FINAL REPORT

SOCIOECONOMIC ANALYSIS OF ENVIRONMENTAL MANAGEMENT AND WASTE DISPOSAL OPTIONS FOR THE CANADIAN WOOD PRESERVATION INDUSTRY

Contract No. K0822-8-0030

Prepared for:

Environment Canada
Regulatory Assessment and Economics Directorate
Options Analysis Division
10 Wellington Street, 22nd Floor
Hull, Quebec K1A 0H3

Draft Report Prepared by:
CARROLL-HATCH (INTERNATIONAL) LTD.
Suite 400, 221 West Esplanade
North Vancouver, B.C. V7M 3J3
P5521
August, 1998

Final Report Prepared by:
RW STEPHENS Consulting Ltd.
310 East Esplanade
North Vancouver, BC V7L 1A4
January, 1999

EXECUTIVE SUMMARY

This study was completed for Environment Canada under Contract No. K0822-8-0030 to review options and identify associated costs for minimizing the release of toxic substances during the manufacture of preservative chemicals and the preservation of wood products. The study also examined volume trends and current management practices for waste treated wood products following their removal from service. The review of environmental management systems for minimizing the release of toxic substances included the Environmental Management Standard ISO 14000 and the 1988 and 1998 Technical Recommendation Documents (TRD) and Best Management Practices (BMP) previously developed for the wood preserving industry.

The application of ISO 14000 to the manufacture of preservative chemicals is judged to be an unnecessary burden due to the fact that it will result in a 1 percent increase in the cost of creosote and a 0.2 percent increase in the cost of chromated copper arsenate (CCA) and have little positive impact on the environmental performance of the two Canadian manufacturers concerned.

The capital cost of upgrading all wood preserving facilities in Canada from pre-1988 conditions to 1998 TRD/BMP standards is estimated to be $93.3 million. Based on 1992 production data, the impact of recovering the TRD/BMP capital cost over a ten year period will increase manufacturing costs by 9.2 percent. In addition, the annualized cost for monitoring TRD/BMP implementation every three years will be $91,700. The cost of implementing ISO 14000 in all wood preserving plants will be $2.88 million with an annual maintenance cost requirement of $640,000.

A comparison of the additional operating costs required to install and manage the TRD/BMP as an industry Environmental Management Program showed that voluntary implementation by the industry and a Code of Practice administered by the Canadian Council of Ministers of the Environment (CCME) will be the most cost effective approaches with the best chance of success.

The implementation of the TRD/BMP recommendations will significantly affect the competitiveness of the Canadian industry versus the US industry. As a result of TRD/BMP implementation, it is estimated that Canadian operating costs will be 5.7 percent higher for CCA plants and 4.0 percent higher for oil borne preservative plants.

The increase in operating costs caused by the implementation of the TRD/BMPs will increase the sales price of CCA lumber and poles by 2 percent, pentachlorophenol (PCP)/oil treated utility poles by 5.6 percent and creosote treated railway ties by 4.5 percent.

Costs related to monitoring the various process discharges and emissions from wood preserving facilities range from $7,000 per year for CCA plants to $21,200 per year for PCP/oil plants. Estimated one-time costs for the installation of monitoring equipment for these facilities range from $15,000 for CCA to $48,000 for PCP/oil plants. Annual monitoring costs for the Canadian creosote manufacturer are approximately $50,000 and $20,000 for the CCA manufacturer.

The volume of oil borne preservative treated industrial products to be removed from service over the next 20 years is expected to be fairly constant at approximately 350,000 to 400,000 cubic metres (m^3) per year. On the other hand CCA treated removals will increase from 112,000 m^3 in the year 2000 to approximately 480,000 m^3 in 2020. Current management practices for industrial product removals are reuse, recycling as wood and fibre, energy recovery in industrial combustion systems and land filling. The expected increase in the volume of waste CCA-treated industrial material represents a major disposal challenge.

The volume of CCA treated consumer products to be removed from service over the next 20 years is expected to increase dramatically from approximately 75,000 m^3 in the year 2000 to in excess of 1 million m^3 in 2020. At present, the only practical disposal methods for this material are land filling and limited reuse.

For the foreseeable future, management practices such as reuse, recycling and energy recovery in industrial combustion systems such as large power boilers and cement kilns, appear to be practical and economically feasible for oil borne preservative-treated products. Furthermore, the owners of these products are motivated to pursue responsible disposal methods in order to avoid the increasing cost of land filling.

In the case of CCA-treated consumer products, the waste material is widely distributed in residential areas. Individual homeowners have no commitment to responsible disposal and in fact, in many cases, may not even be aware that they have CCA-treated wood on their property. The identification, collection, storage and disposal of this material represent major problems due to the growth in volume that is forecasted.

In view of the potential benefits of reuse, recycling and energy recovery, wood preserving stakeholders and regulators should collaborate in the development and implementation of a Code of Practice which will encourage the use of such methods for the management and disposal of treated wood products once they are removed from service. Regulatory action to allow the use of existing combustion systems together with the development of appropriate technology should be initiated without delay, in order to be able to deal with the increasing volumes of CCA-treated waste material which will become available.

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to Dr. Yohannes K.G. Mariam of the Regulatory Assessment and Economics Directorate, Options Analysis Division of Environment Canada, for his guidance and support throughout the project.

Special thanks are due to the many wood preserving industry stakeholders and those involved in the management of waste treated wood products, who provided the information that has made this analysis possible. Particular thanks are due to the chemical manufacturers and wood treating companies who made such an effort to respond to the survey questions within the extremely short timeframe available for the study.

The authors are also deeply grateful to Lawrence Yu, Regina Goold and Jane Williams for all their assistance with the preparation of this report.

1.0 INTRODUCTION

It is well known that wood products suffer biological degradation in exposed applications due to attack by fungi, bacteria, insects and marine organisms. The Canadian Wood Preserving Industry (CWPI) provides a solution to this problem by using special process technology to impregnate wood products with a variety of preservative chemicals which retard biological degradation.

The wood preservatives used in Canada are solutions of either water or oil. The waterborne preservatives include chromated copper arsenate (CCA) and ammoniacal copper arsenate (ACA). The oilborne preservatives include creosote, creosote/oil solutions and pentachlorophenol/oil solutions (PCP). The use of these preservatives generally increases the service life of wood products in Canada by five to ten times.

The use of wood preservatives in Canada is regulated under the authority of the Pest Control Products Act (PCPA), administered by Health Canada through the Pest Management Regulatory Agency (PMRA). Components of the wood preservatives used in Canada have been assessed under the federal government's Priority Substances List (PSL) program. As a result, inorganic arsenic, chromium (VI), creosote impregnated waste materials from contaminated sites, polycyclic aromatic hydrocarbons (PAHs) (components of creosote), hexachlorobenzene (HCB), polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) (components of PCP), were declared toxic under the Canadian Environmental Protection Act (CEPA). In these PSL assessments, the CWPI was identified as a significant source of release to the environment of these toxic substances.

As a result of these findings, the Ministers of Health and Environment announced in November 1994 that the federal government would initiate a Strategic Options Process (SOP) for the wood preservation sector. The fundamental objective of the SOP is to develop recommendations for the Ministers of Health and Environment and for responsible Provincial/Territorial Ministers on the appropriate actions that should be taken to control or eliminate the release to the environment of the toxic substances used by the wood preservation sector.

Accordingly, the Wood Preservation SOP Issue Table has identified the need for a report which will identify options and associated costs for minimizing the release of toxic substances during the manufacture of preservative chemicals, the preservative treatment of wood products and the management of waste treated wood, following removal from service.

2.0 OBJECTIVES

To identify options for minimizing the release of CEPA toxic substances both during the manufacture of wood preserving chemicals and the preservative treatment of wood products and also during the management of waste treated wood, following its removal from service.

3.0 METHODOLOGY

An alliance of consulting expertise was created to address the scope of work and delivery requirements of the project. The alliance included:

R.W. Stephens	Project Manager	Carroll-Hatch (International) Ltd. North Vancouver, BC

G.E. Brudermann	Frido Consulting Halfmoon Bay, BC
D.E. Konasewich	Envirochem Consultants Ltd. North Vancouver, BC

The project team completed the work required for this report in five main tasks, as defined below, in order to comply with Contract No. KO822-8-0030, Appendix A, Statement of Work, as issued by the Regulatory Assessment and Economics Directorate of Environment Canada.

Task 1	Implementation of Environmental Management Programs
Task 2	Monitoring Process Discharges and Emissions
Task 3	Management of Waste Treated Industrial Wood Products
Task 4	Management of Waste Treated Consumer Wood Products
Task 5	Proposed Management Practices for the Disposal of Waste Treated Industrial and Consumer Wood Products

Each main task comprised a number of deliverables designed to meet the terms of reference for the project. As agreed with the Scientific Authority for the project, the results were developed from analysis of existing literature and consultation with key contacts in industry, government and educational institutions. Original research was limited by the available budget and required delivery date for the project.

4.0 TASK 1 IMPLEMENTATION OF ENVIRONMENTAL MANAGEMENT PROGRAMS

4.1 Objective

To determine the costs related to implementing environmental management programs for minimizing the release of toxic substances from the manufacture of wood preserving chemicals and the preservative treatment of wood products, together with an assessment of the subsequent impact of these costs on the competitiveness of the CWPI.

4.2 Preservative Manufacturing Facilities

There are two preservative manufacturers operating in Canada. One produces creosote and the other manufactures CCA concentrate. Both facilities are located in Ontario.

4.2.1 Status of environmental practices, regulatory monitoring and ISO 14000

Creosote Manufacturing

Creosote is manufactured by the distillation of coal tar which results from the preparation of coke. The creosote manufacturer uses established technology to minimize emissions from the distillation process.

- **air emissions:** emissions generated during distillation and from storage tanks are collected and recycled or destroyed by incineration;
- **waste waters:** these are collected and treated (API oil/water separation) before being discharged into the municipal sewer system;

solid wastes and sludges: reuse and recycling on or off-site is maximized to reduce such wastes to the greatest possible extent;

- **soil and groundwater protection:** most of the process and handling areas are paved or concreted and contained;
- **stormwater:** the runoff and treated wastewater discharges are in compliance with municipal criteria.

Conformance to environmental requirements is established by monitoring the waste streams and site condition. This entails sampling and testing as follows:

- Daily sampling and testing of process waters;
- Daily sampling and twice weekly testing of waste waters;
- Groundwater testing 3 times per year;
- Air emissions are estimated on an annual basis.

The monitoring results for groundwater are reported to environmental regulatory authorities. In addition to these reporting requirements, an emission inventory is prepared annually under the National Pollution Release Inventory Program (NPRI). This information is also submitted to the National Emission Reduction Plan (NERM), and the Accelerated Reduction and Elimination of Toxics Program (ARET).

The manufacturer also subscribes to industry initiatives aimed at the protection of workers and the environment. These initiatives include the Code of Practice of Responsible Care, which addresses community awareness and emergency response as well as, manufacturing, transportation, hazardous waste management, distribution and research and development.

Under ARET, the manufacturer has committed to reduce emissions by 50% from 1991 to 2000. This target has already been exceeded. (G. Gilmet, 1998)

The creosote manufacturer has not considered the implementation of ISO 14000 at this stage. If undertaken, ISO 14000 implementation at the creosote facility would probably be part of the entire distillation operation at that site. Based on published cost data for similar sized operations in the US (Anon. 1998), the initial cost will be $30,000 to $50,000 with an annual maintenance cost of $10,000 which would increase the cost of creosote by about 1.0%. This additional cost would be passed on to treaters.

The manufacturer has not contemplated implementation of ISO 14000 and therefore cannot comment on potential benefits or related improvements to the environmental or business performance of the company.

CCA Manufacturing

The CCA manufacturing process consists of dissolving the three chemical components into an aqueous phase. The CCA manufacturer uses state-of-the-art technology to minimize emissions from the manufacturing process.

- **air emissions:** reactor and tank vents are equipped with a wet scrubber;
- **waste waters:** process and waste waters are recycled for the make-up of CCA concentrate;
- **solid wastes and sludges:** the recovery of CCA components is maximized with the remainder being disposed of in compliance with applicable regulations. However, there is a minimal amount of waste requiring disposal;

- **soil and groundwater protection:** process areas are contained and paved. The containment area is coated with a material resistant to the process chemicals. Spills are cleaned up and recycled;
- **stormwater:** as the process facilities are completely enclosed and contained, stormwater contamination is not an issue and monitoring is not required by MOE.

The manufacturer is required to sample, test and report groundwater quality to the MOE on a quarterly basis. Monitoring of arsenic in air emissions is done as per OSA requirements.

The major thrust towards the improvement of environmental performance is the further reduction of solid waste generation.

No experience exists with ISO 14000 at CCA manufacturing sites. The cost of ISO introduction based on similar size facilities in other industries is estimated to be approximately $45,000 with an annual maintenance cost of $10,000 including ISO audits. This would increase the cost of CCA by 0.2%. The increase would probably be added to the cost of CCA and passed on to treaters. The CCA manufacturer considers a mandatory requirement for the introduction of ISO 14000 an unnecessary burden at this time.

4.2.2 Conclusions

It has been stated that "the environmental control technologies and the management practices in wood preservative manufacturing facilities are adequate and effective for such processes". (El Rayes, 1998). A requirement for ISO 14000 would impose an additional operational burden with little positive impact on the environmental performance of the preservative manufacturers expected at this time. The impact on the cost of the preservatives would be relatively small and would be passed on to treaters. Although small, these cost increases will tend to weaken, to some extent, the competitive position of Canadian chemical suppliers and treaters versus US companies and alternative materials such as steel and concrete.

4.3 Treatment Facilities

The task in this segment of the report is to discuss the means whereby the industry may achieve compliance with environmental and worker health requirements through the implementation of the 1998 Technical Recommendation Document (TRD), which includes the Best Management Practices (BMPs). Towards this end the TRD contains design and operational recommendations to minimize the exposure of workers and the environment to preservative chemicals. The industry, represented by CITW and its members, has repeatedly stated that they are prepared to work toward meeting these recommendations provided that all treatment plants across Canada are treated equally in the implementation and monitoring of the process, so that individual plants or regions do not enjoy a commercial advantage. The various options for such a process, presented in the El Rayes report (1998), are subsequently discussed keeping a uniform approach in mind.

4.3.1 Status of TRD/BMPs and ISO 14000 Implementation

4.3.1.1 Canadian Wood Preservation Facilities

The last survey of the industry indicated that in 1995 sixty-four treatment plants were operating in Canada (Stephens et al., 1996). Preservative usage was as follows:

- 49 plants used CCA;
- 13 plants used CCA plus other preservatives;
- 7 plants used creosote or creosote/oil solutions;
- 14 plants used PCP/oil solutions.

Of the 64 plants, 61 were equipped with pressure treating facilities, 2 used non-pressure thermal treating equipment and 1 had both pressure and thermal treating capability. As per an earlier survey (Stephens et al., 1994) and current industry reports it is estimated that 39 plants operate with one treatment vessel (facility), 17 plants with two facilities and 8 plants with 3 to 5 for a total of approximately 100 facilities comprising 70 CCA, 13 Creosote, and 17 PCP. The PCP facilities include the thermal treatment vessels.

4.3.1.2 Implementation Levels of TRD/BMPs and ISO 14000 in the Preservation Industry

The original TRDs were published in 1988 and since that time, industry has been striving to meet the recommendations they contain. In most cases, the local regulatory authorities stipulate that new facilities be built incorporating the TRD recommendations as a minimum requirement. In Alberta, British Columbia and New Brunswick, the TRDs have been adopted by the provincial authorities as guidelines for the construction of new facilities. Retrofitting existing plants is somewhat more difficult and expensive but significant progress has been made in the upgrading of facilities, particularly in terms of containment and preservative fixation and stabilization (H. Walthert, 1998).

The updated TRDs (Brudermann, 1998), which will be published shortly, have so far been available to treatment plants only in draft form. The main additional recommendations in the new TRD are more stringent designs for containment and the inclusion of the BMPs (CITW, 1997) for production of all treated wood. These include the fixation requirements for CCA and the specific process steps to be taken to reduce bleeding and surface deposits on products treated with other preservatives.

The recent report for the SOP Issue Table (El Rayes, 1998) provides information on the degree of TRD implementation from an industry survey, as shown in Table 1.

TABLE 1:

Implementation of the TRDs at Canadian Wood Preserving Plants

	Percent of Plants (%)			Estimated*
	CCA	**Creosote**	**PCP**	% of all Facilities
Full Implementation	23	40	13	24
Partial Implementation	50	20	38	44
Perceived Feasibility of Full Implementation	73	60	63	-

*Authors' estimate based on total of 100 facilities.

It is assumed that the estimates provided by El Rayes in Table 1 are based on the recommendations contained in the original TRDs. Therefore, the plants indicating full compliance will undoubtedly have to add further features to facility design and/or operational procedures to fully comply with the new TRD recommendations.

Industry's perception of the feasibility of full implementation has to be carefully considered. (see Table 1). Factors such as costly operational interruptions, difficulty in retrofitting and specific site conditions which may require more or less stringent approaches cannot be ignored. It was not possible to obtain cost estimates for these factors under the limitations of this study. Nor was it possible to identify additional operational costs which are considered to be quite significant.

The situation with ISO 14000 is clearer than with the implementation of the TRDs. There is no known Canadian treatment plant which has introduced or is undergoing ISO 14000 registration. Plants contacted for this study, including those exporting overseas, have indicated that at present ISO 14000 is not being considered for their operations. According to Jermer (1998) no preservation plants in Europe hold ISO 14000 certification.

4.3.1.3 Cost of TRD/BMP Implementation

As has been shown in Table 1, the authors estimate that the 1988 TRD recommendations have been implemented fully for 24% and partially for 44% of the facilities. Although these estimates are based on an industry survey conducted by El Rayes in 1998, they cannot be considered reliable for the following reasons:

- no audits have been completed to verify that those plants reporting full implementation, do in fact meet all the TRD recommendations.
- the El Rayes report does not provide information on the degree of partial implementation for the plants which were included in the survey.

For these reasons, any estimate of implementation cost already incurred would represent gross speculation. Therefore, all estimates made in this report are based on the total cost required to upgrade all wood preserving facilities in Canada from pre-1988 conditions to 1998 TRD/BMP standards. It should also be noted that only 60 to 70% of the industry members feel that full implementation is feasible.

The implementation of the 1988 TRDs entails improvements in plant designs, such as containment and spill prevention as well as procedural methods to minimize site and product contamination. The 1998 TRD includes additional recommendations for containment, such as secondary liners or impermeable coatings in containment areas, and product safety in terms of preservative deposits and leachability. It also includes the industry BMPs (CITW, 1997), which list processes and process parameters to achieve the desired goals.

It can be assumed that the degree of industry implementation reported in El Rayes (1998) is generally based on the 1988 TRD recommendations, although 82% of the responding CCA treaters reported having accelerated fixation capability, which is a recommendation of the 1998 TRD. However, the authors believe that the survey was responded to by a majority of companies who are generally more compliant with joint industry/regulatory initiatives and, therefore, more advanced in terms of implementation. The authors estimate that approximately 40-45% of industry facilities incorporate accelerated fixation; either steam fixation (approx. 25%) or other measures such as kilns and covered storage, with or without heating.

It also can be assumed that the cost for facilities using different preservatives/processes will vary and that the age of a facility will have a significant bearing on the upgrading required and its associated cost. Hence, a selected range of companies was surveyed for the purpose of this study to establish an average implementation cost for upgrading each preservative facility from pre-1988 conditions to 1998 TRD/BMP standards.

CCA Facilities

CCA markets emerged in the early 1970's at which time a significant number of the existing plants were built. Several plants were constructed during the mid 80's to early 90's and a number of these were able to use the TRDs for their designs. The capital cost of upgrading a typical older plant to meet the 1988 TRDs has been estimated at up to $1 million with an average of approximately $750,000. The average cost for upgrading newer plants is approximately $100,000.

Assuming that 47 of the plants using CCA were built prior to 1988 then the capital cost of upgrading the CCA facilities to meet the 1988 TRD recommendations would be:

47 pre 1988 plants x $750,000 =	$ 35.25 million
15 post 1988 plants x $100,000 =	$ 1.50 million
Total capital cost =	$ 36.75 million

Additional costs would be incurred for loss of production during upgrading, procedural changes, training, documentation, etc. These costs would be quite difficult to establish and are not further addressed here. The cost of monitoring discharges and site conditions is presented later in this report.

The major additions in the 1998 TRD are recommendations for accelerated fixation or additional roofed/ contained storage for freshly treated wood as well as the installation of secondary liners or impermeable coatings in containment areas.

The average cost for such upgrade has been given as approximately $250,000 per facility. For a total of 70 CCA facilities the industry cost is $17.5 million. This results in a total capital cost of $54.25 million to bring CCA facilities from pre-1988 conditions to 1998 TRD/ BMP standards.

There is only one ACA facility in operation. As this treatment is carried out in a CCA facility, it has been included with the CCA plant description.

PCP Facilities

PCP markets emerged in the mid 1950's so that the majority of facilities were built at that time without the benefit of the TRDs. They are normally larger than CCA facilities and upgrading involves substantial changes. It is estimated that there are 17 PCP facilities in operation, including thermal facilities.

The average capital cost required to meet 1988 TRD recommendations is estimated at $1 million per facility, excluding site clean-up costs. The items addressed in the upgrading are usually improved, more extensive containment, water treatment, air emission controls and waste handling. In some instances site clean-up will be required prior to retro-fitting.

Further upgrading in accordance with 1998 recommendations would include further secondary containment and changes to treatment cycles to accommodate the BMP recommendations. This cost is estimated at $150,000 per facility.

Therefore, this results in a capital cost of $19.55 million to bring PCP facilities to 1998 TRD/BMP standards.

Creosote Facilities

Creosote plants are, with few exceptions, the oldest treatment operations in Canada and, hence, extensive upgrades are required to meet the TRD/BMP recommendations. Creosote plants are also large and the major items for upgrading are containment, air emission and wastewater treatments. The compliance with BMP recommendations involves longer treatment cycles. Site remediation is required in part prior to retrofitting.

The average upgrade to meet 1988 TRD recommendations is estimated at $1.3 million per creosote facility, excluding site clean-up costs which could easily double the upgrade costs. The further upgrade to 1998 criteria would cost an additional $0.2 million per facility.

Therefore, a total capital cost of $19.5 million is required to bring creosote facilities to 1998 TRD/BMP standards.

In summary, the capital cost required to upgrade all wood preserving facilities in Canada from pre-1988 conditions to 1998 TRD/BMP standards is estimated to be $ 93.3 million.

4.3.2 Cost of ISO 14000 Implementation

At this time it appears that no Canadian facility is ISO 14000 registered. Therefore, there is no Canadian experience related to effectiveness or cost for Canadian wood preserving plants. The following is a brief discussion of ISO 14000 and what it represents. A more detailed description is attached as Appendix 1. The Appendix also outlines how ISO 14000 relates to the TRD/BMPs.

ISO 14000 is a series of standards for Environmental Management Systems (EMS), developed in 1996 by the International Organization for Standardization, based in Switzerland. These standards do not establish a set of quantitative targets for environmental performance levels or specific methods for measuring environmental outputs. They rather describe the type of management framework needed for an effective EMS and how to establish it. This is very important to note since the environmental process and programs incorporated within the ISO 14000 framework are established on an individual basis and could vary significantly from plant to plant.

Under ISO 14000 a company is required to:

- define an environmental policy;
- create and maintain procedures to assess environmental impacts;
- set goals for environmental improvements and pollution prevention;
- comply with all local laws and regulations;
- set steps for emergency preparedness;
- conduct objective evaluations of progress or deficiencies in environmental management;
- establish an effective system of environmental documentation.

The Standard also establishes guidelines for internal auditing and a process for third-party auditing and certification of EMS.

The benefits from adopting this Standard are claimed to be reduced risk and liability, more efficient operation, improved access to the market place, advantage in dealing with financial institutions and insurance companies and improved relations with communities and regulatory agencies.

The average cost of establishing ISO 14000 in the US in small manufacturing plants (<20 employees) is reported to be about Can $45,000. Third-party certification and auditing will add to the cost and annual maintenance in terms of administration will require costs for training, documentation, auditing, etc. The latter is estimated at $10,000 per annum. This cost does not include any additional cost for facility design or procedural changes or process monitoring required by the certification program.

Implementation of ISO 14000 in 64 plants (regardless of the number of facilities in each) using $45,000 as an average would cost $2.88 million.

Annual maintenance of the ISO 14000 registration would cost $640,000 (64 plants x $10,000).

4.3.3 Cost of Monitoring Using the Assessment Protocol

In 1995 Environment Canada initiated a Technical Coordinating Committee, charged with the development and implementation of the new TRDs. At a meeting on March 26, 1997 in Vancouver this committee and the industry, represented by CITW, agreed on the following:

- a national monitoring program would be initiated;
- the program would include **all** Canadian preservation plants;
- the program would be based on a single assessment protocol and would be preferably carried out by a single contractor to provide consistency;
- the assessment would be used solely to provide a national overview with respect to the implementation of the TRDs;

- the assessment would not be used for regulatory/enforcement purposes.

Subsequently, an assessment protocol was prepared taking into account the basic approach and objectives agreed upon at the 1997 meeting (Brudermann and Konasewich, 1998). This protocol outlines uniform guidelines for assessing all types of preservation facilities. It was envisaged that an industry assessment would be carried out as soon as the protocol and funding were available and that the assessment would be repeated at regular intervals to monitor the progress and degree of conformance.

A tentative assessment cost of $2500 to $3000 per facility (treatment vessel) was established by the industry. This translates into a total industry cost of $275,000 per assessment of all 64 operating plants (total of 100 facilities). The annualized cost to carry out an assessment every two years would be $137,500 and every three years would be $91,700.

4.3.4 Impact of Implementation on Treated Wood Cost

The most comprehensive study of the CWPI was completed by Stephens et al in 1994. This study compiled industry statistics for 1992. In that year the industry treated 1.99 million cubic meters (m^3) of product. Of this volume 79% was CCA treated, 10% was creosote treated and 11% was treated with PCP. The value of production was $547.4 million, of which $353 million (64%) was the value of white wood.

The following summarizes the cost components of the various initiatives.

- Preservative cost increase due to ISO 14000 implementation at Canadian manufacturers based on 1992 use volumes:

- CCA - $ 0.010/kg
- Creosote - $ 0.004/kg

- Capital cost to update to 1998 TRD/BMPs - $ 93,300,000
- ISO 14000 implementation - $ 2,880,000
- ISO 14000 annual maintenance - $ 640,000
- Progress monitoring (3 year schedule) - $ 91,700

The impact on preservative cost caused by the implementation of ISO 14000 at manufacturing plants appears to be small but would put Canadian supply at some disadvantage.

The major impact on the treatment industry is undoubtedly compliance with the 1998 TRD/BMPs. The following shows the cost impact based on recovering the capital cost over a period of ten years.

The 10-year write-off period assumes the following asset mix:

Buildings	$60,000,000 over 20 years	$ 3,000,000
Equipment	$33,300,000 over 5 years	$ 6,660,000
Total	**$93,300,000**	**$ 9,660,000**

The impact of this capital expenditure on production cost, based on the 1992 production volume of 1,985,022 m^3 is $4.87 per m^3.

It should be noted that this cost impact does not include the increased operating costs resulting from the TRD/BMP recommendations. These increased costs must be considered as highly significant. No detailed information on this subject was available from industry, within the time frame of this study.

Manufacturing costs in 1992 were as follows:

• Preservative cost	\$ 41,000,000 -	\$21/m³
• Labour cost	\$ 43,000,000 -	\$22/m³
• Other (energy, taxes supplies, etc.)	\$ 20,000,000 -	\$10/m³
• Total Manufacturing Cost	\$104,000,000 -	\$53/m³

Therefore, based on actual industry data for 1992 and the cost estimates developed for this study, implementation of the TRD/BMPs will increase manufacturing costs by 9.2% for each of the first ten years.

In Stephens et al (1994) the 1992 total book value of industry assets is given as \$153,760,800 and the replacement value as \$270 million. TRD/BMP implementation at \$93.3 million represents 61% of book value and 35% of replacement value.

As can be seen, the implementation of the TRD/BMPs will impose a significant financial burden on the industry in terms of increases in fixed assets, financing and manufacturing costs. The magnitude of the increases clearly demonstrates that a carefully designed phase in period for compliance would be needed to avoid weakening the competitive position of the CWPI in relation to US imports, Canadian exports and the threat of alternative materials such as steel and concrete.

4.4 Options For Environmental Management Program

A major objective of regulatory authorities and industry members is that environmental management programs provide adequate controls and are administered uniformly across the country. CITW has cooperated with the development of the TRDs and other regulatory initiatives, such as the SOP, on the understanding that the applied controls would be administered so that individual plants or regions would not enjoy any commercial advantages or suffer any disadvantages. The following sections discuss various options for implementation of the TRD/BMP recommendations.

4.4.1 Inclusion of TRD/BMPs in ISO 14000 Program

ISO 14000 provides a framework for inclusion of specific environmental targets and management systems. Hence, the TRD/BMPs could be made a specific component under the ISO 14000 program (see Appendix 1).

Areas of consideration are:

- All plants must include all applicable components of the TRD/BMPs in their ISO 14000 protocol;
- A deadline for all plants to implement ISO 14000 and the appropriate TRD/BMPs inclusion has to be set (note the high cost for TRD/BMP compliance and time required to achieve it);
- Compliance with the ISO 14000, which includes the TRD/ BMPs, would require concurrent compliance with the TRD/BMPs. This may be difficult to achieve across the entire industry;
- Maintenance of ISO 14000 registration requires annual third-party auditing by ISO 14000 approved auditors;
- The regulatory agencies would have to monitor the industry status for their own requirements;
- Estimated cost of the program covering the entire industry, excluding cost for upgrading to 1998 TRD/BMPs:

- ISO 14000 initiation: - $2.88 million
- ISO 14000 annual maintenance: - $0.64 million
- Regulatory audit of all plants to determine that all TRD/BMP recommendations are implemented (1 time): - $30,000
- Monitoring of maintenance (annual): - $60,000

It should be noted that ISO 14000 is considered by industry members to be an additional, costly bureaucratic burden on the industry with little benefit in terms of environmental performance and commercial advantage.

4.4.2 TRD/BMPs as a requirement under PCP Act

Pesticide registration is administered by the Pest Management Regulatory Agency (PMRA) of Health Canada. The Pest Control Products Act (PCP) provides the legal basis for establishing the appropriate protocols and procedures. Successful pesticide (preservative) registration allows the use of a label, which contains legally enforceable information on product guarantees and directions for use. Specifically, the information on use is limited in the Act to: "the directions for the use of the control product shall include dosage rates, timing of application and use limitations" (PCP Act, 1988). Due to this limitation PMRA considers a label requirement for TRD/BMPs adherence beyond their statutory authority (K. McCullagh, 1998).

Hence, at this time, the use of the PCP Act to ensure compliance with the TRD/BMPs is not an option.

4.4.3 TRD/BMPs as a requirement for Operating Permits

Various requirements exist in the provinces to obtain operating permits for facilities, equipment, emissions levels, etc. British Columbia, Alberta and New Brunswick use the TRD/BMPs as minimum requirements for the construction of new facilities and alteration of existing facility components. There is no consistent approach to the granting of operating permits across Canada and this may be difficult to change unless there is a concerted effort such as the CCME option might provide.

To implement the TRD/BMPs by this route, existing operating licenses would have to be renewed to reflect such a requirement. In some provinces legislation may be required to allow this approach to be introduced. Time frames for initiation may be difficult to synchronize from province to province. Due to the significant cost to plants, implementation time frames would have to be negotiated with industry. Provinces would have to audit plants periodically to ensure compliance and Environment Canada would monitor uniformity and progress across the country to ensure equitable administration.

Estimated costs of this option for the entire industry are:

Re-issuance of licenses:	$200,000
Periodic provincial audits (3 years schedule):	$275,000
Environment Canada monitoring (annual):	$ 30,000

4.4.4 TRD/BMPs as a requirement under a CCME Code

The Canadian Council of Ministers of the Environment (CCME) is the major inter-governmental forum in Canada for discussion and joint action by federal and provincial regulators on environmental issues of national and international concern. Through task groups under their steering committees the CCME develops guidelines and codes of practice for various industries and their activities. The CCME mandate would allow the development of a code of practice for the wood preservation industry based on the TRD/BMPs.

An advantage of this option is that such a code could be uniformly applied and enforced across Canada with the agreement of all provinces. It would also have more regulatory influence than an understanding between the provinces, Environment Canada and the industry on voluntary implementation of the TRD/BMPs. Although industry, as represented by CITW, has cooperated in a variety of regulatory activities including the development of the TRD/BMPs, CITW cannot speak for or control the entire industry's participation in a voluntary program. A CCME code has, therefore, a greater likelihood of reaching those industry members who normally do not participate in industry/regulatory initiatives or would otherwise be less compliant.

As has been shown previously, the high cost and time frame required to implement the TRD/BMPs would indicate that a phase-in period should be negotiated with industry. Under a Code the program of plant upgrading would have to be monitored and the Code itself would have to be maintained by CCME.

Estimated cost of implementation:	
Introduction as a CCME Code	$ 30,000
Program monitoring (industry assessments, say, every 3 years)	$275,000/3 yrs.

4.4.5 Make TRD/BMPs a Purchaser Requirement

As has been reported (Stephens, et al., 1996), the Canadian wood preservation industry is relatively large compared to that in other countries. In fact, on the world scale only the US industry is larger. This is reflected in the number of plants and number and diversity of purchasers and products. Products going into consumer home markets make up nearly 55% of the total output. These products are sold to numerous purchasers, such as wholesalers, retail buying groups and retail outlets as well as homeowners and contractors. Most Canadian plants (85%) are shipping either exclusively or predominantly to the consumer market.

Industrial product purchasers, such as utilities, railroads and government agencies, are better defined. It is conceivable that some could be convinced to specify treated wood only from plants that meet TRD/BMP objectives, just as some industrial specifiers have implemented a requirement for ISO 9000. For this option the initiative would have to come from the users of treated wood, which would require a significant promotional effort. However, it would be extremely difficult to create and maintain a program that would capture all plants and all purchasers. There would also be no control over importers of treated wood to whom such a program could not be extended.

A program would have to be created under a new or an existing agency, such as the Canadian Wood Preservation Bureau (CWPB) or CSA. This agency would have to initiate and promote the program as well as provide information to purchasers, and monitor the program through regular plant audits. Plants that wanted to enter the program would have to demonstrate their compliance to minimum criteria and would obtain a certificate. Purchasers would then choose from a list of certified plants. As compliance would increase the selling price of treated wood, purchasers may not wish to limit their business to certified enterprises. They may also be encouraged to use imports. This approach would, therefore, probably not achieve the desired objective of implementing the TRD/BMPs in all wood preservation facilities. The time frame for implementation could not be controlled.

Estimated cost of option:

[Creation of new agency:	initiation	$150,000
	annual	$150,000]
Incorporation of program with an existing agency		$ 30,000
Promotion/implementation (1 time)		$100,000
Maintenance of promotion (annual)		$ 20,000
Regular plant audits/certificate (annual)		$275,000

Market loss to imports is probable but cannot be quantified.

4.4.6 Include TRD/BMPs in a Product Certification Program

This option would require user awareness and user pressure to succeed. In general, Canadian environmental programs for products are not as advanced as, for example, in Europe, where a number have been in use for over a decade. In addition, treated consumer lumber representing over 50% of industry output is a commodity, which is generally purchased on a favourable price basis. Program participants would have to incur significant additional cost, which would have to be passed on to the consumer thus discouraging the consumer from buying into such a program.

To make this approach a success, extensive promotion to the public would be required. Similar to the option addressed above in section 4.4.5, an agency would have to carry out the program in terms of promotion, maintenance and industry monitoring. A voluntary system created through user pressure would probably not result in universal and/or rapid implementation so that additional regulatory measures would have to be applied to initiate and maintain the program. Promotion would have to address a wider audience than in the case of a purchaser program as in 4.4.5, resulting in a higher program cost.

Estimated cost of option:

[Creation of new agency:	initiation	$200,000
	annual	$150,000]
Incorporation of program with an existing agency		$ 30,000
Promotion/implementation (1 time)		$200,000+
Maintenance of promotion (annual)		$ 50,000+
Regular plant audits/certificate (annual)		$275,000
Product labeling cost (based on volume)		?

4.4.7 Incorporate TRD/BMPs in a Pollution Prevention Program

A pollution prevention guide has been prepared for Environment Canada (Konasewich, 1996). The purpose of the document is to provide a technical guide for the development of pollution prevention plans at treatment plants. In general, prevention planning involves the following four components:

- Review of all processes that use, generate or release toxic materials;
- Identification of pollution prevention opportunities;

- Ranking of the opportunities and scheduling for their implementation; and
- Implementation and measure of success.

In support of the prevention program, the guide provides a description of facilities and processes, highlights emission sources, and provides audit sheets, based on the 1988 TRDs together with assessment forms to identify action priorities.

It was intended that the guide should be made available to individual plants, so that they could determine their shortcomings and set priorities for eliminating or minimizing the potential for harmful emissions.

It appears that such a pollution prevention program is an independent initiative in part utilizing the TRD/BMPs. As such it is a very useful means for plants to determine where they stand in regards to the TRD/BMP recommendations and where additional action to upgrade is required. In other words it could be used as a tool to achieve compliance.

Regardless of this fact, a vehicle would still be required to implement the pollution prevention program including the TRD/BMPs and monitor its progress by some of the options discussed in this section. Although a pollution prevention program is not mandatory in British Columbia, both Provincial and regional Federal authorities are encouraging industry to adopt the program. Regulators have made it clear that they will assess companies, which do not have the program, more frequently.

4.4.8 Voluntary Implementation and Monitoring of TRD/BMPs

Environment Canada created a Technical Coordinating Committee to develop the new TRD/BMPs and to monitor their implementation across Canada. CITW and its members have participated in this process to this point and agreed to a nation-wide monitoring program based on voluntary implementation by the industry. Subsequently plant assessment protocols were established (Brudermann and Konasewich, 1998) for determination of the implementation status in all facilities. Although it is intended that each plant would be assessed, a means of ensuring that all companies enter the program has not yet been identified. To re-emphasize, all plants need to be covered in the program so that individuals do not gain a competitive advantage by not upgrading their facilities.

As with the other options, voluntary compliance would require setting of an implementation target period. However, no new committees, programs or initiatives would be required for finalizing the implementation and its monitoring. The Technical Coordinating Committee could initiate periodic industry assessments, review progress, set new targets and update the TRD recommendations as required. Additionally, the pollution prevention plan concept, described in Section 4.4.7, could be implemented.

As a result of plant assessments, individual plants meeting minimum criteria could be awarded certificates. Lists of such plants could be published and promoted with buyers of treated wood to encourage purchases from certified plants. In this case the program provides consumers with the option of purchasing from certified plants, which may act as an incentive by creating an initial market advantage for certified plants.

Estimated cost of voluntary implementation:

Initiation	$ 10,000
Monitoring every 3 years	$275,000

4.4.9 Cost Comparison of Available Options and Discussion

A discussion of the various options must address their cost and the likelihood of achieving the desired goal. It should be noted that the cost estimates for implementing the options discussed above are preliminary and should only be used for comparative purposes. To allow comparison, one time costs have been spread over five years and periodic costs have been annualized. The actual cost of TRD/BMP implementation at plants is not included.

- **ISO 14000** — **$ 1,282,000**
  - Industry — $ 1.216,000
  - Regulatory monitoring — $ 66,000
- **Provincial Operating Permits** — **$ 162,000**
  - Industry — $ 20,000
  - Regulatory monitoring — $ 142,000
- **CCME Code** — **$ 122,000**
  - Industry — $ 0
  - Regulatory monitoring — $ 122,000
- **Purchaser Requirement** — **$ 310,000**

Shared by industry and regulators?

- **Product Certification** — **$ 371,000+**

Shared by industry and regulators?

- **Voluntary Implementation** — **$ 94,000**

Discussions have already taken place between industry and Environment Canada to share the cost of periodic country-wide assessments.

As can be seen, the ISO 14000 route is by far the most expensive (nearly 14 x the voluntary option). Product Certification and Purchaser Requirement are the next most expensive options due to the requirement for program promotion. Of lesser cost are requirements for the TRD/BMPs through Provincial Permits or a CCME Code. The least cost would be incurred by Voluntary Implementation maintained and monitored by the Environment Canada Technical Coordinating Committee.

The basic components required for success in meeting the objectives are:

- uniform implementation across Canada with a common phase-in period for each plant;
- uniform maintenance of the program by periodic monitoring of progress and continued compliance; and
- implementation of the pollution prevention plan concept.

These components may be administered and the goals achieved via several of the options or a combination thereof. Not considering cost, the approaches through ISO 14000, Provincial Permits, CCME Code and Voluntary Implementation could lead to the desired goals within a reasonable time frame. Uniformity may be an issue in the Provincial Permit option.

The Purchaser Requirement and Product Certification approaches to encourage introduction of the TRD/BMPs by market forces, may be difficult to implement. This situation may be improved if these programs are combined with ISO 14000, the CCME Code or Voluntary Implementation. As the program requires monitoring, this could be accomplished by a third party empowered to provide a certificate for complying plants. This certificate would allow those plants to label their product accordingly. With some promotion, perhaps by CITW, the public would be made aware of the issue and would be encouraged to purchase labelled products. This would in turn be an incentive for industry members to accelerate their plant upgrading activities.

4.5 Effects of TRD/BMP Implementation on Competitiveness

4.5.1 US Regulations versus Canadian TRD/BMPs

In the USA, the treating industry is regulated under a number of Federal and State Acts (El Rayes, 1998). Authorities use the regulations in the permitting process. The permits cover allowable quantities of toxic releases, including storm waters, and may specify management control requirements, emission criteria and reporting requirements. Under the Resource Conservation and Recovery Act (RCRA), design and operational requirements for drip pads, liquid waste collection, maintenance requirements, record keeping and contingency planning are stipulated. Detailed attention is being paid by the US EPA to drip pad designs and operation. Also, each of the heavy-duty preservatives has to be applied by a licensed operator or by a person under the supervision of such an operator.

The US Pacific Coast treaters have adopted a BMP for the manufacture of treated wood in aquatic environments (WWPI, 1996). However, unlike the BMP recommendations in the TRD, it does not extend to the manufacture of all treated wood products.

The TRD provides very detailed design and operational recommendations that go much further than the US regulatory requirements. It is less specific in other areas, such as emission monitoring. Specific monitoring programs are not outlined but are generally determined by Provincial authorities based on site specific conditions. However all discharges from Canadian plants to receiving environments must meet the requirements of the Fisheries Act, which means that effluent discharges to waterbodies cannot be toxic. There is no such requirement in the US where stormwater discharges are, for example, restricted solely on chemical concentration of copper and arsenic but not pentachlorophenol and PAHS. Canadian plants expend significant resources for monitoring, control and legal matters related to the toxicity issue. For some plants, the costs may exceed $100,000 per year.

In response to the US regulations, US treaters have upgraded their plants primarily in terms of containment and waste management. A number of plants have provided enclosures for storage of freshly treated wood. CCA fixation requirements do not exist, hence, accelerated fixation is not widely practiced. This represents an advantage for the US industry.

The most significant differences between the Canadian and US regulations are the requirements in Canada for accelerated fixation and longer treatment cycles due to implementation of the BMPs. In addition, as already mentioned, toxicity monitoring is a Canadian requirement which can involve significant expenditures.

The average cost of a CCA steam fixation chamber and associated pads and equipment is $250,000 per facility. Operating costs would include handling, energy and sampling/testing. In some instances accelerated fixation may reduce the treatment capacity, since fixation cycles may be longer than the pressure treatment cycles. These operating costs have not all been identified and could be quite significant. They will vary greatly from facility to facility.

The BMP recommendations for the other preservatives (ACA, PCP, creosote) may require solution filtration (capital cost $30,000) and longer treatment cycles, causing capacity reductions and increased energy cost. The cost impact of these modifications are highly site specific and can only be "guesstimated" at this stage.

Plants practicing the BMP recommendations indicate that, aside from reduced environmental risks, a major benefit is a cleaner, more acceptable product. However, insurance and financial institutions do not seem to grant favourable terms to plants that have implemented the TRD/BMPs.

4.5.2 Effect on the Competitiveness of the Canadian Wood Preserving Industry

It has been stated that both industries are primarily domestic in scope and essentially do not compete in each other's primary markets (Stephens et al., 1996). In 1996, industry reports indicated that material and operating costs were essentially equivalent. The major Canadian exports to the US are CCA posts and PCP poles, as well as some consumer lumber and industrial timbers. By far the most important imports are creosote/oil railway ties (60.3% of all imports as per Stephens, et al., 1994). PCP and CCA poles are the next most important commodity, with some CCA industrial timber and consumer lumber also gaining entry from the US.

It is important to note that wood cost represents approximately 65% of total product value. Therefore, the availability and economics of wood supply are key competitive factors. This not only affects cross-border shipments but also competitiveness in off-shore markets, where poles are the prime export commodity from Canada as well as the USA.

In the following cost calculations, it is assumed that US treaters meet all US regulatory requirements and that Canadian treaters will meet the 1998 TRD/BMP recommendations.

4.5.2.1 CCA Facilities

The extra capital cost facing the Canadian industry for TRD/BMP implementation in CCA plants is $250,000 for fixation facilities. The additional operating cost is $1.91/m^3 ($4.50/Mbf - Fink, 1998). Therefore, the total cost increase faced by Canadian treaters, based on 1992 production data, is as follows:

The capital cost in excess of US requirements for fixation at 70 CCA facilities is $17.5 million. The additional operating cost based on 1.56 million m^3 of CCA-treated product is $2.98 million/year.

Capital (year 1 to 10):	$ 1,750,000
Operating:	$ 2,980,000
Total Annual Cost:	$ 4,730,000 (year 1 to 10)

Operating Cost in excess of US requirements:

$ 3.03/m^3 (5.7%)

Additional ISO 14000 implementation would impact costs as follows:

Cost of installation:	$2,016,000 (year 1)
Ongoing maintenance:	$ 448,000/yr.

Year 1 impact:	$1.29/m^3 (2.4%)
Impact in subsequent years:	$0.29/m^3 (0.6%)

The combined impact on operating cost in year 1 is \$4.32 m^3 (8.2%) and in each of the following 9 years is \$3.32 m^3 (6.3%).

These cost increases would have a significant impact on the ability of the Canadian industry to both compete in US markets and also compete against US imports. It appears inevitable that there would be distinct changes in the trade patterns of CCA commodities.

4.5.2.2 Oilborne Facilities

The oilborne sector of the Canadian industry faces a lower capital cost impact than the CCA facilities. With a capital cost in excess of US requirements estimated at \$30,000 per facility, the total oilborne industry capital cost would be \$0.9 million. The additional operating cost for oilborne facilities is assumed to be the same as for CCA facilities, since no hard data was obtained during this study.

The additional cost facing the Canadian oilborne industry segment is based on 0.43 million m^3 of production (Stephens et al., 1994):

The capital cost for 30 oil-borne facilities is \$0.90 million.
The operating cost based on 0.43 million m^3 is \$0.82 million.

Capital (year 1 to 10):	\$ 90,000
Operating:	\$820,000
Total annual cost:	\$910,000 (year 1 to 10)
Cost increase:	\$2.12/m^3 (4.0%)

Additional ISO 14000 implementation would impact costs as follows:

Cost of installation:	\$864,000 (year 1)
Ongoing maintenance:	\$192,000/yr.

Year 1 impact:	$2.00/m^3 (3.8%)
Impact in subsequent years:	$0.44/m^3 (0.9%)

The combined impact on operating cost in year 1 is therefore, \$4.12/m^3 (7.8%) and in each of the following 9 years is \$2.56/m^3 (4.8%).

The impact of the additional operating cost on competitiveness is considerable and it is conceivable that it will have a significant effect on tie imports from the USA, which have already been substantial in the past decade, as well as on Canadian pole shipments into the US.

4.5.3 Effect on Overseas Exports

The level of additional operating cost estimated in this study will undoubtedly affect the ability of the Canadian industry to compete in off-shore markets. These markets are extremely competitive and increased operating costs will undoubtedly result in either loss of business or decreased profitability for Canadian participants. Further analysis of this issue is not possible under the limitations of this study.

4.5.4 Impact on the Canadian Consumer

It is safe to assume that the cost of TRD/BMP implementation will be included in the selling price of all treated products consumed in Canada.

The main product categories selected for discussion are CCA-treated wood other than poles, railway ties and PCP and CCA-treated utility poles. As per 1992 data the volumes of these products are as follows:

CCA treated wood	1.33 million m^3
Utility poles (CCA)	0.17 million m^3
Utility poles (PCP)	0.13 million m^3
Railway ties	0.13 million m^3

The additional cost resulting from an upgrading from pre 1988 to the 1998 TRD/BMPs must be assigned to each of these products to determine the impact on selling price.

4.5.4.1 CCA-treated wood (predominantly consumer lumber)

- There are 70 CCA facilities with a capital cost increase of $54.25 million or $5.43 million annually.
- A volume of 1.33 million m^3 represents 89% of all CCA treatments.
- The cost assigned to this product category is therefore, $4.83 million/yr. Adding a 1.3 margin factor (financing, profit, etc.) the price increase will be $6.28 million or $4.72/ m^3.

4.5.4.2 CCA treated utility poles

A CCA pole volume of 0.17 million m^3 represents 11% of all CCA wood treated and consumed in Canada. The capital cost assigned to this product is $0.597 million. Adding a 1.3 margin factor results in a total price increase of $0.776 million or $4.56/$m^3$ or $3.23 per CCA pole.

4.5.4.3 PCP treated utility poles

The capital cost incurred by the PCP industry segment is $19.55 million or $1.96 million a year for 10 years. Poles account for about 90% of all PCP treated products, so that the proportionate capital cost is $1.76 million/yr. Adding a 1.3 margin factor results in a price increase of $2.29 million for PCP poles or $17.60/$m^3$ or $12.50 per average size distribution pole.

4.5.4.4 Railway ties

Railway ties make up about 70% of all creosoted wood produced for consumption in Canada.

The capital cost assigned to this product is $13.65 million ($19.5 million x 0.7) or $1.37 million annually. Adding a 1.3 margin factor, the additional price increase is $1.77 million for ties or $13.62/m^3 or $1.36 per No. 1 tie.

As has been shown, the additional operating cost incurred by TRD/BMP implementation will have a substantial impact on the final price of treated products. However, a lack of available data precludes further analysis.

Based on the capital cost estimates (operating costs are not considered), price increases for CCA consumer lumber and poles are about 2%, for PCP poles about 5.6% and railway ties at $30/tie, 4.5%.

5.0 TASK 2 MONITORING PROCESS DISCHARGES AND EMISSIONS

5.1 Objective

To determine the costs related to monitoring the various water, waste and air discharges and emissions generated during the manufacture of wood preserving chemicals and the preservative treatment of wood products.

5.2 Introduction

Environmental monitoring programs at Canadian wood preservation manufacturing and treatment plants are highly dependent on regulatory requirements. The requirements may vary significantly even within one regulatory jurisdiction. As an example, wood preserving plants in the Lower Mainland of British Columbia are required by BC Environment to monitor stormwaters on a quarterly basis, while there are no stormwater monitoring requirements for facilities outside the Lower Mainland. Additionally, a facility within the Lower Mainland but located on Federal property, is exempt from the BC Environment requirements. Recently Environment Canada has placed stormwater monitoring requirements on at least one wood preserving facility outside the Lower Mainland. Greater variances are expected in monitoring requirements for process waters, where discharges are likely to sewers and are therefore subject to the requirements of municipalities.

5.3 Wood Preserving Plants

For the purpose of this report, the annual monitoring costs at wood preserving plants are based on probable scenarios which represent a cross-section of requirements within jurisdictions throughout Canada. The assumptions and estimated costs are provided in Table 2. Of significance, are the one-time costs which are required to enable routine sampling, such as those associated with the installation of groundwater monitoring wells. These costs are provided in Table 3.

5.3.1 Stormwater Monitoring

El Rayes Environmental Corp. (1998) reported that only 32% of Canadian CCA wood preserving facilities monitor stormwaters; while stormwater monitoring occurs at 60% of creosote facilities and at 50% of PCP facilities. The statistics indicate a great variance in regulatory approaches throughout Canada. At least four stormwater sampling events are required to adequately assess the quality off runoff waters from a site on an annual basis. The estimated costs in Table 2 are based on two discharge points, composite sampling over a one-hour time frame, analysis of appropriate chemical parameters and reporting.

5.3.2 Monitoring of Wastes

Process solid wastes are generally assumed to be "hazardous materials" without the need for analytical verification. For example, it is unlikely that cartridges from filters and sludges from sumps and cylinders would not require disposal by certified waste management companies. As a result, the actual cost of monitoring wastes by the Canadian wood preserving industry is probably negligible.

5.3.3 Monitoring Process Waste Waters

Excluding contaminated stormwaters, process waste waters within CCA and ACA wood preserving plants are unlikely. No Canadian CCA facilities were reported by El Rayes Environmental Corp (1998) as monitoring process wastewaters. A trend among water-borne wood preserving plants is to recycle stormwaters which may contain CCA residues.

Process waste waters result from oil-borne wood preserving plants and, as noted in the report by the El Rayes Environmental Corp. (1998), 100% of the facilities treating with creosote and 63% of facilities treating with pentachlorophenol had waste water treatment systems which met effluent permit requirements. The remaining pentachlorophenol facilities claimed to recycle their wastewaters, and one discharged to a municipal waste water treatment plant. Only 80% of the creosote facilities and 50% of the PCP facilities monitored their waste waters, again suggesting different requirements of regulatory agencies, i.e., some agencies probably do not require any monitoring. Monitoring of any discharges should be a condition of a discharge permit, and for the purposes of this study, monthly monitoring is assumed.

5.3.4 Monitoring Air Emissions

The El Rayes Environmental Corp. report (1998) indicated that there is no air emission monitoring at Canadian wood preserving facilities, although air emission control systems are said to be installed at 14% of the CCA facilities, 50% of the creosote facilities and 44% of the PCP facilities. The cost estimates in Table 2 assume the need for monitoring twice per year.

5.3.5 Groundwater Monitoring

Groundwater monitoring is suggested in the Technical Recommendations Documents for the wood preserving industry. El Rayes Environmental Corp. (1998) reported that 60-64% of Canadian facilities monitor groundwater. Table 2 provides an estimate of annual monitoring costs for four groundwater wells, including an assessment of groundwater flows at each of two monitoring events per year. Also, of significance are the installation costs for a groundwater monitoring system shown in Table 3.

TABLE 2:

Estimated Annual Cost of Monitoring Process Discharges and Emissions from a Preservative Treatment Plant

Process Stream	CCA $	ACA $	Creosote $	PCP $
Stormwater [1]	4,000	4,200	4,400	4,400
Waste	[2]	[2]	[2]	[2]
Process Water [3]	None	None	7,000	7,000
Air Emissions [4]	[5]	4,200	4,800	4,800
Groundwater [6]	2,800	2,900	4,000	5,000

1 2 discharge points are assumed, four sampling events per year.
2 Sludge quality is generally assumed to be a hazardous waste.
3 Dependent upon regulatory requirements; assume monthly monitoring is required.
4 Dependent upon regulatory requirements; assume monitoring twice per year.
5 No air monitoring at CCA plants.
6 Assume four groundwater wells sampled twice per year.

TABLE 3:

Estimated One-time Costs for Installation of Monitoring Equipment for Preservative Treatment Plants

Process Stream	CCA $	ACA $	Creosote $	PCP $
Stormwater	[1]	[1]	[1]	[1]
Waste	[1]	[1]	[1]	[1]
Process Water [2]	None	None	10,000	10,000
Air Emissions [3]	None	15,000	20,000	20,000
Groundwater [4]	15,000	15,000	17,000	18,000

1 No start-up costs are assumed.
2 Assumes manual sampling with basic field equipment e.g. pH meter etc.
3 Assumes sampling by outside services.
4 Four groundwater wells installed by an auger rig to a depth of no greater than 6 meters are assumed; analysis of eight soil samples and four groundwater samples for background; site survey; determination of groundwater direction.

5.4 Wood Preserving Chemical Manufacturing Plants

There are only two wood preserving chemical manufacturing plants in Canada, one to produce creosote and the other to formulate CCA for the industry. Actual monitoring costs reported by each plant were used to provide the cost estimates outlined in Table 4. It is important to note that wood preservatives are generally by-products of other main manufacturing products. Creosote is manufactured from coal-tar which is a by-product of coke production. CCA is formulated by direct mixing of chromic acid, arsenic acid and copper oxide, purchased from other sources. Arsenic acid is also a by-product of another manufacturing process, i.e., copper smelting.

5.4.1 Stormwater Monitoring

Both operations reported that no stormwater monitoring was conducted at their facilities.

5.4.2 Monitoring of Wastes

El Rayes Environmental Corp. (1998) reported that wastes at the CCA formulating plant are minimal, and that metal recovery occurs to reduce the sludge volume and heavy metal content. It was reported to El Rayes that there was no requirement for disposal of sludges by the formulator. In a response to this study, the formulator indicated that "hazardous waste is monitored periodically and disposed of yearly or every two years".

For the creosote manufacturing facility, El Rayes reported that creosote wastes and sludges are reused or recycled whenever possible, with the wastes either used as stock feed to the distillation units, or recycled off-site as a cokery feedstock in a steel mill. In response to a questionnaire for this study, the manufacturer indicated a $1,200/year monitoring cost for recycled wastes.

5.4.3 Monitoring Process Waste Waters

The CCA formulation process per se does not generate process waste waters. However, wet scrubbers are used to control emissions from tank and reactor vents. The scrubber process water is recycled in the formulation process. As a result, there is no routine monitoring of process waste waters at the CCA formulation facility.

The creosote manufacturing facility reported daily monitoring of process waste waters at a cost of $36.000 per year.

5.4.4 Air Emissions

Air emissions from the CCA formulation facility are not routinely monitored. The facility did report that workplace monitoring for arsenic was undertaken to ensure worker safety.

The creosote manufacturing facility reported that the last air emission survey occurred in 1990, and only as required by the Provincial authorities. Emissions for reporting to the National Emission Reduction Masterplan and NPRI are estimated on a yearly basis.

5.4.5 Groundwater Monitoring

Both facilities reported that groundwater monitoring was required by Provincial authorities. The annual cost of $20,000 for quarterly groundwater monitoring was the only routine monitoring cost reported for the CCA formulation plant. The $15,000 cost for three time per year groundwater monitoring represented 30% of the total annual monitoring costs for the creosote manufacturing plant.

TABLE 4:

Current Annual Monitoring Costs for Wood Preservative Manufacturers

Process Stream	Creosote Manufacturer ($)	CCA Formulator ($)
Stormwater	None	None
Waste	1,200	Not reported
Process Water	36,000	None
Air Emissions	None	None
Groundwater	15,000	20.000

6.0 TASK 3 MANAGEMENT OF WASTE TREATED INDUSTRIAL WOOD PRODUCTS

6.1 Objective

To determine volume trends and current management practices for waste treated industrial wood products.

6.2 Volume and application of treated industrial wood products

Treated industrial wood products are produced by the Canadian Wood Preserving Industry (CWPI) for a wide range of industrial applications where biodegradation is a major concern. The category includes the following product types:

- Poles for electrical and telecommunication distribution.
- Lumber and timber for landscaping, bridges, highway guardrails, sign posts, marine structures, agricultural buildings, fencing and general construction.
- Railway ties.
- Round posts for fencing and agricultural buildings.
- Pilings for buildings, wharves and marinas.

Stephens et al (1994), reported that in 1992 the CWPI produced 924,000 m^3 of industrial products with a value of approximately $258 million. Thus, industrial products represented 46.5% of the total volume and 47.0% of the total value of treated wood produced in Canada in 1992. Production data are presented in Table 5 to illustrate the diversity of the industrial products category, both in terms of preservative treatment and product application.

TABLE 5:

Production of Treated Industrial Products in Canada in 1992

PRODUCT		VOLUME m³					TOTAL BY PRODUCT	
		CCA	ACA	PCP/ Oil	Creosote /Oil	Creosote	Volume m³	%
Poles		181,795	0	203,599	0	37,945	423,339	46
Lumber and Timber		182,645	10,194	850	1,982	16,707	212,378	23
Railway Ties		0	0	20,671	111,569	283	132,523	14
Round Posts		132,524	0	0	0	283	132,807	14
Pilings		1,416	850	0	0	20,388	22,654	3
Other		0	0	0	0	283	283	-
Total by Preservative	Volume	498,380	11,044	225,120	113,551	75,889	923,984	100.0
	Percent	54	1	25	12	8		

Source: Stephens et al., (1994).

Table 5 shows that in 1992, 55% of all industrial products were treated with waterborne preservatives, mainly CCA, while 45% were treated with oilborne systems. Utility poles represented the largest volume of all industrial products.

Approximately 84% of the treated industrial product volume was consumed in Canada in 1992. Export volumes included poles (14%), lumber and timbers (1%) and posts (1%).

6.3 Volume trends for waste treated industrial wood products

In order to determine the trends in the amount of waste material which the users of industrial products must deal with in future years, available data were analyzed to develop a best estimate of the volume of treated products which will be removed from service, over the next 20 years.

Although determination of removed volume is an important step in a study of this nature, it must be recognized that the development of even a best estimate is a challenging undertaking, due to the numerous problems related to the collection and interpretation of the data.

6.3.1 Factors affecting determination of the volume of treated industrial products to be removed from service.

As indicated, attempts to determine the volumes of treated industrial products removed from service are hampered by a number of factors. In those studies which have relied on industry surveys, the major frustration has been a low level of response by the users of industrial products. Low response levels have been due to a combination of extremely short study deadlines and the fact that many major users of industrial products do not maintain accurate records of product removals.

In other studies which have attempted to calculate product removal based on estimated historical production volumes and anticipated service life, there is always a concern, because of the number of assumptions required and the amount of estimation involved.

Unlike the US industry, the CWPI does not maintain records of its annual production data, therefore estimates of product volume must be derived from the historical value of treated wood shipments reported by Statistics Canada. Unfortunately, Statistics Canada data can be greatly understated, by as much as 25%. This is due to the fact that significant volumes, including almost 100% of railway ties and up to 40% of consumer lumber, are shipped under Treating Service Only (TSO) contracts (Stephens et al., 1994).

Reporting of the value of TSO shipments to Statistics Canada does not include the cost of raw material, therefore the use of historical shipment value to determine product volumes can result in major errors. Furthermore, in addition to the challenge of estimating total industry volume in any given year, it is almost impossible to determine individual product volumes with any degree of accuracy.

Other approaches to forecasting removal volumes are encountered in the literature where historical consumption of treated wood has been based on preservative usage. (Cooper, 1993; Cooper-Ung, 1989.)

Although preservative usage, derived from sales statistics provided by the preservative manufacturers, is undoubtedly accurate, the calculation of volume is based on the assumption that the various products were treated to the preservative retention levels specified in the CSA Commodity Standards. Although there have been no recorded incidents in Canada of major product failure due to poor treatment, it is generally recognized that over the years, the required retention levels have not always been met.

When developing estimates for various operational aspects of the CWPI, it is often useful to compare with the US industry by using the "10% rule". The US and Canadian wood preserving industries have similar histories and use the same preservatives and process technology to produce similar products for similar customers in similar markets. The major difference, of course, is that the US industry is approximately ten times the size of that in Canada and does maintain annual records of operating statistics on an industry-wide basis. (American Wood Preservers Institute, 1995.)

Despite the difficulties outlined above, the task in this section is to examine the available data and develop a best estimate of the volume of treated industrial product removals both now and in the future, in order to determine the trends in the amount of waste treated industrial products that users are now facing.

6.3.2 Service life of treated industrial products.

The objective in wood preserving process technology is to inject preservative chemical into a wood product so as to create a shell of treated wood to protect the untreated interior from biodegradation. The ability of the treated shell to provide the required level of protection, or service life, is influenced by a variety of factors. These factors include:

- preservative retention
- preservative penetration
- wood species
- product dimensions
- preservative mobility
- exposure to biological hazards
- tendency of wood to check (split) and expose untreated wood.

Most industrial products are removed from service due to obsolescence of the structure or biodegradation caused by factors such as decay, fungi, wood-destroying insects, marine borers and the deteriorating effects of exposure to the weather.

The preservatives used to treat industrial products have all demonstrated a long and successful history of use in Canada. For example, the CWPI has used creosote for almost 90 years, pentachlorophenol for more than 50 years and CCA for approximately 30 years. As a result, the service life of products treated with these preservatives is well documented (Stephens et al, 1994). The service life ranges for the major industrial products are shown in Table 6. The ranges include various species treated with either oilborne or waterborne preservatives as shown in Table 5 and generally indicate the service life that may be expected for individual product groups before they must be removed due to biodegradation.

TABLE 6:

Service Life Ranges for Treated Industrial Products in Canada

PRODUCT	Service Life Years
Poles	30 - 50
Lumber and Timbers	20 - 30
Railway Ties	30 - 40
Posts	30 - 40
Pilings	30 - 50

Source: Stephens et al (1994)

Some industrial products, particularly poles, are removed from service for reasons other than biodegradation. These reasons include physical damage from traffic accidents or storms, road widening and structural upgrading of distribution lines. In a recent North American survey, Canadian utilities reported that 66% of their total pole removals were for reasons other than decay. The corresponding statistic for US utilities was 28% (Brudermann et al, 1996).

6.3.3 Estimation of the volume of treated industrial wood products to be removed from service

In the literature review conducted for this task, several studies were identified which used different methods to provide spot estimates of current and future treated wood removals in North America. (Cooper and Ung, 1989; Cooper, 1993; Felton and DeGroot, 1996; Stephens et al, 1996a; and Smith and Shiau, 1998). However, only two studies were identified which provided estimates of treated wood removal trends in Canada over the next 20 years (Plackett et al., 1995; Stephens et al., 1996b). These studies were prepared by authors who are familiar with all aspects of the wood preserving industry in Canada. In both studies, determination of product removal was based on independent estimates of historical production volumes and anticipated service life. The report prepared by Plackett et al (1995) was for the Canadian Forest Service (CFS) while the Stephens et al (1996b) report was prepared for the Canadian Council of Ministers of the Environment (CCME). For the purpose of comparison and discussion in this section, these reports will be referred to as the CFS and CCME studies.

In the CFS study, estimates of future volumes of treated wood removed from service are provided for the three major preservative treatments, creosote, pentachlorophenol and CCA. Although service life estimates for individual CCA-treated products are provided, the study objective did not require estimation of the volumes of individual products removed from service. In contrast, the CCME study required estimation of the volume of individual product removals for the next 20 years for waterborne preservative, and PCP and creosote combined as oilborne preservatives.

Table 7 shows a comparison of the estimated industrial product removals for 1990-2020, which was developed from the data reported in the CFS and CCME studies. To develop this comparison, the CFS data for CCA-treated products were calculated as 32% of the total CCA volume reported by Stephens et al., (1994), while the CCME data for PCP-treated products were based on the oilborne-treated pole volumes provided in the same study (Stephens et al., 1994).

TABLE 7:

Reported Volumes of Treated Industrial Wood Product Removals

Preservative Treatment	Removal Volume in 1,000 m^3							
	1990	1995	2000		2010		2020	
	CFS	CCME	CFS	CCME	CFS	CCME	CFS	CCME
Creosote	300	176	260	164	260	161	260	161
Pentachlorophenol	120	(1) 96	200	(1) 94	300	(1) 91	200	(1) 85
CCA	(2) 22	122	(2) 48	176	(2) 214	252	(2) 422	540
TOTALS	442	394	508	434	774	504	882	786

(1) CCME Data for PCP-Treated Industrial Products based on reported pole volumes.

(2) CFS data for CCA-Treated industrial products calculated as 32% of total CCA reported.

The volumes shown in Table 7 for the individual preservatives in each time period are quite different, while the total volumes for each time period are in better agreement. The differences are no doubt due to the independent approaches used to estimate historical production volumes, product mix and product service life in the two studies.

Other data reported in the literature further illustrates the challenge involved in determining removal volumes for individual products and preservative treatments with any degree of accuracy. For example, in response to a survey conducted during 1995, various users reported removal volumes for the major industrial products, for that year (Stephens et al., 1996a). These volumes are shown in Table 8 in comparison with the CFS and CCME data for the same period.

TABLE 8:

Comparison of Reported Volumes of Treated Industrial Wood Products Removals (1,000m^3)

Preservative Treatment	**Survey 1995**	**CFS 1990**	**CCME 1995**
Creosote	273	300	176
Pentachlorophenol	106	120	96
CCA	89	22	122
TOTALS	**468**	**442**	**394**

While the data for PCP are quite consistent, there is greater disparity in the case of creosote and CCA. The survey data are in better agreement with CFS for creosote and with CCME for CCA.

As a general conclusion, the real value of the volumes of industrial product removals estimated for the next 20 years is in the overall trends they reveal for individual products and preservatives, rather than their perceived accuracy as absolute numbers.

For example, based on the available trend data, creosote-treated removal volumes will decline by 9% (CCME) to 15% (CFS) from 1990 - 2020. The forecasts for PCP-treated products for the same period reveal a different pattern as the CFS data show increases of 67%, 150% and 67% compared to 1990, for the years 2000, 2010, and 2020 respectively; while the CCME data show an overall 11% decrease in removal volume. For CCA-treated product removals, both studies forecast significant increases throughout the period 1990-2020. The CFS data indicate an increase of

400,000 m^3 (22,000 - 422,000 m^3) from 1990 to 2020 while the CCME data show an increase of 418,000 m^3 (122,000 - 540,000 m^3) from 1995 to 2020.

The trends outlined above reflect the general historical decline in the use of creosote as a result of substitution by PCP between the 1950's and the 1970's and the dramatic growth in the use of CCA which has occurred in the past 25 years. Although the use of PCP has declined since the 1970's due largely to the use of CCA for pole treatments, the data illustrate the difficulty involved in estimating the effect of the rate of preservative substitution, in the absence of industry data related to actual product consumption and removal.

In view of the fact that it is impossible to rationalize differences in the reported data in the context of this study, it is suggested that the average of the volumes reported for each preservative in each time period, in Table 7, should be considered for the planning of product disposal strategies. These average volumes are shown in Table 9.

TABLE 9:

Estimated Average Volumes of Treated Industrial Wood Product Removals

Preservative Treatment	**Volume in 1000 m^3**		
	2000	**2010**	**2020**
Creosote	212	210	210
Pentachlorophenol	147	195	142
CCA	112	233	481
Total Industrial Products	**471**	**638**	**833**

All the data reported in this section are based on best estimates of normal service life and do not include allowances for natural disasters, such as the ice storm which caused the removal of more than 60,000 poles in Eastern Canada during early 1998.

6.4 Current management practices for waste treated industrial wood products

A comprehensive study prepared for the Electric Power Research Institute (EPRI) in the US, reported that current management practices for used treated poles and railway ties are reuse, co-generation and landfilling (Tetra Tech Inc., 1995). The EPRI report reviewed potential management options for future use and concluded that both utility and railroad companies will continue their reuse and landfill practices and increase their use of co-generation, for the foreseeable future. This is due to the fact that additional information, related to the environmental impact of other options, is needed before widespread use can occur.

The most recent review of current Canadian management practices for waste treated industrial products was prepared by El Rayes Environmental Corp. (1998). The following practices were reported:

- reuse of treated products
- recycling as lumber
- energy recovery in cement kilns
- landfilling.

The survey conducted for this study provided the current status of management practices for poles and ties will serve to update the El Rayes Environmental Corp. report (1998). No information could be obtained on current management practices for other industrial products within the time frame available for this study.

6.4.1 Reuse of waste treated industrial products

6.4.1.1 Railway Ties

From 1989 - 1995, estimates of the number of ties removed from service ranged from 2.5 - 3.1 million and up to 90% of the removals were reused (Cooper and Ung, 1989 and Konasewich et al., 1993). Reuse included installation in secondary lines and sales to landscaping contractors and private individuals.

Information provided by the two major Canadian railways for this study shows that their current plans are based on the annual removal of 1.4 million ties. Of this volume, they expect to be able to reuse 30% or 420,000 ties (Masterton, 1998; Tennier, 1998). The drastic reduction in the volumes available for reuse is due to ties being left longer in service, due to pressure on operating and maintenance budgets (Brimo, 1998).

BC Rail reported the removal of approximately 100,000 ties per year. Of this volume, 20% are returned to service on secondary lines and 60% are sold to contractors for landscaping applications (Brodie, 1998).

6.4.1.2 Utility Poles

The reuse of utility poles includes reuse in distribution systems plus the sale and/or donation of poles to contractors and the general public. The data presented in the El Rayes (1998) report suggests that 75% of the CCA and PCP-treated utility poles removed from service are reused. Inspection of the data revealed that this reported level of reuse also included recycling. Therefore, other literature was examined in order to obtain a clearer picture of actual reuse volumes.

In response to a survey in 1996, 9 major Canadian utilities reported total annual removals of 88,000 poles, of which 79% were donated or sold to the public and 9% were reused in their distribution systems. Due to concerns related to product safety and liability, the same group of utilities reported that their future plans were to reduce donations and sales to 21%, while the number of poles they planned to reuse in their distribution systems would increase to 14% (Brudermann et al., 1996).

6.4.2 Recycling

Recycling is the next step in the hierarchy of management practices when treated industrial products are removed from service and cannot be reused in their original form. Current recycling practices are aimed at the management of waste poles.

6.4.2.1 Recycling as lumber products

El Rayes reported on the conversion of waste poles to lumber products currently practiced in BC. This operation, which is a joint venture between BC Hydro, BC Tel and BC Wood Recycling, has the capacity to convert 5,000 poles per year into landscaping products, garden furniture and fencing. BC Hydro and BC Tel guarantee to deliver the annual pole volume to ensure the viability of the operation. The poles are slabbed to remove the treated outer portion which is then sent to a landfill site. BC Hydro and BC Tel share the landfill cost (50/50). The joint venture partners are currently investigating chipping the treated slabs to allow disposal in a co-generation plant. The partners will share transportation costs and tipping fees, which in total, will be less than the current landfill costs.

Although manufacturing costs are high due to the need for metal removal and several handling stages, the company is now profitable and considered to be a success (Miller 1998; Tigg, 1998). BC Wood Recycling is the only commercial operation of its kind in Canada and appears to be unique in North America. Several US utilities have visited the operation and as a result, some are apparently considering setting up similar operations.

It is interesting to note that in a recent survey, two major Canadian utilities reported that they plan to recycle 45% of their annual pole removals as sawn wood products (Brudermann et al., 1996).

6.4.2.2 Recycling as fibre

During the course of the survey conducted for this study, TransAlta Utilities reported that any PCP-treated poles they remove which cannot be reused in their system or sold to local farmers, are sent to Innovative Recycling in Enoch, Alberta where they are converted into chips (Bedsen, 1998; Pearen, 1998). The chips are then mixed with other waste wood fibre and supplied to IG Paper Recycling Limited in Calgary, Alberta for blending with waste corrugated medium and newsprint. This blend is then used to make a heavy, dry felt paper product. The dry felt product is supplied to IKO Industries Limited, an affiliate of IG Paper Recycling, who use it as the base for manufacturing asphalt roofing shingles. CCA-treated wood is not permitted in this process (Thiele, 1998).

Based on the production statistics provided by IKO Industries for the seven asphalt shingle plants in Canada, it appears that this example of innovative recycling consumes approximately 80,000 tons of treated and untreated waste wood per year. Unfortunately, an estimate of the proportion of treated wood which could be included in this mix could not be obtained (Coleville, 1998).

6.4.3 Energy recovery

Current energy recovery practices identified during this study included the use of cement kilns, industrial boilers and co-generation plants.

6.4.3.1. Cement kilns

St. Lawrence Cement Inc. have successfully tested waste treated wood in their kiln at Joliette, Quebec (El Rayes, 1998). This plant now has a permit which allows 90,000 tons of treated wood to be burned per year and is the only facility in Canada, approved for this purpose.

Although reported as a current practice (El Rayes, 1998), the Joliette kiln has not yet commenced burning treated wood as part of normal production. St. Lawrence Cement Inc. still requires volume commitments from the suppliers involved before investing the $1 million required to burn waste treated wood on a continuous basis.

The suppliers involved are CN Rail (CNR), Canadian Pacific Railway (CPR), Hydro Quebec and Bell Canada. These companies are currently evaluating processing options to reduce their poles and ties to the particle size required for the kiln (Auger, 1998).

St. Lawrence Cement production personnel wished to emphasize that they have not yet established that they can burn treated wood at the rate required to consume 90,000 tons per year. They also emphasized that the CCA component of the fuel feed to the kiln will be limited to approximately 6% (100% CCA-treated). Therefore, the absolute maximum of fully CCA-treated wood will be 5,000 - 6,000 tons per year (Beaulieu, 1998).

Although El Rayes (1998) reported that the economic viability of this operation was based on a tipping fee of $45 per ton, it was established that St. Lawrence Cement are now willing to accept shredded wood, free from metal, at no charge to suppliers (Auger, 1998).

6.4.3.2. Industrial boilers and co-generation plants

It has been pointed out that the recovery of energy from treated wood in industrial boilers and co-generation plants is not practised in Canada, although this is permitted by current regulations (El Rayes, 1998).

While this study did not attempt an exhaustive evaluation of this method of disposal, it was established that BC Rail supply approximately 20,000 ties per year to a co-generation plant in Williams Lake, BC and a pulpmill boiler in Prince George, BC. Although there is no charge for the actual burning, the ties must be chipped and delivered at the supplier's cost. The cost of handling, chipping and transport was estimated at approximately $5 per tie (Brodie, 1998).

CNR and CPR reported that ultimately they plan to use energy recovery as a management practice for 70% of their annual removal volume, which amounts to almost one million ties (Masterton 1998; Tennier 1998). Disposal costs are estimated to be approximately $5 per tie. Both companies are actively researching co-generation plants to determine those interested in using waste ties as a fuel source.

CPR is currently shipping waste ties to co-generation plants in New York State and Pennsylvania and also to a pulpmill in Quebec (Brimo, 1998). Disposal costs for the New York operation are approximately $2.84 per tie which includes a co-generation plant charge of approximately $0.70 per tie.

In the previously referenced 1996 survey, three major Canadian utilities reported that they plan to use energy recovery as a management practice for 16% of their annual pole removals (Brudermann et al. 1996).

6.4.4 Landfilling

Treated industrial products are not considered as hazardous waste and therefore are accepted in landfills. As a result, it is suggested that as much as 30% of the treated wood removed is disposed of in sanitary or industrial landfill sites (El Rayes, 1998).

7.0 TASK 4 MANAGEMENT OF WASTE TREATED CONSUMER WOOD PRODUCTS

7.1 Objective

To determine volume trends and current management practices for waste treated consumer wood products.

7.2 Volume and application of treated consumer wood products

Treated consumer wood products are produced by the CWPI for a wide range of residential applications where biodegradation is a major concern. The production of consumer products involves the pressure treatment of standard dimension lumber, cut-to-size components and plywood with CCA. The category includes products for the following applications:

- patios
- decks
- landscaping
- fencing
- outdoor furniture
- permanent wood foundations (lumber and plywood)
- general residential construction.

Stephens et al (1994) reported that in 1992, the CWPI produced in excess of 1 million m^3 of consumer products with a value of approximately $290 million. Thus, consumer products represented 53.5% of the total volume and 53% of the total value of treated wood products produced in Canada in 1992.

Approximately 97% of the treated consumer product volume was consumed in Canada. The export volume of approximately 29,000 m^3 consisted of lumber products.

In 1992, approximately 96% of the volume of consumer products consisted of treated lumber for general outdoor applications, while the balance of 4% consisted of lumber and plywood treated specifically for use in Permanent Wood Foundations.

The 1994 survey did not produce quantifiable data on the specific end uses of the large volume of treated lumber produced in 1992 for the residential market. However, available information on the US industry (Stephens et al., 1994) does provide a breakdown of this market which is considered applicable to Canadian uses. Table 10 shows the estimated amount of treated consumer lumber used for different applications, based on the volume of treated lumber consumed by the residential market in 1992 and the market share percentages provided.

TABLE 10:

Estimated Volumes of Treated Lumber for Residential Market Applications in Canada in 1992

APPLICATIONS	MARKET SHARE	
	Volume m^3	%
Patios and Decks	377,983	38.0
Posts	46,750	4.7
Landscaping	100.464	10.1
Construction	177,055	17.8
Outdoor Furniture	52,719	5.3
Fencing	100.464	10.1
Miscellaneous	139,257	14.0
TOTAL	994,692	100.0

Table 10 shows that patios, decks and general residential construction consumed more than 50% of the volume of CCA treated consumer lumber which was used in Canada in 1992.

7.3 Volume trends for waste treated consumer products

In order to determine volume trends for waste treated consumer products, a comparison was developed from the data reported in the CFS and CCME studies which were described in Section 6.3.3. This comparison is shown in Table 11 for the period 1990 - 2020. The CFS data were calculated as 68% of the total volume of CCA removals reported, in accordance with Stephens et al. (1994).

TABLE 11:

Reported Volumes of Treated Consumer Wood Product Removals

Study	Removal Volume in 1,000 m^3				
	1990	**1995**	**2000**	**2010**	**2020**
CFS (Plackett et al., 1995)	48		102	456	898
CCME (Stephens et al., 1996)		102	391	1,036	1,691
Average Volume (1,000 m^3)	75		246	746	1,295

As reported for industrial products, Table 11 shows the difficulty involved in forecasting removal volumes. The differences for each time period in Table 11 appear to be due to the assumptions related to historical production volumes and product service life which were used in each study. Comparison of the CCME data for the years 1995, 2000 and 2010 with the CFS data for the years 2000, 2010 and 2020, generally supports this conclusion.

In view of the differences in the reported data, it is suggested that the average volumes shown in Table 11 should be considered in planning disposal strategies for waste treated consumer products. These volumes indicate the dramatic increases in removal volumes which will occur in the foreseeable future. This trend is a reflection of the exponential increase in CCA-treated wood production which took place after 1975 (Plackett et al., 1995).

The production of CCA-treated wood exceeded that of PCP and creosote by about 1980 and currently represents almost 80% of the total volume of treated wood (Stephens et al., 1994). This growth in CCA-treated volume has been due not only to consumer demand for the product for residential applications such as decks, fences and landscaping but also to the increasing substitution of CCA for creosote and PCP-treated industrial products such as poles, piling and timbers.

7.4 Current management practices for waste treated consumer wood products

The most recent review of Canadian management practices for waste treated wood concluded that there are no efforts being made to recycle or reuse CCA-treated consumer products in Canada at this time (El Rayes, 1998). This is due to the fact that the volume removed to date is small and widely distributed geographically. Furthermore, homeowners who may have to remove the product can simply use their local refuse disposal system which ensures that the product is landfilled.

The survey undertaken for this study did not discover any current management practice for waste treated wood, other than landfilling.

8.0 TASK 5 PROPOSED MANAGEMENT PRACTICES FOR THE DISPOSAL OF WASTE TREATED INDUSTRIAL AND CONSUMER WOOD PRODUCTS

8.1 Objective

To review various aspects of management practices which are practical solutions for the disposal of waste treated industrial and consumer wood products.

8.2 Proposed Management Practices

Based on the survey undertaken for this study, the options available for the management of waste treated wood for the foreseeable future are generally, reuse, recycling, the use of combustion to recover the energy component of waste treated wood and continued disposal in landfills.

Other methods have been examined by a variety of investigators at a laboratory or pilot plant level. These methods include use in the manufacture of wood based and inorganic based composite products (Plackett et al, 1995), conversion to gas or liquid fuels, biodegradation and composting (Cooper and Ung, 1995; DeGroot and Felton, 1995; Tetra Tech Inc., 1995). However, no evidence of commercial scale development of these methods was found within the time frame available for this study.

In order to address concerns related to the preservative content of waste treated wood, other investigators have examined pretreatment technologies to remove or reduce the chemicals involved. Such pretreatment methods include solvent extraction, slurry-phase bioremediation and biodegradation. (Tetra Tech Inc., 1995; Felton and DeGroot, 1996; Stephens et al, 1996b; Kazi and Cooper, 1998).

In all cases, the technologies defined for the various options and pretreatment methods require further development before they can be reduced to commercial practice. In addition to specific questions related to the technological feasibility of suggested disposal methods, there are also other concerns to be addressed, which relate particularly to CCA-treated waste materials. For example, in a recent survey of US forest product companies, the majority indicated that they were not in favour of using waste CCA-treated wood in the manufacture of oriented strandboard (OSB), particleboard, medium density fibreboard (MDF), hardboard, parallel strand lumber (PSL), wood-nonwood composites and paper. The primary concerns of the respondents were the health and safety of mill workers and environmental problems which may arise with composite products which are contaminated with treatment chemicals (Smith and Shiau, 1998). These concerns support the conclusion that the elimination of the preservative chemicals from CCA-treated wood is a major environmental issue (Kazi and Cooper, 1998).

8.2.1 Waste treated industrial products

The specific management practices currently available for the disposal of waste treated industrial products may be summarized as follows.

8.2.1.1 Reuse

The reuse of products such as poles and ties in their original form, is well established and will continue as a standard practice for the railways and utilities. Based on the information developed for this study, reuse of poles and ties will receive more attention in future and will be practiced to the maximum level possible. This practice will be driven by the need to minimize both replacement product costs and waste product disposal costs. It is expected that the owners of other industrial products will follow this trend, where appropriate.

8.2.1.2 Recycling

Although not yet fully established as a general practice, the recycling of the untreated portion of treated wood has been demonstrated to be a feasible approach for waste poles. It could also be used for other industrial products, such as ties, timbers and piling, provided their condition allowed the economic recovery of marketable wood products. The commercial pole recycling operation in BC currently disposes of the treated wood residue by landfilling, but plans to use co-generation in the future, whereas the multi-product recycling operation currently being organized in Quebec, will ship its treated waste to a cement kiln. This type of recycling operation uses conventional processing technology and could be readily established in any location convenient to a supply of waste products, a market for wood products and a treated waste disposal facility. This practice will be driven by the need to reduce landfill costs.

The feasibility of recycling oilborne preservative-treated wood as fibre furnish for the dry felt paper substrates used in the manufacture of asphalt and tar based building products, has been commercially demonstrated, in at least one location. However, further investigation is required to determine whether the other Canadian plants will accept this type of furnish. The possibility of using CCA-treated wood in this process should be investigated. The volume of treated wood which can be used in this process, will be limited by the manufacturer's operating specifications, as determined by environmental regulations.

8.2.1.3 Energy recovery

The approval of waste treated wood as fuel for cement kilns in Quebec is a major advance in the development of disposal methods in Canada, as these plants have the potential to use large volumes of material. The Quebec initiative follows the current trend in the US, where there is increasing use of treated wood in cement kilns.

The Canadian Portland Cement Association (CPCA) reported that there are 16 cement plants in Canada located in six Provinces. The provincial distribution is Newfoundland (1); Nova Scotia (1); Quebec (3); Ontario (7); Alberta (2); British Columbia (2). The Canadian cement industry is committed to reducing its dependency on fossil fuels by helping other industries to recycle their waste products as energy. The cement industry is a key player in the Canadian Industry Program for Energy Conservation (CIPEC) and as a result is continually searching for sources of alternative fuels to improve its level of energy efficiency (McLeod, 1998). Therefore, the use of treated wood is a natural fit with current industry strategy.

Assuming that the approved plant in Quebec is similar in size to the other Canadian plants, it would appear that the cement industry has the capacity to use approximately 2.5 million m^3 of waste treated wood per year. This volume would consist of 2.35 million m^3 of creosote and PCP-treated material and 0.15 million m^3 of CCA-treated material based on the 6% CCA limit imposed on the Quebec operation.

Table 9 shows that between the years 2000 and 2020, annual removals of oilborne-treated industrial products will be in the range of 350-400,000 m^3, while CCA-treated products will increase from approximately 100,000 m^3 to 500,000 m^3. Therefore, the cement industry's potential to use treated wood as a fuel greatly exceeds the volumes of creosote and PCP-treated products that are estimated for removal to the year 2020. However, the potential to use CCA-treated products is limited to 6% of the total volume of treated wood available for disposal, based on the approval levels for the Quebec plant. Therefore, from the removal data shown in

Table 9, the maximum volume of waste product treated with CCA that could be accepted by cement kilns would be in the range of 20,000 m^3 - 25,000 m^3 per year. This limited volume is 20-25% of that forecast for removal in the year 2000 and 4-5% of that forecast for 2020.

Needless to say, the use of cement kilns will depend upon the willingness of individual cement manufacturers to seek approval to use waste treated wood as a fuel. This will in turn, depend upon individual plant assessment of the economics of using this alternative fuel.

Based on current regulations and the practices identified during this study, there is obviously an opportunity to use industrial boilers and co-generation plants for the disposal of oilborne preservative-treated products. Further investigation is required to determine the number and location of these units, their potential capacity and also the specific approval requirements in each Province. It is estimated that there may be 100 industrial boilers in Canada operating at temperatures which would allow the safe handling of PCP and creosote-treated materials.

During this study, there was no evidence found to indicate that the combustion of CCA -treated wood in industrial boilers and co-generation plants is being practised in Canada. This may be due to concerns related to air emissions of arsenic compounds and the disposal of ash contaminated with the indestructible components of the preservative (Stephens et al, 1996b), or it may be due to the fact that there have not yet been sufficient volumes of CCA-treated wood to justify a detailed investigation of this type of combustion.

In the US, the combustion of CCA results in ash that exceeds the Toxicity Characteristic Leaching Procedure (TCLP) limits for arsenic in the US

Code of Federal Regulations. It is claimed that even small amounts of CCA-treated wood can result in ash which will be classified as a hazardous waste and require secure landfill disposal (Felton and DeGroot, 1996). Nevertheless, some co-generation plants in the US accept CCA-treated wood.

The disposal of industrial products will continue to be managed by their owners who are generally large companies with well developed infrastructures for organizing the handling, collection and storage of the waste material. It is anticipated that individual owners will select the most cost-effective practice for their particular situation in order to meet existing regulations.

8.2.1.4 Landfilling

Although landfilling is a viable current practice, it is apparent from the information developed in this study that the major users of industrial products are committed to reducing their dependency on this method of disposal. This commitment appears to be driven both by corporate environmental strategies which are designed to respond to and anticipate regulatory trends and also by financial pressures which are directed at reducing disposal costs.

For example, CNR and CPR estimate that landfilling 100% of their removals will cost $8 per tie versus $5 per tie for their preferred strategy of 30% reuse and 70% energy recovery (Masterton, 1998; Tennier, 1998). Those involved in recycling poles referenced reduced landfill costs as an advantage due to the fact that approximately 40% of the volume of a pole may be recovered as lumber (Tigg, 1998). The proponents of cement kiln disposal in Quebec reported that the cost of shredding treated wood to the particle size required for efficient burning is less than their current landfill costs of $30 per ton (Lauzon, 1998; Auger, 1998).

8.2.2 Waste Treated Consumer Products

In contrast to industrial products, the market for consumer products is relatively new and there is, as yet, no experience related to the disposal of large quantities. As a result, there is no infrastructure in place for the handling, collection and storage of this material. The distribution and end use of consumer products presents a number of problems.

Consumer products, treated with CCA, are concentrated in urban areas and dispersed in relatively small quantities among individual residences. They are used in a wide variety of outdoor structures and applications and their removal will be initiated by the homeowner once their useful life is complete. Although some structures may be removed for reasons related to renovation or alteration, it is anticipated that most of the product will be removed due to biodegradation. At this stage, it is anticipated that the average homeowner will probably practise reuse, to the extent possible, by cutting out decay and/or damage and using the sound material for other outdoor projects (Cooper, 1993). If removal is undertaken by a contractor, it is unlikely that reuse will be feasible due to the fact that the material will be demolition wood, consisting of short lengths and broken pieces. Another scenario is demolition of complete houses which occurs when a property is purchased solely for its land value. No selection or separation of materials occurs in this type of situation and all the debris is sent to a landfill.

It is therefore likely that a typical batch of waste products removed from a residence will consist mainly of short lengths of various sizes, containing decay and other defects such as splits and checks. The material will also undoubtedly retain the metal fasteners originally used to secure it in place. Waste consumer products may be coated with stain or paint but will certainly have heavily weathered surfaces. Therefore, it will be difficult if not impossible in some cases, to determine that the removed products are in fact treated, due to prolonged exposure to weathering. This will make the policing and monitoring of consumer product disposal extremely challenging.

Based on the survey undertaken for this study, the disposal options currently available for waste treated consumer products are limited to combustion in cement kilns and landfilling. However, cement kilns are not a practical option due to the problem of limited capacity, described earlier. It is anticipated that the available capacity would be taken up by CCA-treated industrial products.

The possibility of using incinerators, industrial boilers and co-generation plants requires further investigation as these units represent a potential outlet for waste treated wood in Canada. In the US. some co-generation plants accept CCA-treated wood (Tetra Tech Inc., 1995) while in the UK, where there is a long history of CCA use, municipal incinerators are used as disposal centres.

8.3 Location of facilities

Facilities related to the disposal of treated wood products fall into three main categories:

- facilities for sorting and storing waste treated wood products;
- facilities for processing treated wood products prior to disposal;
- disposal facilities.

8.3.1 Sorting and storage facilities

This type of facility already exists for industrial products due to the fact that major users such as railways, utilities and highway authorities, have been dealing with the problem of widely distributed products for a number of years. As a result, they have established field procedures and/or central storage yards, whereby they determine whether a removed product will be reused, recycled or shipped to a disposal facility.

This type of facility does not yet officially exist for treated consumer products and it is suspected that the material is being landfilled via municipal waste transfer depots. In those municipalities which operate incinerators for burning demolition wood, it is possible that CCA-treated material is being burned because it is indistinguishable from untreated wood.

In any event, the dispersion of CCA waste wood among individual residences suggests that its collection could be handled by a "blue box" type of program which would be administered by the existing municipal infrastructure. If this approach created additional costs, collection would depend upon homeowners voluntarily delivering the material to a designated site, such as a waste transfer depot. If incineration or combustion was an option, the removal of metal fasteners, if required, could be handled at this location. Otherwise the waste would be transported to local landfill sites.

8.3.2 Processing facilities

This type of facility is required to prepare waste treated wood for recycling of the untreated component or for disposal by combustion. Typical activities at these facilities will include removal of metal, sawing, peeling, chipping and/or shredding of the various products.

The location of these facilities will depend upon the degree of collaboration that is possible between the owners of waste products, the volume of waste available at a particular location, the location of sorting and storage facilities and the location of disposal facilities.

The only example of a centralized facility identified during this study is the operation currently being organized in Quebec, which is the result of collaboration between CNR, CPR, Bell Canada, Hydro-Quebec and St. Lawrence Cement Inc. In this operation, poles and ties will be delivered to a processing site, yet to be identified, where marketable untreated wood will be recovered in a sawmill and the treated residue will be shredded in a hog mill, before being shipped to a cement kiln.

In some situations, it may be more cost-effective to locate processing facilities adjacent to existing storage yards for treated wood products. For example, BC Wood Recycling is located in a BC Hydro yard which is used to store both new and removed poles. In other cases, processing as a single stage operation, such as chipping, could take place at any point between the removal location and the disposal location, using mobile chipping units.

Based on an analysis of regional economic activity, it is predicted that almost two thirds of the volume of waste treated wood will be generated in

Ontario (40%) and Quebec (23%), (Stephens, et al., 1966b). These statistics combined with the fact that 60% of the cement kilns in Canada are located in these provinces, suggests that there may be more opportunities for centralized multi-product facilities. In other provinces, it is believed that the trend will be to establish smaller, single product facilities.

8.3.3 Disposal facilities

The disposal of waste treated wood will depend upon the use of existing combustion facilities and/or landfill sites for the foreseeable future. Further investigation and possible modification of certain combustion facilities will be required to cope with the volumes of CCA-treated wood that will become available in future years. Development of other methods for handling CCA material will no doubt evolve in response to demand and economic opportunity.

In the meantime, the choices of existing disposal facilities will be determined by their regulatory status, their accessibility and their disposal cost charges.

8.4 Transborder Shipment

The transborder shipment of waste treated wood products is possible but will depend upon transportation and disposal costs. Table 12 shows the number of sites and the disposal costs, excluding transportation, reported for both landfill and combustion facilities in US border states.

TABLE 12: Opportunities for Disposal of Waste Treated Wood in US Border States

	Landfill		Incineration/Co-generation	
State	**Sites**	**Cost $ US**	**Sites**	**Cost $ US**
Maine	1	30/ton		2 fuel brokers for energy plants - accept CCA, creosote and PCP
New Hampshire	1	65/ton		NR
Vermont	2	74/ton		NR
New York	3	10-18/cu.yd.		NR
Pennsylvania	3	45-52/ton	1	80-150/ton creosote, PCP and CCA
Ohio	3	25-47/ton		NR
Michigan	1	12-20/cu.yd.		NR
Wisconsin	3	22-35/ton	2	10-20/ton creosote only
Minnesota	4	75/ton	1	20/ton ties only
North Dakota	2	18-30/ton		NR
Montana	3	50/ton		NR
Idaho	2	2-105/cu.yd.		NR
Washington	1	20/ton		NR

NR: None reported

Source: Tetra Tech Inc. (1995)

The information in Table 12 related to the location of co-generation plants requires updating as CPR's research has identified one plant in New York State, two plants in Michigan and one additional plant in Pennsylvania which accept creosote-treated ties from Canada. Canadian landfill costs are reported to range from $30 to $100 per ton (El Rayes, 1998).

8.5 Costs, Financing and Benefits

8.5.1 Costs

Capital costs for sorting and storage facilities have not been estimated as it is assumed that the existing infrastructures, which are managed by the major users of industrial products, will meet the demand. Similarly, capital costs for disposal facilities are not required as existing installations will be used.

However, cement kilns will require modification to be able to accept treated wood as a fuel. Based on estimates provided by St. Lawrence Cement Inc., such modification is expected to cost approximately $1.5 million per kiln.

Industrial boilers, incinerators, and co-generation plants may require modification to be able to meet air emission standards. Further investigation is required before estimates can be made. Information on the capital cost of processing facilities is somewhat limited due to lack of experience in Canada. As a result, the following estimates should be interpreted with caution.

A basic sawmill operation to recover lumber products from a large volume of poles will cost approximately $3 million, excluding land and services. For a smaller operation, using second-hand equipment to process approximately 5000 poles per year, the capital cost excluding land and services could be about $250,000. The cost of a used hog mill for shredding treated wood will range from $250,000 to $500,000, while a used chipping plant could be purchased for $100,000 to $200,000, depending upon capacity and condition.

8.5.2 Financing options

The financing of sorting and storage facilities for industrial products will be borne by the users as these facilities are part of their current infrastructure. The financing of similar facilities for consumer products will be handled by municipalities and recovered, where necessary, through the residential tax system.

The financing of processing facilities will require collaboration between the parties involved to ensure the viability of individual operations. The responsibility of the owner of the waste product could include delivery of the material to the processing plant at no charge, guarantee of minimum annual volumes, provision of land and buildings, assistance with start-up costs and sharing of landfill costs. The responsibility of the owner of the processing plant will include costs related to supply and operation of the equipment and marketing and distribution of any manufacturing products. Depending upon the type of processing plant, operating costs would be financed either from product sales or from processing charges applied to the waste material.

The financing of cement kiln modifications will be the responsibility of the manufacturer as the use of treated wood waste reduces fossil fuel costs, thus providing a return on the investment required to modify the kiln. In the case of industrial boilers, incinerators and co-generation plants, any capital expenditures required would be financed through tipping fees, unless the use of treated wood resulted in a reduction in the plant's fuel costs. Tipping fees would be absorbed as a direct cost by industrial users and in the case of municipalities, would be recovered through the residential tax system.

8.5.3 Benefits

Commitment to a set of management practices for waste treated wood products will benefit the parties involved in its production, use and disposal in various ways.

The primary financial benefit for the users of industrial products is the reduction in operating costs which will result from increased reuse, recycling and energy recovery practices. The resultant environmental benefit is the reduction in the volume of waste destined for landfilling. A further benefit is the reduction or elimination of product liability issues which can arise from inappropriate use of waste products which are donated to, or acquired by the general public.

The financial benefit for combustion facilities is the reduction in fuel costs which may occur from the use of waste treated wood. The environmental benefit of energy recovery practices is that they result in a reduced dependency on fossil fuels, thus making a direct contribution to Canada's Industrial Energy Efficiency Initiative. This initiative, administered by Natural Resources Canada, oversees the Canadian Industry Program for Energy Conservation referenced earlier.

In addition to reducing operating costs for users and disposal facility operators, the establishment of processing facilities will create employment and business activity which will directly benefit the communities involved.

The Canadian consumer is clearly committed to the principle of responsible management of waste materials as evidenced by the acceptance and widespread use of "blue box" programs. A well publicized waste management plan together with a consumer education program on reuse and recycling would improve the public's image of the forest products industry in general and the wood preserving industry in particular. In this context, the tangible benefits of reuse and recycling will be the conservation of natural resources due to a further contribution by the treated wood industry to the sustainability of Canada's forests.

8.6 Implementation

There appears to be sufficient energy recovery capacity in Canada to deal with the volumes of waste oilborne preservative-treated wood which will be removed each year for the foreseeable future. To address this opportunity, a mechanism should be developed to encourage major users and energy operators to consider the adoption of the recycling and energy recovery options identified by this study. This process could be initiated by the development of the 1996 CCME Provisional Code of Practice for the Management of Post-Use Treated Wood into a final document. This Code of Practice would provide guidelines for users, energy operators, municipalities and others. The Code would be administered by CCME and would be uniformly applied across Canada with the support of all provinces. Liaison with appropriate CIPEC Task Forces should also be considered. The Code would address all preservatives and would recognize the fact that at present, landfill is the major disposal option for CCA-treated material.

To address the need to develop new technology for the disposal of waste CCA-treated products, consideration should be given to the creation of a research fund for this purpose. As proposed by Smith and Shiau (1998) the fund could be generated and sustained by an industry wide contribution derived from an increase in product price. This price increase would be passed on to consumers so that there would be no loss in revenue for the wood preserving industry. The funds would be administered by a current organization of the Canadian wood preserving industry and the research community would compete for these funds through a managed bidding process.

Universal acceptance and implementation of the management options proposed in this report will require extensive collaboration between the various stakeholders. The wood preserving industry and its suppliers, the users of treated wood, energy operators, Codes and Standards organizations and federal, provincial and municipal authorities must all be involved. Responsibilities must be clearly defined and information needs identified to allow development of the guidelines, policies and regulations required to facilitate the efficient disposal of waste treated wood products (Stephens et al, 1996b).

REFERENCES

1. American Wood Preservers Institute, 1995, "Wood Preserving Industry Production Statistical Report".

2. Beaulieu, P., St. Lawrence Cement Inc. Personal communication.

3. Bedsen, R., 1998; TransAlta Utilities. Personal communication.

4. Brimo, S., 1998, Canadian Pacific Railway. Personal communication.

5. Brodie, J., 1998, BC Rail. Personal Communication.

6. Brudermann, G.E., 1998; Recommendations for the Design and Operation of Wood Preservation Facilities. Report for Environment Canada and the Canadian Institute of Treated Wood.

7. Brudermann, G.E. and D.E. Konasewich, 1998; Assessment Protocol for the Canadian Wood Preservation Industry. Report for Environment Canada, National Office of Pollution Prevention.

8. Brudermann, G.E., D.E. Konasewich and R.W. Stephens, 1996, "Management practices for treated wood poles in North America". Report for Bell Canada, Environmental Division.

9. Coleville, J., 1998; IKO Industries Limited. Personal communication.

10. Cooper, P.A., 1993, "Reuse/Recycling of Treated Wood". Proc of CWPA 14th Annual Meeting, pp 229-242.

11. Cooper, P.A. and Y. T. Ung, 1989, "Assessment of Preserved Wood Disposal Practices". Report for Environment Canada.

12. Cooper, P.A. and Y. T. Ung, 1995, "Effect of Vegetable Compost on Leaching of CCA Components from Treated Wood - An Update". Paper presented to the 26th Annual Meeting of The International Research Group on Wood Preservation, June 11 - 16, 1995.

13. CITW, 1997, Best Management Practices for the Manufacture of Treated Wood - Draft.

14. DeGroot, R.C. and C.C. Felton, 1995, "Current and Future Options for Managing Used Preservative-Treated Wood". Paper presented to the 26th Annual Meeting of The International Research Group on Wood Preservation, June 11 - 16, 1995.

15. El Rayes Environmental Corp., 1998; Status of Environmental Controls in use in the Wood Preservation Sector. Report for Environment Canada, Edmonton, Alberta.

16. Felton, C.C. and R.C. DeGroot, 1996, "The recycling potential of preservative-treated wood." Forest Products Journal 46(7/8): 37-46.

17. Fink, M., 1998, Northwood Inc. Personal communications.

18. Gilmet, G., 1998; VFT Inc. Personal communications.

19. Jermer, J., 1998; IRG, Personal communications.

20. Kazi, K.M.F. and P.A. Cooper, 1998, "Solvent Extraction of CCA from Out-of-Service Wood". Paper presented to the 29th Annual Meeting of The International Research Group on Wood Preservation, June 14-19, 1998.

21. Konasewich, D.E., 1996; Pollution Prevention Guide for Pressure Wood Preservation Facilities. Report for Environment Canada, North Vancouver, BC.

22. Konasewich, D.E., N. Hutt and G.E. Brudermann, 1993. "An inventory of sources, uses and waste disposal practices for creosote in Canada". Appendix I to Environment Canada Technical Report on creosote impregnated waste materials (1993).

23. Lauzon, M., 1998, LPB Poles Inc. Personal communication.

24. McCullaugh, K., 1998; Health Canada, PMRA. Personal communication.

25. McLeod, N., 1998, Canadian Portland Cement Association. Personal communication.

26. Masterton, R., 1998, CN Rail. Personal communication.

27. Miller, R., 1998; BC Wood Recycling Limited. Personal communication.

28. Auger, A., 1998, St. Lawrence Cement Inc. Personal communication.

29. Pearen, C., 1998; Innovative Recycling Limited. Personal communication.

30. Plackett, D.V., P.A. Cooper, D.H. Cohen and A.W. Anderson, 1995, "Recycling of CCA-treated wood and opportunities for wood-based composites". Report for Canadian Forest Service, Department of Natural Resources Canada. SSC Contract No. 23103-4-0193/01-SQ.

31. Smith, R.L. and R-J Shiau, 1998, "An industry evaluation of the reuse, recycling and reduction of spent CCA wood products". Forest Products Journal, 48(2):44-48.

32. Stephens, R.W., G.E. Brudermann, P.I. Morris, M.S. Hollick and J.D. Chalmers, 1994. Value Assessment of the Canadian Pressure Treated Wood Industry. Report for Canadian Forest Service, Department of Natural Resources Canada.

33. Stephens, R.W., G.E. Brudermann, D.E. Konasewich and J.D. Chalmers, 1996a, "Wood Preservation SOP - Socioeconomic background study". Report for Environment Canada, Regulatory Economic Assessment Branch. Contract No. K2231-5-0054.

34. Stephens, R.W., G.E. Brudermann and J.D. Chalmers, 1996b, "Provisional Code of Practice for the management of post-use treated wood". Report for Hazardous Waste Task Group, Canadian Council of Ministers of the Environment.

35. Tennier, A., 1998, Canadian Pacific Railway. Personal communication.

36. Tetra Tech Inc. 1995, "Management practices for used treated wood". Report for Electric Power Research Institute, Palo Alto, California. TR-104966, Research Project 2879-02.

37. Thiele, A., 1998; IG Paper Recycling Limited. Personal communication.

38. Tigg, J., 1998; BC Hydro. Personal communication.

39. Walthert, H., 1998; CITW. Personal communications.

40. Wilson, C., 1998; Timber Specialties, Inc. Personal communications.

41. WWPI, 1996, "Best Management Practices for the Treatment of Wood in Aquatic Environments". Joint release by WWPI and CITW.

APPENDIX I

ISO 14000 AND ITS APPLICATION TO THE CANADIAN WOOD PRESERVATION INDUSTRY

ISO 14000 AND ITS APPLICATION TO THE CANADIAN WOOD PRESERVATION INDUSTRY

This appendix provides a brief overview of the key components of the Environmental Management Standard ISO 14000. This overview provides the background for a preliminary gap or deficiency analysis between the requirements set out in the ISO Standards and the contents of the technical recommendations documents (TRDs) "Recommendations for the Design and Operation of Wood Preservation Facilities." Following the gap analysis, a brief review of the costs and benefits associated with implementing an ISO 14000 environmental system is presented.

Background to the ISO 14000 Standards

The International Organization for Standardization (ISO) has developed a variety of standards to facilitate the efficient international exchange and quality assurance of goods and services. An example of these standards is the now widely accepted ISO 9000 series, which is directed toward quality assurance and control in manufacturing. The purpose of the standard is to provide consumers with assurance that when they purchase goods from an ISO 9000 certified supplier, manufacturing processes and controls are in place to assure the continued or ongoing quality of the products.

In 1996, the organization developed an environmental management series called ISO 14000. This is a series of environmental management system (EMS) standards designed to provide organizations with guidelines for setting up effective management systems or structures for dealing with the environmental aspects of their operations. The focus is on the management systems rather than the environmental practices and criteria.

The main purpose of the ISO 14000 standards is to provide a framework that will allow corporations to create environmental management systems that can be independently certified as meeting a given set of criteria and that can allow them to demonstrate continued environmental improvement.

An independently certified and internationally recognized EMS standard will help to:

- level the international playing field with respect to environmental diligence;
- facilitate a common industrial language, provide consumer confidence, and promote environmental protection;
- satisfy the expectations of a broad range of stakeholders;
- reduce the number of environmental audits conducted by customers, regulators, or registrars;
- provide future savings in the form of lower insurance rates;
- lead to waste reduction, pollution prevention, substitution of less toxic chemicals and other materials, less energy usage, and cost savings through recycling programs;
- reduce the level of environmental noncompliance and increase overall efficiency; and
- achieve environmental excellence.

It is important to remember that ISO 14000 standards are process, not performance standards. That is, they do not tell the company what environmental performance levels they must achieve. Instead, they provide the company with the building blocks for a coherent management system to achieve their goals. The actual level of performance depends on economic, regulatory and other circumstances. The basic assumption is that better environmental management will lead to better environmental performance.

The ISO 14000 standards are divided into two categories which include organizational standards and product standards.

Organizational standards include the following:

- Environmental Management Systems Specifications ISO 14001
- EMS Guidelines ISO 14004
- Environmental Auditing ISO 14010/11/12
- Environmental Performance Evaluation ISO 14031

The elements of a management system necessary for certification are stipulated in document ISO 14001. ISO14004 provides a reference and guide to EMS principles and implementation. ISO 14010, 14011 and 14012 provide the necessary framework for fair, consistent environmental auditing and ISO 14031 helps an organization establish environmental performance goals.

Product standards include the following:

- Environmental Labeling ISO 14020/21/22/23/24
- Life Cycle Assessment ISO 14040/41/42/43
- Environmental Aspects in Product Standards ISO 14060
- Terms and Definitions ISO 14050

The purpose of ISO 14020/21/22/23/24 is to provide standards which harmonize national labeling programs. Guidelines, principles and procedures represented in the ISO 14040/41/42/43 series aid managers and organizations in assessing and understanding the life cycle of their products. Lastly, ISO 14050 provides terms and definitions to aid readers in interpreting ISO 14000.

The remainder of this background review focuses on ISO14001 to give the reader an understanding of the specifications required for an approved or ISO certifiable EMS.

Key EMS elements of ISO 14001

The key elements of ISO14001 are presented in **Figure 1** and summarized below. Some of the elements contain examples of how they may pertain to the wood preservation industry. Examples are italicized and provided in parentheses.

1. Environmental Policy

The organization should have a policy that is appropriate to the scale and risk of its activities, products and services. The key requirements of the policy should:

- include a commitment to pollution prevention;
- include a commitment to continual improvement;
- include a commitment to comply with organization and corporate requirements;
- include a commitment to comply with regulations, (e.g. Wood Preservation Company A will be in compliance with all applicable regulations and implement programs to minimize environmental risks from both regulated and non-regulated impacts);
- provide a frame work for setting environmental objectives and targets;
- provide a frame work for reviewing objectives and targets;
- be documented;
- be implemented and maintained;
- be communicated to all employees; and
- be available to the public.

2. Planning

The next major requirement, the planning phase, has four basic elements which should:

- Identify environmental aspects of the organization over which it has control and can be expected to have an influence. This element also involves determining which aspects are associated with significant environmental impact (e.g. stormwater and groundwater discharges of wood preservation chemicals, hazardous waste disposal of wood preservation sludges).

- Establish and maintain a procedure to allow tracking of legal and other requirements that are applicable to the environmental aspects of its activities, services and products (e.g. stormwater sampling protocols, confirmation of fixation).

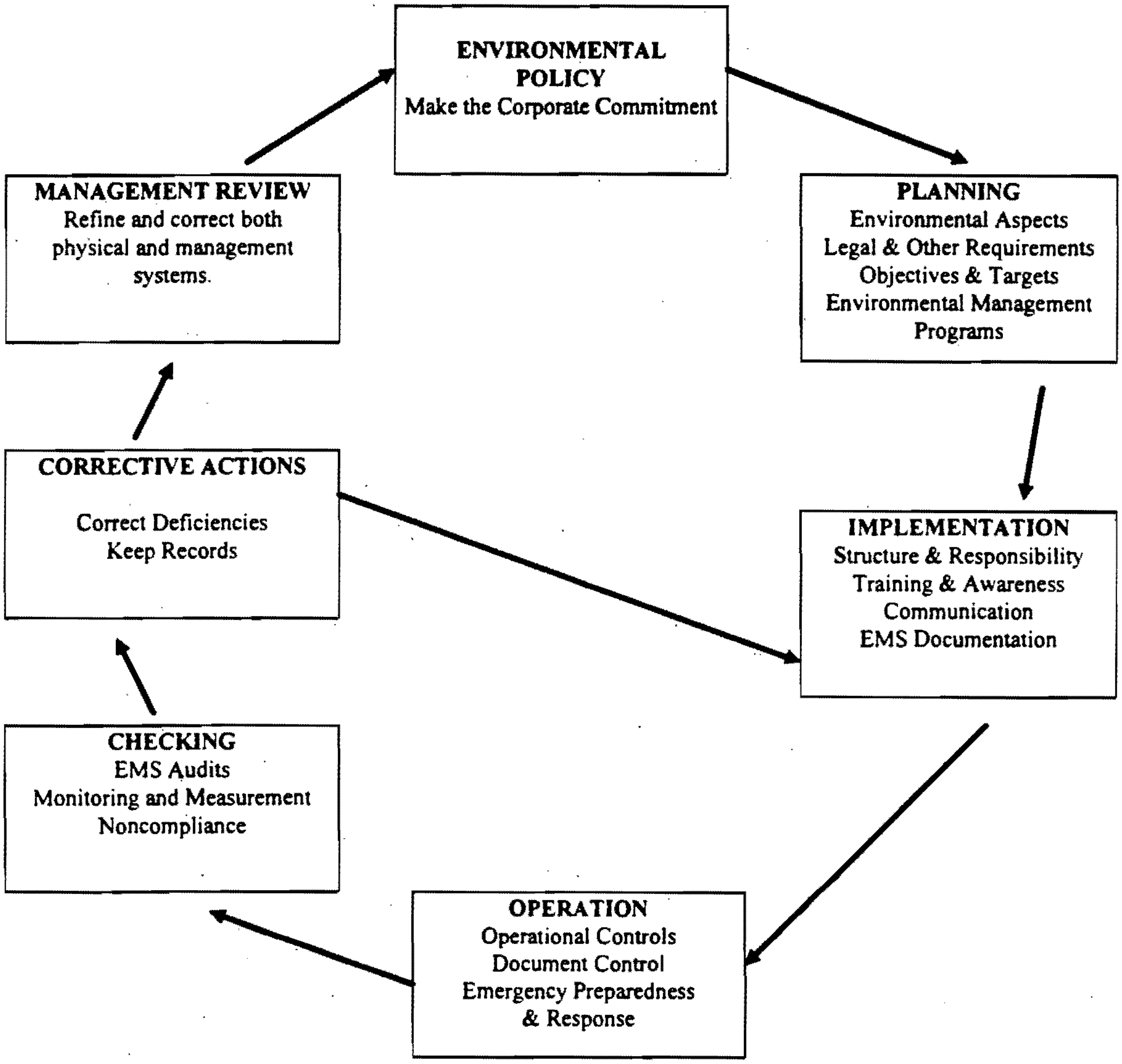
- Establish and document objectives and targets which consider relevant legal and other requirements, significant environmental aspects, technological options, financial, operational and business requirements, and views of interested parties (e.g. Wood Preservation Company A's objective is to reduce the generation of wood preservation sludges by 30% in two years).

- Establish and maintain environmental management programs to achieve objectives and targets by designating responsibilities and providing a means and time frame to meet objectives and targets. This also involves amending programs to meet new or modified developments or activities, services and products. (e.g. To reduce the potential for toxic stormwater discharges to the environment, Wood Preservation Company A's work plan is to construct a holding tank to collect and recycle stormwater back into the wood preservation process.)

<u>**FIGURE 1**</u>

KEY ELEMENTS OF AN ISO14000

ENVIRONMENTAL MANAGEMENT SYSTEM



3. EMS Implementation

The third step in the EMS process is the actual implementation of the program using required human, physical and financial resources focusing on the following areas:

- Structure and Responsibility - assigning and documenting roles, responsibilities and authorities with the approval of top management (e.g. assigning personnel to specific programs such as stormwater management, hazardous waste management, management of wood preservation chemicals and providing them with the tools they need to manage these programs).

- Training, Awareness and Competence - identifying and providing training to all employees whose work could create a significant impact on the environment; and, ensuring all employees are aware of the importance of compliance with the EMS requirements and other important environmental areas. (e.g. training for process and chemical control) .

- Communication - establishing and maintaining internal communication between various levels and functions of the organization; receiving, documenting and responding to relevant communication from external parties regarding environmental affairs in the organization. (e.g. If a process change is made, ensure that all necessary parties are informed of how it affects their job responsibilities) .

- EMS Documentation - establish and maintain information which describes the key elements of the EMS (e.g. documentation of EMS components such as policy and planning documentation related to wood preservation) .

- Document Control - establish and maintain procedures for creating and modifying documents (e.g. procedure to update spill response manual in the event of a change in the internal and external resources which aid in the spill response).

4. EMS Operation

Operational Control - establish operational controls for activities such as daily production procedures, chemical handling, product labeling, marketing, customer service, hazardous waste disposal, pollution prevention, research and development, product design and life cycle analysis. The operational controls may include: documenting procedures or specifying operational procedures for the activities described, to ensure that they do not deviate from policies, objectives, and targets. (e.g. procedures to ensure proper fixation of chemical to wood and, procedures to ensure proper handling and disposal of wood preservation sludges).

- Emergency Preparedness and Response - establish and maintain procedures for potential emergency situations which could arise at the site including accidental discharge of contaminants to land, water and the atmosphere. The key components of an emergency contingency plan should include: identification of high risk areas for emergencies on site, information on hazardous materials stored on site, establishment of a chain of command and emergency response team, internal and external resources, easy to follow emergency procedures, location of emergency equipment, exit and evacuation areas, and training programs. (e.g. developing a spill response manual to address chemical spills or evacuation procedures to address fires and earthquakes).

5. Checking

The area of checking provides the framework to assess the EMS. This involves the following two main components:

- Monitoring and Measurement - for those activities which may have a significant impact on the environment, procedures for regular monitoring and measurement are required. This may include data collection and analysis and tracking performance to objectives, targets or relevant regulations. It may also include calibrating and maintaining monitoring equipment and maintaining calibration and maintenance records. (e.g. assessing quarterly stormwater monitoring results from site based on applicable regulations).

- EMS Audits - to ensure the company EMS program has been properly implemented and maintained, an audit is necessary to assess the system. Note that this is a systems audit, and not necessarily an environmental audit to determine compliance with regulations. Both internal or external auditors can be used, as long as they are qualified individuals as per the qualification criteria stipulated in the ISO 14 012 document.

6. Corrective Actions

The deficiencies noted in the above checking, measurement and monitoring programs should be itemized, prioritized, and corrected as required. The corrective action programs should include:

- Non-conformance and corrective and preventative action - when problems arise such as malfunction of a piece of equipment, procedures must be prepared to correct the problem and prevent it from reoccurring. The basic requirements in order for this to occur include defining responsibilities to investigate the non-conformances, acting to minimization the impact to the environment, developing corrective and preventive action, and recording changes to documented procedures (e.g. In the case of operational practices, driving a forklift through a drip area that could result in an environmental impact, Wood Preservation Company A develops a work plan to correct the problem and prevent further contamination from occurring).

- Records - keeping up-to-date documented records is an important component of "checking and corrective action". Examples of records include: training records, regulatory requirements, inspection, maintenance and calibration records, incident reports, environmental audits, contractor or supplier information, emergency response records.

7. **Management Review**

The final step in the EMS model is for top management to review the EMS, whenever it is deemed appropriate to ensure its effectiveness. This review may centre around EMS audit results, deficiency and corrective action reports, policy or objective changes, legislative changes, technology advances or other EMS elements.

ISO 14000 and the Wood Preservation Industry TRDs

Many sectors of business are either registered to ISO 14000 or are improving their EMS systems to conform with ISO 14000 specifications.

As part of their own EMS, many wood preservation companies in Canada are adhering to the TRDs to improve the environmental performance of their operations. To assess how conforming to this document compares with the requirements of an ISO 14000 EMS, a preliminary gap analysis was conducted and is summarized in the following table. With reference to the table; a designation of "Complete" implies that the TRDs meet the requirements of the relevant section of ISO 14001; "Not complete" implies that the TRDs refer to, but do not fully meet the requirements of ISO 14000; and, "Not present" implies that the TRDs do not contain any component which meets a specific requirement of ISO 14000.

This gap analysis is intended to show the elements which should be either added to the TRDs to develop them into an EMS document or added to an EMS system which incorporates the TRDs. As indicated before, the gap analysis presented requires further review to detail all components of an EMS system.

Gap Analysis between ISO 14001 and TRDs

ISO 14001 REQUIREMENTS	Status of TRDs Document in Relation to ISO 14000			COMMENTS
	Complete	Not Complete	Not Present	
POLICY				
Commitment to continual improvement			✍	Policy statement required
Commitment to comply with organization and corporate requirements			✍	Policy statement required
Commitment to comply with regulations			✍	Policy statement required
Provide a frame work for setting environmental objectives			✍	Policy statement required
Provide a frame work for setting targets			✍	Policy statement required
Provide a frame work for reviewing objectives and targets be documented			✍	Policy statement required
Be implemented and maintained			✍	Policy statement required
Be communicated to all employees			✍	Policy statement required
Be available to the public			✍	Policy statement required

PLANNING				
Identifying environmental aspects of the organization's APS that can control and can be expected to have an influence	✍			The main environmental aspects are identified including soils, surface and groundwater, air emissions and liquid discharges (Table 14 p: G50)
Establish and maintain a procedure to identify and provide legal and other requirements		✍		Regulations are referenced in the TRD however a system of regulatory tracking needs to implemented
Establish documented objectives and targets		✍		Major objectives are identified for key process areas however no targets are indicated
Establish and maintain environmental management system to achieve objectives and targets		✍		The means to fulfill various activity objectives are provided however no targets are specified
IMPLEMENTATION AND OPERATION				
Structure and responsibility			✍	Roles are not defined or documented, nor are essential resources specified
Training, awareness and competence		✍		Training defined but implementation missing
Communication			✍	Procedures for internal and external communication are not identified
EMS documentation		✍		TRDs provides a good base for EMS documentation
Document control			✍	No procedures for document control
Operational control		✍		There are documented procedures for such areas as chemical handling and hazardous waste management
Emergency preparedness and response		✍		Guidelines present for spill and fire contingency planning, however actual plans required, along with a disaster plan

CHECKING AND CORRECTIVE ACTIONS				
Monitoring and measurement			✓	No protocol established
Non-conformance and corrective and preventative action			✓	No protocol established
Records		✓		Protocol established to keep applicable records current for chemical delivery, use and inventory, equipment condition and maintenance, volume of liquid in bulk tanks (Table 10 p: G43)
EMS audits			✓	No protocol established for EMS audits to be conducted
MANAGEMENT REVIEW			✓	No protocol established for senior management to review EMS

The gap analysis indicates the TRDs do provide a good foundation for an EMS, and contain some of the EMS components of planning, implementation and operation. however, further development is required in several areas specifically in the areas of policy, checking and corrective actions and management review.

ISO 14000 and Associated Costs

Although, the ISO 14001 standard is relatively short, covering less than ten pages, the time and costs required to implement an ISO 14000 EMS may be considerable. Companies with little or no documented environmental management programs may require a considerable effort to develop and implement their system before it can be evaluated against the ISO 14001 standard. The Canadian Standards Association, which is certified as an ISO registrar, has stated that, on average it takes approximately a year for a company to become registered. In the case of companies who have well developed EMS programs, less time will be required to become certified.

The cost of becoming an ISO 14000 registered company depends on such factors as:

- the size of the company;
- number and complexity of sites which require registration;
- the environmental risks associated with company's activities, which defines the required detail of the EMS; and
- the extent of the EMS and operational controls already in place.

Depending on these constraints, the cost of developing, implementing and having an EMS certified as ISO 14000 compliant may range from $15,000 to more than several hundred thousands of dollars. For a typical Canadian wood preservation facility the EMS design and implementation cost should be anticipated to be in the region of $25,000. Certification costs would be in addition to this.

Annual EMS operating costs may also be incurred for:

- environmental monitoring and measurement;
- corrective and preventative actions (maintenance and repair);
- up dating records and documentation;
- auditing;
- senior management review; and
- training.

However, if many of these programs are already in place, as is often the case at operating facilities, the additional annual costs associated with an ISO compliant system may be minimal.

Benefits Related to an Effective Environmental Management System

From a corporate standpoint, there are many benefits to implementing an EMS including:

- Tracking compliance to permits, policies and procedures;
- Minimizing both corporate and individual environmental liabilities;
- Simplifying and improving environmental management;
- Providing the ability to easily access, update, and communicate environmental information;
- Demonstrating due diligence and corporate commitment to the environment;
- Providing marketing and PR support; and
- Achieving continued environmental improvement.

In addition to the above advantages, other financial reasons for implementing a well constructed EMS include:

- Reducing risks protects assets and reputation;
- Reducing the potential for fines;
- Reducing amount of fines provides a potential defence in the event of any legal action;
- Reduces environmental management and reporting cost;
- Prioritizes and tracks costs of environmental activities and expenditures (e.g. waste disposal);
- Reduces losses through improved emergency response; and
- Reduces site closure (remediation) costs.

Growing recognition of ISO and its standards is providing strong support for the international acceptance of this standard. It should be kept in mind, however, that there are other widely accepted, environmental management system frameworks or references available in addition to the ISO model. EMS can be custom developed to meet individual corporate or industry requirements, and although the ISO standard has many good features and is well supported, it may not be the best choice for all industrial groups and locales. However, with the increasing pace of industrial expansion, growing populations and international trade creating mounting pressures on the environment and resources, it is essential to have good environmental management to offset these pressures and achieve sustainable development.

References:

Tibor, Tom, Ira Feldman, "ISO 14000 - A Guide to the New Environmental Management Standards", Irwin Professional Publishing, 1996.

CSA, "Plus 1117-Competing Leaner, Keener and Greener-A Small Business Guide to ISO 14000", CSA,

International Standards Initiative, Conference Proceedings - November 6-7, 1995, Bellevue, Washington, USA, "ISO 14000 - Environmental Management for the 21st Century"

Beauchemin, Computer Application to Environmental Management, PNWIS, Air and Waste Management Meeting, 1997, Vancouver, BC