

INTERPROVINCIAL PIPE LINE (NW) LTD.

NORMAN WELLS PIPELINE

ENVIRONMENTAL ASSESSMENT OF BORROW PITS
SCHEDULED FOR DEVELOPMENT, WINTER 1983

November, 1982



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1.0 INTRODUCTION

At the request of Interprovincial Pipe Line (NW) Ltd., Hardy Associates (1978) Ltd. has conducted a survey and prepared a report outlining environmental conditions, development considerations and reclamation procedures for eight sites which have been selected for development along the Norman Wells pipeline route in winter 1983.

1.1 PURPOSE AND USE

This report provides a review of predevelopment environmental conditions, an assessment of potential impacts resulting from development, and appropriate preliminary reclamation procedures for borrow sites scheduled for development along the Mackenzie Valley Pipeline route in winter 1983.

The report summarizes general environmental conditions and impacts in Section 2.0, general development plans in Section 3.0 and plans for the optimum reclamation of sites are presented in Section 4.0. These plans are patterned after guidelines established by various provincial and federal agencies.

1.2 OBJECTIVES

The objectives of this report are:

- a) to provide a description of environmental conditions prior to borrow development;

- b) to provide an assessment of environmental impacts during and following development;
- c) to provide general development plans in order to minimize environmental impacts and optimize reclamation;
- d) to provide general plans to the operator in order to minimize environmental and visual impacts and optimize rehabilitation;
- e) to satisfy the regulation requirements itemized in the National Energy Board, "Terms and Conditions of the Certificate of Public Convenience and Necessity No. OC-35" Section 13a; and
- f) to ensure that the commitments expressed by Interprovincial Pipe Lines (NW) Ltd. (IPL) to minimize environmental impacts and disturbance will be maintained.

SURVEY METHODS

The information presented in this report is based on a joint soils, vegetation, wildlife and archaeological survey conducted by firms including Hardy Associates (1978) Ltd., McCourt Management Ltd., and Fedirchuk McCullough and Associates Ltd.

Of the approximately 50 sites visited during the survey, 7 are addressed in this report. One additional site, 1-11b, also selected for development in winter, 1983, has not been surveyed.

During the helicopter assisted survey of each site, soil and vegetation investigations included observations on dominant vegetation, regenerating species in disturbed areas, general landscape characteristics such as drainage and topography and soil characteristics such as peat thickness, mineral texture, depth to gravel and depth to permafrost.

Wildlife habitat was evaluated by assessing quality and use of the site by various wildlife types along 50 m spaced transects.

Archaeological investigations at the sites involved extensive subsurface testing along transects spaced 50 m apart as well as surface inspections of exposures.

3.0 ENVIRONMENTAL CONDITIONS AND IMPACT ASSESSMENT

This section provides a general inventory of terrain, vegetation, soil, wildlife habitat and historical resource conditions and associated impacts at the eight sites designated for development in winter, 1983. The eight site locations are shown in Figure 1 and site characteristics and presented in Table 1.

3.1 PRE-DEVELOPMENT ENVIRONMENTAL CONDITIONS

Table 1 presents the environmental inventory for each of the eight sites. Additional site information is available in the "Granular Borrow Inventory" Volumes 1 - 3 prepared by Hardy Associates.

A discussion of terrain, vegetation, soil, wildlife and archaeology respectively is presented below for each of the eight sites.

3.1.1 Site 1-11b

This deposit consists of the talus slope and a small alluvial fan located at the base of the south side of Bear Rock. At the surface the deposit consists of very coarse, angular fragments of limestone up to 1.0 in size. The area is rapidly drained on an overall slope of approximately 40 percent to the southeast and is crossed by two deeply incised channels which carry run-off waters from Bear Rock.

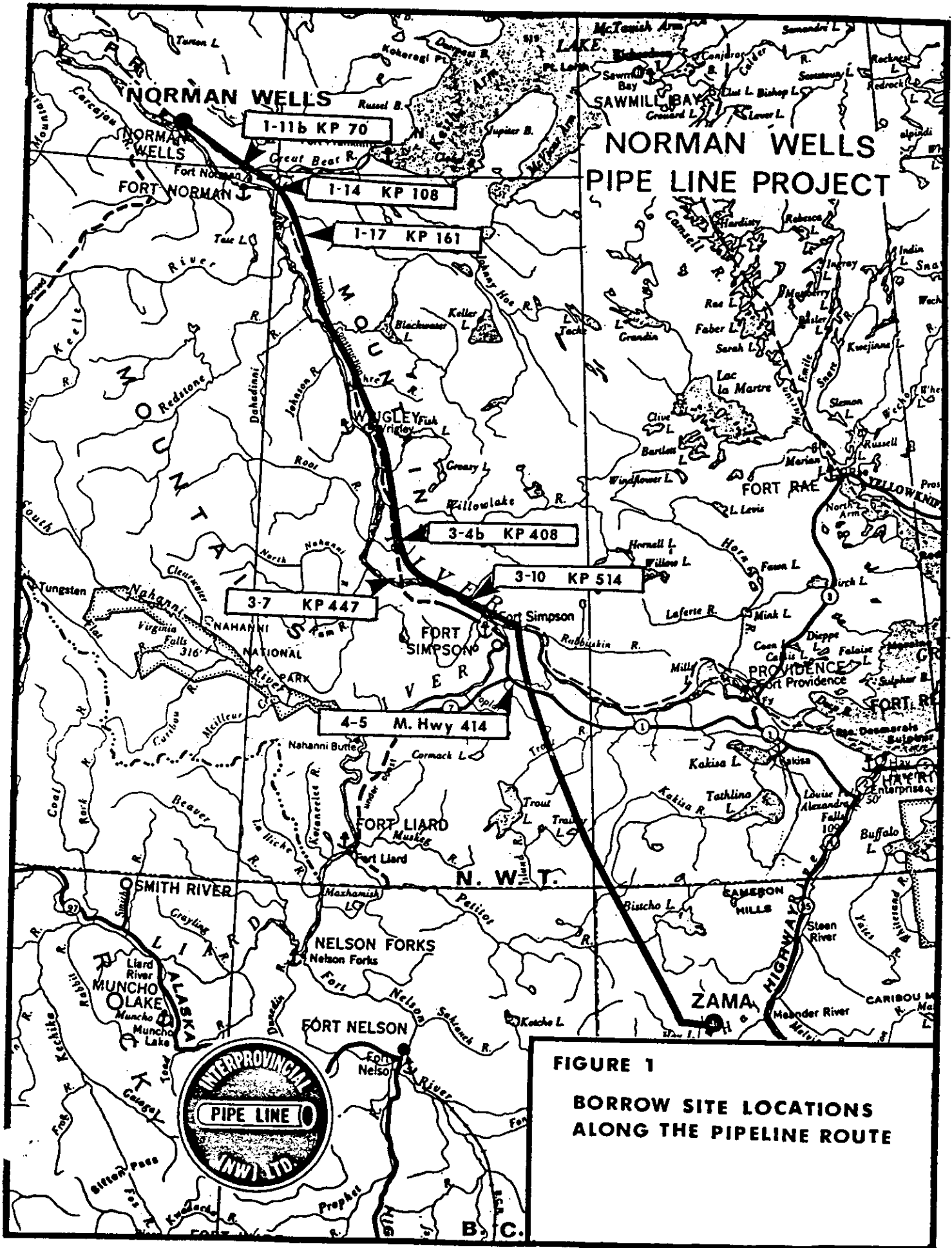


FIGURE 1
BORROW SITE LOCATIONS
ALONG THE PIPELINE ROUTE

TABLE 1

ENVIRONMENTAL CHARACTERISTICS OF BORROW SITES ALONG THE NORMAN WELLS TO ZAMA ROUTE
SELECTED FOR DEVELOPMENT DURING WINTER 1983

Parameters	Sites							
	1-11h	1-14	1-17	3-4b	3-7	3-10	4-5	585
kmp	70	108	161	408	447	514	N. Hwy 414	585
Deposit type	Alluvial fan and Talus	Eolian ridge (dune)	Glaciofluvial outwash	Esker-kame	Alluvial terrace	Glacial outwash	Glacial outwash	Till
Site condition	Undeveloped	Undeveloped	Existing pit and undeveloped surroundings	Existing pit and undeveloped surroundings	Existing pit and undeveloped surroundings	Undeveloped	Existing pit	Existing
Dominant vegetation	Bare with some gnarled white spruce and low shrub cover	Black spruce-birch	Black spruce - jackpine - birch	Aspen - jackpine	White spruce - birch	Black spruce - aspen	Jackpine	Aspen-Jackpine
Regeneration vegetation		Rose, raspberry on trail	Aspen, willow, birch, rose raspberry	Aspen, willow, rose, and raspberry	Aspen, spruce, willow, birch rose, raspberry		Poplar, rose, hawkweed	Willow, poplar, birch
Topography	25-70%	Ridge - 0-10%	1-2%	2-60% slopes	1-2%	1-2%	1-2%	1-2%
Drainage	2 major and several minor channels rapidly drained	imperfect to well drained	imperfect with ponding in existing pit	well drained to the west at 10% slope	imperfect to well with ponding in existing pit	poor to well with near surface water table	well	Well
Soil texture		Loamy sand	Silt loam	Loamy sand	Silt loam over loamy sand	Clay loam	Loamy sand	Loamy sand to silt loam
Soil type	Non-soil	Orthic Dystric Brunisol	Brunisolic Static Cryosol	Orthic Eutric or Dystric Brunisol	Eluviated Dystric Brunisol to Orthic Gray Luvisol	Gleysolic Static Cryosol to Orthic Brunisol	Orthic Dystric Brunisol	Eluviated Brunisol
Soil salvage depth	-	20 cm	20 cm	20 cm	20 cm	20 cm	20 cm	20 cm
Peat thickness	0	5-10 cm	15-20 cm	0-15 cm	5-10 cm	10-50 cm	2-5 cm	2-5 cm
Depth to frost	Unknown	Greater than 1 m	50 cm in July	Greater than 1 m	Greater than 1 m	Greater than 1 m	Greater than 1 m	1 m
Depth to gravel or sand	Surface	10 cm	35-50 cm	0-15 cm	50 cm	Unknown	30 cm	10 cm to 100 cm
Erodibility	Low-moderate	High-(wind)	Low-moderate	Low	Moderate-high	Moderate	Moderate-high	Low
Wildlife Habitat quality/use*								
Moose	N.S	M/M	M/L	P/L	P/L	P/L	F/L	L/L
Bear	N.S	P/L	F/M	M/L	M/M	P/L	F/L	M/M
Canids	N.S	M/L	M/L	M/L	M/L	P/L	M/L	L/L
raptors	E/N in the area	M/L	M/L	M/L	M/L	M/L	M/L	M/L
Historical resource	Unknown	None	None	None	None	None	None	None

Habitat*

Quality	Use
P - Poor	L - Low
F - Fair	M - Medium
N - Moderate	H - High
E - Excellent	N.S. - Not Surveyed

The slope is mostly bare of vegetation but does contain some white spruce and low shrub-heath vegetation in favourable sites. The vegetation has been classified by Reid (1974) as open gnarled white spruce, tamarack/Dryas/Cetraria.

Soil is mostly absent on the site except for localized areas of limited extent where shallow Regosols (Lithic phase) have developed in association with the sparse vegetation cover.

In terms of wildlife habitat, the site is probably poor in quality and of low use. However, because it is located near known Peregrine Falcon nesting sites, it is situated within an area rated as highly sensitive to disturbance between April 15 and September 15 of any year.

An archaeological survey of the site has not been conducted to date, so it is not known whether historical resources exist on the slope. It is known that the area has some spiritual significance to the people of the area.

3.1.2 Site 1-14

This site is located on an eolian or dune ridge deposit 15 km east of Ft. Norman. The ridge is approximately 1 000 m long and about 30 to 80 m in width. The moderately well drained ridge projects approximately 2 to 3 m above the surrounding poorly drained glaciolacustrine plain and has side slopes of 5 - 10 percent. Although the surface is generally moderately well to well drained, the site contains near surface permafrost at depths of approximately 1.5 m.

The ridge is vegetated mainly by black spruce and birch which has been classified by Reid (1974) as black spruce-white birch/lingonberry. Trees range from 15 to 20 m in height with diameters of 10-15 cm and stem densities of 0.25 to 0.50/m².

Soils are moderately well to well drained on the ridge top but become increasingly wetter towards the ridge perimeter. The soil is predominantly classified as an Orthic Eutric Brunisol on loamy sand. The surface organic layers range from 5 - 15 cm in thickness at the ridge top and is underlain by a brownish B horizon to a depth of about 50 cm. Towards the ridge perimeter, the surface organic layer generally thickens to 15 to 20 cm with permafrost somewhat nearer the surface.

Habitat quality for wildlife is rated as moderate for moose, canids and raptors, fair for caribou, game birds and others, and poor for bear. Results of the survey indicate that wildlife use is generally low, probably because of the isolation of the ridge within a poorly drained open black spruce landscape. Important beaver habitat is located around nearby lakes and streams.

Although no historical resources were found at this site it has been assessed as having a medium potential for prehistoric campsite locations.

3.1.3 Site 1-17

This site is located 2 km southeast of Little Smith Creek on a large glaciofluvial outwash plain. The area to be developed is located adjacent to an existing borrow pit, a large portion of

which is presently water filled. The area surrounding the existing pit is fairly level and is characterized by a uniform black spruce forest. The existing pit is approximately 100 m x 100 m in dimensions in an L shape and has a relief of approximately 1.5 m between pit bottom and perimeter.

Vegetation surrounding the existing borrow pit consists of a predominantly black spruce forest of uniform density and height associated with a ground cover of almost entirely composed of feathermoss. Reid (1974) has classified this vegetation type as black spruce/feathermoss. Trees range from 10-15 m in height with diameter of 10-15 cm (dbh), and stem densities of 0.5 to 1/m².

The existing pit supports a regenerating vegetative cover of approximately 50 percent. Ground regeneration is confined to wet areas near the water's edge in the pit end to areas containing stockpiled overburden and soil materials. Areas with poor or no regeneration generally contain an abundance of undecomposed slash and clearing debris material which is located around the old pit perimeter. Regenerating tree species include balsam poplar, aspen, willow, and white birch. Other species present include raspberry, prickly rose, fireweed and several grasses.

Soils are mostly imperfectly drained, and at the time of survey (early July), were frozen at depths of 30 to 50 cm. They are characterized by a surface peat layer of 20 cm which is underlain by material of variable textures including clay, silt and gravel. However, gravel becomes common at depths of 40 to 50 cm. Although frozen at the time of survey soils are

probably unfrozen later in the season. They are classified as Orthic and Gleyed Eutric Brunisols.

Wildlife habitat quality for most classes is rated as moderate, however, useage is generally low.

Archaeological test results were negative and the potential for future finds in this area is low.

3.1.4 Site 3-4b

Borrow Site 3-4b is an existing borrow pit along the Mackenzie Highway. It is located in an area of ridged to hummocky glaciofluvial ice-contact features with slopes of 30 to 50 percent and local relief of up to 10 m. The irregularly shaped, bare abandoned pit is approximately 4 ha in size and has a packed and gullied gravel surface sloping at 5 to 10 percent to the west.

Natural vegetation around the perimeter of the pit consists mainly of jackpine and aspen on knolls and ridges, and black spruce in lower positions. The vegetation on dry ridges and knolls may fit Reid's (1974) description of a jackpine/soapberry/twinflower vegetation type. Windthrow is evident around portions of the pit perimeter but is especially noticeable along the southern edge of the pit which probably experiences high winds from across the large bare pit surface. Significant areas of dead or dying jackpine are also evident around the pit perimeter, however, the causes are unknown.

Regeneration of the pit area is very low (1-2 percent cover). However, a substantial regenerating cover was observed around the pit perimeter where greater amounts of soil materials remain and protection is better, and also occurring near moist areas. The major species observed include aspen, balsam poplar, willow, rose raspberry, and a few grasses.

Soils outside of the pit are highly variable reflecting the complex topography. Well to rapidly drained ridge tops have little soil development because of the proximity of gravel to the surface (0 - 2 cm). Soil depth increases downslope from the ridge tops ranging in depth from 5 - 15 cm to gravel. Soils are classified as Orthic Regosols along ridges with near surface gravel, and Orthic and Eluviated Brunisols in areas of fine sandy loam to silty loam textured materials under several centimeters of organic surface and over gravel.

Wildlife habitat quality around the pit has been assessed as moderate but use is low.

Archaeological test results were negative in this area.

3.1.5 Site 3-7

Borrow Site 3-7 is an existing pit along the Mackenzie Highway near the Mackenzie River crossing point. It is located on a high and level alluvial sand terrace approximately 35 m above the Mackenzie River. The existing pit has dimensions of approximately 100 x 200 m oriented north and south, with a relief of approximately 2-3 m between overburden piles around the pit perimeter and the shallow water covered pit bottom.

Gullies up to 1.0 m in depth are prevalent on pit slopes of 10 percent or more.

The natural vegetation around this site is composed of a fairly dense cover of white spruce and white birch with some trembling aspen. Spruce ranges from 15 to 30 m in height, 10 to 60 cm in diameter and 0.2 to 0.30/m² in density. Birch is commonly 15-20 m in height, 15-20 cm in diameter and 0.10 to 0.2/m² in density. The larger white spruce are of merchantable size. The understory is generally sparse, being composed of some alder, rose, twinflower and dogwood with a good ground cover of feathermoss.

Regeneration success in the pit area is highly variable. Areas containing salvaged soil make up approximately 10 percent of the total pit area and support a regenerating vegetative cover of more than 100 percent. This cover is composed of trembling aspen, balsam poplar, birch, willow, spruce, and raspberry. The remainder of the pit area, with the exception of the pit bottom and adjacent areas to the south, has a very sparse (less than 1 percent) cover of the species listed above. The wet pit bottom area contains an abundant cover of willow and horsetail. A striking uniformly spaced stand of 4 to 5 year old spruce seedlings is situated near the south end of the pit on the moist level bottom and adjacent drier slope. Here, from 5 to 10 seedlings/m² ranging in height from 30 to 50 cm provide the predominant cover on a sandy loam surface of approximately 0.1 ha in areal extent.

The dominant soil type in the undisturbed area adjacent to the pit is classified as an Eluviated Eutric Brunisol. This soil

has developed on materials with silt loam textures and is characterized by a surface organic layer of 5-10 cm in thickness over a thin eluviated horizon and a 30 to 40 cm brown coloured B horizon. Materials below 50 cm generally become coarser in texture. Soils are generally well drained and were moist at the time of survey. They are considered to be moderately to highly erodible by wind and water.

Wildlife habitat quality around the pit is rated as poor to moderate, and use was observed to be low.

Although archaeological test results were negative at the time of the survey, the proximity of the site to the Mackenzie River combined with the well drained site conditions suggests a potential for the occurrence of sites.

3.1.6 Site 3-10

Borrow Site 3-10 is located about 1 - 2 km east of the Mackenzie River on a relatively flat and featureless thin glaciofluvial outwash deposit with a gently slope towards the river. Near surface and surface water tables are common in the area.

As a result of the fire history of the area, the vegetation pattern is complex. Isolated areas which have not burned recently are scattered throughout, and are vegetated with mature stands of black spruce with some tamarack on poorly drained sites, and sparse black spruce on very poorly drained organic soils. Recently burned areas are vegetated with very

dense (3 - 5 stems/m²) stands of black spruce-aspen in wetter areas, and aspen-black spruce in drier areas.

Regeneration along the cutline consists of sedges, grasses and low shrubs in wet areas and aspen, willow, fireweed, and spruce in drier sites.

Soil development in this area is closely related to surface drainage conditions and water table levels. In poorly drained areas containing near surface water tables, soils were frozen at depths of 20 to 30 cm during late June. Profiles are characterized by 30 - 40 cm surface organic layers over gleyed sandy clay subsurface materials. Soils here are classified as Rego Gleysols. In drier areas, soils have surface organic horizons of 5 - 10 cm over brownish B sandy loam horizons to gravel at depths of 10 to 20 cm. In these drier areas soils are classified as Orthic Brunisols and Regosols.

Wildlife habitat quality is rated as poor and use was observed to be low.

Archaeological test results were negative in this area although the proximity to the Mackenzie River suggests some potential.

3.1.7 Highway Crossing Site

This existing borrow site is located on a gently sloping morainal deposit along the Mackenzie Highway. Approximately 50 percent of the cleared area of the pit is water bound.

Vegetation in the area is composed of an aspen dominated mixed forest containing aspen, birch and jackpine with understory species including medium to dense alder, juniper, cranberry, Ewinflower, dogwood and rose. Regenerating species along the road include willow, balsam poplar and birch seedlings.

Soils have developed on loamy sand, sandy loam and sandy clay loam materials with coarser materials at depths ranging from 10 cm to greater than 1 m. The surface organic layer ranges from 2 to 5 cm in thickness and is underlain by either an eluviated horizon of 2 to 8 cm in thickness over a brownish B or Bt horizon to depths of 15 to 35 cm in finer textured materials, or by a Bm above the depths of 50 cm in materials of loamy sand textures. Soils developed in coarser materials are classified as Orthic Eutric Brunisols, and those in finer textured materials as Orthic Gray Luvisols.

The habitat is assessed as having a low to moderate quality for wildlife and survey evidence indicates a generally low use by wildlife.

Archaeological test results were negative.

3.1.8 Site 4-4 (alternate)

Borrow Site 4-4 is an existing borrow site located along the Mackenzie Highway on a glaciofluvial outwash plain bordering a large meltwater channel. The cleared portion of the deposit covers an area of 2 ha.

The region around the existing pit is dominated by 15 to 25 m tall spruce with an understory of alder, juniper, cranberry, dogwood, bearberry and twinflower. Beyond the tall spruce vegetation, aspen-spruce dominates, ranging in height from 10 to 15 m with somewhat greater densities.

Regeneration occurs mainly on salvaged overburden and soil piles where covers vary from 50 to 100 percent. Regenerating species include raspberry, balsam poplar, trembling aspen, fireweed, spruce, dogwood and wheat grass. Several weedy species such as dock and hawkweed have established around small wet areas in the pit bottom.

Soils are imperfectly to well drained outside of the pit perimeter and contain a surface organic layer of 5 - 10 cm over 6 - 10 cm of eluviated loamy sand and 10 cm of brown Bm material also of loamy sand texture gravel. Gravel contact occurs at 30 cm. Soils are classified Eluviated Eutric Brunisols. Wildlife habitat is rated as being fair to moderate in quality and useage was observed to be low.

Archeaological test results were negative.

3.1.9 Site 4-5

Site 4-5 is an existing borrow site along the Mackenzie Highway located on a glaciofluvial outwash plain. The existing pit cleared area covers approximately 3 ha and is situated on fairly level terrain.

Vegetation on this site consists of jackpine with heights of 5 - 10 m, diameters of 10 cm and densities of 0.5 /m². Understory species include dense alder, a 50 percent cover of twinflower and some wild rose.

Regeneration in the pit was observed mainly on stockpiled overburden and soil and near moist areas. The overall cover of regenerating vegetation is about 10 percent. The major regenerating species include dense patches of rose on the spoil pile and hawkweed on the gravel. Soils in the surrounding jackpine forest have developed on medium loamy sand materials over gravel at 40 cm. They are generally capped with 2 - 5 cm of surface organics and are classified as Orthic and Eluviated Eutric Brunisols.

Wildlife habitat is rated as being fair to moderate in quality and useage was observed to be low.

Archaeological survey test results were negative.

3.2 IMPACT ASSESSMENT

The impacts of borrow development on the environmental parameters are expected to be insignificant, providing that appropriate development and rehabilitation procedures are implemented as outlined in Sections 3.0 and 4.0, and in the "Environmental Protection Plan" for site development.

Development of new and expansion of old borrow areas will result in changes (impacts) to those areas and their

surroundings. These changes will be of short duration and mainly affect local areas. The major changes expected are:

- 1) the loss of vegetative cover and;
- 2) alterations of the drainage characteristics of the area.

Since the development areas are remotely located and of small areal extent, overall visual effects are expected to be insignificant. New borrow areas scheduled for development in winter, 1983 will affect approximately 9 ha while 4 ha will be added to existing pits for a total of 13 ha along the 866 km route or 0.6 percent of the total area disturbed during project activities.

The major non-visual effect of development will be the impact on wildlife through the loss of habitat, increased human pressure due to better access and disturbance to wildlife on and near development areas. However, the overall impact on wildlife is expected to be negligible.

Proper development and reclamation procedures will serve to reduce the initial and long term negative effects of development. Reclamation procedures will include recontouring of pit slopes, replacement of salvaged soil materials on the recontoured surfaces, scarification of slope areas and the application of appropriate seed and fertilizer to the prepared surfaces (see Section 4.0). In most areas, as natural and assisted revegetation proceeds (following reclamation) wildlife habitat quality will improve rapidly, often exceeding pre-development quality due to the increased habitat complexity, plant species diversity and accelerated growth

rates of plants. Site appearance will also improve following reclamation due to rapid revegetation, however, the visual impact of development will be long-term or permanent.

The following discussion summarizes the expected impacts of development on terrain, vegetation, soils and wildlife. (Historical resources are not expected to be impacted because they will be avoided wherever they have been identified during surveys). Impacts are discussed in terms of the areal extent of disturbance, duration and in terms of the effect on biological resources.

3.2.1 Terrain

The impact of borrow development on terrain will be local, in terms of areal extent, but long-term in duration. The resulting effects on drainage may in some instances go beyond the local development boundaries. This is the case at sites with sloping terrain such as at sites 1-11b and 3-4b. With the implementation of appropriate reclamation procedures, however, these impacts on drainage will be short term and negligible.

Impacts of development will likely be greater at the three new development sites (1-11b, 1-14 and 3-10) than at the expansion sites (1-17, 3-4b, 3-7, kmp 585 and 4-5). This is partially due to the inherent site characteristic differences between the old and new sites (water table levels), in addition to the existing effects of the present development area. All the expansion sites, with the exception of Site 1-17, are located on generally well drained areas with relatively deep water

tables, whereas the new sites contain near surface water tables in the case of 1-14 and 3-10, and intermittent flowing surface and subsurface water in the case of the site 1-11b.

Following development and reclamation, borrow sites, 1-11b, 1-17, 3-10 and 585 are expected to contain permanent ponds. With proper recontouring, drainage control and by avoiding overdeepening of the pits, the areal extent of these ponds will be minimized. The existing pond areas at sites 1-17 and kmp 585 are not expected to increase in size following the implementation of appropriate development and rehabilitation procedures.

3.2.2 Vegetation

The impact of site development on vegetation will be local and of medium termed duration in most sites. The degree of impact will be negligible because of the large areas of similar vegetation types nearby which will be unaffected by the development.

Of all the sites to be developed, vegetation on site 1-11b will be impacted to the greatest extent because it is probably the most unique. The gnarled white spruce/dryas/cetraria type which has taken a long time to develop will not regenerate in the short or medium term.

Development of borrow sites 1-14 and 3-7 may have commercial consequences because of the merchantable sized black and white spruce situated at those sites.

3.2.3 Soils

Impacts of development on soils will be local and short term as a result of the implementation of appropriate salvage and replacement procedures. The degree of impact will be negligible in consideration of the large surrounding undisturbed area.

3.2.4 Wildlife

The impacts of development on wildlife will be local and of short term duration. The degree of impact will be negligible for the following reasons:

- a) Winter development of borrow site.
- b) Generally low habitat quality and use on development sites.
- c) Low wildlife population densities in much of the northern boreal forest.
- d) Rapid revegetation of development sites.

3.2.5 Archaeology

The impact of borrow site development on archaeological sites is considered to be non-existent because of the lack of positive test results. However, since development operations could conceivably uncover previously unknown resources, specific impacts could occur. The results of such impacts

cannot be assessed at this writing. An environmental monitoring program during site development will serve to minimize potential impacts.

4.0 DEVELOPMENT CONSIDERATIONS AND PROJECT DESCRIPTION

This section provides a description of the project as it relates to borrow site locations, borrow requirements and uses, and development planning. Preliminary details of the project description for each site are presented in Table 2 and are discussed in the following subsections.

4.1 LOCATION

Borrow sites to be developed in winter 1983 are situated within activity spreads 1, 4, 5, and 6. Site locations are presented in Figure 1. The three northern sites which are situated in Spread 1, are located in areas of permafrost without adequate all weather access nearby, while all the southern sites except 3-10 are likely frost-free with all-weather access. Site 1-11b, 1-14 and 3-10 are located in undeveloped areas while the remainder of the sites selected for development are located on existing borrow sites established by the Department of Public Works in 1975 for the construction of the Mackenzie Highway.

All sites are located in areas of low environmental sensitivity for winter development. However, wildlife and terrain sensitivities may restrict summer development at some northern locations.

4.2 SITE SIZE, VOLUMES AND USE

As indicated in Table 2, borrow clearing areas will range from 0.5 to 3 ha in size while actual development areas within the

TABLE 2
BORROW SITE SPECIFICATIONS, USES AND SCHEDULES - NORMAN WELLS PIPELINE PROJECT

Specifications	Site						
	1-11b	1-14	1-17	3-7	3-10	4-5	585
Location (kmp)	70	108	161	447	514	Hwy 414	585
Approximate Clearing Size (ha)	3	3	no clearing	3.6	2.5	no clearing	0.5
Approximate Development Size (ha)	3	1.0	-	2.0	1.0	-	0.25
Approximate Volumes required (m ³)	50,000	30,000	1,500	50,000	30,000	2,000	8,500
Use	winterroads campsite stockpile site fuel storage wharf	road stockpile wharf pipelining	stockpile wharf road repair pipeline construction	campsite stockpile access roads wharf site pipelining	stockpile road wharf river crossing	surfacing	storage site road access roads wharf site pipelining
Clearing Schedule	No clearing	1983-winter	No clearing	1983-winter	1983-winter	No clearing	1983-winter
Development Schedule	1983-winter	1983-winter 1984-winter	1983-winter 1984-winter	1983-winter 1984-winter	1983-winter 1984-winter	1983-winter	1983-winter
Reclamation Schedule	1983-winter	1983-winter 1984-winter	1984-winter	1984-spring	1984-winter and spring	None Required	1983-spring

cleared areas will range from 0.25 to 3 ha in size. Borrow site sizes will be determined by volumes of borrow required and depths of extraction specified. Material volumes extracted will vary from a low of 15000 m³ at site 1-17 to a high of 50 000 m³ at site 1-11b and 3-7. Extraction depths are not expected to exceed 3 m.

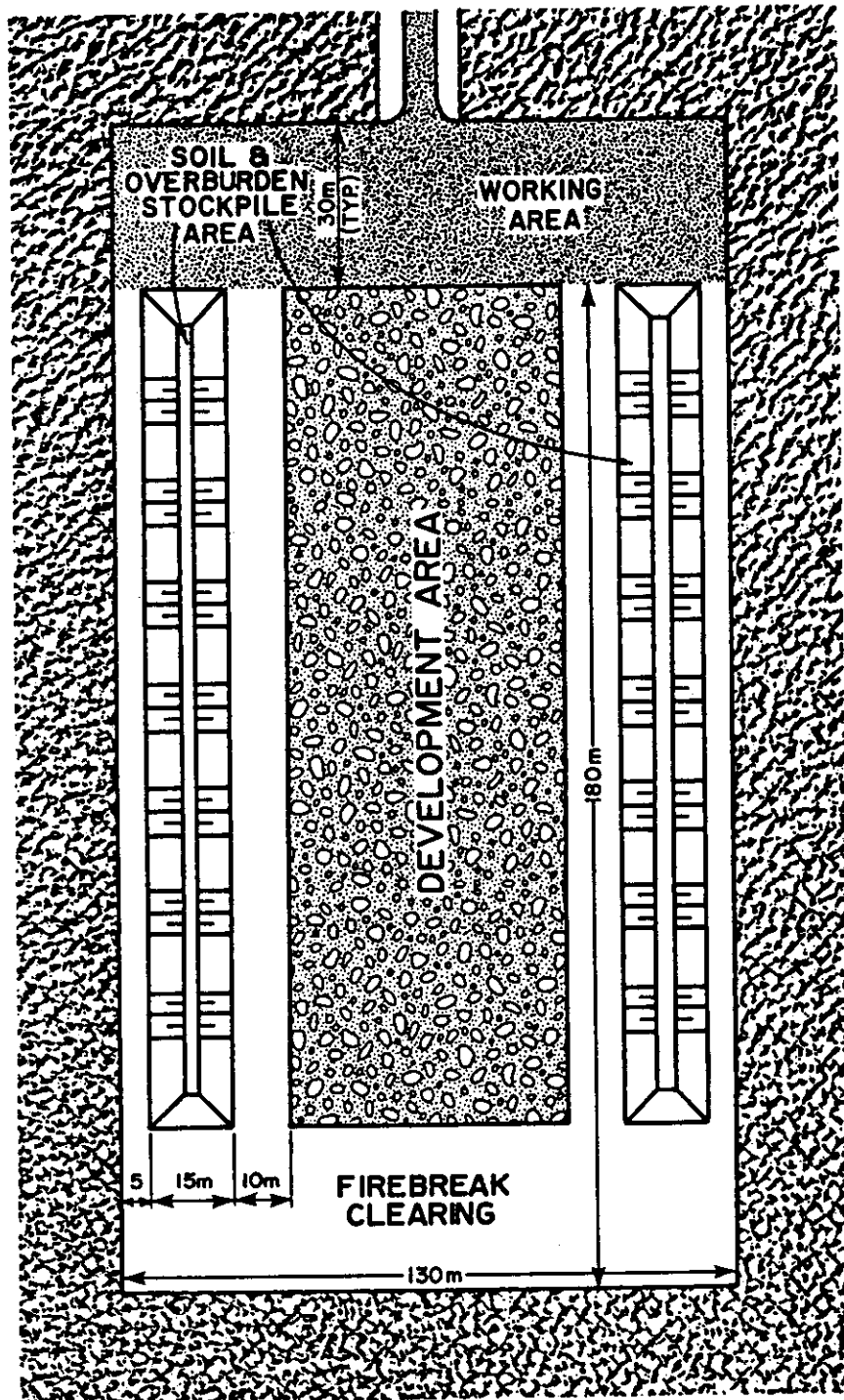
Material requirements at a particular site will be determined by the number, type and size of dissolved facility sites. For example, in the case of site 1-11b, granular material is required for a campsite, stockpile site, wharf site, fuel storage site and access road. In the case of Site 1-17, only one stockpile size will be developed in winter, 1983 resulting in low requirements for granular materials.

4.3 PRELIMINARY DEVELOPMENT PLAN

The preliminary borrow development plan, including schedules and procedures, is based on site conditions, material volume requirements, and materials handling requirements. These are discussed in the following sections. A typical borrow site is illustrated in Figure 2.

4.3.1 Development Schedule

All sites referred to in the report and listed in Table 2 are scheduled for development in winter, 1983. All sites referred to in this report and listed in Table 2 are scheduled for development in wint, 1983. However, development activities at most sites will continue into either spring and summer of 1983, and/or into winter 1984.



Gravel Pad
Trees

Scale 1:1300*



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**PLAN VIEW OF A TYPICAL
BORROW DEVELOPMENT AREA FOR THE
NORMAN WELLS PIPELINE PROJECT**

CE00686

FIG. 2

The development and reclamation schedule is presented in Table 2.

4.3.2 Development Events and Procedures

Development of selected borrow sites will include the following general events and order:

- survey and site boundary flagging;
- machine clearing of flagged area;
- hand clearing and timber stacking as required where timber is to be salvaged;
- survey and flagging of pit area;
- grubbing of stumps where possible over pit area;
- piling and burning of cleared debris and grubbed stumps;
- stripping and stockpiling of soil and stumps where grubbing is impossible;
- stripping and stockpiling of overburden; and
- borrow extraction.

These events will not necessarily apply to all sites due to site condition differences. Figure 2 illustrates a typical borrow site showing the cleared area, excavation area, soil storage piles and spacings between the various areas. The purpose of the various spacings and distances are as follows:

1. 30 m space - this space is required as a working and truck turnaround area near the entrance but also provides a firebreak around the entire site.

2. 5 m space between clearing edge and soil stockpile base - this space is required to accommodate the construction of a 2:1 to 3:1 slope following development.

A description of site development procedures and sequences is presented below.

Site 1-11b

This site will be surveyed and boundaries will be flagged for development in early January, 1983. The proposed site will be approximately 200 m long along the base, by 150 m wide, tapered towards the top of the alluvial fan.

Since vegetation, soil and overburden are virtually absent at this site, clearing and salvage operations are not required.

Material from this site will be used in the preparation of several temporary off-right-of-way sites, including short distance winter roads, one campsite, one stockpile site, one fuel storage site and one wharf site.

Material requirements are assessed as being approximately 50 000 m³. Because of the coarse material size and steep slopes present at this site, heavier equipment than normal will be required for handling the material.

Extraction depth will vary between 2 and 3 m depending on the requirements for fine or coarse materials and the presence of subsurface seepage or ice. Finer textures and higher water contents are expected at depth and within the lower one-third

portion of the fan. These conditions, if encountered, may necessitate shallower removal of material near the base and deeper extraction near the top of the fan.

Site 1-14

Site 1-14 will be surveyed and the clearing boundaries flagged before development begins in early January, 1983. The proposed cleared area will have dimensions of approximately 60 by 550 m along the north-south trending ridge.

Clearing of the area may include machine as well as hand clearing operations. Areas of open black spruce beyond the ridge will be machine cleared, however, some hand clearing and black spruce timber salvage may be required on the ridge itself. If so, salvaged timber will be stacked near the pipeline route at the south end of the ridge at least 5 m away from burning piles and soil stockpiles. All remaining timber and debris will be windrowed on the soil storage area.

Following the clearing operation, the development area will be flagged. This area will be approximately 1 ha in size along the ridge. Remaining stumps on this area will be grubbed if possible and piled on the debris windrow which will then be burned.

After burning is complete the burning area will receive the stripped topsoil. Approximately 15 cm of surface soil will be removed from the grubbed area and pushed into linear piles with spacings maintained as illustrated in the typical plan view in Figure 2.

Borrow material from this site will be used in the preparation of the stockpile site, wharf site and road at kmp 93. Approximately 30 000 m³ are required in 1983. (Additional volumes will likely be required in 1984 during pipelining operations.) Extraction depths will be determined by the elevation of the adjacent terrain so that the final pit bottom does extend below the average elevation in the area. This depth will vary from 1 to 3 m.

Site 1-17

Because of the small quantities of materials required from this existing pit (1000 to 1500 m³), no expansion is proposed. As a result, the area will not require surveying or clearing. However, excavation areas will be pre-cleared of topsoil and overburden materials prior to excavation. These materials will be stored on stable areas away from the pit edge. The material will be used for the preparation of a pipe stockpile site, wharf site, fuel storage site, road repair and possibly for pipeline construction.

Site 3-4b

This site has been designated as an alternate site if granular supplies at 3-7 are not sufficient. No expansion is proposed.

Site 3-7

This existing borrow site is designated for expansion. The expansion area will be surveyed and the boundaries of the area to be cleared will be flagged so that development can begin in

January, 1982. The expansion cleared area will have dimensions of approximately 260 x 140 m and will be located east of the existing pit area.

Clearing of the area may include machine as well as hand clearing operations because of the presence of very large white spruce too large for handling with the proposed equipment.

Simpson. It may be required that these larger trees be salvaged and stacked. If so, they will be cut and stacked near the existing pit entrance. All remaining timber and slash debris will be windrowed and burned at least five m from the clearing edge.

Following the clearing operation, the development area will be flagged. This area will have dimensions of approximately 110 x 210 m within the centre of the cleared area. Stumps within this area will be grubbed and burned.

Following burning, approximately 15 cm of surface soil will be removed from the total pit area and pushed to the designated soil storage areas at least 10 m beyond either side of the pit area. Overburden material if present will be pushed to the far end of the pit.

Borrow material from this site will be used in the preparation of one campsite, one stockpile site and several access roads situated 1.5 km north, as well as the wharf site situated 1.0 km south. Approximately 50,000 m³ will be required for site preparation in 1983. (Additional volumes will likely be required in 1984 during pipeline operations). Extraction depths will not exceed 3 m.

Site 3-10

Site 3-10 will be surveyed and the clearing boundaries will be flagged before development begins in January, 1983. The proposed cleared area will be approximately 2.5 ha in size.

The area will be machine cleared and the debris will be windrowed no closer than 5 metres to the clearing edge. Following the clearing operations, the development area will be surveyed and flagged. Grubbing operations will be conducted in the flagged areas and grubbed stumps will be added to the debris pile and burned.

Following burning, 15-20 cm of surface soil will be removed from the grubbed area and pushed to the soil storage area, the base of which will be located at least 10 m beyond either side of the grubbed area. Overburden materials, if present, will be pushed to the ends of the development area.

The granular materials removed will be used in the preparation of a nearby stockpile site, a wharf site and a connecting access road. Additional volumes are required at the river crossing camp and stockpile at pipeline kmp 526. A total of 30,000 m³ will be required during site preparation and river crossing construction. The extraction depth will not exceed 3 m.

Site at kmp 585

The development of this site will involve the expansion of an existing nearby water filled pit. Clearing boundaries will be

surveyed and flagged before development begins in January 1983. The clearing area will extend to the south of the existing pit with clearing and pit areal extent of approximately 0.5 and 0.25 ha respectively.

The area will be machine cleared and the debris windrow base will be no closer than 5 m to the south edge of the clearing. Grubbing operations will be conducted on the flagged area of approximately 0.25 ha, and the grubbed stumps will be added to the debris pile and burned.

After burning, 15 cm of soil will be removed from the grubbed area and pushed to the soil storage area along the south edge of the clearing.

Granular materials will be used in the preparation of the temporary pad and access road across the Mackenzie Highway to the north. Only 8500 m³ will be required initially. The extraction depth will be maintained above the elevations of the water levels in the existing pit.

Site 4-5

Approximately 2000 m³ may be extracted from this existing site. No additional clearing is proposed.

4.3.3 General Reclamation Procedures

Although major biological impacts of borrow development will be avoided through proper site selection, well planned site development and reclamation is desirable to minimize impacts,

assist natural recovery and to reduce the visual impacts of site development.

The reclamation measures and procedures outlined in this section are preliminary and deal primarily with site stabilization through erosion control and vegetation establishment. Site specific plans will be prepared as final design plans and specifications are available.

The post development reclamation procedures are designed to complement measures already implemented during borrow site development as discussed in the previous section. They include measures such as the designation of clearing boundaries, excavation boundaries, topsoil and overburden storage areas and pit depth and extent.

Measures to be implemented after site development will include the following:

- initial site inspection and cleanup;
- site grading;
- development of 2:1 or less pit wall slopes;
- construction of erosion control diversion berms where required;
- construction of settling basins where required;
- construction and incorporation of drainage channels where required;
- construction of rounded slope edges;
- construction of shallow contour terraces or berms on slopes;
- replacement of waste gravel;

- replacement of overburden;
- replacement of soil;
- contour scarification;
- seed and fertilizer application; and
- final inspection and site cleanup.

The types of rehabilitation procedures required at each site are presented in Table 3 and are discussed below.

Site 1-11b

The major objective of reclamation at this site will be to control erosion following the excavation of granular materials. This will be accomplished first of all by recontouring the entire area, then contour scarifying the slope as winter conditions allow, and finally by constructing appropriately spaced and angled diversion berms. A settling basin may be constructed near the base of the slope, if required. Revegetation will not be necessary because the site is unvegetated prior to development.

Following the completion of reclamation procedures, appropriate abandonment procedures will be implemented. This will involve a final inspection and cleanup and the severing of access roads to this sensitive Peregrine Falcon nesting area.

TABLE 3

RECLAMATION PROCEDURES TO BE IMPLEMENTED FOLLOWING DEVELOPMENT
AT SEVEN BORROW SITES ALONG THE NORMAN WELLS PIPELINE ROUTE

Reclamation Procedures	1-11b	1-14	1-17	3-7	3-10	4-5	585
Initial site inspection and cleanup	X	X	X	X	X	X	X
Site grading	X	X	X	X	X	X	X
2:1 pit slopes			X	X	X		X
Diversion berms	X						
Settling Basins	X						
Drainage Channels	X				X		
Smooth pit edges			X	X	X		X
Replacement of materials		X	X	X	X		X
Contour scarification	X	X	X	X	X		X
Seed and fertilizer application		X	X	X	X		X
Final inspection and cleanup	X	X	X	X	X	X	X

Site 1-14

The major objective of rehabilitation at this site will be to prevent wind erosion during 1983, and to promote the establishment of a vegetation cover after 1984.

Appropriate development procedures will result in a nearly level site following development at this location. Consequently, water erosion will not be a concern. However, in order to prevent wind erosion, the 1983 developed portion of the site will be reclaimed immediately after winter development ceases in 1983.

The initial reclamation in winter 1983 will only involve the replacement of soil on the developed portion of the site.

Following further extraction of materials in 1984, the entire site will be rehabilitated. This will involve recontouring and scarifying as required, which will be followed by the application of an appropriate seed and fertilizer mix.

Abandonment procedures will involve a final site inspection and cleanup.

Site 1-17

The objective of rehabilitation at this site will be to reduce the present undesirable visual impact by contouring the site and establishing a vegetation cover. This borrow site will not be rehabilitated until winter 1984. At that time the site will be cleaned up, and pit walls will be graded back to

slopes of less than 2:1. Waste gravel will be replaced, the site will be contoured, and then overburden and soil materials will be replaced.

Additional soil materials which were stockpiled but not replaced during the original highway operation, may also be used in rehabilitation procedures. After soil replacement operations have been completed, the site will be contour scarified to a depth of 30 cm in preparation for application of the appropriate mix of seed and fertilizer. A final site inspection and cleanup will follow.

Site 3-4b

Since this site is only considered to be an alternate borrow site, rehabilitation plans will not be developed at this time.

Site 3-7

Rehabilitation procedures at this site will not be implemented until project completion in 1984. At that time, rehabilitation will be conducted in spring rather than winter in order to optimize the materials handling operation. The objective of rehabilitation here will be to control erosion and promote the establishment of a suitable vegetation cover.

The site will be cleaned up and all garbage and waste will be disposed of.

Waste gravel will be deposited in the pit bottom after which pit walls will be graded to slope angles of less than 2:1.

This procedure will be followed by the placement of overburden materials in the pit bottom. The pit edges will then be rounded and the whole pit area will be graded and smoothed in preparation for soil replacement.

Soil will then be spread on the slopes, which will require a greater replacement depth than the pit bottom. Approximately 15-20 cm will be placed on slopes and the remainder will be spread out over the pit floor. Pit slopes and floor will be then cultivated or scarified parallel to the contours to a depth of at least 30 cm in preparation for placement of seed and fertilizer.

Abandonment procedures will involve a final site inspection and cleanup which will be followed by the severing of access roads into the site.

Site 3-10

The objective of rehabilitation at this site will be to prevent pit slope erosion, and to reduce the size and visual impact of the pond which will likely develop during and following excavation. Rehabilitation measures will not be implemented until project completion in 1984. Rehabilitation will be conducted in spring to optimize materials handling.

During site cleanup, waste and garbage will be collected and disposed of. Waste gravel will then be deposited in the pit bottom and spread, after which drainage channels may be constructed, if required, to reduce water levels. The pit walls will then be graded to slopes of less than 2:1 and all

pit edges will be rounded. This procedure will be followed by the placement of overburden materials in the pit bottom to reduce the water depth and possibly areal extent of the surface. The pit surface will then be capped with soil materials in all areas not expected to be water covered in spring. The pit will be monitored in summer 1983 to determine high water level locations.

All dry surfaces will be cultivated or scarified parallel to the contours, to a depth of at least 30 cm in preparation for seed and fertilizer placement.

A final inspection and cleanup operation will then be conducted.

Site at kmp 585

Objectives of rehabilitation and general rehabilitation plans and abandonment procedures will be similar to those described for site 3-7.

Site 4-5

New excavations are not planned and the pit is currently in use so rehabilitation is not required. However, thorough cleanup will be conducted.

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