

PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES

HON. R. G. WILLISTON, *Minister*

A. F. PAGET, *Deputy Minister of Water Resources*

REPORT
of the
WATER RESOURCES
SERVICE

YEAR ENDED DECEMBER 31

1964



Printed by A. SUTTON, Printer to the Queen's Most Excellent Majesty
in right of the Province of British Columbia.

1965

PROVINCE OF WESTERN AUSTRALIA
DEPARTMENT OF PUBLIC WORKS AND WATER SUPPLY
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REPORT
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WATER RESOURCES
SERVICE

YEAR ENDED 31st DECEMBER 1964

1964



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CONTENTS

Introduction of the Report by the Minister of Lands, Forests, and Water Resources..... 1

The Water Resources Service..... 2

Water Resources Development..... 3

Water Conservation..... 4

Water Pollution..... 5

Water Quality..... 6

Water Rights..... 7

Water Resources Administration..... 8

Water Resources Legislation..... 9

Water Resources Research..... 10

Water Resources Training..... 11

Water Resources Publicity..... 12

Water Resources Statistics..... 13

Water Resources Planning..... 14

Water Resources Conservation..... 15

Water Resources Development..... 16

Water Resources Conservation..... 17

Water Resources Development..... 18

Water Resources Conservation..... 19

Water Resources Development..... 20

Water Resources Conservation..... 21

Water Resources Development..... 22

Water Resources Conservation..... 23

Water Resources Development..... 24

Water Resources Conservation..... 25

Water Resources Development..... 26

Water Resources Conservation..... 27

Water Resources Development..... 28

Water Resources Conservation..... 29

Water Resources Development..... 30

Water Resources Conservation..... 31

Water Resources Development..... 32

Water Resources Conservation..... 33

Water Resources Development..... 34

Water Resources Conservation..... 35

Water Resources Development..... 36

Water Resources Conservation..... 37

Water Resources Development..... 38

Water Resources Conservation..... 39

Water Resources Development..... 40

Water Resources Conservation..... 41

Water Resources Development..... 42

Water Resources Conservation..... 43

Water Resources Development..... 44

Water Resources Conservation..... 45

Water Resources Development..... 46

Water Resources Conservation..... 47

Water Resources Development..... 48

Water Resources Conservation..... 49

Water Resources Development..... 50

Water Resources Conservation..... 51

Water Resources Development..... 52

Water Resources Conservation..... 53

Water Resources Development..... 54

Water Resources Conservation..... 55

Water Resources Development..... 56

Water Resources Conservation..... 57

Water Resources Development..... 58

Water Resources Conservation..... 59

Water Resources Development..... 60

Water Resources Conservation..... 61

Water Resources Development..... 62

Water Resources Conservation..... 63

Water Resources Development..... 64

Water Resources Conservation..... 65

Water Resources Development..... 66

Water Resources Conservation..... 67

Water Resources Development..... 68

Water Resources Conservation..... 69

Water Resources Development..... 70

Water Resources Conservation..... 71

Water Resources Development..... 72

Water Resources Conservation..... 73

Water Resources Development..... 74

Water Resources Conservation..... 75

Water Resources Development..... 76

Water Resources Conservation..... 77

Water Resources Development..... 78

Water Resources Conservation..... 79

Water Resources Development..... 80

Water Resources Conservation..... 81

Water Resources Development..... 82

Water Resources Conservation..... 83

Water Resources Development..... 84

Water Resources Conservation..... 85

Water Resources Development..... 86

Water Resources Conservation..... 87

Water Resources Development..... 88

Water Resources Conservation..... 89

Water Resources Development..... 90

Water Resources Conservation..... 91

Water Resources Development..... 92

Water Resources Conservation..... 93

Water Resources Development..... 94

Water Resources Conservation..... 95

Water Resources Development..... 96

Water Resources Conservation..... 97

Water Resources Development..... 98

Water Resources Conservation..... 99

Water Resources Development..... 100

VICTORIA, B.C., January 20, 1965.

To Major-General the Honourable GEORGE RANDOLPH PEARKES,
V.C., P.C., C.B., D.S.O., M.C.,
Lieutenant-Governor of the Province of British Columbia.

MAY IT PLEASE YOUR HONOUR:

Herewith I beg respectfully to submit the Annual Report of the British Columbia Water Resources Service of the Department of Lands, Forests, and Water Resources for the year ended December 31, 1964.

R. G. WILLISTON,
Minister of Lands, Forests, and Water Resources.

VICTORIA, B.C., January 20, 1965.

*The Honourable R. G. Williston,
Minister of Lands, Forests, and Water Resources,
Victoria, B.C.*

SIR,—I have the honour to submit the Annual Report of the British Columbia Water Resources Service of the Department of Lands, Forests, and Water Resources for the 12 months ended December 31, 1964.

A. F. PAGET,
Deputy Minister of Water Resources.

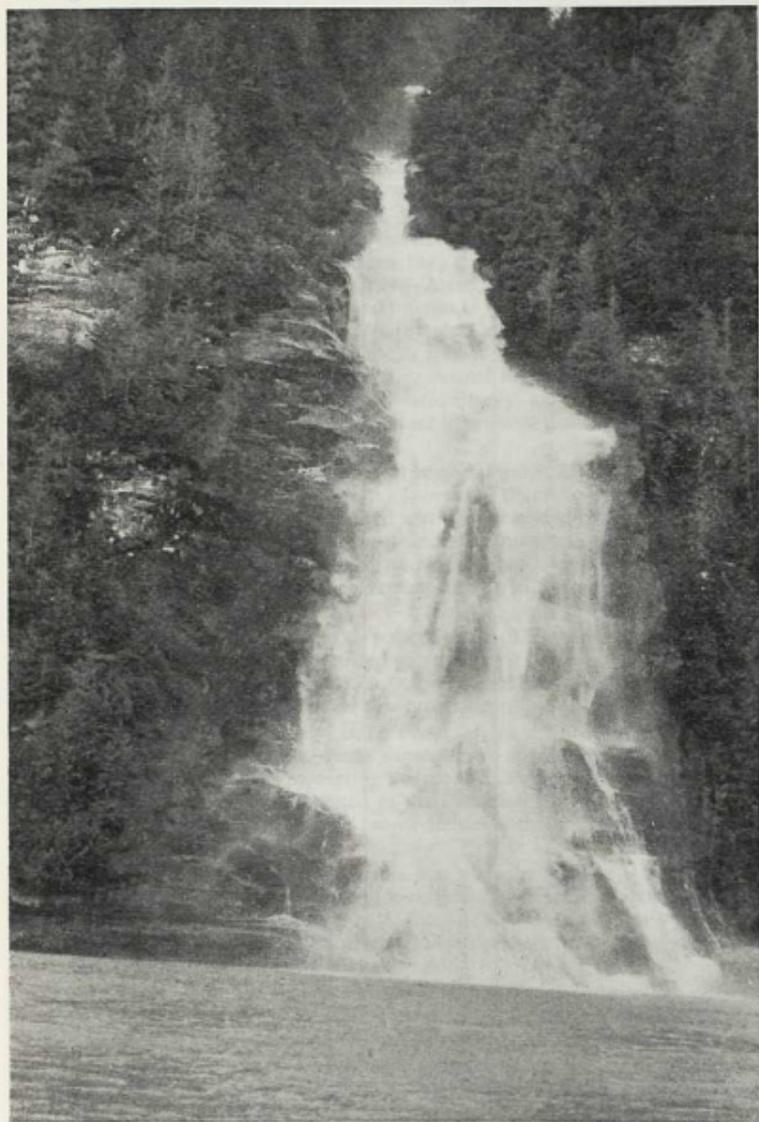
CONTENTS

PAGE

Organization Chart of the Water Resources Service.....	8
Introduction by the Deputy Minister of Water Resources.....	9
The Water Rights Branch—	
Organization Chart of the Water Rights Branch.....	13
Comptroller.....	13
Water Licensing Division.....	15
District Engineers Division.....	22
Improvement Districts Division.....	30
Power and Major Licences Division.....	37
The Water Investigations Branch—	
Organization Chart of the Water Investigations Branch.....	49
Chief Engineer.....	49
Water Supply and Investigations Division.....	50
Hydrology Division.....	57
Ground Water Division.....	59
Basin Planning and Power Division.....	61
ARDA Division.....	63
Records Compilation and Reports Section.....	65
Draughting Office.....	66
Southern Okanagan Lands Project.....	69
Accounting Division.....	73
Personnel Section.....	77

CONTENTS

vii	Foreword
1	Introduction
3	The Water Rights Issue
11	Organization Chart of the Water Resources Board
13	Committee
14	Water Planning Division
21	Water Resources Planning
24	Investment Division
27	Power and Water Resources Division
31	The Water Resources Board's Role in the National Water Program
32	The Water Resources Board's Role in the National Water Program
33	Chief Engineer
34	Water Resources Planning Division
35	Hydrology Division
36	Ground Water Division
37	Water Planning and Power Division
38	ARCS Division
39	Special Operations and Research Section
40	Operating Office
41	Southern Oregon Water Project
42	Accounting Division
43	Personnel Section

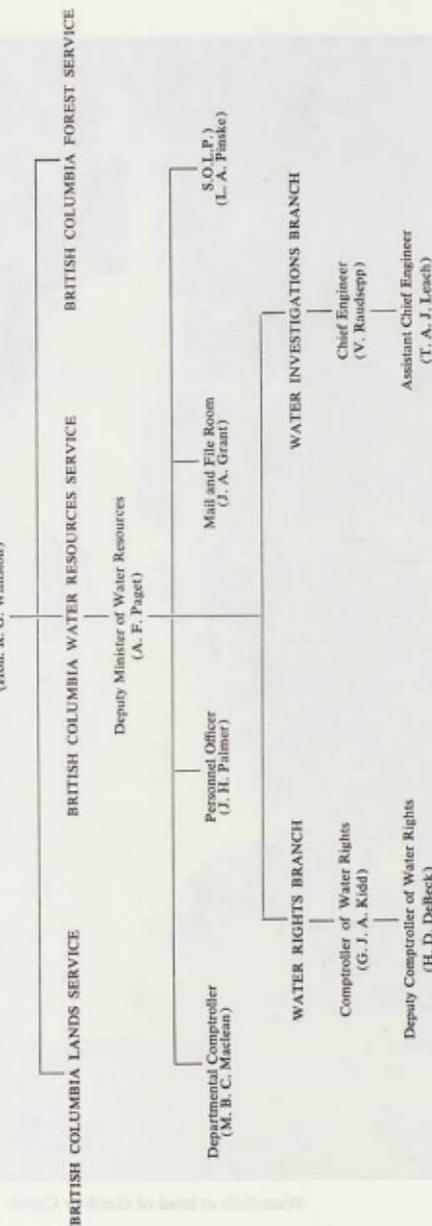


Waterfalls at head of Gardner Canal.

ORGANIZATION CHART OF THE BRITISH COLUMBIA WATER RESOURCES SERVICE
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES, VICTORIA, B.C.

Year Ended December, 1964

MINISTER OF LANDS, FORESTS, AND WATER RESOURCES
 (Hon. R. G. Williston)



Charts showing organization within the two branches of the Water Resources Service are contained in the reports of the Water Rights Branch and the Water Investigations Branch.

Report of the Water Resources Service

A. F. PAGET, P.Eng., DEPUTY MINISTER OF WATER RESOURCES

The Service expanded its Departmental interest during the year to deal with some of the problems of flooding and erosion. Discussions have been under way with the Federal Government to present information on necessary work that could be considered under the Canada *Water Conservation Assistance Act*.

With the final report of the Fraser River Board to Governments and the termination of this Board, efforts to carry out its recommendations are going forward. The rehabilitation of the dyking system has been considered as a project under this Act that should receive the highest priority. Arrangements have been discussed at the local levels to ascertain if there is local interest to have this necessary work done. So far no work has been carried out. The Fraser Valley, along with other parts of the Province, passed through a very difficult freshet season with the longest high-water period of record, combined with above normal rainfall. With the exception of one minor dyke, the system performed satisfactorily, although it was indicated that extensive work will be needed in the future to improve drainage systems behind the dykes.

The Southern Okanagan Lands Project passed through a period of reorganization, during which the Village of Oliver took over the domestic water system. Mr. F. O. McDonald, Project Manager, retired and was succeeded by Mr. L. A. Pinsky as Project Supervisor. An improvement district was formed to negotiate an agreement with the ARDA administration for the rehabilitation of its system, with the first work now under way. The improvement district will take over the operation of the system when this is rebuilt.

The Service's responsibilities with respect to the ARDA programme for soil- and water-conservation projects increased greatly during the year. It is hoped that the lack of trained technical staff, which is now appearing as a major British Columbia problem, will not unduly affect this programme.

The Columbia River Treaty and Protocol were ratified by the Canadian Government, and an exchange of notes subsequently appointed Mr. G. MacNabb and myself to the permanent Engineering Board. The British Columbia Hydro and Power Authority was earlier appointed as the Canadian Entity. The Board is at present making arrangements for the proper liaison with the Entity and with the United States section of the Board.

The Government of British Columbia met with the State of Alaska and the Territory of the Yukon, at Whitehorse, for the third conference dealing with problems concerning all three jurisdictions. A decision was made to form a committee to report to the next conference on practical developments for power and industry that could help the economics of the whole region.

The rapidly expanding industrial growth of the Province, together with the increasing population is placing increasing pressures on the Service, and new applications or approaches must be devised to deal with these, sometimes unique, problems.

The helpfulness of many Government agencies and departments is acknowledged, especially the Lands Service, the Department of Mines and Petroleum Resources, and the Department of Agriculture.

Report of the Water Pollution Control Board

Presented to the House of Representatives, 1964

The Board reports on the work done during the year of 1964. It also reports on the progress of the various projects which have been started since the Board's inception in 1961. The Board has been very busy since its inception and has accomplished a great deal of work.

One of the main tasks of the Board has been to study the water pollution problem in the United States and to recommend ways in which it can be solved. The Board has held many public hearings and has received many suggestions from the public. It has also conducted many studies and has issued many reports. The Board has been very successful in its work and has made many contributions to the solution of the water pollution problem.

The Board has also been very active in the field of water pollution control. It has been instrumental in the development of many laws and regulations which have helped to clean up our water. The Board has also been very active in the field of water pollution research and has supported many research projects.

The Board has also been very active in the field of water pollution education. It has been instrumental in the development of many educational programs which have helped to educate the public about water pollution and its effects.

The Board has also been very active in the field of water pollution enforcement. It has been instrumental in the enforcement of many laws and regulations which have helped to clean up our water. The Board has also been very active in the field of water pollution monitoring and has supported many monitoring projects.

The Board has also been very active in the field of water pollution control technology. It has been instrumental in the development of many new technologies which have helped to clean up our water. The Board has also been very active in the field of water pollution control equipment and has supported many equipment projects.

The Board has also been very active in the field of water pollution control policy. It has been instrumental in the development of many policies which have helped to clean up our water. The Board has also been very active in the field of water pollution control administration and has supported many administration projects.

WATER RIGHTS BRANCH

U. S. GEOLOGICAL SURVEY

The Water Rights Branch, established in 1904, is the central agency for the collection, compilation, and dissemination of information on water rights. The branch is organized into several divisions, each with its own staff of experts.

WATER RIGHTS BRANCH

The Water Rights Branch is organized into several divisions, each with its own staff of experts. The divisions are: 1. Division of Water Rights, 2. Division of Water Rights, 3. Division of Water Rights, 4. Division of Water Rights, 5. Division of Water Rights, 6. Division of Water Rights, 7. Division of Water Rights, 8. Division of Water Rights, 9. Division of Water Rights, 10. Division of Water Rights.

THE WATER RIGHTS BRANCH

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WATER RESOURCES SERVICE

THE WATER RIGHTS BRANCH

The Water Rights Branch is the agency of the Provincial Government which administers the control and use of surface water under the authority of the *Water Act*.

The main principles of the *Water Act* regarding the use of water are:—

- (1) The property in and the right to the use and flow of all water at any time in any stream in the Province are for all purposes vested in the Crown in right of the Province. The common-law principle of riparian water right has been abolished.
- (2) Licence-holders have a right to the use of water under the terms and conditions of the water licence issued by the Comptroller of Water Rights. Earlier licences have priority over licences issued later.
- (3) Retention of a water licence is dependent upon the beneficial use of the water, payment of the water-licence rentals, and observance of the regulations of the *Water Act*.
- (4) A water licence is generally made appurtenant to a parcel of land, mine, or undertaking, and it will pass with any conveyance or other disposition thereof.
- (5) If it is necessary that a water licensee construct works on another person's land, he can expropriate the land reasonably required if an amenable agreement cannot be reached. If the works will be on Crown land, the water licensee may acquire a permit to occupy Crown land for such purpose.

The second major function of the Water Rights Branch is to generally supervise and assist the administration of the improvement districts which have been incorporated under the *Water Act* for irrigation, waterworks, drainage, dyking, street-lighting, providing financial aid to hospitals, fire protection, and several other purposes. An improvement district is a self-governing public corporate body administered by elected Trustees. The undertakings of an improvement district can be financed by Provincially guaranteed debenture issues.

The administration of the *Water Act* is carried out by the Comptroller of Water rights and his staff, who are located at a headquarters office in Victoria and district offices at Victoria, Kamloops, Kelowna, Nelson, Prince George, and Mission City.

Water is a natural resource which often has a controlling influence on economic development of other resources and, therefore, is in competitive demand by the utilizers of other resources. Much of the vast industrial expansion presently occurring in this Province is associated with the use of British Columbia water. A large number of communities have been incorporated into improvement districts under the *Water Act* to operate community projects and provide essential amenities.

WATER RIGHTS BRANCH

G. J. A. KIDD, COMPTROLLER OF WATER RIGHTS

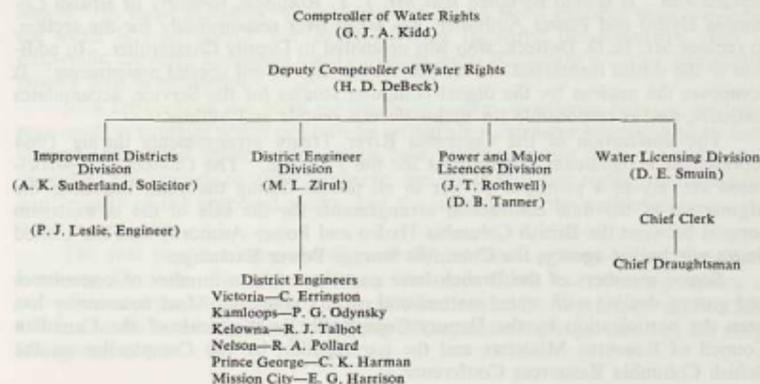
The Water Rights Branch during 1964 was primarily concerned with matters of water licensing and the administration of the *Water Act*. The great economic development going on in the Province has resulted in greater demands on water use, and thus the administrative work involved has become increasingly heavier and more complex. The accelerated subdivision of lands that is taking place with the attendant apportionment of water licences is only one example.

Although the general field of water investigation, hydrology, and scientific and technical studies became the responsibility of the Water Investigations Branch during 1963, the Water Rights Branch continued to carry out a large number and variety of independent engineering feasibility and design projects during 1964. A noteworthy example of this work is the design and supervision of the water system for the Fort Steele rehabilitation project, which is being developed by the Province as a historic monument for the forthcoming Centennial Year.

In many areas of water-resource planning and use there are no clearly defined boundaries of separate responsibilities, and close liaison and co-operation are maintained between the two branches of the Service. The District Engineers' offices of the Water Rights Branch, because of their location in the field, provided office facilities as well as staff assistance to the Water Investigations Branch, and the headquarters staff of the Water Rights Branch provides certain other services to its sister branch, such as filing. On the other hand, the Water Investigations Branch assists the Water Rights Branch by providing specialist advice and carrying out engineering investigations.

During 1964 the dual responsibility of Deputy Minister and Comptroller of Water Rights was separated. Mr. DeBeck was appointed as Deputy Comptroller, and the general strengthening of the administrative sections of the Water Rights

ORGANIZATION CHART OF THE WATER RIGHTS BRANCH,
YEAR ENDED DECEMBER, 1964



Branch during the past year resulted in greatly increased production. This is clearly indicated by the fact that the number of water licences issued during the year set a new record which far exceeded any other previous year's production. A significant part of this greatly increased production was due to the large increase in final water licensing, which had declined seriously over the past several years. In spite of the large number of licences issued, however, the number of outstanding applications has not been decreased accordingly. This is partly because the receipt of new applications continued at a high level, although down somewhat from the record year of 1963.

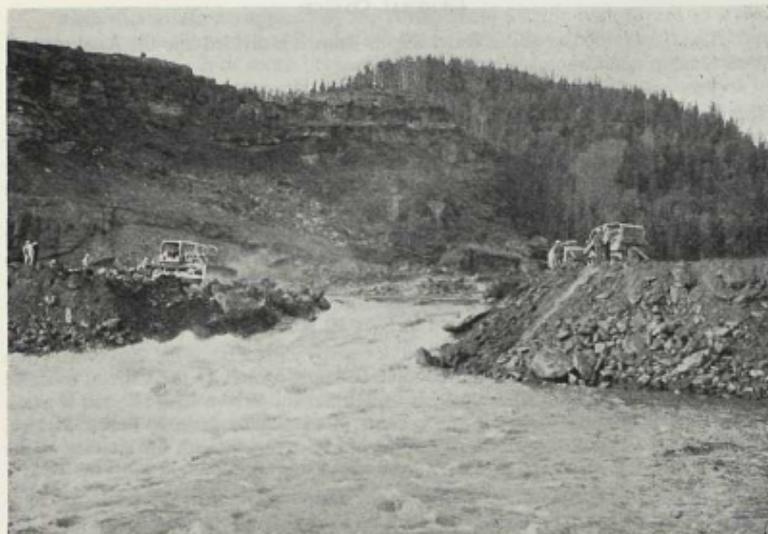
Mr. R. G. Harris, who was District Engineer at Kelowna, joined the Water Investigations Branch during the year and was replaced by Mr. R. J. Talbot, who was formerly Assistant District Engineer in the Kamloops office.

Work associated with improvement districts has continued to expand, and the resulting pressure has made it necessary to organize some of the work, particularly the engineering, on a priority basis. This has resulted in the building-up of a backlog of work, and indicates the section should be further strengthened. Some alleviation of this problem has been achieved by having the District Engineers' offices carry out studies wherever possible, and in some cases special assignments have been taken on by other staff members of the Branch. The financial assistance given under the Federal *Municipal Development and Loan Act* has made possible the construction of many improvement district projects that had previously been uneconomical. This has added a further work load involved in the approval of consulting engineers' designs and in the handling of general administrative factors that are involved. A further indication of the economic development in the Province during 1964 is the large number of new improvement districts incorporated, which amounted to about 8 per cent of the total of all improvement districts in existence at the end of 1963.

With the Portage Mountain project on the Peace River under active construction and with the Columbia River projects reaching final design stage, the Power and Major Licences Division was very busy with the work associated with the approval of plans for these projects in accordance with the terms of the water licences. In addition, this section participated actively in the Columbia River Treaty hearings of the External Affairs Committee, which were held in Ottawa, and which extended over a period of several weeks. The section has been under strength for some months because of the resignation of Mr. D. Priestman and the inability to replace him. It should be noted that Mr. J. T. Rothwell, formerly of British Columbia Hydro and Power Authority, has taken over responsibility for the section, to replace Mr. H. D. DeBeck, who was promoted to Deputy Comptroller. In addition to the duties mentioned above, this section carries out special assignments. It composes the nucleus for the digital computer studies for the Service, accumulates statistics, and is responsible for major licence rentals and billings.

The finalization of the Columbia River Treaty arrangements during 1964 represented a significant achievement for the Province. The Comptroller participated actively as a principal adviser in all phases during the year, including the negotiation of the final contractual arrangements for the sale of the downstream benefits between the British Columbia Hydro and Power Authority and the United States purchasing agency, the Columbia Storage Power Exchange.

Senior members of the Branch have participated in a number of committees and groups dealing with water matters and other resources. Most noteworthy has been the participation by the Deputy Comptroller in the work of the Canadian Council of Resource Ministers and the participation by the Comptroller on the British Columbia Resources Conference.



Closing of cofferdam, Peace River project.

WATER LICENSING DIVISION

D. E. Smuin, Administrative Officer

The Water Licensing Division is the instrument through which the Comptroller of Water Rights fulfils his statutory responsibilities with regard to the issue of new water licences and the amendment of existing water licences as set out in the *Water Act*. This involves the maintenance of a complex system of records which consists of files, maps, and various indexes.

The need for the protection afforded by a water licence is well known in the rural areas of the Province where the individual is responsible for his own water supply. In many instances, water licences become more valuable than the lands the water is used upon. For example, large industrial developments, such as pulp-mills, are often dependent upon obtaining water licences in order to successfully finance their programmes.

New applications are often on the same stream as existing licences, and this may result in conflicts which can only be settled after extensive investigation by both clerical and district office staffs. Each new application has to be considered in respect to the amount of water available, the effect on prior rights, the suitability and security of the proposed works, and the intention of the applicant to use the water beneficially.

The year past has been one of generally increased activity within the Water Licensing Division. Specific details are included within the following reports of two sections of the Division—the General Office, under the supervision of the Chief Clerk, and the Administrative Draughting Office, under the supervision of the Chief Draughtsman.

GENERAL OFFICE

The General Office of the Water Rights Branch is divided into the Applications, Amendment, and Ground Water Sections.

The Application Section processes all new applications for water licences, approvals, and permits over Crown land. In the course of this processing, it is necessary to maintain indexes by name, licence number, file number, and water district, and to make use of records of the Accounting Division by account number and the Draughting Room records by stream and legal description. All applications must be considered in relation to existing water licences, or to previous applications on the same stream. Every person whose rights or lands may be affected by a new application must be notified before the application is adjudicated. If objections to an application are received by the Comptroller, they are thoroughly investigated. In some instances, determinations on applications are made by the Comptroller only after formal hearings have been held to hear all pertinent arguments.

All applications for permits to cross or occupy Crown lands for the construction and maintenance of works, or the flooding of lands owned by the Crown, must be investigated and determination made as to whether the Crown land affected is available. This requires searches in the records of the Lands Service, Forest Service, and Parks Branch and any other Government department with an interest in the property.

The Applications Section also processes applications for approvals for non-recurrent use of water and for changes to be made in and about a stream.

The Amendment Section processes applications for amendments to existing licences by apportionment, changes of works, transfers of appurtenancy, and sundry amendments.

When the land to which a licence is appurtenant is subdivided, the rights and obligations imposed under the licence may be apportioned among the new owners in proportion to the interest held by each owner.

If a licensee wishes to transfer the rights held under a licence to another or to an additional parcel of land, he may apply for a transfer of appurtenancy, which the Comptroller may grant in whole or in part. However, the diversion of an additional quantity of water cannot be authorized under any amendment to a licence.

Amendment by change of works authorizes the construction of additional or other works than those previously authorized, such as the relocation of a point of diversion or pipe-line. Sundry amendments pertain to matters such as the authorization of additional time for the completion of works or for changes of purpose, corrections of errors, etc.

Other functions of the General Office are the duties involved with the processing of abandonment and cancellation of licences, in whole or in part, for various reasons, such as failure to establish or continue beneficial use of water or non-payment of rentals. While licences can be abandoned voluntarily by the licensee, the cancellation of licences entails searches at the Land Registry Office, Surveyor of Taxes, and any other records available to discover the ownership of the property concerned. Notices must then be sent to each person and a waiting period of 60 days allowed for payment of rentals or for filing objection to the proposed cancellation. If many persons' rights are affected, notice may be published once a week for four consecutive weeks in a local newspaper. The protections afforded by law to all who may be entitled to any interest in a water licence make the amendment or cancellation of licences a difficult and time-consuming operation.

Records are also maintained by the Amendment Section with regard to water-users' communities incorporated under the *Water Act*. These communities are composed of groups of six or more licensees who have joined together for the purpose of constructing and maintaining a joint water system or storage dam, financed by levying assessments on the members. At the end of 1964 the number of such communities in existence in the Province was 71, an increase of 4 during 1964.

The Ground Water Section represents a relatively new activity of the General Office. During the past year, inquiries were sent out to all the Provinces of Canada and many of the Western States of the United States requesting copies of their ground-water legislation. A study of information received is at present being carried out in order to assess the problems involved in licensing this water source and to determine procedures to be followed. The various approaches taken by the authorities canvassed indicates that the administration of ground-water use will be at least as difficult as for surface water, and hence our policies will be formulated with caution. It is anticipated that certain specific areas will be proclaimed for ground-water licensing in the year 1965.

Water Resources Service files, formerly stored with and forming part of the Lands Service numerical file system, have been transferred to the Water Resources Service vault and now come under the control of this department. The numerical system will not be changed, and hence certain liaison will be maintained with the Lands Service, who will allocate blocks of numbers for our use in creating new files.

The onerous task of compiling a file register is proceeding. The Lands Service file register has been checked to assure that all Water Resources Service files have been transferred from the Lands Service vault and are now in our possession. As time permits, files will be scrutinized to determine whether they should be micro-filmed and destroyed. This operation will, in time, provide valuable file space, for which our needs constantly expand due to the continuing nature of water-resource administration.

The principal activities of the General Office in the 12-month period ended October 31, 1964, are shown in the following table, together with the same data for the four preceding years. The development of these activities over the past 10 years is shown graphically on Plates 1 to 3.

	1960	1961	1962	1963	1964
Applications for licences	939	1,102	1,173	1,295	1,144
Applications for apportionment	36	25	55	56	38
Applications for transfer of apportionment	31	31	59	62	72
Applications for change of works	115	175	106	160	157
Applications for extension of time	85	67	69	102	159
Applications for right-of-way	160	184	166	151	198
Applications for approvals	7	24	12	21	28
Totals	1,372	1,608	1,640	1,847	1,795
Average monthly applications	114	134	137	154	149
Changes of ownership, address, etc.	2,293	2,669	2,652	2,232	2,267
Cancellations and abandonments	222	384	341	294	248
Totals	2,515	3,053	2,993	2,526	2,515
Conditional licences issued	718	810	880	660	990
Final licences issued	228	220	200	229	403
Totals	946	1,030	1,080	889	1,393
Rights-of-way issued	183	185	196	158	306
Approvals disposed of	7	24	12	21	28
Totals	190	209	208	179	334
Annual over-all total	5,023	5,900	5,921	5,441	6,038

ADMINISTRATIVE DRAUGHTING OFFICE

The Administrative Draughting Office staff is composed of a Chief Draughtsman, a Supervising Draughtsman, eight draughtsmen, and a clerk. The main functions of this office are checking the legal status of water applications, maintaining stream registers and plan indexes, compiling, maintaining, and revising water rights maps, preparing plats for water licences, clearing land applications for the Lands Branch, checking petitions and preparing legal descriptions and plans for improvement districts, and attending to requests for maps and various information from our district offices, other departments of Government, and the public.

Applications for water licences and amendments to licences received by the Licensing Division are cleared through the Draughting Office, and a complete check is made of the legal status of every application received. No licence can be issued, no change of appurtenancy or works, no extension of time, apportionment, or right-of-way for any licence can be made without first checking or clearing through the Draughting Office to ensure that no individual's vested water rights or property rights are violated. In most cases, this work entails a search of the records of other departments of Government, such as Lands Branch, Land Registry Office, Surveyor of Taxes, Department of Highways, and Department of Mines and Petroleum Resources. Upon completion of this work, all applications are entered on the water rights maps and in the stream registers, which together form a record of all pertinent data regarding water licences and applications.

The Draughting Office also prepares the plats which are attached to every water licence issued. These plats consist of a plan of the licensee's property and show in detail all works, such as the intake point, pipe-lines, pumps, power-house, and buildings where water is to be used.

Another function of the Draughting Office is the scrutiny of applications to the Lands Branch with respect to Crown lands in order to establish whether the rights of water licensees would be affected.

A major function of this office is the checking of petitions pertaining to improvement districts. This involves searches of the records of the Land Registry Office and Surveyor of Taxes to obtain correct property descriptions. When a petition to incorporate an improvement district has been checked and found correct, a plan showing all lands within the boundaries of the proposed district is drawn up and a legal description defining the boundaries of the district is prepared. This work accounts for about 25 per cent of the time of the Draughting Office. During 1964, 25 new improvement districts were incorporated and the boundaries of 47 districts were amended.

The following table illustrates the general increase in work which the Draughting Office has handled during the last three years:—

	1962	1963	1964
New water applications cleared and plotted on maps	1,097	1,269	1,099
Final and conditional licence plats compiled and traced	1,195	1,281	1,633
New water rights maps compiled and traced	49	9	50
Water rights maps revised	19	10	15
New improvement districts described and plans prepared	10	14	25
Improvement districts descriptions and plans amended	42	38	47
Reference maps renewed	36	30	13
Change of ownership, apportionments, cancellations, etc.	3,213	2,868	2,810
Land clearances (purchases, Crown grants, leases, etc.)	6,700	6,808	7,155
Land-clearances (cancellations)	1,660	1,493	2,263
Right-of-way over Crown land	203	162	306
Totals	14,224	13,082	15,416

APPLICATIONS

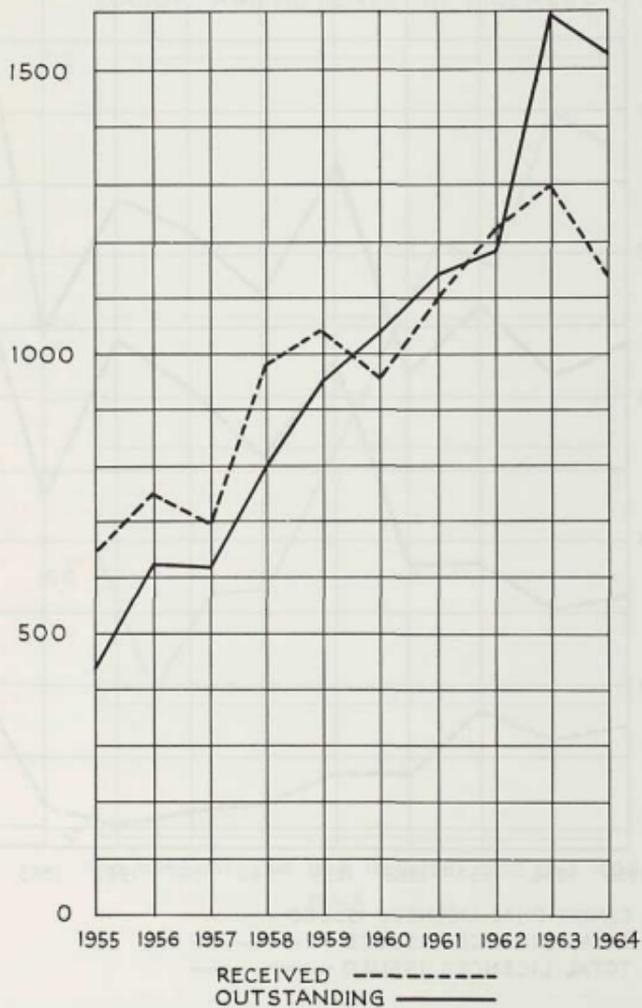


Plate 1.

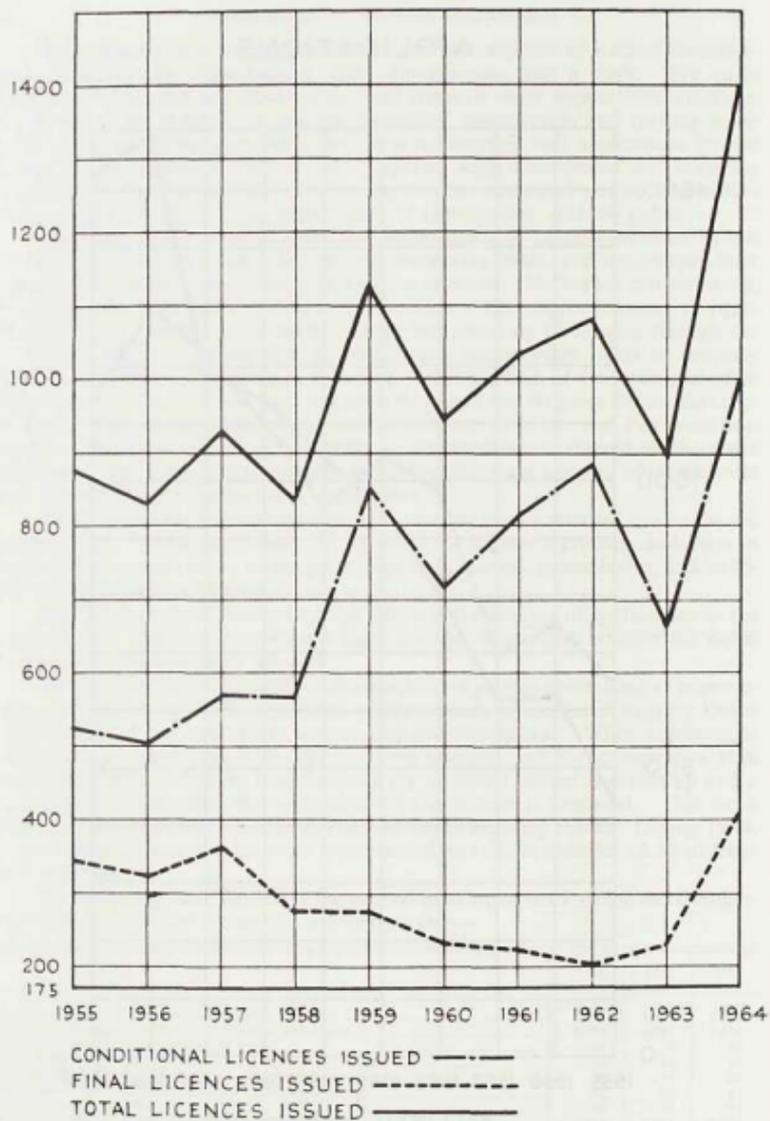


Plate 2.

MAJOR AMENDMENTS TO LICENCES

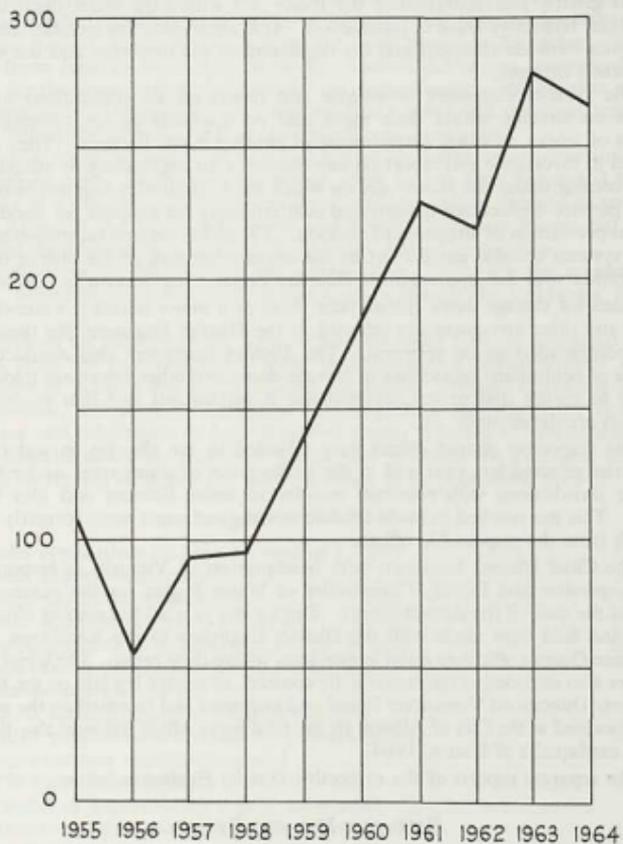


Plate 3.

DISTRICT ENGINEERS DIVISION

M. L. Zirul, P.Eng., Chief District Engineer

Water Rights Branch district offices, each in the charge of a District Engineer, are located at Kamloops, Kelowna, Mission City, Nelson, Prince George, and Victoria. The District Engineers at these six offices, with their staffs, are charged with the general administration of the *Water Act* within the water districts falling within their respective areas of jurisdiction. This administration includes the settling of disputes between licensees and the regulation of the diversion and use of water under water licences.

The District Engineers investigate and report on all applications for water licences on streams within their areas and on applications for apportionments, changes of works, or other amendments of existing water licences. They are also required to investigate and report on any matter of an engineering or administrative nature coming under the *Water Act* on which the Comptroller requires information and to prepare engineering designs and cost estimates for projects for flood protection and prevention of stream-bank erosion. Feasibility reports on proposed water-supply systems are also carried out by the engineering staff of the district offices in co-operation with the Improvement Districts Engineering Section in Victoria.

Plans for storage dams (other than those of a major nature), water-diversion works, and other structures are referred to the District Engineers for their review and recommendations or approval. The District Engineers also conduct a programme of continuing inspections of storage dams and other structures under water licences to ensure that proper maintenance is carried out and that no hazardous situations are developing.

The respective district offices have adjusted to the changes in water district boundaries effected last year and to the reallocation of some areas under their respective jurisdictions with resultant transfer of water licences and files between offices. This has resulted in more efficient coverage of some areas formerly difficult to reach from the responsible offices.

The Chief District Engineer, with headquarters at Victoria, is responsible to the Comptroller and Deputy Comptroller of Water Rights for the general supervision of the staff of the district offices. During the year all the district offices were visited and field trips made with the District Engineers of the Kamloops, Nelson, and Prince George offices to assist in problems within their areas. The Chief District Engineer also attended to the removal, by contract, of a large log jam on the Koksilah River near Duncan on Vancouver Island and inspected and reported on the extensive damage caused at the City of Alberni by the tidal wave which followed the disastrous Alaska earthquake of Easter, 1964.

The separate reports of the respective District Engineers follow.

KAMLOOPS DISTRICT OFFICE

P. G. Odynsky, P.Eng., District Engineer

The Kamloops District Office administers the *Water Act* throughout the central section of the Fraser River drainage basin, which is divided into four water districts—Ashcroft, Cariboo, Kamloops, and Nicola.

The staff of the Kamloops District Office consisted of a District Engineer, two Assistant District Engineers, a field engineering assistant, and a clerk-stenographer, in addition to which three students were hired to assist with surveys and clerical duties during the summer months.

The average annual precipitation within the water districts varies from 7 inches at Ashcroft and 10 inches at Kamloops to 20 inches in the eastern part of the Cariboo District. Since most of the precipitation occurs during the winter months, irrigation is required in all districts to grow crops successfully. The majority of water licences issued are for irrigation or for storage to supplement deficient irrigation supplies.

Nature provided the 1964 water-year with higher than average precipitation. Winter snowfall, from December, 1963, to March, 1964, totalled 36 inches at the Kamloops Airport, while the average for the same period is 29 inches. Summer rainfall from June to September, inclusive, totalled 6.2 inches, compared to an average for the same period of 4 inches. As a consequence, the number of complaints regarding shortages of water was relatively small and occurred principally in May, before the advent of the spring run-off, and June rains.

Run-off from melting snow was augmented by warm rains occurring during the month of June. In the Kamloops area, civic groups were concerned that the possibility of a flood on the Thompson River would result in damage to populated areas. Although the North Thompson and South Thompson Rivers did rise to levels that were higher than average, flood levels did not materialize.

Levels recorded for Nicola Lake during June, 1964, are the maximum on record. Minor flooding occurred on low lands adjoining the Coldwater River at Merritt.

Although the number of applications for new water licences decreased slightly in 1964 from the past two years, more applications for apportionment and for amendment of licences and more requests for studies of water regulation and use were received, reflecting the problems resulting from the increasing density of population and subdivision of land in settled areas. The list of investigations and studies undertaken by the Kamloops Office staff indicates the problems occurring from the increasing demands for water resulting from population growth.

Summary of Year's Work

Water applications on hand November 1, 1963	319
Water applications received	294
Water applications cancelled	55
Water application reports forwarded	290
Water applications on hand October 31, 1964	268
Final-licence survey reports forwarded	93
Final-licence surveys run	44
L.R.O. searches made for Victoria Office	20
L.R.O. plans ordered and sent to Victoria Office	338
Apportionment reports forwarded	22
C/W reports forwarded	35
Transfer of appurtenancy reports forwarded	5
Extension of time recommendations forwarded	55
Dam inspections	75

Investigations and Studies

1. Feasibility reports submitted concerning domestic water supplies for the communities of Sorrento, Aspen Park area near Rayleigh, Hefley Creek community, Blue River Improvement District, Spences Bridge Waterworks District.
2. Feasibility of increasing storage on Little Disdero Lakes.
3. Study of flooding on the Quilchena Golf and Country Club resulting from high water levels in Quilchena Creek and Nicola Lake. Report submitted.

4. Daily records in the month of June of river-levels on the Thompson Rivers at Kamloops and Savona. Inspection of dykes in North Kamloops and Halston.

5. Studies and surveys of existing and potential storage capacities on Scuitto, Campbell, Barnes, and Willard Lakes.

6. Investigations of encroachment of sawmill operations on the Quesnel River at Quesnel, made jointly with C. K. Harman, District Engineer at Prince George.

7. Joint inspection with B.C. Fruitlands Irrigation District and Department of Highways of ponds located above Westside to determine the possibility of controlling spring run-off in order to minimize flooding of the housing area at Westside.

8. The review for approval of designs, plans, and specifications, together with inspection of the construction, was carried out for the following new dams:—

- (a) A 45-foot-high, earth-fill dam on Charcoal Creek, tributary of Chase Creek.
- (b) Timber-crib rock-fill dam on Star Lake, near Clearwater.
- (c) Construction of a new sluiceway in the earth-fill dam at Hefley Lake, operated by the Hefley Irrigation District.
- (d) An 11-foot-high earth-fill dam on Blecker Lake.
- (e) A 30-foot-high earth-fill dam for a water reservoir for Clinton Village on Clinton Creek.
- (f) A 12-foot-high earth-fill dam on Beaton Lake; construction deferred.

9. Inspections of the condition of existing dams included the following:—

- (a) Bonaparte and Machete Lakes.
- (b) Five dams on Sword Creek, located west of the Fraser River.
- (c) Dam failure on Ogden Reservoir, near Lac la Hache.
- (d) Construction features of 11 dams were surveyed for issue of final water licences.

KELOWNA DISTRICT OFFICE

R. J. Talbot, P.Eng., District Engineer

The Kelowna District Office administers the Princeton, Fairview, Grand Forks, Vernon, and Revelstoke Water Districts, which comprise the Kettle, Similkameen, and Okanagan drainage basins, the Shuswap River drainage basin above Sicamous, and the part of the Columbia River basin from its confluence with the Canoe River down to the north end of the Upper Arrow Lake.

The increased use of water and a demand for the use of more water has necessitated a step-up in hydrologic studies. In 1956 it was estimated that the Okanagan and Similkameen Valleys contained 35 per cent of the Province's irrigated acreage, and this acreage has increased annually. In addition, the increase in requests for engineering advice by improvement districts has resulted in a very heavy demand on the District Office. Despite this heavy demand for engineering reports, however, a record number of water applications were reported on, and the office recommended on amendments for 38 existing water licences.

The precipitation for the period November 1, 1963, to October 31, 1964, recorded at Penticton Airport (elevation, 1,121 feet) was 12.20 inches, slightly higher than the annual average of 11.35 inches. As a result, complaints of water shortage received by this office were less than average.

An inspection of storage-works is being continued to ensure that licensees are carrying out routine maintenance of their storage-works. Forty-three storage-site inspections were made this year, and remedial work of one sort or another was suggested following most of the inspections.

The Kelowna District Office has received co-operation and assistance from the staff of the Dominion Government Research Station at Summerland, the Soil Survey

staff of the Provincial Department of Agriculture at Kelowna, the Soil Testing Branch of the Department of Highways, the local Provincial and municipal land assessment offices, and from water bailiffs, irrigation districts, and many individual licensees. We are grateful for their assistance.

A summary of work done by this office in connection with water licence applications for the years 1959 to 1964, inclusive, is given below:—

Year	Water Applications Received	Reports on Water Applications	Applications Cancelled or Abandoned	Total Applications Disposed Of
1959	156	112	10	122
1960	193	141	22	163
1961	168	146	13	159
1962	115	153	31	184
1963	211	177	18	195
1964	192	193	46	239

Applications— *Summary of Year's Work*

Applications outstanding November 1, 1963	82
New applications received	192
Applications inspected and reported on	193
Applications cancelled or abandoned	46
Applications on hand October 31, 1964	35
Licence amendments reported on	38
New water licences issued in 1964—	
Conditional licences	155
Final licences	39
Final-licence surveys	59
Miscellaneous surveys	10
Meetings attended	65

Engineering Investigations and Studies

1. General supervision of the reconstruction of dams on Trapper Lake, Hidden Lake, Glenmore Balancing Reservoir, and Nickel Plate Lake, and the sluice replacement at Aberdeen Lake.

2. Extensive supervision and engineering assistance were provided for the Meadow Valley Irrigation District (newly formed in 1964) during the reconstruction of its Darke Lake Dam.

3. Report with recommendations made on Lakeview Irrigation District's irrigation distribution system, annual maintenance and the condition of the main flume, and the administration of the district.

4. Investigated the possibilities of storage on Glanzier Creek to supplement the domestic supply for Stepney Waterworks District.

5. Preliminary plans drawn for a diversion dam on Gardom Creek, for the proposed replacement of the Mission Creek Smithson-Alphonse Dam, and for an intake on Mission Creek for South Kelowna Water-users' Community.

6. Surveys and minor engineering advice for Canyon Waterworks District, Westbank Irrigation District, Ellison Irrigation District, Grandview Flats Waterworks District, Steele Springs Waterworks District, Covert Irrigation District, and the Kelowna Vocational School.

7. A storage survey of Eleanor and Naramata Lakes and adjacent watersheds was carried out and report submitted in connection with Naramata Irrigation District's request for ARDA assistance for increased storage.

8. Preliminary design and estimate of costs for the replacement of Nickel Plate Lake dam.

9. Layout and supervision of Fascieux Slough (South Kelowna) drainage ditch.

10. Report made on the feasibility of rehabilitating the irrigation distribution system as a closed system for Scotty Creek Irrigation District.

MISSION CITY DISTRICT OFFICE

E. G. Harrison, P.Eng., District Engineer

The Mission City District Office administers the *Water Act* in the recently revised Vancouver and New Westminster Water Districts, in South-western British Columbia. Most of the work in the two water districts is concentrated in a 1,000-square mile area contained between Hope, Vancouver, Squamish, and the Sechelt Peninsula.

The office was established in 1961, and the staff consisted of a District Engineer, Assistant District Engineer, and a clerk-stenographer. This year the staff was increased to include an engineering aide and his assistant on a temporary basis so that final-licence surveys and other field work can now be carried out.

Water supplies during the year have been good due to above average precipitation, so that only a few water shortages were experienced. Any water problems that did arise generally involved drainage and surpluses, rather than shortages. The increasing demand for water for irrigation and domestic use from many streams requires increasingly detailed investigations of the applications for licences, especially with respect to the quantity of water available.

During the year this office continued to assist the Water Investigations Branch in the collection of ground-water data in the Lower Fraser Valley, and in June the office staff assisted in the inspection and collection of information in respect to the dykes in the Fraser Valley during the period of high water levels. The office also continued to co-operate closely with the large number of municipalities and other organized areas on the Lower Mainland.

Summary of Year's Work

Applications received	133
Applications investigated and reported on	111
Applications refused, cancelled, or abandoned	34
Final-licence reports submitted	84
Miscellaneous field surveys	9
Investigations—	
Pollution	2
Flooding	39
Miscellaneous	25
Meetings with municipalities and organized areas	11
Number of small streams measured	10
Conditional licences added to files	184

NELSON DISTRICT OFFICE

R. A. Pollard, P.Eng., District Engineer

The Nelson District Office administers the *Water Act* in the Nelson, Kaslo, Cranbrook, Fernie, and Golden Water Districts within South-eastern British Columbia.

Staff working in the Nelson Office during 1964 consisted of a District Engineer, two Assistant District Engineers, a field survey party chief, and a stenographer, all full-time employees, and two student assistants during the summer.

Two conditions resulted in a plentiful water supply in this region during the 1964 irrigation season. First, there remained a much higher than normal snowpack in the mountains because of the late spring. With the spring run-off so retarded, there existed a severe flood potential. It was fortunate that the weather remained unseasonably cool in the early summer, with the result that few damaging floods occurred. Second, the ensuing months were exceptionally cool and wet. Not until an "Indian summer" in October was the weather fine. As a result, there were few complaints by licensees of shortage of water.

During 1964, 184 new conditional licences and 79 new final licences were added to the Nelson Office files, making a total of 7,319 water licences. Of these, 4,578 are now active and 2,741 have been cancelled.

There were many more applications for water licences in 1964 than in any previous year. Much of this increase resulted from the sale by the Land Settlement Board of the old Doukhobor lands in the Brilliant, Ootischenia, and Pass Creek areas near Castlegar to the Orthodox Doukhobors. Starting in September, 1963, these Doukhobors applied for some 120 individual water licences until, in February, 1964, they petitioned to form an improvement district under the *Water Act*. Following this petition, the new Doukhobor land-owners ceased to apply for licences, and all work on the processing of their applications was suspended pending decision on the improvement district proposal.

Despite the staff increase in the autumn of 1963 and the fewer time-consuming complaints and disputes by licensees over water shortage during 1964, the Nelson Office now has more unreported applications than one year ago, largely because of the numerous applications received from the Doukhobors. However, based on the applications for water licences dealt with during the period, office output during 1964 exceeded that of the previous year. There has also been an increase in the number of engineering studies undertaken by the Nelson Office staff.

Summary of Year's Work

Applications on hand at beginning of year	148
New applications received	333
Applications inspected and reported on	231
Applications cancelled or abandoned	50
Applications on hand at end of year	200
Final-licence and licence-amendment surveys	146
Pollution investigations	8
Flooding investigations	11
Water-use investigations	7
Meetings with improvement districts and water-users' communities	20
Miscellaneous meetings and investigations of non-routine nature	22
Sampling snow courses	14

Engineering Investigations and Studies

1. Domestic water supply for Bluebird Corner in Village of Fruitvale and proposed Goat Mountain Waterworks District (incomplete).
2. Irrigation supply for Castlegar and District Golf Club.
3. Assistance in arrangements for annual Western Snow Conference in Nelson.

4. Pump tests of Green Gables Waterworks Co. well near Trail and of Beaver Falls Waterworks District's new well near Fruitvale.
5. Design of division tanks for licensees on two streams.
6. May, 1964, flood of Croasdaile Creek near Gray Creek.
7. Measurements of yield of Nakusp Hot Springs for Department of Recreation and Conservation and of Ainsworth Hot Springs and of Harris and Davis Springs at Bonnington for Highways Department.
8. Supervision of test well-drilling at Fort Steele.
9. Design of new water system for Fort Steele restoration project and supervision of construction.

PRINCE GEORGE DISTRICT OFFICE

C. K. Harman, P.Eng., District Engineer

The Prince George District Engineer is responsible for local water matters in the Prince George, Quesnel, Fort Fraser, Hazelton, Prince Rupert, Peace River, and Liard Water Districts. This area includes the Skeena River drainage, the Peace and Liard River drainages within British Columbia, and the Fraser River drainage upstream of a point approximately 21 miles north of Williams Lake.

There were no water shortages in the Prince George District during 1964. The precipitation during the irrigation season was much above normal in the whole District. Prince George recorded a total precipitation of 22.6 inches from April to September for this year, while the long-term average for the same period is only 12.3 inches. As a result of the much increased precipitation, many complaints of flooding were received from land-owners situated on smaller streams.

Relatively cool spring weather resulted in a late snowmelt in the major river drainages, with the result that above normal spring flows were recorded on the Fraser, Skeena, and Peace Rivers. Some flooding occurred near Terrace, Prince George, and Fort St. John. The maximum water-levels this year at Prince George were about 2 feet lower than for the 1948 flood year.

The work in the Prince George District Office increased sharply in 1964 because of the addition of the new water districts late last year and because of the new large industrial and power projects in the area. The number of new water licence applications received increased over 100 per cent, from 77 last year to 161 this year. Only 50 per cent of this increase is due to the addition of the new water districts.

The new interest in the construction of pulp-mills in this area has resulted in a large demand for water for these plants. Two new pulp-mills are under construction at Prince George. The mill at Port Edward is to be expanded, and several others are proposed in the area. We have already received applications for a total of 260 c.f.s. of water for pulp-mill purposes. It is indeed fortunate that water of good quality is abundant in this area, and it appears that ample water will be available for all of the pulp-mills planned in the district.

The industrial expansion at Prince George has accelerated the formation of improvement districts in the rural area around the city. Four new improvement districts were incorporated during the year near Prince George—namely, Crooked River Waterworks District, Charella Gardens Waterworks District, Western Acres Improvement District, and Nechako Improvement District.

A clerk-stenographer was added to the district staff in June of this year.

Summary of Year's Work

Applications on hand at beginning of year.....	44
New applications received.....	161
Applications inspected and reported on.....	116
Applications cancelled or abandoned.....	30
Applications on hand at end of period.....	59
Conditional licences added to the files.....	82
Final licences added to the files.....	5

Engineering Investigations and Studies

1. A new water-supply intake dam was designed by this office for the New Hazelton Improvement District. Construction of the new dam should begin early in 1965.

2. A brief study and investigation was made of the Starlane Waterworks District's water system. Recommendations were made to the Trustees for improvements required to bring the water system up to an acceptable standard.

3. An investigation was made and a design submitted for the Town of Fort St. John to control the water levels at the outlet of Charlie Lake.

4. The District Engineer co-operated in a ground-water test-drilling programme in the Nechako Improvement District that will continue until next year.

5. An investigation was carried out and report is being completed on the feasibility of a water-supply system for the Port Clements Improvement District on the Queen Charlotte Islands.

6. Investigated complaints of erosion at two sites on the Nechako River at Vanderhoof—one on Canyon Creek at Hixon and one on the Kitimat River near Kitimat. A bank-protection project was undertaken to protect land on the Nechako River at Vanderhoof, the actual work being done by the Department of Highways.

VICTORIA DISTRICT OFFICE

C. Errington, P.Eng., District Engineer

The Victoria District Office administers water rights matters over Vancouver Island, the Gulf Islands, and adjacent islands. These comprise the Alberni, Nanaimo, and Victoria Water Districts.

The Port Renfrew, Tofino, Kelsey Bay, and Port Hardy areas are becoming more accessible as new roads are being developed. The greatly improved ferry service to the various islands is helping to speed up the settlement of what used to be almost inaccessible areas. These developments all require domestic water, and we are often asked for advice and assistance in this respect. Available sources of water quickly become subject to applications for water licences.

On the other hand, some of the more populated areas, as on the Saanich Peninsula, are becoming incorporated into improvement districts for waterworks purpose, when one licence may replace many small ones together with their problems. This trend has been quite pronounced in recent years, and offsets to some extent the additional work resulting from new areas coming into the licensing picture.

The summer of 1964 was an excessively wet one; for example, at Campbell River the average precipitation for the months June through to September was 3.00 inches, compared to a long-term average of 2.01 inches, and there was a minimum of hot drying weather during the period. We therefore had practically no water-shortage complaints during the irrigation season.

During the year under review some 24 special studies, investigations, or reports were made.

Summary of the Year's Work

Total applications received.....	119
Conditional licences issued.....	115
Final licences issued.....	76
Conditional licences reported on.....	111
Licences abandoned or cancelled.....	47

IMPROVEMENT DISTRICTS DIVISION

A. K. Sutherland, Solicitor

The number of improvement districts in operation has been increasing steadily for many years, as illustrated in Plate 4, and there is now a total of 308 districts in existence. During the year the following new districts were incorporated: Alouette Dyking District, Bowser Waterworks District, Charella Gardens Waterworks District, Crooked River Waterworks District, Hagensborg Waterworks District, Kelowna and District Hospital Improvement District No. 35, Little River Improvement District, Mayne Island Improvement District, Meadow Valley Irrigation District, Michel-Natal Hospital Improvement District No. 36, Nechako Improvement District, Noosatsum Waterworks District, Olalla Improvement District, Radium Sewerage District, Raspberry Irrigation District, Riverview Improvement District, Rocky Mountain Hospital Improvement District No. 37, Sorrento Waterworks District, Southern Okanagan Lands Irrigation District, Vavenby Improvement District, Western Acres Improvement District, Whaling Bay Station Improvement District, and Wood Lake Improvement District. The following districts were dissolved: Chase River Fire Protection District, Chetwynd Waterworks District, Clinton Waterworks District, Girouard Irrigation District, Mamquam Sewerage District, Mamquam Waterworks District, and Harrison Mills Dyking District.

As already stated, the object (or objects) for which a district is incorporated is set out in its Letters Patent. Upon petition of the Trustees, action may be taken to have such Letters Patent amended to include extra objects, and many districts which were originally incorporated for one purpose now have several. The activities for which the existing districts are responsible include irrigation system—ownership and operation; domestic waterworks—ownership and operation; dyking-works; drainage-works; land-improvement works; fire protection—provision and (or) operation; street-lighting—provision and (or) operation; garbage—collection and (or) disposal; sewerage-works—ownership and operation; parks and playgrounds—provision and (or) operation; cemetery—operation; community hall—provision and (or) operation; electric power—generation and (or) distribution; mosquito control—financial aid toward; hospital—provision and operation, or provision of financial aid toward building and (or) operation of a hospital; ambulance service—ownership and (or) operation.

Improvement districts incorporated for hospital purposes are distinctively named, with the words "Hospital Improvement District No." contained within the corporate name. There are 36 such districts now in existence. Two of these have the responsibility for the provision and the operation of hospital facilities, but the remainder are responsible only for providing financial aid toward the constructing, equipping, or operating of a hospital in the vicinity.

All improvement districts are empowered by the *Water Act* to raise revenue by the levying of a tax or taxes upon one or more of a number of bases, and to raise money by the imposition of tolls and charges. They are also empowered to issue debentures and to obtain funds for capital purposes (this is the usual method in

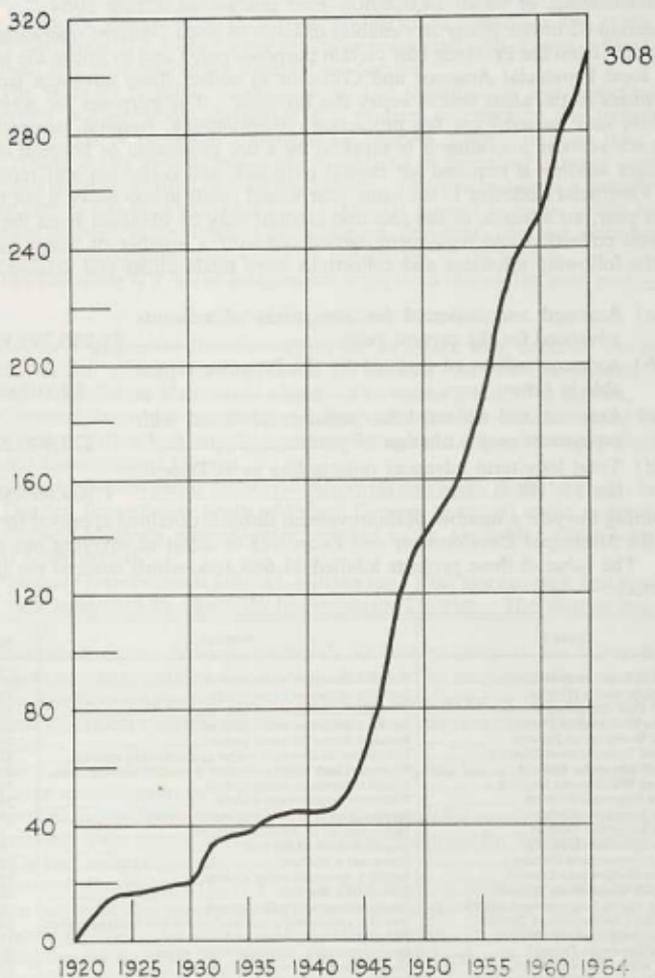
NUMBER OF
IMPROVEMENT DISTRICTS

Plate 4.

use). In many cases, improvement district debentures and the interest thereon are guaranteed by the Province pursuant to the *Improvement Districts Assistance Loan Act*. At the present time there are \$14,162,800 of such guaranteed debentures outstanding, of which \$4,060,600 were guaranteed during 1964.

Section 62 of the *Water Act* enables districts to obtain current operating funds as advances from the Province (for certain purposes only) and to utilize the services of the local Provincial Assessor and Collector to collect these advances from the land-owners in the areas and to repay the Province. The purposes for which this procedure may be used are fire protection, street-lighting, hospital purposes, and ambulance services providing it is supplied by a fire protection or hospital district. If a larger amount is required for capital purposes, and collection and repayment by the Provincial Collector in the same year would result in too heavy a tax burden for that year, an advance of the required amount may be obtained from the Province, with collection and repayment carried out over a number of years. During 1964 the following advances and collections were made under this section of the Act:—

(a) Assessed and collected for repayment of amounts advanced for the current year	\$1,130,793.82
(b) Amounts advanced in 1964 by the Province repayable in future years	89,807.00
(c) Assessed and collected for amounts advanced with repayment over a number of years	223,406.27
(d) Total long-term advances outstanding as at December 31, 1964	1,509,667.88

During the year a number of improvement districts obtained approval for loans under the *Municipal Development and Loan Act* to assist in carrying out capital works. The value of these projects totalled \$1,669,806, which covered the following projects:—

District	Purpose	Amount
Airport Hill Improvement District	Install a domestic water system	\$42,645.00
Bowser Waterworks District	Install a domestic water system	52,038.00
Cranberry Fire Protection District	Construct a community hall	25,950.00
Deep Cove Waterworks District	Install a domestic water system	181,000.00
Fernwood Waterworks District	Install a domestic water system	26,400.00
Fort Nelson Improvement District	Extensions to domestic water and sewerage systems	85,000.00
Frutivale Waterworks District	Extension and improvement of domestic water system	60,500.00
Hagensborg Waterworks District	Install a domestic water system	73,700.00
Mamquam Sewerage District	Extension to sewerage system	21,037.00
Naramata Irrigation District	Improvements to domestic water system	19,881.00
Naramata Irrigation District	Improvement to irrigation system	3,850.00
Naramata Irrigation District	Improvements to fire hall	8,183.00
Nechako Improvement District	Construct a fire hall	28,175.00
Noosatsum Waterworks District	Install a domestic water system	14,325.00
North Cedar Waterworks District	Construct a fire hall	26,070.00
Pemberton North Improvement District	Install a domestic water system	28,740.00
Port Clements Improvement District	Install a generating plant and power-distribution system	37,750.00
Port Hardy Improvement District	Install a domestic water and sewerage system	213,000.00
Rutland Waterworks District	Improvements to domestic water system	18,862.00
Sandwick Waterworks District	Install a domestic water system	63,000.00
Sicamous Waterworks District	Install a domestic water system	147,825.00
Sidney Waterworks District	Extensions to a domestic water system	56,500.00
South Pender Harbour Waterworks District	Install a domestic water system	234,000.00
Valleyview Irrigation District	Install a sewerage system	120,675.00
Westbank Waterworks District	Install a sewerage system	45,000.00
Wilmer Waterworks District	Install a domestic water system	36,000.00

IMPROVEMENT DISTRICTS ENGINEERING SECTION

The Improvement Districts Engineering Section handles the technical and engineering work associated with improvement districts incorporated under the *Water Act*. While the objects of an improvement district, as defined in its Letters Patent, may be numerous, it is mainly those functions connected with domestic water supply, irrigation, and sewerage which concern the Section.

The Section's principal functions consist of investigating and reporting on the engineering and economic feasibility of a project, or checking the technical and financial aspects of proposals submitted by districts, usually through their consultants. Other duties include assistance to districts in operating existing engineering works and the dispensation of technical advice. In some instances a complete engineering service has been provided for a particular project from the initial investigation stage through to preparation of the design drawings, contract documents and specifications, and finally supervision of installation of the works.

The following is a list of assignments completed during the past year:—

Review of Water-supply Proposals

Bowser Waterworks District.—Plans for an intake well, concrete storage tank, and distribution system were approved for Bowser Waterworks District, located north of Parksville on Vancouver Island. The works are now in service.

Diamond Improvement District.—Proposals for the installation of a water-supply system with a bulk supply from the Village of Ladysmith were submitted by Diamond Improvement District.

Nechako Improvement District.—Approval was given to the Nechako Improvement District, immediately north of Prince George, to install water systems if test-wells showed adequate ground-water supplies to be available. Test-holes are at present being drilled.

Fruitvale Improvement District.—Plans for a steel storage tank and new supply main were submitted by Fruitvale Improvement District. The district lies east of Trail.

Riverview Area.—Various proposals to supply water to the Riverview area near Creston were examined, but all were found to be economically unfeasible.

Garden Bay.—Approval was given for the installation of pipe-lines forming the first stage of system renewal for the Garden Bay Improvement District on Sechelt Peninsula.

Alice Siding Area.—Various alternative schemes for a water supply to Alice Siding area near Creston were studied.

Spences Bridge Waterworks District.—Proposals for repair of the Murray Creek dam, renewal of the supply main, and provision of storage for Spences Bridge Waterworks District were reviewed.

Rutland Waterworks District.—The possibility of diverting water from Daves Creek to augment the supply to Rutland Waterworks District was examined and found economically unfeasible. Subsequently, the district submitted a proposal for extending the existing system to serve the West Rutland area, using an established well as a source of supply. This scheme was appraised, and suggested modifications are currently being considered by the district's consulting engineers.

Airport Hill Improvement District.—Final plans and specifications for a water system to serve the Airport Hill Improvement District, Prince George, were approved. The works are currently under construction.

Fernwood Point Improvement District.—Following approval of final plans and specifications, a water system to serve the Fernwood Point area, Saltspring Island, was installed and is operating successfully.

Dean Park Road Area.—In conformity with recommendations made in a report on water supply for North Saanich, the Dean Park Road area was included in the Sidney Waterworks District. Plans for a water-system were approved, and the works are now in service.

Sandwich Waterworks District.—The district obtained approval of final plans for a water system which has subsequently been installed.

Naramata Irrigation District.—Consulting engineer's plans were approved for the installation of bulk chlorinators on both the north and south intake pipe-lines.

Wilmer Waterworks District.—The district obtained approval for, and subsequently installed, a domestic water-supply system.

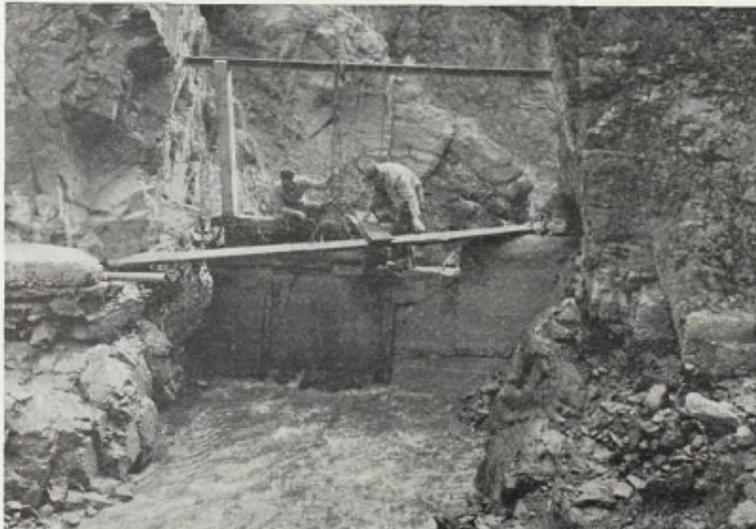
Curteis Point Area.—The Curteis Point area of North Saanich was included in the recently organized Deep Cove Waterworks District. A report submitted by the district's consulting engineer indicated that the provision of water-supply facilities to Curteis Point was economically feasible.

Sicamous Waterworks District.—Final plans and specifications were approved, and a water system installed.

Bluebird Corner.—Following the preparations of a feasibility report prepared by the District Office, Nelson, the Beaver Falls Waterworks District agreed in principle to include the Bluebird Corner area. Preliminary plans for the water system have been studied, but are currently held in abeyance whilst alternative sources of supply are being investigated.

Beaver Falls Waterworks District.—The district has purchased an existing water system previously operated as a public utility. Plans have been approved for system extensions and modifications, but construction is held up pending the selection of a supplementary source of water supply.

Chetwynd Waterworks District.—The district obtained approval for the extension of the water system. Subsequently, Chetwynd obtained the status of a village and the district has been dissolved.



Spences Bridge dam, to be rebuilt under Water Rights Branch supervision.

Hagensborg Waterworks District.—Final plans and specifications for a water system to serve Hagensborg in the Bella Coola Valley were approved. The works are substantially completed and should be in operation early in the new year.

Port Hardy Improvement District.—Studies were made of several reports regarding the provision of sewer and water services for Port Hardy on North Vancouver Island.

Pemberton North Improvement District.—Plans and specifications were approved for a water system to serve Pemberton North, located on the Lillooet River north of Garibaldi Park. The works have now been installed.

Sorrento Waterworks District.—Following a report by the Water Rights Branch, the Blue River Improvement District is negotiating to obtain ownership of the existing C.N.R. water system at Blue River. It is proposed that the system be extended to serve the majority of existing homes in the district.

Noosatsum Waterworks District.—Final plans and specifications were approved for the installation of a water system to serve the Noosatsum Waterworks District, located in the Bella Coola Valley.

Sidney Waterworks District.—Plans covering proposed modifications and extensions to the water system were approved.

Clearbrook Waterworks District.—A report on proposed extensions and modifications to the existing water system was reviewed.

Miscellaneous Subdivisions.—Numerous plans and specifications for water systems to serve private subdivisions were reviewed in connection with water licence applications.

Review of Irrigation Proposals

Winfield and Okanagan Centre Irrigation District.—Further site investigations, air photography, surveys, and mapping were carried out in connection with a proposed report on the rehabilitation of the domestic and irrigation system serving the Winfield and Okanagan Centre Irrigation District.

Oyama Irrigation District.—Proposals for the rehabilitation of the Oyama Irrigation District's system were reviewed.

Review of Sewerage Proposals

Proposals for the installation of sewer systems for the following districts were reviewed by the Section:—

- (1) Westbank Waterworks District.
- (2) Valleyview Irrigation District.
- (3) Extensions to existing system of Mamquam Sewerage District.

Investigations for Reports

Sechelt Area Water Supply.—A study is being made to examine the technical feasibility and economic implications of forming a Greater Sechelt Water Board encompassing the Village of Sechelt, West Sechelt Improvement District, Selma Park Improvement District, and the area supplied by the Davis Bay Waterworks Company. A detailed field survey of the area and existing facilities was conducted during the summer.

Sointula.—A request was received from the residents of Sointula, Malcolm Island, to investigate the possibilities of installing a community water-supply system, as many of the private wells in use had become polluted. A field investigation was made, which indicated the need for further research into the availability of groundwater. This is in hand at the present time.

Gillies Bay Improvement District.—The Gillies Bay Improvement District on Texada Island is negotiating the take-over of the water system owned by Texada Mines Ltd., and proposes extending the system. Engineering advice was requested by the district's Trustees, and a field survey of the system was recently carried out.

Reports Prepared

Gold Bridge Waterworks District.—The Gold Bridge Waterworks District is located some 60 miles west of Lillooet. The district supplies domestic water to a population of approximately 100 persons living in the Gold Bridge townsite.

Following field studies, a report was prepared outlining the economic feasibility of rehabilitating the existing works. The report recommended adjustments in the existing schedule of water charges, following which the district would receive adequate revenue with which to carry out the renewal of the system.

Lyll Harbour Area.—The Lyll Harbour area on Saturna Island obtains a domestic water supply from four small systems owned by a private company.

At the request of the existing consumers, a report was prepared in which the feasibility of forming an improvement district to take over the systems was investigated. The report recommended that the operation of the water service be left with the present owners.

Vavenby Improvement District.—A report for the Vavenby Improvement District, near Clearwater, examined the technical feasibility and probable costs of a domestic water-supply system. The report concluded that, with the full support of the existing potential consumers, the scheme could be economically feasible.

Fort Nelson Improvement District.—The Fort Nelson Improvement District is faced with the problem of maintaining sewer and water services under very adverse climatic conditions. The resultant high cost of system installation was emphasized in a report prepared for the district to investigate the economic feasibility of providing sewer- and water-system extensions to serve the Hospital Hill area. The construction of the system extensions is currently in hand.

Fanny Bay Waterworks District.—The Fanny Bay Waterworks District is located on the Island Highway south of Courtenay on Vancouver Island. In response to a request from the Trustees, a report was prepared which investigated the implications to the district of assuming responsibility for domestic water supply to a large private subdivision on Ship Point.

Little River Improvement District.—Following a report on the economic feasibility of providing a domestic water system to serve the Little River area north of Comox, an improvement district has been organized. A successful well has been developed, and the preparation of final system design is in the hands of the district's consulting engineers.

Area South of Union Bay.—A report was prepared on the economic feasibility of providing a water supply for a small collection of properties bordering the Island Highway approximately 1½ miles south of Union Bay, Vancouver Island. Owing to the absence of a suitable independent source of water supply, the report advised the property-owners concerned to negotiate an agreement with the Union Bay Waterworks District.

Mayne Island.—A survey of the existing water-supply system serving various areas on Mayne Island was carried out, and a report-memorandum prepared.

Design and Engineering Services

Spences Bridge Waterworks District.—The recommended programme for rehabilitation of the domestic water system serving Spences Bridge Waterworks Dis-



Fort Nelson Improvement District water-storage tank.

trict called for reconstruction of the Murray Creek dam as the first stage. A field inspection of the site was made, and subsequently detailed plans for a new dam were drawn up, together with the necessary specifications and contract documents.

Canyon Waterworks District.—The rehabilitation of the water system serving the Canyon Waterworks District was approved under the *Agricultural Rehabilitation and Development Act*. Final plans and specifications are currently in hand, and it is anticipated that construction will start next spring.

Throughout the year, personnel from the Section travelled extensively in the Province holding meetings with district Trustees, organization committees, municipalities, and other groups actively concerned with problems of development. The stimulus imparted to development by the Winter Works Incentive Programme and the *Municipal Development and Loan Act* was evident from the considerable increase in the number of proposals submitted and approved, particularly in areas where schemes had previously been uneconomic.

POWER AND MAJOR LICENCES DIVISION

The Power and Major Licences Division is responsible for engineering and administrative duties in connection with the use of water for power purposes. The various duties performed by the Division include:—

- (a) Reporting upon the suitability of all power licence applications, and undertaking any further investigations that may be required.
- (b) Administration of the *Water Act* in so far as it applies to the use of water for power purposes, including the calculation and billing of annual rentals and fees.
- (c) Investigation and research necessary to guide the development of Government policy with respect to the utilization of the hydro-electric power potential of the Province.

- (d) Carrying out an engineering review of plans for major licence applications for industrial and mining purposes.
- (e) Completion of statistics concerning the use of water for all purposes, as a guide to future water resource planning.

MAJOR LICENSING ADMINISTRATION

All water licence applications for power purposes are scrutinized by an engineer of the Division for suitability and to determine the rentals payable. Where the amount of power to be developed is fairly substantial, further investigation may be made by the Division, including, where necessary, the hiring of specialist consultants.

In the case of major power licence applications, special attention is paid to public safety. This may require carrying out specific studies or obtaining expert advice on such matters as the stability of dams and the necessary measures for dealing with floods. The optimization of site potential also receives serious attention with regard to the integration of a hydro development with other loads and resources in the most economic fashion.

Other aspects commonly taken into consideration as being in the public interest are the extent to which reservoirs should be cleared of flooded timber, the general effects on fish and wildlife, and the use of reservoir areas for recreation.

Existing Licences

The duties of the Division staff with respect to existing power licences consist of the calculation and billing of annual rentals and fees; the compilation of annual generation figures for use in calculating rentals and preparing statistical records; administration in connection with special clauses in licences, including carrying out the necessary studies and investigations; and interpretation of the *Water Act* with respect to use of water for power purpose, including any general matters pertaining thereto.

In certain major storage licences, notably those applying to the Columbia and Peace River power projects, the powers of the Comptroller have been set forth explicitly in special clauses in the licences. These special clauses cover such matters as approval of plans for dams and other structures, the clearing of reservoirs, public access to reservoirs, the release of water from reservoirs, and the protection of fish and wildlife. An important function of the Power and Major Licences Division is the carrying-out of the studies and administrative work necessary to enable the Comptroller to exercise his responsibilities with respect to major water resource projects.

Work proceeded during 1964 on approval of plans for the Peace and Columbia projects. With major projects of this nature, approval of plans is a continuing process which is expected to continue throughout the period of construction for each project. In the case of the Portage Mountain project on the Peace River and the Arrow and Duncan projects on the Columbia, approval in principal has been given of most aspects of the projects as presently conceived, but in each case certain features of the projects are under study as final designs evolve.

Because of the highly specialized nature of major dam construction, it is necessary for the Comptroller to obtain advice from specialist consultants of internationally recognized stature for the review of plans for major dams. For the Portage Mountain dam, our general consultant is Mr. D. J. Bleifuss, of Atherton, California, who is actively involved in major dam projects on four continents. Dr. H. Q. Golder, of Toronto, has also been retained as specialist consultant on soil and foundation problems for the Portage Mountain dam. Mr. Bleifuss is also acting as consultant

for the Duncan Lake dam, while the consultant for the Arrow Lakes and Mica Creek dams is Mr. F. S. Slichter, of Burke, Virginia. Mr. Slichter was formerly chief civil engineer of the U.S. Corps of Engineers, and brings from his career with the corps a wide experience with dams and other hydraulic structures.

The Power and Major Licences Division is responsible for the background work necessary in making the services of the specialist consultants effective in providing the advice necessary to the Comptroller in the approval of plans. During the course of this work in 1964, meetings were held with our consultants, and with engineers of the British Columbia Hydro and Power Authority and their consultants. Visits were also made with our consultants to the Portage Mountain and Mica sites during 1964.

Requirements with regard to the clearing of the Duncan and Arrow reservoirs were issued on August 17, 1964. These requirements were based on a study of the very wide experience which exists in British Columbia with regard to the clearing or non-clearing of reservoirs. Talks were also held with responsible authorities in the United States and information obtained on policies and experience in the Western States. The requirements are intended to establish the standard of clearing to be achieved, which in the case of the Arrow Lakes is complete clearing of the reservoir within five years of flooding. The manner in which this is to be achieved has been left to the discretion of the licensee, in order to allow maximum flexibility in the design of the clearing programme. However, a right of further approval has been retained by the Comptroller, particularly with respect to such matters as public access to recreational areas and clearing in advance of flooding for areas accessible to the public.

Other Major Licences

The Division is also responsible for the review of plans and other details in connection with major licence applications. Around a dozen major licence applications are being processed by the Branch at present; principally for use in pulp and paper plants or in mining operations.

POWER-POLICY PLANNING

An important duty of the Division is to assist in the over-all planning of power development in the Province. Studies are made of all potential major developments to determine how they might best fit into a Province-wide hydro-electric system. This is a continuing task, as fresh scientific and engineering developments constantly improve the feasibility of different projects and thus entail periodic reassessment of the situation.

Specific fields of study in connection with power-policy planning include the compilation of historical electric generating records and the preparation therefrom of forecasts of future load growth; studies of international power-system developments, such as the Columbia River; investigation of other public benefits obtainable at hydro-electric developments; and preparation of an inventory of available undeveloped power resources.

The studies leading to the initiation of the Columbia River development have been a major activity of the Division for more than 10 years, and these studies continued actively during 1964.

The Division assisted in the preparation of material which was presented at the hearing held by the External Affairs Committee at the House of Commons relating to ratification of the Columbia River Treaty and Protocol. The Committee, in its report to the House, found itself in favour of the proposed treaty, and parliamentary approval took place very soon thereafter.

Formal exchange of instruments of ratification of the Columbia Treaty took place on September 16th, together with the payment to Canada of \$253,929,534.25 in United States funds by Columbia Storage Power Exchange, this sum being the purchase price for the Canadian power entitlement under the treaty. By the time of completion of the Mica Creek dam in 1973, the United States payments under the treaty and sales agreement will be worth \$501,000,000 (Canadian), which is well in excess of the estimated cost of the treaty projects.

The Columbia River Treaty initiates the greatest water-resource development in the history of the Province by providing for the sharing with British Columbia of the benefits which would inevitably result downstream in the United States from any major development of the Columbia River in Canada. It would indeed be difficult to overestimate the magnitude of this achievement.

UNDEVELOPED WATER POWER IN BRITISH COLUMBIA

In 1954 the Water Rights Branch published a booklet entitled "Water Powers of British Columbia." Studies subsequent to that date have shown the available potential to be several times greater than was then anticipated. Because of this, a review is under way to update the information previously published and to make a more precise estimate of the Province's undeveloped hydro-electric power resources. In the past, calculations of power potential have been unduly conservative, and it is therefore intended to correct this situation by applying modern techniques in the development of major sites and the transmission of power over long distances.

The first stage of the above-mentioned study is almost complete, and consists of an itemized list, or inventory, of all potential sites and the power available at each one on an individual basis. Present intentions are that a complete tabulation of all known sites will be included with the 1965 Annual Review of Water Powers of British Columbia. The next stage of the study consists of determining the contributions which individual sites can be expected to make when operated in an integrated system. It is believed that this method of calculating potential output will increase the total from known sites by perhaps as much as 50 per cent on the present figure of 22,000,000 kilowatts. There are, however, many sites that have not yet been investigated at all, and it is possible that the ultimate figure may be several times that amount.

DEVELOPED HYDRO POWER

The following paragraphs summarize the development of hydro-electric power in British Columbia during the past year. For further details, reference should be made to previous Annual Reports or to the Annual Reviews of Water Powers of British Columbia.

Generation and Load Growth up to December 31, 1963

During 1963 the total amount of energy generated by hydro-electric plants in British Columbia was 14,260,000 megawatt-hours. This represents an increase of 5.09 per cent over the corresponding value for the previous year.

Total electrical-energy production in 1963, from all sources, amounted to 15,418,000 megawatt-hours. Over 92 per cent of all energy was produced by hydro power.

The total energy consumption 10 years earlier, in 1953, was 6,122,000 megawatt-hours, so that over the last 10 years the load has grown at an average rate of 9.7 per cent compounded annually. Generation by private industries accounts for

about half of the total; most of this is produced by the two major industrial users, Alcan and Cominco, who account for 26 and 21 per cent respectively of the Provincial total. It is inevitable, therefore, that the characteristics of these two industrial loads reflect very heavily on the Provincial total.

Plate 5 shows the hydro-electric development in British Columbia to date, and the following table shows the hydro and thermal generating totals for the past 11 years. Plate 6 shows the breakdown of generating statistics amongst the major producers.

ELECTRICAL GENERATING STATISTICS FOR BRITISH COLUMBIA, 1953-63

Year	Electrical Generation in Mwh.			Total in Average Mw.	Increase on Previous Year Per Cent
	Hydro ¹	Thermal ²	Total		
1953	5,585,814	555,892	6,121,706	698.8	12.85
1954	6,384,762	568,780	6,953,542	793.8	13.57
1955	7,859,933	628,680	8,488,613	968.9	22.05
1956	9,315,129	740,058	10,055,187	1,147.8	18.47
1957	10,161,546	586,385	10,747,931	1,226.9	6.90
1958	11,218,679	704,677	11,922,756	1,361.0	10.93
1959	11,750,270	779,915	12,530,185	1,430.3	5.09
1960	12,669,191	1,020,756	13,689,947	1,562.8	9.26
1961	12,371,019	1,050,087	13,421,106	1,532.1	-1.96
1962	13,571,637	—	14,730,000 ³	1,674.7	9.30
1963	14,262,400	—	15,417,600 ³	1,760.0	5.09

¹ From Water Rights Branch records.

² From Bureau of Economics and Statistics.

³ Estimate.

HYDRO-ELECTRIC POWER PROJECTS UNDER CONSTRUCTION

Additional Installation at Existing Plants

There were no additional units installed at any of the major hydro-electric plants during 1964.

Peace River Development

Apart from additions to existing plants, the next major hydro-power installation to be completed in British Columbia will be the Portage Mountain project on the Peace River, scheduled for first power production late in 1968.

The diversion-works for Portage Mountain dam were completed in time to withstand the 1964 summer freshet, which was the highest ever recorded. Fill-placing operations, employing the 15,000-foot-long conveyor system, were started in August, and during the 3½-month placing season 5,000,000 cubic yards of embankment material were placed. The conveyor system is the world's largest and cost \$10,000,000 to construct. Of the 466 miles of transmission-line surveying that were scheduled for 1964, 445 miles were completed, while 260 miles of the 276 miles of transmission-line right-of-way clearing were completed.

The contract for the main dam, at a price of \$73,600,000, was let in 1963, but a number of other contracts were let in 1964 covering the grout curtain beneath the embankment, power-house access tunnels, and the supply and erection of five sets of turbines and governors. Surveying and clearing of the transmission-line are well advanced, and contracts have been placed for transmission towers, hardware, and conductors.

Columbia River Development

Arrow Lakes Dam.—Preliminary activities on the project were in progress late in 1964, consisting of land acquisition, railroad relocation, and construction of a pipe-line to assure a supply of pure water to the Celgar Limited pulp-mill. Tenders for the construction of the dam were issued on September 16, 1964, with tender-opening scheduled for January 26, 1965. Major construction on this project is expected to commence early in 1965. The project is scheduled to be in operation by April 1, 1969.

Duncan Lake Dam.—Clearing of the dam-site area has been carried out, and a contract was let on October 6th for the construction of the project. The contract for slightly under \$16,000,000 covers almost the entire project and gives a good indication of a final cost within the estimate of cost in connection with treaty negotiations. The project is scheduled to be in operation by April 1, 1968.

Mica Creek Dam.—This dam, at over 700 feet in height, will be the highest in British Columbia and among the highest in the world. Although it is not required to be in operation before April 1, 1973, the project is so large that commencement of construction cannot be delayed. Accordingly, contracts have been let for clearing at the dam-site and construction of an exploratory tunnel and test chamber to provide information on the conditions to be encountered in diversion-tunnel construction.

Use of Electric Computing Equipment

Work was continued during 1964 on the preparation of a system power-study programme for use on the I.B.M. 1620 computer. An extensive check of the whole programme was made prior to preparation of the initial set of instruction cards. Testing on the computer itself was commenced in August, and has progressed satisfactorily to the point at which it can now be said to be operational. It is expected, however, that further revisions and improvements may have to be made from time to time.

This programme has been designed to study the needs of an expanding hydro-electric system, with particular emphasis on the optimum timing and sequence of construction, and the extensive testing has indicated that it should perform this function satisfactorily.

WATER LICENCE STATISTICS

The work of compiling water licence statistics, which was commenced during 1963, was continued. Using the I.B.M. 1401, it was possible to prepare a listing showing the basic details of all water licences in good standing. Checking and updating of the listed information has been proceeding, and almost total accuracy should soon be possible. A statistical analysis of the data recorded during 1963 was made, and the results are recorded below. It must be emphasized that the figures are not yet final since they are based on the unchecked data, but they can be construed as giving a reasonable estimate of the magnitude of licensed water use in the Province. A more precise and detailed analysis will be made in the early part of 1965.

Interim Totals for All Water Licences Issued up to August, 1963¹

Purpose	Total Licensed Quantity
Domestic	g.p.d. 12,619,000
Incidental domestic	g.p.d. 2,399,383

¹ Does not include licences issued with units of quantity that do not conform to standard practice (for example, domestic in acre-feet).

WATER RIGHTS BRANCH

DD 43

Purpose		Total Licensed Quantity
Irrigation	ac.-ft.	768,509
Land irrigated	ac.	265,712
Industrial	g.p.d.	218,780,000
Industrial	c.f.s.	1,483
Land improvement	g.p.d.	78,400
Mining	c.f.s.	969
Mining	g.p.d.	31,504,108
Power	c.f.s.	214,212
Storage	ac.-ft.	90,065,803
Miscellaneous	g.p.d.	491,760
Mineral trading	g.p.d.	706,400
Waterworks	g.p.d.	217,690,509
Waterworks	c.f.s.	390

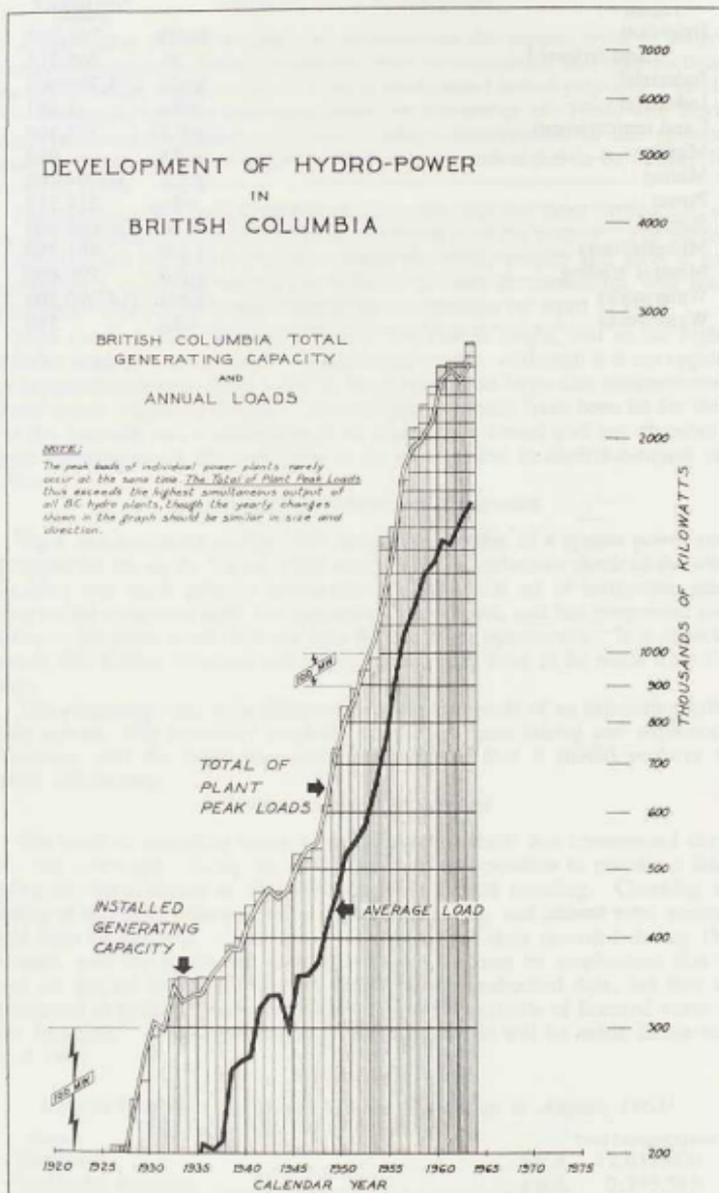
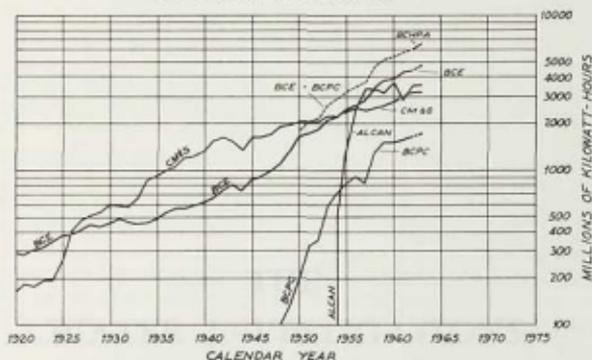


Plate 5.

DEVELOPMENT OF HYDRO-POWER IN BRITISH COLUMBIA

ANNUAL PRODUCTION OF HYDRO-ELECTRIC ENERGY
BY MAJOR PRODUCERS



ALCAN

Aluminum Company of Canada.

BCE

British Columbia Electric Company.

BCPC

British Columbia Power Commission. Shown solid until amalgamation then dotted.

CMES

Consolidated Mining & Smelting Company & West Kootenay Power & Light Company.

BCNPA

British Columbia Hydro & Power Authority. Shown dotted prior to amalgamation then solid.

INSTALLED GENERATING CAPACITIES
OF MAJOR PRODUCERS

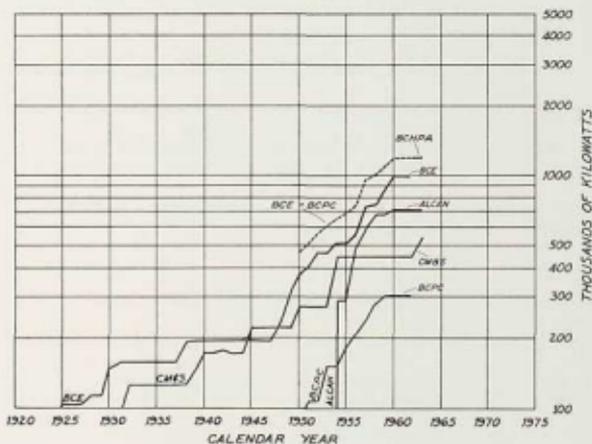
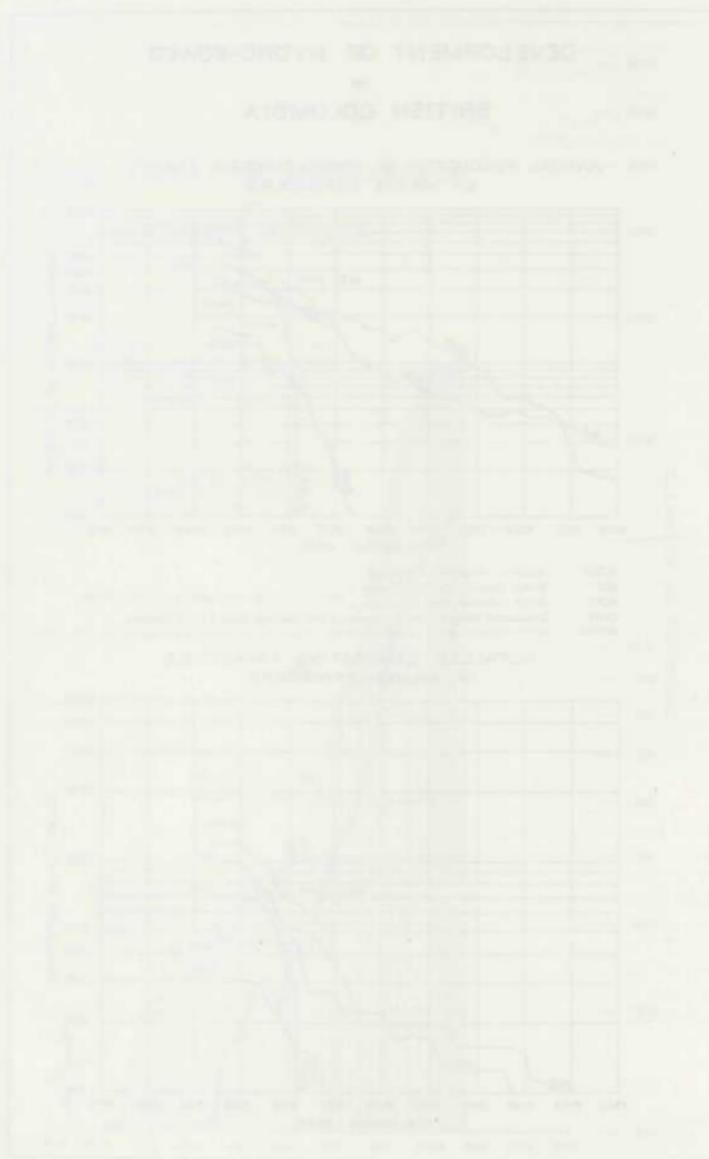


Plate 6.



WATER INVESTIGATIONS BRANCH

V. K. ...

The Water Investigations Branch, of the ...

The Water Investigations Branch, of the ...

THE WATER INVESTIGATIONS BRANCH

Table with 4 columns and 2 rows of text.

WATER RESOURCES SERVICE

THE WATER INVESTIGATIONS BRANCH

The Water Investigations Branch was formed in late 1962 as a consequence of the creation of an independent British Columbia Water Resources Service which took effect on April 1, 1962. The Hydraulic Investigations Division of the Water Rights Branch was transferred to the Water Investigations Branch, and it formed the nucleus of the new Branch.

The functions of the Water Investigations Branch, which is headed by the Chief Engineer, are to deal with technical matters pertaining to the water resources of the Province, which matters are not directly connected with the administration of the *Water Act*. These functions, carried out by various divisions of the Water Investigations Branch, are briefly summarized below.

- (1) Water Supply and Investigations Division:
 - (a) Irrigation and domestic water-supply investigations to assist and advise the Department and general public in the development and maintenance of water-supply projects.
 - (b) Flooding, drainage, and stream-erosion investigations to give engineering advice and assistance in solving water-damage problems.
- (2) Hydrology Division:
 - (a) Snow surveys and snow-melt run-off forecasting to guide judicious utilization of water supply.
 - (b) Hydrologic studies of the Province to compile and evaluate basic hydro-meteorological data in such a form as to make them readily adaptable.
- (3) Ground Water Division: Collection of existing ground-water data and investigation and evaluation of ground-water potential to encourage and guide the future use and conservation of this source of water supply.
- (4) Basin Planning and Power Division:
 - (a) Development of plans for water conservation on regional basis with an immediate aim to indicate possibilities of augmenting the existing water supply.
 - (b) Investigation and inventory of undeveloped hydro-electric power potential of the Province.
- (5) ARDA Projects Division: Processing of water-project proposals made under the *Agricultural Rehabilitation and Development Act* and investigation of project proposals.

The above functions are carried out in co-operation with a number of other Governmental agencies with an aim to enable the *British Columbia Water Resources Service* to foster better use of water resource, which is one of the principal physical foundations of the economic development of the Province.

WATER INVESTIGATIONS BRANCH

V. RAUDSEPP, P.ENG., CHIEF ENGINEER

The Water Investigations Branch, which was created in December, 1962, deals with technical matters related to the water resources of the Province, where such matters are not directly connected with the *Water Act*. At the year-end, the staff consisted of 38 permanent and 16 temporary positions, among which were 17 civil engineers, 2 geological engineers, and 1 hydro-meteorologist. One position was transferred to the office of the Deputy Minister of Water Resources and two were vacant.

The principal functions of the Water Investigations Branch are carried out by five divisions, as follows:—

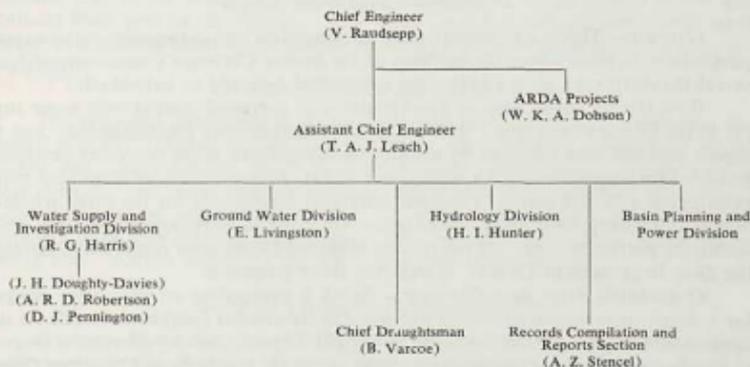
- (1) Water Supply and Investigations Division.
- (2) Hydrology Division.
- (3) Ground Water Division.
- (4) Basin Planning and Power Division.
- (5) ARDA Division.

These divisions are supported by a Draughting Office and a Records Compilation and Reports Section. Both these sections perform certain services also to the Water Rights Branch of the British Columbia Water Resources Service.

An account of the work carried out by the Water Investigations Branch is given in some detail on the following pages. A few general observations are given below.

The Water Supply and Investigations Division, under Mr. R. G. Harris, had again a variety of irrigation and domestic water-supply and river engineering projects under study. A number of these projects have been initiated in connection with applications for assistance under the *Agricultural Rehabilitation and Development Act* or are projects which may receive consideration under the *Canada-British Columbia Joint Development Act* and *Canada Water Conservation Assistance Act*. Three small river-improvement projects and one low-dam construction project were carried out.

ORGANIZATION CHART OF THE WATER INVESTIGATIONS BRANCH YEAR ENDED DECEMBER, 1964



The Hydrology Division, headed by Mr. H. I. Hunter, is re-evaluating snow-melt run-off forecasting procedures using computer techniques. The 1963/64 heavy snow, combined with late spring, resulted in high water levels and required a great deal of additional urgent activities in evaluation of snow-melt potential. The second main function of the Division—compilation and evaluation of useful hydrologic data—is a challenge of major magnitude, and the efforts made to date are of preparatory nature only.

The Ground Water Division, under Mr. E. Livingston, is expanding ground-water data collection by test drilling, water-table observations, well inventories, and geological reconnaissance surveys. Main emphasis is directed toward the dry Interior of the Province, where cheap surface-water supplies have been exhausted.

In the Basin Planning and Power Division, work continued on Similkameen Basin hydrologic and water-supply studies. Potential water-power studies are being carried out on Stikine River and other northern streams.

The ARDA Division, under Mr. W. K. A. Dobson, is facing a heavy work load in processing, investigating, and designing water-project proposals which have been made under the *Agricultural Rehabilitation and Development Act* assistance programme. It is noted that the Division has no permanent-staff positions.

Senior members of the Water Investigations Branch have participated in a number of committees and boards dealing with water matters, such as Hydrology Sub-committee of the National Research Council, National and Provincial Committees for the International Hydrologic Decade, several committees in connection with ARDA activities, and the Pollution-control Board. Active participation in the studies carried out by the Fraser River Board under Mr. T. A. J. Leach, Assistant Chief Engineer, was continued until termination of the Fraser River Board activities.

WATER SUPPLY AND INVESTIGATIONS DIVISION

R. G. Harris, P.Eng., Chief of Division

The functions of the Water Supply and Investigations Division can be divided into two main engineering sections—(a) irrigation and domestic water-supply projects and (b) flood- and erosion-control and drainage projects.

The main projects that have been dealt with in 1964 are summarized below.

IRRIGATION AND DOMESTIC WATER-SUPPLY PROJECTS

Doukhobor Lands Water Supply

General.—This is a continuation of investigations into community water-supply possibilities in areas where the holdings of the former Christian Community of Universal Brotherhood Limited have been subdivided and sold to individuals.

West Grand Forks Area.—Two reports were prepared dealing with water supply in the Grand Forks area. Three separate schemes were recommended: one to supply domestic water only to 95 acres of residential lots, while two other proposals provided for irrigation and domestic water to two adjacent areas of farm land comprising 510 and 225 acres. The total estimated capital cost for the three schemes was approximately \$475,000. In all cases, water would be pumped from deep wells within the particular area. At the present time, the Doukhobor community, through the Zion Improvement District, is studying these proposals.

Ootischenia Area, near Castlegar.—Work is proceeding on alternative designs for a distribution system to supply water to the subdivided Doukhobor lands on the Ootischenia Bench near the Castlegar Municipal Airport. Among alternative sources of supply considered are ground-water wells, a gravity supply from Champion Creek

some 2 miles south of the area, and a pumping-station which would deliver treated water from the Kootenay River. Cost estimates have been prepared for various combinations for domestic and irrigation purposes. Because of the shortage of gravity supply and the considerable pumping lift under other schemes, the cost of an irrigation supply for this area is extremely high. Schemes for supplying domestic water only are still being explored.

Immediately to the south lies the Champion Creek area. Here, the original proposals for domestic and irrigation water supplies (1956) have been revised and new estimates of cost are being prepared.

Raspberry and Brilliant Areas, near Castlegar.—Three alternative projects of supplying water to the subdivided Doukhobor community land at Raspberry and an adjoining group of privately owned properties were examined. Subsequent to the presentation of the report on these three alternatives, an estimate was made of the cost of constructing a first stage of the gravity supply scheme for service to the properties on the west side of Norns (Pass) Creek. In November, 1964, these properties were incorporated as the Raspberry Improvement District for implementation of a water-supply scheme.

The Branch's report proposed a system for the Brilliant community that would supply domestic and irrigation water to 65 small lots and 82 acres of irrigable farm land by pumping from two wells. No exploratory drilling has been done for this area, however.

Black Mountain Irrigation District

Irrigation System.—Studies on irrigation-system replacements for the Black Mountain Irrigation District were completed. A detailed inventory and replacement schedule for existing system works was prepared, together with plans showing layouts of existing and proposed works. Studies conclude that during the ensuing 40-year period some \$1,708,000 may be required to replace existing system works which serve 4,582 acres of irrigable land. Of this total, \$808,000 of replacements may be required within the next 10 years. The district is presently considering what programme should be adopted for carrying out system replacements, and it is anticipated that additional alternative proposals will require further consideration.

Domestic System.—Studies on replacements for the Black Mountain Irrigation District's Belgo domestic-system works have been started. In addition to an inventory and replacement schedule for existing works supplying about 100 connections, this study will consider the feasibility of supplying some 46 connections in the Upper Benches area of the district and some 125 connections in the Lower Bench and Rutland Flats area of the district. This work has been delayed temporarily until results of a ground-water investigation for domestic water supplies in the area are available.

Boundary Line Irrigation District

The proposed rehabilitation of the Boundary Line Irrigation District was discussed with the Trustees during August, 1964. This involves replacement of the pumps and pumping-main, which become seriously overloaded during periods of peak demand, and are at present unable to deliver adequate sprinkler pressures to some of the higher areas in the district. It is also proposed to replace the steel pumping-main with asbestos-cement pipe. The estimated cost of the improvements is \$18,000. ARDA assistance has been requested by the district.

South-east Kelowna Irrigation District

Domestic Water Supply.—The South-east Kelowna Irrigation District is presently supplied with domestic water through a gravity intake on Canyon Creek, a

tributary to Mission Creek. The flow from Canyon Creek is inadequate to supply the system during exceptionally dry seasons. Extension to areas not presently served by the domestic system is limited by the capacity of the existing mains and by the lack of an adequate supply from the present intake.

Preliminary investigations were begun in 1963, and topographic maps of the district were prepared. Studies were made during the past year of two possible sources of supply—one from a pumping-station on Mission Creek and one from ground-water wells. Test drilling at several locations was undertaken by the Ground Water Division of the Water Investigations Branch. These tests have recently been completed and have indicated that wells of sufficient capacity could not be developed. Further study will be required on the Mission Creek scheme, particularly with regard to treatment equipment necessary to remove the silt carried by the creek during periods of flash floods.

Irrigation System.—An examination of proposed renewals of part of the district's irrigation system known as Stirling extension was carried out in connection with application for ARDA assistance.

Oyama Irrigation District

The existing system supplies irrigation water only, domestic water being stored in cisterns for winter use. The Trustees had requested a feasibility study be made on a new joint irrigation and domestic scheme. The surveys and preliminary investigations for this report were begun in 1963. Several alternate layouts were considered, involving pumping from Kalamalka and Wood Lakes and from ground-water. Two ground-water test-wells were drilled, and results indicate that adequate capacity could be obtained from two wells. However, the water quality was not good, being relatively high in iron and hardness. Possible treatment methods and then costs were discussed. While the relatively small system would not warrant a central treatment plant, individual water-treatment equipment on domestic lines would be feasible.

The Trustees have made application for ARDA assistance to proceed with the ground-water scheme. The estimated capital cost of this project is \$132,000.

Ashcroft Area Irrigation Proposal

An investigational programme conducted during the years 1961 and 1962 was concluded with the publication of a report on "Ashcroft Area Irrigation Possibilities."

The area considered for irrigation extends along the north and west sides of the Thompson River between Kamloops Lake and Basque, a distance of some 36 miles, and along the tributary valleys of the Bonaparte and Deadman Rivers.

Department of Agriculture soil surveys and land-classification data covered a total of 51,000 acres, of which 24,500 were considered arable. Of this arable portion, 8,765 acres in the vicinity of Cache Creek and Ashcroft were included in the development plan proposed for the area.

The studies cover irrigation of a 5,900-acre tract south of Cache Creek by pumping from the Bonaparte River, where a 2,000-horsepower installation would be needed. Supplementary local pumping would be necessary because of the variations in topography which occur.

North and east of Cache Creek a total of 2,862 acres would be dependent on the Thompson River and might be developed as a number of separate entities, each with its own pumping plant. The total horsepower needed would be about 2,850.

Capital costs are estimated in the region of \$450 per acre developed, and total annual charges are expected to lie between \$45 and \$70 per acre, depending on location and topography.

No economic studies were attempted, and the desirability of irrigating these new lands has not been established.

Kaleden Irrigation District

Investigations into the problems associated with rehabilitation of the Kaleden irrigation system were completed, and the district was successful in qualifying for assistance under the ARDA programme.

The original decision to proceed with a renewal of the existing gravity system was reversed after receiving ARDA approval, and a revised approval based on pumping from Skaha Lake was subsequently obtained.

Civil-engineering design work was commenced with a view to implementing a construction programme early in 1965.

The district comprises some 540 acres of orchard land and about 120 homes. Total capital expenditure on the rehabilitation is estimated at \$300,000.

Okanagan Falls Irrigation District

The Okanagan Falls Irrigation District obtains its water from an intake on the Okanagan River near the outlet of Skaha Lake. The system, now irrigating some 135 acres and supplying domestic water to about 150 consumers, was constructed in 1953. Since then, there has been an increase in domestic water use, as well as an increase in the use of sprinkler irrigation. A growing problem in the past has been the occurrence of disagreeable tastes and odours in the water during the summer months. The cause of these tastes and odours has not yet been definitely established.

Proposed improvements to the pumping system include the installation of a booster pump and the construction of a storage tank to provide automatic pump operation. Also recommended is the replacement of some sections of pipe. The cost of the proposed improvements is estimated at \$28,000, with annual costs of \$1,550.

Westbank Irrigation District

The Westbank Irrigation District has made an application for ARDA assistance for rehabilitation of its irrigation system. Investigations are being carried out in order to determine preliminary design and cost estimates for the replacement of the main supply flume. Further studies will be required on rehabilitation of distribution system and the storage dams.

Nickel Plate Lake Dam Reconstruction

This irrigation storage dam, operated by the Similkameen Improvement District, was reconstructed under ARDA assistance programme. The design and supervision of construction was carried out by this Division. The dam is located some 6 miles north-east of Hedley at 6,000-foot elevation and provides some 2,000 acre-feet of storage.

Construction was completed in seven weeks, in November, 1964. Some 5,600 cubic yards of material was stripped from the old dam and 7,500 cubic yards of embankment were placed in the new dam. Concrete culvert structure required 50 cubic yards of concrete. Construction was by the Interior Contracting Company Limited of Penticton. Payment was based on equipment rental, with an upset price of \$32,500.



Nickel Plate Lake dam sluice pipe.

Ladysmith Region Water Supply

A water-resource investigation of the Ladysmith region of Vancouver Island was undertaken at the request of the British Columbia Department of Public Works in connection with a proposed institute and its water requirements.

Existing and potential water sources for domestic purposes were investigated, and a report completed showing potential future developments that might be undertaken to meet the growing needs of this area. In addition to surface supplies, ground-water sources were investigated.

In general, it would appear that through careful expansion of existing facilities it should be possible to serve a population several times the present one.

Water-storage Reservoir Inventory

A programme of mapping major water-storage reservoirs in the Southern Interior of the Province was undertaken. This information will assist in administering of water rights and will enable the Division to carry out water-supply augmentation studies in water-deficient areas.

Mapping is being prepared from air photographs and field surveys. Some 60 reservoirs require mapping. Of these, seven were surveyed in 1964.

FLOODING, DRAINAGE, AND EROSION PROJECTS

Okanagan Flood-control Works

In the summer of 1963 a survey of the Okanagan flood-control channel and structures was undertaken. Structure plans, channel profiles and cross-sections were drawn from the data obtained on the survey. Calculations were continued in 1964 and the design flow high-water profile was calculated.

Several modifications and improvements in the Okanagan flood-control works are considered necessary. Extensive bank and channel-bottom protection is required to stabilize the channel at high or design maximum flows. Modification or lowering of the water-supply intake culverts is necessary in order to supply irrigation water to the lands adjacent to the river channel when river flows are below 500 cubic feet per second. Some dredging of the channel and entrance to Osoyoos Lake is also recommended. Replacing of portions of the boundary fencing and gates and minor repairs to some of the vertical drop structures are also considered desirable. Costs of the above-mentioned repairs are being calculated, and a report detailing requirements to bring the Okanagan flood-control to full operating condition is being prepared. Further study is planned on the hydraulic operation of the Okanagan flood-control system, and results of this study will be available in 1965.

Vedder-Chilliwack River Flooding and Erosion

A number of river-channel cross-sections were established in 1958 with an aim to check locally made suggestions that the river bed is gradually aggrading. In the fall of 1963 a field survey was undertaken to resurvey the cross-sections established in 1958, and to obtain additional field data necessary to prepare a preliminary design of channel stabilization, erosion, and flood-control works, including preliminary cost estimates. The river is divided into two sections—(a) the Vedder River and the Chilliwack River within the District Municipality of Chilliwack, a distance of 4.65 miles, and (b) the Chilliwack River above the District Municipality of Chilliwack, a distance of 3.2 miles.

The total cost of the proposed river-improvement work is estimated at \$1,222,000, of which \$810,000 applies to section (a) and \$412,000 to section (b). These estimates contain no allowance for rights-of-way. Above the municipality boundary, the river would be contained within its present course, protecting approximately 283 acres of land on the right bank, including a sawmill, 17 houses, and 16 other structures. The access road to the Chilliwack Working Circle of the British Columbia Forest Service would also be protected. On the left bank, erosion at the Soowahlie Indian Reserve No. 14 would be prevented. In addition, a total of 73 acres of land on both banks may be reclaimed between the groin system.

Within the District Municipality of Chilliwack, some 140.5 acres of land within the present flood channel would be protected by dykes and a further 217 acres between the groin system may be reclaimed, subject to occasional flooding. An estimated 1,245 acres of land, including 73 houses and 91 other structures, would be protected against local flooding.

Squamish River Flooding and Erosion

In 1963 a field survey of the Squamish River was made to obtain a longitudinal profile and 11 cross-sections over a 10-mile reach upstream from the river mouth. This work was extended in 1964 by a survey of 2½ miles of the Mamquam River upstream from its junction with the Squamish River.

A preliminary design of channel stabilization, erosion, and flood-control works, including cost estimates, is now under way and is scheduled for completion by the end of 1964 or early in 1965.

Similkameen River Survey

In response to requests for flood and erosion control on this river, a field survey was carried out during the summer of 1964. In all, the survey covered some 70 miles of river from Princeton to the International Border. At present the flood

profile for the unprotected channel, for a design 50-year flood of 40,000 cubic feet per second at the border-crossing point, is being calculated. Preliminary meetings have also been held to arrange for an economic study of the area. This information will be used to determine the feasibility of any flood-control project on the basis of a favourable cost-benefit ratio.

Improvements to Similkameen River at Princeton

Construction of improvements to the Similkameen River channel at its junction with the Tulameen River commenced in November, 1964. It is hoped that the new location of the river junction will alleviate a flooding problem in the Village of Princeton caused by ice jams. The work involves the removal of some 30,000 cubic yards of material to form a new river channel, the placing of 2,500 cubic yards of rock riprap, and the protection of a sewer and water-line crossing the river by means of a gabion structure.

Fraser River Basin Maximum Water-level Observations

During 1964 arrangements were made through the Water Rights Branch District Engineers to observe daily water elevations at Prince George, Quesnel, and Kamloops. At or near the peak of the flood, air photography of the above-mentioned areas was obtained at an approximate scale of 1,000 feet to the inch through the Air Division of the Surveys and Mapping Branch, British Columbia Lands Service. Areas flooded were also indicated on the 1,000-feet-to-the-inch topographic maps in the case of Quesnel and Prince George.

Personnel from the Water Investigations Branch assisted in patrolling the Lower Fraser River dykes and making notes on evidence of failure or seepage during the mid-part of June. Most of the dykes patrolled had 3 to 4 feet of freeboard during the peak river stage. Seepage was noted along the inside toe of most of the dykes patrolled.

Mission Slough Channel Improvements near Kelowna

Subsequent to the examination of drainage problems in the Fascieux Slough area of South Kelowna in 1963, channel improvements were made by local property-owners during 1964. A petition from owners of property adjoining the northerly branch of Mission Slough initiated a further examination for this section of the drainage area. The estimated cost of improvements to the northerly branch of Mission Slough and to the main channel below the junction of Mission Slough and Fascieux Slough was presented to the petitioners in March.

Bowker Creek Discharge

During the winter of 1963/64, discharge measurements of Bowker Creek were carried out in four stations in an effort to assist the Municipality of Saanich in arriving at flood flows. However, no storms of major significance occurred during this time, and the programme is being continued over another winter.

Coquitlam River Gravel Removal

A proposal by a local company to remove some 2,670,100 cubic yards of gravel over a 10-year period from the Coquitlam River at a point immediately upstream of Lincoln Avenue within the District of Coquitlam and City of Port Coquitlam was studied at the request of municipal government. It was recommended that measures be taken to maintain an adequate waterway during the gravel-removal operation, and that river control structures be incorporated in the final design to prevent deleterious effects on the river regime.

Cowichan River

An attempt was made to calibrate the discharges through the boat lock in the B.C. Forest Products weir at Cowichan Lake by taking measurements from the foot-bridge a short distance downstream. Some additional cross-sections were taken on the river downstream in the vicinity of Duncan for comparison with previous sections taken some years ago. Office studies include the preparation of a differential mass curve of the inflow to Cowichan Lake.

Vancouver North Shore Streams

The District Municipalities of North and West Vancouver have requested the Greater Vancouver Sewerage and Drainage District to prepare engineering proposals for flood and erosion control of several streams under the Canada *Water Conservation Assistance Act*. Preliminary plans, cost estimates, and benefit-cost studies have been reviewed by this Division.

HYDROLOGY DIVISION

H. I. Hunter, Meteorologist, Chief of Division

SNOW SURVEYS AND WATER-SUPPLY FORECASTING

One of the primary functions of the Hydrology Division is the annual inventory of Provincial watershed snow-pack during the snow-accumulation and snow-depletion periods. Snow surveyors made 541 trips to isolated mountain sampling-sites during the winter and spring of 1964 to gather snow-depth and water-equivalent data. These trips were made close to the regular measurement dates of February 1st, March 1st, April 1st, May 1st, May 15th, and June 1st, with the resultant data published in the six issues of the British Columbia Snow Bulletin. Most measurements were made near the maximum snow-accumulation dates of April 1st and May 1st, at which time quantitative volume stream-flow forecasts for British Columbia rivers were made for periods covering the spring and summer snow-melt season. Selected snow-course measurements were made at the earlier and later dates to show build-up and depletion of the mountain snow.

With the installation this summer of two new courses on Bulkley River drainage, a total of 141 courses will be in active operation in the coming 1965 sampling season. Of this total, 82 will be measured by personnel of co-operating agencies and the remainder by part-time employees of the Water Resources Service. Excellent co-operation continues with private and government agencies in the gathering and exchange of snow-course data.

Hydrology Division personnel visited 36 courses at regular winter sampling dates to provide at-site snow-surveying instruction, and as part of the necessary summer maintenance work, trips were made to 24 courses to clean them up and put them in satisfactory condition.

Seasonal stream-flow forecast procedures are developed by multiple regression, with the Provincial Government's electronic computer doing the mathematical computations. New computer programmes were investigated and a combination of the best ones adopted for use in the development of forecast procedures, which has resulted in work leading to a complete review of existing station forecast procedures and the development of new station procedures. Work is continuing in the development of daily stream-flow forecasting procedures for the Fraser River.

1964 SNOW-MELT RUN-OFF

The May 1st snow-course readings indicated that mountain snow was above average on most of the Province's watersheds, with this heavier than usual snow particularly applicable to low elevations. Unseasonably cool weather in May further accentuated these above average mountain snow-packs, indicating the possibility of high peak flows on our major rivers. This possibility became factual in the northern regions of the Province in June with the recording of new maximum daily flows for the Skeena and Peace Rivers. Fraser River flooding occurred in the low-lying Cache area near Prince George, with maximum flow farther downstream at Hope well above average but well below the 1948 peak discharge. Fortunately the weather, in particular the melt rate during the critical high-water period, was not too far from normal, so that major flooding was averted in the Lower Fraser Valley. On the other major rivers, annual peaks ranged from average to above average.

HYDROLOGIC STUDIES

These included a hydro-meteorological network study for the Columbia Basin in British Columbia which was presented as a technical paper at the Western Snow Conference meeting at Nelson, frequency study of tidal heights at the City of Alberni, and several smaller studies resulting from water-supply and water-damage problems.

HYDRO-METEOROLOGICAL DATA COMPILATION

Hydro-meteorological record compilation is a continuing programme, but in the past year a determined effort has been made to rearrange and list this basic data in an easily presentable and useable form. In particular this applies to the data of several hundred British Columbia stream-flow stations, with some records dating as far back as 1911. It involved sorting, arranging, filing, indexing, and mapping of the individual station data. This work is nearing completion and is expected to be both a time-saver and valuable reference to the engineering staff.

Authorization has been given to put snow-course data on punch-cards, which, in addition to a saving in man-hours, will ensure accuracy of results. Key-punching is expected to start in December.

WESTERN SNOW CONFERENCE MEETING

In April, 1964, the Water Resources Service hosted the three-day annual meeting of the Western Snow Conference at Nelson. This conference is an association of technical men and organizations from the Western United States and Canada with an interest in all aspects of snow. Technical papers presented at this meeting included those related to instruments and measurements, water-supply forecasting, physics and meteorology, and projects and basic data network. Over 100 engineers, hydrologists, and meteorologists attended this meeting, with by far the greater number coming from the United States.

INTERNATIONAL HYDROLOGIC DECADE PROJECT

A proposal to study water balance in a small watershed within the framework of the International Hydrologic Decade is under consideration. Depending on available funds, one or more small basins in the dry Southern Interior of the Province will be studied with an aim to develop improved snow-melt run-off forecasting procedures.

GROUND WATER DIVISION

E. Livingston, Geological Engineer, Chief of Division

WATER-WELL INVENTORY

The collection of data on existing water wells and ground-water use is continuing. An informal arrangement for exchange of data has been made with most of the well-drillers operating in the Province. This is providing data on most recently drilled wells. At the beginning of the year, well-location maps had been prepared covering only the Lower Fraser Valley and the east side of Vancouver Island, including the Gulf Islands. Mapping in both of these areas has been extended somewhat, and water-well maps have been started or completed in the following areas:—

- (1) Salmon Arm to Kelowna, including the valley bottoms from Armstrong to Monte Lake and Vernon to Lumby.
- (2) Oliver to Osoyoos.
- (3) Similkameen Valley from Keremeos to United States Border.
- (4) Castlegar-Kinnaird area.
- (5) Prince George and vicinity.
- (6) Vanderhoof and vicinity.
- (7) Dawson Creek to Fort St. John.

Some of the mapping listed above has been done in preparation for well inventories to be carried out in the field. A well inventory has been completed for the area from Salmon Arm to Kelowna and from Oliver to Osoyoos. Almost all of the well records collected in the Province by the Geological Survey of Canada in the past have been plotted on the well maps.

OBSERVATION WELLS

Four wells were added to our observation-well network in the Lower Fraser Valley near Langley. One well in the network at Mount Lehman was lost. Three new wells were added near Kamloops. One deep observation well is being observed near Prince George. Data from several wells near Kelowna are being assessed before deciding which of these wells will be added to the permanent network. Several observation wells are being drilled in the North Okanagan.

GROUND-WATER TEST DRILLING

Several test-drilling projects were undertaken during the year in the dry Interior of the Province in order to make available to the public data on ground-water occurrence and potential yield. In most cases, water-quality analyses were carried out by the Department of Health Services and Hospital Insurance.

Oyama Test Drilling

Two test wells were drilled and test-pumped at Oyama to test the feasibility of using ground-water for a combined irrigation-domestic water system of the Oyama Irrigation District. The test wells indicated that ground-water use is feasible. The two test wells were purchased by the Oyama Irrigation District for possible future use in such a system.

Canyon Waterworks District Test Drilling

A test well was drilled in Canyon Waterworks District west of Enderby to find a source of ground-water to replace or supplement the surface source which had

proved to be inadequate. A suitable aquifer was found. The capacity of the test well was adequate for present requirements, so the well was purchased by Canyon Waterworks District. We believe that the aquifer encountered in this well has not been known before and may be fairly widespread in this area.

South-east Kelowna Test Drilling

Two test wells were drilled at South-east Kelowna Irrigation District in order to test the feasibility of using ground-water as a source for an improved and extended domestic water system in this area. This project was unsuccessful: one hole was dry, and the other had a capacity too low to be of interest.

Ootischenia Test Drilling

The feasibility of using ground-water for a proposed irrigation and domestic water-supply scheme at Ootischenia near Castlegar was tested by drilling. Three separate areas were checked by drilling. In one area a new aquifer of limited capacity was tested. Insufficient water for the irrigation scheme was found, but this aquifer should prove to be an adequate source of good-quality water for domestic use. Drilling in the other two areas indicated that wells of limited capacity could be constructed, but the actual capacity was not checked by pump testing.

Rutland-Black Mountain Test Drilling

A test well was drilled in the north-west part of Rutland to test the feasibility of using ground-water as a source for domestic supply for an extension of the present Rutland Waterworks District. A new aquifer was discovered. The first well constructed had insufficient capacity to be of interest, but analysis of the pump test indicated that the well was very inefficient. In order to evaluate well-construction requirements, another well was drilled nearby and was constructed with a much longer screen. This was far more successful and may be bought by the Rutland Waterworks District for use as a source for the planned extension of the domestic system.

A well drilled near Reid's Corner, about 2½ miles north-east, to test the feasibility of using ground-water as a source for possible extension of a domestic system of Black Mountain Irrigation District reached the same aquifer as the Rutland well. The Black Mountain well, which is a flowing artesian well, had not been completed at the year-end.

These two wells indicate that an extensive aquifer with good characteristics occurs in this area. It may be much more extensive than this drilling has indicated. Important geologic information was also obtained in this drilling.

Grandview Flats, near Armstrong

At the year-end a test well was also being drilled at Grandview Flats, south-west of Armstrong. This hole was drilled to study sub-surface conditions in this area, which are believed to be on the path of underground flow from the Salmon River into Okanagan Lake, and to check the feasibility of obtaining ground-water for future irrigation use and also to supplement the surface-water source used by the Grandview Waterworks District. The well penetrated over 200 feet of gravel saturated below 40 feet; all indications are that good supply of ground-water is available.

Nechako Improvement District Test Drilling

Two test wells had been drilled in the Nechako Improvement District, north of Prince George, at the year-end to locate a source of ground-water for a proposed domestic system. The first hole was successful in locating a thin aquifer which prob-

ably has sufficient capacity to supply part of the district. The second hole near the north end of the district was dry. A third was being drilled at the year-end.

MISCELLANEOUS INVESTIGATIONS

During the winter and spring, geologic mapping of pleistocene deposits in the Saanich-Sooke area was done in co-operation with the Geological Survey of Canada as a part of a training programme.

The site of a proposed garbage dump on Quadra Island was examined in order to determine whether dumping would pollute existing ground-water supplies or would interfere with future water storage.

Several proposed sites for a new Provincial gaol on Vancouver Island were examined to determine whether ground-water might be a more feasible source than surface-water for domestic water supply. Several proposed sites for small dams were also examined at one of the gaol-sites.

Brief reconnaissance geologic mapping projects were carried out at Welcome Beach Waterworks District and Hopkins Landing Water-users' Community, Sechelt Peninsula, to assess the feasibility of using ground-water for domestic supply in these areas. Results were negative at Welcome Beach, but possible ground-water sources were located at Hopkins Landing.

A brief geologic investigation followed by supervision of drilling of two test wells at Long Beach Camp-site of the Parks Branch, Department of Recreation and Conservation, at Wickaninnish Bay, Vancouver Island, found only salt water.

Geologic mapping of Pleistocene deposits in the Okanagan Valley continued during the year as a continuation of a general study of the Okanagan Valley water resources.

Pump test results from a new well at Little River Improvement District near Comox were analysed.

Map and field reconnaissance of small drainage basins suitable for general hydrologic and ground-water studies by the Federal Geological Survey of Canada or the Water Investigations Branch were undertaken.

BASIN PLANNING AND POWER DIVISION

This Division of the Water Investigations Branch has two main functions—(1) development of plans for water conservation on regional or watershed basis with an immediate aim to indicate feasibility of improving the dependability of surface-water supplies in areas where readily available water supplies have been exhausted, and (2) continuation of inventory of undeveloped water-power potential of the Province.

SIMILKAMEEN BASIN WATER SUPPLY

A study was commenced in 1963 to ascertain economic and engineering feasibility of small and medium water-storage sites in the Similkameen River basin where presently available dry-season water supplies have been fully appropriated under the existing water licences.

As no basin-wide data on run-off or precipitation are available in the Province of British Columbia, it was necessary to develop empirical procedures for determination of precipitation, losses, and run-off and its variation in the Similkameen Basin, particularly for higher elevations where no meteorological data are available.

Following this, a number of apparently feasible storage-sites were selected by a map reconnaissance, some of which were covered by field reconnaissance. Air

photography was also obtained of these selected areas, and it is intended to carry out preliminary field inspections to determine the cost of potential storage dams.

Suspension of this project in September was caused by resignation of the hydraulic engineer who had been in charge of this work for about one year.

STIKINE RIVER HYDRO POWER

A study to determine the hydro-power potential of the Stikine River has been continued. Investigations into the possible diversion of water from the Dease River catchment into the Stikine River have shown that this diversion would not be economically attractive, and preliminary engineering investigation has therefore been confined to possible developments on the main stem of the Stikine River itself.

The storage-regulation charts resulting from the hydrology studies show clearly the need for a large storage reservoir located above the Grand Canyon of the Stikine to provide a highly regulated flow for power generation. Whereas natural minimum winter flows immediately upstream from the canyon are in the range 900-1,500 cubic feet per second, a regulated flow of 8,000 cubic feet per second can be provided by the operation of 4,000,000 acre-feet of live storage. As further increments of storage do not yield any greatly increased regulated flow, it is anticipated that approximately this amount of live storage will give maximum economic advantage.

The presently envisaged scheme of development consists of a dam located near the "gate of the canyon" to provide the storage required for regulation, with power generation also at this site, two run-of-the-river generating plants located in the Grand Canyon, and a dam near the settlement of Telegraph Creek, which would provide storage to regulate the flow of the main tributaries, such as the Tuya and Tazilla Rivers, together with power generation.

A short field inspection of possible dam-sites using helicopter was carried out during the summer, the visiting party including Dr. M. S. Hedley, Senior Geologist, Department of Mines and Petroleum Resources. Due to complex geological conditions resulting from volcanic activity and glaciation, it must be anticipated that considerable further exploratory work will be necessary to verify the sites selected or alternative sites and to outline the extent of sub-surface work required.

ISKUT RIVER HYDRO POWER

An office review has been made of the hydro-power potential of the Iskut River basin, the study being based upon currently available topographic mapping and air photography and a short period of hydrometric records. While this information is inadequate to support a firm conclusion, it would appear that the development of a substantial block of hydro power on this river may be feasible. Large-scale mapping with close contours, together with engineering and geological investigation of potential dam-sites and improved stream-flow data, will be necessary before a more accurate and reliable assessment of this potential can be made.

A new hydrometric station was installed at the outlet to Kinaskin Lake in September, and stage readings of the lake are also being taken.

It is understood that private interests are investigating a site on the lower part of the river with a view to hydro-electric development.

COTTONWOOD RIVER HYDRO POWER, NEAR CASSIAR

Investigations have continued into the feasibility of a hydro-power development to supply the electric-power requirements of the mining operation of Cassiar Asbestos Corporation Limited and the Cassiar townsite. A preliminary engineering

inspection of potential dam-sites has been made and air photography of the river obtained. Preparation of large-scale maps from the air photography is proceeding.

An automatic recording hydrometric station has been installed and is in operation.

ARDA DIVISION

W. K. A. Dobson, P.Eng., Chief of Division

GENERAL

This Division was formed for the purpose of investigating and preparing water-project submissions under the Federal-Provincial *Agricultural Rehabilitation and Development Act* (ARDA) assistance programme, and for the supervising of the construction of certain approved water projects. The Deputy Minister of Water Resources submits ARDA water-project proposals to the Provincial Deputy Ministers' ARDA Committee, who in turn make recommendation to the Provincial Department of Agriculture. If a water project is approved by the Provincial and Federal ARDA authorities, the British Columbia Water Resources Service will be responsible for its implementation. Over-all responsibility for ARDA activities lies with the Department of Agriculture.

At the end of 1963 there were 31 water-project proposals under various stages of review and three were under construction.

At the end of 1964 the number of water projects under review had increased to 48, of which 18 proposals have been forwarded to Ottawa for approval, 12 have been approved, and 6 projects have been completed.

The status of the water projects which have been approved by the Provincial and Federal ARDA authorities are listed below.

The following projects have been completed:—

- (1) Glenmore Irrigation District—reconstruction of balancing-reservoir dam. Total cost of the project, \$90,000. Designed and supervised by consulting engineers.
- (2) Scotty Creek Irrigation District—reconstruction of Trapper Lake storage dam. Total cost of the project, \$76,745. Designed and supervised by consulting engineers.
- (3) Vernon Irrigation District—rehabilitation of King Edward Lake storage dam. Total cost of project, \$40,425. Designed and supervised by consulting engineers.
- (4) Ellison Irrigation District—rehabilitation of a part of the irrigation system. Total cost of the project, \$13,294. Designed by the Water Rights Branch.
- (5) Hefley Irrigation District—rehabilitation of the Hefley Lake storage dam. Total cost of the project, \$11,100. Designed and supervised by consulting engineers.
- (6) Similkameen Improvement District—reconstruction of Nickel Plate Lake storage dam. Total cost of the project, \$36,000. Designed and supervised by the Water Investigations Branch.

The following water projects have been approved and are at various stages of completion:—

- (1) Kaleden Irrigation District—rehabilitation of the existing water-supply system involving pumping from Skaha Lake. Total approved cost of the project, \$285,000. Design work is being done by the Water Investigations Branch and construction will take place in 1964/65 and 1965/66 fiscal years.

- (2) Canyon Waterworks District, near Armstrong—rehabilitation of the farm water-supply system. Total cost, \$60,000. Design and supervision of construction by the Water Rights Branch in 1964/65 fiscal year.
- (3) Prince George area ground-water appraisal—a research project to be undertaken by the Water Investigations Branch. Total approved cost, \$98,000. Steps have been taken to recruit necessary personnel, and it is hoped to commence work in early 1965 with a completion date in 1966/67.
- (4) Vernon Irrigation District—a research project covering engineering and economic aspects of operation of an irrigation system. Total approved cost, \$70,000. Engineering phase (\$35,000) of this project is being carried out by the Water Investigations Branch and the economic phase by the economists of the Federal Department of Agriculture. This project will be completed in early 1965.
- (5) South-east Kelowna Irrigation District—rehabilitation of a part of the existing irrigation system. Total approved cost, \$60,000. Design and construction by the irrigation district under general supervision by the Water Investigations Branch. Completion of construction in 1965.
- (6) Meadow Valley Irrigation District—improvements to an irrigation system. Total approved cost, \$45,000. Designed and supervised by a consulting engineer.

The following water-project proposals are under consideration by the ARDA authority:—

- (1) Southern Okanagan Lands Irrigation District—rehabilitation of the irrigation system of the Provincially operated Southern Okanagan Lands Project. Designs prepared by the Water Investigations Branch. Estimated total cost, \$2,000,000.
- (2) City of Penticton—irrigation-system rehabilitation. Design prepared by the Prairie Farm Rehabilitation Authority, Federal Department of Agriculture. Estimated total cost, \$1,303,000.
- (3) Oyama Irrigation District—reconstruction of the existing water-supply system. Estimated total cost, \$150,000. Design by the Water Investigations Branch.
- (4) Vernon Irrigation District—rehabilitation of Aberdeen Lake storage dam. Estimated total cost, \$90,000. Designed by the irrigation district's engineer.
- (5) Shuswap River-Okanagan Lake Canal—an engineering research project to evaluate proposed water diversion from Shuswap River to Okanagan Lake, to be undertaken by the Water Investigations Branch.
- (6) Nicomekl-Serpentine Rivers drainage-problem research—engineering and economic study of flood protection, drainage improvements, and irrigation possibilities within the District Municipality of Surrey. Proposed to be carried out by the Water Investigations Branch.

WATER-PROJECT INVESTIGATIONS

A number of ARDA projects or project proposals are being investigated by the Water Rights Branch of the British Columbia Water Resources Service and the Water Supply and Investigations Division of the Water Investigations Branch. The ARDA Division is investigating the following projects:—

Southern Okanagan Lands Irrigation District Rehabilitation

This project proposal involves a gravity irrigation system which is operated by the Province under the Southern Okanagan Lands Project and was incorporated in 1964 as the Southern Okanagan Lands Irrigation District.

A survey of the system rehabilitation was carried out in 1963. Several alternative proposals were prepared, and the Trustees of the newly formed district have decided to approve a proposal under which water under pressure will be available to all irrigated lands. Water will be pumped from Osoyoos Lake to the southern end of the district and from the Okanagan River to the area north of Oliver. The remainder of the district will receive pumped supply from the existing main diversion canal.

The proposed system will irrigate some 5,000 acres, and its total cost is estimated to be \$2,000,000. The project will require five years to complete. An application for ARDA assistance has been made, and construction could be commenced in 1964/65 fiscal year.

Vernon Irrigation District

This is a research project approved by ARDA authorities and covers the engineering and economic aspects of operation of a rehabilitated irrigation system.

A survey of the existing irrigation-works of the Vernon Irrigation District has been carried out and system renewal requirements have been assessed. Two alternative rehabilitation proposals are under study. One of these will involve reconstruction of the existing irrigation-works for 8,050 acres of land, comprising some 42 miles of open canals and some distribution pipe-lines. The other will provide piped water supply under sufficient pressure for sprinkler irrigation for all lands presently registered for irrigation, a total of 8,050 acres.

The capital and annual costs of these two alternative systems will be estimated and will be available to the economists of the Federal Department of Agriculture. The latter will assess the benefits resulting from irrigation.

RECORDS COMPILATION AND REPORTS SECTION

This Section of the Water Investigations Branch assembles and maintains engineering reports and other technical records, performs general office duties of the Branch, and undertakes technical computations arising from water investigations.

During 1964 almost 100 new engineering reports were assembled and registered in the reports library, bringing the total of available reports to 1,215.

The increase in the number of reports received and registered during 10-year periods is illustrated in the following table:—

Period (Years)	Number of Reports	Percentage of Total
1915-24	175	14.4
1925-34	40	3.3
1935-44	37	3.0
1945-54	113	9.3
1955-64	850	70.0
Totals	1,215	100.0

In addition to the new reports, over 200 reprints of previous reports have been prepared and distributed, and requests for over 150 copies of various other publications have been filled.

Other work performed by this Section included the collection and compilation of technical and cost records of interest to the Branch, the undertaking of technical computations arising from engineering investigations, and general office duties for the Branch.

The project of microfilming of engineering reports and calculations data undertaken by the Central Microfilm Bureau during 1963 was completed early this year.

During the year we have continued the A.S.C.E.-initiated programme for more efficient retrieval of information, and there are now almost 1,000 keyword cards on file.

Over 740 reports of the total of 1,215 in the reports library have been prepared by Water Resources Service staff. The following table shows the number of such reports and the general fields which they cover:—

*Technical Reports in Library Prepared by Water Resources Service Staff as of
December 31, 1964*

Period (Years)	Water Power	Water Supply	Floods, Drainage, Dyking	Ground-water	Hydrology	Miscellaneous	Totals
1911-20	13	3	—	1	—	2	19
1921-25	107	25	3	1	—	4	140
1926-30	25	5	—	1	—	2	33
1931-35	7	1	—	—	—	1	9
1936-40	8	—	—	—	—	—	8
1941-45	21	10	—	1	—	3	35
1946-50	14	27	8	1	2	7	59
1951-55	26	57	39	8	10	10	150
1956-60	6	69	38	1	9	14	137
1961-64	3	71	44	5	11	19	153
	230	268	132	19	32	62	743

DRAUGHTING OFFICE

During the past year the draughting of some 26 projects has been completed, involving a total of approximately 230 sheets. A large portion of this work was in connection with river surveys such as Okanagan Flood-control Works, Vedder-Chilliwack Rivers, Squamish River, and Vancouver North Shore streams. A considerable amount of work was also done in connection with snow surveys and the meeting of the Western Snow Conference at Nelson.

Several river-improvement investigations required extensive determination of land-ownership in the areas affected by the proposed improvement works. The Draughting Office also maintains British Columbia precipitation records.

There are four permanent draughtsmen in the Draughting Office, who were assisted for varying periods by three temporary-staff members from other divisions. In addition, one draughtsman is working in the Ground Water Division assisted by another on loan from the Water Rights Branch. Three temporary draughtsmen were working at the year-end in the ARDA projects division.

The Draughting Office of the Water Investigations Branch continued to perform certain engineering draughting services for the Water Rights Branch.

SOUTHERN OKANAGAN LANDS PROJECT

GENERAL

The Southern Okanagan Lands Project permits settlement of about 2,700 acres of land in the Okanagan valley area and forms the basis for the improved land industry of British Columbia. The project was initiated in 1939, the Project was later authorized and administered by the Government first by the Lands Branch, then by the Department of Agriculture, and finally since 1955, by the Water Resources Service.

During 1968 an important step was taken toward the transfer of responsibility for the project again to the water. In accordance with the recommendations in the original agreement on the last side of the Southern Okanagan Lands Project, the lands of general rearing value from the project were designated first as improvement lands following a general meeting held in Courtenay on August 6, 1964.

The Southern Okanagan Lands Project will continue to be developed under the "improve" land use and will continue to acquire and maintain the original capital until such time as the productivity of the water has been developed.

The first development project of the Water Resources Service has been to reorganize some of the water of the service and has done so for the primary purpose of expanding the water content of the irrigation system within the Southern Okanagan Lands Project.

SOUTHERN OKANAGAN LANDS PROJECT

Improve water from the Okanagan River, August 27, 1964. Service was authorized by a resolution of about the 16th of August on 149-42. Service was authorized May 15 and completed by September 30, 1964. Financial account was implemented from the irrigation system from February 24th to 27th and from November 27th to 28th.

Due to the proposed water changes of the irrigation system, capital requirements have been increased, and such records maintenance has been started on June 1964.

The Southern Okanagan Lands Service provided Water Right's under the Okanagan River Project, and that the irrigation system by authority of an Order in Council.

The Order in Council water project was accepted by the majority of the Order in Council. This project was transferred to the Department of the Village of Okanagan on October 1, 1964, by Order in Council. The Order in Council was signed by the majority of the Southern Okanagan Lands Project which is a holding in the village. The work of the Project moved together in the new Government.

Mr. F. L. McInnes, Project Manager since 1955, retired in December 1964. Mr. L. A. Power was appointed Project Supervisor, effective December 1st.

FINANCIAL STATEMENT FOR 1964

Improvement activities	287,344.71
Development activities	27,014.98
Land sale	77,211.00
General interest, general fund, other, etc.	16,237.74
Total	\$487,808.43

The purpose of this study is to determine the impact of the Southern Oklahoma Lands Project on the local economy. The study is based on a survey of 100 landowners in the project area. The results of the survey are as follows:

- 1. The majority of landowners (75%) are currently unemployed.
- 2. The majority of landowners (80%) are currently living in poverty.
- 3. The majority of landowners (90%) are currently receiving government assistance.

TABLE 1
Summary of Survey Results

Category	Percentage
Unemployed	75%
Living in poverty	80%
Receiving government assistance	90%

CONCLUSIONS

The results of this study indicate that the Southern Oklahoma Lands Project has had a significant negative impact on the local economy. The majority of landowners are currently unemployed and living in poverty. This is due to the fact that the project has resulted in the loss of land to the federal government, which has then been sold to other parties. This has resulted in the loss of income for the landowners and the local economy.

The study also found that the majority of landowners are currently receiving government assistance. This is due to the fact that the project has resulted in the loss of land to the federal government, which has then been sold to other parties. This has resulted in the loss of income for the landowners and the local economy.

The study also found that the majority of landowners are currently receiving government assistance. This is due to the fact that the project has resulted in the loss of land to the federal government, which has then been sold to other parties. This has resulted in the loss of income for the landowners and the local economy.

SOUTHERN OKANAGAN LANDS PROJECT

GENERAL

The Southern Okanagan Lands Project provides irrigation to about 5,000 acres of land in the Oliver-Osoyoos area, and forms the basis for the important fruit industry of the area. Since its inception in 1920, the Project has been developed and administered by the Province, first by the Lands Service, then by the Department of Agriculture, and finally, since 1963, by the Water Resources Service.

During 1964 an important step was taken toward the transfer of responsibility for the irrigation system to the users. In accordance with the recommendation in the original agreement of the land titles of the Southern Okanagan Lands Project, the lands at present receiving water from the project were incorporated into an improvement district following a general meeting held in Osoyoos on August 6, 1964.

The Southern Okanagan Lands Project will continue to be administered under the *Soldiers' Land Act* and will continue to operate and maintain the irrigation system until such time as the rehabilitation of the system has been completed.

The Water Investigations Branch of the Water Resources Service has made an engineering study of the works of the district and has drawn up five alternative proposals regarding the rehabilitation of the irrigation system within the Southern Okanagan Lands Irrigation District.

PROJECT OPERATIONS, 1964

Irrigation water was turned into the main canal on April 28, 1964. Service was interrupted due to a washout of Flume No. 16 at 10 p.m. on May 4th. Service was restored May 7th and continued to September 30, 1964. Domestic cisterns were replenished from the irrigation system from February 24th to 27th and from November 27th to 29th.

Due to the proposed rehabilitation of the irrigation system, capital replacements have been suspended, and only essential maintenance has been carried out during 1964.

The Southern Okanagan Lands Project provided Water Bailiff service for the Osoyoos, East Osoyoos, and Black Sage Irrigation Districts by authority of an Order in Council.

The Oliver domestic water system was extended in the vicinity of the Oliver Airport. This system was transferred to The Corporation of the Village of Oliver on October 1, 1964, by Order in Council. The Order in Council also allowed for the transfer of the Southern Okanagan Lands Project administration building to the village. The staff of the Project moved to quarters in the new Courthouse.

Mr. F. O. McDonald, Project Manager since 1952, retired on October 31st. Mr. L. A. Pinske was appointed Project Supervisor, effective November 1st.

PROJECT REVENUE FOR 1964

Irrigation-water collections	\$58,714.47
Domestic-water collections	27,014.86
Land sales	17,574.99
Sundries (topsoil, gravel, sand, maps, etc.)	12,002.34
Total	\$115,306.66

ACCOUNTING DIVISION

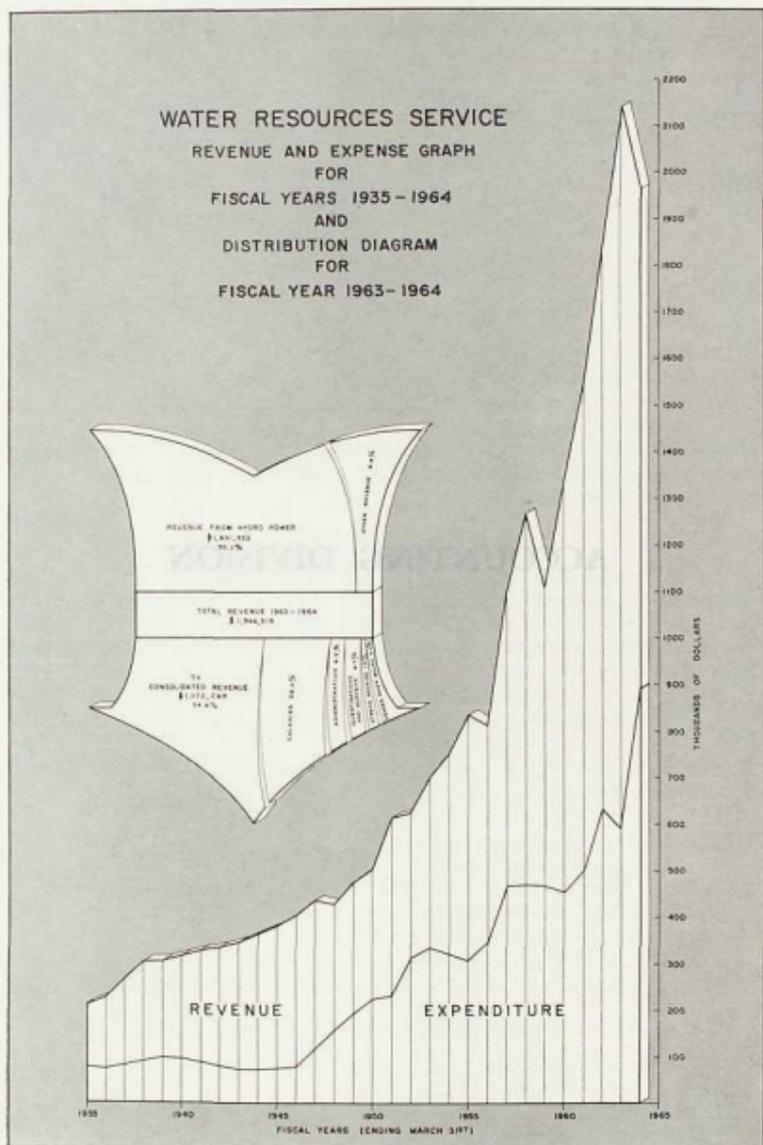


Plate 7.

ACCOUNTING DIVISION

M. B. MACLEAN, B.COM., DEPARTMENTAL COMPTROLLER

Water Rights Branch revenue for the calendar year 1964 totalled \$2,175,223, an increase of \$239,445 or 12.4 per cent over the previous year. This increase is almost entirely attributable to increased hydro-power generation.

The source of revenue by purpose is as follows:—

Domestic, incidental use and fees	\$71,244
Waterworks	13,627
Irrigation	3,689
Power	2,041,952
Funds held on application	44,711
Total	\$2,175,223

Water-licence rental is payable annually, and the billing (except for power) is mailed early in January of each year. As of December 31, 1964, the Branch had on file 19, 236 active licences, an increase of 1,367 over the previous year.

*Comparison of Water Rentals and Recording Fees Revenue for 10-year Period
1955-63, Inclusive*

1955	██████████	\$849,980.00
1956	██████████	1,081,592.07
1957	██████████	1,152,370.05
1958	██████████	1,256,004.37
1959	██████████	1,363,939.33
1960	██████████	1,510,277.86
1961	██████████	1,853,653.18
1962	██████████	2,115,738.00
1963	██████████	1,935,778.43
1964	██████████	2,175,223.11
Total		\$15,294,556.40

Ten-year average, \$1,529,455.64.



Year	Number of employees (thousands)
1970	210
1971	215
1972	220
1973	225
1974	230
1975	235
1976	240
1977	245
1978	250
1979	255
1980	260
1981	265
1982	270
1983	275
1984	280
1985	285
1986	290
1987	295
1988	300
1989	305
1990	310

Source: Statistics Canada

The number of employees in the public sector has increased steadily over the period 1970-1990. This increase is primarily due to the expansion of government services and the growth of the public sector as a whole. The data shows a consistent upward trend, with the number of employees rising from approximately 210,000 in 1970 to over 300,000 by 1990.

The following table provides a detailed breakdown of the number of employees in the public sector for each year from 1970 to 1990. The data is presented in thousands of employees. The table shows a steady increase in the number of employees over the period, with a notable jump around 1980. The total number of employees in the public sector reached approximately 310,000 by 1990.

Year	Number of employees (thousands)
1970	210
1971	215
1972	220
1973	225
1974	230
1975	235
1976	240
1977	245
1978	250
1979	255
1980	260
1981	265
1982	270
1983	275
1984	280
1985	285
1986	290
1987	295
1988	300
1989	305
1990	310

БЕКТОНИЕТ ЗЕСЛОИ

PERSONNEL SECTION

J. H. PALMER, B.A., B.COM., PERSONNEL OFFICER

The following table summarizes personnel activities for the year:—

Recruitments for continuous staff	18
Reclassifications	16
Promotions	7
Internal transfers	3
Transfers to other departments	3
Terminations for continuous staff	5
Retirements	1
Extensions of service granted	1
Short-term appointments and terminations	18

Nine new positions were added to the permanent staff during the year. One of these was the creation of a separate position as Comptroller of Water Rights to be distinct from the position of Deputy Minister of Water Resources. This resulted in the promotion of Mr. G. J. A. Kidd to Comptroller of Water Rights and Mr. H. D. DeBeck to Deputy Comptroller of Water Rights. Mr. R. J. Talbot was promoted to District Engineer, Kelowna.

Mr. W. R. Tuthill completed the three-year Public Administration Course sponsored by the Civil Service Commission, and Messrs. C. K. Harman and J. T. Gulliver completed the second and first years respectively. Mr. R. F. Mousley was enrolled in the first year of this course, and Mr. J. W. P. Martin enrolled in the one-year course in Basic Public Administration.

An active safety programme was pursued during the year, and with the exception of the Southern Okanagan Lands Project the Department was entirely free of accidents.

PROVINCE OF BRITISH COLUMBIA
DEPARTMENT OF EDUCATION & CULTURE

PROVINCIAL MUSEUM
OF NATURAL HISTORY
and ANTHROPOLOGY

REPORT FOR THE YEAR 1984



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