PIPELINE RECLAMATION TECHNIQUES

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By

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ABSTRACT

Successful reclamation of a pipeline right-of-way is contingent upon the proper material handling procedure, especially for topsoil conservation. NOVA's practice of topsoil conservation is discussed along with its definition of topsoil in the various soil zones of Alberta. Some of the new ideas and innovations under evaluation at NOVA are also presented.

INTRODUCTION

NOVA believes that pipeline construction is a short-term impact on the land and that comparable productivity can be attained on disturbed land, especially in cultivated soils. In examining some pipeline reclamation techniques, more attention will be paid to the materials handling aspects of pipeline construction than final cleanup and revegetation. There will be a brief explanation of the construction of pipeline and a sequence of the events of construction, as well as a definition of topsoil and the rationale behind this definition.

Pipeline construction is a multi-phased linear development. Some of the more important phases are surveying, topsoil stripping, grading, stringing, welding, X-ray analysis, trenching, lowering-in, backfilling, tie-in, topsoil replacement, hydrostatic testing, operation, cleanup, reseeding and maintenance.

The successful reclamation of pipeline rights-of-way is critically dependant on the efficient handling of topsoil, its conservation and subsequent replacement. If this goal is achieved, then complete revegetation and restoration of the right-of-way is possible within one to three years.

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TOPSOIL

Macyk (1981) defines topsoil as the surface "A" horizons of the soil profile in the Plains Region, with subsoil then being the rest of the soil profile down to 1.15 m including the "B" horizons and upper part of the "C" horizon or parent material. In the Eastern Slopes Region, the top 15 cm should be considered, while in the Northern Forest Region it is suggested that an upper lift of 30 cm should be used.

NOVA basically agrees with these definitions but feels that some refinement of this criteria is necessary. Soils have been formed over the last 8,000 years principally through the interaction of climate and vegetation with variations from the modal concept influenced by topography, drainage and parent material. The definition of topsoil then, should recognize the soil zones in Alberta.

In the Brown Soil Zone (Figure 1), NOVA defines topsoil as the A and B horizons. This would give a depth of topsoil between 15 and 35 cm and while the A horizon contains the most soil organic matter, the B horizon would still have more than 50% as much organic matter as the A horizon (Peters et al, 1978). This depth of material is also practical and desirable from a construction standpoint, since it is generally difficult to distinguish any colour difference in surface horizons in Brown Soils, or remove less than 15 cm of surface material.

In the Dark Brown Soil zone, topsoil is defined as the A horizon and upper part of the B horizon and in the Black and Dark Grey Soil zones, the A horizon only is taken. In the Dark Grey and Grey Luvisolic Soil zones the definition of topsoil is less clear and there is no conscious effort to classify it by surface horizons. Most of these soils are on marginal agricultural land and have a thin L-H or O horizon overlying an Ahe and/or Ae horizon. Topsoil here is defined as an arbitrary 20 cm, more or less corresponding to a little more than the depth of cultivation. The surface material saved here will be low in organic matter and may form a crust when replaced, however, this concern will be addressed later.

In Solonetzic Soils, only the A horizon, including Ah, Ahe, Ae and AB horizons is conserved regardless of the soil zone. This can be effected fairly easily by scraping the dozer blade over the tops of the hard Solonetzic B horizon.

NOVA believes topsoil need only be conserved on agricultural land or areas having agricultural potential. On cultivated land, topsoil is stripped from the ditchline and spoil area, and is placed on the edge of the right-of-way beyond the spoil pile (Figure 2). On pastureland, forested land between cultivated field, grazing leases or land which may be potentially arable, topsoil is stripped over ditchline only (Figure 3). The topsoil is placed on the working side beside the ditch and not compacted down or feathered out over the right-of-way. Subsoil is placed on the spoil side near the trench. Both piles would be about 2 m from the ditchline to allow room for the trencher.

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MAJOR SOIL GROUPS IN ALBERTA

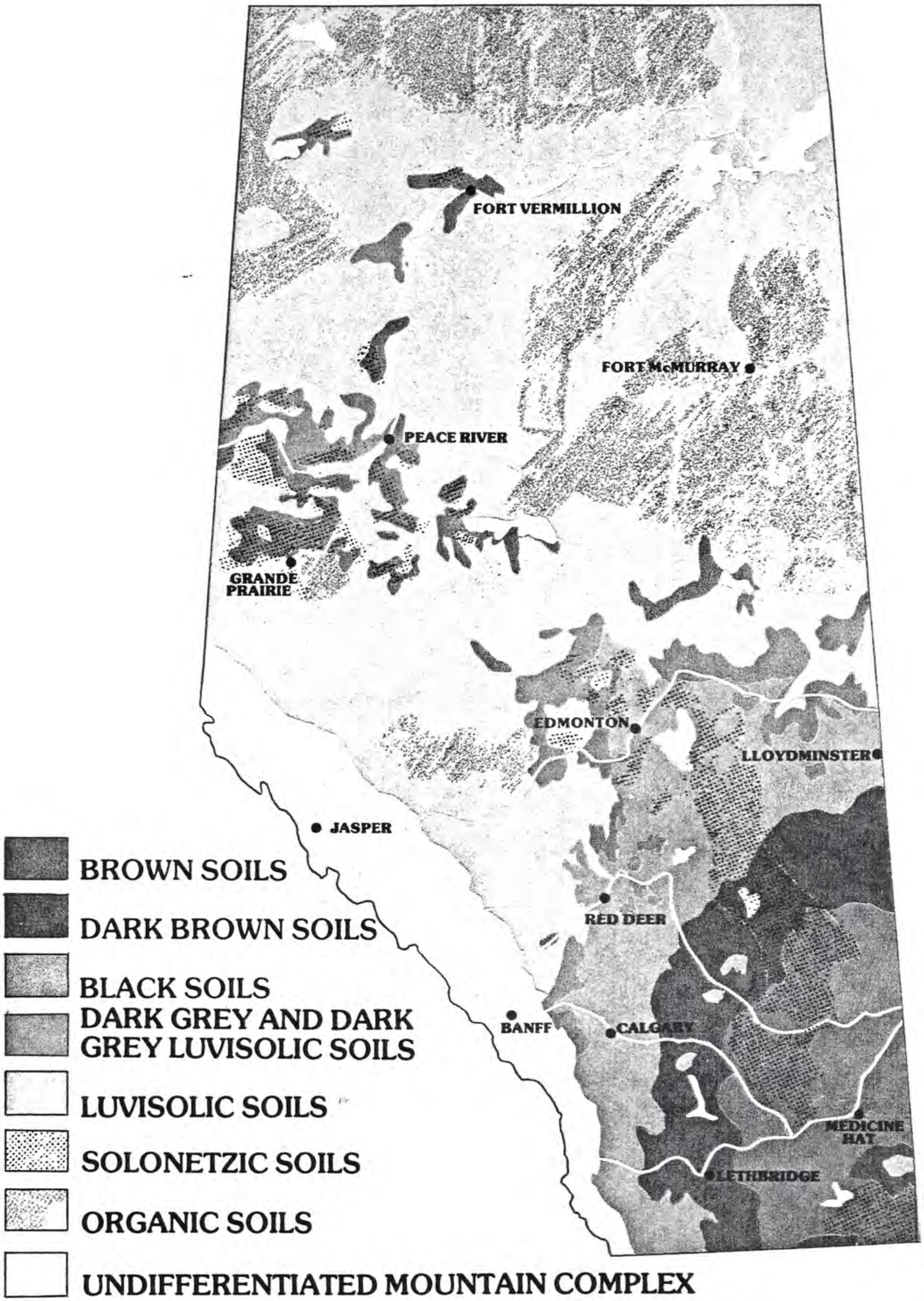

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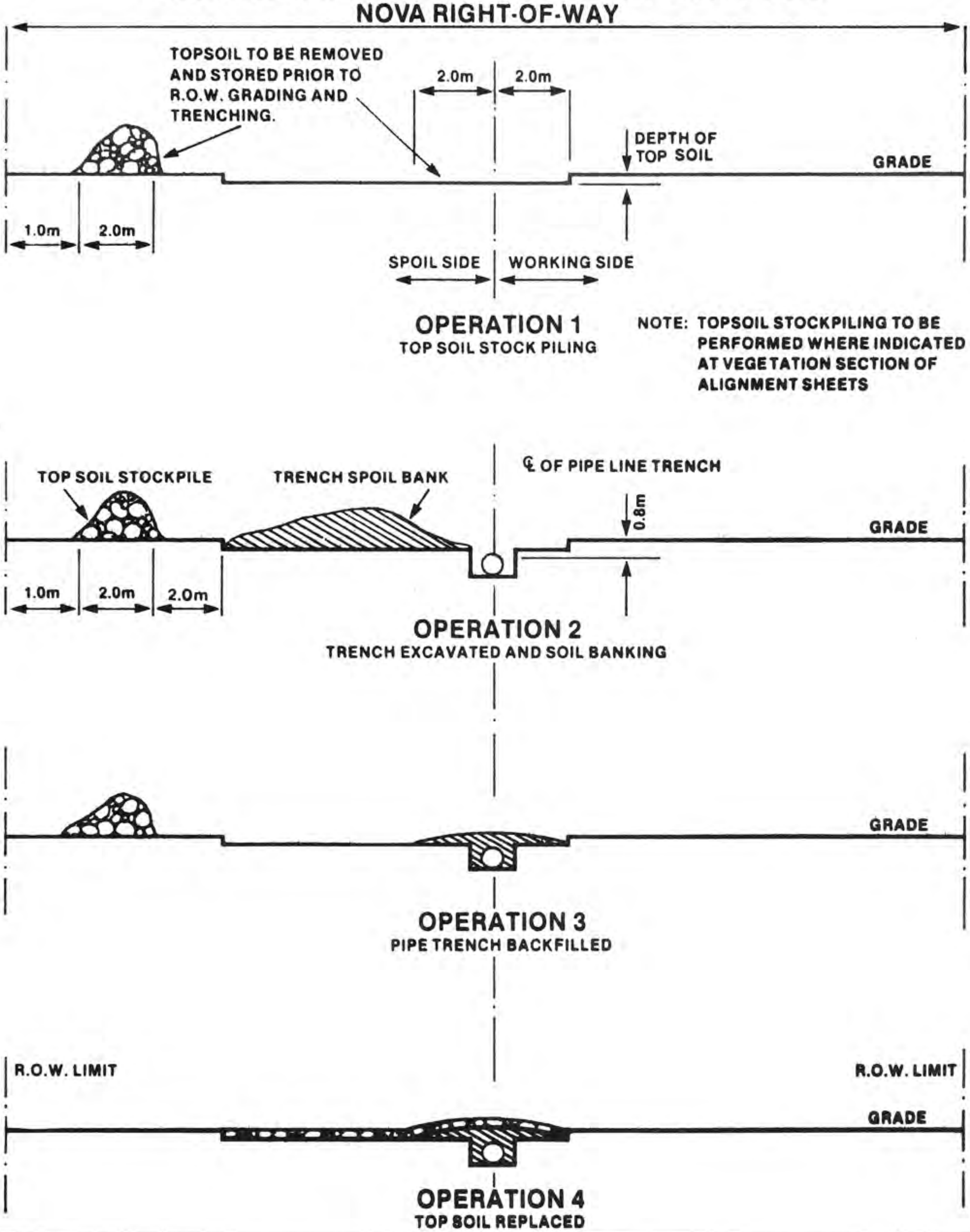
FIGURE 2:
TOPSOIL CONSERVATION OVER THE DITCHLINE & UNDER THE SPOIL PILE



PIPELINE TRENCHING OPERATION SEQUENCE

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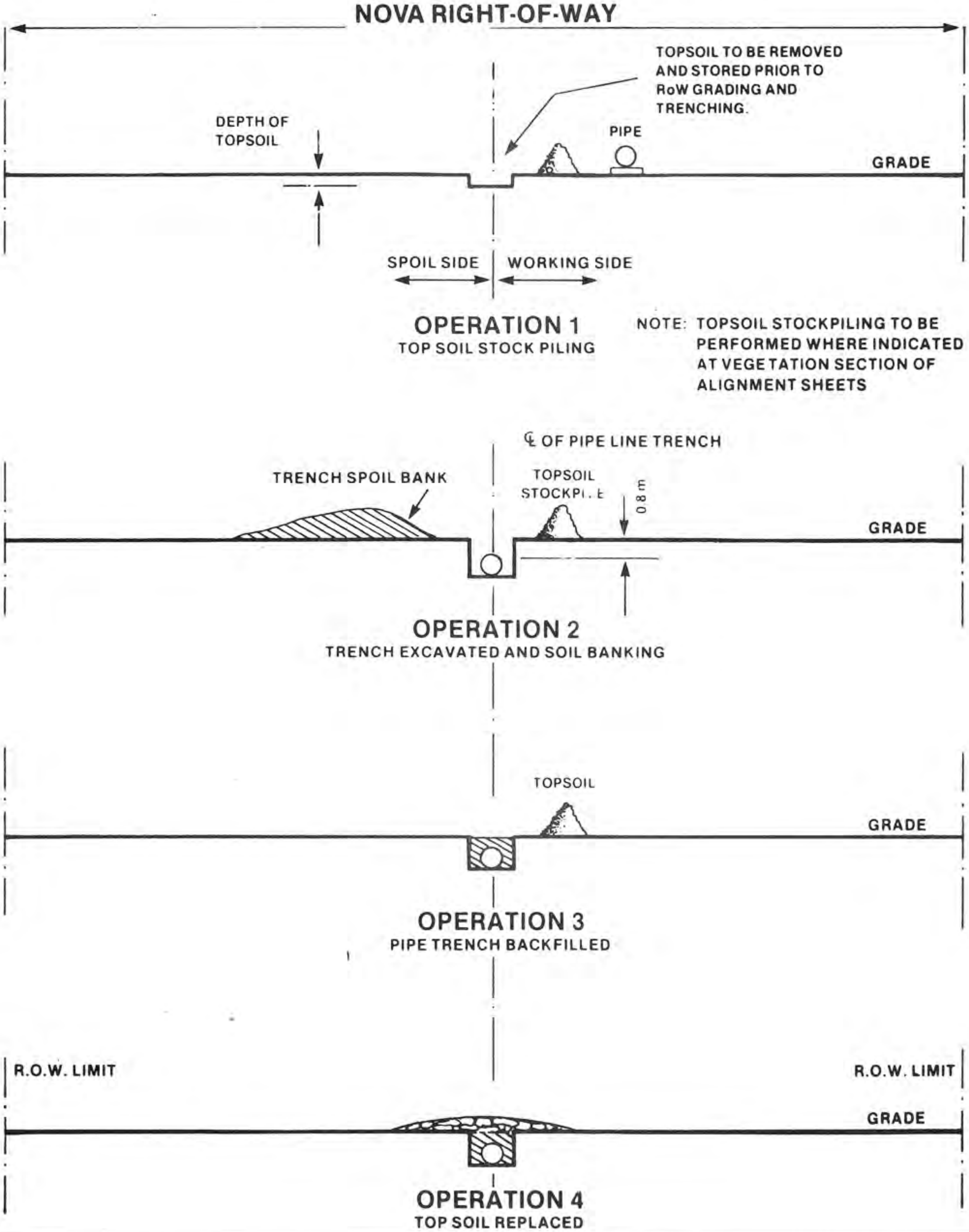
FIGURE 3:
TOPSOIL CONSERVATION OVER THE DITCHLINE

(DITCH – WIDTH)



PIPELINE TRENCHING OPERATION SEQUENCE

Topsoil is not stripped from the working side of the right-of-way and all vehicular traffic operates on the existing vegetation or soil surface. The topsoil with its higher organic matter content, acts as a buffer and reduces the amount of subsoil compaction (Deloitte, Haskins and Sells Associates, 1980, Table 1). Compaction of the topsoil can be reduced by deep cultivation or chiselling but it is very difficult to deal with subsoil compaction. Topsoil conservation is further moderated by landowner concerns and in some instances, NOVA may not conserve topsoil at the landowner's request. Where grading is required, as on steep side slopes, topsoil is stripped from the entire right-of-way and placed in piles apart from the subsoil.

TOPSOIL CONSERVATION TECHNIQUES

Topsoil conservation is normally effected by using either a bulldozer or grader, however, the choice of equipment is very much dependent on the method of stripping and the individual contractor. On cultivated lands, where topsoil is stripped over the ditchline and spoil area, either a bulldozer or a grader is used, with the blade angled, in a series of sequential passes. The topsoil is rolled off the end of the blade and into the final topsoil pile. The grader generally has to take cuts 7 to 10 cm each, whereas the dozer can probably take 15 - 20 cm in a single pass. The grader gives a smoother job with greater depth control, but its wheels cause greater compaction than the tracks of the dozer. Cultivated land is the easiest case to strip off topsoil, since the topography is generally level to undulating or gently rolling. Topsoil is replaced using a grader in sequential passes.

On pasture lands and marginal agricultural lands, only ditchline stripping is employed. Topsoil over the ditchline may be stripped using a bulldozer equipped with a step-blade. The step-blade is set up for the width of the trench at an average fixed depth determined by soil sampling (10 - 30 cm). By this procedure the topsoil can be placed on the working side near the trench. It has the advantage of disturbing less land but has the disadvantage of being rather inflexible in responding to depth variations. The topsoil pile on the working side is about 1 - 1.5 m from the trench and can easily be replaced over the completed backfilled trench by use of a grader.

Marginal land is often more complex topographically and in site-specific instances, the use of alternate equipment may be considered. On one small pipeline in sandy soils and low hummocky topography caused by sand blowouts, it was evident that a conventional grader and dozer operation would require substantial grading and topsoil stripping. Instead the pipe was strung out and welded prior to any soil disturbance. A backhoe was used to dig the trench, putting the topsoil, here defined by depth of rooting, on the working side, and the sandy subsoil on the spoil side. When the first backhoe was about 200 - 300 m ahead the pipe was lowered in and a grader was used to fill in the trench with subsoil. Following these operations, the

TABLE 1

EFFECT OF PIPELINE CONSTRUCTION OF PHYSICAL PROPERTIES OF SUBSOIL

	DRY DENSITY (g/cm^3)			
	Location			
Condition Represented	1	2	3	4
1. Undisturbed farm field (control)	1.42	1.43	1.40	1.40
2. Spoil side stripped	1.55	1.53	1.46	1.56
3. Spoil side not stripped	-	1.66	1.52	1.62
4. Over pipeline	1.58	1.54	1.41	1.56
5. Travel side stripped	1.57	1.60	1.64	1.70
6. Travel side not stripped	1.56	1.47	1.45	1.48

(Deloitte, Haskins and Sells Associates 1980)

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grader replaced the topsoil over the entire line in a single pass. The open trench was only exposed for two days at most and wind erosion of the sandy material was greatly reduced. This was not the normal method of construction advocated by NOVA, but in this situation it worked out quite nicely. It must be stressed, however, that such options are restricted by the size of pipe being used. With large diameter pipe, such a construction schedule would be totally impractical.

NEW IDEAS AND TECHNIQUES

The success of reclamation of a pipeline following construction is more often attributable to poor training or communication with the equipment operators than to poor pre-construction planning. It is essential on every job to have environmental personnel involved in the various facets of pipeline construction. Environmental awareness is very much an integral part of in-house training at NOVA. However, it is even more important to have an environmental inspector on-site from the start of a job until its completion, in order to avoid or minimize problems encountered during construction.

The Alberta Gas Transmission Division of NOVA is actively evaluating new equipment to solve winter construction problems. The topsoil stripping machine for use during winter construction is our newest and most exciting project and this will be discussed by Steve Morck following this presentation. Another machine being studied is a subsurface interfacing radar system. This unit can be dragged along the ditchline and can identify the size, location and composition of buried rocks which can affect the performance of the topsoil stripping machine or the pipeline ditching machine. However, a more exciting application is that this machine has the potential to accurately map the interface between A and B horizons in the soil. It is quite conceivable that radar units could eventually be mounted on topsoil stripping machines as well as graders and dozers which could control the hydraulics and blade depth so that only the A horizon was conserved regardless of its wavy boundaries.

Another machine which could have some application is a climbing backhoe with two wheels and two legs capable of operating on 1:1 or steeper slopes. Currently, such steep slopes must be regraded to allow the use of bulldozers and trenchers. Use of the climbing backhoe may mean that there would be less disturbance and a reduction in reclamation costs.

In the past, it has been the practice of pipeline contractors to grade the right-of-way smooth, creating a "table top" aspect in hilly or rolling terrain. However, apart from the requirements of the ditching machine and the side-boom machines (for lowering-in of pipe) the other vehicles involved in construction can tolerate some degree of rough terrain and slope. NOVA is examining reduced grading requirements or grading in lifts or tiers where less soil would have to be moved.

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Following construction of the right-of-way, it is re-seeded. The revegetation seed mixes that are used are specified for each site and may be changed according to edaphic, topographical or drainage conditions. However, some of the proven grasses used for reclamation, such as smooth brome or crested wheatgrass can be very competitive and can come to dominate a stand. While a monoculture may be satisfactory in terms of soil stability and erosion control, it may be susceptible to disease or pests, and if destroyed, will leave the right-of-way unprotected. Less competitive species in the seed mixes may give greater species diversity, and more resilience to environmental stress.

It has been the practice of NOVA and other companies to reseed rights-of-way in forested areas to grass and then to use brush control to maintain a wide right-of-way. Vegetation management of some NOVA rights-of-way in forested areas would reduce the operational widths and would involve the use of low growing and medium height shrubs to blend the right-of-way into the surrounding forest. Streambank management using logs, boulders, gravel and shrubs can also enhance fish habitat at stream crossings and reduce siltation. Instant revegetation can be accomplished in critical areas by using islands of trees and shrubs "borrowed" from off right-of-way locations with authorization of Alberta Forest Service officials.

Pipelines are required to have at least 0.8 m of cover over the top of the pipe. In irrigation districts, tile drainage is placed at the optimum depth of 1 - 1.2 m. Therefore, in areas which may be potentially irrigated, NOVA has put up to 2 m of cover over the pipe.

Research into construction practices can improve the efficiency and reduce the costs, both direct and indirect, of materials handling.

This spring NOVA will be conducting a comprehensive follow-up study on the use of the topsoil stripping machine. Soil properties will be examined specifically for compaction effects, and quality of construction indicated by organic matter content and particle size distribution. Research on conventional construction practices will also be continued and expanded.

A controversial aspect of topsoil conservation is the preservation of leached Ae horizons of luvisolic soils. This material is low in clays and organic matter, is often siliceous and may crust on the surface after replacement. Research by McAllister (1980) suggests that mixing of the profile or use of till may be more beneficial than the preservation of the topsoil. For the present NOVA will continue to conserve the top 20 cm of soil on marginal agricultural lands, but will establish research plots on new lines to examine the merits of topsoil stripping in luvisolic soils.

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SUMMARY

Pipeline construction is a multi-phased linear development which involves extensive materials handling. Improvements in the efficiency of the materials handling benefit the cost effectiveness of construction as well as the success of reclamation of a pipeline following construction. NOVA's definition of topsoil varies with the soil zone throughout the province but basically regards the A horizons or 20 cm, as the depth of topsoil. Topsoil is conserved over the ditchline and spoil pile on cultivated land and over ditchline only on pasture and potential agricultural land. Topsoil stripping is accomplished using either graders or bulldozers. Topsoil is generally only replaced by a grader. The evaluation of new equipment such as the topsoil stripping machine, subsurface interfacing radar and new ideas such as vegetation management, decreased grading requirements and the use of less competitive but more diverse seed mixes is an ongoing process.

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INTRODUCTION

Last Spring the Provincial Government's Reclamation Research Technical Advisory Committee presented a two day Reclamation Research Seminar at the Chateau Lacombe. We were surprised by the large turnout and an overwhelming majority of those in attendance indicated the desirability of an Annual Reclamation Conference for Alberta which would focus on Policy and Practice as well as Research and which would include industry, academic and government participation.

These were very sensible suggestions though their implementation would exceed the mandate and manpower of the Reclamation Research Technical Advisory Committee. So various groups were contacted to sponsor and help organize the Conference. Positive responses where received from the Canada Land Reclamation Association (CLRA) The Alberta Government's Land Conservation and Reclamation Council, The Coal Association of Canada and The Oil Sands Environmental Study Group (OSESG).

The CLRA authorized formation of an Alberta Chapter to serve as the umbrella organization with a Program Committee consisting of representatives of the Government and the two Industry groups. Through this Conference and perhaps other functions the Alberta Chapter of the CLRA can fulfill two important roles:

1. To provide an opportunity for members of the Reclamation community to meet, exchange experiences or argue and otherwise improve communications among its industry, government and academic factions.

2. To provide a public forum for reclamation activities, capabilities, issues and challenges.

This was the first function of its kind in Alberta. Special thanks are due the Sponsors, Speakers and the other Members of the organizing Committee: Jennifer Hansen, Malcolm Ross and Al Fedkenheuer. Their talents and efforts made the Conference a success.

One final word on the Speakers: they were given very short notice of the Conference and not only responded enthusiastically but prepared presentations which were of remarkable quality and consistency. We are fortunate to have individuals of this caliber working in the Field of Reclamation in Alberta.

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