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MODELS FOR VEGETATION MANAGEMENT ON ELECTRICAL UTILITY TRANSMISSION RIGHTS OF WAY

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Appendix B Management Support Services

MANAGEMENT SUPPORT SERVICES

Introduction

A distinction can be drawn between those tasks that directly execute the objectives of management in a utility vegetation management program and those tasks and interactions that aid in maintaining a viable program. Further, these tasks and interactions may be separated into those that embrace the scientific and technical needs of a program, and those which are administrative and supportive in nature. This chapter examines these latter components.

Historical profile data bases (HPD's) provide the collected documentation of past experiences and conditions that form an important component in the decision making process for proposed future actions. Ongoing field data collection and appraisal of present conditions is the most important factor that will influence these decisions. The technology for right-of-way surveillance is moving away from untrained ocular estimation toward sophisticated automation using remote sensing and high resolution photography. New computerized techniques are being developed to translate base data into management information.

The maintenance of stock, equipment, and resource inventories provide an opportunity to monitor the general "holdings" of a program. These holdings will then be applied to the tasks identified from field problem or administrative requirements. These requirements can be identified using various workload analysis techniques. In turn, the projects which result from the eventual project execution phase should be recorded and appropriately costed. The hard copy planning and recording production from these phases will

eventually result, in most cases, in the preparation of various types of reports.

In order to sustain the organizational continuity of a program and to take advantage of expertise existing within each utility, the vegetation manager may turn to a number of support groups to prepare outlines and support documents. The shared services available to the vegetation manager allow for cost effective application of specialized knowledge and training, without directly incorporating it into the staff complement of the vegetation group. The incorporation of working policies and information sources into formal support documents provides an unambiguous information source for general guidance of the program and review by those outside the vegetation management group.

Historical Profiles

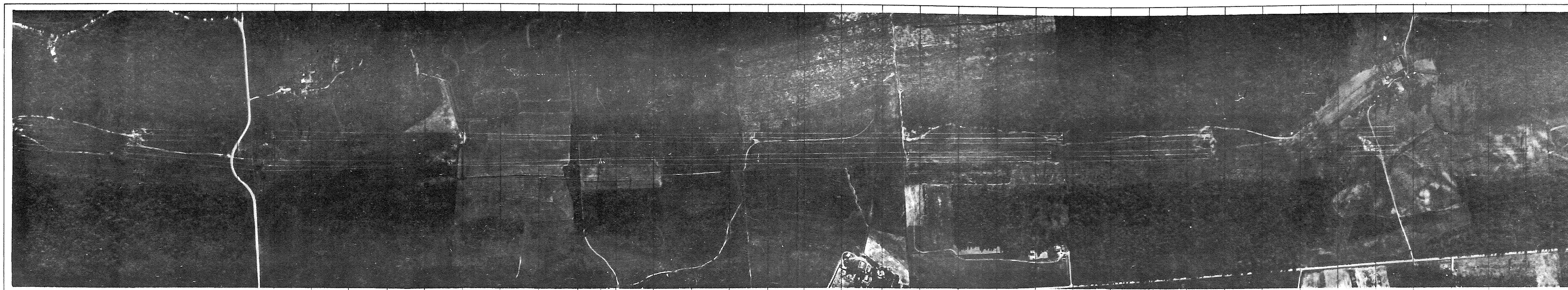
Few authors have noted the importance of maintaining detailed field data as a basic underpinning to utility vegetation management. Pitman (1969) and Turner (1967) note, in the context of claims handling, that a record system is essential but give no definitive discussion as to type. Sorensen (1976) in one of the few comprehensive papers, notes field inventories and good records are two basic ingredients of any successful vegetation and/or land management program. It is suggested that inadequate field inventory data results in inefficiencies in planning and overall management, while comprehensive information allows maximization of environmental values without jeopardy to line security. A 35% increase in right-of-way acres added to the (Minnesota Power and Light) system in a five year period ending in 1973 meant that management requirements increased from 14,000 acres to 22,000

acres. In order to accomplish better management and more detailed budget requirements, a computerized "Line and Vegetation Control History" was developed. This system provides computer printout only, as a working copy.

The Bonneville Power Administration has also developed a detailed computer record system for right-of-way information storage and retrieval (Slatt 1973). One of the principle features of this inventory system, noted in the introduction to the inventory system manual, is the capability of providing an historical record. It is suggested that this will be particularly useful in evaluating the effectiveness of vegetation management. Eight other advantages are recognized: budget preparation, planning and programming, location of problem areas, multiple use development, provision of statistical data, ancillary facility data, summary information for impact studies and analytical studies on plant growth. A more detailed outline of the system is found in Appendix H. Sophisticated systems which incorporate outage statistics and vegetation management/land use records with civil and electrical information are being developed by some utilities, but will not be operational for some time (McPhail 1977).

One failing of most historical profiles is an inability to provide a graphic representation of the area recorded. Although most right-of-way data inventorying systems rely heavily on maps and air photos, it is not apparent that any system has been developed which incorporates both historical record information and a right-of-way image. An initial approach to such a system is shown in Figure 18. A 9" x 9" aerial panchromatic vertical film flown to produce a scale of 2,000 feet to the inch has been enlarged five times to produce a 400 feet to the inch image track. This image track of the right-of-way and vegetation on either side is transferred

Figure 18 Historical Profile Format Used to Record Vegetation Management Information on HV and EHV Transmission Systems



Section	Item	No.
STATIC BASE DATA	Tower number	1
	Tower design	2
	Voltage	3
	R W width	4
	Hectares per km this section	5
	Slope	6
	Elevation	7
	Soil type	8
	Clearing standard & date	9
	Seed mixture	10
	Other restoration	11
	Access road all weather	12
	summer	
	winter	
	Lake	13
	Stream river	14
	Swamp	15
	Ditch	16
	Bridge	17
	Culvert	18
	Fence	19
	Locked gate	20
	Helicopter landing site	21
CRITICAL BASE DATA	Clearance	1
	Hazards	2
	Critical areas	3
	Unique features	4
	Impact statement constraints.	5
	Special agreements	6
	Water rights	7
	Bio climatic zone	8
	Growth rates conifer	9
	deciduous	
	Other	10
CHANGING BASE DATA	Vegetation assocations	1
	Conifer area	2
	density	
	height	
	Deciduous area	3
	density	
	height	
	Danger trees	4
	Road crossing screens	5
	Other vegetation	6
	Land ownership	7
	Easement restrictions	8
	Land use	9
TREATMENT DATA	Treatment objectives	1
	Year & date	2
	Method	3
	Cost	4
	Restrictions	5
	Results	6
	Remarks	7
	Retreatment projections	8

REMARKS	NAME	DATE	REMARKS	NAME	DATE	REMARKS	NAME	DATE

NOTE 1: THESE PROFILES WOULD BE PREPARED AFTER CLEARING
NOTE 2: EACH RECORD SEGMENT IS 100 METERS WIDE
NOTE 3: A SIDE ELEVATION OF TERRAIN CONTOURS AND CONDUCTOR PROFILE MAY BE GHOSTED AT TOP

RECOMMENDED TRANSMISSION RIGHT-OF-WAY HISTORIC PROFILE AND RECORD FORMAT

SCALE : 1 cm to: 50m
DWG. NO. FIGURE 4.9
SHEET OF
THIS RECORD HAS BEEN REDUCED TO ONE HALF FULL SIZE OF 3km A SHEET

to a master Cronoflex with existing data headings and approximately forty 100 yard wide recording segments. The occurrence of any item in the data headings for each segment is readily recorded for permanent record. In addition, these historical profiles may be joined end to end to produce a continuous roll plan. This can then be mounted on a small automated viewing table for use in direct data collection during the helicopter line inspections, allowing real time updates for field management between aerial photograph retake cycles.

It is not a purpose of this thesis to develop a fully operational historical profile system. Refinement of the idea presented here is possible in a number of ways. For example, the six inch image track is sufficiently wide to superimpose ghosted ground and conductor profiles in side elevation on the mosiac without loss of fine detail. Similarly some ground contour and elevation detail could be added to the plan image.

Investigation of new high resolution multispectural scanning or side-looking radar techniques (Jensen et al 1977) may supplant some normal aerial photogrammetric methods of aerial mosaic production. In addition, digital thematic mapping may allow computer production of updated fine resolution historical profiles with static information printed directly on the image shoulder beside the right-of-way with revised or changing information on a smaller extended leaf than in Figure 18. Alternatively the low level photographic techniques discussed in the following section on Data Collection may have attractive simplicity and cost advantages.

Two categories of historical profile are required: that which traces new rights-of-way from the time of initial survey, clearing, construction and restoration to subsequent maintenance, and that which establishes

historical profiles for existing rights-of-way based on current records and updated air photos.

Information recorded on historical profiles can be designated in four groups; Static Base Data, Critical Base Data, Changing Base Data, and Treatment Data.

Static Base Data implies data which will remain unchanged during the life of the right-of-way and will include terrain, bio-climatic and engineering details. Critical Base Data is distinguished from Static Data by a potential for change and a 'critical' importance in management decisions. Changing Base Data, as the name implies, contains details of information requiring constant revisions as in the case of vegetation growth, land use, and regulatory agency restrictions. Treatment Data will note maintenance activities as they occur and possibly record success of treatments if post-treatment monitoring is conducted. The number of actual items recorded in the four groups will depend on the sophistication of systems desired, Base Data available, and cost constraints. Figure 18 suggests a minimum 45 items. The Bonneville Power system records 51 "information bits". As right-of-way management intensifies and pressures on land use increase, the trend will be toward more refined historical profiles.

Such refinement is already available using additive colour quadro-channel image viewers. For example, the International Imaging Systems I^2S Mini-Addcol System 6040 allows four multispectral and/or multidate images to be viewed and superimposed simultaneously. The optical projection can allow for arbitrary colour signature assignment in order to enhance and record visual comparisons among a combination of images. Magnifications of up to 20 diameters are possible. This system, which is designed specifi-

cally for 70mm photography, allows photographic records to be maintained on the right-of-way and immediate analysis of changes over time. Individual species can, for example, be colour coded and a sequential overlay prepared and printed directly on a colour print console.

Coupled with the advances in computer technology and colour air photo techniques discussed in the following section on Data Collection, it would appear that very detailed managerial, ecological, and sociological profiles are presently possible and will enjoy increasing acceptance in vegetation management on rights-of-way.

Data Collection

One of the most important, yet onerous and time consuming direct tasks which face right-of-way vegetation managers is the acquisition and interpretation of situational data. The transmission right-of-way net falling under the responsibility of a single utility vegetation management group may exceed 20,000 miles (Medicky 1976). In order to manage this resource efficiency, a constantly updated situational information data base (SID) is required. An accurate assessment of existing conditions is necessary for reasoned judgements for program and project planning. In the past, stereoscopic pairs of 9" x 9", black and white aerial photographs, ground, and helicopter patrols have provided the vegetation manager with planning information. Substantial drawbacks exist from reliance on these methods. Aerial photography appropriate for maintenance is normally of doubtful accuracy unless of recent origin or purpose flown. Forest cover type photography, the most common available for transmission line areas, rarely has flight lines corresponding to all of a right-of-way, and does not provide ideal

scales for identification of small undesirable vegetation, making useful, uniform mosaics impossible.

Ground patrols are often conducted by linemen rather than botanically trained staff, and even when such staff are available, continuity and uniformity of recording is unlikely. Helicopter patrols, though often on a regular schedule for electrical and civil inspection, have vegetation management concerns as an incidental interest and normally require ground confirmation of observed vegetation hazards or conditions. The need therefore, is to develop a cost-effective, detailed, accurate, and readily interpretable update of right-of-way conditions. Ideally it should also later form, or become a contributor to, a historical profile data base (HPD).

As with other technologies, photogrammetric engineering and remote sensing have advanced rapidly in the last 20 years. Techniques developed for remote military surveillance, aerospace experiments in resource analysis, new film, camera and electronic instrumentation, now allow high resolution photography and remote sensing in a wide variety of wavebands and at numerous scales. Satellites (Sullivan 1975, Oswald 1976), spacecraft (Fleming 1974), high altitude aircraft (Rehder 1972), various conventional aircraft (Zsilinsky 1972a), and helicopters (Bernstien 1974) have all provided vegetation or power line information of various types. Equally diverse collection media obtained from the carrying vehicles mentioned above have, or are becoming, appropriate for right-of-way information analysis.

Satellite imagery from Landsat-1 (now ERTS-1, Stewart 1974) in the redband (0.6 - 0.7 um) has been used for revisions to Canadian topographic map series at 1:250,000 to include new 735 kV transmission lines from Churchill Falls to Sept-Illes in Quebec (Fleming 1975). It is also noted that the

infrared band (0.7 - 0.8 um) is exceptionally accurate for water determinations. Sullivan (1975) used imagery from the same source to provide prints at 1:10,000 to determine power line corridors in Montana. Constraint mapping was then prepared at 1:31,500 from colour infrared air photographs for the various route options within the five mile corridor. Despite poor filming conditions, small "bushy" vegetation could be readily determined. ERTS imagery has also been used for forest managers to monitor changes in the forest environment. In particular the control of logging operations and power line clearing in the interior of British Columbia is reported (Lee 1974) with the additional use of 1:500 or 1:2,000 low level 70mm for ground truth comparison. Progress is being made toward ERTS MSS5 or a composite MSS4, 5 and 6 waveband enhancement in order to better distinguish hardwood from conifer regeneration. Oswald (1974, 1976) reports that objects such as water bodies, river drainage patterns, perpetually wet areas, and short non-shrubby vegetation are readily distinguishable on band 7 and usually on band 6, while major pathways such as roads and power lines (presumably rights-of-way) are discernable on bands 4 and 5 especially when they pass through forested areas. These areas exhibit tonal differences which indicate variations in stands. Tonal signatures for various species or mixed stands is discussed with the conclusion that composites of bands 5, 6 and 7 are best for this vegetal cover while bands 4 and 5 record clearings most visibly.

Rehder (1972) in a cooperative study with NASA using RB-57 high altitude aerial surveillance aircraft and small scale imagery (1:120,000) found that interpreters using 9" x 9" Ektachrome colour contacts and a 4x light table could detect and identify transmission towers with surprising regularity. Of 795 observations, 717 had positively identifiable towers.

Vegetative cover and clearing conditions within the right-of-way swaths was easily distinguishable and the observer could certainly detect (for a monitoring capability) changes in ecological (vegetation versus non-vegetated versus erosional) conditions on the right-of-way. Lewis et al (1969) have examined the possibility of determining rights-of-way with K band multi-polarized radar imagery and have concluded that like-polarized (HH) imagery is more suited to determination when the right-of-way traverses land when aligned to the flight path and cross polarized (HV) imagery when the feature is at right angles to the flight path. Statistical analysis provided a 99.9% confidence level for detections.

High altitude photography and imagery does not at present have the fine resolution with the magnification needed to distinguish detailed features on rights-of-way. It does, however, have a possible place in preparing system overview net maps, regional base maps and providing broadscope determinations of ecological change or possibly identifying areas of stressed vegetation resulting from poor soil (Wobber et al 1975).

Low level photography and multispectral scanning appear to hold greater potential for direct detailed data acquisition of right-of-way features, new conditions and vegetation growth. The important limiting factor appears to be cost. With the exception of Bennet (1974) no technique cost comparisons are available and no cost to scale analysis was found in the literature, the majority of papers remarking only on decreased coverage per unit of film with improving scale and consequently higher film and print cost. Klein (1970) and Zsilinszky (1972a) argue strongly in favour of 35mm film format using a motor driven Nikon F 250 in two, three and four vertical camera mounts (Zsilinszky 1972b) producing stereoscopic pairs for contact scale

printing or enlarged scale projection or magnification. Scales of 1:2727 (flight at 500 a.g.l. with 55mm f.l. lens or 7 x lens stereoscopic magnification) to 1:390 are recommended. Scale and other parameters have been calculated for various combinations of altitude and focal length by Smyth (1972).

Plantation inventories of small regeneration has been attempted with varying degrees of success in forestry. Bernstein (1974) reports that work at 1:1,000, 1:3,000 and 1:5,000 did not provide encouraging accuracy on trees ranging from 1 to 4.5 feet in height. Slightly better results were obtained at 1:5,000. Black and white, colour (MS Aerographic, Kodak Ektachrome), and false colour infrared were used. The paper omits to record either film size or resolution obtained. A more useful study by the Canadian Forest Service (1975) using Kodak Aerocolour 2445 negative 70mm film, found that, using a regression equation which relates photo stocking to ground stocking, reliable determinations could be prepared for trees 30cm or taller.

Baribeau et al (1970) has successfully developed a system for distinguishing the difference between herbaceous and ligneous vegetation and subsequently determining herbicide control effectiveness as soon as 10 days after treatment. Kodak Aerochrome 2443 Infrared 70mm negative film in vertical stero from a fixed wing aircraft is now preferred for this program (Baribeau 1977).

A similar film in 35mm format was used by this author to prepare oblique tower span takes from a Bell helicopter. The results (Figure 19) provide good definition of undesirable woody species from 600 feet a.g.l. at an air speed of 45 knots using a hand held 35mm single lens reflex Konica TL.

Figure 19 35mm Kodak Aerochrome Infrared 2443 Film-Enlargement of Right-of-Way Oblique View Showing Vegetation Growing Under Conductors

Photography for the tree monitoring system Initial Clearing described in the section in engineering considerations, is presently flown at 6,000 feet a.g.l. on standard aerial panchromatic film to provide 60% overlap 9" x 9" stereopairs.

Relatively low level multispectral scanning data may also hold considerable potential for vegetation determination on rights-of-way. Much of the work so far (Girard 1974, Institute of Sciences and Technology, University of Michigan 1970) has been directed toward agricultural crop determinations, although the latter have provided detailed orchard surveys, Figure 20. Air transportable equipment, able to scan in 24 discreet wavelength bands from ultra violet to thermal infrared can provide thematic mapping. Developments by General Electric, Bendix Corporation and Itek are presently being declassified. Information on the Mohawk AN/AAS - 14 airborne infrared scanning detector which incorporated complete on film data annotation and could transfer I/R pictures and data directly to a ground station many miles away is now available (Sup R 1976).

Chandler (1972) notes that remote sensing is "data," not "information," while Zsilinszky (1972a) suggests that photography or remote sensing is like a book written in a foreign language yet containing essential information. Such information can only be revealed by an interpreter or if the reader learns the language himself. Oswald (1976) observes that the recognition of an object is largely dependent upon its size and reflective contrast and distinction (signature) between the object and its background.

Several image enhancement techniques have been developed to assist in recognizing the information content of an image. These range from simple magnification or image combining techniques that require little photo-

interpretation skill or expense to operate, to sophisticated electronic devices (Blansjaar et al 1972) requiring highly trained, skilled operators. The advantage of daedal interpretative equipment is the possibility of separating different objects possessing nearly similar signatures.

Schlosser (1974) reported the Spatial Data Systems development of a television scanning densitometer which will allow density slicing of signatures into 32 colour bands over a range of two density units (2 DU). This allows for rendition of 250 presentation levels. Source data can range from thermal infrared scans in the 8 to 10 um band to photographs in the visible or infrared portion of the spectrum. Density slicing using this equipment allows any colour or gray scale contour to be displayed on a cathode ray tube (CRT) in highly contrasting colours. Schlosser records tree stress, oil spills, arctic ice distribution, hot water effluent, air pollution, water quality and soil type determination as possible applications of the technique.

The potential use of the microdensitometer for enhancing right-of-way vegetation signatures from low level 70mm colour and false colour film was investigated. Four frame strips of Kodak MS 2443 Aerographic film (Fig. 1) and Aerochrome 2443 infrared film (Fig. 2), Plate 2, were selected. The colour film was flown in coastal British Columbia from an Otter aircraft using two Hasseblad ELM's coupled with an intervalvometer to expose stereo pairs from 300 feet a.g.l. The infrared film was flown on the 735 kV 7017 transmission line in Quebec for Quebec Hydro and is the first flight photography used to conduct the prior/post herbicide treatment analysis mentioned earlier (Baribeau 1970). Each film negative was placed on a light table and viewed with a Videocon TV camera equipped with a Cannon TV, V 10 x 15 Zoom

Plate 2 Fig. 1 - Four Frames - 70mm Kodak MS Aerographic 2448 Film Contact Printed at Actual Size

Fig. 2 - Four Frames - 70mm Kodak Aerographic Infrared 2443 Film Contact Printed at Actual Size

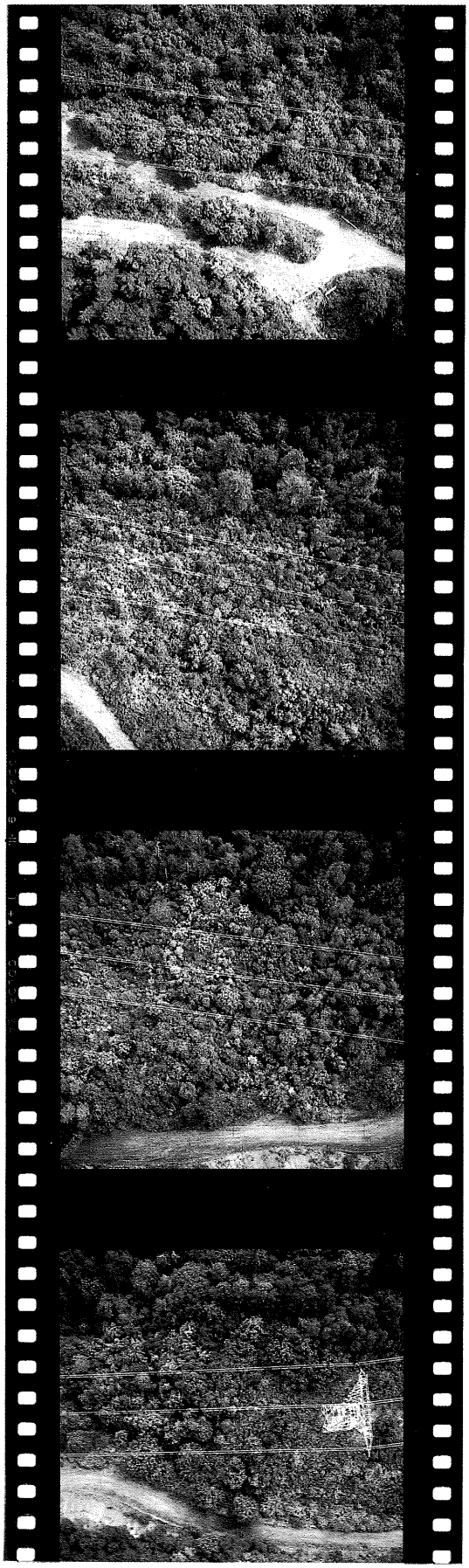


Fig. 1

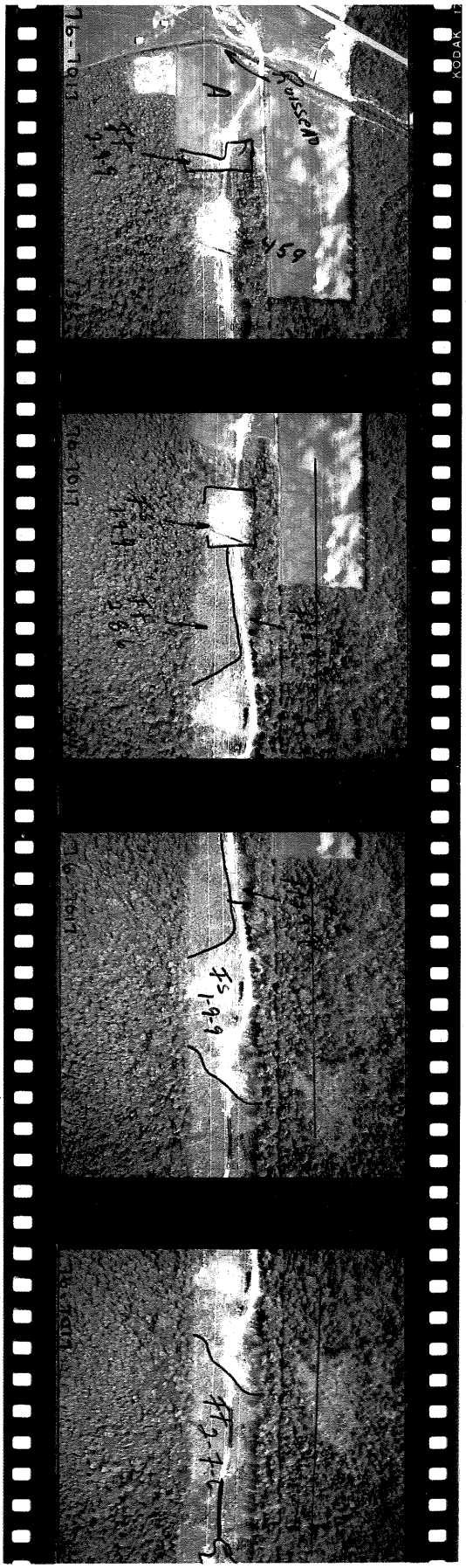


Fig. 2

Fig. 2

lens. A Spatial Data System Microdensitometer Model 703-32 density slicer was used to analyze the tonal differentiation of the film at various magnifications. The results are shown in Plates 3, 4, 5 and 6. Fig. 1 in Plate 3 shows the infrared false colour film without magnification or colour enhancement photographed from the CRT screen, while Fig. 2 shows low growing vegetation on the right-of-way, colour enhanced with a red signature. Plates 4 and 5 record enlargements of the transmission line from the Quebec infrared film. Fig. 1, Plate 4 shows the right-of-way with the conductor passing over a narrow band of vegetation without colour enhancement. Fig. 2, Plate 4 shows an attempt to determine woody vegetation shown with a deep purple signature. Plate 5, Fig. 1 shows the removal of all signatures except that for shadows, while Fig. 2 shows the difficulty in showing a discrete signature for woody vegetation compared with the signature for shadow. Plate 6, Fig. 1 shows low level British Columbia photography without colour enhancement and Fig. 2, a brown signature for woody plants.

The difficulty in separating the vegetation signature from shadow can be clearly seen.

This technique holds promise for future development in automated vegetation analysis. Limitations at present include the difficulty of obtaining discrete signatures for individual species and the probable necessity for continuous ground truthing. If these limitations can be overcome with high contrast, high resolution film, it may be possible in the future to record rights-of-way on 70mm film, automatically distinguish between species, electronically determine vegetation heights, planimeter species boundaries, store, manipulate, and print out cover type mapping. Ability to record

Plate 3 Fig. 1 - Kodak Infrared 2443 70mm Single Frame Without Magnification - Photographed from Density Slicer CRT Screen Without Colour Enhancement

Fig. 2 - Kodak Infrared 2443 70mm Single Frame Without Magnification - Photographed from Density Slicer CRT Screen with Enhancement of the Vegetation Signature and Rendered in Purple

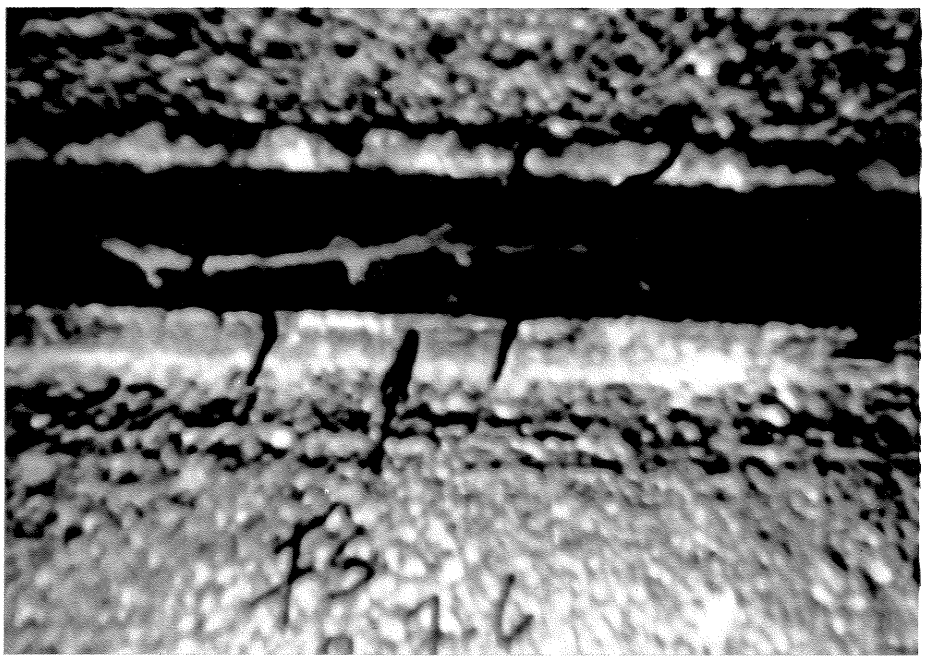


Fig. 1

Fig. 2

Plate 4 Fig. 1 - Kodak Infrared 2443 70mm Single Frame Enlarged - Photographed from Density Slicer CRT Screen Without Colour Enhancement

Fig. 2 - Kodak Infrared 2443 70mm Single Frame Enlarged - Photographed from Density Slicer CRT Screen with Tonal Enhancement Providing Blue Wave-Length Separation

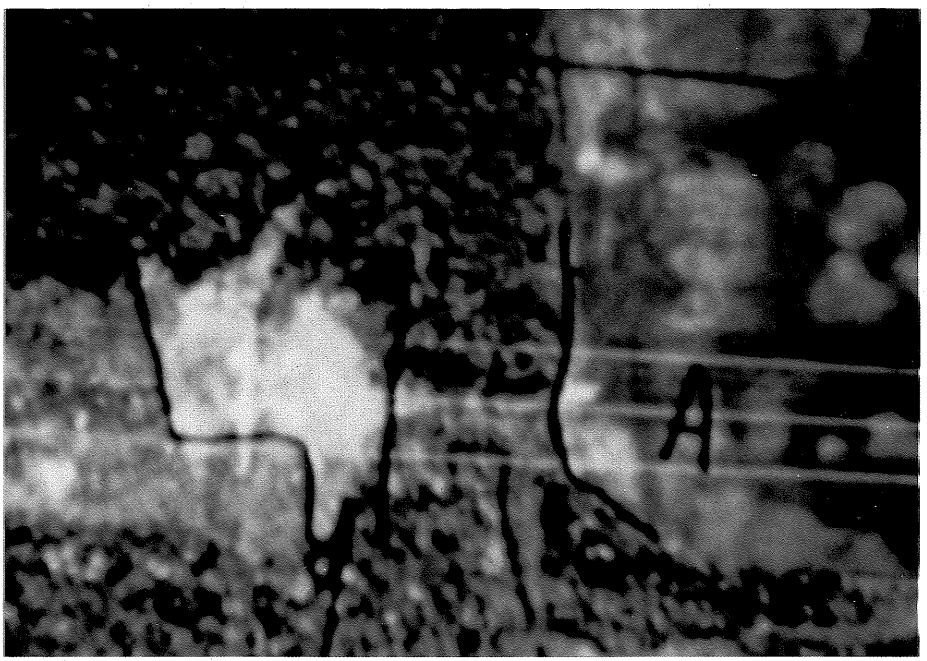


Fig. 1

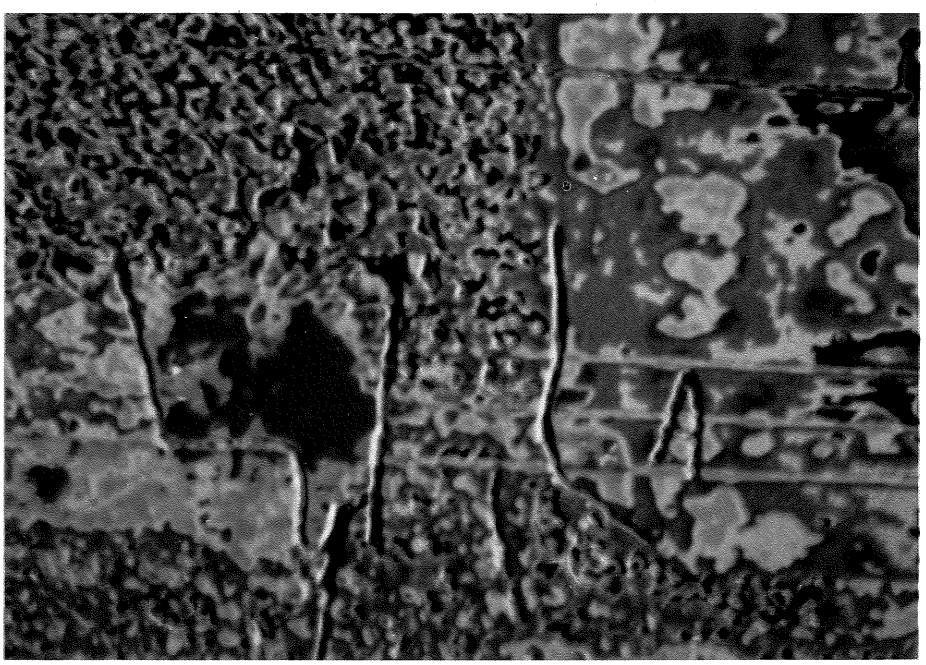


Fig. 2

Plate 5 Fig. 1 - Kodak Infrared 2443 70mm Single Frame Enlargement - Photographed from Density Slicer CRT Screen with Removal of all Signatures Except Specific Colour Waveband for Shadow

Fig. 2 - Kodak Infrared 2443 70mm Single Frame Enlargement - Photographed from Density Slicer CRT Screen Showing Difficulty of Separating Discrete Signature for Woody Vegetation from that for Shadow

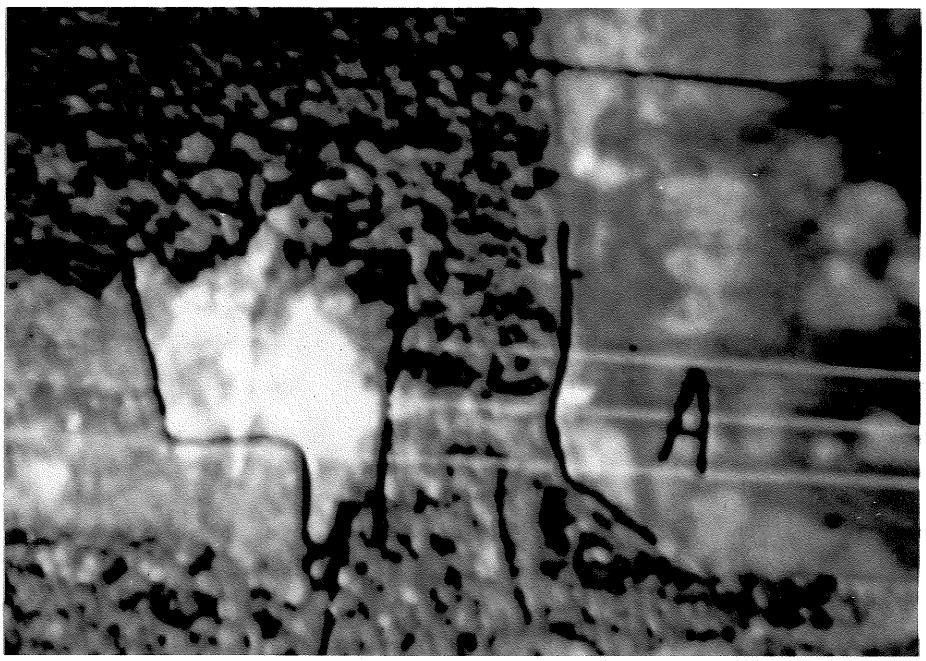


Fig. 1

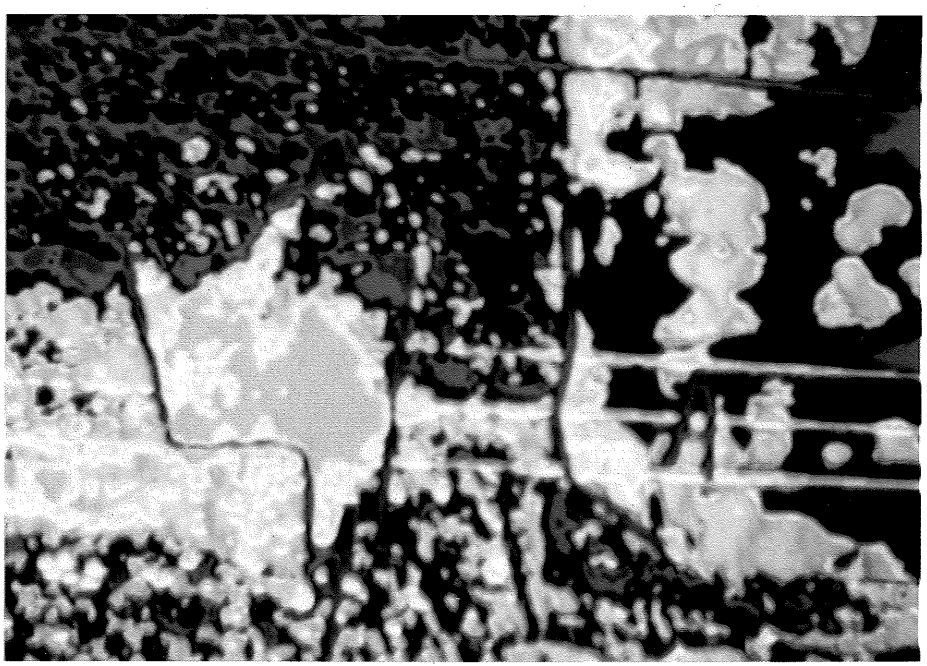


Fig. 2

Plate 6 Fig. 1 - Kodak Aerographic Colour 2443 70mm Single Frame of Low-Level Aerial View with Minimum Magnification Photographed from Density Slicer CRT Screen Showing Right-of-Way Vegetation Without Colour Enhancement

Fig. 2 - Kodak Aerographic Colour 2443 70mm Single Frame of Low-Level Aerial View with Minimum Magnification Photographed from Density Slicer CRT Screen Showing Right-of-Way Vegetation Enhanced with a Brown Signature but Poor Discrimination of Shadow and Ground Reflections

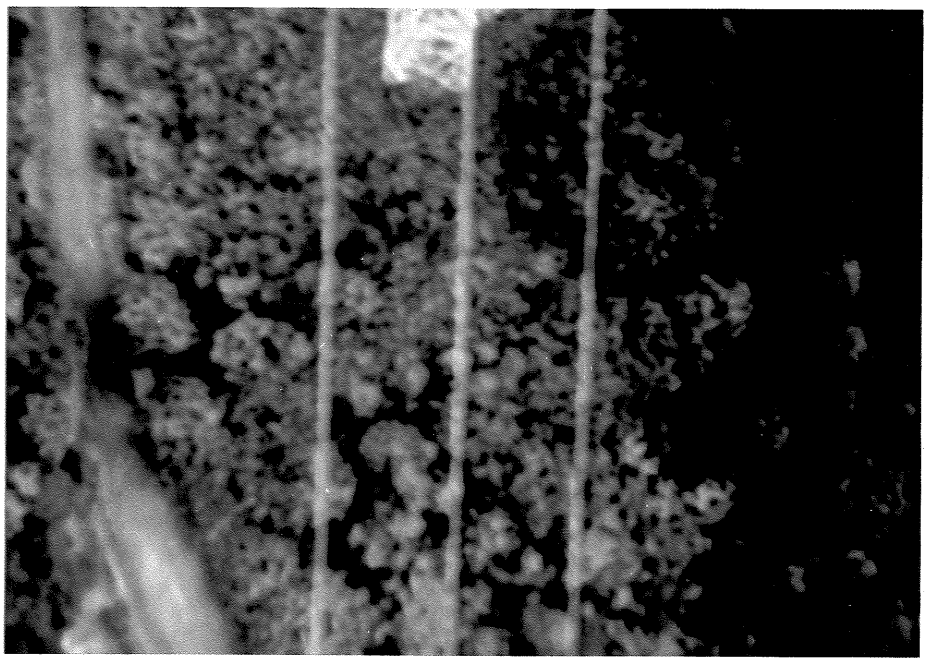


Fig. 1

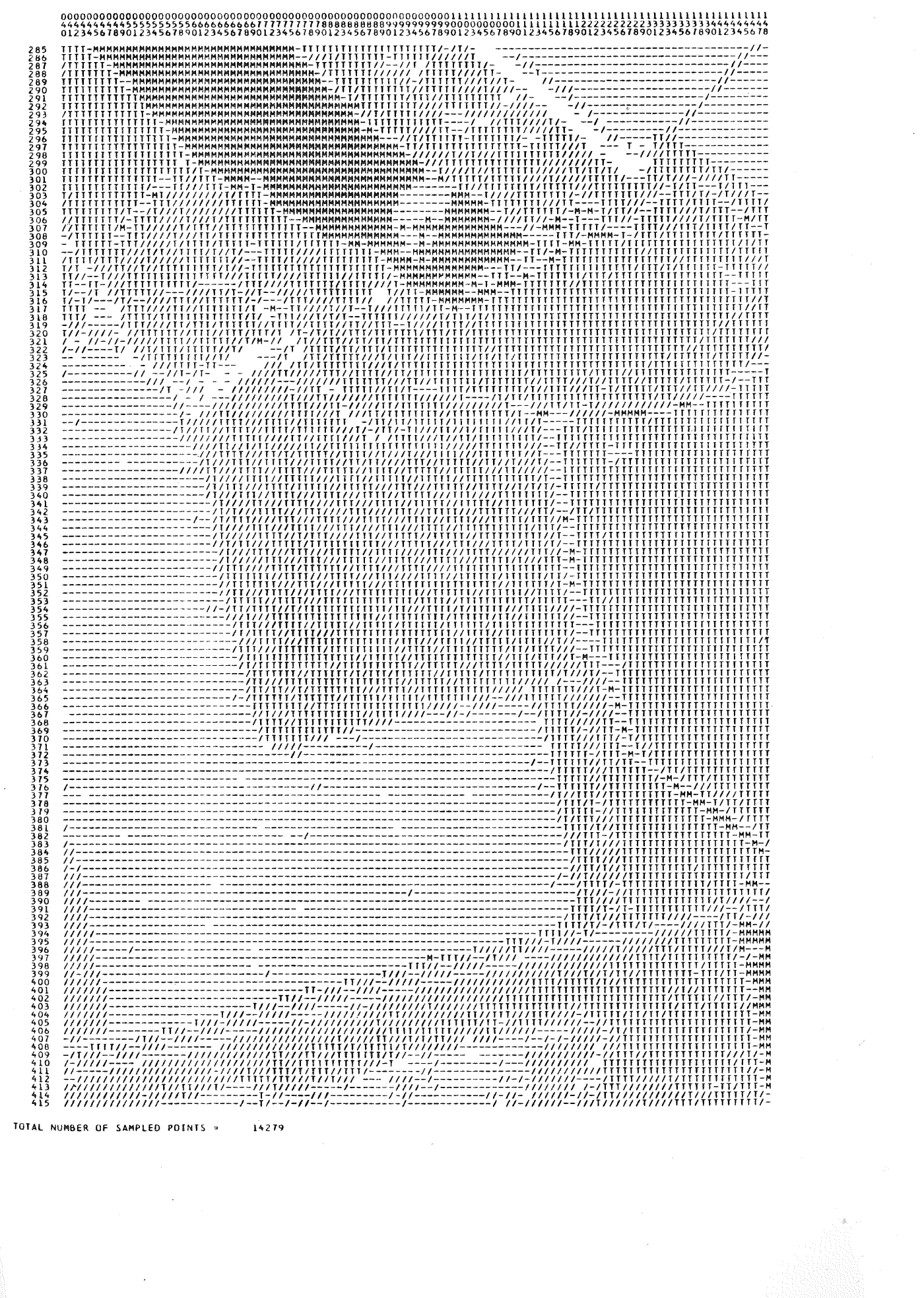
Fig. 2

vegetation stress may also allow automated assessment of herbicide applications.

Not only is data interpretation an onerous exercise for the vegetation manager, the task of data handling and information presentation offer a daunting challenge. Photographic and remote sensing techniques generate immense quantities of data and computer interpretation, storage, and retrieval appears to present optimum handling efficiency. Analog digitizing of multispectral scanning output or of CRT scans can be prepared on computer compatible tape (CCT). In the United States the Laboratory for Applications of Remote Sensing (LARS) has been able to demonstrate accurate automated crop recognition, Figure 20. Digitized radiance values for small resolution elements (RSU's) in each of four wavebands are combined to provide a computer symbol. This pattern is then categorized by a pattern recognition algorithm and the individual RSU's classified as to crop species or cover type. It appears possible to differentiate and identify crop species rather accurately using automated pattern recognition techniques (LARS 1970). Differentiation of various tree species has also been documented and the reflectance values published (Hoffer 1967, 1969).

It would appear that with sufficient development of existing technology it would be possible to fly rights-of-way at relatively low level with a variety of waveband receptors and, with adequate ground truthing or "training sets," to automatically process and computer identify (Blansjaar et al 1972) both desirable and undesirable vegetation by height, density, species, location and percentage cover per unit area. With bioclimatic data, weather data, soil type or by sequential height analysis, it would be possible to predict growth rate and consequently develop long range planning

Figure 20 Computer Classification of an Orchard in Weslaco, Texas. The Individual Remote Sensing Units are "M" - water, "---" soil, "/" vegetation, and "T" trees. "T" do not represent individual trees due to poor scanner resolution. (From LARS 1970, p. 77)



TOTAL NUMBER OF SAMPLED POINTS = 14279

schedules and by retrospective analysis, predict program effectiveness and projected cost.

Presentation of information in field usable form requires more sophisticated application of computer graphic printout programs. Gray scale printouts, RSU direct printouts, Figure 20, overprinted tonal display as used in the Harvard University (1977) synagraphic mapping system (SYMAP) or line plotter three dimensional contour maps (SYMVU) and CRT automated oblique perspective views, as with the ASPEX computer programs also from the same source are available. These powerful programs allow presentation of information in a variety of modes or the preparation of cartographical data base (CD's).

Computerized corridor and route alignment constraint mapping (EDAP) has been undertaken by at least one organization (Madeson Gas and Electric 1973) and provided detailed vegetation density and height printouts for a wide study area.

Computer assisted corridor route selection has also been undertaken by a number of other workers using locational cell analysis but with larger cells and less specific vegetation data. Giles et al (1976) report a weighted system on a 42 "stacked" component 1/9th Km^2 cell data base which expressly excludes maintenance concerns from the analysis, while Rosemarin (1976) uses a 40 acre cell but again does not appear to incorporate future maintenance constraints in new line location analysis. The same is true of similar systems developed by Schaal (1972), Wenger (1974), and Niemann and Murray (1974), the original project manager in the 1973 EDAP Study.

Of more interest to the vegetation manager is the detailed soil analysis conducted on 2.5 acres cells by Smart et al (1976). This study expressly

relates soil type and productivity potential (site index) to vegetation type and notes that information on the relative vigor of woody growth on transmission rights-of-way is one valuable input to the process of scheduling maintenance activities and determining appropriate control techniques. It is the view of Howlett (1976) that although computer inventory systems are possible, large cell size precludes their use on a reliable basis. Further, it is suggested that as most output systems are single purpose, single use, and difficult to interpret for the layman, cost will relegate computer use to evaluation of data rather than actual route selection. Development of these techniques into a broader base construction and maintenance management plan may offset these disadvantages. If such programs for new line location become commonplace, a natural linkage should evolve with subsequent maintenance, documentation, and handling systems. Utilization of multi-stage hierarchical photographic and sensing systems (Langley 1969, Legge 1974, Simonson et al 1973) and multiple scales will provide the vegetation manager with very powerful, cost effective, predictive management information. Given the many electrical utilities, the trend toward state and province wide computerized data banks (Zimmermann 1977) and the necessity to predict and quantify vegetation management needs or possible environmental impacts, it seems that possible advanced data collection systems will be operational in the near future.

Inventories

In order to maintain a systematic and comprehensive resource account, it is necessary to maintain a number of inventories. Workload and project planning require basic data. To some extent trend analysis and projections,

although relying heavily on records and summaries for a data base, require inventory information in order to test capability or stock on hand against anticipated needs.

Inventories may include figures or written synopsis on equipment, tools and spares, consumable material, personnel capabilities or accreditation and similar resource information.

In addition to administrative desirability, inventories may be required to serve an economic or accounting function. In order to compute amortization, enforce stock control, and satisfy taxation appraisal of assets, rapid and accurate information is desirable.

Inventories should also be established and maintained where emergency supplies are held. For example, petrol caches, clean-up materials for spill response, electrically insulated tool emergency stores, location and status of first aid equipment should be considered.

Wherever possible, systems which allow for ready update and retrieval such as magnetic tape and computer printout should be utilized for inventory data, otherwise usefulness in management decisions is seriously impaired.

Workload Analysis

In order to prepare strategic plans and to identify project manpower needs, it is necessary to determine the anticipated time blocks which must be allocated for individual tasks. A proportion of these tasks will be administrative, a proportion supervisory, and the bulk actual execution of projects.

The essence of effective vegetation management must evolve from comprehensive examination and assessment of apparent conflicts. It must then

predict consequent cost in time and effort required to overcome the examined problems under incremental degrees of effectiveness (Gardner 1976).

This assessment procedure is commonly known as workload analysis. Such analysis must address the suggested need for tasks, establish a rationale for undertaking such tasks, then move to quantitatively and qualitatively examine the work in a temporal dimension. The analysis must then provide a review of solutions as task methods, with a further assessment of their relative capital costs and cost effectiveness. It must also calculate the effort in terms of manhours or mandays which must be expended over time. Without such basic information, it is neither possible to objectively assess present conditions, nor comprehensively plan for the future.

Figure 21 displays the subsets which form a workload analysis. Predictive planning utilizes an assessment of what tasks, where, over what area and to what intensity, to prepare the anticipated program workload.

Project planning is derived from an assessment of more definitive information from field records, and the intended project size to provide a time based unit area workload. Program quality is an option analysis which allows the vegetation manager to conceptually manipulate a number of different factors and determine the range of workload variance between a particular task carried out at any level from very high quality, to minimum acceptable. Project unit cost are calculated by assessing expenditures per task and dividing them by task area.

Work and manpower scheduling and program budgeting become readily visible with workload analysis. Long term budget projections can be calculated from aggregate unit costs, inflation rates and anticipated program

Figure 21 Workload Analysis Schematic: Predictive Program and Project Task Workload Components

Predictive Planning	What Projects Where **Quantitative dimension** **Qualitative dimension**	Per Task=	Workload anticipated
Project Planning	Method Proposed Effort Time Problem dimension	Per Task=	Workload per unit area
Project Quality	Place Productivity Pride Training Supervision	Per Task=	Workload quality per unit area
Project Costs	Overhead Method effectiveness Productivity Manhours Materials & Equipment needs	Per Task=	Workload costs per unit area

size providing corporate financial planners a clear picture of anticipated operating costs. In the field, individual budget requirements can be prepared from actual project cost records and projected workload assessment.

A final and important function of workload analysis is to provide the baseline information that allows a program manager to eventually compare current task productivity against planned targets of time and quantity. This step is required in utility vegetation management as a check on program effectiveness for any system that would rely on problem appearance cannot apply where a basic management objective is to ensure continuity of service. Without this checkloop, it is possible for a district to gradually slip behind in program accomplishment. Since vegetation control is cyclical in nature and is based on providing a number of years protection, inattention to annual program reevaluation can lead to a false sense of security. This in time may precipitate a major discontinuity in normal workload and demand a crash program, unscheduled costs, unplanned contract work, and similar program aberrations.

Work Records

Systematic record keeping is vital in a vegetation management program. Without a record system, it is not possible to exercise the judgements implicit in the concept of "management." The vegetation manager arrives at program decisions using both established information and experience. Together these meld to form judgements on which will hinge the efficiency and environmental safety of a program. If the established information is inaccurate or incomplete, or experience the result of perception not written record, then the program manager forsakes his professional, ethical and

social responsibilities (Gardner 1975).

Record keeping has four clear purposes and three distinct phases. Documentation of past and present right-of-way status, establishment of projections for the future, and problem identification justify record keeping, while collection, compilation and computerization represent the phases in information gathering for records.

The format for information collection will largely influence its acceptance and accuracy while completeness and purpose will govern its usefulness. Simple, clear instructions should be obtained. An example of a comprehensive herbicide application record form, by this author, is contained in Appendix I. This field form provides the base data for a comprehensive system which would compute and provide project summaries on a weekly and monthly basis, allowing the project and program manager a comparison update on work completion versus desired targets. This allows a manager to feel the pulse of a program as a season progresses and alter a project as circumstances dictate.

Records should be maintained on productivity in all task methods, on equipment available, hours and down time, accident type and frequencies, and public concerns. In addition, more fundamental information on staff training, salary and benefits, and on project locations, timing and method effectiveness should be recorded. When necessary, vegetation management group records and supporting systems should be compatible with, or conform to, the requirements of regulatory agencies.

At a predetermined stage, the infeed system should be transferred to a data base and a tabular or graphic compilation of all program sets published. In this way, the program manager receives a picture of all

activities. In turn, the information on past experience becomes source data for projections on costs and budget requirements, manpower and training needs, and program consumable requirements. It also serves as an indicator of research and development fields and the basis for workload calculations.

Present fiscal constraints in many utilities demand the establishment of reasoned task priorities. Although vegetation management tasks may be delayed for some years, plant growth will ultimately endanger system security. The longer vegetation is allowed to grow, the more expensive and complex become the methods of control. The false economy in delaying vegetation management tasks can only be well illustrated with accurate costs and outage records. In addition, with the trend toward integrated vegetation management with other elements of the utility, emphasis must be placed on efficient and effective task scheduling. The budgeting rationale then, for the five and 10 year plans now prevalent in utility operations, can only be established from a benchmark of accurately recorded data to be effective. Record keeping should not be burdensome; properly designed and implemented, it should be a flexible, dynamic management tool which substantially assists in planning, implementing, and maintaining advanced management techniques and field methods.

Work Costing

A clear distinction must be drawn between budgets, that is proposed expenditures or work costing that is retrospective in scope, and documents or calculated expenditures which have occurred. Quite obviously work costing does, however, provide the baseline information used in preparing both short term operating budgets and long term financial projections.

The choice of task method can and should be regulated by a realization that a method providing short term control, say two growing seasons, though providing cheaper initial cost, is more costly than an expensive method which provides control over five growing seasons. If the elapsed time in years before retreatment is required is divided into the accumulative job cost, a Cost per Unit per Annum can be calculated. An obvious comparison here is between mechanical and chemical brush control costs and the relative time effectiveness of each, the social and environmental considerations apart.

Measurements of vegetation are normally those of density, diameter, height, and area covered. Small areas, no matter the problem, can be readily managed, however, rights-of-way are unique as a land use covering hundreds of miles. Moreover, increases in width substantially increase area. For example, a six meter wide right-of-way 1.6 kilometers long encompasses one hectare, a 20 meter right-of-way, 3.2 hectares, but a 152 meter wide right-of-way, 24.2 hectares. When viewed in the light of manpower limitations imposed by union agreements, productivity variance, lost time and logistics, it can be seen that small increases in growth are magnified considerably as right-of-way length increases. It follows that it is incumbent on the aware and motivated manager to examine his methods and costs with great care as system expansion, voltage step up, and environmental demands increase progra size.

Using the costs and cost effectiveness information available from records, it is possible for the vegetation manager to base choice and comparison of methods, staff, contractors, equipment, and materials on a sound economic footing. On the one hand, project unit costs which provide the source of this information are primarily internal to the vegetation

management program and should be retained as such since a considerable amount of interpretation and experience is required to draw valid conclusions from site specific field charges. On the other hand, program cost and operating overhead should be corporate knowledge and incorporated into company financial planning and strategy. A natural reticence appears to pervade the science of vegetation management in making public unit costs associated with vegetation control activities. Admittedly individual project costs are not reliable for comparison unless similar conditions and requirements existed. Collective unit and program costs can, however, provide the public with an insight into the scale and scope of vegetation management practices on rights-of-way.

In addition to the survey by Lincicome (1964) which suggested a $17 million conservative figure spent by 68 utilities in 1963 for vegetation management, a number of other authors have discussed cost in varying degrees of detail. McPhail (1972) reporting on the Ontario Hydro program records 40,000 acreas of "brush" sprayed at a cost of $1,200,000 and 5,000 acres of weeds controlled at a cost of $50,000. It is suggested that by comparison, hand cutting (conducted on 1,500 acres) is 6.5 times more expensive. Since some 200,000 acres comprise the Ontario Hydro right-of-way management program, it is calculated that a change from herbicide use to cutting and accounting for the shortened period of clearance would escalate the annual cost of maintenance to $11,700,000. In an earlier study on the same system, (Wilson 1970) [and assuming a cost increase to only $7 million],it was estimated that this increase would be reflected in a rate increase to direct customers of 0.7% and retail customers 2.5%. Accurate work costing can

obviously be used for public purpose to help support a rational argument for retention of certain methods or restrictions of others.

Beck (1973) in examining environmental issues and utilities, observed the need to demonstrate, in economic terms, the industries' commitment to environmental protection and beautification. In more detail the same author noted the advantages of accurate work costing to support a large percentage of operations and approaching contract work only a three-year bid basis. A relationship between effectiveness, costing, scheduling judgements, and a drop in customer interruptions is developed.

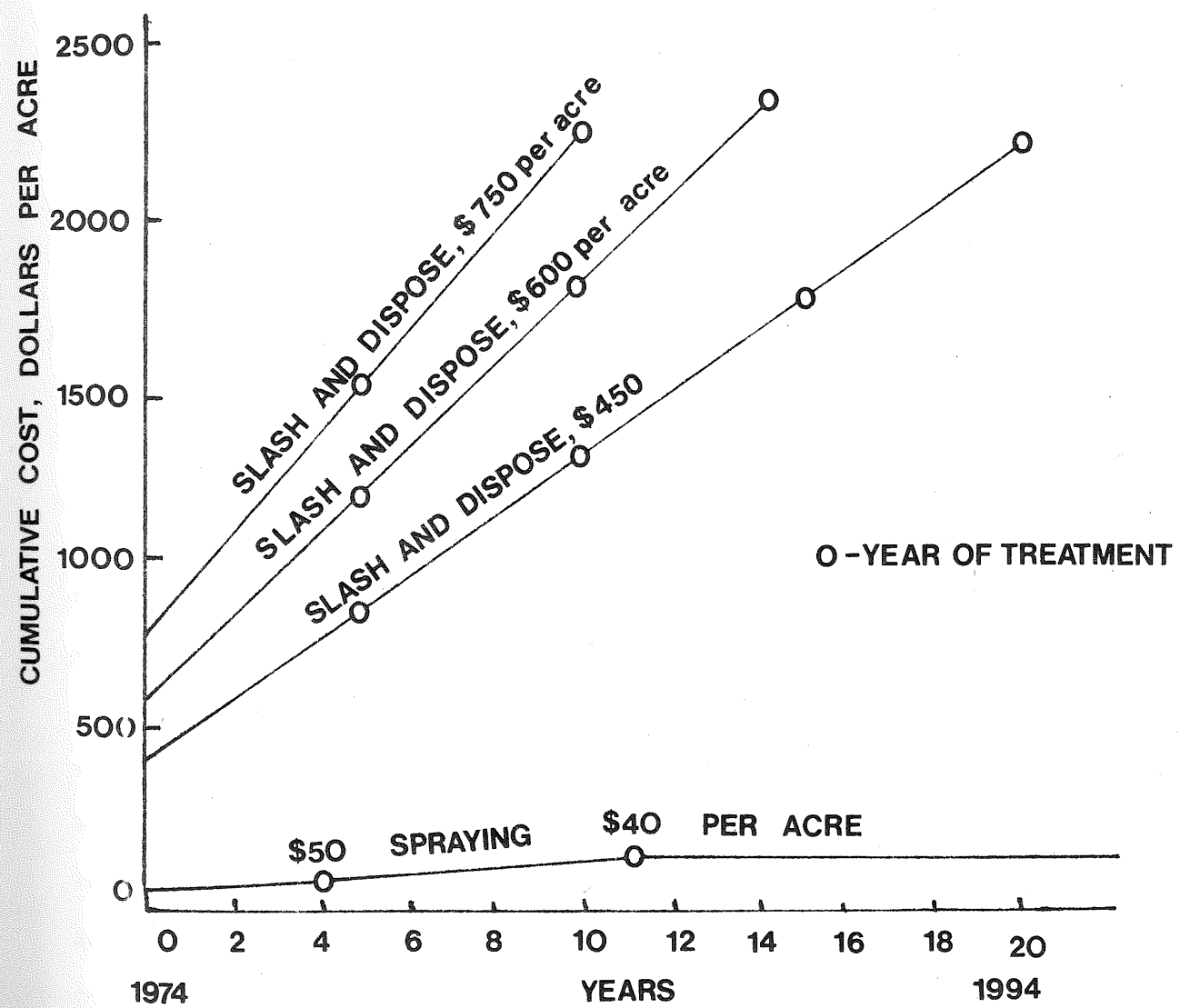
Abbott (1964) indicates a reduction of 41% in average annual right-of-way maintenance costs per mile as a result of herbicide use over hand cutting. Pacific Light and Power (Anon 1968a) reportedly used a survey of western utility practices and costs to establish their right-of-way policy, while Miller (1975) records savings of $250,000 per annum as a result of costing audits of line clearing contractors. The Potomac Edison Company have used accurate work costing as a means of demonstrating the implications of the undesirable trend toward "Ultra sophisticated clearing". The initial clearing and ten-year maintenance cost comparison for an 800 acre line indicates a differential of $2,792,000 between the "Sophisticated" method and a more practical but equally acceptable "selective clearance and maintenance" method.

Carvell (1973) alludes to, and Johns (1969) expressly notes the importance of accurate costing in developing a rationale for continuity of work.

Reduced personnel and training problems, lower overhead and supervision costs, and better results can be identified. Further, it is suggested that most utility managers, researchers, and contractors have had little appreciation of equipment costs and that greater care is required in determining chargeout rates.

Clements (1973) suggests that for the first time in their history the electrical utilities are having to fully justify increasing power costs. It is predicted that this scrutiny will require utilities to reexamine their budgets and in the field of vegetation management favour more economic and socially sophisticated programs. VandenBorn et al (1974), in a Brief before the Alberta Environment Conservation Authority examining pesticide use in that province, maintained that the utility companies have successfully used the most economical vegetation management systems in order to keep consumer rates as low as possible. As evidence of corporate responsibility Figure 22 was submitted to the Authority. It was offered that it is incumbent on utilities to take full advantage of the economics offered by the use of herbicides as long as they can be satisfied that no detrimental effects, either temporary or permanent, will result to the environment. The graph prepared was based on work costing over a prolonged period and the records open for inspection. It was concluded on the basis of the cost considerations (without allowances for inflation) that the use of herbicides in vegetation management has distinct advantages over alternative methods of controlling undesirable plant species. It is doubtful if such a sweeping conclusion can be drawn from the information provided without recourse to a more complete study of alternatives over a prolonged period as is contended

Figure 22 Right-of-Way Vegetation Control Cumulative Cost Analysis: Cost of Herbicide Treatments in Poplar Compared with Three Different Mechanical Cutting Costs Depending on Density. (From Actual and Projected Costs by VandenBorn 1974)


CUMULATIVE COST, DOLLARS PER ACRE
2500
2000
1500
1000
500
0
SLASH AND DISPOSE, $750 per acre
SLASH AND DISPOSE, $600 per acre
SLASH AND DISPOSE, $450
O-YEAR OF TREATMENT
$50 SPRAYING $40 PER ACRE
0 2 4 6 8 10 12 14 16 18 20
1974
YEARS
1994

by Egler (1953, 1958) and Niering and Goodwin (1974).

It is evident, however, from the replies to a Canadian survey (Canadian Electrical Association 1976) that most Canadian utility managers do not maintain sufficiently detailed costs to judge maintenance program success or adequate outage statistics in order to compare vegetation management expenditures with targets of reliability.

Little emphasis appears to be placed on determining productivity and the literature does not contain any references to work study, standard times, or similar cost-effectiveness criteria used in other industries. As noted in record keeping there seems little point in maintaining detailed cost data unless, or until, it is used as an accurate and dynamic tool for management decisions.

Reports

Information flow through complex systems must normally make the transition from the document level to the report level in order to provide a more definitive subject review, or "hard copy" resource for reference. This author suggests six report types.

Strategy reports are those which outline a conceptual approach or approach options. For example, a broadscope strategy report would examine system wide the management options for vegetation management in a utility and recommend courses of action. Once approved, the appropriate courses of action would form the skeleton Management Plan for operations or administration.

Status reports provide an examination of present conditions, either technical or administrative. The degree of development or "state of the art"

with regard to particular herbicides, classes of equipment, or training program effectiveness are illustrations. Right-of-way conditions for a given reference date would also be the subject of status reports and would form important summaries between, or a contributor to, historical profiles not updated directly from aerial photography.

System reports attempt to examine a complex unity of many often diverse parts, and subjects the parts to ordered placement in a common plan. A study of a vegetation management group's role in relation to other operating or support groups, or a systematic examination of individual vegetation management projects over time are examples that might be the subject of a system report.

Scheduling reports provide a temporal dimension to work programming. They may prescribe the time frame for particular projects by location or indicate predetermined servicing requirements for equipment, for example.

Scopic reports provide a visual appraisal of situations, locations, conditions, equipment, results, or aesthetics. Three dimensional presentations as in terrain constraint mapping, two dimensional tables and graphs, or planoptic oblique and stereo photographs may be used for presentation. Panchromatic, colour and false-colour rendition are possible.

Schematic reports present organization or project relationships, workload and staff consociations or similar patterns in a hierarchical or flow diagram format allowing ready appraisal of component interdependencies.

Support Services

If full attention is to be paid to the administrative planning and technical roles in vegetation management, access to a number of support

services is required. Most utilities already maintain a variety of capabilities to service other elements. Purchasing and supply, cost accounting, salary and benefits administration, safety, legal, land, medical and occupational health services, community and labour relations, cartography, drafting and computer science are best provided by staff groups who are responsive to the day to day program of the operating units.

Distance, centralization, unclear policy and objectives, poor interpersonal trust and communication, and compartmentalization of responsibilities may nullify many of the potential benefits of an interdepartmental framework. The utility vegetation manager must be aware of all system protocols, personality or efficiency conflicts and procedural blockages which affect program continuity. He should be alert to procedural and personnel changes in support services which may diminish or improve past experience and work actively for improvement within his own operation and lobby for efficiency in support operations.

A number of support services must, by necessity, operate at many levels in a utility. Salary and cost accounting is an ubiquitous example. Inventory and stock control, vehicle maintenance, and work study may also span all levels of the organization. Research and Development, discussed in a later section, should be conducted on two levels. Basic research into "state of the art" development may best be undertaken by a corporate research group. Applied research and field testing on a large scale should be a cooperative venture between research and vegetation management field services. For personnel improvement, the manpower and training group should work closely with the vegetation management group to establish training and career planning objectives. These objectives should dovetail with the long range

mission and program workload outlined in the vegetation management and corporate management plans.

The relationship between the vegetation management group and the utilit support services must be clearly established. Overlapping and ill defined responsibilities lead to administrative tensions which cloud the work objectives. In order that support services do not "drive" the system, a clear client/user consociation should be recognized.

Three critical components, all interrelated; data base, record and wor costing are often the weakest in many utilities. There are a number of reasons for this, of which lack of management training, lack of corporate interest, and a dearth of information in the literature appear prime. The vegetation management group should rely heavily on the appropriate expertise in support groups to ensure these facets of management are upgraded to a degree of reliability which ensures confidence in their use in program decisions.

In order to fulfill then, the objectives of management in a utility vegetation program on rights-of-way, it is necessary to provide a structured summary of support services. A proportion of these services deal primarily with information handling and are internal to the vegetation management program while some have shared responsibilities and some must provide a true client/user relationship. Without these services clearly identified, developed, and documented, there is a very real possibility of program, or at least project failures, administrative dislocation, undefined staff accountability, poor morale, and both public and company judgements of poor management.

Support Documents

In order to operate a vegetation management program successfully a number of formalized documents require preparation. Some are noted in the Synopsis of Operational Requirements, Table 4 and a number are dealt with more directly in the sections on Records and Support Listings. These documents form the hardcopy skeleton necessary to provide continuity and consistency in a vegetation program.

The first and most important written instrument of management must be a Policy and Procedures Manual (PPM) which outlines the administrative and operational guidelines approved by corporate management. The preamble to the manual should set out the vegetation management group role, responsibilities, objectives and strategies in the context of Corporate Goals and Policies.

Sanctioned task method alternatives should be layed out in the manual as a series of Policy and Procedure Instruments (PPI's). Where stipulations and intensity of a work method alternative or procedure are flexible, it should be viewed as a guideline and where immutable, as a standard. For example, in a PPI dealing with mechanical cutting of vegetation, the general parameters may be layed out while the choice of machine is left to the discretion of field staff, while a PPI dealing with clearance between vegetation and electrical conductors would set out, as a standard, minimum limits of approach which must be maintained. A working example on herbicide use, prepared by the author, is contained in Appendix J.

As the underlying factor in success of any ongoing program is one of the attitudes, it is imperative that an active role in shaping attitudes be

assumed by the vegetation management group. Attitudes crystallize from information. Education, then, is a critical factor in ensuring safe and efficient programs - education at all levels of responsibility (Gardner 1975). Programmed study for craft and supervisory staff requires detailed training manuals. Comprehensive utility vegetation management training manuals have been prepared, for example, by Ontario Hydro (1963, 1967a, 1967b) and more recently by Washington State University (Johns 1976). Following from the noted necessity for training manuals, there is a further requirement for a Safety Practices Manual (SPM). Utility vegetation management by its very nature is a potentially hazardous occupation and requires detailed rules and procedures to protect both plant and personnel. Preparation and updating may require a four party participation from the vegetation management group, from the corporate safety practices group, Provincial or State Workman's Safety Boards and, of course, union representation.

A constant concern with support documents is the problem of updating. Between the formal issuance of PPI's and Safety Code sections, Bulletins should be issued which specify new approved practices, procedures, materials etc. Bulletins should not be regarded as a newsletter medium but rather as a communication level only once removed from PPI's and codes, and equally binding.

In order to appraise new staff of approved procedure, to ensure a feeling of accountability in field personnel and because Policy and Procedures Manuals and Safety Code become cumbersome references outside office conditions, individual Field Manuals should be issued in the form of condensed reference books. As major new practices and safety rules are approved, a synopsis should be prepared as a replacement or addendum to

Manuals. These documents should be seen as important personal responsibility, signed by the owner and inspected by management from time to time. A very thorough knowledge of the manuals should be required of all members of the vegetation management group.

Where contracts are let for field work, consultants engaged for special projects, or research agreements concluded with other agencies, form and content of the appropriate documents should be a joint undertaking with the legal support group. Specifications, tender documents, terms of reference or research protocols should be the responsibility of the Vegetation Management Group.

Although not strictly documents, adequate provision should be made for acquisition, distribution and storage of Equipment Maintenance Manuals, Material and Chemical information sheets, computer printouts and research development reports. In order to organize, file and retrieve all working copies, a Filing Manual and Thesaurus should be prepared. A decimalized version specifically for forestry has been published by the Oxford University and one utility has a comprehensive example for environmental management (Gardner 1974).

Clear responsibilities and accountability are necessary for staff to function in a productive, independent and innovative climate. The simple personnel job description form should be elevated to a dynamic individual discussion and appraisal form. This can then be coupled with the expectations developed from one of the many "Managements by Objectives" work and staff planning schemes. A detailed vegetation management staff job description is given in Appendix K.

Support Listings

Lincicome (1964) has noted that only 20% of utility vegetation management work in the United States is undertaken by utility staff while 80% is conducted on their behalf by contractors. Since the low bid for vegetation control is often favoured and is, except in extenuating circumstances, often required by law for many Government owned or regulated utilities, it is evident that some mechanism must exist to protect the utility from unscrupulous contractors whose work practices will be damaging to corporate image or where work performance is incompetent. A strategy for overcoming this operating constraint is to establish a system of Approved Listings. A contractor wishing to be considered, when tenders are issued, must previously have had work inspected and approved, be bondable, and have references from previous clients. Where a new contractor wishes to become established, small contracts should be awarded and inspected. An ongoing program of inspection and completion holdbacks should be enforced for all contract work. Where productivity or work quality drop below a certain standard, one warning only should be issued and after that a contractor should be dropped from an approved list.

Such lists and independent inspections should also confront the problem of favouritism in contract awards prevalent in some utilities. A variety of competent contractors should be encouraged by utilities, with emphasis placed on local employment except where economics and advanced equipment or methods are more than marginally in favour of large organizations. The utilities may wish to extend training and instructional facilities to approved contractors.

When vegetation management programs are supported by external expertise in universities or the commercial consulting field, listing should be maintained of competent experts. Area of specialty, report writing capabilities, expert witness experience, past utility experience and current fee schedule should be maintained as an updated listing.

Government agency staff that interact with the vegetation management staff should be catalogued as to Department, responsibilities mandate, reporting structure, interest and qualification. In this way communication system with external staff will flow smoothly.

A large number of suppliers normally interact with a vegetation manager. In particular, herbicide and equipment suppliers are important in providing program continuity and information updates. Supplier staff should be listed by background, expertise and orientation towards sales or technical developments. Supplier resources of research, development, competency, and comprehensiveness should be documented. Supplier products, costs and terms should be recorded.

Confidential listings should be maintained as appropriate on staff qualifications, job definition, experience, competency and personnel profile. These listings are suggested in addition to the normal Personnel File retained by the appropriate support services group. The vegetation program manager at each level in the organization should have an ongoing interest in developing the fullest potential from their staff and should initiate or collaborate on training and career planning programs.

It is later noted that an important component of an ongoing vegetation management program is a Research and Development capability. The aware manager should always be appraised of current practice and new developments

in other electrical utilities and linear land management.

To this end, the vegetation management group should consider receipt and circulation of the journals and magazines cited in Table 7. A central group location or library support service may be designated to abstract or photocopy pertinent articles to distribute to field locations. In this way the head office group can assist in fulfilling its obligatory resource role in a decentralized system. Two further functions in new information source access can be performed by the central location. It can act as a repository for research reports, scientific papers, consultants' findings and provide an updated list of statutes and regulations which govern vegetation management operations. In addition, it should be able to service requests for references particularly those now held in computerized data banks. A remote terminal for searching INFOMART (Southam Press Ltd.) WATDOC (Fisheries & The Environment Canada) DIALOG (Lockheed Information Systems) and CCRS (Canadian Remote Sensing Technical Information Services) holdings should be considered.

Once prepared, every effort should be made to keep listings current and circularized to field staff. Direct addressed computerized printouts should be considered for all general use listings.

Many Provinces and States, manufacturers' consortiums, and transportation groups maintain accident response capabilities. Access numbers for these and local emergency services should be accumulated, updated and circulated to all staff.

TABLE VII SUPPORT LISTING: UTILITY VEGETATION MANAGEMENT INFORMATION SOURCES

Cary Arboretum Reports on Right-of-Way Management

Down to Earth (Dow Chemical Company)

Electrical World

Forest Abstracts

Grounds Maintenance

Industrial Vegetation Management (Dow Chemical Company)

Journal of American Right-of-Way Association

Journal of Horticultural Science Society of America

Journal of International Society of Arboriculture

Journal of Weed Science Society of America

Label Recommendation Printout - New Pesticide Registrations - Canada Agriculture and U.S. Environmental Protection Agency

Ontario Annual Guide to Chemical Weed Control: Pub. 75

Proceedings of British Weed Conference

Proceedings of N.E. Weed Sciences Society

Transmission and Distribution

Utility Aborists Association Newsletter

Weed Abstracts

Weed Research

Weeds Today

Weeds Trees and Turf

Appendix C Communications

COMMUNICATIONS

Introduction

Public Acceptance of Vegetation Management Programs

A great deal of criticism has shadowed the expansion and execution of utility operations in the last decade. Books by Carson (1962), Whiteside (1970), Shoecraft (1971), and others, have directly or indirectly caused critical examination of utility vegetation management programs in the public forum. The press and environmentalists have extrapolated from *in vivo* laboratory tests to field conditions and condemned vegetation managers as party to deliberate degradation of environmental and human health.

Paterson (1974) has suggested that vegetation control on rights-of-way is normally accomplished in the most economically advantageous way to the specific agency with no consideration of the public. As a consequence it is proported that the Canadian public has been reacting strongly against these practices on the basis of aesthetic change and the loss of valuable wildlife habitat. As a result of public pressure two provinces, New Brunswick and Nova Scotia, banned the use of herbicide on right-of-way. Although such public pressure may have in part precipitated enquiries into pesticide use in these provinces VandenBorn (1974) notes that these programs were soon reinstated. Similar experience in British Columbia (Mackenzie *et al* 1975) and Alberta (Environment Conservation Authority 1976) have served to examine but not radically change right-of-way practices.

There can be little doubt that public concern was fueled by military use of a variety of herbicides in Vietnam (Barrons 1969, Tschirely 1969).

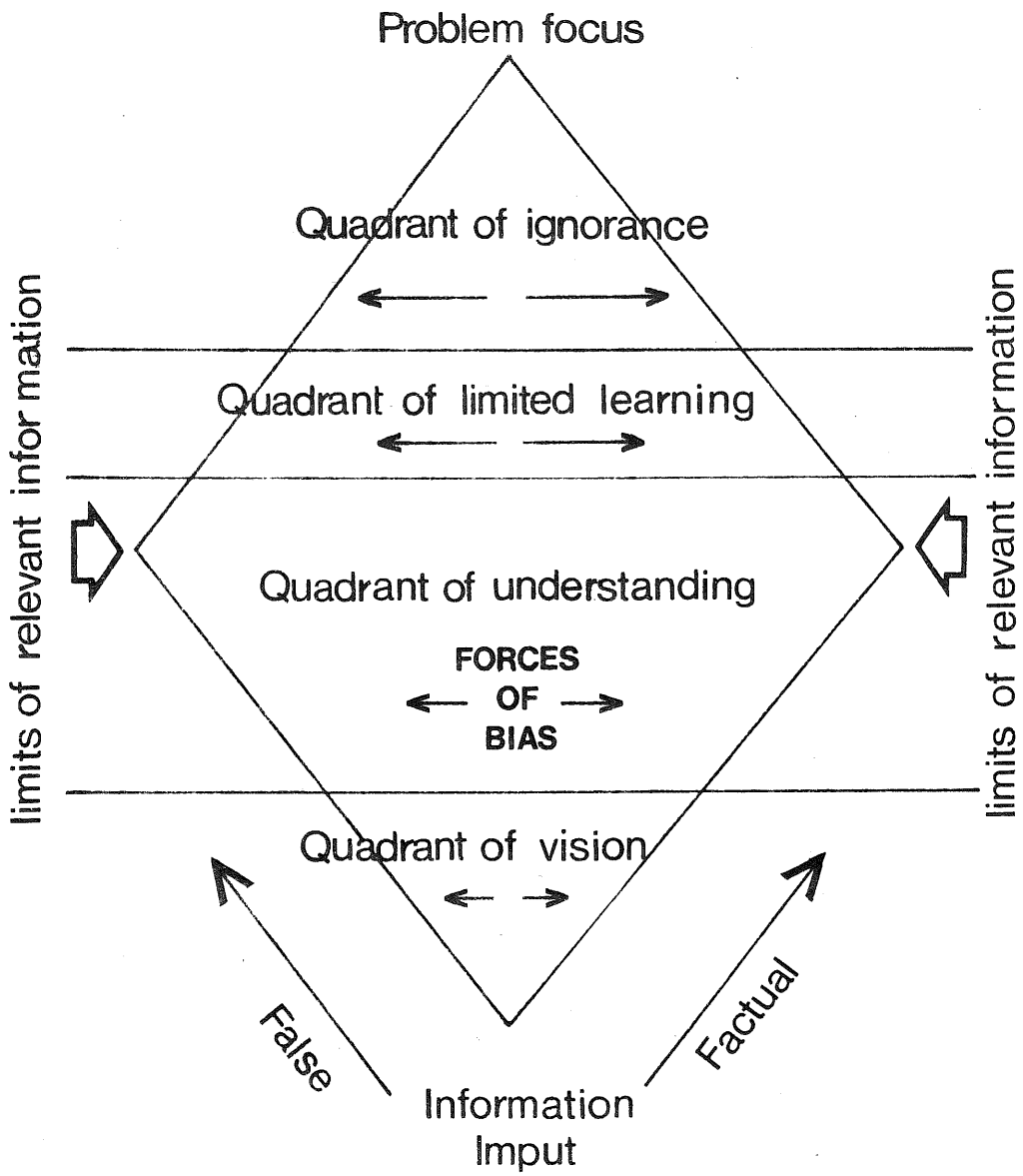
The subsequent controversy over a dioxin contaminant with teratogenic potential (Courtney 1970, MacLeod 1971, Leopold 1971) in a common right-of-way herbicide (2,4,5-T) inflamed public opinion (Toronto Globe and Mail 1971). Detailed investigation of environmental implications (Tschirely 1970) and of health implications (Johnson 1971) have now discounted hazards associated with registered uses of 2,4,5-T. Some rancor still exists (Vancouver Sun 1973a, 1973b) but in general the public outcry has been muted by the redirection toward inflationary trends in western economies and the growing realization that energy resources are not inexhaustable. Nevertheless the residue of this concern is now firmly embedded in regulations requiring the right-of-way manager to provide a more detailed and articulate description of proposed practices, especially on Federal or Crown land.

Human Perceptions

Humans apparently stand alone in nature in the ability to reason in the abstract, to take information and deduce relevance and consequence. From this process is derived our appreciation of circumstances and sets of circumstance. This might be termed our individual insight. In order to document this process, to better understand the needs of a communication program, a model, Figure 23, was developed to graphically illustrate that man attains varying levels of understanding characteristically modified by a variety of biases. In addition, perceptions are filtered by each individual's interpretative processes, and based on either Factual or False sources, Complete or Incomplete.

The model is termed the Diamond of Individual Insight. Hypothetically an individual's perception of a problem or issue can be assessed within

Figure 23 Human Perceptions: Diamond of Individual Insight


Problem focus
Quadrant of ignorance
Quadrant of limited learning
Quadrant of understanding
FORCES OF BIAS
Quadrant of vision
limits of relevant information
limits of relevant information
False
Factual
Information Imput

the bounds of a diamond representing the individual's state relative to the body of knowledge on a particular subject. One apex of the diamond represents the focus of the problem, the broadest dimension the limits of relevant information, while the central axis from the point of focus through the centre of the figure represents a line of absolute objectivity. Individual knowledge regarding a particular topic is reflected by placement in the diamond. If the depth of knowledge is minimal, perspective of the total information on a subject is limited, and suggests placement in a "quadrant of ignorance." As knowledge increases the individual passes through the "quadrant of limited learning" to the "quadrant of understanding."

In any population there will be a few individuals approaching or in the "quadrant of vision." Here the individual has distinguished the limits of relevant information, synthesised and drawn conclusions from the body of knowledge and ordered those conclusions such that an issue may be judged relative to other issues. In a simple system with few complex issues a number of individuals will attain this "state." With complex philosophical, social or scientific issues only a few minds will attain this "state" in any century.

So far the explanation has dealt only with the ideal case when all facts are viewed with total objectivity. Deviations from the central axis may be represented as a reduction in objectivity. Wildly differing opinions exist on all subjects. Although the "correctness" of facts will influence individual perceptions, a number of important imprinted biases colour individual interpretations of information. These form every man's character to varying degrees. An understanding of this process which can radically distort communications effectiveness must underlie the preparation, execu-

tion and feedback mechanisms used to operate a vegetation management program.

The influences which tend to shape men's minds include: upbringing, level of formal education, ego, sense of fear, greed, past experience, reasoning, learned values, prejudice and righteousness, complacency and disinterest, expediency, and mental or social deprivation.

Upbringing and education form the basis of each man's catalogue of information. Innate ability, experience, and learning will shape his retention and colouration of facts. In adult life, reading, watching, talking, and employment play principal roles in the receipt of information. Information will be forgotten, discarded or retained depending on interest, form of presentation, and, for some, deductive reasoning. Pollock (1974) reports memory curves that show within two days people forget 20% of what they have learned, within four days 40%, nine days 60%, and in a month 75% is lost.

For the most part people will believe what they read or hear. And for the most part this information is provided by the media. However, only 12% of those surveyed in Canada (Davey 1970) felt that the press was very honest in its reporting and 59% expressed doubts about the quality of information they received. For Canadian news, individuals in the survey relied 48% on television, 19% on radio, and 29% on newspapers. About 50% felt that television was credible in presenting Canadian news compared with 17% for radio and 26% for newspapers. Fifty-five percent of those surveyed felt that newspapers required the most energy and concentration to understand.

It is not reasonable to draw specific conclusions from this data. However, the aggregate of these observations allied with our differing abilities to comprehend the intended meaning of words, aptly summarized

this conversation (Carroll 1871)

> "When I use a word, "Humpty Dumpty said, in rather a scournful tone, "it means just what I choose it to mean - neither more nor less."
>
> "The question is, "said Alice, "whether you can make words mean so many different things."
>
> "The question is, "said Humpty Dumpty, "which is to be the master - that's all."

has meant that many external public and on occasion government critics of utility operations have come armed with an array of dubious information with which to challenge the status quo. The opposing forces met head on and open confrontation often grew from corporate rebuttle, silence or inertia. Critics became more insistent and marshalled more "facts." Few, however, could grasp either the administrative or technical process of electrical utility operations which, even from within, are complex, technical, and often intimidating. Change has been slow but a pattern of dialogue has evolved. Belatedly, democratic reconciliation has begun to replace mistrust.

A recognition of the cultural, informational and educational, social and physiological factors which distort, alter or negate communication, should be borne in mind for both successful internal and external public communication in and out of the vegetation management group or its support services.

Corporate Responsibilities

Both private corporations and government managed utilities have, and are seen to have, a significant impact on the quality of the natural environment. This impact is generally seen as degrading environmental quality.

This perceived overall disbenefit must be weighed against the benefits which accrue from readily available electrical energy at modest cost. Moreover, a argument can be made that in some instances the initial disbenefits, after construction, of appearance and clearing impact are later mitigated in a properly managed vegetation program which reduces visual impact and improves wildlife habitat by encouraging a diversified vegetation canopy.

Corporate responsibilities in public communication are to clearly portray a corporate environmental ethic in a well reasoned, balanced style. It is important that advocacy of position be supported with clear purpose, evidence, and rationale. Public information and public education should evolve as a public "right." Electrical utilities provide a trusted service. The utility must not, by indifference or intent, betray that public trust.

Corporate responsibility in communication with government agencies must rest on a firm foundation of honesty and openness. Without this policy both motives and projects will be suspect. The process is simple; candor gains respect, and involvement aids agreement. The responsibility that the organization has in internal communication is more subtle. It serves, in addition to the purposes suggested in public and government communications, the added role of developing corporate morality and realizing individual worth. A corporate interest in positive self image, a clear understanding of individual, group, and corporate responsibilities and mission, and a feeling of contribution, support a healthy organization. Through a healthy vital organization, comes responsive, responsible attitudes toward the totality of our environment.

Information Systems for the Public

Public Brochures

A great deal of misinformation about vegetation management has been carried in the press and similar sources, creating in the public mind a mistrust of such utility operations. Since public utilities are particularly vulnerable to external criticism, a well conceived public outline of vegetation management practices should be an essential constituent in any complete program. It should be a joint effort between the vegetation management group and a community relations group. It is unwise to leave preparation solely in the hands of a public relations oriented group who may place too great an emphasis on presentation and too little on content.

A two step approach has been utilized by some utilities (Ontario Hydro 1967c, 1971, British Columbia Hydro 1970, 1971). A simple pamphlet providing basic information on electrical system size, program rationale, methods, compliances with regulatory agency requirements and the degree of training and supervision given to field staff, provides a handout which can be used by field crew and field offices. This, or a similar brochure, can be considered as a "bill-stuffer" which would be sent to all customers or possibly to customers in a region or district which will require treatment projects that season.

A more substantial booklet can be prepared for public meetings concerned with new line location approvals or vegetation management practices specifically. As with the pamphlet, the booklet should address system size, but include a more detailed examination of the relationship between voltage,

right-of-way widths, power demand and system growth. It should examine vegetation management rationale and discuss continuity of service, line security and protection policies. Task method alternatives should be recognized and the criteria which govern choice described in the context of vegetation management objectives. The implications for environmental, social, and occupational safety should be illustrated with examples, supported with economic and administrative verity. The training, supervision and inspection procedures which ensure compliance with internal policy and procedures and the mechanisms for adherence to regulatory structures should be clearly identified. Staff accountability should be reflected in a discussion on responsibilities which then leads into a review of staff expertise and ethics. Finally, statements of fact should be supported by references, further information sources noted, and the whole written in a non-technical prose and adult, mature style.

Project Notices

Since much public concern originates from ignorance as to vegetation management rationale, it is incumbent on the aware manager to initiate a process of public information. A two stage system is advisable in areas where vegetation management programs are relatively well known and accepted, and a three stage approach in areas which have been previously contentious or where projects are occurring for the first time.

In major ongoing established programs, project notices in the local press indicating task rationale, method(s), size, location, duration and contact points for further information, are good practice. If vegetation

control measures present a public hazard, as in major cultivation, cutting or chemical projects, job site warnings may be posted. For minor operations, warning flags should be considered.

In the case of major projects in new or contiguous areas the addition of public information meetings should be considered. Task method alternatives, the benefit/risk and benefit/cost tradeoffs and the task rationale should be clearly presented in unbiased form. When possible, scientifically supportable answers should be prepared beforehand for known controversial issues. Factual, relevant handouts should be available. Community leaders with known concerns should be asked to participate by invitation. Adequate advance notice should be given for such meetings which should occur with sufficient leadtime to allow for project modification if necessary.

Individual Notification

Many regulatory agencies now appear to include adjacent landowner notification as a stipulation of permit approvals involving herbicide use on both owned or easement lands. In rural areas, where surface water sources are used for drinking water, vegetation management activities which may produce siltation or reduced flow for short periods should be indicated to the registered owner. Where an impact on stock watering or grazing is anticipated, farmers should be given advance notice. In urban areas, prior notice should be given to adjacent residents if noise from operations is likely to be a disturbance or if equipment such as gang-mowers present a potential hazard to young children and pets. In areas where multiple land use agreements are in force, adequate provision should be made to inform appropriate parties that projects are anticipated.

An argument against individual notification is often raised by field staff because of the difficulty of contacting property owners and in distinguishing between property owners and tenants. Obviously rules governing contact must be flexible, however the onus rests with senior management to explain the community relations purpose behind individual contact so that the logic is understood and appreciated at the local level.

Lack of attention to this simple though perhaps tedious duty has resulted in unnecessary and ill-informed press coverage of utility operations (Squamish Times 1973, Vancouver Sun 1973a).

Complaint Handling

Ditman (1969) indicates that complaints that are investigated and settled without delay enhance a utility's public relations policy and presumably, by inference, a company's public image. A complaint handling system is recommended. Turner (1967) notes that by far the greatest majority of complaints have developed from the application of herbicides and examines the legal implications. Where vegetation control is carried out on a bid basis with contractural agreements with applicators, it is observed that most contracts hold an indemnity running in favour of the utility but where drift damage has occurred, courts have applied a basic tenet of law which indicates that no one can contract against their own negligence. It is strongly recommended that financial responsibilities and insurance provisions be included in vegetation management contracts to protect the contractee.

Both in the case of contract work and with "in-house" staff, permanent

or temporary, it is the utility which is seen to be the offending party. Complaint systems must be accessible and responsive to each individual complaint. Where complaints are the result of contract operations they should be dealt with by the contractor but with final resolution documented by letter to the vegetation management and legal support groups.

Evolving from a complaint handling procedure must be a claims handling procedure. A survey of Canadian utilities (Canadian Electrical Association 1976) indicates that of 14 utilities contacted, 13 had some method of handling claims although the survey replies, in some cases, appear to apply to post construction claims, not operating and maintenance damages. Moore (1967) noted that promptness in investigation and handling claims in a forest vegetation management program allowed positive proof to be collected that the project did not cause a number of alleged contaminations of water. Ditman (1969) records that an unnamed utility which investigated claims promptly, found that over 50% had no connection with that company's activities.

Turner (1967) and Ditman (1969) provide cogent thinking on the methodology for handling claims and the staff qualities and training required. Turner suggests that staff should have a penchant for walking, that the claims negotiator should travel to see, on location, a complaining party and once there, should be friendly and businesslike. Ditman suggests that personnel should be highly motivated, fair, thorough and interested in exercising responsible business citizenship. Specialized consultants such as veterinarians, plant pathologists and agronomists are recommended where technical doubts arise.

Both authors stress the need for prompt handling of complaints and claims, with Ditman (1969) noting that lost time results in hardened attitudes. Turner strongly endorses the need to be comprehensive and suggests an eleven point procedure for claims: do not admit liability, beware of the way written communication may be construed by courts, be friendly, examine work records carefully to substantiate that utility personnel were actually operating where alleged damages occurred and make detailed field notes both of apparent damage and surrounding conditions, immediately notify insurance adjusters or ask permission to have damage inspected by expert opinion, obtain complete information or witnesses, take appropriate photographs, make sure operating records are up to date and finally, preserve whatever evidence would be pertinent to the case.

Ditman (1969) suggests that utilities require exact records of every complaint (real or imagined) to maintain an efficient claims program, presumably in order to establish trends and identify research needs. An example of a Complaint Investigation and Handling Form is given in Appendix L.

Complaint and claims handling then will directly reflect on public attitudes toward utilities and the vegetation manager charged with administrating an already contentious facet of operations. A utility should strive to handle public concerns with acumen and honesty.

Information Systems for Government

Municipal and Regional

A number of municipalities have bylaws which restrict or prohibit the

use of herbicide within city limits despite such boundaries encompassing an area far removed from the concentration of population. The findings of various Commissions of Enquiry into the use of herbicides has tended to reinforce this trend (Mackenzie et al 1975, British Columbia Royal Commission, Environment Conservation Authority 1976, Public Hearings into the Use of Pesticides in Alberta). Vegetation control which requires herbicide use because of terrain or undesirable plant density within such boundaries may be possible if the Council concerned is approached with a well supported case. British Columbia Hydro have tried this approach with some success (Tatlow 1976).

With routine work, which does not require approval but which may cause public concern, planning should include the courtesy of informing Regional and Municipal governments. Such a strategy was undertaken by British Columbia Hydro and appears to have headed that Authority away from a period of confrontation (Tatlow 1976).

A two-level information system in writing is recommended. An initial letter once the project planning stage is complete and a record letter just prior to job startup provide an adequate communication mechanism. At the first stage, aims and rationale for the proposed project should be filed with a letter of intent. The success of this approach can be gauged from the response to an open information process adopted by British Columbia Hydro, Appendix M.

Regulatory Agencies

State or Provincial, and in some cases Federal regulating agencies

require information on proposed programs and may actually operate a Permit and Approval System. In these cases adequate lead time is required for regulating agencies to inspect proposed projects and return approved permits. The applicant is advised to apply for such permits well in advance for two reasons; if there is any dispute on proposed areas or methods, time is required to resolve conflicts, and where projects are approved, but with hazard advisories or operating strictures, adequate time is required to transmit this information to field operations. This latter time requirement will depend on the proponents' internal communication's efficiency and the degree of decentralized authority vested in field staff.

In some instances work methods, especially those employing herbicides, are subject to routine or research monitoring. If extensive research-based surveillance is planned, the agency must be notified at a point which allows adequate lead time for their own logistics plan to be prepared.

The need for communication with agencies with power of regulation or approval must be understood by corporate management, vegetation managers, and by field staff. Good working relations with these agencies are essential to accomplish the objectives of management. Corporate staff must recognize that internal communication in other agencies is often poor and the onus for informing regulatory agencies at all levels rests with the proponent. On no account should either differences of technical opinion or personality conflicts be allowed to mar the corporate/regulatory agency communications process.

Resource Agencies

As with regulating agencies, resource agencies may wish to monitor vegetation management operations. In particular Fish and Wildlife Departments with a mandate for resource protection and Water Resource Departments with a mandate for water quality and human health have a constant concern about right-of-way disturbance. Since linear corridors cross many terrain and ecosystem types, it is important to provide accurate information on location and task methods proposed. Safety procedures for resource protection should be clearly identified and stated. Prior warning of right-of-way activities should be communicated to resource agencies at local and central levels. Working liaison with resource agencies is essential. Interpersonal confidence builds respect and cooperation.

As understandings of concern and responsibility interchange, so improves the work climate, job efficiency, and task accomplishment. If and when a problem does occur, resulting in environmental impact, the level of personal contact and individual trust developed will be amply reflected in the severity of censure.

Information Systems for Internal Corporate Operations

Field and Management Staff

The information gathering system in the field which provides the data for project decision is perhaps the most crucial element of internal communications. It is this mechanism which predicates the validity of vegetation management programming. Field reports may accrue from a combination of patrol reports, ground inspections and air photos. In special circumstances

this "status" information may be supplemented with outage or trouble reports. Separate systems may exist for handling unscheduled work occasioned by line "incidents" but often control center information is not properly utilized unless electrical circuit reclosure has not been possible. This synthetic information and visual field inspection must however be interpreted by competent personnel using training, experience, and judgement to prepare the comprehensive program plans and implement key decisions. This will require a complex network of communications between many internal departments and trigger the communication processes which inform outisde agencies and suppliers. This web of information links must function effectively and efficiently for a vegetation management program to accomplish its objectives.

Since a wide variety of technical and administrative information "bits" must move up, down and across the organization smoothly and without misinterpretation or misdirection, consideration should be given to colour coded forms and memo-heads which are used specifically for vegetation management programs. In order that this information is not confused with vegetation management information for other utility elements, right-of-way copy may be assigned an appropriate symbol or code.

No material decision should be communicated verbally. Task methods, timing, job size, location and budget approval should be written in clear concise terms and reported to all staff levels responsible for the vegetation management project and to the support services which require documents initiating actions. Such documents as work orders and requisitions must have clear definition, destination, and data for completion. Approval should state authority, limitations and exact subject decisions and approval given.

The vegetation manager must be constantly vigilant for interruption in the orderly flow of internal information both in and out of the group. Internal information systems often have the two part purpose of communication and education. The content of one should not confuse the intent of the other. Care should be taken to draft all communications with forethought and with clear objectives in mind. Beware of the "memo mentality." Nothing written is worth writing if the reader will not, or cannot, understand it. It is better then, to use verbal communication guided by the rule that it is better, if possible, to talk to people in person rather than to talk by telephone.

One final item of internal communication, also important in fostering morale and team spirit, is the circulation of a group newsletter which combines personal interest, technical and corporate information in a style which will appraise staff of current activities of interest. Not only does this type of newsletter serve an important internal group communication purpose, but it also helps enhance corporate appreciation of a vegetation management group and addresses the important concern raised by Gilbert (1971) that internal public relations are as every bit important as those directed outside an organization.

Community Relations

Central office, regional and local level community relations officers should be appraised of both proposed annual programs and individual project scope. In this way site specific jobs may be set in perspective and information dossiers compiled for individual projects allowing advance prepara-

tion of question boards and press communiques. The simplicity or complexity of details should hinge on project size and past experience.

Complaint procedures and vegetation management staff contact points should be documented well in advance of job startup. At time of job initiation, the local vegetation management supervisor should inform the community relations network in writing, and outline the backup information available.

Where a previous history of community concerns indicates that local leaders or populace are opposed to particular vegetation management techniques, every effort should be made to provide informed counsel to identifiable groups, elected representatives or influential individuals. The emphasis should not be on convincing opponents of a particular point of view or justifying particular practices. Rather, a balanced, well supported picture of the alternatives and implications of choice should be provided. This may either be organized through the medium of a community relations group, if such exists as it does in most large utilities, or directly by local level management staff. If dependence will rest with community relations as a support service, it is incumbent on the vegetation managers to provide the detailed content and presentation on his program rationale. It must not be, or seem to be, anything other than an honest, frank presentation by those accountable for vegetation management (Hansen 1971). Community relations, as a group, should provide no more than the logistical support for this public information activity.

Support Staff

Information flow to support staff will take two forms; information

updates, and action required. Information should be brief, formal and precise. Request communications to support staff should have a clearly stated purpose, required actions, and timeframe for implementation.

Particular care should be exercised in routing of internal communications. The principal impediment in effective written communications, after unclear content, is found in the inability of documents to promptly reach their desired destination. That destination should be viewed as the individual required to initiate action as a result of the communication and not as the department or managerial hierarchy. Wherever possible, a feedback check of initiated actions should be incorporated if those actions would not normally manifest themselves for some time but are critical to project success.

Appendix D Logistics

LOGISTICS

Introduction

Logistics are the Who, What, Where, When and Why indicated in the management model. These simple management questions become the preparatory key to determining the "go" field projects. Initial consideration of logistics becomes the transition phase between project planning and final project modification in the light of changing conditions over the elapsed period between planning and implementation. Seasonal weather fluctuation, unusual vegetation growth patterns, unplanned or unknown electrical system changes, previous project delays, delivery or availability problems, budget alterations and government restrictions are external causative factors in plan modification.

Once past the financial approval stage the individual program projects can be readied for implementation. Individual staff are assigned, the site specific task methods determined, and detailed maps, air photos or location plans finalized.

Timing and scheduling of equipment, supplies, staff and support services are now required. Tasks and emphasis will obviously change depending on the decision for "in-house" or contract work, but a mobilization phase should be viewed as essential in both cases.

Finally, the program manager should conduct a pre-project review to reexamine rationale. This should not require extensive time or effort, particularly if the planning and project development stages have progressed logically. Such a stage is suggested as a last reexamination step to ensure

that individual projects meet the fundamental objectives of the vegetation management program and that this justifiability has not been clouded by subtle change as condition and content evolved.

Following the general audit of projects, appraisal and assignment of individual project requirements and notification of support services, the management theme must become largely field oriented for each project. Decision and authority levels now rest more directly with field foreman and their direct supervisors who are often not part of the Vegetation Management Group in a decentralized system. It is at this stage that a vegetation management program becomes most vulnerable. Procedures must leave little opportunity for misinterpretation while retaining sufficient flexibility to allow effective implementation. Project command must be vested in sensitive, well trained, alert staff. The managerial communication climate must be one of receptiveness and provide rapid, informed response to field problems.

In order to provide a framework for field project staff, four distinct stages of review are suggested in this chapter in order to identify potential problems and provide corrective solutions.

Project Pre-Job Conferences

A project is the logical combination of a number of tasks either of like nature or more commonly in a contagious geographical area. Projects should not be confused with programs which are broader based entities as in a vegetation management "program." A number of integrative planning requirements must be settled at the project pre-job stage. Since most utilities and/or contractors have limited resources in terms of men and machinery, it is necessary to set realistic limits on project size and to program the

availability of staff and equipment well in advance. This is particularly true of those utilities working on a shared pool system for equipment or where equipment is multipurpose as in the case of timberskidder prime movers, used for tree trimming in winter and as spray vehicles in the summer. Equipment scheduling requires time for annual maintenance and testing. This is particularly true of large mechanical mowing or chipping equipment which may need magnaflux crack analysis to detect incipient metal fatigue and major overhaul, or spray equipment which may need pump testing, pressure and nozzle calibration.

Project pre-job conferences should document the necessary critical path (CP) planning or time horizons and the system responses needed. For example, chemical ordering, staff training and certification, and equipment availability must be determined. From this process, appropriate seasonal task method alternative choices, and proposed project sizes will come an assessment of time frame. Once the groundwork needs and timing have been established, it is possible to log and prepare the information entities discussed previously under communication. Depending again on program size and complexity, project pre-job conferences may be formal or simple discussions. It is unlikely that a single meeting will suffice and two stages appear to warrant attention. At the conceptual stage, when the basic source data is assembled which indicates need, a project plan should be established. At the formative stage, once the project is approved the more complete planning should evolve.

Pre-job conferences will normally involve the field crew foreman and the district level vegetation manager. Also included may be local level

support staff if a project is of a continuing nature over a number of months. The local stores supervisor, safety officers and land representative may benefit from discussion of a project and conversely may contribute information on prevailing circumstances from their perspective. Formality of special meetings may not be necessary as local level department head meetings may act as an information vehicle for internal communication. Vegetation managers at all levels should impress upon other elements of their utility that vegetation management tasks are unique in the array of contacts and potential impacts involved in executing their mission. With the exception of those groups directly involved in new plant impact studies, no other group must react with such a broad spectrum of both internal and external contacts. Pre-job conferences are, then, an important aid in soliciting and synthesizing intimate local knowledge of prevailing conditions.

Job Site Setups

The economics of most tasks are governed in large part by labour costs. Effective working time on the job may seriously effect the unit cost, productivity obviously rising with the increased manhours available Travel time is the most serious factor in eroding available manhours. It becomes evident that choice of locations for both major programs or site specific projects must be responsive to the desire for efficient management. Where possible an in-depth analysis of job start locations, union stipulations and work efficiency should determine the appropriate course. Outside contracts should be considered for jobs far removed from permanent staff home bases.

Efficiency of operations is also an important consideration in selecting job sites. Here, right-of-way width and mileage, terrain and availability of access, ground conditions, equipment capabilities, fuel consumption, vegetation density, size, and occurrence, are all important. Choice of task method alternative will also dictate various requirements which influence job site setup. Foliar herbicide applications require both chemical supplies and carrier, often water. Caches for herbicide and adequate provision of tanker supplies of water or identification of suitable water sources is necessary. In the case of mechanical equipment, particularly that used for brush cutting which often causes repetitive unscheduled down time, provision must be made for services and repair.

Supplies of fuel and like materials should be strategically located but care in placement and storage is needed to prevent theft. Likewise equipment should be parked away from ready sight to discourage vandalism. With contentious operations, notwithstanding their validity, equipment and personnel should be no more evident than necessary.

Environmental and aesthetic concerns should be considered in job-site selection. Disposal of containers and refuse should be carefully undertaken. Spills of fuel, oil, or herbicides should receive prompt attention and equipment and materials should be available in order to ensure that this is possible. (Where required in law or of sufficient size, spills should be rapidly reported to government agencies.) Parking of equipment and service vehicles should not impede access for emergency or routine service of other plant or personnel on the right-of-way. Parking of equipment at night should satisfy the criteria of safe distance for fire protection and

discourage vandalism. Supplies should be secure from human, weather, or wildlife disturbance.

Finally, thought should be given to a job-site layout. Adequate spacing should exist between different stores and turnaround and access should satisfy simple time-study principles.

Work Site Pre-Job Conferences

These brief informal meetings, often referred to as "tailboard" meetings are intended as a final review before work proceeds. These are particularly important at the beginning of a new season when good work habits have been dulled by time and when unskilled additional staff are engaged for seasonal employment. Such meetings should ideally be held at the beginning of a new task or at any major new location and should involve the appropriate level vegetation manager, the crew foreman and the crew. An understanding of the objectives and method or methods to be employed, must be clear. Those environmental and work hazards likely to be encountered on the job should be discussed. Government stipulations and legal obligations should be reviewed. The balance between safety and productivity must be clearly stated.

Finally the public relations aspect of work quality, reasonable appearance, and pleasant manner should be stressed.

Assessment of Hazards

Assessment of hazards may be examined under four subheadings: Job Safety, Environmental Safety, Season, and Information Sources. Extensive

literature exists concerning job safety and most utilities have a detailed Safety Code, carry out a program of safety training or accident prevention and are regulated by Federal, State or Provincial regulations. There are, however, a number of direct hazards which exist in right-of-way field operations which should be borne in mind.

Dangerous ground conditions prevail in many areas since transmission lines traverse wide varieties of topography. Extremes of ground condition, including adverse slopes, rock, swamp, and areas subject to pot-holing are all potentially unsafe both for the employees and equipment. Dangerous equipment is an inherent hazard in many vegetation control operations. Tools or equipment intended for cutting, spraying, grubbing, or crushing undesirable plants are by their very nature, hazardous. Every effort should be made to ensure equipment is safe in design. Any equipment is of course only as efficient and safe as the owner and operator wishes to maintain it (Gardner 1975). Protective clothing appropriate to certain hazardous operations were once poorly available and little used. With the advent of extensive regulations, the pendulum has swung the other way with workers almost burdened with precautions. Recent statistics and occupational health findings by the Occupational Health and Safety Administration (OHSA) in the United States and the Workman's Compensation Boards (WCB) in Canada, however, strongly endorse the need for employee protection from noise, cutting, crushing and falling accidents. The provision of first aid supplies, training and evacuation procedures should be prerequisite for all tasks, especially in isolated locations. Staff should not undertake, or be required to undertake, hazardous operations on their own.

Great care is required in geographic areas where stinging or biting

insects, poisonous snakes and poisonous or puncturing vegetation are known to infest rights-of-way. Crews should be given adequate warning and be alert for such hazards and to be particularly careful where dangerous wildlife may occur especially during the period when young are reared. During hunting season, "Work in Progress" signs should be posted on right-of-way access and staff cautioned to wear high visibility jackets.

Fire hazards are present on almost every right-of-way operation. Gasoline powered engines require care and adherence to the rules governing safe handling of gasoline. Fueling large equipment under transmission lines is not recommended. Where unavoidable, equipment must be grounded. Dormant herbicide operations using fuel oil as a carrier requires explicit safeguards against fire (McPhail 1967). Oil-soaked protective clothing and equipment constitute both a fire hazard and unsafe footing. Good housekeeping and anti-skid materials can reduce these hazards greatly. The potential for burns from hot equipment, hydraulic oil and breaktime fires should be recognized.

Environmental safety, unlike job safety, is concerned with the impact of the job on the surrounding area rather than on the worker himself. Of primary concern are those elements of the environment particularly sensitive to disturbance and which have little or no capability for recovery. It is possible that, despite all the planning design, impact analysis, reports, promises and public relations, to then destroy, perhaps irreparably, areas of unique vegetation, the stability of some soils and the purity of some water courses.

Transient effects are also possible but may visit substantial hardship

on wildlife or adjacent landowners.

A legitimate concern often voiced is the impact of maintenance on drinking water quality and on fish bearing waters. Care should be taken to document and protect water resources on the right-of-way.

The hazards associated with removal of vital wildlife habitat, disturbance on the right-of-way during nesting and ungulate calving (Wan 1975) and herbicide operations which may injure or destroy bees (Hachey 1975), sensitive crops, Table VIII, or enhance the palatability of poisonous vegetation to livestock (Stahler 1950, Lynn 1952, Grigsby 1952, Frank 1957, MacLean 1970a, 1970b) should all be considered prior to and during the execution of projects.

Information sources for the assessment of work hazards may also be separated into those appropriate to job safety and those primarily concerned with environmental protection. Job safety practices should be contained in the task Safety Practices Manual discussed in the section on Support Documents. In addition, training workshops and safety meetings should promote worker safety awareness. Safety newsletters and accident statistics should be readily available.

Environmental safety should be embodied in the guidelines and task methods employed. Where necessary, clear standards should be prepared, circulated and understood by field staff both permanent and temporary. Where contract staff are engaged, contract documents must clearly stipulate requirements for environmental protection. Since many vegetation management programs, and in particular those employing herbicides, are reviewed by various regulatory agencies, it may be that hazard information is provided in the Permission to Spray (Heskin 1975).

TABLE VIII HAZARDS: CROP AND HORTICULTURAL PLANTS SUSCEPTIBLE TO HERBICIDE SPRAY DRIFT

Tobacco

Tomatoes

Grapes

Beans and Peas

All Clovers

Peppers

Carrots, Turnips, Cauliflower, Cabbage, Sugar Beets

Cereal Crops - Oats, Buckwheat and Flax

Annual Flowers

Ornamental Shrubs

Orchard Trees - Cherries, Peaches and Pears

Brush burning operations must observe the appropriate Forest Service rules and should be considered as a serious risk. Fire fighting equipment should be carried or available when appropriate.

Radio contact with control dispatches should be maintained whenever there is potential for fire, serious bodily injury, emergency evacuation, or where electrical service interruption may occur from reclearing operations. In this latter case, every effort should be made to have lines deenergized if a conductor strike is possible. Lastly there are two additional important sources of information concerning environmental safety. The utility should maintain updated historical profiles and possibly aerial photography as discussed in the section on Historical Profiles. Further, the easement agreements and multiple use agreements, which will increasingly become a function of right-of-way management, should contain details of potential hazards.

A factor which has a profound influence on the degree of hazard associated with utility rights-of-way maintenance in that of seasonability. Winter operations, though posing less risk of environmental impact, increase the potential for worker injury, while other hazards are heightened during spring or summer periods. Projects should be planned with worker safety as a prime consideration and adequate provision made for response in emergencies.

Appendix E Research and Development

RESEARCH AND DEVELOPMENT

Introduction

In order to sustain a viable vegetation management program it is necessary to establish a research and development capability. Irrespective of program size, program improvement should be a basic objective. New practices, equipment, materials, scientific knowledge, data management systems, and administrative hardware are constantly reported in the literature. Applicability of new information in light of program needs should be examined and where appropriate, field tested (McPhail 1971).

It should not be implied that program improvement should only respond to external knowledge. The scale of internal research and development may range from the innovative vegetation manager reading a few articles and initiating a moderate field trial based on his own and other utility experience, to an advanced research program of basic and applied projects conducted jointly between a vegetation management group and a research support service.

Although research and development are suggested as essential ingredients in a vegetation management program, it should not be conducted as an aside to daily responsibilities, as a favour to suppliers or in a haphazard manner. It must be an integral part of program planning, have clearly identified objectives and respond to rigorous protocols. Documentation of existing conditions, application of the method and materials, collection and interpretation of results, and use in the context of program improvement should be supported by statistically and economically sound procedures. Every effort should be made to establish research and development projects on a term

appropriate to the study concern and to dedicate the staff and resources to both follow through and follow up. All too often vegetation management research projects are started and ongoing evaluations not considered. Despite the continuous nature of vegetation growth and even where research conclusions are implemented, adequate provisions are not made to follow the validity of these findings over a period of years on a system wide basis. In this way it is possible for practices or materials of dubious merit to become established and enjoy continuing use with little scrutiny. If a diversity of task method alternatives and geographic locations do not exist, it is not possible, even with accurate records, to evaluate a method by comparison with others. It would seem that poor record keeping and inadequate monitoring of existing vegetation management methods after introduction are largely responsible for the static, conservative nature of many utility vegetation programs.

Five separate areas of right-of-way vegetation management investigation are recommended: Materials, Machinery, Methods, Multiple Use and those which do not directly fit these categories - Miscellaneous.

Materials

Applied research to establish efficiency, degradation, and environmental impact of the range of new selective and non-selective herbicides registered for right-of-way application has not been undertaken on a consistent basis amongst utilities. In some cases, development work carried out by chemical companies in conjunction with utility users has not been followed up or has been undertaken using inadequate research protocol and statistical design (Gardner 1975).

Variability, as a result of application technique, season, soil type, target species and density, ambient meteorological conditions, formulations and rate has not been adequately documented.

Routes of entry into the environment, long and short term consequences, metabolism, degradation rates and potential for selecting resistant bio-types remains to be quantified for many chemicals. Little or no recent work has been carried out by utilities into the many drift control agents, stickers and adjuvants (Woodgerd 1976). Penetrating agents and translocation modifiers require further study, as do the variants of formulation and carrier, in terms of both effectiveness and environmental impact. In particular, the impact on non-target organisms as a result of broadcast right-of-way herbicide projects should be clearly documented and published. Effect on pollinators, aquatic organisms, and enhancement of toxic properties in browse species (Grigsby 1952, Lynn 1952) are candidate topics often raised and apparently remain unanswered (Hortman 1977). Narrow spectrum herbicides, seedicides (Day 1967), product combinations and split applications should be investigated. With the exception of Krenite (Dupont 1975, Stevenson 1975, Niehuss 1974, Chappell 1976) it appears that no concerted effort has been made to assess the potential of growth regulators to replace herbicides in some programs.

On the other hand, sufficient information is not yet available about selective retention or establishment of desirable vegetation on rights-of-way. Chemicals which enhance woody shrub seed germination, suppress transpiration and evaporation loss while moving large trees, fertilizers, soil amendments, and materials which retard or prevent erosion, warrant further investigation.

Insufficient emphasis has been given to accomplishing the transition from initial research to field practice (Crafts 1967). Materials technology outpaces the vegetation manager's abilities to test and assess products. Manufacturer's field plots and regulatory agency efficacy testing cannot substitute for large field scale trials for the unique rights-of-way circumstance. Utility research cooperatives, pooling resources and expertise to answer common problems in similar bioclimatic regions should replace the present emphasis on independent and consequently uncoordinated research. Interested utilities should consider formation of a centralized right-of-way management information library system (ROWMILS).

The final responsibility for the safe introduction of synthetic chemicals into the environment rests with the user. Inappropriate or unsafe use can negate all effort at developing a "safe" compound. Carvell (1973) suggests that the controversy over herbicide use (often fought in the forum debating utility practices) has curtailed the agrochemical industries' involvement in herbicide development. It would seem good practice to ward against eventual denial of all chemical tools for vegetation management by developing products and practices which refute unfounded scientific and public criticism.

Machinery

Heavy equipment and hand tools specifically designed for vegetation management have undergone rapid development in the last decade. Hydraulics, hydrostatics, and metallurgy have allowed new applications of energy and light-weight materials. Present day timber skidders and chainsaws are two eminent examples.

Herbicide application equipment has been developed or adapted by utility companies and their contractors. Basic requirements for such equipment are that it minimizes drift, whether application is liquid, pellet, or powder, and that it maintains accurate delivery rates evenly at the target area. These premises are generally true irrespective of ground or aerial application, broadcast or spot treatment. With the notable exception of Amchem (Microfoil boom, Directa Spray Nozzles) few chemical companies have addressed the problem of application equipment.

Efficiency of equipment will be reflected in ability to traverse various terrain types with load capacity appropriate to project size, except where equipment is developed explicitly for level ground application, as in roadside truck mounted boom sprayers. Equipment should be versatile, yet developed with its expected work clearly in mind. Demountable units require intensified development, allowing the prime mover to be adapted for a variety of purposes. McPhail (1976) suggests that there is a need to develop air cushion vehicles for soft ground, while Baribeau (1976) expressed a need for improved equipment to apply pellets and mechanical brush cutters which will work all year round. Peters (1976) notes a need for snowmobile mounted seeding equipment.

Equipment safety research would appear important, but is not discussed in the utility vegetation management literature. The continuing emphasis on mechanical cutting by machine or hand tools with their attendant danger of operation injury bears further investigation at least to develop a data base on frequency and type of injury specific to right-of-way operations.

Development of criteria for work study analysis of equipment productivity, and for assessing durability and down time appear necessary to allow

equatable comparison of equipment within or available to the utility industry. Design and experience sharing should find a concrete vehicle for expression between and within companies as suggested in the management information library.

In summary, lack of uniform research, identification of needs, and few mechanisms for directly sharing information characterize the present weakness in equipment or tool research and development for utility vegetation management operations.

Methods

A wide variety of methods have been developed to meet individual needs in the field of utility vegetation management. Despite the existance of possibly 3,000 utilities in North America with rights-of-way carrying high or extra high voltage transmission lines, barely a handful of authors have consistently published their experiences and documented their method failures and successes.

A more detailed understanding is required of the benefit/risk and benefit/cost techniques of appraising vegetation control methods. Criteria are required for comparison of task methods and for comparison of technique alternatives within task methods. "Cost" effectiveness must be judged over decades rather than over years, and tested against the objectives of management, as well as against an economic scale.

Administrative and vegetation management theory is, in general, poorly elucidated. The application of sophisticated game plans, strategies, and right-of-way management plans must attend the future of right-of-way development. Automation of data acquisition and synthesis, computerization of data

handling, storage and retrieval, and utilization of low impact technology will dominate the field of research and development into new methods. Such an embrace must not, however, ignore the apparent inability of existing systems to adapt quickly and new technology to make the quantum leap from genesis to application. Overcoming man's reticence to respond to innovation must be recognized as an integral step in the search for, and application of new methods.

Multiple Use

Much has been written about the benefits of multiple use of rights-of-way (Carvell 1973, Randell 1973, Young 1970). Much remains to be written. The compatability of differing utilities within the common corridor concept requires functional and aesthetic validation. The incompatability between conflicting multiple use values, as in wildlife habitat enhancement but unrestricted hunting access, require documentation and resolution. Physical impact of some multiple use as in recreational vehicle erosion on right-of-way integrity require more detailed examination.

The productive capacity of rights-of-way to produce food and fibre (Popovinnkoff 1976) will become increasingly apparent before the beginning of the 21st century as energy input analysis will demand a higher yield of return for resources expended.

Miscellaneous

Some basic biological, social and managerial research needs are evident from an assessment of existing vegetation management programs. Too little is yet known about successional development on rights-of-way after initial

clearing and the most appropriate maintenance practices which should subsequently follow. The relationship between restoration planting after clearing and subsequent maintenance requires clearer definition. The seed production and establishment of native species and the appropriateness of various species has been barely started.

Interaction with the public and inter and intra utility communications requires improvement. Mechanisms to facilitate improved communications are yet ill defined despite rapid advances in media technology.

Intensified regional planning will require right-of-way incorporation into detailed land use plans as urban centres expand. Right-of-way managers will require a broader spectrum of skills and understanding. The era of the generalists and integrationalist will and is replacing the era of the narrow specialists and individualists. This should not indicate an erosion of the creative and innovative toward the insensate, rather the emphasis will be for excellence of concept with greater universiality of application.

The vegetation manager of the future will require training and experience far broader than at present. An integration of biological and social sciences must form a fundamental educational grounding on which to build an array of Managerial Skills. Considerable research remains in order to establish the market needs for vegetation and right-of-way managers and the basic curriculum appropriate to their training for the future.

Appendix F Non-Electrical Right-of-Way Maintenance Tasks

Re-clearing

Bulldozing

Scarifying

Stump Removal

Burning

Seeding

Right-of-way inspection and policing of easements

Multiple land user supervision

Erosion observation, control and maintenance

Stream observation, control and maintenance

Rubbish collection and disposal

Sign placement and maintenance

Fence and building grounding

Fence and gate construction and repair

Danger tree determination and removal

Woody 'brush' cutting - machine

Woody 'brush' cutting - hand

Woody 'brush' spraying

Woody 'brush' chemical treatment - other

Water crossing construction and maintenance

Water crossing repair

Helicopter landing site clearing and maintenance

Road crossing screening

Road crossing pruning

Selective cutting maintenance

Chipping of debris

Recreational facility servicing

Tower inspection

Tower painting

Insulator washing

Noxious weed spraying

Noxious weed chemical treatment - other

Grass cutting - machine

Grass cutting - hand

Grass growth control - chemical

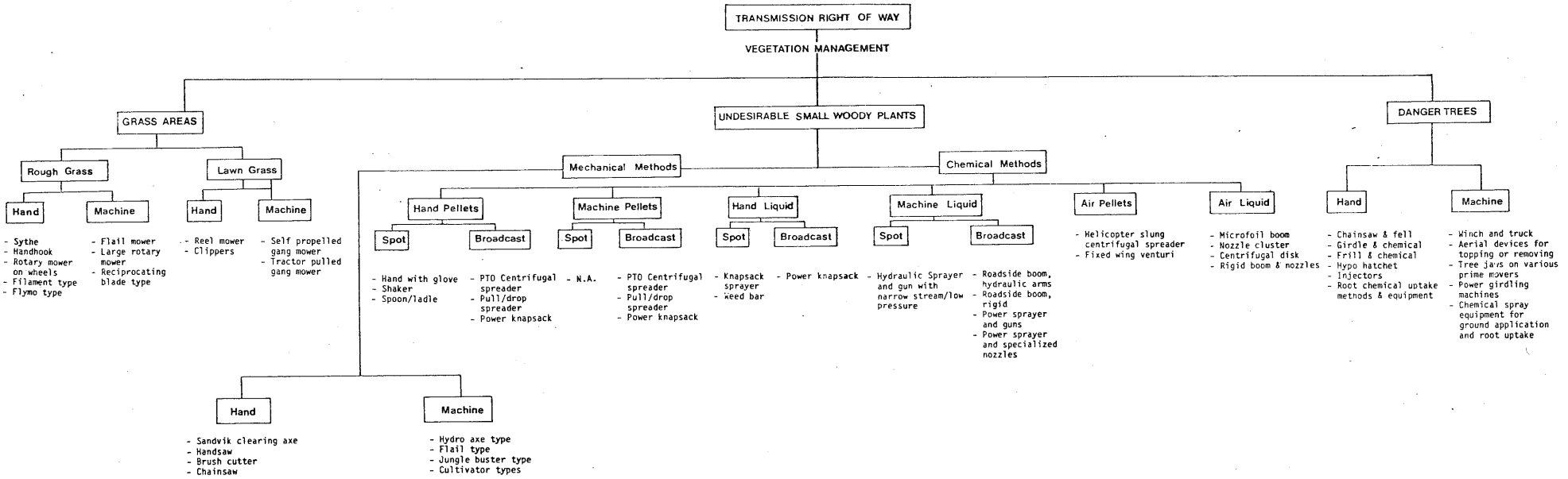
Insect and rodent control

Pole treatment

Liaison with property owners

Applied research and development
- material
- equipment
- techniques

Appendix G Example Task Method Breakdown


TRANSMISSION RIGHT OF WAY
VEGETATION MANAGEMENT
GRASS AREAS
Rough Grass
Hand
- Sythe
- Handhook
- Rotary mower on wheels
- Filament type
- Flymo type
Machine
- Flail mower
- Large rotary mower
- Reciprocating blade type
Lawn Grass
Hand
- Reel mower
- Clippers
Machine
- Self propelled gang mower
- Tractor pulled gang mower
UNDESIRABLE SMALL WOODY PLANTS
Mechanical Methods
Hand
- Sandvik clearing axe
- Handsaw
- Brush cutter
- Chainsaw
Machine
- Hydro axe type
- Flail type
- Jungle buster type
- Cultivator types
Chemical Methods
Hand Pellets
Spot
- Hand with glove
- Shaker
- Spoon/ladle
Broadcast
- PTO Centrifugal spreader
- Pull/drop spreader
- Power knapsack
Machine Pellets
Spot
- N.A.
Broadcast
- PTO Centrifugal spreader
- Pull/drop spreader
- Power knapsack
Hand Liquid
Spot
- Knapsack sprayer
- Weed bar
Broadcast
- Power knapsack
Machine Liquid
Spot
- Hydraulic Sprayer and gun with narrow stream/low pressure
Broadcast
- Roadside boom, hydraulic arms
- Roadside boom, rigid
- Power sprayer and guns
- Power sprayer and specialized nozzles
Air Pellets
- Helicopter slung centrifugal spreader
- Fixed wing venturi
Air Liquid
- Microfoil boom
- Nozzle cluster
- Centrifugal disk
- Rigid boom & nozzles
DANGER TREES
Hand
- Chainsaw & fell
- Girdle & chemical
- Frill & chemical
- Hypo hatchet
- Injectors
- Root chemical uptake methods & equipment
Machine
- Winch and truck
- Aerial devices for topping or removing
- Tree jaws on various prime movers
- Power girdling machines
- Chemical spray equipment for ground application and root uptake

Appendix H Bonneville Power Manual on Right-of-Way Inventory

BRANCH OF MAINTENANCE·DIVISION OF POWER MANAGEMENT·BONNEVILLE POWER ADMINISTRATION

BPA Manual on R/W Inventory

Functions and Implementation

A total management system requires a total inventory. To assure ourselves of a full understanding and uniform application of the inventory method for the entire Bonneville Power System, a standard procedure has been devised which will satisfy the needs and conditions of the system and each Area.

The Inventory Program and its adaptation to the ADP system makes possible a multitude of uses. Some of these uses are:

(1) Budget preparation.
(2) Planning and Programming.
    a. Scheduling.
    b. Determining method or techniques from "what's there".
    c. Furnish data for contracts.
(3) Location of problem areas.
(4) Use in developing multiple right-of-way uses.
(5) Provide answers to statistical questions such as how much and where (ownership, vegetation, critical areas, etc., by Line, District, Area).
(6) Miscellaneous facility data.
(7) Summary data for reports such as "Environmental Impact Statements".
(8) Detailed analytical studies such as growth predictions resulting in identification of problem areas.

It is recognized that the compilation of this inventory is no small task. It will involve many hours of field work, office time and computer time. It will require new tools to improve and expedite the process. To satisfactorily serve the purposes of the inventory the Right-of-Way Maintenance Specialists will have photos, type maps and computer data available to be used in combination.

Continual updating of the right-of-way inventory including the addition of new facilities is a basic requirement. The concepts which have been developed were devised with this need in mind.

The updating procedure is designed to not only provide a view of the current status of the rights-of-way but also a historical record. Only with such a record can we fully analyze the effectiveness of the Right-of-Way Management and Maintenance program.

No specific procedures will be established as to the collection of inventory data. Photos and maps are to be used to a great extent and field work generally to confirm photo and map interpretation. Recording of data for computer application will be precise and performed by a predetermined procedure. Each Area will establish a priority for the order in which rights-of-way will be inventoried. The same priority will be used to set up a schedule for the necessary photography. Mapping procedures will be

standardized and are set forth in Section II. Definition of terms is found in Section IV.

To make the inventory, recording the data, flexibility for data use and ready availability of data, the procedures for taking the inventory are controlled for computer application. In the process of development, coordination and uniformity with other systems was of particular concern. As a result, some format has been adopted from BLM and USFS procedures.

During the early stages of development of the inventory system the hope had been to control the data by the tract identification as used by the Branch of Land. After much study and interchange of ideas it was determined that "tract identification" created a degree of inflexibility that was not compatible with the desired uses of the inventory. The decision was made that the basic unit to be inventoried will be the "span", the starting point being a structure and ending at the next structure ahead-on-line. The unit is fixed in that it is always one span but flexible in that it accommodates both the variable widths of the rights-of-way and the variable lengths of the spans. The section on "treatment data" is patterned after the program developed by the Portland Area. In addition to the computer application of the inventory system, certain other procedures have been developed for office and field use of the program.

The major tools of the inventory program are the photos, graphic aids such as maps and the computer program.

A. Graphic data will be recorded in several ways. Data considered to be permanent can be recorded on the working photo maps. Reproduction of these will be made for field use whether it be for gathering of inventory data, for BPA crew use in assignment of right-of-way work or for use by Contractors in vegetation control work.

   Scale of the photo maps will be retained at the present scale of 1" to 400'. Photo maps are compiled on the basis of providing a pictorial facsimile of the right-of-way and therefore are not photogrammetrically correct. The error in scale is negligible over short distances and can generally be ignored.

   Plan and Profile maps are still of utmost value as information is contained on them not available on the photo maps.

   Data to be mapped will consist of vegetation types, species land use, critical areas, water courses and restricted areas. A full tabulation of inventory data to be recorded in graphic form is included in Section I. Mapping keys and symbols are illustrated in Section III. Certain data will be identified on the map in the identical manner that it is recorded for the computer program and is included in the description of the computer program.

B. Photography suitable to serve the inventory system is the key to the program. After serious consideration of the available photography

the decision was to use the 1" to 1000' color which is presently being developed. This type has versatility for other uses now in progress. These are DT analysis, photo-maps and reconnaissance of possible parallel new construction. The present priority of scheduled photography for DT analysis complements the needed photography to initiate the inventory program.

It is also possible to reduce cost of photography by incorporation of existing black and white photos into the inventory process. Some equipment will be necessary to provide the means of transferring photo data accurately and rapidly to the base maps.

C. Computer application provides the means of extracting inventory data in a usable form. To assure the uniformity of data collection, recording and interpretation for management purposes all data has been strictly coded and defined. Slightly modified has been the coding developed by the Portland Area for the segment of treatment data. The inventory listing in Section I has been developed on a broad scale so as to encompass the multitude of situations that exist within the system. By the proper selection of the specific data an accurate inventory will result with little error for interpretation.

There has been some testing and thorough review of the cards on which the data will be recorded. A sample is attached in Section II, which also includes the coding which will be used to record the inventory data.

The program is designed to extract for compilation any particular data desired by line, district, Area, or any combination, up to system totals. Section I contains definitions of all terminology used in the inventory system. This includes that used for mapping and computer programming. These definitions should preclude any misunderstanding of the terminology meaning or misuse of the terminology.

To maintain uniformity of the system contact between Areas and the computer programmer will be through the Branch of Maintenance, Right-of-Way Management Specialist. Proposals for changes, additions or deletions will be submitted to the Branch for consideration and implementation. The entire Inventory program will be published as a separate chapter of the Right-of-Way Management Standards handbook.

One of the principal features of the inventory system will be the capability of providing an historical record. This will be of particular use in evaluating the effectiveness of the vegetation management.

In the following sections the various functional aspects of the inventory system are described.

BPA Manual, R/W Inventory

Section I. Sets out the inventory data in the order that it appears on the computer coding form. Under each numbered data items are shown the numerous categories of data that will be specifically identified. The last page of this section is a copy of the coding form. This section also includes a brief description of each data item.

Section II. The data again is listed in the order in which it appears on the coding form. In this section the exact coding of all data is shown. Coding requires a very specific vocabulary to be applied in a very legible manner.

Section III. Contains all the necessary mapping data; keys, symbols and aids. Most of this data is self-explanatory.

Section IV. Sets out the mapping procedures that will provide the reliable data source necessary to the success of the inventory program.

Section V. Briefly sets out procedures and guidelines for the proper use of the inventory data sheet.

Appendix I Daily Vegetation Control Record

DATE
REVIS ON

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INDEX

D75-251

USE OR APPLICATION OF HERBICIDE
DAILY VEGETATION CONTROL RECORD

REGION _____
DISTRICT _____
LOCATION _____ FROM/TO _____

LINE _____
STATION _____
OTHER _____

PREPARED BY INDUST. ENGRG.

NO.	ITEM	REMARKS
A	**ENVIRONMENT DATA**	
1	TARGET SPECIES AND DENSITY	_____ ____% _____ ____% _____ ____% / _____ ____% _____ ____% _____ ____%
2	TOPOGRAPHY	_____ TERRAIN _____ SLOPE
3	PREDOMINANT SOIL TYPES	
4	PREDOMINANT SOIL MOISTURE	
5	DRAINAGE FEATURES	
6	WATER BODIES	
7	STIPULATED PRECAUTIONS FROM PERMIT FOR THIS DATE	
8	HAZARDS FROM PRE-JOB CONFERENCE FOR THIS DATE	
B	**CLIMATIC DATA**	0900 HRS. / 1200 HRS. / 1500 HRS.
1	WIND SPEED	_____ MPH / _____ MPH / _____ MPH
2	WIND DIRECTION	_____ DIR. / _____ DIR. / _____ DIR.
3	HUMIDITY	_____ % / _____ % / _____ %
4	TEMPERATURE	_____ MAX. °F
5	PRECIPITATION	_____ BEFORE/AFTER _____
C	**HERBICIDE DATA**	HERBICIDE NO. 1 / HERBICIDE NO. 2
1	HERBICIDE NAME COMMON OR PRODUCT CHEMICAL	
2	PCP REGISTRATION NUMBER	
3	CARRIER NAME	
4	HERBICIDE TO CARRIER RATIO	
5	TOTAL MIXTURE APPLIED	
6	TOTAL ACRES TREATED	
7	RATE/ACRE OF MIXTURE APPLIED	
8	ACTIVE INGREDIENT PER ACRE	
9	APPLICATION METHOD	

REMARKS:

DATE _____
SUPERVISOR'S SIGNATURE _____
APPLICATOR'S SIGNATURE _____
APPLICATOR'S CERTIFICATE NO. _____

OPERATIONS ENGINEERING DIVISION — STRUCTURES DEPARTMENT

D75-251

USE OR APPLICATION OF HERBICIDE REPORT GUIDE

NO.	ITEM	REMARKS
A	**ENVIRONMENT DATA**	
1	TARGET SPECIES AND DENSITY	NAME MAJOR SPECIES AND PERCENT TO BE CONTROLLED.
2	TOPOGRAPHY	RECORD TERRAIN IN AS FLAT, ROLLING OR MOUNTAINOUS. RECORD SLOPE AS LEVEL, MODERATE OR SEVERE.
3	PREDOMINANT SOIL TYPES	RECORD AS ROCKY, GRAVELLY, SANDY, CLAY, LOAMY OR PEAT.
4	PREDOMINANT SOIL MOISTURE	RECORD AS WET, DAMP OR DRY.
5	DRAINAGE FEATURES	NAME ALL RIVERS AND STREAMS IN OR NEAR TREATED AREA.
6	WATER BODIES	NAME ALL SLOUGHS, PONDS, LAKES IN OR NEAR TREATED AREA.
7	STIPULATED PRECAUTIONS FROM PERMIT FOR THIS DATE	RECORD ALL INSTRUCTIONS, CAUTIONS AND SUGGESTIONS. FROM B. C. PESTICIDE COMMITTEE OR FEDERAL E. P. AGENCY.
8	HAZARDS FROM PRE-JOB CONFERENCE FOR THIS DATE	RECORD ALL HAZARDS FROM PRE-JOB CONFERENCE NO NOTED IN ITEM A7, STIPULATED PRECAUTIONS.
B	**CLIMATIC DATA**	
1	WIND SPEED	RECORD WIND SPEED IN MPH. AT TIMES SPECIFIED.
2	WIND DIRECTION	RECORD WIND DIRECTION AT TIMES SPECIFIED.
3	HUMIDITY	USE STANDARD WET BULB METHOD.
4	TEMPERATURE	RECORD MAXIMUM TEMPERATURE FOR THIS DATE.
5	PRECIPITATION	RECORD AS HEAVY. MEDIUM. LIGHT AND CONTINUOUS OR SHOWERS AND IF BEFORE OR AFTER APPLICATION.
C	**HERBICIDE DATA**	
1	HERBICIDE NAME COMMON OR PRODUCT CHEMICAL	RECORD COMMON NAME OR PRODUCT NAME FROM CONTAINER. RECORD FORMULATION AND PERCENT ACTIVE INGREDIENT BY WEIGHT
2	PCP. REGISTRATION NUMBER	RECORD PEST CONTROL REGISTRATION NUMBER.
3	CARRIER USED	ALSO INCLUDE ANY STICKER, EMULSIFIER OR SPREADING AGENT.
4	HERBICIDE TO CARRIER RATIO	RECORD RATIO OF ACTIVE INGREDIENT TO CARRIER USED.
5	TOTAL MIXTURE APPLIED	RECORD TOTAL AMOUNT OF HERBICIDE MIXTURE APPLIED.
6	TOTAL ACRES TREATED	RECORD TOTAL ACRES TREATED.
7	RATE/ACRE OF MIXTURE APPLIED	CALCULATE RATE PER ACRE OF MIXTURE APPLIED.
8	ACTIVE INGREDIENT PER ACRE	CALCULATE ACTIVE INGREDIENT PER ACRE TREATED.
9	APPLICATION METHOD	RECORD APPLICATION METHOD AND EQUIPMENT USED.

Appendix J Policies and Procedures for Use of Pesticides

Note: All specific references to originator are deleted.

POLICIES AND PROCEDURES	PAGE 1 of 5	NUMBER EO-E1
	DATE 1 March 1976	

Subject: USE OF PESTICIDES

For further information apply to: Vegetation Management Supervisor
Structures Department
Operations Engineering Division

POLICY

Herbicides used by will accord with policy set by Directors and pertinent legislation.

This Policy applies to Contractors employed on authorized work as well as all staff.

NOTE: Provincial legislation may be changed as a result of the findings of the Royal Commission of Inquiry into the Use of Pesticides

PROCEDURE

1. All proposed pesticide treatments, irrespective of size of program and whether undertaken by staff or a contractor, must be submitted on the appropriate form. Submissions, including maps clearly showing the location of the proposed treatment should be sent to the Interdepartmental Pesticide Committee and Environment Canada for prior approval. See Appendix A.

In order to reduce the delay in processing applications, proposals should be forwarded to the regulatory agencies as soon as program needs are recognized. Programs applied for but not completed in the calendar year for which application was made must be applied for again the following calendar year.

This requirement includes:

A. Foliar application of herbicides on a broadcast or spot basis.

B. The use of pelletized herbicides, either on a broadcast treatment or scattered touch-up basis.

C. The use of either liquid or pellet soil sterilants.

D. The use of dormant sprays or treatments on exposed cut stumps.

E. The use of chemical mowing agents (desicants) for grass control.

F. The use of selective herbicides to control broadleaf weeds and grass in landscape plantings.

G. Insecticide treatments and treatments intended for the control of birds and vermin.

POLICIES AND PROCEDURES	PAGE 2 of 5	NUMBER EO-E1
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2. Only those pesticides registered under the Pest Control Products Act are authorized for use by personnel or by contractors. A schedule of Approved Chemicals and Formulations may be obtained from Vegetation Management.

3. Where it is necessary to carry out the work by contract the contractor shall be accredited under the Act of the Province of

4. Accurate records of all pesticide treatments should be made on form D75-251, (Appendix B), obtainable from Vegetation Management. In addition, a program summary sheet should be completed and any discrepancies between the size of the program applied for through the regulatory agencies, and the size of the program carried out should be clearly indicated. Surplus herbicide on hand should be clearly noted.

These summary sheets should be forwarded to the Vegetation Management Section as each program is completed.

5. Each herbicide application shall be supervised by a employee (or a contractor's employee) who holds a valid Non-Agricultural Non-Forestry Vegetation Control Pesticide Applicators Certificate. Other classes of certificates are not permitted except a Landscape and Garden Pest Abatement Certificate for insect control or weed control in landscaping.

The certified applicator must be present during the execution of the work. He must also be conversant with permit recommendations from both the Interdepartmental Pesticide Committee and Environment Canada for that specific job.

6. Each Provincial Regional District in which herbicides are to be used should be informed by letter early in the year of the herbicide program for the coming season. At the same time request a meeting between Hydro officials and their representatives, at their convenience, to provide further information on the program: its extent, timing, procedures, and rationale.

Wherever possible an attempt should be made to contact adjacent landowners prior to commencement of the spraying to inform them that this work will be carried out. Care should be taken to determine if prior agreements have been made with Properties Division on easement property which specifically precludes the use of herbicides for brush control. Where disagreements arise which cannot be resolved at the Regional Divisional level, the matter should be referred to the Vegetation Supervisor. The Local or Regional District Councils, the Fish and Wildlife Office and the appropriate health unit must be informed of proposed programs not less than one month prior to intended start up date.

Particular care must be taken with stem foliage programs adjacent to susceptible crops and ornamental vegetation. Where possible it is recommended that dormant application be substituted for foliar application where the possibility of drift damage exists. The following is a partial list of susceptible plants of economic importance in

(a) Orchard trees, cherries, peaches, pears, etc.
(b) Grapes
(c) Tomatoes
(d) Peas and beans
(e) Carrots, turnips, cauliflower, cabbage and beets
(f) All clovers
(g) Annual Flowers
(h) Ornamental shrubs and trees.

7. Conditions of Spraying:

A. Water: Under no circumstances should herbicide drift, spillage, or leakage be allowed to enter into potable water. Extreme caution should be exercised in spraying low-lying areas which may fill with water during heavy run-offs. Specific recommendations for the protection of streams and other water bodies are normally contained in the recommendations from the regulatory agencies, which must be closely followed.

B. Wind: Extreme care should be exercised during any type of spray operation to ensure that no drift of spray solution is allowed off the area being treated. With any foliar spraying where susceptible crops or ornamental vegetation are nearby, any breeze, whether steady or gusting, shall be treated as hazardous. It shall be the responsibility of the applicator to exercise extreme caution under these conditions, and if considered necessary to suspend operations using aqueous or oil carriers. The adjustment of spray gun nozzles must always be maintained to produce a minimum of fine particles, and tank pressures should not exceed those which will cause fogging of the spray mix.

C. Height of Vegetation: Vegetation which is greater than 10 ft. in height shall not be chemically treated unless specific authorization has been obtained from the Divisional Manager or Head Office. Under no circumstances should vegetation over 10 ft. in height be sprayed and left standing in areas readily accessible to the general public. In addition, no dense vegetation greater than 3 ft. in height shall be sprayed on road sides.

As an alternative, vegetation should be mechanically cut and deciduous stumps treated to prevent re-suckering. Wherever practical, vegetation at road crossings in forested areas should not be sprayed in order to encourage natural screening of the right-of-way.

D. Permissible Spray Temperature: The effectiveness of translocated herbicide applications to control vegetation is dependent upon ambient temperature. In addition there is an increased risk of fire and volatization from herbicides at high temperatures. Listed below are the temperature ranges permissible for various types of spraying:

(i) Brush control:

- stem, foliar spraying	10°C to 27°C
- dormant spraying	-13°C to 30°C

(ii)	Weed control:	
	- lawn areas	10°C to 30°C
	- rights-of-way	10°C to 30°C
	- stump treatment - summer	10°C to 20°C
	- winter	-13°C to 20°C
(iii)	Insect control	5°C to 27°C

E. Storage: All pesticides should be stored in locked buildings, appropriately identified with a Chemical Storage Warning Notice. Buildings should be preferably dry, well-ventilated, fire-proof and frost-proof. Liquid herbicide concentrate should be stored in a separate area from wettable powders and pelletized formulations and drift control agents. Inflammable liquids of petroleum origin, such as solvents, diesel fuel, etc. should not be stored with pesticides. Wooden buildings should not be used for the storage of herbicides or their carriers.

F. Personal Hygiene: Although herbicides used by (with the exception of Gramoxone) are not considered to be hazardous to humans, every effort must be made not to contaminate clothing or equipment. Great care should be exercised with Gramoxone to ensure that no chemical comes in contact with other than the target area. Once sprayed this chemical is de-activated on contact with soil or vegetation.

If any pesticide is spilled on skin or clothing, the clothing should be removed and contaminated skin washed with soapy water. Avoid contaminating natural water sources. Clothing must be thoroughly cleaned before re-using. Where possible, arrange the program for each day to work upwind of spray operations, working away from the area last treated.

G. Disposal: Under no circumstances should surplus herbicide, storage containers or packages be disposed of in such a way as to present a hazard to fish, wildlife, or human beings. Final spray operations should be arranged so that spray mix is appropriately used up. Small quantities of surplus herbicides, contaminated mop-up material, and surplus containers should be buried under 18" of soil in a location well away from ground water or drainage channels.

H. Safety: In addition to Items 5(a) Protection of Water, and 5(b) Drift Control, it shall be the specific responsibility of the licensed applicator on the job to supervise the following:

(a) Herbicide mixes shall be prepared at the rates applied for in the application to the regulatory agencies. Permission to use rates less than the specified rate must be cleared by the appropriate program supervisor. Under no circumstances should rates greater than the label recommendations for the herbicide in question be applied.

(b) No equipment shall be used on a weed control program where that equipment is not functioning in a reliable and safe manner.

POLICIES AND PROCEDURES	PAGE 5 of 5	NUMBER EO-E1
	DATE 1 March 1976	

(c) At no time shall herbicide concentrate or spray mix be decanted into any container other than one marked to specifically show its contents and bearing the appropriate hazard symbols.

(d) At no time shall spray equipment, herbicide or spray mix be left unattended in such a way that unauthorized personnel may have access to them.

(e) In the case of an operational mishap such as spills, overspray or potential environment damage, contact the Environmental Protection Service at 666-6711, or in the case of an emergency, call 666-6100 which can be reached 24 hours a day.

Manager, Operations
Engineering Division

Assistant General
Manager, Electrical Operations

General Manager

Appendix K Example Vegetation Management Job Description

job identification data

title	total points	rating classification
TECHNICIAN - VEGETATION MANAGEMENT	365	63

group	occupation code	date
Engineering and Operations	330027	July 14, 1975

branch	department	
Operations	Forestry	10-5

division (region)	section or unit
System Maintenance	Vegetation Management

title of immediate supervisor	occupation code
Senior Forester - Vegetation Management	723401

title of all jobs directly supervised	occupation codes

JOB FUNCTION

Assist others in the section by carrying out field assignments and performing a variety of technical analyses and evaluations on matters pertinent to vegetation management, such as, outage data, experimental line-clearing work, workload survey data, development of work practices and equipment, biological vegetation control and herbicides and growth retardants. Attend meetings and equipment demonstrations as requested. Prepare technical lesson material and act as back-up instructor in connection with the forestry training program. Assist in research and development of specialized tools, materials and equipment and participate in discussions with internal and external sources pertinent thereto. Participate in evaluations of contractors' resources and assessment of work done by them.

THIS DOCUMENT REPLACES THAT DATED APRIL 4, 1974, CODED 330027 AND TITLED TECHNICIAN - VEGETATION MANAGEMENT.

JOB DESCRIPTION

1030 (FRONT)
REV. 9-65

SHEET 1

TITLE	CODE NUMBER	DATE
TECHNICIAN - VEGETATION MANAGEMENT	330027	July 14, 1975
	TOTAL POINTS	RATING CLASSIFICATION

1. Analyse outage data to determine from a forestry standpoint the reasons for outages from data gathered from Outage Reports and on-site investigations. Extract all pertinent data and analyse to determine reason for outages, such as, size and specie of vegetation doing the damage, and past maintenance practices. Associate with past outages in the area concerned to assist in identifying if outage is caused by a repetitious or unique fault. Prepare reports on findings and submit to appropriate section personnel for further study. Maintain all pertinent outage record data by region and area for reference purposes.

2. Participate in establishing line-clearing experiments and follow up on the evaluation of same to determine the value and benefits of extending line-clearing cycles, pruning techniques and the like. Receive assignments from Supervisor or other section personnel indicating area of concern, locality and other general data. Study assignment and decide on method of approach and schedule. Visit regional and field personnel to discuss and agree on suitable experimental sites and gain their cooperation. Coordinate the activities of field personnel and equipment and other staff services, such as Management Services Department, Safety Department, Customer Service Division and other concerned personnel. Initiate experiment and stay with it until either complete, or running smoothly. Visit areas from time to time to assess progress and keep assignment originator informed. Assess experiment upon completion considering such aspects as economics, outages, customer acceptance, public safety and prepare a report covering findings and recommendations. Submit to originator of assignment for review and further processing.

3. Participate with field personnel in the survey of workload to establish the manpower and equipment requirements to fulfill the area forestry needs. Receive assignments from Supervisor or other section personnel with a general outline of requirements. Study assignment and lay out sample plot locations on map. Contact field personnel to discuss program, obtain their concurrence and arrange for the necessary personnel and equipment. Visit field location and supervise and assist field personnel in surveying workload. Tabulate workload data in a suitable format and forward to assignment originator for review, analyses and finalizing.

JOB DESCRIPTION SHEET 2

62030 (FRONT)
REV. 9-65

TITLE	CODE NUMBER	DATE
TECHNICIAN - VEGETATION MANAGEMENT	330027	July 14, 1975
	TOTAL POINTS	RATING CLASSIFICATION

4. Instruct, as required, Forestry Tradesman both in the classroom and the field in specialized subject matter, such as, workload surveys, experimental line-clearing work, herbicide application and the like. Assist in the preparation of training material, present lectures, demonstrate various techniques and use of specialized tools and equipment. Act as back-up man to regular forestry instructor.

5. Assist others in the section, as assigned, in the research and development of specialized tools, materials and equipment pertaining to forest operations and in the development of work practices and procedures pertinent thereto. Contribute from a practical standpoint, based on field trials and experience with similar equipment, any modifications that would result in an efficient, reliable, safe and economic operation. Arrange for assistance of field personnel during field trials and take over the field testing and development phase of the program. Work with Transport and Work Equipment Department personnel and suppliers' representatives on design and modifications.

6. Participate with others in the section, as assigned, in research and development work involving herbicides, growth retardants and biological brush control. Receive a general outline on the type of assignment, locality involved and other essential information. Study assignment, gather the necessary data and in conjunction with regional or area personnel select a desirable test plot. Arrange with area personnel for the application of chemical if a large area is considered and if a small area is chosen, in conjunction with assignment originator, mix and apply as necessary and tag and/or record species treated. Cooperate with chemical suppliers on matters associated with above. Inspect area at a predetermined time to assess the effectiveness of the program. Prepare report on findings and submit to assignment originator for consideration and further action.

7. Attend internal and external meetings associated with the section's activity and report on outcome of meeting. Attend forestry equipment demonstrations to become familiar with new equipment and make recommendations as required.

JOB DESCRIPTION

TITLE	CODE NUMBER	DATE
TECHNICIAN - VEGETATION MANAGEMENT	330027	July 14, 1975
	TOTAL POINTS	RATING CLASSIFICATION

8. Investigate field complaints, suggestions, new developments, etc, with regard to hand tools, small power tools, chippers, aerial lifts, pesticide application equipment, materials, etc. Work with appropriate Ontario Hydro personnel, suppliers and/or other outside contacts to resolve quality and supply problems to department's benefit.

9. Assist in the evaluation of contractors' resources and assessments of their work. Follow up on contract jobs to ensure standards are met. Recommend to Supervisor action needed to remedy substandard work performed by contractors.

10. Advise section head on field practicality of proposed policies and practices, of safety rule changes and matters dealing with the equipment, tools and materials of the trade. Participate in regional audits and provide input from a standpoint of quality of work, quality of tool and equipment maintenance, adherence to safety rules and general overall crew performance.

11. Perform other duties as required.

JOB SPECIFICATION

TITLE	CODE NUMBER	DATE
TECHNICIAN - VEGETATION MANAGEMENT	330027	July 14, 1975
	TOTAL POINTS 365	RATING CLASSIFICATION 63

	DEG.	PTS.
EDUCATION - Requires a knowledge of business practices and procedures and a knowledge of forestry trades to assist in coordinating, collecting, analysing, evaluating and maintaining appropriate data associated with vegetation management covering such subjects as experimental line-clearing work, research and development involving herbicides and growth retardants, workload surveys and the like. Requires a knowledge of communicative skills, oral and written, to prepare clear concise reports, to converse intelligently with internal and external contacts, to prepare lesson material and instruct Forestry Tradesman. This knowledge is considered to be normally acquired in and equivalent to a Grade XII education in a secondary school plus additional short specialized training courses in appropriate subject.	4	72
EXPERIENCE - Requires experience in forestry or associated work to become familiar with the use, operation and maintenance of tools and equipment essential to forestry work, the use and application of herbicides and growth retardant chemicals, and the proper treatment of trees and underbrush pertaining to line clearing. Requires experience in analysing and evaluating a variety of subject matter pertinent to forestry management and preparing written reports on findings. Requires experience in preparing training material and instructing in methods, techniques and procedures. Requires experience on the job to become familiar with Hydro forestry methods and procedures, geographical locations, responsibilities of Head Office, regional and area personnel, internal and external contacts and to become generally familiar with the duties involved. A period of up to eight years is considered necessary to gain this experience.	8	91
DIFFICULTY OF SOLUTION OF WORK PROBLEMS - Difficulties are often encountered in deciding on a suitable site for line-clearing experiments and arranging for workload surveys. Requires gathering all essential data, analysing and assessing all requirements, discussing	3	45

CONTINUED ON SHEET 2

JOB SPECIFICATION

62028 (FRONT)
REV.12-65

TITLE	CODE NUMBER	DATE
TECHNICIAN - VEGETATION MANAGEMENT	330027	July 14, 1975
	TOTAL POINTS	RATING CLASSIFICATION

DEG.

various alternatives with regional and area personnel and based on findings, experience in handling similar circumstances, and a knowledge of the requirements decide on a course of action that will meet the needs, modifying as required to meet extenuating conditions.

PHYSICAL FATIGUE - Requires performing some duties while seated at a desk with frequent visits to field locations requiring many periods of standing and walking, walking over rough terrain, handling reasonably heavy apparatus and testing, using and demonstrating forestry equipment. 3

MENTAL FATIGUE - Requires concentration for periods of varying duration, often in excess of one hour, while analysing outage data, while participating in line-clearing experiments and workload surveys and evaluations of same, in the development of equipment and work practices and in the application and development of herbicides and growth retardants. 3

RESPONSIBILITY FOR INDEPENDENT ACTION - Assignments are received from Supervisor or others in the section with a general outline in the requirements, locality and contacts involved. Requires studying assignments, gathering and reviewing all essential data, contacting internal and external sources and following assignments through to completion according to guidelines received and departmental policies. Requires keeping assignment originator informed of progress and seeking their guidance on unusual problems or matters not often encountered of a significant nature. Work is checked through discussions from time to time and the submission of reports on findings and recommendations. 3

RESPONSIBILITY FOR SUPERVISION - Requires assigning and checking work of personnel on loan from time to time while performing field forestry assignments.

JOB SPECIFICATION

62028 (FRONT)
REV. 12-65

SHEET 3

TITLE	CODE NUMBER	DATE
TECHNICIAN - VEGETATION MANAGEMENT	330027	July 14, 1975
	TOTAL POINTS	RATING CLASSIFICATION

	DEG.	PTS
NUMBER SUPERVISED - Direct - 0 Indirect - 0	1	6
CONTACTS - Requires collaborating with regional and area personnel while investigating field complaints and on the utilization of appropriate equipment and manpower when arranging for the implementation or assessment of work programs, such as, workload surveys, equipment development and experimental programs. Requires contact with Transport and Work Equipment personnel and with representatives of government agencies and suppliers to discuss design, legislation, quality and delivery of vehicles and equipment and attempt to reach agreement on changes to meet Head Office and field requirements. Requires contact with contractors when evaluating their resources and assessing their work.	3	24
RESPONSIBILITY FOR ACCURACY - Errors in analysing outage data or while participating in the setting up and evaluation of forestry experiments, development and work survey programs may be difficult to detect in the early stages resulting in senior personnel utilizing such data in establishing programs across the province and reaching conclusions that could be erroneous. Such errors when discovered could result in embarrassment and loss of time of senior personnel in reassessing their programs, upsetting field and Head Office work schedules and could have a harmful effect on field personnel's acceptance of forestry programs.	3	25
WORKING CONDITIONS - Requires frequent trips by automobile or truck to field locations to participate in field activities and examine results for forestry requirements resulting in exposure to varying weather conditions, the handling of toxic substances and exposure to highway travel and field hazards. Requires occasional travel by commercial aircraft and occasional small fixed-wing aircraft and helicopter flights to assess results of forestry experiments when large areas are involved. Such visits require driving approximately 10,000 miles per year and absence from home averaging four to five nights per month.	3	14

Appendix L Chemical Damage Investigation Report

Alberta

AGRICULTURE
Plant Industry Laboratory

CHEMICAL DAMAGE INVESTIGATION REPORT

File No. .....
Date Received .....
Acknowledged .....

1 **Investigator**

Name ..... Title .....
Organization ..... Address .....
Postal Code ..... Telephone Number ..... Date of Investigation .....

2 **Client**

Name ..... Address .....
Postal Code ..... Telephone Number .....

3 **Legal Location of Affected Area**

Section ..... Township ..... Range ..... West of .....

4 **Chemical Suspected to Have Caused Damage**

Name ..... Date Applied .....
Insecticide ..... Fungicide ..... Herbicide ..... Unknown or other .....
Industrial fume ..... Name and location of suspected industry .....

5 **Details of Crop Affected**

Name of crop ..... Variety ..... Acreage .....
Commercial crop? Yes ... No ... Other vegetation affected .....
Age of affected crop: Years ..... Months ..... Weeks ..... Days ..... Height: Feet ..... Inches .....
Symptoms .....
Part of Plant affected: Lower leaves ..... Upper leaves ..... Roots ..... Stems .....
Entire plant ..... One side of plant only ..... (indicate N, S, E, W)
Suspected duration of crop damage Months ..... Weeks ..... Days .....
How much vegetation is affected Throughout entire field ..... Only in a specific portion of the field .....
Crop grown in same field: Last year ..... Two years ago .....

6 **Physical Characteristics of the Soil**

Texture: Light ..... Medium .... Heavy ..... Moisture: Moist ..... Wet ..... Dry .....
Drainage: Good ..... Fair ..... Poor ..... Surface: Loose ..... Crusted .....

7 **Weather Immediately Prior To and Immediately Following the Observation of Damage**

High temperature: Before ..... After ..... Low temperature: Before ..... After .....
Sunny or overcast: Before ..... After ..... Estimated wind velocity: Before ..... After .....
Humidity high or low: Before ..... After ..... Rainfall: Before ..... After .....

Please Complete Reverse Side of This Form

8. **Chemical Applied** (a) to this crop or soil (b) to last year's crop (or soil in previous years)

Name of chemical(s): (a) ..... (b) .....

Type of chemical(s): Insecticide (a) ... (b) ... Fungicide (a) ... (b) ... Herbicide (a) ... (b) ... Nematocide (a) ... (b) ...

Date(s) of application: (a) ..... Time ..... am/pm (b) .....

Rate(s) of application: (a) ..... (b) .....

Reasons for chemical usage (pest involved) and results observed:

(a) ..... (b) .....

9. **Method of Seeding the Crop**

Disc drill ..... Hoe drill ..... Disc plow ..... Broadcast ..... Depth of seeding .....

10. **Has This Field Been Soil Tested?**

Yes ... No ... If "Yes", give date ..... Report number .....

11. **Fertilizer(s) Applied to This Field**

Date(s) of application: This year ..... Last year .....

Drilled in: This year: Type ..... Rate ..... Last year: Type ..... Rate .....

Broadcast: This year: Type ..... Rate ..... Last year: Type ..... Rate .....

Incorporated: This year: Yes ..... No ..... Last year: Yes ..... No .....

12. **Have Neighbours Sprayed Recently** (or had any spraying done for them)

Yes ..... No ..... Date(s) ..... Wind direction and velocity on that date .....

Crop sprayed ..... Chemical used ..... Type of equipment .....

13. **Sketch** affected field and surrounding area. Relate the damaged area to topography, drainage pattern roads, transmission lines, railway lines, wooded areas as well as adjoining crops. Include locations of sprayed areas in the vicinity of the affected field. Indicate "North."

I certify that the information I supplied for this report is correct to the best of my knowledge.

.....
Client

We certify that the observations detailed in sections 5, 6 and 13 of this report are in agreement with the situation on the date of the investigation.

.....
Client

.....
Investigator

Appendix M Community Relations Correspondence on Vegetation Management

The Corporation of the Village of Sechelt

TELEPHONE
885-2043

P.O. BOX 129
SECHELT, B.C.
V0N 3A0

June 24, 1975

Mr. E. Hensch,
B.C. Hydro,
Box 159,
Sechelt, B. C.

Dear Mr. Hensch:

Thank you very much for your letter of June 10th pertaining to vegetation control on the R/W. It was received with great pleasure by the Village Councilors, who were most appreciative of the steps being taken to control the spraying, and of your trouble in communicating your intentions so fully.

Yours truly,
(Per M. G.)

J. W. Wood

Village Clerk

TW/mg

RECEIVED
BRITISH COLUMBIA HYDRO
AND POWER AUTHORITY
JUN 25 1975
L.D. 27/5/75
SECHELT, B. C.

cc/ W.S. Kent
G.L.P. Morrell

SUNSHINE COAST REGIONAL DISTRICT

TELEPHONE: 885-2261/2

OFFICE OF THE SECRETARY-TREASURER

BOX 800, SECHELT, B.C.
VON 3A0

July 9, 1975

B.C. Hydro & Power Authority
Box 159
Sechelt, B.C.

Attention: Mr. E. Hensch

Dear Mr. Hensch:

Re: Spraying of B.C. Hydro Transmission Right-of-Way

The Sunshine Coast Regional District Board wishes to express their appreciation for the before hand information regarding the above spraying.

There have been no complaints received by the Regional District to date which indicates the public notification has been of valu

We look forward to your continued co-operation.

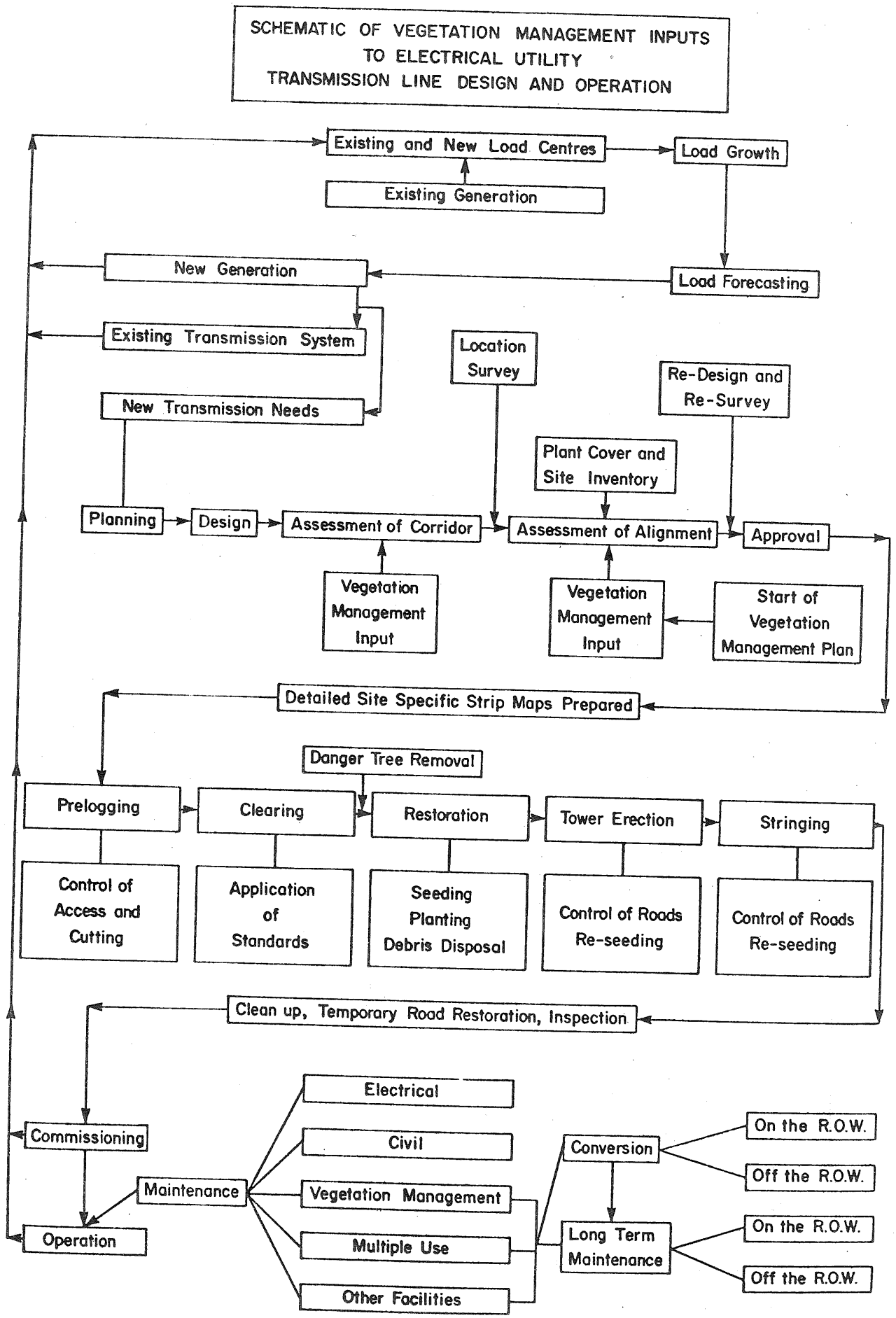
Yours very truly

(Mrs.) A. G. Pressley
Secretary-Treasurer

AGP/sje

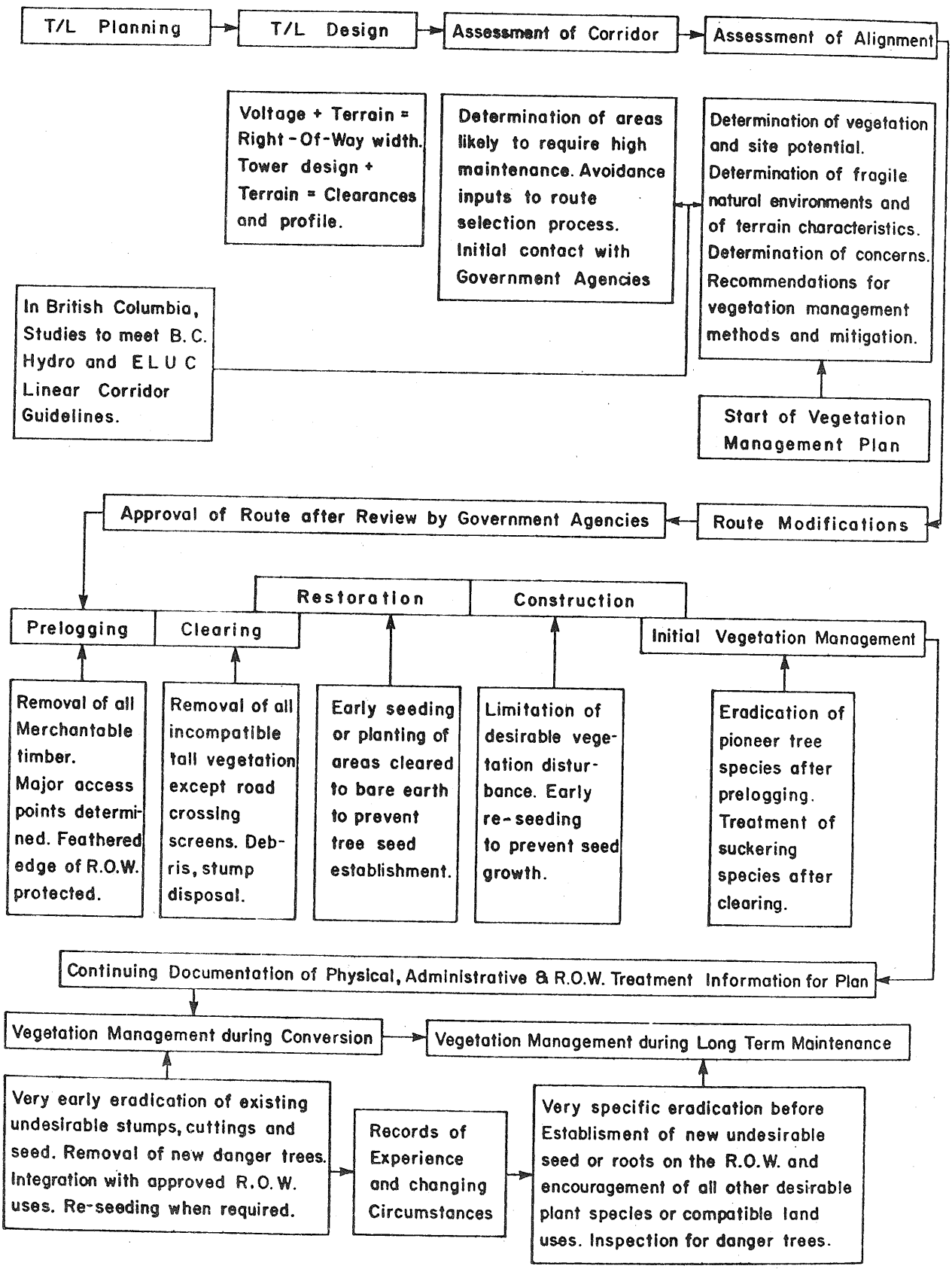
Copy Sent to: Messrs: N. S. Kent
G. L. Morrill

Appendix N Schematic of Vegetation Management Inputs to Electrical Utility Transmission Line Design and Operation

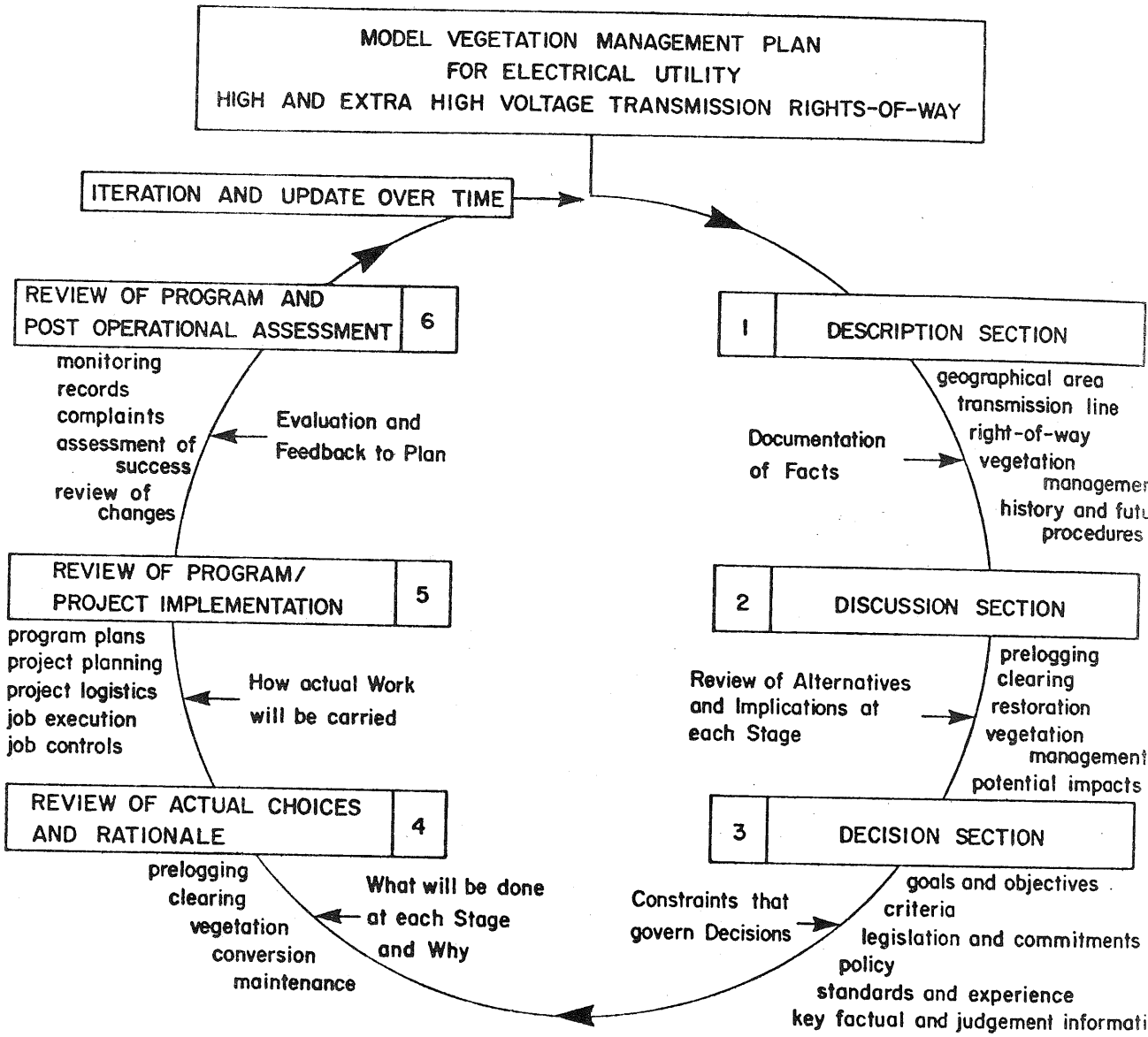

SCHEMATIC OF VEGETATION MANAGEMENT INPUTS TO ELECTRICAL UTILITY TRANSMISSION LINE DESIGN AND OPERATION
Existing and New Load Centres
Load Growth
Existing Generation
New Generation
Load Forecasting
Existing Transmission System
Location Survey
Re-Design and Re-Survey
New Transmission Needs
Plant Cover and Site Inventory
Planning
Design
Assessment of Corridor
Assessment of Alignment
Approval
Vegetation Management Input
Vegetation Management Input
Start of Vegetation Management Plan
Detailed Site Specific Strip Maps Prepared
Danger Tree Removal
Prelogging
Clearing
Restoration
Tower Erection
Stringing
Control of Access and Cutting
Application of Standards
Seeding Planting Debris Disposal
Control of Roads Re-seeding
Control of Roads Re-seeding
Clean up, Temporary Road Restoration, Inspection
Commissioning
Maintenance
Operation
Electrical
Civil
Vegetation Management
Multiple Use
Other Facilities
Conversion
On the R.O.W.
Off the R.O.W.
Long Term Maintenance
On the R.O.W.
Off the R.O.W.

Appendix Q Schematic of Vegetation Management Process during Electrical Utility Transmission Line Design and Operation.

SCHEMATIC OF VEGETATION MANAGEMENT PROCESS DURING ELECTRICAL UTILITY TRANSMISSION LINE DESIGN AND OPERATION



Appendix P Model for Vegetation Management Planning on Electrical Utility Transmission Rights-of-way.


MODEL VEGETATION MANAGEMENT PLAN
FOR ELECTRICAL UTILITY
HIGH AND EXTRA HIGH VOLTAGE TRANSMISSION RIGHTS-OF-WAY
ITERATION AND UPDATE OVER TIME
1 DESCRIPTION SECTION
geographical area
transmission line
right-of-way
vegetation
management
history and futu
procedures
Documentation
of Facts
2 DISCUSSION SECTION
prelogging
clearing
restoration
vegetation
management
potential impacts
Review of Alternatives
and Implications at
each Stage
3 DECISION SECTION
goals and objectives
criteria
legislation and commitments
policy
standards and experience
key factual and judgement informati
Constraints that
govern Decisions
4 REVIEW OF ACTUAL CHOICES AND RATIONALE
prelogging
clearing
vegetation
conversion
maintenance
What will be done
at each Stage
and Why
5 REVIEW OF PROGRAM/ PROJECT IMPLEMENTATION
program plans
project planning
project logistics
job execution
job controls
How actual Work
will be carried
6 REVIEW OF PROGRAM AND POST OPERATIONAL ASSESSMENT
monitoring
records
complaints
assessment of
success
review of
changes
Evaluation and
Feedback to Plan

Appendix Q Suggested Rights of Way Management Plan Contents at Time of Location Studies on New Rights-of-way.

Note: Detailed information would be added as the stages of development from environmental impact statement through to initial maintenance use completed over time.

ABSTRACT

INTRODUCTION

- The Need for Vegetation Management Plans
- The Objective of Vegetation Management Plans
- Description of the Report
- Objectives of the Report
- Sources of Information for the Report
- Underground as an Alternative to Aerial Transmission of Electricity
- Relationship of Vegetation Management to other Electrical Utility Departments
- Relationship of Vegetation Management to Resource Agencies
- Relationship of Vegetation Management to Other Right-of-Way Users
- Distribution of the Report

DESCRIPTION SECTION

- DESCRIPTION OF THE GENERAL AREA
  - Geographical
  - Topographical
  - Climatological
  - Natural Resources
  - Unique Features
  - Demography
- DESCRIPTION OF THE AREA ADJACENT TO THE RIGHT-OF-WAY
  - General Location of the Right-of-Way
  - Nominal Clearing Width
  - Topographical
  - Climatological
  - Natural Resources Affecting Vegetation Management
    - Vegetation
    - Soils
    - Rivers
    - Creeks
    - Wildlife
    - Unique Features Including Visual Resources
  - Nominal Clearing Width
  - Unique Features Including Visual Resources
  - Demography
    - Cities
    - Towns
    - Unincorporated Town Sites
    - Recreation Lands
    - Institutions
    - Individual Residences
    - Other

- Land Use
  - Now
  - Potential

- Access
  - Main Roads
  - Secondary Roads
  - Other

DESCRIPTION OF TRANSMISSION LINE

- Source
- Termination
- Voltage
- Tower Design
- Profile and Minimum Clearances
- Tower Locations
- Critical Design Areas
- Other

DESCRIPTION OF THE RIGHT-OF-WAY

- Specific Location
- Specific Width and Clearing boundaries
- Management Sections
  - Size
  - Boundaries

- Topography
  - Elevation
  - Slopes
  - Aspect

- Soils
  - Type
  - Growing Capability

- Water
  - Ocean
  - Bays and Inlets
  - Fresh Water Lakes
  - Other Open Water Bodies
  - Rivers
  - Creeks Permanent
  - Creeks Ephemeral
  - Swamp Areas
  - Water Sheds
  - Drinking Water
  - Other Drainage Concerns

- Adjacent Land Use
  - Now
  - Future

- Right-of-Way Land Use
  - Now
  - Future Planned

- Botanical Inventory
  - Prior to Clearing
  - Post Clearing

- Roads on the Right-of-Way
  - Prior to Clearing
  - Post Clearing Temporary
  - Post Clearing Permanent

- Legal Status
  - Ownership
  - Easements

- Special Vegetation Management Areas
  - Alternate Land Uses
  - Road Crossings
  - Other

GENERAL DESCRIPTION OF VEGETATION MANAGEMENT

- Necessity for Vegetation Management on Rights-of-Way
- Definition of Vegetation Management
- Concepts of Vegetation Management
  - Secondary Succession
  - Ecological Stability
  - Conversion and Competitive Leverage
  - Eradication Versus Control
  - Desirable Versus Undesirable Tall Growing Plants
  - Initial Vegetation Management Plans
  - Conversion Phase
  - Maintenance Phase

RESPONSIBILITIES

- Mandate of the Utility
- Responsibilities of the Utility
  - Changes of Responsibility as Transmission Line Progresses from Planning to Operation
    - Corporate Responsibilities
    - Divisional Responsibilities
    - Departmental Responsibilities

- Responsibilities of Other Groups Prior to Construction
  - Environment Agency or Agencies
  - Resource Agencies
  - General Public

- Responsibilities of Other Groups Post Construction
  - Environmental Agency (concerned with vegetation management practices)
  - Resources Agencies
  - General Public
  - Individual Land Owners

HISTORY TO DATE

- The Planning Process
- Environmental Impact Assessment
- Environment Decisions
- The Public Information Process
- Corridor Selection
  - Input from Vegetation Management Studies

- Route Selection
  - Input From Vegetation Management Group Studies
  - Input From Vegetation Management Consultant Studies if Appropriate

- Status of Concerns Raised by Various Groups
  - Federal
  - Provincial or State
  - Regional District
  - Organizations
  - The General Public
  - Land Owners

FUTURE PROCEDURES

- Submission of Environmental Impact Assessment
- Preparation of Addendum
- Vegetation Management Plan
- Prelogging
- Clearing
- Restoration
- Vegetation Management During Conversion
  - On the Right-of-Way
  - At the Edge of the Right-of-Way
  - Substations and Other Ancillary Areas

- Vegetation Management During Maintenance
  - On the Right-of-Way
  - At the Edge of the Right-of-Way
  - Substations and Other Ancillary Areas

DISCUSSION SECTION

INTRODUCTION

PRELOGGING

- Factors Influencing
- Method Options
- Implications for Vegetation Management

CLEARING PRACTICE

- Factors Influencing
- Method Options
- Clearing Standards
- Implications for Vegetation Management

RESTORATION

- Factors Influencing
- Method Options
- Restoration Standards
- Implications for Vegetation Management

VEGETATION MANAGEMENT

- Options During Conversion
  - On the Right-of-Way
  - Danger Trees
  - Other Facilities
- Options During Maintenance
  - On the Right-of-Way
  - Danger Trees
  - Other Facilities

POTENTIAL ECONOMIC CONSIDERATIONS

- Economic Costs
- Economic Benefits
- Capital Expenditures
- Operating Expenditures

POTENTIAL ENVIRONMENTAL IMPACTS

- Social and Human Health Concerns
- Drinking Water
- Watersheds
- Desirable Vegetation on Right-of-Way
- Desirable Vegetation off Right-of-Way
- Agricultural Crops
- Horticultural Crops
- Surface Water not Potable
- Streams and Rivers
- Ground Water
- Wildlife Habitat
- Visual Resources

POTENTIAL FOR MITIGATION OF POSSIBLE ENVIRONMENTAL IMPACTS

- Social and Human Health Concerns
- Drinking Water
- Watersheds
- Desirable Vegetation on Right-of-Way
- Desirable Vegetation off Right-of-Way
- Agricultural Crops
- Horticultural Crops
- Surface Water not Potable
- Streams and Rivers
- Ground Water
- Wildlife Habitat
- Visual Resources

DECISION AND CONSTRAINT SECTION

INTRODUCTION

GOVERNMENT GOALS

- Social
- Environmental
- Economic

UTILITY GOALS AND OBJECTIVES

- Social
- Environmental
- Economic

VEGETATION MANAGEMENT GOALS AND OBJECTIVES

- Program
  - Social
  - Environmental
  - Economic
- Project
  - Social
  - Environmental
  - Economic

VEGETATION MANAGEMENT CRITERIA

- Program
  - Social
  - Environmental
  - Economic
- Project
  - Social
  - Environmental
  - Economic

LEGISLATION GOVERNING VEGETATION MANAGEMENT

- Federal
  - Direct
  - Impinging
- Provincial or State
  - Direct
  - Impinging
- Regional
- Municipal

UTILITY POLICY

- Program
  - General Policy
  - Reliance on Other Agencies

- Project
  - Policy Documents
  - Line Protection Policy
  - Line Clearance Policy
  - Compliance with Legal Requirements
  - Vegetation Management
  - Environmental Protection
  - Public Information
  - Appeals
  - Reliance on Other Agencies

UTILITY STANDARDS

- Construction
- Restoration
- Conversion
- Maintenance

EXPERIENCE AND APPLIED RESEARCH

- Prelogging Experience
- Clearing Experience
- Restoration Experience
- Conversion Experience
- Maintenance Experience

KEY VEGETATION MANAGEMENT INFORMATION FOR THE R.O.W. PRIOR TO CONSTRUCTION

- Social
- Environmental
- Economic
- Theoretical
- Technical

KEY VEGETATION MANAGEMENT INFORMATION FOR THE R.O.W. POST CONSTRUCTION

- Social
- Environmental
- Economic
- Theoretical
- Technical

ESTABLISHED REQUIREMENTS OF GOVERNMENT AGENCIES

- Federal
  - Environment
  - Fisheries
  - Wildlife
  - Agriculture
- Provincial or State
  - Environment
  - Wildlife
  - Agriculture
  - Lands
  - Water

COMMITMENTS MADE

- Government Departments
- Corporations
- Private Parties
- Easement Agreements
- Other

COMPREHENSIVENESS OF DATA AND DATA COLLECTION

- Scale of Data Base Information
- Date of Data Base Information
- Data to be Obtained
- Data Missing and Unlikely to be Obtained
- Consequences

WORKLOAD ANALYSIS AND ANTICIPATED WORKLOAD

- Restoration
- Conversion
- Maintenance
- New Data Collection

PRECEDENT AND EXISTING PROCEDURES

- History
- Documentation of Procedures

REVIEW OF ACTUAL CHOICES AND RATIONALE

INTRODUCTION

PRELOGGING

- By Location

CLEARING

- By Location

RESTORATION

- By Location

CONVERSION

- By Location

MAINTENANCE

- By Location

REVIEW OF PROGRAM AND PROJECT IMPLEMENTATION

INTRODUCTION

DISCUSSION OF PROGRAM

- Relationship of Program Requirements to Specific Right-of-Way
- Relationship of Various Project Requirements to Specific Right-of-Way

PROJECT PLANNING

- Priorities and Work Load Analysis
- Recognition and Extent of Problems
- Training
- Reassessment of Legal Status and Agreements
- Reassessment of Commitments
- Scheduling and Timing
  - Availability of Equipment
  - Availability of Staff
  - Availability of Funds

- Information and Communications
- Applications to Regulatory Agencies
- Utility Approval Systems
  - Approved List of Contractors
  - Approved List of Herbicides
  - Approved List of Equipment
  - Approved Methods

- Contract and Specification Preparation Awarded Notifications
- Contract
- Contingency for Appeals to Regulatory Agencies by Interveners
- Assessment of Accident Response Capability

LOGISTICS

- Project Pre-Job Conferences
- Information and Communications
  - General Public
  - Specific Land Owners
  - Levels of Government
  - Internal Corporate Information
- Worksite Pre-Job Conferences
  - Worksite Security
    - Stores
    - Equipment
- Marking of Hazards
  - On Right-of-Way
  - Off Right-of-Way
- Job Safety Requirements
- Assessment of Access

JOB EXECUTION

- Supervision
- Protective Clothing
- Familiarization with Plant Target Species
  - Buffer Zones
- Storage of Chemicals
- Disposal of Containers
- Breakdown of Equipment
- Integration of Various Techniques
- Site Specific Herbicide Use Constraints
- Other Site Specific Method Constraints

REVIEW OF PROGRAM AND PROJECT POST-OPERATIONAL ASSESSMENT

INTRODUCTION

PROJECT MONITORING

- Ground Survey and Desirable Vegetation Checks
- Buffer Strip Checks
- Water Samples
- Air Photos
- Other Agencies Involvement

RECORDS

- Daily
- Monthly
- As Required by Government Agencies
- Other

RETREATMENT REQUIREMENTS

- Location of Retreatment
- Methods for Retreatment
- Reasons for Retreatment

COMPLAINT HANDLING

- Government Agencies
- Corporations
- Organizations
- Private Parties

HISTORIC PROFILES

- Static Base Data
- Changing Base Data
- Critical Base Data
- Treatment Data

REVIEW OF GOALS AND OBJECTIVES

- Social
- Environmental
- Economic

REVIEW OF NEW SOCIAL CIRCUMSTANCES

- Land Use
- Water Use

REVIEW OF NEW ENVIRONMENTAL CIRCUMSTANCES

- Land
- Water
- Fauna
- Flora

REVIEW OF OUTAGE STATISTICS

UPDATE OF MANAGEMENT PLANS

- Incorporation of New Information on Right-of-Way
  - Land Use
  - Water Use
  - Other
- Incorporation of New Information Off Right-of-Way
  - Land Use
  - Water Use
  - Other

- Incorporation of Revised or New Responsibilities
- Incorporation of Revised or New Constraints
- Incorporation of Revised or New Objectives
- Incorporation of Revised or New Vegetation Management Techniques

Appendix R Options for Management of Undesirable Right-of-Way Vegetation.

Method	Timing of Treatment
CULTURE: (seeding, planting, Selective clearing, etc)	At time of prelogging At time of clearing Immediate post construction and clearing At time of conversion Long-term maintenance
CUTTING: (hand/mechanical)	At time of construction At time of conversion Long-term maintenance
CHEMICAL: (summer/winter liquid/pellet broadcast spot)	Immediate post construction and clearing At time of conversion Long-term maintenance broadcast/spot
COMBUSTION: (Debris disposal prescribed burning etc.)	Immediate post construction and clearing Conversion
CULTIVATION: (Disk and Harrows grading and seeding etc.)	At time of clearing Immediate post construction and clearing At time of conversion Long-term maintenance
COMBINATIONS:	At time of prelogging At time of clearing Immediate post construction and clearing At time of conversion Long-term maintenance
CONTROLLED ADDED USE:	Agriculture Horticulture Tree farms Recreation Wildlife Industry & Commerce Housing
CONTROLLED MULTIUSE:	Wildlife and recreation Agriculture and recreation Grazing and recreation

Appendix S Vegetation Management Strategies for Different Transmission Line Areas over Time.

At Time of Construction	During Conversion	During Long-Term Maintenance	Typical Area
Case #1 Leave overstory and ground cover intact	No treatment	No treatment	Deep canyons and gullies
Case #2 Thin overstory	Remove wolf trees Remove tall growing species	Encourage lower growing species	Edge of water bodies
Case #3 Top overstory	Encourage smaller growing species	Suppress tall regrowth and prune larger trees. Limit side growth.	Road crossings in wooded areas
Case #4 Remove overstory. Recover merchantable timber. Leave ground cover intact. Leave roots and clearing debris in place.	Enhance ground cover. Repair areas of open ground. Treat sucking stumps, etc.	Eradicate undersirable tall growing woody vegetation. Remove danger trees.	Forested area with >35 cunits/acre of accessible timber.
Case #5 Remove overstory. Leave ground cover intact. Leave all clearing debris in place.	Treat existing woody plant propagules. Eradicate new undesirable growth.	Eradicate undesirable tall growing woody vegetation. Remove danger trees.	Area without merchantable volume. Very unstable soils. No aesthetic constraints.
Case #6 Remove overstory. Leave ground cover intact. Leave roots and remove all debris.	Treat existing wood plant propagules. Eradicate new undesirable growth.	Eradicate undesirable tall growing woody vegetation. Remove danger trees.	As above but with visual concerns.
Case #7 Remove overstory. Recover merchantable timber. Leave ground cover intact. Leave roots. Remove debris.	Enhance ground cover left. Repair areas of open ground. Spot eradicate tall growing woody plant.	Eradicate undersirable tall growing woody vegetation. Remove danger trees.	Forested areas with >35 cunits/acre of timber. Unstable soil. Line protection or aesthetic considerations.

At Time of Construction	During Conversion	During Long-Term Maintenance	Typical Area
Case #8 Remove overstory. Remove ground cover to bare earth. Pile and burn debris. Leave roots. Allow natural regeneration.	Spot eradication of tall growing woody plants. Seed and fertilize areas with no regeneration.	Eradicate undesirable tall growing woody vegetation. Remove danger trees.	Non merchantable volume of forest trees. Few residual trees to act as undesirable seed source. Good possibility of ground cover establishment.
Case #9 Remove overstory. Remove ground cover to bare earth. Pile and burn debris. Leave stumps 60 cm or greater. Plant or seed native ground cover and forbs.	Spot eradication of tall growing woody plants. Seed and fertilize areas of no regeneration. Limit grazing until forbs establish.	Spot eradicate undesirable tall growing wood plants. Remove danger trees.	Right-of-way clearing in forest land. Machine cleared and suitable for wildlife. No other multiple use objectives.
Case #10 Remove overstory. Remove ground cover to bare earth. Pile and burn debris. Remove roots. Seed to grass species for Forest Range.	Eradicate regrowth from seed and cutting propagules. Reseed and fertilize areas of poor catch.	Watch for increased fire hazard. Eradicate woody plants. Revitalize depleted grassland. Remove danger trees.	B.C. interior lightly forested grassland suitable for grazing. (Not fragile bunchgrass areas.)
Case #11 Remove overstory. Remove ground cover to bare earth. Pile and burn all debris. Remove roots. Go over with pock picker. Plow and harrow for agricultural use.	Eradicate regrowth of all woody plants.	Ensure proper rotation and cropping practice. Eradicate or prune trees in shelter-belts or hedge rows that would constitute a danger on the right-of-way.	Fertile valley bottom land with good access and near population centres. Above average agricultural capability.

agricultural use.

At Time of Construction	During Conversion	During Long-Term Maintenance	Typical Area
Case #12 Remove overstory. Remove ground cover to bare earth. Pile and burn all debris. Sod or otherwise prepare for multiple use recreation activity.	Eradicate regrowth of all woody plants. Exempt compatible shade trees, etc.	Vegetation management responsibility for long-term maintenance rests with resource agency or department. Continue periodic inspection.	Urban Park.

Appendix T Vegetation Management With Herbicides on Electrical Utility Transmission Rights-of-Way - Considerations Prior to Use.

HERBICIDE TYPE Selective, Non-selective, Growth Regulator

Considerations:
- Vegetation Management Objectives
- Type of application method anticipated
- Time of application
- Undesirable plant species
- Undesirable plant density
- Undesirable plant percent cover and height

TECHNIQUE USED Dormant, Stem foliage, Stubble treatment, Root update

Considerations:
- Environmental concerns
- Safety
- Public pressure
- Aesthetics
- Agriculture crop proximity
- Time of application
- Undesirable plant density
- Undesirable plant percent and height
- Accessibility and topography
- Equipment availability
- Operator skill
- Past experience
- Costs

GENERAL HERBICIDE CHOICE Manufacturer, Trade Name, Herbicide Family

Considerations:
- Weed or undesirable plant species
- Label recommendations
- Provincial recommendations
- Reliability of supplier
- Technical support from supplier
- Costs
- Packaging
- Chemical toxicity
- Anticipated weather conditions
- Applicator training
- Equipment available
- Chemical characteristics
- Past research and experience

SPECIFIC HERBICIDE CHOICE Within any one named herbicide there are often a number of marketed alternatives.

Considerations:
- Formulation
- Percent active ingredient
- Need for additives or carrier
- Odour
- Affective temperature range
- Efficacy
- Undesirable plant resistence
- Environmental concerns
- Experience
- Toxicity, acute and chronic to non-target organisms
- Rate and pathways of degradation

HERBICIDE RATE May be less than, but no greater than, label stipulations.

Considerations:
- Label recommendations
- Provincial recommendations
- Utility research and experience
- Cost
- Undesirable plant density
- Undesirable plant species
- Percent of resident species
- Percent control desired

APPLICATION TECHNIQUE Spot, Limited Broadcast, Broadcast, Total Coverage.

Considerations:
- Undesirable plant density
- Extent of area affected
- Availability of equipment
- Operator skill
- Social constraints
- Environmental constraints
- Regulatory agency constriants
- The preceding considerations

SPOT TREATMENT Ground Summer Application

Options:
- Hydraulic sprayer
- Mist blower
- Knapsack sprayer
- Dribble bar
- Hand sprayer
- Power injector
- Hypohatchet

SPOT TREATMENT Ground Dormant Application

Options:
- Hydraulic sprayer
- Mist blower
- Knapsack sprayer
- Dribble bar
- Hand sprayer
- Power injector
- Hypohatchet

STEM FOLIAGE BROADCAST Air application

Options:
- Thickened Multi-nozzle
- Thickened single nozzle
- Unthickened microfoil boom ULV

STEM FOLIAGE BROADCAST Group Application

Options:
- Hydraulic sprayer with guns
- Boom sprayer
- Invert emulsion sprayer
- Mist Blower
- Knapsack sprayer

STUBBLE LIQUID TREATMENT Ground Application

Options:
- Hydraulic sprayer
- Mist blower
- Knapsack sprayer
- Boom sprayer

STUBBLE PELLET TREATMENT Ground Application

Options:
- Mechanical centrifugal spreader
- Hand centrifugal spreader
- Mist blower
- Hand spreading

PELLET BROADCAST Air Application

Options:
- Centrifugal spreader
- Gravity fed venturi

PELLET BROADCAST Ground application

Options:	Centrifugal spreader
	Mechanical spreader - hand
	Mist blower
	Hand spreading

PELLET SPOT TREATMENT Group Application

Option:	Hand application

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