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DYNAMICS OF WOOD CHIP STORAGE
Task I

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SERI

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PREFACE

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SECTION 1.0

INTRODUCTION

The purpose of this report is to document Dow Corning's decision making process in establishing a fuelwood supply and procurement system with emphasis on how this relates to private forest landowners.

The report will provide background on the decision to investigate wood energy systems and key management questions in that decision process. Information used to answer the key management questions will be highlighted and its usefulness documented, including resource assessment and requirements.

The report will discuss the development and implementation of the landowner assistance program and supplier-producer program. At the end of the report, Dow Corning's experiences will be summarized and some conclusions drawn concerning the success of the programs.

SECTION 2.0

BACKGROUND

Dow Corning is a world leader in the development, manufacture and sale of silicone materials. Dow Corning operates 21 manufacturing plants around the globe and produces more than 1,100 silicone products. Dow Corning was founded in 1943. During the original construction of the Midland, Michigan facility, two boilers were installed to provide steam for the new expanding manufacturing site. These boilers continue to function, but are antiquated and in need of replacement.

In 1975 an energy situation analysis was completed of the Dow Corning Midland, Michigan manufacturing facility. The analysis included current and future energy requirements, fuel types in use and available, and an energy breakdown for the complete site. The analysis was conducted because the original boilers were old, and new direction was needed towards a site energy policy. The analysis team came to the conclusion that at that time no clear path was available to Dow Corning. The use of coal was a problem because Midland was already classified by the Michigan Department of Natural Resources and the EPA as a non-attainment area. Because of this, standards for clean-up would be monumental. Gas and/or oil were suspect because of future sources and unpredictable costs. So the energy situation analysis report recommended that Dow Corning continue to fire the old equipment and make necessary updates such as replace ID fans, modernize instrumentation and replace tubes inside the boiler until a clearer picture developed on fuel sources, types, and regulations that affect the fuels. With this in pocket, the corporate managers made the decision to wait to see what the energy picture would look like in a few years.

In 1976, one of Dow Corning's stockholders (Dow Chemical Company), through their manager of energy development, contacted Dow Corning's manager of Engineering Suport Function concerning the use of a different fuel type. The new fuel was wood. Dow Chemical had considered using wood as a fuel source at one of their large manufacturing sites, but had decided their needs (2 million pounds per hour of steam) were too large for a bulky fuel such as wood. However, Dow Chemical Company managers felt that with Dow Corning's needs of between 200,000 and 300,000 pounds of steam per hour, the concept of wood as a fuel was feasible. Dow Chemical's Manager of Energy Development discussed the information gathered from the Michigan Department of Natural Resources Forestry Division and Morbark, Inc., a whole-tree equipment producer. After this meeting, Dow Corning's Manager of Engineering Support Functions informally discussed the wood fuel concept with other Dow Corning professionals. Included were engineers from the Utility Department, plant accountants, and other facility design

engineers.

SECTION 3.0

DECISION PROCESS

The informal discussions within Dow Corning raised questions concerning supply of wood, suppliers of wood and ownership of the forest. To better understand these topics of concern, the Manager of Engineering Support Functions met with the Michigan Department of Natural Resources Forestry Division (Department of Natural Resource) and Morbark, Inc.

During the meeting with the Department of Natural Resource, the Forest Products Utilization Specialist was the key person who answered many of the forest resource related questions. He provided copies of two bulletins, The Growing Timber Resource of Michigan 1966 (U.S.D.A. Forest Service Resource Bulletin NC-9, 1970) and Michigan Timber Production--Now and 1985 (MSU Research Report 192). These were both very useful in assessing overall wood supply sources. Besides these documents, the Department of Natural Resource specialist informed Dow Corning of others who might have more information. These included the U. S. Forest Service Lake States headquarters in Madison, Wisconsin, and the wood fuel specialist from the Michigan Public Services Commission. He listed Michigan Maple Block at Petoskey, Kimberly Clark at Munising, and Kody High School in Detroit as in-state users of wood as an energy source. Three others were listed as having studied wood as a fuel source. They were Central Michigan University; City of St. Louis, Michigan; and General Motors Corporation.

The first meeting with Morbark was very informative. Morbark provided whole-tree harvested chip samples, literature on their whole-tree chip harvestor, and a film showing their equipment in operation. Morbark loaned the film to Dow Corning for future use.

The first two meetings led to meetings with the wood fuel specialist from the Michigan Public Service Commission and a timber producer who used whole-tree harvesting equipment to supply chips to the paper industry.

Early in 1977 these findings, along with the Morbark film, were discussed with Dow Corning's upper management and U. S. area operating board. The board decided the wood fuel concept had enough merit to warrant a full study, so a study team was appointed. The team consisted of the manager of engineering support functions, an engineering specialist from the utilities group, and a plant accountant to make economic evaluations. The team was charged with the control, assessment and direction of the wood fuel study.

The board also had specific questions concerning the wood resource: How much wood is there? Who owns the wood? How available is the

wood? Who would produce the wood? How much competition is there for this resource? These were to be addressed by the study team.

The team decided that consultants would be the best route to follow since information on the forest resource, wood supply, wood producers, and wood-fired boiler systems were not common knowledge within Dow Corning. To gather information on the wood resource consultants, the team arranged several meetings. The meetings were with the Department of Natural Resource, Michigan State University, University of Michigan, Michigan Technological University, and the Michigan Public Service Commission wood specialist. Discussions centered on consulting firms who had the proper background, personnel, and interest along with the time to do a timely cost efficient study on a wood fuel program for Dow Corning.

To expand its base of information, the team visited the U.S. Forest Service offices in Madison, Wisconsin. This visit was extended at the suggestion of the Forest Service personnel to include visits to a number of pulp mills. On these trips, the team focused on wood handling and wood-fired boiler operations. The U. S. Forest Service personnel provided copies of U.S.D.A. Forest Service Resource Bulletin NC-34 (Pulpwood Production in the North Central Region by County 1975) and Wood Residue as an Energy Source published by the Forest Products Research Society. The first bulletin gave insight into the drain of wood from the area around Midland. The second was useful in assessing many aspects of wood as a fuel source. The booklet contains chapters on the energy supply outlook and regulatory situation, energy requirements for wood processing, energy potential of wood residues, handling and preparing wood fuel--equipment and economics, combustion systems for wood and bark fuels, and wood industry experience in using residue as fuel--case histories. This very important because this basic information allowed the team to ask pertinent questions of the consultants who were interviewed.

The team decided to select two consulting firms: One to concentrate on a wood-fired boiler/turbine system; and the other firm to concentrate on the wood resource, procurement systems, and the economics of wood as a fuel source.

The results of the search for the two consultants were that two smaller sized firms were hired. Campbell, DeBoe and Associates, Inc. of Toledo, Ohio was hired to do the wood-fired boiler/turbine study. They had a fine reputation, good staff experience, and had concentrated most of their effort on industrial and small utility size projects. This specific experience fit very well to the size of boiler system in which Dow Corning was interested. Their study was to be completed by the end of the third quarter 1977.

Greentree Associates of Lansing, Michigan was hired to provide a three-phase study concerning the wood resource. The first phase was

to provide an economic evaluation of Dow Corning obtaining its energy requirements from Michigan's wood resource. The second phase was to identify general wood procurement sources, procedures and practices which offered the best opportunities for obtaining dependable long-term wood supplies at a reasonable cost. The third phase was to recommend a specific wood procurement system that fit Dow Corning's needs. The three phases were to be completed by mid-September 1977.

Dow Corning's team decided that a forester should be hired to help direct and interpret the findings of the three-phase study; thus insuring interjection of Dow Corning's perspective and policies into the three-phase report. The forester was hired in mid-year 1977 and had a B.S. in forest management, general forestry background, and work experience with a state agency, as well as in private consulting forestry.

Once the forester was added, more trips were planned to gather additional information. There were trips to the west coast to observe a number of Weyerhaeuser operations which used wood residue as their primary fuel. At these mills the boiler/turbine systems were essentially the same; however, the wood residue handling was different at each site. This gave the team a good opportunity to compare pneumatic with belt conveying systems, open outdoor storage with silo storage, rotary drum driers with pelletizing equipment and reclaim systems. Since these mills had been operating since the early 1900's, there were many years of operation knowledge from which to draw. The information gained proved beneficial in the design phase.

The other trips were to observe woodchip-producing firms using whole-tree harvesting technology. Four different operations were reviewed. They ranged in size from a small four-man operation up to a very large 12-man operation. The differences in these operations were equipment size and work scope. Knowledge of these equipment differences and their operation helped in the evaluation of contractors in the wood procurement development stage.

Greentree Associates three-phase reports were delivered by September of 1977. The Phase I report showed that wood chips are an economical fuel, if:

1) The fuel oil prices inflate at least as rapidly as wood prices.

2) The savings resulting from generation of electricity with excess steam capacity at least equaled the wood chip storage and handling costs.

3) The delivered wood chips could be purchased for a cost between $10.00 to $16.00 per green ton with the lower limit

being determined by the level and rate of increase assumed for fuel oil.

The Phase I report stated that with a wood moisture level of 75 percent (oven dry = zero percent) a total of 431,000 green tons of wood will be required annually to operate a 250,000 psi boiler 365 days per year.

The Phase II report was to identify general wood procurement sources, procedures, and practices which offered the best opportunities for obtaining dependable long-term wood supplies at a reasonable cost. Greentree Associates' Phase II report stated that there is more than an adequate physical supply of wood fuels to provide any desired mix of forest-based, urban and industrial sources of wood fuel and recommended that:

1) That wood fuel be obtained from sources in the following proportions:

	%
Primary chips	50-45
Secondary chips	35-45
Residues	15-10
	100

2) Dow Corning need not purchase forest land or directly hire timber cutters to obtain needed fuel supplies.

3) Procurement efforts should be concentrated within 50-75 miles west and north of Dow Corning.

4) Primary and secondary chips should be acquired via one- to two-year purchase contracts with independent producers.

5) Contract volumes with producers should be about 50,000 green tons annually.

6) Brokers should be used to collect urban and industrial wood residues.

7) Delivery of wood fuel should be by truck only.

8) Prices paid for wood fuel should be based on a bone dry ton.

In Phase III, Greentree Associates recommended more specific procurement strategy including:

1) The identification of wood producers in our procurement area and their anticipated chip production costs, residue costs and hauling costs.

2) The identification of specific residue sources within the procurement area.

3) The identification of large forest landowners within the procurement area.

As a part of the Phase III report, Greentree also worked with Dow Corning to develope a 35mm slide presentation public relations program to explain the woodburning project to the public.

Phase II and Phase III reports were supported by resource assessment data on a county-wide basis by landowner group, timber type, timber growth, timber removals, total forest inventory and residue sources. Further detail on this will be found in the Resource Assessment section.

Just after the Greentree reports were received, the report from Campbell, DeBoe and Associates was received. In that report, three alternative woodburning systems were outlined and compared. They were:

1) A woodburning boiler producing only Dow Corning's steam needs.

2) A woodburning boiler with superheater with non-condensing turbine producing all of Dow Corning's steam needs and some of its electrical needs

3) A woodburning boiler with superheater with a condensing turbine producing all of Dow Corning's steam and electrical needs

The team analyzed the data developed by the consultants and found the concept of a wood fueled boiler with a condensing turbine to be the best choice. The condensing turbine provided more flexibility by opening the option of producing extra electricity and afforded the best potential return on the investment.

After the analysis was run, the team began to explore possible long-term contracts with the largest landowner within the procurement area, the Department of Natural Resources. They control 21% of the forested land within the procurement area. Meetings were held with both the Forestry Division and the Wildlife Division of the Department of Natural Resources. Long-term contracts were not in use by the Department of Natural Resources, so new policies would have to be developed. Once developed, these policies would need to be reviewed

and approved by the Michigan Natural Resource Commission. The meetings with the Michigan Department of Natural Resources also provided a number of other facts and concerns. These were:

1) If Dow Corning needed to purchase wood from private landowners, the Department of Natural Resources felt Dow Corning should provide foresters to help determine the harvesting areas.

2) Most harvesting was beneficial to Michigan's wildlife.

3) Michigan's timber types regenerate naturally.

4) The Michigan Department of Natural Resources was pleased to see a wood fuel market being established.

As discussions continued through late 1977 with the Department of Natural Resources, two more matters came into focus.

The first was the potential development of a wood fuel burning power plant about 100 miles west of Dow Corning's facility. The two electrical utility companies that were planning the power plant had encountered some very vocal opposition because they were planning on getting most of their wood fuel from state and federal forested land. The opposition presented the picture that the long-term agreements would only benefit the large concerns and so small purchasers would be excluded. This vocal opposition generated many newspaper articles and made long-term contracts a potential public relations problem.

The second matter was the Department of Natural Resources itself. They were very slow in developing the long-term contracts. Although Dow Corning received much verbal support, no written contracts were being prepared.

These two items caused Dow Corning to consider the private forest landowner as a wood fuel source. To assess these private forest landowners, a letter was composed asking a number of questions concerning the landowners interests and willingness to sell timber. This will be detailed in the Landowner Assistance Program section later in this report. The response to Dow Corning's survey (44% positive reply) was excellent. The replies indicated the owners' major interests were in wildlife. The survey became the basis for the Dow Corning Landowner Assistance Program.

The team added Dow Corning experts from the insurance group, legal group, and from the budgeting group to prepare for a presentation of findings to the Dow Corning Board of Directors. The reports from Greentree Associates; Campbell, Deboe and Associates; and the results of the landowner survey were all used to prepare the presentation.

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The presentation was made at the March 1978 Board of Directors meeting. The information presented included wood resource assessments, boiler/turbine assessments, and the teams recommendations. In brief, the team recommended that detailed engineering for the boiler/turbine be approved along with the development of a procurement system.

The Board of Directors were not comfortable with the woodburning concept and developed a list of questions that they wanted answered before they would take any further action. The questions were:

1) How much land is required to have the project self-sufficient using 100% wood chips?

2) How much does forested land cost?

3) How much of Dow Corning's current Michigan land could be used to support this project?

4) What is required for Dow Corning (or any other party) to become a "producer"?

   a) capital investment?
   b) personnel requirements?
   c) costs?
   d) seasonality issues?
   e) logistics and transportation equipment?

5) How much land must be obtained via long-term contracts?

6) What conditions will make long-term contracts attractive to the average landowner?

7) Should Dow Corning sell a forestry service?

8) Should Dow Corning go into a brokerage business on wood supply?

9) What will the economics be for each major type of landowner?

10) How does the team see the relationship between landowner and producer?

11) What are the recommended operating practices for the following:

   a) weighing practices?
   b) back up when wood supply is interrupted?
   c) quality control?

The team began to refine data already collected and gather additional references and studies that would help answer the Board of Directors' questions.

Since Dow Corning is a silicone based industry, the Board of Directors was not familiar with wood harvesting, handling, or burning. Because of this, two field trips were arranged for these people so they could see these practices on a first-hand basis. The first trip was to a Michigan whole-tree harvesting operation. This operation demonstrated how trees were harvested with feller-bunchers, skidded with grapple-skidders, processed with whole-tree chippers, and loaded into vans for transport. This trip was extremely educational for these chemical industry executives.

The second trip was to a Weyerhaeuser Company plant in Plymouth, North Carolina. On this trip, the emphasis was on Weyerhaeuser's 400,000 pound per hour boiler which uses 1500-1800 green tons of bark and wood residues per day. Along with this, the executive observed the wood fuel reclaim system, wood fuel conveying system, and the associated equipment. Although this boiler/turbine system was larger than the one Dow Corning was considering (250,000 pounds per hour), there were more similarities than differences. One reason the trip was successful was the presence of two engineers from Campbell, DeBoe and Associates. They were a constant source of information and answered many of the executives' questions.

The two trips allowed the team a chance to discuss the questions asked by the Board of Directors and to find out what specific information was desired. Over this same time frame, much reference material was accumulated to support the answers to these questions. Three reports had tremendous background data that fit our project. Forest Residues Energy Program from North Central Forest Experiment Station, Forest Service - U. S. Department of Agriculture, St. Paul, Minnesota has case studies, forest inventory, harvest systems, forest drain and forest assessment for northern Michigan and Wisconsin. This was considered by the executives as good reference material since it was close to Midland and written by a credible author.

The second report was written by Wood Energy Analyst for the Energy Administration of the Michigan Department of Commerce. The report, "The Wood Energy Concept--Its Applicability in Michigan", covered all of Michigan. This allowed individual data to be extracted for a specific area around Midland. Since this report supported the Greentree reports and that of Campbell, DeBoe and Associates, it added more credibility to those reports, findings and recommendations.

The third report provided support to Greentree's and Campbell, DeBoe and Associates' reports. It was written by a number of authors from Battelle-Columbus Laboratories. Its title is "Comparison of Fossil and Wood Fuels." It was prepared for Environmental Protection Agency, Office of Research and Development in Washington, D.C.

The collection and refinement of these additional sources provided the answers to the Board of Directors questions. Detailed answers will be highlighted in the following sections.

By the time the questions were answered and the Board met again, it was early in 1979. At that time, the team was appropriated monies to begin detail engineering for the boiler/turbine and to develop a natural resources program, including staff suggestions.

Campbell, DeBoe and Asosciates were awarded the contract for the development of detailed engineering on the boiler/turbine. The development of the natural resources program was to be done by the team.

Throughout the discussions with Department of Natural Resources personnel, federal staff, and Greentree, the need for a Dow Corning Natural Resources Department was emphasized. Each of these groups felt Dow Corning needed a small staff of foresters to help private landowners decide what needed to be harvestsed. The team also noted the response from private forest landowners survey. With all these facts, the team decided a mixture of foresters and wildlife biologists would best serve the landowners' interests and in so doing, would provide Dow Corning with the most reliable supply of wood. In August 1979, a wildlife biologist and a forester were added to the new Dow Corning Natural Resources Department. This brought the staff to one supervisor (the original team-hired forester), a wildlife biologist, and a forester. By this time, the Greentree 35mm slide presentation had been reworked through Dow Corning's Public Relations Department to reflect project changes and some Dow Corning history.

Armed with the excellent public relations program, one of the Natural Resources Department staff and an engineer from the original team gave the two-part program to anyone interested. The interest was high and many contacts were made with landowners interested in managing their lands.

Dow Corning Natural Resources Department was assigned the job of helping these landowners manage their lands. Details about the management plans will be found in the Landowner Assistance Program Section.

Through the public relations program and management plans, the Dow Corning Natural Resources staff, by start-up (9/82) of the woodburning facility (SECO), had made nearly 200 presentations to just over 10,000 people. This interest led to a staff of three foresters, two wildlife biologists, one field ecologist, secretary and supervisor. The wood under contract at start-up fulfills Dow Corning's needs through mid-year 1984.

The detailed engineering produced a design package which was acceptable to the Board of Directors and their authorization for construc-

tion. Construction began early in 1980 and will be completed in the third quarter of 1982.

SECTION 4.0

RESOURCE ASSESSMENT

A. Resource Requirements

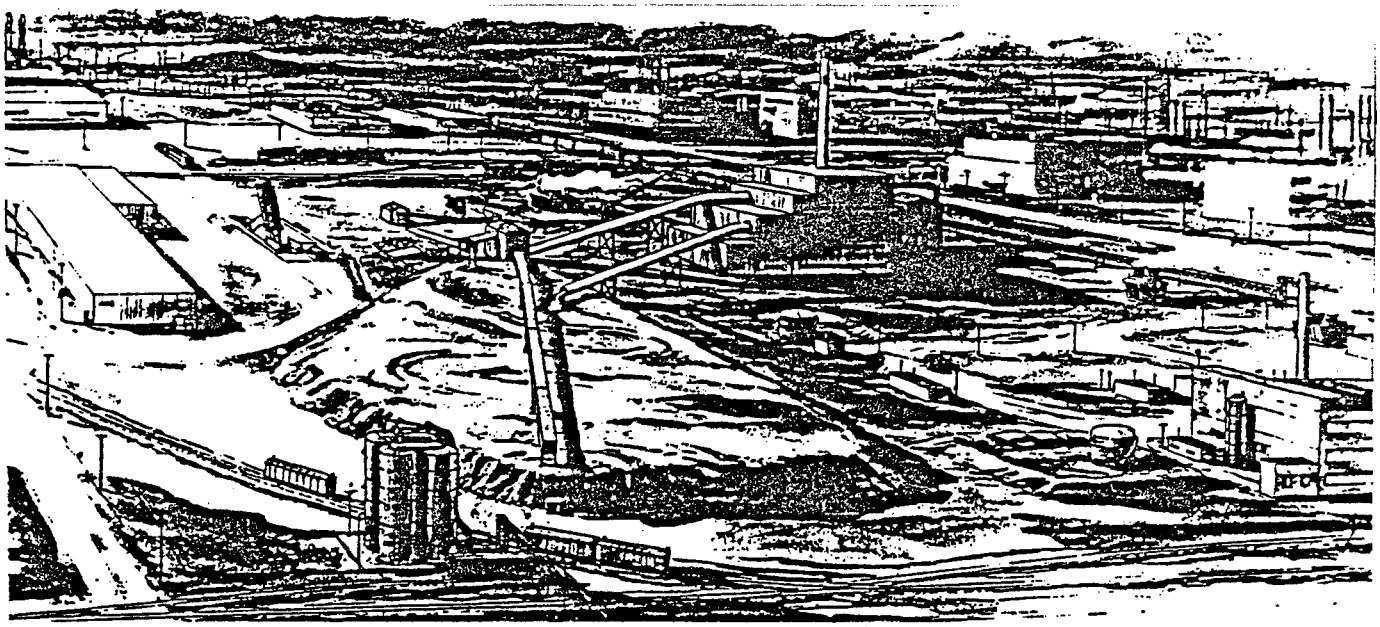
The Dow Corning team, along with the two consulting firms, went through a number of exercises like those found in Appendix C (pg. 162-202 in Forest Residues Energy Program; North Central Forest Experiment Station Forest Service - U.S.D.A. St. Paul, Minnesota). By beginning with the total BTU's needed by Dow Corning, factoring the efficiency losses and adding Kw generation, the total BTU needs were figured. Then some general assumptions were made concerning the wood to be fired. These included 50% moisture factor, 8500 BTU per dry pound of wood and all energy needs would be obtained from wood fuel. From this calculation came the conservative figure of 431,000 green tons of wood as an annual requirement.

The final boiler design was complete and the 431,000 green tons were refined to 180,000 dry tons. This would cover all Dow Corning's energy needs. This number was shifted down once more when operating procedures were drawn up. The final number for full operation is 165,000 dry tons of wood annually. This will be burned in a 90/10 split of wood to gas or oil. The gas/oil is used to stabilize the flame so a constant rate (temperature and pressure) can be put through the turbine. This will allow operating the turbine more efficiently.

The final tonnage will be used over an 11 month period with one month per year being considered down time for state law required shutdown for boiler and turbine inspection.

Because of shifts in requirements during Michigan's seasonal year, the monthly wood fuel requirements have a 20 percent plus or minus swing. On the average, Dow Corning will use 15,000 dry tons per month, 500 dry tons per day, and almost 21 dry tons per hour.

The amount of wood on hand ranged from a few days to three months at the mills visited by the Dow Corning team. The general trend was that the farther north the location, the more storage was required. Because of this, early thoughts were to incorporate a 60-day storage; however, when the area available for wood fuel storage was measured and calculations made, Dow Corning found it only had sufficient room for a 30-day supply. The limits beyond the square feet size was the height of the pile caused by the wood fuel gallery. The gallery can be seen in the drawing below.



The question of wood quality was reviewed many times throughout the planning stages. The question of preferred species is not an issue if wood is purchased on a per ton basis. When Michigan's species of wood are compared by BTU per pound, there is very little difference, about 8.5 percent. However, if the wood purchase is made by the cord, then specie preference is important because the bulk density of each species is different and have a wide range. This difference on a BTU basis ranges 27.3 percent from low to high (taken from "The Wood Energy Concept-Its Applicability in Michigan" (by Tom Heck - Wood Energy Analyst, Energy Adm., Michigan Department of Commerce 1/1/78).

The majority of Dow Corning's wood will be purchased in sizes ready for the boiler. The preferred fuel size for the boiler is one inch by one inch by three-eighths inch chip. The maximum size that can be introduced to the boiler is a two inch cube. The boiler can handle 40 percent fines (that material from sawdust size particles down). Besides the chip size requirements, the boiler is also designed to burn 50 percent moisture wood; although at the current mix of sources, Dow Corning's wood will be around 40 percent moisture when it enters the boiler. Some sources that are much drier may be taken directly to the boiler if operations can be worked out to accommodate this switching. The wood coming from sawmills and whole-tree harvested chips will have moisture contents that range from 40 percent to 50 percent, wood that is reprocessed (hogged pallets and lumber) will range from 20 to 30 percent, and the wood harvested from dead timber (forest fire area) will range from 20 to 30 percent moisture.

The ash content of the wood and bark has a wide range. In T. Lee Bush's report, "Boiler Selection and Design, Including Stock Control

Measures" (Mid-American Wood Combustion Conference 11/8-9/79), the ash content ranges from .23 percent in wood to 1.28 percent in bark. In other reports and documents, the ash content has been reported as high as two percent. Because of these wide differences and the unknown amount of sand, dirt, and other residue that will be received along with the wood, Dow Corning has estimated it will have from 5 to 10 tons of ash to dispose of each day (1 to 2% of daily wood usage). Interest has been shown by a local municipality to mix this ash and the city's sludge to produce a high grade mulch. Since the ash has a low fertilizer value, this would be a very good use.

Because some of the wood delivered to Dow Corning could possibly be contaminated, the following problems were sited.

1. Corrosion of boiler and auziliary equipment; equipment failures.

2. Carry through of contaminants into ash and interference with outlets for the ash.

3. Employee exposure to hazardous materials.

4. Air emissions in violation of the DNR permit.

Recognizing that each of these have different potentials of seriousness and risk factors, together they are enough reason to warrant a strong effort to minimize the amount of contaminated wood being recieved into SECO.

The types of contamination to be avoided are:

1. Chemical (Major concern is heavy metal or chlorinated materials. Examples are shown in Table 1 from EPA hazardous waste regulations. These could come into contact with wood when used as preservatives, pesticides, herbicides, etc. Hydrocarbon chemicals such as oil, grease, etc. are of less concern.)

Table 1. Maximum Concentration of Contaminants for Characteristic of EP Toxicity

EPA Hazardous waste number	Contaminant	Maximum concentration (milligrams liter)
D004	Arsenic	5.0
D005	Barium	100.0
D006	Cadmium	1.0
D007	Chromium	5.0
D008	Lead	5.0
D009	Mercury	.02
D010	Selenium	1.0
D011	Silver	5.0
D012	Endrin (1,2,3,4,10,10-hexachloro-1, 7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo,endo-5,8-dimethano naphthalene)	0.02
D013	Lindane (1,2,3,4,5,6-hexachlorocyclohexane, gamma isomer)	0.4
D014	Methozychlor (1,1,1-Trichloro-2,2-bis[p-methoxyphenyl]ethane).	10.0
D015	Toxaphene ($C_{10}H_{10}Cl_8$, Technical chlorinated camphene, 67-69 percent chlorine).	0.5
D016	2,4-D,(2,4-Dichlorophenoxyacetic acid).	10.0
D017	2,4,5-TP Silvex (2,4,5-Trichlorophenoxypropionic acid).	1.0

2. Demolition rubble (glass, brick stone, metal, cement, etc.)

3. Miscellaneous contaminants such as asbestos and other types of insulating materials.

The level of contamination was also considered to be significant. It was decided that incidental contact of wood with chemicals, except for PCB's, should be acceptable. Wood which was purposely treated with heavy metal or chlorinated preservatives, fungicides, etc. should be considered signficantly contaminated and avoided. Forest areas sprayed with chlorinated pesticides or herbicides should be considered excessively contaminated up to 30 days after spraying. Hydrocarbon

contamination is excessive if pooling or dripping of liquid can be seen or if a strong odor is present.

Specifications for the use of demolition rubble were set as follows: Pieces of non-wood items larger than two to four inches in any dimension could damage equipment and would therefore be avoided. No more than two percent non-wood material should be present to avoid interference with possible uses of the resultant ash.

The presence of any visual insulation pieces or dust from miscellaneous sources suspected to possibly contain insulation would justify considering the material contaminated.

Therefore, the recommended points of control were:

1. At the source. A need for strong reliance on the purchasing agent and/or Natural Resource staff to,

    a. Educate and provide information to sellers as to types of contaminated wood we wish to avoid.

    b. Become knowledgeable and comfortable with sources of wood through on-site inspections.

    c. Limit sources of hogged fuel to "approved sources only".

    d. Perform unannounced audits of sources.

2. At the receiving area. Personnel advised to visually inspect loads as they are received and use standard operating procedures relying on physical observation of excessive contamination.

3. Through analytical testing. This was seen appropriate only as a spot check. Sampling inaccuracies and testing time make it impractical to use as a load acceptance criteria.

The level of concern and need for control is low for wood from forest, medium for sawmills, and high for central hogging firms or "one time only" sources.

Greentree Associates calculated the general distances wood could be economically transported. When haul rates were examined there was a definite loss in productivity beyond 75 miles. Although Dow Corning has a number of contracts that exceed 75 miles, they are for residues and not very far beyond 75 miles. This distance allows two to three trips per day per truck.

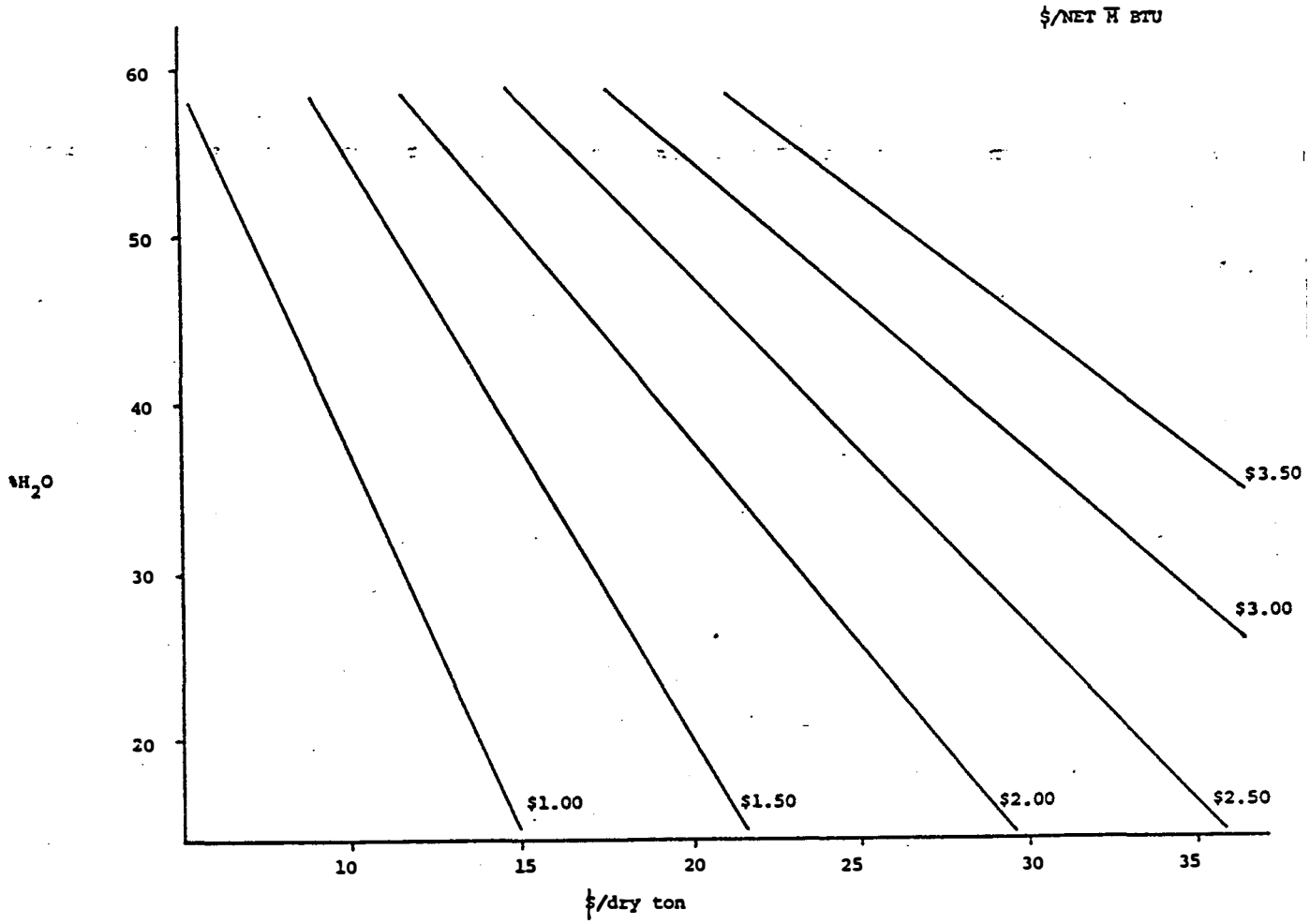
The whole-tree producers have developed minimum volumes and tonnages that can be used in planning purposes. These contractors feel there

must be must have five to seven cords per acre (about 20 green tons per acre) before it is economical for them to operate their equipment. They would prefer to harvest 750 green tons per set-up.

Seasonal problems arise mainly in winter and spring. The snow and/or ice of winter can effect both trucking and field operations. The spring thaw and related road restrictions can effect both operations. To minimize these potential problems, Dow Corning has contracted for timber ranging north to south and east to west a distance of 120 miles. This will allow shifting of producers into low snow areas or north or south of road restrictions. Dow Corning also is contracting for timber located on roads that have no spring weight restrictions. The annual boiler inspection and shutdown will be at the same time to reduce wood requirements during this difficult time of the year.

When the project began, the economics were figured using the most expensive source as the cost of the wood. In Dow Corning's case, that would be whole-tree harvested chips. This was done on purpose knowing a mix of wood sources would improve economics.

As the project gets underway and the sources are set for the first 12 to 18 months, a best sources strategy must be developed. The following chart will be used to compare sources on a useable BTU basis.



Two examples will illustrate the usefulness of this type of chart. Two wood fuels being purchased for the same price per dry ton can have two entirely different values to the wood fuel user. Source number one is urban residue being trucked 120 miles, composed of hogged pallets, lumber and wood demolition with an average moisture content of 20 percent. Source number two is whole-tree harvested chips and trucked from 20 miles away with an average moisture content of 45 percent. Both sources are being purchased at $20.00 per dry ton. However, on a dollars-per-useable-million-BTU's basis, source number one will cost $1.50/MBTU's while source number two will cost $2.25/MBTU's. As can be seen, two sources of the same gross cost can be of completely different net value to the user.

Much time was spent on consideration for public attitude (PR) issues. These included the topics of clearcutting, the use of public land, nutrient balances, wildlife concerns and overall wood supply issues. Much time and expense was put into the development of a complete story about these issues and Dow Corning's woodburning project. The work culminated in three brochures (see Appendix), 35 mm automated

slide/tape presentation and a 35 mm slide presentation usually given by two people (one project engineer and one natural resources staff member). The public relations presentations were given to 200 groups (10,000 people) over a two and a half year period. These presentations not only answered many questions and quieted nearly all potential opposition, but also accounted for most contacts with private landowners. These original contacts led to contracts for timber in many instances.

B. Potentially Available Resources

A majority of the information base used for assessing the available resource was provided as back-up in the Greentree reports. The Greentree work developed data for Dow Corning purchase area. To support and verify this information, Dow Corning used the following publications: "Forests and Michigan's Future," Michigan State Universtiy, 6/1/78; Research Report 192 Natural Resources, "Michigan Timber Production -Now and 1985", 5/73; U.S.D.A. Forest Service Resource Bulletin NC34, "Pulpwood Production in the North Central Region by County", 1975, J. E. Blyth and J. T. Hahn, North Central Experiment Station, Forest Service, U.S.D.A.; U.S.D.A. Forest Service Resource Bulletin NC-9, 1970, "The Growing Timber Resource of Michigan", 1966, C. D. Chase, R. E. Pfeifer, J. S. Spencer Jr.; and "Wood As An Energy Resource: Demand, Supply, and Impact in Michigan", by Wood Energy Task Force, Michigan Department of Natural Resources, Forest Management Division, Lansing, Michigan, 7/81.

Greentree provided the following tables to Dow Corning for counties within a 75-mile radius of Midland, Michigan.

From Table 1, the commercial forested land by ownership north and south of Midland, it is easy to see why Greentree felt Dow Corning should concentrate its purchase efforts north and west of Midland.

Table 2. Commercial forest land,

	All ownership	State	Federal	Private	
				Club	Other
		(Thousand acres)			
North Counties	3065	855	403	93	1714
South Counties	1092	46			1046
Total	4157	901	403	93	2760

From Table 3, the commercial forested land by broad forest type, the clearcut areas (aspen-birch) made up just over 30 percent of the total timber.

Table 3. Commercial forest land, by broad forest type

	All types	Conifer	Aspen-birch	Other hardwood
	(Thousand acres)			
North counties	3065	680	1069	1316
South counties	1092	50	211	831
Total	4157	730	1280	2147

Each of the tables were supported with county-by-county data as table 4 shows. This information made it easy to pinpoint counties that had the best potential to furnish wood to Dow Corning.

Table 4. Commercial forest land, by ownership and county within an approximate 75-mile radius of Midland

Region and County	All Ownership	State	Federal	Private		
				Total	Club[1]	Other
		(Thousand acres)				
North 1/2						
Lower Peninsula						
Alcona	323	2	101	220	28	192
Arenac	105	28		77		77
Bay	48	3		45		45
Clare	229	48		181	6	175
Crawford	304	175	45	84	3	81
Gladwin	187	86		101		101
Iosco	242	23	97	122	3	119
Isabella	97	2		95		95
Mecosta	148	12	2	14		134
Midland	170	38		132		132
Missaukee	227	99		128	8	120
Ogemaw	239	71	19	149	4	145
Osceola	175	16		159		159
Oscoda	301	55	139	107	17	90
Roscommon	270	197		73	24	49
Total	3,065	855	403	1,807	93	1,714
South 1/2						
Lower Peninsula						
Clinton	45	3		42		42
Genesee	56	1		55		55
Gratiot	49	3		46		46
Huron	62	1		61		61
Ingham	58	5		53		53
Ionia	63	4		59		59
Lapeer	80	2		78		78
Livingston	92	2		90		90
Montcalm	134	9		125		125
Oakland	137	3		134		134
Saginaw	99	7		92		92
Sanilac	70	1		69		69
Shiawassee	42	3		39		39
Tuscola	105	2		103		103
Total	1,092	46		1,046		1,046
All counties	4,157	901	403	2,853	93	2,760

[1]Club holdings less than 640 acres in size excluded.

The growing stock volumes by broad species groups were shown in table 5.

Table 5. Growing stock volume, by broad species groups

	All species	Conifer	Aspen-birch	Other hardwoods
	(Million cubic feet)			
North counties	2365	497	648	1220
South counties	730	32	84	614
Total	3095	529	732	1834

The net annual growth was summarized in table 6. This showed the growth rate was at 3.7 percent for all species conbined.

Table 6. Net annual growth in growing stock on commercial forest land

	All species	Conifer	Hardwood
	(Million cubic feet)		
North counties	89.4	24.4	65.0
South counties	26.1	1.1	25.0
Total	115.5	25.5	90.0

To assess the volume of wood available, the drain (removals) had to be subtracted. These removals are summarized in table 7. It was determined that the total usage would have to double before the total drain would approach the total growth.

Table 7. Annual timber removals from growing stock

	All species	Conifer	Hardwood
	(Million cubic feet)		
North counties	43.4	9.1	34.3
South counties	12.3	.4	11.9
Total	55.7	9.5	46.2

The biomass excess after removals on an annual basis is summarized in table 8. This is the information in tables 5 and 6 combined and calculated for tons instead of cubic feet. Since Dow Corning's needs were described as tons/year, the conversion from cubic feet to tons made these table more easily understood.

Table 8. Biomass excess of annual growth of growing stock trees over timber removals

	All species	Conifer	Hardwood
	(Thousand tons)		
North counties	1399	417	982
South counties	438	20	418
Total	1837	437	1400

There is also a portion of the forest that has up until this time gotten very little positive attention. This standing tree residue is made up of rough, rotten, cull, small and salvageable dead trees. Table 9 summarizes this by conifer and hardwoods.

Table 9. Standing tree residues

	All species	Conifer	Hardwood
	(Million tons)		
North counties	32.7	2.8	29.9
South counties	11.3	.2	11.1
Total	44.0	3.0	41.0

Added to all of this tonnage are the residues left in the forest after conventional logging. This is summarized in table 10.

Table 10. Logging residues generated annually from commercial timber harvests

	All species	Conifer	Hardwood
	(Thousand tons)		
North counties	354	42	312
South counties	111	2	109
Total	465	44	421

These tables, along with the county-by-county back up data, yielded very useful information. The approximate four million acres were growing an average of 745 cubic feet per acre or an average 9.4 cords per acre. Those four million acres also averaged 10.6 tons of standing tree residue per acre.

Just the standing tree residue portion of the forest contained over one hundred times DowCorning's annual requirement. In addition to

this, growth exceeded removals by a wide margin. These two factors were weighed very heavily by Dow Corning's management.

Although logging slash is residue, it was included with the growth information because the source was directly from the forest. Other residue sources were outlined and discussed including those from sawmills (primary wood using industry). Table 11 summarizes the information split on a north/south line.

Table 11. Annual residue production and disposal[1] by primary wood using industry within 75-mile radius of Midland, by county

Region and County	Total residue generated	Sold	Used within plant	Surplus
		(Tons)		
North 1/2				
Lower Peninsula				
Alcona	2,378	180	0	2,198
Arenac	7,732	5,069	91	2,572
Bay	372	176	0	196
Clare	4,882	2,367	0	2,515
Crawford	4,522	1,424	272	2,826
Gladwin	488	0	0	488
Iosco	6,104	3,415	0	2,689
Isabella	10,851	10,025	0	826
Kalkaska	7,144	4,930	0	2,214
Lake	5,467	3,102	0	2,365
Mecosta	NA			
Midland	17,290	799	0	16,491
Missaukee	5,626	3,029	0	2,597
Newaygo	16,368	6,738	0	9,630
Ogemaw	21,832	2,184	696	18,952
Osceola	13,615	2,739	0	10,876
Oscoda	18,566	3,766	0	14,800
Roscommon	7,227	110	0	7,117
Wexford	12,104	3,554	0	8,550
Total	162,568	53,607	1,059	107,902
South 1/2				
Lower Peninsula				
Barry	28,620	22,695	3,426	2,499
Clinton	9,760	9,196	564	0
Eaton	15,373	12,679	2,317	377
Genesee	173	173	0	0
Gratiot	1,493	733	0	760
Huron	5,601	4,015	0	1,586
Ingham	13,110	10,691	0	2,419
Ionia	22,044	16,696	0	5,348
Kent	23,788	19,570	0	4,218
Lapeer	1,966	612	0	1,354
Livingston	5,861	5,861	0	0
Montcalm	5,603	2,771	82	2,750
Oakland	2,947	2,947	0	0
Saginaw	38,609	36,735	0	1,874
Sanilac	4,259	80	0	4,179
St. Clair	7,395	5,882	226	1,287
Shiawassee	0	0	0	0
Tuscola	11,235	6,704	0	4,531
Total	197,837	158,040	6,615	33,182
All Counties	360,405	211,647	7,674	141,084

[1]Cubic feet of green wood and bark residue converted to weight on basis of 1 cubic foot equals 45.65 pounds.

The total weight of the sawmill residues generated were very large. From Greentree and direct contacts with the mills, we learned that much of the sold portion was disposed of at a very low cost ($1.00 to $2.50/green ton). The form of these residues were ususally in sawdust, ground bark, slabs and chunks from the ends of logs and boards. All of this material was useable to Dow Corning although chunk and slabs would have to be processed into smaller and more practical sizes.

Another source considered but difficult to measure was wood material being landfilled around central Michigan's urban areas. This was felt to have good potential but no actual data could be found. However, as an indicator of this tonnage, the residential structure demolition was tabulated from demolition permits. Table 12 summarizes the numbers of residential structures demolished annually in selected Standard Metropolitan Statistical Areas of Michigan.

Table 12.

SMSA	Distance from Midland	Structures demolished	Wood waste[1]
	Miles	Number	Tons
Ann Arbor	126	70	873
Battle Creek	135	109	1490
Bay City	19	52	671
Detroit	120	4584	57163
Flint	60	840	9954
Grand Rapids	111	66	794
Jackson	116	78	924
Kalamazoo-Portage	159	137	1623
Lansing-East Lansing	86	158	1875
Muskegon-Muskegon Heights	126	263	3340
Saginaw	24	240	2393
Total		6597	81600

Although this just begins to show the potential, it is one of the few documented urban sources of wood residue.

Used railroad ties were considered. The chemical treatment of the ties and tramp metal, finally made this source of wood residue very questionable.

After weighing all the information on sources, Dow corning's wood procurement source breakdown is as follows: 50 percent of the wood fuel will come from sawmill residues. It will be sawdust, bark and chips all in forms useable in Dow Corning's system without further processing. Thirty-three percent will come from whole-tree harvesting directly from the forest landowners for whom Dow Corning has provided wildlife and forestry management plans. Fifteen percent will come from a salvage harvest of dead pine created by a huge forest fire. The remaining wood will be from urban and industrial wood residue sources.

SERI ----------

There will need to be a shifting of sources in a few years as the forest fire damaged timber deteriorates beyond salvage. As this happens, that portion of residue will be replaced with more urban/commercial wood residue sources and by some additional whole-tree harvesting from private forest landowners.

SECTION 5.0

LANDOWNER ASSISTANCE PROGRAM

As was stated earlier in the report, the private landowner was focused upon after the state balked on long term agreements and two utilities were taken to task when they planned to use state and federal timber to fuel a potential power project. To assess the interest of the "unknown" landowner group, the following letter and questionnaire were sent to 150 owners.

Dear Landowner:

Dow Corning Corporation is exploring the use of wood as an energy source to replace the fuel oil and natural gas we now use in our Midland, Michigan Plant. This letter is being sent to landowners and hunt club representatives, requesting their opinions and assistance in this study.

The wood for fuel would be produced in chip form, from whole trees or residues left from other sales. The sources will be thinnings, timber stand improvement cuts, game habitat improvement cuts, site conversions, cleanups and/or clear cuts. Our proposed need for wood chips is 430,00 tons annually.

Benefits to the landowner include complete utilization of now wasted resources, better forest game management, and equitable compensation.

We invite your comments about our proposed program. Please fill out and return the enclosed card, including any suggestions or comments which may be helpful in our evaluation of long-term wood availability, possible sources and public reaction.

Sincerely,

P. G. Sworden
Forester

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QUESTIONS:

Do you have timber land in need of harvest?	Yes___	No ___
Would you harvest more if whole-tree chipping was involved?	Yes___	No ___
Would you like to see a demonstration of whole-tree chip harvesting?	Yes___	No ___
Would you like to upgrade your present timber stand?	Yes___	No ___
Would you like to upgrade your wildlife habitat?	Yes___	No ___
Would you consider a long-term contract?	Yes___	No ___

COMMENTS AND/OR SUGGESTIONS:

They were selected because they owned large acreages (>< 640 acres) within our projected purchase area. Because the list was a few years old, 53 were returned "non-deliverable" from the U. S. Postal Service. This left 97 letters that we considered received. When all the replies were tallied, 43 had answered. Table 13 summarizes the results of these replies.

Table 13.

QUESTION	YES	NO	?
Do you have timber land in need of harvest?	40	2	1
Would you harvest more if whole-tree chipping was involved?	36	4	3
Would you like to see a demonstration of whole-tree chip harvesting?	36	7	-
Would you like to upgrade your present timber stand?	37	6	-
Would you like to upgrade your wildlife habitat?	38	5	-
Would you consider a long-term contract?	29	9	5

This was a 44 percent total reply rate and these 43 owners controlled 78,500 acres of forested land. That represented more than enough to get Dow Corning running and keep it running for a long time.

Dow Corning's team felt these private landowners were very interested in our project and two-thirds of them were interested in long-term contracts. The team also saw that these private landowners had more interest in wildlife than any other item on the questionnaire. This led to the realization that to work with these landowners, those wildlife needs would have to be considered. Along with this was the urging by the Michigan Department of Natural Resources that Dow Corning provide professional forestry assistance to the private landowners.

Dow Corning's upper management was concerned that harvesting on private land be done in the proper manner. The team decided that with the landowners' interest, upper management's concerns, and the Michigan Department of Natural Resource's concerns, Dow Corning should have a Natural Resource Department to insure proper harvesting on private lands. The Natural Resource group now consists of three foresters, two wildlife biologists, one field ecologist, secretary and supervisor.

The first step of any harvesting program is knowing what is to be harvested. The Dow Corning Natural Resource staff draws up management plans to make sure proper management is being carried out on harvests for Dow Corning. The objectives of the forest management plans are to incorporate the individual landowner's goals on his property with sound forest and wildlife management practices. Along with this, proper soil conservation practices are considered. These four components (landowner's goals, soil, wildlife and timber) go into nearly every plan.

The procedure that is normally followed is that the landowner will contact Dow Corning concerning management or harvesting on his land. The owner is questioned concerning long-term/short-term goals, concerns about wildlife, species, timber interests, and recreational needs. The next step is to review the aerial photographs of the property in question and check on soil types from Soil Conservation Service information. Once these are all reviewed, the property is inventoried (cruised). This is done by setting up a pre-determined pattern so the inventory takes into account all of the property. The cruise (inventory) is based on about five percent coverage. Timber type, age, condition, species, and minor vegetative understories are noted. References on wildlife signs, sightings and potential habitat are noted.

The next step is to draw up the management plan based on the collected field data and landowner's desires. (See Appendix A for sample management plan.)

Standard management plan information includes soils information, vegetation maps, harvest maps, harvest schedule, timber volumes by type, timber types by acreage and location map. The extra information

beyond the standard items pertain to landowner specific goals, such as ruffed grouse management, turkey management, pine plantation thinnings, or special recreational needs.

These plans clarify the management so everyone (Dow Corning, landowner, and interested third parties) knows what is going to happen and when. Once in the hands of the owners, the management plans become educational tools for the owners, their families, and neighbors. This helps in the long run since more people are aware of how management plans work and of what they are composed.

Once the plan has been reviewed with the landowner, the next step is acceptance by the landowner. Until this time, there are no commitments (contracts) attached to the management plan. If the landowner is interested in initiating the management plan, then a contract is drawn up that includes the management prescription for harvest within a certain period of time. That may be for one harvest on a one-year contract or multiple harvests over many years. Dow Corning's view is that proper harvesting and acceptable work is the way to insure future supplies.

To help insure this future supply, Dow Corning's Natural Resource staff will mark all timber sales. This will include boundaries, leave trees, landings, and in some cases, skid trails. The supervision will continue when the producers move onto each parcel to harvest. By showing the producer the harvest site and periodic inspections during the harvesting operation, the Dow Corning Natural Resource staff will be able to influence (control) the producers. This will benefit landowner and producer since Dow Corning personnel will be directing the work and taking responsibility for the proper harvest job.

The sawlogs that may be harvested along with the pulpwood and residue will be decked so the landowner can sell or use them after the harvest. Since longs are higher value items, Dow Corning does not want them for fuel. The Dow Corning Natural Resource staff will provide the landowner with a summary of board feet by species in the logs and a list of sawmills who purchase timber in the landowner's area. Dow Corning personnel will provide some general value guidelines, but it will be the landowner's responsibility to negotiate the price and sale arrangements.

The contracts that Dow Corning is using are similar to those recommended by the public agencies for private landowners. The only difference is that Dow Corning's contracts refer to the management plan when defining harvest areas, timing, and special conditions. (See Appendix B for sample.)

The results of these arrangements have been excellent. Landowner agreements cover enough timber to meet this portion of Dow Corning's fuel needs for the next two and a half years. The landowners have

been very receptive and have initiated most of the contracts. The reasons for this are Dow Corning's use of a variety of natural resource professionals, tailoring proper management to meet each person's goals, and having enough time to do complete work.

SECTION 6.0

PRODUCERS

Dow Corning's requirements/specifications concerning producers are that they will meet state and federal laws, have certain insurance requirements, produce a one-inch chip, work from Dow Corning stumpage, and be responsible for their own trucking.

By having the producers work on Dow Corning stumpage (Dow Corning contracts with private landowners), the control of the size of harvests, types of harvests, road layouts, and any special provisions of the management plan can be controlled by Dow Corning. This allows Dow Corning's Natural Resources staff to be the communication link between producer, landowner, and Dow Corning while insuring implementation of the management plan.

Greentree personnel assisted Dow Corning in locating producers, as did the Michigan Department of Natural Resources. Besides the contacts provided by these two organizations, producers came to Dow Corning because they "heard" Dow Corning would be purchasing chips. From this list, Dow Corning selected 15 producers who had good reputations as businessmen. This included a reasonable record in dealings with the state, federal, and private landowner. Some of these producers had whole-tree harvesting equipment and others were producing other forest products.

Once selected, the 15 producers were sent a packet of information including: a letter of invitation to bid, bid instructions sheet, sample contract, contractor's data form, bid form, Dow Corning SECO porducer's data information, and Dow Corning's contractor safety rules (see Appendix C). The bid allowed each of the producers to bid the tonnage of chips they wanted to produce for Dow Corning at the price they felt they could afford to produce and transport to the Dow Corning facility. They had the opportunity to indicate their preference of operating location. The primary reason the chip prices were bid and not set was that the economics of each operation is different. The documented economic studies of whole tree harvest equipment are usually concern a compliment of equipment not balanced in production rates. As an example, in the Northern Logger (July 1982), the article "The Cost of Thinning With a Whole-tree Chip Harvesting System" by Neil K. Huyler states that the total delivered cost of wood chips from 76 miles away is $15.42/green ton. However, in the discussion section, a problem was described that caused an average one hour delay for each van. Another factor was a road slope exceeding 20 percent, thus requiring skidders to push vans out onto the road. These add tremendous bias to the $15.42/green ton figure.

Because the producers are a better judge of what they and their equipment can and cannot do, the bids reflected individual economics, not

some "average" set by Dow Corning. To allow the producers to make a reasonable bid on long-term contracts covering unseen harvest sites, the Dow Corning SECO producer's data information sheet was developed.

At first the producers were apprehensive about the package. However, as they studied the information and became more familiar with the idea, some of the producers liked the new concept. From the 15 bid packages sent out, six were completed and returned. Two decided they could not bid because of other commitments, and the remaining seven took a wait-and-see approach.

Three producers were selected. Two would be producing on private land and the third would produce chips from the forest fire area on federal land.

Each of the three were selected because of bid price, location of production desired, and tonnages required. The producers each contracted for the tonnage they needed to produce (bid), the counties in which they preferred to produce, and at the price they had bid.

SECTION 7.0

WASTE WOOD SUPPLIER PROGRAM

There are a large number of mills within the Dow Corning area as outlined in Table 4 in section 4. All of the mills have excess waste wood which needs to be marketed or waste wood now being disposed for which the mills would like a better return.

The other needs of these mills are a steady market and someone to take the sawdust, bark and slabs generated from their mills over the past few years. Since mill residues are produced only when sawn products are selling, the supply of sawmill residues can be erratic.

Dow Corning used sawmill size, quantity of residues available, and delivered price as the criteria for selection of suppliers. The larger mills are more stable in uncertain economic times and they usually produce the largest quantity of wood residues. The delivered price included hauling distance, handling at the mill, and loading of the residues. The mill owners recognize these residues as such, but like all business people, know that need creates demand. Once there is a demand, the price for mill residues will increase.

Dow Cornings contracts for mill residues allow for 15 to 20 percent variation in the delivered volumes. The residue is priced on a dry ton price and a maximum moisture content. Since the dry ton price is based on an average moisture content of 45 to 48 percent, the sawmill operators can produce extra earnings by managing their residues to reduce the moisture content below the average. This also helps Dow Corning by improving the boiler efficiency.

Since Dow Corning's wood handling system can only tolerate 40 percent fines, the total amount of mill residues are limited. Currently, there are seven sawmills under contract to Dow Corning. Their projected deliveries range from eight van loads per day to one van load per week. Each van will hold about 15 dry tons of mill residue.

SECTION 8.0

SUMMARY AND CONCLUSIONS

Dow Corning's programs for landowners, suppliers and producers has secured wood fuel for many months ahead. The program for private landowners has scheduled timber to harvest covering those needs for well over two and a half years. The contracts with producers run for the same period of time.

The suppliers of sawmill residues have contracts ranging from one to five years. This range will allow for individual negotiations with each supplier.

Since those sources have been identified and contracted, more sources for wood fuel have been identified. These sources include a number of whole-tree producers, sawmills, urban wood residue sources and industrial wood residue. Because of the sound base programs and abundant back-up sources, wood fuel security for Dow Corning is solid.

The Dow Corning Landowner Program has provided 100 forest-wildlife management plans covering a total of 35,000 acres. The utilization of industrial and sawmill wood residue will bring this resource into use. Altogether the use of these wood sources and cogeneration will save 600,000 barrels of oil annually. With these benefits, the SECO project is viewed by Dow Corning as a success at this time.

A. Lessons Learned

Although it is too early to tell about overall long-term success, a few lessons have been learned. The first was that individual landowners are easier to work with than a public agency.

If another Dow Corning project similar to SECO were to begin, more detail to the sources of wood would be gathered. These would center around actual moisture content and not assumed moisture content. The graph shown on page 24 would be used to evaluate the true BTU value of the wood sources.

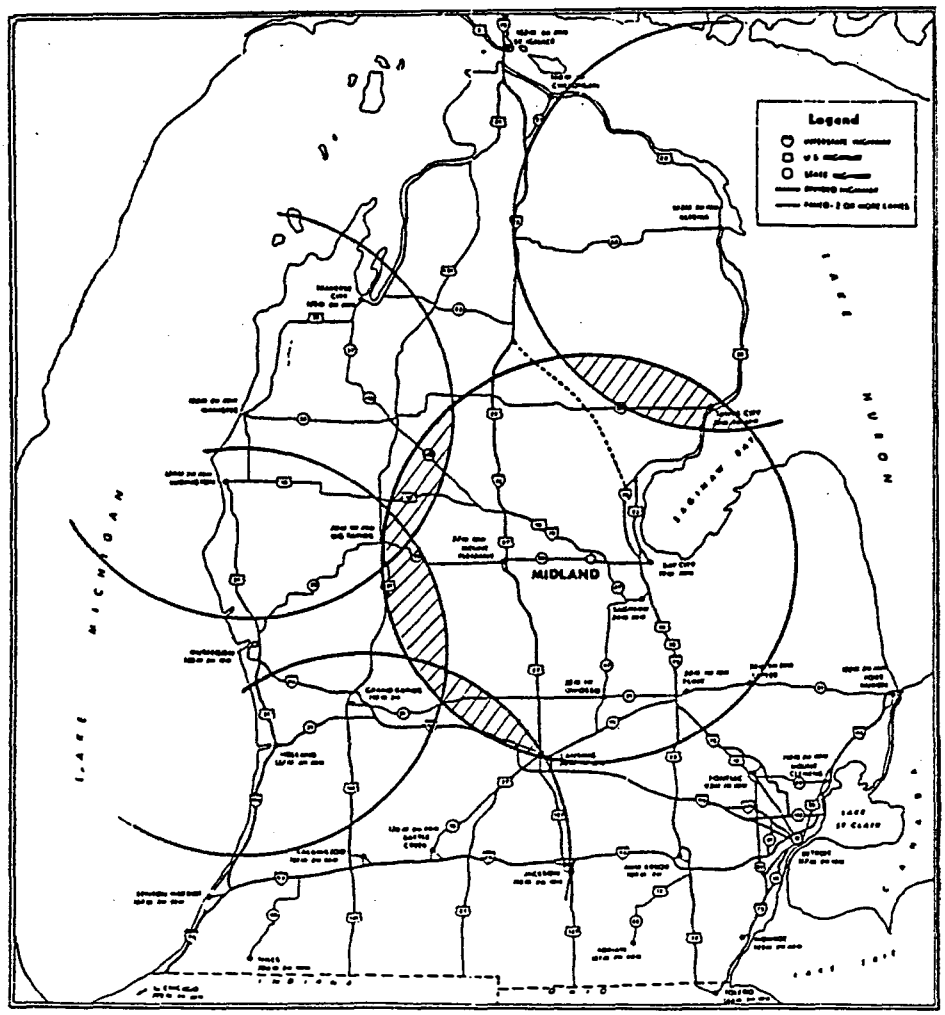
Many of the lessons learned are also key elements of success in Dow Corning's project. These include Dow Corning's upper management and its willingness to allow adequate time for the development of wood fuel resources. The Natural Resources staff was organized and functional three years before wood was delivered to the site. The three year period gave the staff the time needed to develop all sources. Landowner contacts take more time to develop than those with wood resource businesses. The landowners must sort out their thoughts, goals, and wishes before any progress can be made.

Another important key to success was the excellent public relations program that was developed early. By honoring all requests for pre-

sentations on the SECO project, the resource staff and engineering group quelled many potential problems. Dow Corning's willingness to discuss the project allowed the local community to become comfortable with the wood burning concept.

There are many conditions that helped as elements of success. These included a depressed wood market which caused many producers to have limited work or no work at all. The depressed wood market also kept the prices of wood purchases, wood producing, and hauling down.

Dow Corning is located within an area that has little competition for most of the wood grown locally. There is a sufficient sawlog market but markets for pulpwood products are very weak because the users are many miles away. The map in Figure 8-1 shows this very clearly.



The major pulpwood purchasers are all well outside our procurement area with only a small amount of overlap on the outside fringe (The

shaded area shown on the map). Since all markets are also trying to reduce their hauling distances, the competition is minimal.

The staffing of Dow Corning's Natural Resources Department is a major key to success. By matching professional expertise with landowner interest, the success was insured. Dow Corning's wildlife biologists, ecologist, and foresters are very knowledgeable in their respective fields. The private landowners feel that wildlife biologists know wildlife, ecologists understand whole ecosystems, and foresters know about growing trees. This allows each landowner to direct questions and receive answers directly from the most appropriate professional. In the landowners' eyes, this is the most important aspects when dealing with Dow Corning.

B. Recommendations for Starting Up A Wood Burning Project

1. Begin procurement efforts as soon as possible.

2. Compare sources by useable BTU value.

3. Publicize your wood fuel needs so all sources can be identified early in project development.

4. Develop a good public relations program to inform all the publics about the project. (internal, private, and public.)

5. Get bids as often as possible. Do not set prices for wood, producing, or hauling unless absolutely necessary.

There are some problem areas that need additional study. These are sound information on biomass versus cordage from any given forest; a single source for information on wood resources, wood fuel characteristics, and burning systems is also needed. The information can be found but it is in the hands, minds, and control of many different sources.

APPENDIX A

SAMPLE OF PROPOSED FOREST-WILDLIFE MANAGEMENT PLAN

PROPOSED FOREST-WILDLIFE MANAGEMENT PLAN

for

T.16N-R.2E
SECTION 13, MILLS TOWNSHIP
MIDLAND COUNTY

January 29, 1980

Submitted by:

DOW CORNING CORPORATION
Natural Resource Management Team
Box 1592 (Mail No. 138)
Midland MI 48640
Phone: (517) 496-4593

INTRODUCTION*

Dow Corning Corporation's Midland Plant has chosen wood as a primary fuel for its new co-generation power facility. The corporation has made a firm commitment to both energy conservation and service to the surrounding area. This technical forest and wildlife management assistance to private forest owners will help them achieve their goals for their property.

The landowner's primary goals for this property are the improvement and maintenance of good wildlife habitat. The primary species of wildlife for which to manage are white-tailed deer, ruffed grouse and several species of waterfowl. Along with this, a second goal of sustained production of wood fiber is also desired. A well stocked stand of timber is desirable from both the landowner's and Dow Corning's point of view. The landowner has a need for a quality stand of timber for not only his personal fuel needs, but also for his aesthetic objectives for the property. Dow Corning has a need for wood fiber as fuel at the Midland Plant.

These goals, objectives and needs are quite compatible. Sound forest and wildlife management practices compliment each other.

LOCATION

This 160 acre parcel is located in the south half of the north half of Section 13, Mills Township, Midland County, T.16N-R.2E. The property borders Midland-Bay County line and is approximately 11 miles east and one mile south of Edenville, Michigan. (See Figure 1.)

SOILS

There are five different soil series represented on this property. They are Lenawee Silty Clay Loam; Bowers Silt Loam; Poseyville Loam; Wixom Loamy Sand; and Pipestone Sand. (See Figure 2.) Of these, the Lenawee series occupies most of the acreage as can be seen in Figure 2. A typical profile of the Lenawee Silty Clay Loam would show approximately two feet of silty clay loam over silty clay. A soil of this type has a firm sub-soil and is relatively poorly drained.

Topography on the property ranges from slopes of zero to six percent, with an average of less than four percent.

*A glossary is included of selected terms used.

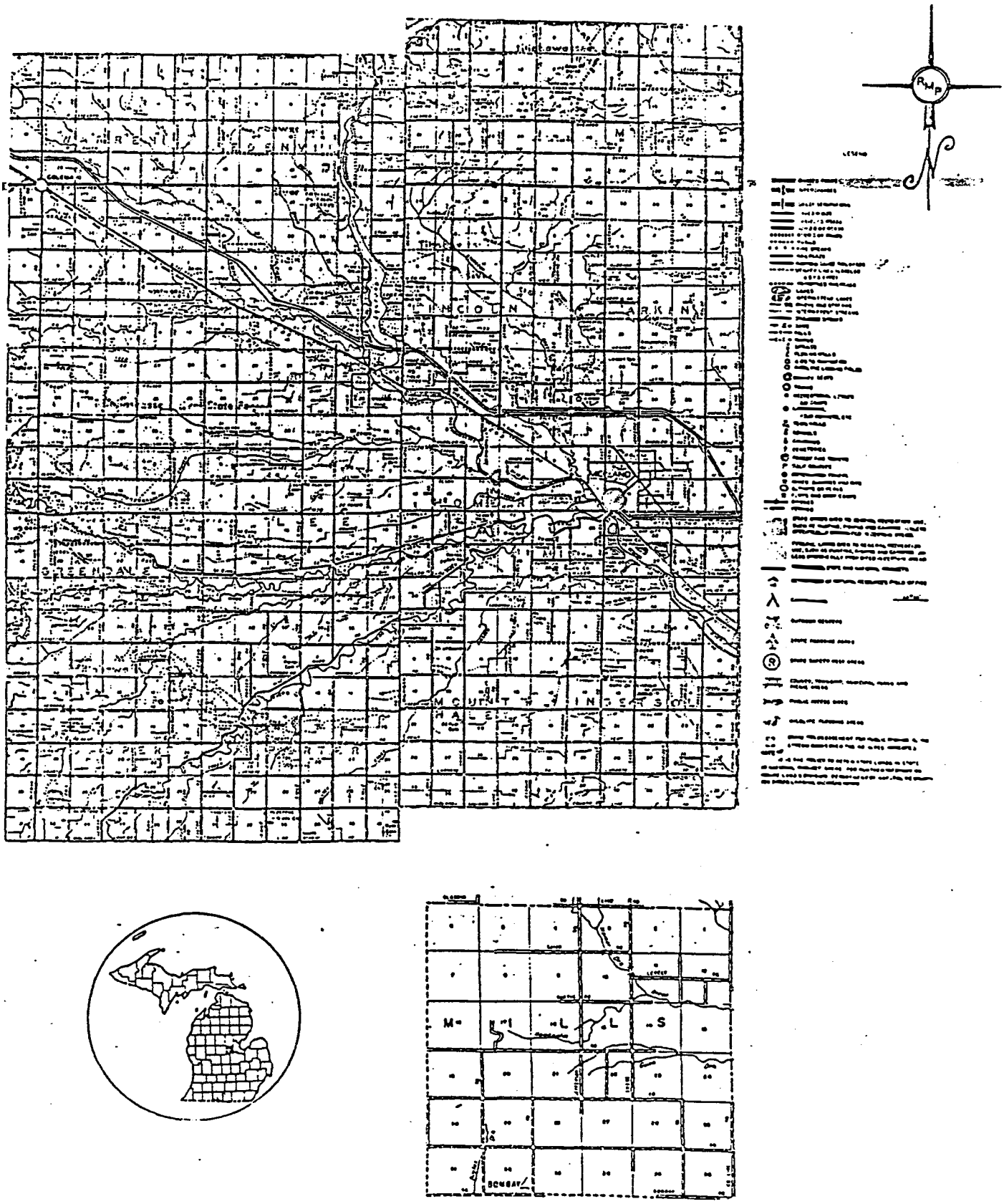
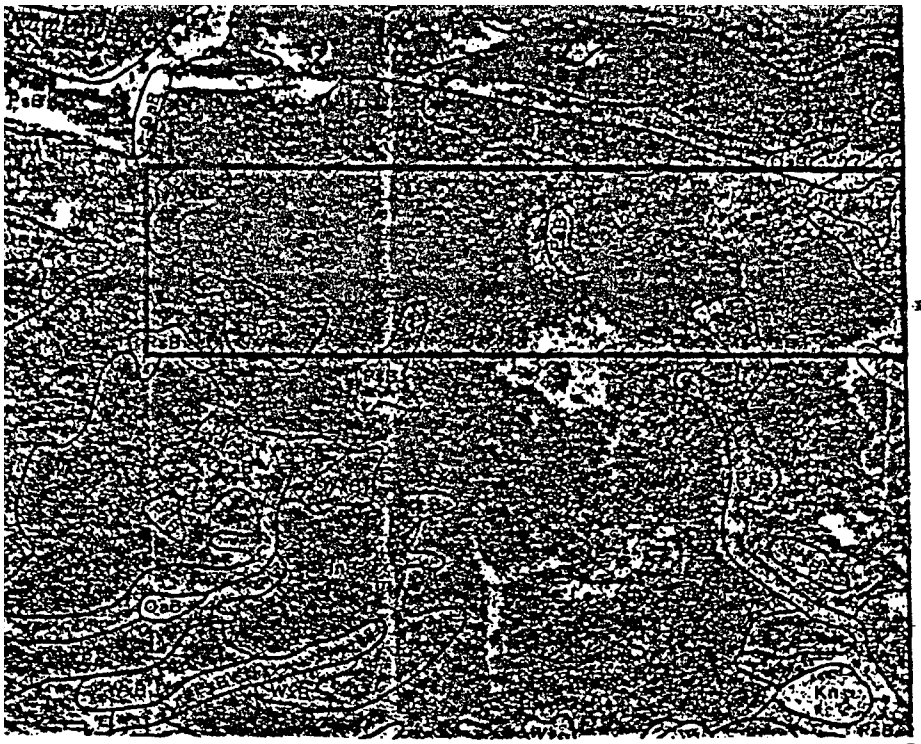
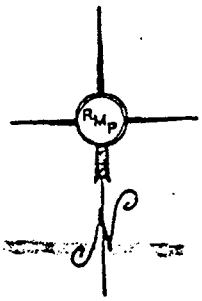


Figure 1. GEOGRAPHIC LOCATION OF LEE NELSON'S PROPERTY, T.16N-R.2E, SECTION 13, MILLS TOWNSHIP, MIDLAND COUNTY.





Scale: 4 inches = 1 mile

SOIL LEGEND

Each symbol consists of two or three letters, for example, Be, AbB, or AeB. If the slope is given in the soil name, the third letter A or B indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas.

SYMBOL	NAME
AbB	Abscota loamy sand, 0 to 6 percent slopes
Ad	Adrian muck
AeB	Aquents
Be	Belleville loamy sand
BoB	Bowers silt loam, 0 to 3 percent slopes
Ch	Cohoctah fine sandy loam, gravelly substratum
CoB	Covert sand, 0 to 6 percent slopes
CsB	Covert sand, loamy substratum, 0 to 6 percent slopes
InB	Ingersoll silt loam, 0 to 3 percent slopes
Kg	Kingsville loamy fine sand
Kn	Kinross mucky sand
Le	Lenawee silty clay loam
LrB	Lenawee–Wixom complex, 0 to 4 percent slopes
LtA	Londo loam, 0 to 3 percent slopes
MeB	Menominee sand, 2 to 6 percent slopes
OaB	Oakville fine sand, 0 to 6 percent slopes
Pa	Parkhill loam
Pe	Pella silt loam
PsB	Pipestone sand, 0 to 3 percent slopes
PtB	Pipestone sand, loamy substratum, 0 to 3 percent slopes
PuB	Pipestone–Oakville–Urban land complex, 0 to 6 percent slopes
PwB	Plainfield sand, 0 to 6 percent slopes
PxB	Poseyville–Londo complex, 0 to 4 percent slopes
Sz	Sloan loam
Ur	Urban land
Wa	Wauseon sandy loam
WtB	Wixom loamy sand, 0 to 3 percent slopes
WzB	Wixom–Belleville–Urban land complex, 0 to 3 percent slopes

Figure 2. MAJOR SOIL SERIES FOR THE SOUTH 1/2 OF THE NORTH 1/2 OF SECTION 13, MILLS TOWNSHIP, MIDLAND COUNTY.

Site index is estimated at 55 for red pine, red maple, paper birch and all of the oaks. There is a somewhat higher index of 60 for both quaking and big tooth aspen and a site index of 90 for eastern cottonwood.

These soils have a medium growth potential of approximately four-tenths of a cord per acre per year of pulpwood; and approximately 130 board feet per acre per year of saw timber. Trees to favor in a natural stand include aspen, soft maple, oak and ash.

TIMBER

The major timber type is a mixture of aspen and lowland hardwood consisting of red maple, white birch, ash and cottonwood. There are several small groups of oak and lesser amounts of black cherry and basswood throughout the property. (See Figure 3.) Underbrush is lacking as will be discussed in the wildlife section, but where shrubs and smaller trees are found, they consist mainly of tag alder, dogwood, viburnum and hawthorn. The herbaceous vegetation consists mostly of raspberry, bracken fern and some wintergreen.

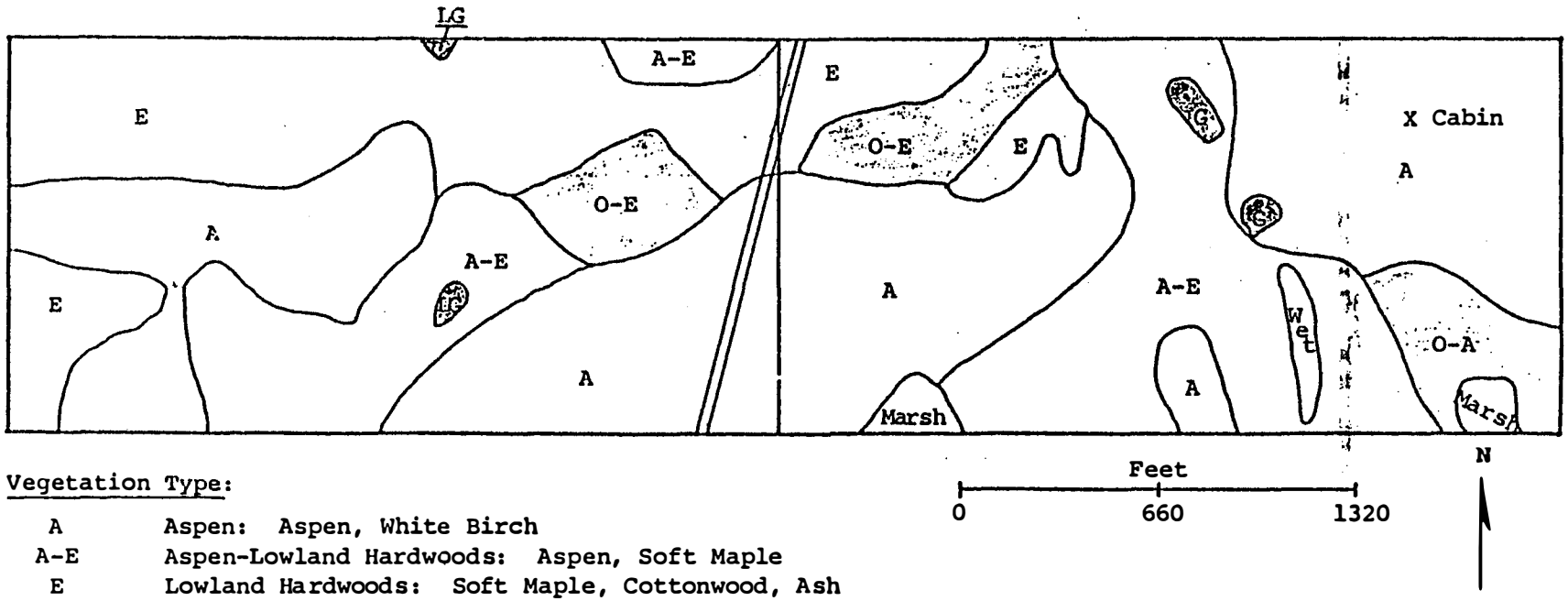
Timber on the property averages approximately 16 cords per acre on both the east and west halves. A noticeable difference, however, is found in volume of sawlogs. The east half averages approximately 2,000 board feet per acre of saw timber, but the west half averages approximately 4,300 board feet of saw timber per acre.

WILDLIFE

Wildlife inventories on the Nelson property indicate low population of ruffed grouse, cottontail rabbits, snowshoe hares with fair populations of white-tailed deer and a good population of squirrels, especially in the lowland hardwoods. Many of the essential ingredients for grouse and deer habitat are found on the property.

For example, the understory consisting of dogwood, raspberry, blackberry, wintergreen and bracken fern, in addition to the mature aspen, makes this area well suited for ruffed grouse during the summer and winter months. Dense, young vegetation is needed to provide better habitat through all seasons. The young vegetation provides drumming sites for males and offers protection of young grouse during the spring and early summer. With proper management, this area will provide better habitat for ruffed grouse and white-tailed deer. Cottontail rabbits and showshoe hares will benefit from the dense underbrush. Management will also provide habitat for several non-game species such as chipmunks, squirrels and a wide variety of song birds.

Roads and chipping sites will allow 10 to 15 percent of the area to be left in permanent openings. Although these openings will benefit many species of wildlife, the grasses found in these openings are of specific significance to the deer. Vegetation in these openings is the first to green up in the spring and provide a nutritious diet to deer coming off a submarginal winter range.



Vegetation Type:

O	A	Aspen: Aspen, White Birch
O	A-E	Aspen-Lowland Hardwoods: Aspen, Soft Maple
●	E	Lowland Hardwoods: Soft Maple, Cottonwood, Ash
◍	O-A,O-E	Oak-Aspen, Oak-Lowland Hardwoods: White Oak, Red Oak, Aspen, Lowland Hardwoods
●	G	Upland Grasses
O	LG	Lowland Grasses

Figure 3. MAJOR COVER TYPES FOR SOUTH 1/2, OF THE NORTH 1/2 OF SECTION 13, MILLS TOWNSHIP, MIDLAND COUNTY.

Selected trees will be left for the benefit of wildlife. These include two to three den trees per acre for the benefit of squirrels and cavity nesting birds. In addition, oaks that have a history of high mast production will not be harvested. Continued mast production will benefit several species of wildlife, such as squirrels, white-tailed deer and many species of non-game and game birds.

The cattail marsh located on the south boundary of the property could be managed for wetland species, primarily waterfowl and muskrat. Management options include burning and/or dredging. A controlled burn in the spring would remove much of the vegetation possibly resulting in areas of open water. More intensive management would include dredging so that water would remain throughout the year. Once permanent open water is established, muskrat will be able to utilize the area, thus keeping the vegetation in check.

Several wood duck nest boxes have been installed around the property. Additional wood duck nest boxes could be installed around the marsh to help increase the population of breeding waterfowl.

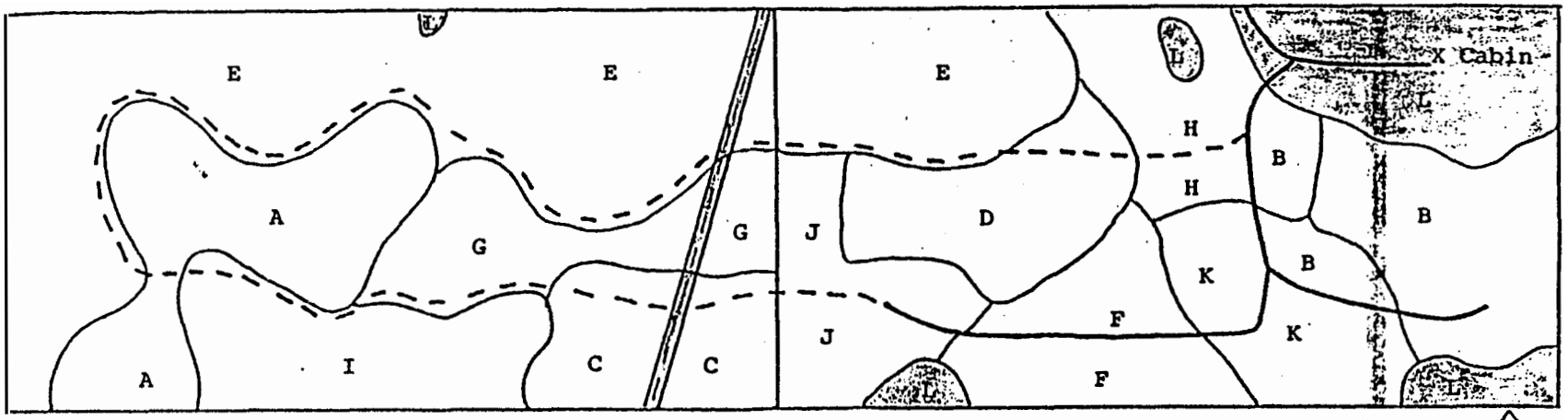
MANAGEMENT

As discussed in the timber section, there are basically two different types of timber found on this property: The aspen type and the lowland hardwood type. Different timber types require different management decisions. Therefore, each type will be addressed separately.

Aspen

For best management and optimal regeneration of aspen, harvesting will be accomplished through a series of clearcuts of approximately 8 to 15 acres in size until the desired acreage has been treated. (See Figure 4.) This will treat most of the property in approximately 30 years of rotation (1982-2010). Good quality pockets of oak will be selectively managed within the stand to favor those trees capable of high mast (acorns) production.

Much of the aspen is mature and regeneration is poor. Trees are showing the characteristic signs of maturity and over maturity, such as deep furrowing of the bark and conks. Many of the trees in the stand have reached an age where optimal growth is no longer being obtained. Aspen regeneration is very important not only to the wildlife, but also for continued timber production. Because aspen sprouts from the roots when cut, harvesting will increase the number of stems per acre. For example, for every mature aspen removed, as many as 300 trees will sprout (about 10,000 trees per acre). Clearcut areas will naturally regenerate and it is not uncommon for sprouts to reach six feet in height during the first growing season. Five years after thinning will have reduced the stand to about 5,000 stems per acre. Approximately 12 to 15 years after initial harvest, the aspen will be evaluated and a decision made on the possibility of strip thinning. Strip thinning is normally accomplished by removing strips of timber 6 to 10 feet in width permitting improved growth of the remaining trees. A 15 year old aspen stand will be about 30 feet tall and trees will be entering their



Year	Acreage West	Acreage East	Area	Treatment
1982	13.8	---	A	Clearcut
1982	---	10.3	B	Clearcut
1983	7.5	---	C	Clearcut
1984	---	9.9	D	Clearcut
1986	36.5	10.9	E	Thin to 90 sq. ft.
1992	---	8.4	F	Clearcut
1995	10.9	---	G	Clearcut
2000	---	8.3	H	Clearcut
2000	10.8	---	I	Clearcut
2005	---	7.9	J	Clearcut
2010	---	9.8	K	Clearcut
---	0.5	14.5	L	No Commercial Harvest Treatment

Figure 4. PROPOSED WILDLIFE MANAGEMENT SCHEDULE.

period of maximum growth and attractiveness. By 25 years, the stand will be about 50 feet tall. Through natural thinning and timber stand improvement, the stand will be reduced to about 500 stems per acre.

Lowland Hardwood

Lowland hardwood, consisting of red maple, swamp white oak, ash, cottonwood and basswood, are best managed under a selective harvest system. (See Figure 4.) A selective harvest to favor the shade tolerant soft maple should leave a relatively high stocking level. If too many trees are removed, such problems as windthrow can damage the residual stand. Along with this, an invasion of undesirable shrubs and grasses can be expected. Removing too much of the overstory also results in a reduction in volume growth and excessive branching of the remaining trees. This epicormic branching reduces the quality of the sawlog for future harvest. For these reasons, a selective harvest should be made in 1986 to reduce the present average basal area of approximately 113 to an approximate basal area of 90 square feet per acre.

Within the lowland hardwood type, trees to be removed include all of the aspen and individually selected trees of other species that are crooked, forked, rotted, damaged, or otherwise competing with the better quality growing stock. Trees to be removed will need to be marked before harvest. This kind of management will result in a continuous yield of hardwoods and will preserve the overall aesthetics of the stand.

ACCESS ROADS

Roads will be located approximately as shown on the management plan map (Figure 4). Soil conditions are well suited for the construction of access roads. In most cases, roads will be about 30 feet wide. Culverts will be installed so roads will not interfere with natural drainage patterns. Approximately 10 to 15 percent of the area will be left open by construction of roads, chipping zones and permanent wildlife openings.

These areas will be seeded with a mixture of grasses and legumes (Table 1). The final smoothing of the roads and landings after harvesting is completed. will prepare the seedbed. The area will be seeded, fertilized and lightly dragged to cover the seed. Optimum seeding dates are May 1 to June 10, and August 1 through September 20.

Table 1. SEED AND FERTILIZER RATES PER ACRE FOR ROADS AND CHIPPING ZONES.

Pounds	Seed Variety	Reason	Cost Per Acre*
10	Creeping Red Fescue	Tolerates shade	$15.00
2	Perennial Rye Grass	Germinates quickly	1.96
3	Smooth Bromegrass	Wildlife food	1.90
3	Alfalfa	Wildlife food	6.51
3	Alsike Clover	Wildlife food	2.16
100	12-12-12 Fertilizer or equivalent		8.00
TOTAL ESTIMATED COST PER ACRE			$35.53

*Prices in Midland, Michigan on November 1, 1979

As mentioned earlier, open areas are important for most wildlife species. In addition where quick cover and grazing for deer is desired, annual rye can be seeded at the rate of two to three bushels per acre (100 to 150 pounds per acre).

SUMMARY

This property is typical of over mature aspen stands and lowland hardwood in Midland County. It is uniform with very few changes throughout the entire property. Because of this, wildlife habitat is of low quality and so quantities of wildlife are low. This management plan, over a 30 year period, will put the 160 acres back into full production for timber as well as wildlife. The periodic cuttings will stagger the age classes (timber size) so variety in habitat will be achieved. This harvesting will also return vigor to the growth of the trees. When trees are growing rapidly, they are far less susceptible to disease and insect infestations. By maintaining this vigor, growth can be maximized.

Under the guidelines suggested in this management plan, the 160 acres will be highly productive for wildlife and timber.

GENERAL GLOSSARY

Basal Area - a measurement in square feet of the area of a tree at DBH.

Board Feet - a board one foot long, one foot wide, and one inch thick.

Canopy - the uppermost spreading branchy layer of a forest.

Clearcutting - removal of virtually all the trees, large or small in a stand in one cutting operation.

Co-generation - a power production process in which useful steam and electricity are produced in one operation at a single power plant.

Cord - a stack of wood, 4 x 4 x 8 feet, generally 128 cubic feet.

Cover Type - sometimes refers to actual stands of any vegetation type whether dominated by tree, shrub or grass species.

DBH - diameter breast high; the measurement of the diameter of a tree at a point 4.5 feet from the ground.

Habitat - the natural environment of a plant or animal.

Mast - nuts, acorns and similar products of hardwood species which are consumed by animals.

Overstory - that portion of the trees in a forest with more than one roughly horizontal layer of foliage which forms the upper and upper most layer.

Pulpwood - wood used in the manufacturing of paper products, particle-board and fiberboard, generally 100 inches long, with a minimum diameter of four inches.

Sawlog - sound wood eight feet or longer, with a diameter of ten inches or greater at small end.

Selectively Cut - see thinning.

Site - foresters speak of a site not just as a location, but with reference to its ecological capacity to produce trees or other vegetation.

Site Index - an evaluative term based on the height of a dominant stand at an arbitrarily chosen age. In this case, it is the height a tree can be expected to obtain in 50 years of growth.

Soil Series - a group of soils, formed from a particular type of parent material having layers that, except for the texture of the surface layer, are similar in characteristics such as color, texture, and composition.

Stand - see site.

Thinning - cutting made in an immature crop or stand in order to accelerate the growth of the residual trees and to improve the average form of the trees that remain without permanently breaking the canopy.

Timber Stand Improvement - it refers to the improvement of cutting conditions to improve the timber stand.

Timber Type - see cover type.

Topography - configuration of a surface including its relief, elevation, position of its natural and man-made features.

Understory - that portion of the trees and shrubs in a forest which forms the lower layer of vegetative growth.

APPENDIX B

SAMPLE OF LANDOWNER AGREEMENT

APPENDIX B

LANDOWNER AGREEMENT

Dow Corning Corporation (Dow Corning) of Midland, Michigan seeks to procure wood as a source of fuel for its solid waste disposal cogeneration facility.

In consideration for the right to remove from the landowner's property certain pulpwood and residue, Dow Corning is providing the landowner a Forest Management Plan prepared by the Corporation's professional forester(s) and wildlife biologist(s) detailing the harvesting plan and further agrees to pay a fee to the landowner for all harvested pulpwood of marketable quality ("Pulpwood").

This Agreement between Dow Corning (Buyer) and _____ _____(Seller) of _____, Michigan shall become effective on _____ and shall cover all trees which have been identified, marked or designated according to the Forest Management Plan attached to this Agreement.

TERMS AND CONDITIONS

The Seller warrants that all trees covered by this Agreement are the property of Seller and free and clear of all incumbrances, and Seller further represents and warrants that the fee payable hereunder is solely in payment for Pulpwood of marketable quality and that none of such payment constitutes compensation for tops, branches, cull trees, or other residues removed by Buyer pursuant to this contract.

The parties agree that the price to be paid for the Pulpwood shall be negotiated, using the average local price as determined by the most current Michigan timber price and market reports. If negotiation fails to yield an agreeable fee, this Agreement shall be automatically cancelled. The Buyer agrees to pay for the material removed under this contract in strict accordance with the following:

(A) All trees harvested for wood products shall be cut in a manner that will produce the maximum amount of sawlog timber.

(B) If any marked or designated trees are left uncut or any unmarked trees are cut, injured through carelessness, or killed by fire which the Buyer caused or should have prevented, then the Buyer may be charged the value of such timber as liquidated damages and such amount shall be the total amount due, and under no circumstances shall

the Buyer be liable for consequential or incidental damages.

(C) A cord of wood shall be defined as a quantity of wood containing a gross volume of 128 cubic feet.

(D) The amount of payment for Pulpwood shall be determined on a per-cord basis of standing timber and payment shall be made prior to the time of harvest.

(E) The title to all trees and/or products included in this contract shall remain with the Seller until paid.

The Buyer agrees to exercise reasonable care in his operations to protect property of the Seller:

(A) Reasonable effort shall be exercised to protect trees from damage.

(B) All refuse and debris generated by Buyer's operations, such as abandoned equipment, broken machinery, parts, oil and fuel cans, lunch papers, etc., shall be removed from Seller's premises.

(C) During the time this Agreement remains in force, the Buyer shall independently do all in his power to prevent and suppress forest fires on the Seller's property and surrounding areas.

Location and construction of roads, landings and decking areas shall be mutually agreeable to the Seller and Dow Corning within the general guidelines set forth in the attached Forest Management Plan (See Attachment 1).

All trees covered by this Agreement, cut or uncut, remaining on the tract after termination of the Agreement shall be and remain the property of the Seller.

Unless an extension of time is granted, all designated timber shall be cut and removed on or before the scheduled harvesting completion dates set forth in the Forest Management Plan.

Neither Dow Corning nor the Seller shall have the right to assign any rights provided by this Agreement without the written consent of the other party.

FACTORS EXCUSING PERFORMANCE

In the event that environmental laws (statutes or regulations) are enacted by federal, state or local authorities after this contract becomes effective, but before harvesting is completed and these laws add extraordinary costs (greater than 25%) to either the harvesting or transporting of wood products from the Seller's property, the parties agree that Dow Corning may either terminate or renegotiate this Agreement at Dow Corning's discretion after sixty (60) days written notice. It is further agreed that the Forest Management Plan shall remain the property of the Seller.

It is Dow Corning's intention to harvest the wood from Seller's property within the calendar year scheduled in the Management Plan. However, should the power demand at Dow Corning's Midland facility substantially decline, Dow Corning agrees to notify Seller of this situation and also reserves the right to extend the harvesting period twenty-four (24) months. Dow Corning further agrees to pay a surcharge of ten percent (10%) if Seller's wood is harvested during this extension period.

In the event of war, fire, flood, strike, labor trouble, accident, riot, act of governmental authority, Act of God, changes in any laws or regulations or other contingencies beyond the control of the parties that prevents performance of this Agreement by either party, performance shall be suspended during the period of such event or act without liability to either party.

LIABILITY

In case of default by either party, the aggrieved party must give written notice to the party in default, specifying such default and electing to terminate this Agreement at the end of thirty (30) days from the date of such notice, unless the party in default offers a reasonable and binding timetable to cure such default within said thirty-day period. If the party in default fails to cure such default within the above timetable, this Agreement shall terminate without further notice.

The Seller shall not be held liable for any injury or damage suffered by the Buyer resulting from the use of the premises here described or arising out of the performance of any act or thing required by the terms of this contract, and the Buyer does hereby release and discharge the Seller from any claims or demands that he may have of whatsoever kind and

nature in any manner arising out of any matter or thing related to this contract or the premises described; and the Buyer covenants and agrees with the Seller that he will indemnify and save harmless the Seller from any claims and demands that any person may have or make in any manner arising out of any matter or thing related to this contract or the premises described unless caused by the sole negligence of the Seller.

TERMINATION

This agreement shall terminate _____ years after it becomes effective. However, Seller reserves the right to terminate this Agreement on ten (10) days written notice if Dow Corning has not begun a scheduled harvest on Seller's property within the extension period described above. Should the Seller terminate this Agreement under this paragraph, Dow Corning agrees that the Forest Management Plan shall remain the property of the Seller.

ARBITRATION

In case of dispute over the terms of this contract, final decision shall rest with an arbitration board of three persons, one to be selected by each party to this contract and the third one to be selected by the first two members of the board. Costs of arbitration would be shared equally by the Seller and the Purchaser.

GOVERNING LAW

The terms of this contract shall be construed according to the laws of the State of Michigan.

NOTICE

Where written notice is required by the terms of this contract, the following shall be utilized:

BUYER: Dow Corning Corporation
3901 South Saginaw Road
Midland, Michigan 48640
ATTN: Supervisor of Natural Resources

SELLER:

Dated: _____

BUYER:

DOW CORNING CORPORATION

_____
Stephen P. Smith
Purchasing Specialist

SELLER:

_____

_____

APPENDIX C

SAMPLE OF BID INFORMATION PACKET

This bid packet of information contains the following:

Invitation Bid

Bid Instructions

Sample Producer Contract

Contractor's Data Form

Bid Form

Dow Corning SECO Producer's Data Information

Contractor Rules (Safety)

3/12/81

mjs

INVITATION TO BID ON CHIP PRODUCTION FOR DOW CORNING CORPORATION

Your Bid is solicited for:

Location: Dow Corning, Midland Plant

Title (Description):

Dated:

Bid documents, including specifications will be given to you.

Your sealed bid must be submitted on the Dow Corning furnished "Bid Form." It must be received by 1:30 P.M. on _____.

Bids will not be opened publicly and the conditions of the bidding will be determined by Dow Corning, who reserves the right to reject any or all bids and waive irregularities in the bidding.

The successful bidder shall be required to sign a Producer's Contract within 30 days of the due date.

Address all communications during the bidding period to the Purchasing Specialist.

Dow Corning Corporation
P. O. Box 1592
Midland, Michigan 48640
Attn: Stephen P. Smith
(Mail No. 6)
(517) 496-4038

INSTRUCTIONS TO BIDDERS

If for any reason bidder is unable to quote, please advise Dow Corning as soon as this fact is known and as far in advance of the date bids are due as possible. If more time is required for preparing and submitting bid, please advise us at once. If an extension can be granted, we need time to notify all bidders.

Should a bidder find discrepancies in, or omissions from, the documents, or should he be in doubt as to the meaning, he may request clarification from the purchasing specialist who will issue a bulletin to all bidders. Dow Corning will not be responsible for any oral instructions.

In some cases materials or equipment are specified by trade name or manufacturer's model or type and it is intended that the base bid shall be made on the basis of the material specified; however, if the bidder has an alternate method or alternate materials which would benefit the job, either from a cost, delivery, or operation standpoint, bidder should include with his base bid an alternate, giving either addition to or deduction from the base bid due to this substitution.

Alternate proposals will not be disclosed to other bidders and will be considered proprietary to the contractor for this project only.

The following days are Dow Corning non-work days: Jan. 1, April 17, May 25, July 2 & 3, Sept. 7, Nov. 26, and Dec. 25.

S A M P L E

BIDDERS:

Attached is one informational copy of the Dow Corning Corporation Producer's Contract. The successful bidder will be required to sign this contract.

Bidders are requrested to return all bid documents with proposal.

DOW CORNING

PRODUCER CONTRACT

Contract made as of this ____ day of _____, 198__ between _____ of _____ hereinafter called Contractor, and Dow Corning Corporation, a Michigan Corporation with its principal place of business at Midland, Michigan, hereinafter called Company, witnesseth:

WHEREAS, Contractor is engaged in the business of producing and delivering pulpwood, lumber and other forest products, and

WHEREAS, Company owns, or holds under purchase contract, stumpage suitable for pulpwood or other forest products, situated on property in various counties, State of Michigan, to-wit:

NOW, THEREFORE, Contractor agrees to produce the following described pulpwood or other forest products from described property and deliver the same to the Company, and the Company agrees to pay Contractor therefore at the rate designated, all in accordance with the terms and conditions herein set forth:

CONTRACT PERIOD: Beginning _____

RATE: $_____ per dry ton (producing cost)

$_____ per dry ton mile (transportation cost)

Contract to be effective for _____ year(s). Request for rate change requires _____ days prior notice and documentary proof of said change. Any change in terms and conditions is subject to Company approval and just cause to open contract for bid.

CONTRACTOR FURTHER AGREES:

1. To make deliveries of said pulpwood or other forest products as directed by Company.

2. To direct and control all details in connection with his operations, including Contractors Safety Rules as specified in Attachment "A" and the hiring and discharge of all labor and the furnishing maintenance and repair of tools, machinery and equipment.

Contractor shall be an independent Contractor under this agreement and shall assume all of the rights, obligations

and liabilities applicable to it as such independent Contractor hereunder and any provisions in the Agreement which may appear to give Company the right to direct or supervise Contractor as to the details of doing the work herein covered or to exercise a measure of control over the Work shall be deemed to mean that Contractor shall follow the desires of Company in the results of the Work only.

Contractor understands and agrees that it is responsible for the control, management and direction of its subcontractors. Contractor agrees to require each subcontractor (and each subcontractor's delegee) to be bound by such terms of this construction contract and its document including insurance coverages as are appropriate to insure that the rights, benefits and duties of all concerned parties are not jeopardized by any subcontractual agreement.

3. To carry at all times a workmen's compensation insurance policy so that the Company shall be fully indemnified against liability under any applicable Workmen's Compensation Law or otherwise for injuries or death sustained by Contractor's employees, and to furnish Company a certificate of coverage before work under this contract commences.

4. Contractor assumes entire responsibility and liability for losses, expenses, damages, demands and claims based on any injury or alleged injury to persons (including death) or damage or alleged damage to property sustained, or alleged to have been sustained, in connection with the performance of the Work (unless caused by the sole negligence of Company including losses, expenses or damages sustained by Company, with respect to the Work or otherwise, and agrees to indemnify and hold harmless Company, its agents, servants, and employees from any and all such losses, expenses, damages, demands, and claims, and agrees to defend any suit or action brought against them, or any of them, based on any such alleged injury or damage, and to pay all damages, costs, and expenses, including attorneys' fees, in connection therewith or resulting therefrom.

5. To carry, at his own expense, Automotive Liability Insurance covering owned, non-owned and hired automotive equipment for at least $1,000,000 covering injury to or death of any one person; for covering injuries including death to more than one person in any one occurrence; and for covering property damage in any one occurrence or as specified by state statute.

To carry, at his own expense, the following minimum liability insurance:

a. Statutory Workmen's Compensation and Employer's Liability for $100,000 per occurrence.

b. Comprehensive General Liability coverage, including Contractual and Logger's property damage endorsement, for combined single limit of $1,000,000 covering bodily injury including death in any one occurrence; and covering damage to the proeprty of Company and third parties.

c. Comprehensive Umbrella/Excess Liability for $1,000,000. This Umbrella coverage may be combined with coverage listed in "b" to total $2,000,000.

The carrying of the above insurance shall in no way be interpreted as relieving the Contractor of any responsibility whatever and the Contractor may carry at his own expense, such additional insurance as he may deem necessary.

6. To fully comply with the Fair Labor Standards Act of 1938, as amended, and all other applicable federal, state and local laws and ordinances.

7. To exercise the utmost care so no unnecessary damage shall be done to young growth or to trees left standing; to take immediate and independent action to prevent and suppress forest fires on said property and shall require his employees to do likewise.

   To keep such camp areas in a sanitary condition at all times. Disposal of garbage, rubbish and refuse to be removed from property.

COMPANY FURTHER AGREES:

1. To pay Contractor within 30 days after the pulpwood or other forest products are received and accepted and upon receipt of the bill of lading, or oftener at the Company's discretion.

CONTRACTOR AND COMPANY MUTUALLY AGREE:

1. That measurements of pulpwood or other forest products shall be made by the Company and will govern all settlements.

2. That in the event Company receives evidence that Contractor has not or is not complying with the Fair Labor Standards Act of 1938, as amended, or any other applicable federal, state or local law or ordinance, or in the event of fire, strike or other labor difficulty or other contingencies beyond the reasonable control of the Company which affects its operations, or terms and conditions of this contract, it shall have the right to terminate this contract upon giving Contractor five (5) days written notice.

3. That this contract is not assignable and the validity, the operation and the performance of this contract shall be governed and controlled by the laws of the state of Michigan, and the terms of this contract shall be construed and interpreted in accordance with said laws.

IN WITNESS WHEREOF, the parties hereto have duly executed this contract as of the day and year first above written.

DOW CORNING CORPORATION

BY:_____
Stephen P. Smith
Purchasing Specialist

CONTRACTOR:

BY:_____

_____
Employer's Identification No.

S A M P L E

DOW CORNING CORPORATION
MIDLAND, MICHIGAN 48640

CONTRACTOR'S DATA FORM

NOTE: Use blank sheet if additional space is needed on any question.

DATE: _____

A. Organization

1. Name of Company _____

Local Address _____

Phone Number _____

Home Office Address _____

Phone Number _____

2. Ownership of Company (Corporation, Partnership, Individual, or Other. If a subsidiary of another company, name the parent company.)

_____

3. Names of Owners (Stockholders holding over 20% of stock.)

_____ _____

_____ _____

_____ _____

4. Principals of Company (Officers' Names and Titles)

_____

_____

_____

_____

5. Subsidiaries (Indicate whether wholly owned or percent controlled.)

_____

_____

6. Number of years in business under present name: _____ years

7. Number of full time employees _____/Part time employees ____

B. Classification

1. Check type of work your company performs with your own employees.

_____ Felling	_____ Skidding	_____ Chipping
_____ Hauling	_____ Sawlog	_____ Sawmilling
_____ Other _____		

2. Percent of work done as a prime contractor _____
Percent of work done as a subcontractor_____

3. What contractor organizations are you affiliated with and what are the objectives of the organizations?

_____

_____

C. Work History

1. List 12 property landowners, companies, and business that you have had business with during the past three (3) years.

2.

Name of Client	Project Title & Scope of Work	Approx. Value	Year

3. Has your company, or any officer or partner of your company ever failed to complete any work awarded? ____ If yes, give details.

_____

_____

_____

_____

D. Financial

1. Submit last annual Financial Report and current Profit and Loss Statement. (AGC Standard Form No. 42 Contractor's Financial Statement is acceptable.)

2. a. What is the maximum tonnage you believe your company is capable of handling? _____ tons

   b. Over what period of time? _____

3. Is there any litigation now in progress or pending with clients, subcontractors or suppliers? _____ If yes, give details.

_____

_____

_____

E. Equipment

1. List the major pieces of equipment that you own and are available for proposed work.

QUANTITY	ITEM	DESCRIPTION

2. List the major pieces of equipment that you will need to purchase to perform the proposed work.

QUANTITY	ITEM	DESCRIPTION

F. Labor and Scheduling

1. How is the majority of your work performed? (Negotiated, lump sum, cost plus.)

_____

2. Do you use critical path method of scheduling? _____

3. If answer to number 2 is no, describe normal method of scheduling and monitoring a job.

_____

_____

4. Do you perform work as an open shop, closed shop or both? If both, is it performed under same name?

_____

5. Do you have any national agreements? (If yes, with which crafts?)

_____

_____

6. If you are signator on local agreements, indicate the following:

Crafts and Local	Holder of Your Bargaining Rights

S A M P L E

DOW CORNING CORPORATION
BID FORM

DATE: AUTH. NO.:
BLDG. NO.: ACCT. NO.:
LOCATION: TITLE (Description):

WHEREAS, Contractor is engaged in the business of producing and delivering pulpwood, lumber and other forest products, and

WHEREAS, Company owns, or holds under purchase contract, stumpage suitable for pulpwood or other forest products, situated on property in various counties, State of Michigan, to-wit:

NOW, THEREFORE, Contractor agrees to produce the following described pulpwood or other forest products from described property and deliver the same to the Company, and the Company agrees to pay Contractor therefore at the rate designated, all in accordance with the terms and conditions herein set forth:

CONTRACT PERIOD: Beginning July 1982

RATE: $_____ per dry ton (producing cost)
_____ % petroleum
_____ % labor
_____% other (Identify)_____

QUANTITY: $_____ per dry ton mile (transportation cost)
_____ % petroleum portion
_____ % labor
_____ % other (Identify)_____

Contract to be effective for three (3) years. Request for rate change requires ninety (90) days prior notice and documentary proof of said change. Any change in terms and conditions is subject to Company approval and just cause to open contract for bid.

ALTERNATE BID _____ Completion Date _____

DESCRIPTION:

SUBCONTRACTORS - The undersigned proposes to employ the following subcontractors for work indicated:

NAME	TRADE

THIS BID IS SUBMITTED IN THE NAME OF _____

ADDRESS _____

_____

PHONE _____

BY _____
(Legal Signature)

TITLE _____

DATE _____

(NOTE: Any bid qualification, exceptions, assumptions or alternate proposals or substitute items together with applicable price deductions or additions should be attached and enclosed in the bid envelope.)

DOW CORNING (SECO)
PRODUCERS DATA INFORMATION

COUNTIES INCLUDED:

(In which Dow Corning has stumpage and/or could procure stumpage.)
IOSCO, OGEMAW, ROSCOMMON, OSCODA, OSCEOLA, CLARE, GLADWIN, ARENAC, ISABELLA, MIDLAND, BAY, TUSCOLA, LAPEER, SAGINAW

DISTANCE BETWEEN HARVEST SITES:

With all types of harvest sites included, the average move from one to the next is eight miles.

TYPES OF HARVEST AND PERCENT OF TOTAL

A - 50% of harvests are clearcuts
B - 15% of harvests are clearcuts leaving scattered hardwoods
C - 10% of harvests are pine thinnings
D - 25% of harvests are thinning projects

SIZE AND VOLUME OF HARVEST BY TYPE OF CUT

A - averages 20 acres (12 cords/acre)
B - averages 28 acres (10 cords/acre)
C - averages 17 acres (7 cords/acre)
D - averages 48 acres (7 cords/acre)

WHEN SAWLOGS ARE A PART OF THE HARVEST...

They average 400 board feet/acre;
They will be cut in log length and piled at landing (12" solid wood, 8' minimum length)

CHIP SIZE -- One (1") Inch

TRUCK DUMP SPECIFICATIONS:

(a) 65' total length or less
(b) ~~65~~ 50 ton gross weight
(c) overhead safety frame 31 feet from backstop
(d) front axile holddown chains are provided on dump
(e) full retractable backstop 4'6" maximum height. The trailer springs should be stiff enough so rear of trailer does not raise more than 6" as it is being unloaded.

PGS/mjs
DATA3/12/81

CONTRACTOR RULES

1. Hard hat, safety glasses with side shields and badge will be worn at all times.

2. Smoking is prohibited.

3. Accidents or injuries not matter how slight must be reported.

4. Must stay in assigned area of operation.

5. In case of emergency, shut off your equipment and leave the area with Dow Corning People.

6. On entering or leaving the plant, you must sign a register; in case of an emergency, Dow Corning may need to know immediately who is in the plant.

   You will be subject to the same security policies as Dow Corning employees. Unannounced security inspections will be conducted on a random basis.

7. The following items are prohibited on Dow Corning property and properties Dow Corning is having harvested:

   weapons of any kind (firearms and concealed weapons)
   cameras (only on Dow Corning properties)
   intoxicating beverages
   narcotics and other controlled substances

8. Anyone engaging in any of the following activities on Dow Corning controlled property will risk the loss of current and future work for Dow Corning:

   stealing
   destroying property
   scuffling or horseplay
   drinking or drunkenness
   gambling
   reckless driving
   creating an unsanitary condition
   violation of safety rules
   hunting

9. Clothing: Wear personal clothing and footwear that is safe and proper for the job. Wearing of canvas shoes, sneakers, or houseshoes and working in an undershirt, shorts or stripped to the waist is prohibited.

10. Supervisors (the contractor) will instruct employees regarding other rules and safety procedures which you may encounter. All work shall be performed in accordance with the various local, state, and federal regulations governing the work. MIOSHA regulations will be considered the minimum standard under a Dow Corning contract.

These rules apply as follows:

Inside Dow Corning Plant - Rules 1 through 10
On Dow Corning forested property -Rules 1 through 10 except 2 and 5
On private property on which Dow Corning has purchased the stumpage - Rules 1 through 10 except 2 and 5

PGS/mjs - 3/12/81