).

PLATE 58 - A culvert in disrepair eroded the road embankment causing sedimentation to the watercourse and a maintenance problem (km 63.4, Hwy. 4).

PLATE 59 - Berms constructed of gravel material are subject to continual erosion. Maintenance crews have recently placed additional fine material on the far berm to replace material that has been eroded (km 62.4, Hwy. 10).

PLATE 60 - The berm on the left side suggests that the watercourse has eroded the berm and diverted flows down the roadside ditch (km 48.7, Hwy. 5).

PLATE 61 - Berms constructed of large diameter rock require less maintenance and present no environmental concern (km 1696, Hwy. 1).

PLATE 62 - Revegetated streambanks provide significant ecological benefits and pose no conflict with highway maintenance objectives (km 637.8, Hwy. 2).

PLATE 63 - Excessive disturbance by construction activity has long term affects on stability of the watercouse. Revegetation should be encouraged to stabilize the streambanks (km 1903, Hwy 1).

PLATE 64 - Maintenance programs should leave streambanks in a stable condition to facilitate natural revegetation. In this situation, there are several erosional areas that will take years to stabilize (km 1893.1, Hwy. 1).

For the same reasons, highway maintenance projects which involve the realignment of stream channels should ensure that the streambanks have been restored to prevent long term erosion and sedimentation (Plate 64). Any vegetation control should be done by 'hand clearing' to minimize terrain damage and preserve the root structure of streambank vegetation.

Stream crossings on abandoned sections of highways were often breached in a manner which caused chronic erosion/sedimentation (Plate 65). Abandoned embankments should be cut wide enough to accommodate the natural stream meander width and sloped to the angle of repose to encourage revegetation. The spot application of suitable seed would also aid in stabilizing the abandoned embankment and thus minimize the environmental impact.

Stream crossings can present an obstacle to fish migration where there are outfall drops (Plate 66) or excessive water velocity (Plate 67). Even culverts that were constructed for fish passage can become impassible if not periodically and properly maintained. There are a variety of corrective measures, but the most common is arranging stable rocks in the outlet area to eliminate the barrier (Plates 68 & 69).

Fish migration is also affected by debris plugging the culvert (Plate 70). The backwatering affect may also kill vegetation beyond the right-of-way boundary (Plate 71). Debris also affects the efficiency of the culvert and threatens the stability of the road embankment (Plate 72). Unfortunately, very little can be done to prevent debris movement in streams and therefore, necessitates frequent maintenance. In some situations, debris removal can be facilitated with the installation of debris catchers or trash racks upstream of the crossing.

River training is a common maintenance practice on streams with a high bedload movement (Plates 73). This appears to be a necessary activity to maintain the efficiency of the stream crossing, and is preferred over the consequences of a possible road wash-out. Streams with these characteristics are numerous in the Kluane region, where it is impractical to avoid the section of aggradation.

PLATE 65 - Abandoned road crossings should be breached to accommodate the natural stream meander width and the angle of repose of the embankment material. If a stable substrate is provided, natural revegetation will occur (km 1171.7, Hwy. 1).

PLATE 66 - Outfall drops are a barrier to fish migration (Km 1895.3, Hwy. 1).

PLATE 67 - Excessive water velocity is another barrier to fish migration (km 203.7, Hwy. 4).

PLATE 68 - A circular arrangement of rocks in the outlet area improves fish passage through problem culverts (km 333.1, Hwy. 4).

PLATE 69 - Stable rock arrangements in the downstream channel are useful techniques to decrease water velocity and improve fish passage (km 190.6, Hwy. 3).

PLATE 70 - Debris plugging this culvert blocked fish passage and flooded off-right-of-way vegetation (km 1411, Hwy. 1).

PLATE 71 - A beaver dam near the culvert inlet is flooding off-right-of-way vegetation (km 473, Hwy. 4).

PLATE 72 - Debris will affect the capacity of the culvert to pass water, which is particularly important during periods of high flow. Improperly maintained culverts are a threat to the stability of the road embankment (Km 29.6, Hwy. 5).

PLATE 73 - Streams with a high bedload movement are dredged for extensive lengths above and below the highway right-of-way to maintain the integrity of the road crossing (km 1724.8, Hwy. 1).

PLATE 74 - The downstream portions of these streams may receive periodic use by fish which reside in the lake. River training programs should be properly planned to avoid possible conflicts with fish utilization (km 1715.8, Hwy. 1).

River training causes environmental impact through the displacement of stream dwelling invertebrates and in some situations, river training could conflict with fish spawning habitat (Plate 74). Minimizing the environmental impact can be accomplished through selection of timing, frequency, and location of river training programs. Consultation with other government agencies, and in particular, the Department of Fisheries and Oceans, is recommended prior to commencement of a river training program.

7 OTHER MAINTENANCE ACTIVITIES

Other highway maintenance activities which presented an environmental concern were the calcium chloride and vegetation control programs.

The stockpiles of calcium chloride were always located on well drained sites and protected from water runoff. At only one site did the stockpile site appear to present a concern. This occured when calcium chloride was pushed into standing timber which resulted in localized killing of the surrounding vegetation (Plates 75 & 76).

The trucks which haul calcium chloride are routinely washed to prevent corrosion. In a recently publicized example, the truck washing was purported to have contaminated domestic water supplies at the Beaver Creek maintenance camp. Although this survey never investigated this type of problem, it is not unreasonable to assume that this could be occurring unknowningly at many other washing sites. It is suggested that the Highway Maintenance Branch evaluate this activity and consider methods to prevent contamination of surface and groundwater.

Associated with the calcium chloride program are the numerous water withdrawal sites. These sites can be damaging to local watercourses if the area is not properly prepared. The pump, where possible, should be located on a well drained site and sloped away from the water source, preferrably into a vegetated buffer. In this manner, accidental oil and water spills can be filtered before re-entering the watercourse (Plate 77). If a sump is required, the spoil should be placed above the highwater mark (Plate 78).

All water pump intakes were screened, whether or not located in a fish bearing stream. However, none of the screens met the current design specifications recommended by the Department of Fisheries and Oceans (Plate 79). Intake screens can be easily modified to comply with the mesh opening size of 0.1 inch (25mm). These and other regulatory matters should be clarified with Department of Fisheries and Oceans prior to establishing a water withdrawal site.

PLATE 75 - Calcium chloride has been inadvertently mixed with overburden material and caused localized killing of the vegetation (km 38.9, Hwy. 11).

PLATE 76 - Surface runoff from a calcium chloride stockpile site is affecting the nearby vegetation (km 38.9, Hwy. 11).

PLATE 77 - Water withdrawal sites should be prepared so that accidental water and oil spills are contained or drain into a vegetated buffer. Oil contaminated soil should be removed to a site where it will not affect water quality (km 637.8, Hwy. 2).

PLATE 78 - The spoil from this sump was deposited into the stream on the right hand side of photograph. If sumps are necessary, the spoil material should be deposited in a stable location above the high water mark (km 128.3, Hwy. 2).

PLATE 79 - A typical water intake screen which exceeds the recommended mesh opening size of 0.1 inch (25 mm). Intakes, such as this, may entrap small fish (km 128.3, Hwy. 2).

PLATE 80 - Vegetation control is a common maintenance program along Yukon highways (km 202, Hwy. 5).

The control of vegetation is a necessary part of highway maintenance (Plate 80). Various methods are in use ranging from hand clearing to mechanized methods using the hydro-axe or road graders.

Hand clearing causes the least environmental disturbance and should always be used, if necessary, on streambanks (Plate 81). The hydro-axe has certain environmental advantages in that it can operate from the roadway and avoid terrain damage. Road graders, on the other hand, cause considerable environmental damage by destroying all vegetation, instead of selectively removing the problem shrubs as the hydro-axe does. The blading method exposes the erodable soil surface and redirects surface runoff patterns, contributing to accelerated surface erosion and sedimentation to watercourses. In addition, blading the right-of-way directly conflicts with aesthetic values (Plate 82), and in certain areas with the benefits of revegetation programs.

Although blading on well drained granular soil types generally caused minimal environmental impact, the objectives of the maintenance program are questioned when stable, self perpetuating grass communites are destroyed (Plate 83) and when the bladed width appears to be excessive (Plate 84). It was also observed that repeated blading may actually encourage the growth of non-desirable shrub species (Plate 85).

Before a road grader is used for vegetation control, some important considerations should be reviewed, such as; is there a better method, is vegetation control actually necessary, and how much should be done? These are important questions that should be considered to ensure that the program benefits offset the concerns regarding aesthetic and environmental values.

PLATE 81 - If vegetation control is necessary at stream crossings, the least environmental impact is caused by hand clearing methods (km 37, Hwy. 8).

PLATE 82 - Blading the entire right-of-way exposed large areas to surface erosion and conflicts with aesthetic values (km 193, Hwy. 3).

PLATE 83 - Blading in areas which are predominantly grass communities conflicts with good right-of-way management (km 1549.3, Hwy. 1).

PLATE 84 - Blading, if necessary to restore drainage systems, should not expose large areas (km 1547, Hwy. 1).

PLATE 85 - In certain areas, repeated blading may actually encourage the growth of undesirable species of shrubs (km 1573.8, Hwy. 1).

8 SUMMARY

The preceeding sections presented environmental concerns observed along Yukon highway rights-of-way. In this section, a summary of environmental considerations for maintenance programs are listed. Most of these points are already in practice along the highways. However, in view of the fact that there are still site specific examples, it suggests some improvements can be made.

Road Embankment

- disperse road surface runoff through adequate crowning
- prevent runoff from accummulating on the road surface
- use half section culverts to transport concentrated road surface runoff across erodable material
- take corrective action to unstable embankments
- encourage the establishment of grasses along the road embankment
- along encroachments of waterbodies, direct road surface runoff to the ditch side.

Backslopes

- take corrective action to unstable backslopes
- intercept subsurface and surface water above the backslope and control in an effective manner
- install a carefully designed bench cut on large backslopes
- encourage revegetation of backslopes.

Drainage Controls

- line ditches through fine textured soils with coarse material
- divert ditches away from erodable soil sources
- use ditch blocks and cross drains on long grade sections
- use energy dissipators at culvert outlets
- provide settling basins to trap sediment before entering a watercourse
- keep ditches and culverts in good working condition
- waste material should be deposited at a stable waste site where it will not enter a watercourse.

Stream Crossings

- maintain culverts in an efficient working manner
- periodically inspect crossing structures for fish migration problems
- take corrective action to ensure fish passage
- armour road embankments and berms with a non-erodable material
- encourage vegetation growth along streambanks
- use only hand clearing methods on streambanks
- ensure river training programs are approved by other government agencies
- abandoned stream crossings should be left in a stable manner that will facilitate natural revegetation.

In concluding, the results of this survey have identified several areas of environmental concern with respect to highway maintenance practices. Although, in consideration of the 4,000 kilometers of highway in the Yukon, the frequency of environmental problems was relatively low. This is partly due to the regional geology and climate, but also is a function of the quality of existing highway maintenance programs. It is felt that the majority of environmental concerns identified can be resolved to the mutual benefit of environmental and engineering objectives through consultation with highway maintenance personnel.

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