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# REPORT OF MEETING OF THE INTERDEPARTMENTAL COMMITTEE ON FOREST SPRAYING OPERATIONS

SIR CHARLES TUPPER BUILDING, OTTAWA

JANUARY 14, 1964

9:00 A.M. - 1:00 P.M.

Those in attendance:

(a) Members of the Committee

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| M. L. Prebble, Chairman | Department of Forestry |
| H. W. Beall | Department of Forestry |
| V. E. F. Solman | Canadian Wildlife Service, Northern Affairs & National Resources |
| W. E. Ricker | Fisheries Research Board |
| A. L. Pritchard | Department of Fisheries |
| E. W. Burridge, Secretary | Department of Fisheries |

(b) Others

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| R. M. Belyea | Department of Forestry, Fredericton |
| J. J. Fettes | Department of Forestry |
| D. A. S. Dyer | Department of Forestry |
| G. Cooch | Canadian Wildlife Service, Northern Affairs & National Resources |
| R. R. Logie | Department of Fisheries, Halifax |
| J. A. Dalziel | Department of Fisheries, Halifax |

The Chairman introduced a provisional agenda. Dr. Pritchard indicated that he would be quite willing to have the discussion follow the provisional agenda provided it were understood that the discussions of investigational studies in forestry, fisheries and wildlife did not imply tacit approval of the suggested

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budworm control operation in 1964 as circulated earlier to members of the Interdepartmental Committee. On assurance that no such tacit approval was implied, adoption of the provisional agenda was moved by Dr. Pritchard and seconded by Dr. Ricker (see below).

1. Introductory Comments
2. Budworm Control Operations, New Brunswick, 1964
3. Forestry Studies
4. Fisheries Studies
5. Wildlife Studies
6. Other Business

1. Introductory Comments

The Chairman complimented the Fisheries Department on the report entitled "A Field Experiment to Assess the Effects of Spraying a Small Coastal Coho Salmon Stream with Phosphamidon", which was not discussed at the October 29 meeting of the Interdepartmental Committee but which had been included as Appendix VII to the Report of that meeting. He felt this was a most interesting and comprehensive piece of work. Dr. Pritchard responded by saying that he thought the study would be published in due course.

The Chairman also noted that some dissatisfaction had been expressed to the Secretary by a visitor at the October 29 meeting regarding the omission of what was felt to be a significant statement presented at the meeting. The Chairman stated that he and the Secretary had reviewed notes taken by themselves and by the stenographers and felt that no important omission had been made. However, procedures at recent meetings of the Committee had been somewhat irregular, with more than one member talking simultaneously and this had made recording very difficult. He appealed to the members to direct their questions and comments to the Chair, and in cases where they wished particularly significant statements to be recorded, to impress on the

recording secretaries the need for exact transcription.

2. Budworm Control Operations, New Brunswick, 1964

In opening discussion of this topic, Dr. Belyea referred to the suggested spray plan for New Brunswick as outlined in a statement prepared in November, 1963 (see appended tentative spray plan and accompanying correspondence of November 22 and November 25). To supplement the information contained in these appendices, the Chairman distributed copies of a map received from Mr. B. W. Flieger, along with covering letter of January 2. The latter is included in the appendices and the map was distributed to members of the Interdepartmental Committee at the meeting.

Dr. Belyea outlined the major features of the proposed control operations in 1964 as follows:

a) Several large blocks in the Miramichi drainage, the Nashwaak drainage and the St. John River Valley, west of Fredericton, are proposed for control operations in 1964, based on hazard assessed in the fall of 1963. The aggregate acreage is about two million acres. These areas are outlined by solid red lines in the map that was distributed.

b) Certain areas between the solid blocks and representing rather narrow corridors or indentations in the proposed spray blocks are suspect and will be given special pre-spray surveys in the spring of 1964 to determine whether in fact budworm populations are sufficiently high in the corridors to warrant their incorporation into the spray blocks. These corridors or indentations are identified on the map by dotted red lines.

c) It has been decided that there would be no late additions to the spray program in 1964 because experience in 1963 had shown very poor results could be expected from areas treated late in the period of larval development.

d) The intended formulation for most of the area to be sprayed is ½ lb. DDT per .7 gallons per acre in a single application, no areas being sprayed twice. Phosphamidon at ½ lb. per 3/4 gal. of water spray per acre will be used in a single application in double swath widths on each side of major salmon streams. This would provide ribbons approximately .44 miles wide along the major streams for an aggregate distance of some 250 miles. Phosphamidon at the same rate of application will also be applied to solid blocks aggregating some 60 thousand to 80 thousand acres within the general area to be sprayed, but identified as areas with persistent populations during the last few years, or areas known to have budworm populations showing evidence of resistence to DDT. The "persistent" areas are defined as those that have had high egg populations four or five years during the past five years in spite of having been sprayed three or more times in the same period. The actual blocks to be treated with Phosphamidon have not been precisely defined as yet.

e) The Phosphamidon formulation proposed for 1964 is identical with that used experimentally in 1963. The proposed DDT formulation differs from the ¼ lb. per ½ gal. per acre used in 1963, representing an increase in concentration of DDT in the spray mixture and an increase in the volume of spray mixture per acre.

f) It is proposed to use Phosphamidon on important salmon streams in the corridor areas referred to above because of the strong probability that some of the corridor areas will be found to be in need of treatment in the spring of 1964. It would be preferable to have the Phosphamidon treatment applied early to avoid confusion in subsequent application of DDT sprays in the corridor areas. Dr. Ricker mentioned that much of the Cains River marked for Phosphamidon does not lie in a "corridor" in the sense referred to above, and he felt this represented an anomalous situation. The reason for the apparent anomaly could not be explained by Dr. Belyea or Dr. Prebble.

Dr. Pritchard wanted information on the method by which decisions are reached in Forest Protection Limited and the source of the proposed spray plan being considered at the meeting. It was pointed out by Dr. Belyea and the Chairman that members of the Forest Entomology and Pathology Branch provide information to the Advisory Committee of Forest Protection Limited, comprising technical forestry staff of the member companies, and also to the Directors of Forest Protection Limited, comprising senior executive officers of the companies and the Deputy Minister of Lands and Mines in New Brunswick. Decisions arrived at by the Corporation are made by the Board of Directors and while officers of the Forest Entomology and Pathology Branch offer information and advice they are not involved in the decision-making process. The proposed spray plan for 1964 was produced in this manner.

Dr. Logie asked whether studies had been made of the susceptibility to Phosphamidon of budworm populations resistant to DDT. . Dr. Fettes stated that laboratory studies showed that they are susceptible. In reply to a further question by Dr. Logie, Dr. Fettes indicated that it is quite possible that in time budworm populations might develop resistance to Phosphamidon.

Dr. Ricker asked whether consideration had been given to the use of Phosphamidon on a much wider scale than had been proposed. Dr. Prebble indicated that cost of Phosphamidon was an important obstacle to its more widespread use. Dr. Logie, referring to the details of the proposals submitted by Forest Protection Limited and using the figure of $1.40 per acre contained in Mr. Flieger's statement of November 22, indicated that the cost would be approximately doubled by the use of Phosphamidon.

Dr. Pritchard stated that the Department of Fisheries is not in sympathy with the proposed spray plan. At his request Dr. Logie outlined the main points of objection as follows:

a) Previous reports by the Forest Entomology and Pathology Branch showed the major correlation of budworm mortality to be with droplet counts

of the spray mixture, not with the concentration of DDT in the formulation.

b) On the other hand, the Fisheries scientists believe that fish mortality is quite closely related to DDT concentration in the formulation, being more at ½ lb. DDT per acre than ¼ lb. per acre. Young salmon are very susceptible at time of spraying and about 60% of the susceptible age classes might be killed by applications at ½ lb. per acre.

c) The Fisheries Department is particularly disturbed at the prospect that ½ lb. DDT spray might be used in the general spray program for 1964 following the high salmon runs of 1963. This might lead to a greater number of dead fish in susceptible age classes at the time of spraying.

d) Not all of the salmon-bearing tributaries are marked in green on the map supplied by Forest Protection Limited. He expected that consultation would be held with the Fisheries Department on this question.

e) In the view of the Fisheries Department, treatment of the stream banks with Phosphamidon will not give full protection to the fish populations because of general spraying in the watersheds with DDT. With the DDT application scheduled for ½ lb. per acre, this would largely counterbalance the beneficial effects to be anticipated from use of Phosphamidon along the main streams. Why would not the whole area be treated with Phosphamidon to avoid injury to the fish?

Dr. Fettes stated that he doubted very much whether the 500 tons of Phosphamidon needed for the whole area would be available since only one factory is producing the insecticide in Europe and demand for the product has been very heavy.

There was a general discussion on the significance, in terms of subsequent adult salmon in-runs, of mortality in the early age classes and

the effect of DDT and mixed Phosphamidon-DDT spraying on mortality in the early age classes. This question had been referred to briefly in the discussion of October 29, in which some of the original studies of the Fisheries Department had been synopsized in a composite statement appearing as Appendix II of the October 29 Report. More complete information was contained in the report by J. R. MacDonald and R. W. Dunfield and copies will be supplied by the Fisheries Department to Committee members. In general, Phosphamidon spraying along the major streams, combined with DDT spraying throughout the watershed, produced variable mortalities depending on the relative size of the watershed. As the latter increased, mortality of young fish approached that which was produced by spraying with DDT exclusively, either at ½ lb. per acre in a single application or ¼ lb. per acre in double spraying.

Dr. Prebble asked whether in the view of the Fisheries Department the proposal to use Phosphamidon along the streams was an important consideration. Dr. Logie replied that this would be helpful although apparently offset by use of ½ lb. DDT elsewhere; and he also felt that some streams important for salmon or speckled trout, not shown on the maps supplied by Forest Protection Limited, should be added to the plan for Phosphamidon spraying. Dr. Belyea indicated that there undoubtedly would be an opportunity for further consultation between the Fisheries Department and Forest Protection Limited.

Dr. Logie questioned whether the forest entomologists would have any objection to the general usage of Phosphamidon for budworm control, disregarding the question of cost or availability. Dr. Fettes replied that there is no objection to its more widespread use, although it must be rocognized that Phosphamidon at ½ lb. per acre is probably not as reliable for budworm control as ½ lb. DDT per acre. Dr. Logie referred to studies of the longer-term effects of DDT spraying on young salmon. Delayed mortality during periods of stress has been found to be more serious at ½ lb. per acre than at ¼ lb. per acre.

Dr. Prebble stated that in view of the extensive resurgence of budworm populations in central New Brunswick in 1963, the evidence of development of resistance to DDT, the existence of hazardous conditions over much of the infested area, and especially considering the experience with budworm populations in Maine in 1962 and 1963, the proposal as advanced by Forest Protection Limited involving use of Phosphamidon along the major streams and in selected blocks is regarded by the Department of Forestry as reasonable. He admitted that spraying was not undertaken to benefit fish populations but as a forest protection measure. The proposal, as advanced, represents a compromise between lack of protection of the forest at the one extreme and absence of injury to the fish at the other extreme.

Dr. Pritchard stated that the proposal as advanced will cause injury to fish populations. If the Department of Forestry feels that the only way to control budworm populations is to use 1 lb. DDT per acre the Department should say so. Under such circumstances the Fisheries Department will object on the basis of injury to fish. He felt that greater consideration should be given to the use of an alternative insecticide over the entire area, one that will not cause damage to fish populations.

Dr. Prebble stressed that the proposed program does not involve spraying at 1 lb. DDT per acre. Dr. Pritchard responded that even at ½ lb. per acre injury could be anticipated to the fish populations and the Department of Fisheries would object.

To conclude the discussion on the proposed operational program, 1964, Dr. Prebble asked the views of the Fisheries Department on the topic raised in the fourth paragraph of Mr. Flieger's letter of January 2, namely, the possible spraying of the waters flowing into the South Esk hatchery with Phosphamidon as a means of checking the effect of this insecticide on caddis flies. The Department of Fisheries is much opposed to this suggestion and stated that they would request exemption of the waters flowing into this hatchery from spraying of any kind.

3. Forestry Studies

Dr. Belyea indicated that the routine field studies will be continued as in previous years and that additional effort will be put into studies in areas where Phosphamidon is used, and also in areas where there is evidence of budworm resistance to DDT.

Dr. Fettes stated that toxicological studies of the budworm in relation to Phosphamidon and DDT will be continued. This work is done primarily in the laboratory at Ottawa. He also stressed the need for more effort on deposit assessment both in plot studies and in the routine spray area. Assessment of Phosphamidon deposit in the water spray is somewhat more complicated than assessment of DDT oil sprays, but has been based on colour detection on deposit cards. A purple dye is incorporated with Phosphamidon sprays and is adequate for deposit assessment at moderate dosages. In experimental studies additional blue dye is added to increase detectability.

In a response to a suggestion by Dr. Fettes that Phosphamidon is quite injurious to caddis fly populations, Dr. Logie stated that the experience of the Fisheries scientists had shown no ill effects on caddis fly larvae at ½ lb. dosage rate per acre.

No work fully comparable to that of the Chemical Control Section is being done on forestry problems elsewhere in Canada. The Section is still concerned with several systemic insecticides. The work of testing these toxicologically against fish populations is onerous and the co-operation of the Fisheries scientists will not be requested further until the choice of systemics has been narrowed down to about two or three.

4. Fisheries Studies

Dr. Logie pointed out that the extent of joint studies by the Research Board and the Department would be dependent on approval of the proposed program. However, it is expected that testing with caged fish will again be undertaken.

He added that there is some question as to whether the Research Board will undertake the aquatic insect study but noted that this is an internal problem. Dr. Ricker felt that aquatic insects had been adequately studied with reference to their susceptibility to DDT and he doubted whether the aquatic insects are exact indicators of the toxic effect of insecticides on fish populations.

Dr. Logie suggested that electro-seining in salmon streams is the best known method of assessing juvenile salmon populations. He explained that the Department will consider taking over the electro-seining program if the Research Board find that they are unable to continue.

Dr. Fettes pointed out the glaring need for the measurement of toxic material in the streams. A lengthy discussion followed on the complexity of such a program and it seemed apparent that none of the agencies represented is in a position to provide the trained chemists necessary to conduct analyses.

5. Wildlife Studies

Drs. Solman and Cooch stated that little information is at hand on the effects of Phosphamidon on birds, although there is a suggestion from 1963 observations in Montana that grouse may be susceptible to Phosphamidon at 1 lb. per acre. The Canadian Wildlife Service proposes to carry out studies in blocks sprayed with Phoshamidon. Because of the mobility of bird populations, the rapid disappearance of bird carcasses, inflights into plot areas, etc., it is expected that studies will be conducted by establishing experimental birds in enclosures up to ½ acre in size, utilizing grouse and woodcock in the adult and juvenile stages. Such studies will be carried out in areas treated with DDT and in unsprayed areas, as well as in the Phosphamidon blocks. They pointed out that the work might be done under contract but plans are still quite indefinite.

In a general discussion of sources of assistance in proposed wildlife studies, Dr. Belyea referred to the interest of the Department of Lands and Mines and their undoubted willingness to co-operate; Dr. Logie mentioned the Biology Department of the University of New Brunswick as a possible source of graduate students capable of doing the work; Dr. Fettes noted that CIBA Co., manufacturers of Phoshphamidon, are very much concerned about the infrequent reports of adverse effects of Phosphamidon and in conversation have mentioned their willingness to provide funds or scientific personnel to work with any group set up to make a critical study of the effects of Phosphamidon on birds. Drs. Logie and Belyea also stated that they felt that assistance could be anticipated from Forest Protection Limited if it were necessary to have certain areas sprayed with Phosphamidon to simplify the field studies on birds. Dr. Belyea noted that the facilities of his laboratory, which is close to the field operations, would be available to anyone engaged in blood analysis of experimental birds, but he could not provide a staff member to do such work.

Dr. Solman asked Dr. Fettes whether there would be hazards to personnel if they entered experimental plots too soon after spraying with Phosphamidon. Dr. Fettes indicated that he and his associates and representatives of the CIBA Co. had been in experimental plots at the time of the spraying at the rate of ½ lb. per acre, and periodically afterwards, with no ill effects. He thought there would be no difficulty in carrying out biological observations in sprayed plots provided that precautions were taken. He felt the greatest danger was associated with the actual mixing operations.

Representatives of the Canadian Wildlife Service will maintain liaison with Dr. Belyea regarding selection of experimental areas and with Chemical Control Section regarding assessment of spray deposits associated with the studies of birds.

6. Other Business

There being no other business, Dr. Pritchard stated in conclusion that the Department of Fisheries is greatly concerned that the proposed spray operation, 1964, which in addition to the use of Phosphamidon along streams and in selected blocks, involves much more extensive use of DDT at ½ lb. per acre, and urges that Phosphamidon be used over a larger proportion of the total area. He was also concerned that the viewpoint of Fisheries did not coincide with that of the Department of Forestry which considers that the proposed spray program is a reasonable compromise between the interests of Forestry and Fisheries.

It was agreed by Drs. Pritchard and Prebble that the differences in viewpoints should be drawn to the attention of the Deputy Ministers of the two Departments for resolution at the ministerial level.

E. W. Burridge
SECRETARY.

M. L. Prebble,
CHAIRMAN.

OTTAWA
February 3, 1964

FOREST PROTECTION LIMITED

43 Roseberry Street,
Campbellton, N.B.

January 2, 1964.

Dr. M.L. Prebble, Chief
Forest Entomology and Pathology Branch
Canada Dept. of Forestry
Motor Building
238 Sparks Street
Ottawa, Ontario

Dear Malcolm,

Attached is (a) a general outline of the area recommended for spraying in 1964 (1/500,000 map of New Brunswick), and (b) a schematic 10X blow-up sample (1/50,000 map sheet of an area inside spray perimeter).

Please note that in (a) the green areas, intended to represent Phosphamidon coverage near main salmon streams, are just a wee bit thick, averaging about one half mile across the stream. Actually it should be that of four paired aircraft swaths of theoretically approximately 0.44 miles width straddling the streams. The exaggeration is deliberate and is due to the pen. We used one which came nearest to giving the right width. At this scale you can hardly tell the difference between the map as drawn and the theoretical value.

You get a good picture of the intended distribution of Phosphamidon from (a) and a better idea of how this is combined with D.D.T. from (b).

I draw your attention in (a) to the small pond just S.W. of the second "R" in Northumbe"R"land. This is the top of the watershed feeding South Esk Hatchery. Pay no attention to the fact that the indicated smooth spray plan boundary is in the brook between the pond and the hatchery because this boundary will be changed one way or another by the detail plan makers. But you might feel out the fish culture people on use of Phosphamidon in and near fish rearing establishments such as this one. I have a special reason for asking. Last year there occurred at South Esk an epidemic of caddis fly larvae such as to complicate the even flow of water to the trays of freshly hatched fish (circa June 1st or earlier). This took place almost seven years after this watershed area was completely

(90 some %) sprayed. Should it be included in the Phosphamidon treated area in 1964, there should be available an opportunity to corroborate effect of this insecticide on aquatic insects, especially to corroborate a 1963 report of caddis fly larvae mortality. Of course the hatchery superintendent would be happy to have the trial and the corroboration since he can do without these and other insects in his business of raising fish.

Happy New Year to you and the boys in the E. and P. Branch.

Sincerely,

P.W. Flieger, Manager

Enclos.

Fredericton, N.B.
November 25, 1963.

Dr. M. L. Prebble
Director
Forest Entomology and Pathology Branch
Department of Forestry
Ottawa, Canada

Dear Dr. Prebble:

You will find enclosed for your information a copy of a letter handed me by B. W. Flieger on Friday, November 22, with a memorandum and a map attached. Dr. Belyea of your staff has seen this and a copy is being forwarded to him. This is in accordance with the recommendation of the Directors of Forest Protection Limited that a spraying operation be carried out in 1964.

The Minister of this Department has indicated his support in principle and will place the matter before the Provincial Treasury Board at first opportunity. A letter will then be forwarded to your Minister requesting Federal financial support in connection with the operation.

In the meantime Mr. Flieger will obtain quotations for supplying insecticide and solvent oil. Since these quotations will be good until December 15 there is some urgency in reaching decisions in the matter.

Yours very truly,

K. B. Brown
President, Forest Protection Limited

Fredericton, N. B.
November 22, 1963.

Mr. K. P. Brown
President
Forest Protection Limited
N.B. Department of Lands and Mines
Fredericton, N. B.

Dear Ken:

Attached in very general outline form is the plan for spraying in 1964 which I recommemd to you.

In arriving at the scope design and cost estimate I have taken into account our past experience especially in regard to the following:

(a) Area to be sprayed - analysis of 1963 defoliation survey data, 1963 detail of the egg mass survey data and of tree hazard categories indicates that about 2,000,000 acres is likely to be heavily defoliated in 1964 if not sprayed. This is not a firm figure but may turn out to be 1,800,000 or 2,200,000. We should, I think, prepare for the larger eventuality. In arriving at this estimate of area no considerable amount of highly populated forest has been left out and no included areas of medium egg numbers has been excepted.

(b) Insecticide strength and theoretical rate of deposit - As you know we have been using $\frac{1}{4}$ pound of DDT in $\frac{1}{2}$ gallon (U.S.) oil per acre since 1961 for the single proven reason that it is less drastic in effect upon fish than our former $\frac{1}{2}$ pound insecticide used at the $\frac{1}{2}$ gallon rate per acre. It is not as good as our former strength in reducing budworm populations except where uniformly deposited under good conditions of spraying and of larvae susceptibility to the poison.

In 1963 we had some success in developing a buffer against the full side effect of DDT on fish life by using a new insecticide, Phosphamidon, on the forest near the salmon streams and DDT elsewhere.

An improvement in knockdown of budworm can now be obtained rather economically by expanding use of the two insecticides and returning to the former theoretical deposit rate of $\frac{1}{2}$ pound of DDT per acre. I suggest that we move in a direction which the experts recommend and carry the DDT in 0.70 gallons of solvent for better coverage. This last will raise the cost more than the increase in strength but will be a good compromise especially when

combined with the further recommendation that all areas receive one spray only except by redirection from Canada Department of Forestry.

(c) Aircraft and bases of operations: It appears best after a preliminary assessment to split the main area of spraying between two bases of operation at Dunphy and Juniper and to do all of this work with T.B.M. aircraft assisted by Cessna control aircraft and to use the block system which has worked so well for us.

Woodlot spraying near the Saint John River from Hartland down can best be done in our earlier technique using small aircraft based at Kesnac.

Other things equal it is desirable not to use Fredericton Airport for spraying operations.

(d) Use of insecticide

1. Phosphamidon will be used to spray forest in the immediate vicinity of many salmon streams viz. two team passes on either side of the stream covering a distance at right angles to the stream of approximately 0.4 miles.

2. Phosphamidon will be used to spray certain selected blocks in areas of persistent populations of budworm according to a plan to be worked out with Canada Department of Forestry.

3. In using DDT elsewhere all spraying will stop on entering a Phosphamidon buffer zone (1) and resume on leaving it.

This plan is fairly clear to me but in reading the letter and the plan you may be confused by some of my lack of clarity. If so please let's talk it over.

Yours very truly,

B. W. Flieger
Manager, Forest Protection Limited

# TENTATIVE SPRAY PLAN - FOREST PROTECTION LIMITED - 1964

1. Area 2,000,000 acres ± 200,000 acres. For outline and location see accompanying 1/500,000 map sheet.

The area included contains practically all forest in which heavy feeding is indicated in 1964 and in which spraying can be expected to significantly reduce insect populations. It includes as well some areas of moderate population surrounded entirely or in part by those of high indicated numbers of insects. It includes as well all areas of forest in which there are a noticeable number of trees in poor vigor. It is based on all information available at this time.

2. Insecticide requirement. Based on the following assumptions

(a) that two insecticides be used as follows:
DDT on roughly 90% of the plan area,
Phosphamidon on roughly 10% of the plan area,
will
(b) that DDT/be used in a single application at the rate of ½ pound in 0.70 gallons of formulation per acre and that phosphamidon will be used in a single application at the rate of ½ pound in 3/4 gallon of formulation per acre.

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| DDT requirement | 500 tons |
| Phosphamidon | 50 tons |
| Solvent Oil | 1,350,000 U.S. Gallons |
| Water | 150,000 U.S. Gallons |

3. Aircraft requirement -

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| T.B.M. Sprayers | 26-28 |
| Stearman or equivalent | 10 |
| Cessna Control | 16 |
| Helicopter | 1 |

4. Bases of Operations - Airstrips at Dunphy and Juniper will be used for all T.B.M. operations. Some maintenance of runway expense at Juniper will be required to bring it into operational condition.

Kesnac will be used for Stearman type spraying and some runway expense will be necessary to bring this field into operational condition.

Insecticide formulation will take place at Dunphy for DDT and Phosphamidon dilution at both Juniper and Dunphy.

5. Spraying specifications - Spraying is planned for approximately 1,800,000 acres firm with part or all of 400,000 acres to be added by

early June based on larval sampling up to that time by Canada Department of Forestry.

All spraying will be conducted so as to follow in chronological order and as closely as the elements will permit the timetable provided by Canada Department of Forestry.

If possible all operations will conclude before the larvae have advanced far into the sixth instar and certainly before any pupation.

6. Surveys - Full cooperation with Canada Department of Forestry in conduct of insect surveys having to do with the spray program will be maintained and the necessary assistance given.

7. Estimated cost - Based on above requirements and assumptions the cost will be approximately $1,500,000 or about 75¢ an acre.

8. Estimated cost of alternative combinations of insecticide strength and rate and number of applications

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| (a) ¼ pound DDT in ½ U.S.G. | one application | 50¢ per acre |
| (b) ¼ pound DDT in ½ U.S.G. | two applications | 100¢ per acre |
| (c) Phosphamidon substituted for DDT at ¼ pound in 3/4 gallon water on application | | 140¢ per acre |

Notes re above alternatives to recommendation

Alternative (a) cannot be depended upon to reduce populations of budworm by an acceptable amount in all conditions of spraying and in all stages of larval development.

There is no justifiable combination of (a) and (b) based on our knowledge.

Alternative (b) in addition to expense, guarantees a limited gain in reduction of insect numbers over (a) and cannot be handled except with more of everything - planes, fields, time and money.

Alternative (c) may be a future worthwhile method provided costs come down. Now in addition to expense there is lacking a complete documemtation of the ability of the material to compete with DDT as a budworm killer.