Soil Conservation and
Rivers Control Council

A Review of work on Investigation Areas No 2 - To 31 December 1969

Soil Conservation and Rivers Control Council:

A REVIEW OF WORK ON INVESTIGATION AREAS AND RESEARCH PROJECTS NO. 2.

TO 31 DECEMBER 1969

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A REVIEW OF WORK ON INVESTIGATION AREAS AND RESEARCH PROJECTS

NO. 2 : TO 31 DECEMBER 1969

INTRODUCTION

This report reviews the 1969 activities on, and the significant results obtained from, the Water and Soil Conservation areas and other miscellaneous research projects.

In many sections of the work acknowledgement is given to the catchment authorities, Government and other agencies which have given assistance. For each area or project the principal person responsible for it has been named. For further information on any aspect, enquiries should be directed to the District Commissioner of Works in whose district the work is being conducted.

Annual Research Reports and Report No. 1 in this series are available from the Water and Soil Division, Ministry of Works.

SOIL CONSERVATION AREAS

Black Birch:

(H. Morris, District Soil Conservator, Wellington)

Location: Approximately 30 miles south of Blenheim.
Area: 1000 acres
Purpose: Established during 1969 to carry out research into high altitude (3000-5500 ft) revegetation and erosion control.

The Grasslands Division, Entomology Division, and the Soil Bureau of the D.S.I.R.; Tussock Grasslands and Mountain Lands Institute; Marlborough Catchment Board; and the Ministry of Works have already, co-operatively or singly, initiated a number of projects.

The research programme is now well under way and includes the following:

1. **Revegetation Studies**

   (a) Influence of fertilisers and mulch-producing annual grasses on the establishment of perennial grasses and clovers. Unfortunately the trial area is not homogeneous and was grazed for three months following sowing. Therefore plant establishment was poor. Interim results show that the most promising species after one year are sweet vernal, browntop and yorkshire fog, and that there were fertiliser responses by both the native and introduced species especially at the highest rates.

   (b) Use of coated rye grasses as mulch-producers for tetraploid red clover. These were sown in March 1969 and by mid-April there had been reasonably good germination, especially on the high nitrogen fertiliser plots. However, by the end of the year few grasses or clover plants were to be seen, and it is concluded that autumn sowing cannot be recommended.

   (c) Trial sowings in spring 1969, from which no conclusion can yet be drawn, are:
   (i) Comparison of coated versus non-coated seed for rapidity of establishment.
   (ii) Effect of magnesium, boron and potassium fertiliser supplementary to nitrogen and phosphorous fertiliser on establishment and seed setting of grasses and clovers.
   (iii) Rates of sowing of grasses.
   (iv) Establishment of vegetative cover on extremely unstable soil at 5,200 feet.

2. **Further work arranged**

   (a) Instrumentation of four microclimate stations.
   (b) Land use capability survey.
   (c) Soil sampling and soil survey.
   (d) Entomological survey.

   A bulletin outlining the facilities available for high altitude research at Black Birch has been published.

Mid-Dome:

(W.O. Sly, Senior Soil Conservator, Invercargill)

Location: Parawa, Southland.
Area: 1,666 acres.
Purpose: Investigations into and development of methods of controlling severe sheet, scree, and gully erosion.

Progress was again delayed. In July, just when the backlog of maintenance had been overcome and an investigation programme prepared, the technician was transferred, and the work had to be set back.

On the lower country under lax grazing pastures continue to improve. Areas damaged and exposed by 1968 and 1969 floods have made an excellent recovery following oversowing.

On the mid-altitude country cover has also improved under light grazing. A 300-acre block between 2,000 and 2,500 feet responded excellently to the application of 1½ cwt of sulphurised superphosphate.

At high altitude the native species have continued to improve in the absence of grazing, and the amount of bare ground and erosion has decreased. High altitude plantings of trees made satisfactory growth. Spread of *Pinus contorta* is being kept under close observation by the N.Z. Forest Service. Seedling survival has been high where there is a reasonable cover of snow grass and interrelated species around or close to the parent trees. Unlike previous years, no stock health problems occurred.

Plant Materials Centre:

(C. Van Kraayenoord, Scientist, Palmerston North)

Location: Massey University, Palmerston North.
Area: Approximately 15 acres.
Purpose: Selection and development of plant materials for soil conservation.

During the year good progress was made in consolidating the Plant Materials Centre on a permanent and national basis. A new 30-acre site for the centre at Aokautere has been selected and purchased, and the staffing has been improved with the appointment of another scientist and technician. A new site has been necessary because Massey requires the present site for university purposes and a larger area is needed for future expansion in this field.

1. Overseas Stock

Poplar clones have been received from overseas and are in quarantine at the Plant Diseases Division, Auckland. Poplar clones have been sent to research stations in Italy and Holland. An Australian deltoides clone received in 1967 has made fast growth and appears to be one of the most promising selections for the warmer districts.

2. Breeding Work

Poplar and willow breeding work has continued with the object of developing:

(a) Poplar clones better suited to differing ecological conditions, incorporating opossum resistance, drought resistance, and general hardiness.
(b) A bitter tree willow suitable for pole production.
(c) Male clones of desirable varieties for which only female clones are available, for use where willow seeding is a problem. Approximately 4,500 seedlings have been obtained and planted out from the crosses attempted. Difficulty was experienced in crossing tree willows with bitter shrub willows, and only one cross was successful.

3. Field Testing

Eight trials of Italian tree willows and seven trials of Australian poplar selections were established throughout the North Island as part of a primary field testing programme. A series of highway revegetation trials was established in the Napier and Gisborne districts. The "Brushlayer" technique of planting, whereby 3 ft long wands are laid horizontally in contour trenches with only 6 in. out of the ground, was used. This method gives some immediate stabilising effect while the plants become established and take over. Plants laid horizontally are not affected by falling debris as this will slide over the branches.

4. Diseases

During the year an outbreak of silverleaf disease *(Stereum purpureum)* was discovered in nurseries of the Marlborough Catchment Board, compelling the removal and burning of several acres of stoolbed. Silverleaf is a wound disease which can spread rapidly in stool nurseries if no control measures are taken. The best control method is to paint the wounds with a fungicidal paint as soon as the poles are cut, together with strict nursery hygiene. All slash and branch material should be burnt without delay.

A research project investigating willow diseases in New Zealand has begun in collaboration with the Microbiology Department of Lincoln College.

Punakitere

(A.N. Glass, District Soil Conservator, Auckland)

Location: 5 miles west of Kaikohe.
Area: 46 acres.
Purpose: To study the influence of contour structures on the hydrological regimen.

Major development work for the contouring trial has been completed. Uniformity measurements of pastures, soils and stock have commenced. Preliminary analyses indicate an unexpectedly high aspect difference and this may lead to modification of the experimental design. Structures to measure runoff and soil loss from two plots are now operating.

Tangoio

(N.W. Sutherland, District Soil Conservator, Napier)

Location: 20 miles north of Napier.
Area: 450 acres.
Purpose: To demonstrate fertility improvement and promote better land use with soil conservation practices.

1. Vegetation Trials

Through oversowing, topdressing and more judicious grazing management the poorer pastures have been greatly improved. Existing tree trials have been measured and the data are being collated for analysis and interpretation. A further series of tree trials, predominantly stock damage and protection from same, were initiated.

2. Slip Investigation

In co-operation with Dr Eyles, Victoria University of Wellington, an investigation into the historical and present sequence of slipping on the reserve and its relationship to soil types and phases and their physical characteristics has been commenced.

3. Sheep and Cattle Treading

A trial site to assess the effects of cattle and sheep treading at medium and high stocking rates has been selected. The soil and vegetation sampling areas within each plot have been delineated and fencing of the individual paddocks has commenced.

4. Cross-Breeding Sheep Trial

In co-operation with the Research Division, Department of Agriculture, preparations are well in hand for the commencement of a comprehensive cross-breeding sheep trial.

Waerenga-o-Kuri

(N.W. Sutherland, District Soil Conservator, Napier)

Location: 13 miles north west of Gisborne.
Area: 1,000 acres.
Purpose: To study the effect of land management practices and erosion control on the stability and productivity of the land.

A further series of tree and pasture trials, primarily varietal and establishment performance on difficult sites, were laid down. Routine assessment of all trials was continued and an increasing effort is now being directed to the analysis and interpretation of the data which have been accumulating over a long period.

Wither Hills

(H. Morris, District Soil Conservator, Wellington)

Location: 2 miles south of Blenheim Post Office.
Area: 404 acres.
Purpose: To control erosion, reduce or prevent flooding and spread of debris on to lower lands, and to develop a permanent productive system of farming.

This reserve is now being managed in accordance with its land capability, using cattle for grazing. A breeding herd has eliminated the need to buy in young stock.

The lucerne-phalaris grazing trial has continued but it is too soon to comment on pasture and stock responses. Preliminary data indicate that the lucerne-phalaris pastures in comparison with the original native vegetation has reduced runoff by 80% and increased soil moisture by 20%. Field techniques have been inadequate to accurately determine differences in soil loss.

Attempts to establish trees on the drier sites have been unsuccessful. Further work on the problem of tree establishment including the use of trickle irrigation is being planned.

EXPERIMENTAL BASINS

Camp Stream

—I.H.D. basin No. 12 (J.Y. Morris, Scientist, New Zealand Forest Service, Rangiora)

Location: Within Craigieburn National Forest Park (State Forest 22).
Area: 234 acres, in mountain beech forest and alpine grassland.
Purpose: To study the hydrological effect of restoring good cover in sub-alpine conditions on the high country yellow-brown earths. Operated by the New Zealand Forest Service's Forest and Range Experimental Station at Rangiora.

The N.Z. Forest Service has maintained flow, climate, snow and rainfall observations. A barrier to protect the climate station from avalanche damage has been constructed. A shelter has been constructed over the gauging site to abate icing problems.

Dye-dilution gaugings were successfully carried out to determine the stage-discharge rating of the flume. A report is being prepared in which these results are compared with the rating determined from the rate of pondage draw-down and the theoretical rating.

Annual Research Report No. 2 is in press, and No. 3 has been prepared for publication.

Mangatu

—I.H.D. basin No. 9 Part I (P.J. Grant, Scientist, Napier)

Location: Within Mangatu State Forest, approximately 35 miles from Gisborne.
Area: 50 acres.
Purpose: To study the hydrological effects of a land-use change from grass to pines on unstable central yellow-brown earths.

The experiment was to include the study of the effect in the hydrological regimen of land management practices such as grazed versus ungrazed, channel planting, the use of mechanical aids and tree-planting. However, the area was so unstable that it was not possible to find one basin for the entire experiment. It is proposed to site Part II of the experiment on the unstable mudstones somewhere between Napier and Masterton.

As Mangatu was approved late in the year, little progress could be made.

Manorburn

—I.H.D. basin No. 16 (I. Simmers, Scientist, Dunedin)

A basin has been provisionally selected near Manorburn, to study the hydrological effects of management practices on a yellow-brown earth/low tussock association. Initial planning is proceeding.

Manukau City

—I.H.D. basin No. 20 (J. Waugh, Scientist, Whangerei)

Location: Auckland district.
Area: Approximately 90 acres.
Purpose: The Ministry of Works, in co-operation with Manukau City Council and the University of Auckland (School of Engineering) established the basin to study the effect of urbanisation on the hydrological regimen. The basin is at present zoned rural and housing development is expected to commence in 5 years.

The basin was instrumented early in 1969 and uniformity flow and climatic data are now being measures.

Otutira

—I.H.D. basin No. 3 (R.J. Pittams, Scientist, Hamilton)

Location: North shore of Lake Taupo (Kawakawa Bay).
Area: 843 acres.
Purpose: To study the hydrological effects of a change in land use from scrub to grass and the effect of soil conservation techniques on yellow-brown pumice soils.

The collection of basic hydrological data continued. Because of below-normal annual rainfall, very few runoff events occurred during the year.

The rainfall-flow relationships have been analysed and the results, which include a method of predicting discharge hydrographs, are being prepared for publication. The nature of the hydrological regimen in this basin has led to a decision to reduce the area under measurement by approximately one third. As a consequence of improvements in instrumentation, a new interception loss plot was established in October.

In co-operation with Mr P. Noble, Department of Agriculture, intensive investigation of the soil-moisture regimen of the pumice soils and parent materials of the basin has continued. The erosion and runoff plot project of Mr Selby, University of Waikato, has been continued. Results of both these studies are being collated and reports prepared. Annual research report No. 2 is in press.

Puketurua

—I.H.D. basin No. 1 (J. Waugh, Scientist, Whangerei)

Location: 20 miles north-west of Whangerei.
Area: 613 acres.
Purpose: To study the hydrological effects of a change in land use from scrub to grass and, subsequently, the effects of particular land management practices on the northern yellow-brown earths.

Routine collection of flow, interception, groundwater and meso- and micro-climate uniformity data have been continued. A detailed botanical and phytomorphological survey has been completed. With the installation of 68 soil moisture access tubes, moisture sampling using the neutron technique was commenced.

Gully stabilisation techniques especially in the Pukewaenga sub-catchment have not been very effective; this is no doubt due to high soil acidity. Quantitative measurements of sediment outflow from the gullies are being obtained. Sediment samples taken at the outlet of the main catchment and at the adjacent developed Aponga stream under flood conditions have shown the latter to have up to forty times greater sediment concentrations.

Analysis of data except flow is well up to date.

Purukohukohu

—I.H.D. basin No. 4 (R.J. Pittams, Scientist, Hamilton)

Location: 20 miles south of Rotorua.
Area: 280 acres—consisting of three catchments (two in introduced grasses and one in native trees).
Purpose: To study the influence of introduced grasses versus pines and pines versus native trees on the hydrological regimen on yellow-brown pumice soils.

Basic climate, rainfall and flow instrumentation was completed. Scrub-covered areas have been cleared and sown to pasture by the Department of Lands and Survey.

The New Zealand Forest Service completed a botanical survey of the native podocarp forested catchment. Procedures for assessing pasture productivity and selecting sampling sites are nearly finalised.

Reduction of rainfall and flow data is up to date and seven major storms during the year were analysed for their hydrological parameters. Peak discharges show strong correlation with vegetation type, e.g. peak discharges are considerably less from the native forest than from pasture. Research on water quality in this basin is being carried out in conjunction with the Marine Department as part of a study of the eutrophication of lakes.

Taita

—I.H.D. basin No. 7 (R.J. Jackson, Scientist, Soil Bureau, Lower Hutt)

Location: Approximately 15 miles north-east of Wellington.
Area: About 200 acres, consisting of four catchments.
Purpose: To compare the hydrology of grassed versus podocarp/beech versus exotic pine catchments on the stable central yellow-brown earths. This basin is operated by the Soil Bureau, DSIR.

In catchments 4 and 5 flow measuring structures were completed and rainfall networks installed. Routine data collection is now carried out on the four catchments in this basin.

The backlog in data reduction has been considerably reduced but no flow analyses have been undertaken.

COMBINED EXPERIMENTAL BASIN AND SOIL CONSERVATION AREAS

Adair

–I.H.D. basin No. 14 (G. Martin, Scientist, Christchurch)

Location: 6½ miles south-west of Timaru.
Area: 134 acres.
Purpose:
(a) To investigate and measure differences between contour cultivation and up and down hill cultivation on soil loss and runoff on downlands.
(b) To evaluate on 2-acre catchments the effect of contour practices on runoff, soil loss, soil moisture, and crop and grass production.
(c) To demonstrate comprehensive soil conservation practices particularly contour works on the downlands of South Canterbury.

Good progress is now being made with the complex flow collecting channels in the catchments. For one storm of 1.3 inches in one day late in the year it was interesting to note that while there was no measurable surface flow there was considerable sub-surface flow.

Annual research report No. 1 is in press.

Makara

–I.H.D. basin No. 6 (R.J. Bellamy, Scientist, Wellington)

Location: 5 miles west of Wellington City.
Area: 116 acres.
Purpose: To study the hydrological effects of grazing management techniques and in some catchments the effect of afforestation on stable central yellow-brown earths.

Routine data collection was continued. Data reduction up to the end of 1968 was virtually completed. Owing to staff shortages no new field observational work was initiated.

Data analysis of lax-grazed pastures has been undertaken and a paper on preliminary results prepared for the Lincoln College Symposium on Watershed Management. Earlier analyses had shown that improvement of hard-grazed pastures by oversowing and topdressing had reduced the annual runoff. Individual hydrographs showed decreased peak discharges, decreased flow before the peak and increased surface detention. The recent analyses have shown these changes to be of greater magnitude when the improved pastures are lax-grazed.

Annual research report No. 1 is in press.

Moutere

–I.H.D. basin No. 8 (F. Scarf, Scientist, Nelson)

Location: Near Brightwater, Nelson.
Area: 579 acres.
Purpose: Recently the main emphasis has been on catchment trials and runoff plots and these have been part of the I.H.D. experimental basin programme.

Farm management and maintenance has continued at a high level. In February 33 acres were cultivated and sown to crop and 28 acres were cultivated and sown to pasture. In October 50 acres of summer crop were sown. During September, heavy rains caused some slipping and slumping in catchments 1, 10 and 12 and control measures were immediately taken. On 18 December, during a storm of 1.9 inches in three hours, severe rilling occurred in the cultivated catchment 12.

Extension to the administration and laboratory building was completed. The remote water-level recording system has been moved into this building and the old recorder building has been demolished. Installation of a new water supply system for farm stock, fire protection and other experimental purposes was completed.

Hydrological observations have been continued. The data have been processed and are being prepared for publication in the Hydrology Annual. Some analysis of rainfall-flow relationships has been undertaken and has shown that:

(a) After cultivation on gorse-covered catchments, peak discharges are more than doubled.
(b) The depth of surface detention for a given peak discharge for gorse and pasture covers were not significantly different but were considerably and significantly less than for cultivated soil.

Analysis of soil moisture and rainfall data has resulted in more efficient sampling programmes being adopted.

Four years of runoff plot measurements have been summarised and a report prepared for circulation to catchment boards. Annual soil losses from cultivated plots (up to nine tons per acre) although varying from year to year, have greatly exceeded the losses from pasture plots (up to four tons per acre). Runoff from cultivated plots has been approximately double that from pasture plots. There were no significant differences between set and mob-stocked pasture plots.

Annual research reports Nos. 2, 3 and 4 are in press.

REPRESENTATIVE BASINS

The representative basin programme has had the support of council since 1962. This programme was designed to determine the hydrological characteristics of any given natural area by intensively studying sample catchments (representative basins). New Zealand was divided into 90 hydrological regions, and in general each region will be represented by a single study catchment. Data from the representative basins is used for:

(a) Extending short records of the stations.
(b) Developing prediction equations on a national or regional basis.
(c) Determining the hydrological effect of natural changes (climate and/or geomorphological changes).
(d) Carrying out research on hydrological processes in natural areas.

Fifty-three representative basins are now in full operation and a further 21 are in various stages of completion.

Papers published to date on representative basins and on results from representative basins include:

Toebes, C., Neef, G. 1962: Regional hydrology. In: *Hydrology and Land Management.* Wellington, Soil Conservation and Rivers Control Council.

Toebes, C., Palmer B.R. 1969: *Hydrological Regions of New Zealand.* Miscellaneous Hydrological Publication No. 4. Wellington, Water and Soil Division, Ministry of Works.

New Zealand Ministry of Works (in press): *Representative Basins in New Zealand.* Miscellaneous Hydrological Publication No. 7. Wellington, Water and Soil Division, Ministry of Works.

Morrissey, W.B. 1967: Precipitation measurement in New Zealand representative and experimental basins. *Journal of Hydrology (N.Z.)* 6 (1): 20-32.

Morrissey, W.B. 1968: Representative basins in New Zealand. *Soil and Water* 5 (1): 23-25.

Chandler, A. 1969: Use of representative basin data. *Soil and Water* 5 (2): 24-25.

Blake, G.J. et al 1970: The use of principal component factor analysis to establish the uniformity of a hydrological region in Northland, New Zealand. In *Proceedings of IASH Symposium on the Results of Research on Representative and Experimental Basins.* Wellington.

Waugh, J.R. (in press): *The Relationship between Summer Low Flows and Geology in Northland, New Zealand.* Miscellaneous Hydrological Publication No. 6. Wellington, Water and Soil Division, Ministry of Works.

Waugh, J.R. 1970: Base-flow recessions as an index of representativeness in the hydrological regions of Northland, New Zealand. In: *Proceedings of IASH Symposium on the Results of Research on Representative and Experimental Basins,* Wellington.

MISCELLANEOUS SOIL CONSERVATION INVESTIGATIONS

1. Wairakei Agricultural Research Station (R. Clare, Technical Officer, Department of Agriculture, Wairakei.

The tree nursery which has supplied material for the reserve and district planting has been closed and is being replaced by a nursery containing only Italian hybrid varieties for future planting on the reserve.

A range of poplar trials indicate that, for the district:

(a) Italian hybrids were superior in height and diameter gains, with I 214 and I 78 the best of the hybrids.
(b) Although planting rooted trees gives slightly better growth, the planting of poles is recommended.
(c) Keeping the area surrounding the trees cultivated and free from weeds in the establishment phase increased the vigour of the trees and this has been perpetuated during the subsequent five years of growth.
(d) The application of 6 ozs of sulphate of ammonia per tree has resulted in increased growth but muriate of potash did not increase growth.

2. Kauri Nursery: Polythene x Fertiliser Trial (A.N. Glass, District Soil Conservator, Auckland)

Observations continued concerning the extent to which the advantages of the polythene mulch, so obvious in the first season's growth, are carried forward into the subsequent season. A report is being prepared for publication.

3. Fencing (C.H. Pearse, District Soil Conservator, Palmerston North)

A completely new fencing system (the Flexifence) has been developed and is being field tested at a number of sites.

4. Pole Damage Survey (W.R.N. Edwards, Scientist, Palmerston North)

Approximately 16% of the poles planted in 1967 in the Poverty Bay, Hawke's Bay, Rangitikei, Manawatu and Wairarapa districts, with the co-operation of catchment board staff, have been surveyed for pole damage in 1968 and 1969. Collation and analysis of the poplar data have revealed that:

(a) Barking losses (3%) are generally not high but can be devastating on some farms.
(b) Losses through opossum damage (2%) are not high except in the Rangitikei district.
(c) A very significant loss (17%) occurred from unknown or unnamed factors. Observers suggested that drought and dry situations were major factors.
(d) Of the poles seen in the first year survey, 15% could not be accounted for in the second year survey. These poles were either overlooked or lost through slips, cattle breakage, subsidences or floods.
(e) The incidence of loss due to cattle grazing was quite high but damage could not be related to any factor of farmer management.

The willows sector of the survey showed that they tend to be more susceptible to some types of damage, especially barking. A report has been prepared and is being edited for circulation.

5. Pole Protection (W.R.N. Edwards, Scientist, Palmerston North)

A further series of trials has failed to reveal any satisfactory chemical repellent. Plastic sleeves are still the more effective means of protection. The method of attaching the sleeve to the poles presents a problem and further work on this is continuing.

A report is being prepared for distribution to catchment boards.

MISCELLANEOUS HYDROLOGICAL RESEARCH PROJECTS

1. Phytomorphology (G.J. Blake, Scientist, Wellington)

(a) **Water Retention Properties of Leaves**
Data has been obtained in order to determine whether leaf wetness characteristics can be used as an index of interception losses. An interim report is in preparation and further testing is to begin using the DSIR scanning electron microscope.

(b) **Mathematical Estimation of Crown Leaf Area**
Data has been collected and analyses begun to determine improved methods of estimating vegetation cover for hydrological purposes, using mathematical techniques.

(c) **Determination of Phytomorphological Characteristics**
A procedure defining a number of characteristics in forest vegetation has been prepared. The procedure has still to be extensively tested but will be available for limited circulation.

2. Flow

(a) **Overland Flow Processes** (W. Burke, Scientist, Wellington)
Runoff plots are being used in an attempt to determine the influence of vegetation on surface detention. Projects are in the planning stages. Plots at Moutere and Makara will be used under both artificial and natural rainfall conditions.

(b) **Flood Characteristics of Representative Basins** (C. Toebes, Chief Scientific Hydrologist, Wellington)
Data from the representative basin network is being collected. Geomorphological characteristics are being collated at present.

(c) **Chemical Methods for Measuring Stream Flow** (R.J. Bellamy, Scientist, Wellington)
Investigations are well advanced and a report will be available in 1970.

3. Soil Moisture Assessment using the Neutron Scatterer (G.J. Blake, Scientist, Wellington)

This project is well advanced and a report is being prepared. The accuracy of soil moisture measurement obtained from this equipment has been assessed for depths greater than 2 feet. The number of soil moisture sampling sites required to give a good measure is less than expected. Testing in the upper 2 feet of the soil profile continues.

4. Root Characteristics (G.J. Blake, Scientist, Wellington)

A UNESCO project on root survey techniques has been carried out in collaboration with the U.S. Geological Survey and the following paper published:

Blake, G.J.; and Branson, F.A. 1969: Root survey methods for hydrological experiments. *Journal of Hydrology (N.Z.)* 8 (1): 3-7.

This report will be the basis of root studies in experimental basins.

5. Precipitation

(a) Fog (S. Franks, Scientist, Wellington)
The first phase of this project which is to test the Grunow fog sampler under New Zealand conditions has commenced at Makara.

(b) **Determination of Seasonal Snowline** (T. Chinn, Scientist, Timaru)
Snow courses for long-term assessment of snow depths, densities and water yield have been established in the Tasman, Ohau and Round Hill basins. The year was notable for the lack of snow. University of Canterbury personnel collaborate in this project. An annual research report is in preparation.

6. Mathematical Models

(a) **Representativeness of Representative Basins** (G.J. Blake, Scientist, Wellington)
This study concerns the basin characteristics of 14 basins on the Northland Peninsula. The following paper is being prepared:

Blake, G.J. et al 1970: The use of principal component factor analysis to establish the uniformity of a hydrological region in Northland, New Zealand. *Proceedings of IASH Symposium on the Results of Research on Representative and Experimental Basins,* Wellington, N.Z. 1970.

(b) **Unit Hydrograph by Diffusion Analogy** (F.H. Pearson, Senior Engineer, Wellington)
For the Puketurua Stream the unit hydrograph shape could be modelled according to the diffusion of an exponential decay profile, but this model was only valid downstream of the point at which the falling limb of the hydrograph was approximately exponential throughout its length. A paper is being prepared for presentation at the IASH Symposium.

(c) **Urban Runoff** (F.J. Pearson, Senior Engineer, Wellington)
The Rewarewa basin is becoming urbanised. Rainfall and flow records are being used to test alternative methods for design of stormwater drains and sewers, and to assess the effects of urbanisation on stormwater runoff.

7. Chemical Measurement of Radiation. (J. Patterson, Scientist, Wellington)

This is an inexpensive method of measuring radiation. Sensors have been prepared and, when calibrated, will be located in a range of environments.

8. Groundwater

(a) **Puketurua Experimental Basin** (J. Waugh, Scientist, Whangarei)
Groundwater bores have been installed and preliminary results indicate that the basin is watertight over most of its area.

(b) **Heretaunga Plains** (P.J. Grant, Scientist, Napier)
In co-operation with the Heretaunga Plains Underground Water Authority a detailed investigation of the major recharge zone of the plains continued. Four more wells have been drilled. Chemical aids have been used to trace the source of some of the surface streams in the investigation area.

9. Sediment and Erosion

(a) **Sediment Sampling Techniques Using Radioactive Sources** (W.B. Morrissey, Scientist, Wellington)
Two gauges (portable and recording) have been tested, under New Zealand conditions, on behalf of the International Atomic Agency.

Field testing of the portable gauge has been completed and results and recommendations are presented in:

Morrissey, W.B. 1970: *Field Testing of the I.A.E.A. Radioisotope Sediment Concentration Gauge*. Miscellaneous Hydrological Publication No. 5. Wellington, Water and Soil Division, Ministry of Works.

Field testing of the recording (Parametrics) gauge suffered considerable delays because of failure of component parts. It gives continuous recordings of sediment at a single point and will operate for over a week on battery power. An interim report has been prepared.

(b) **Gully Formation on Pumice Soils** (R.J. Pittams, Scientist, Hamilton)
Field measurements have been continued.

(c) **Gully Erosion on Argillites** (R.K. Smith, Scientist, Napier)
Initial surveys have been commenced.

(d) **Lake Roxburgh Sediment Survey** (I. Simmers, Scientist, Dunedin)
The rate and origin of the rapidly accumulating sediments continued to be assessed. Initial field work and reports from the Geological Survey, DSIR, indicate the need for further field work in the form of sediment sampling before final conclusions are reached.

10. Evapotranspiration

(a) **Evapotranspiration in the High Country** (R.J. Bellamy, Scientist, Wellington.)
Equipment to assess evapotranspiration of low-standing plant communities has been prepared.

(b) **Measurement of Transpiration** (G.J. Blake, Scientist, Wellington)
By measuring the heat flow in the stem of the plant it is possible to obtain an estimate of evapotranspiration. Suitable equipment is being obtained. The evapotranspiration is an essential factor in the water balance but is difficult to determine. Accurate measurements from individual plants will assist in the calibration of simpler techniques which have a regional application.

(c) **Measurement of Interception** (G.J. Blake, Scientist, Wellington)
Work continued on a number of vegetation types throughout New Zealand. Experience has led to improved instrumentation and more satisfactory data is now being obtained. An interim report on results is being prepared.

11. Water Balance and Water Resources

(a) **Water Resources Project, Northland** (J. Waugh, Scientist, Whangerei)
This project aims at assessing low flow values in the region and determining relationships between rock type, antecedent rainfall and minimum flow.

Main conclusions are:

(i) Droughts occur frequently enough to be a continuing problem for future planning.
(ii) Areas available for water supply systems are limited.
(iii) Future development of farming on the easy hill country of the Hokianga region could be restricted by inadequate water supply.

A paper is in preparation for the I.A.S.H. Symposium.

(b) **Water Resources Project, Hawke's Bay** (P.J. Grant, Scientist, Napier)
Groundwater flow has been measured in selected limestone, mudstone and argillite basins. The data is at present being analysed.

(c) **Upper Taieri Water Balance and Taieri River Water Resources** (I. Simmers, Scientist, Dunedin)
Feild investigations have been completed and preliminary results will be given in:

Simmers, I. 1970: Preliminary water resource production of the Upper Taieri Basin. In: *Proceedings of I.A.S.H. Symposium on the Results of Research on Representative and Experimental Basins,* Wellington, N.Z.

Hutchinson, P.; Simmers, I. (in press): A modified catchment model of the Upper Taieri River, Otago, New Zealand. In: *Journal of Hydrology (N.Z.)*

(d) **Water Balance Studies on Lake Rotoma** (R.J. Pittams, Scientist, Hamilton)
Work is proceeding and the following paper was published:

Pittams, R.J. 1968: Preliminary water balance studies of the Rotorua lakes. *Journal of Hydrology (N.Z.)*, 7 (1): 24-37.

12. Ivory Glacier (T. Chinn, Scientist, Timaru)

The water, ice and energy balances of this glacier are being studied. Snow poles, precipitation gauges, water level recorder, climate screen and ice ablation stakes have been installed. A six-man hut has been erected.

Organisations assisting in the project include the New Zealand Forest Service, Geological Survey (DSIR), Canterbury University and Massey University. An annual research report is in preparation.

13. Instrument Development

The appointment of a scientist with an electronic background has enabled various development programmes to be started. The most important of these has been the modification of analogue-to-digital recorders from fixed time to event recording. These modifications will enable drastic reductions in the amount of data recorded with consequent large savings in staff and computer time. This is important when an estimated $65,000 is to be spent on computer processing of hydrological data this year. A provisional patent has been taken out on these modifications and negotiations for manufacture of the instruments are now under way. This is being handled by the Inventions Development Authority, and it is expected that there will be a considerable overseas market for the machines.

The following paper has been prepared for the I.A.S.H. Symposium:

Chandler, A.; Patterson, J.E. 1970: Digital event recorders for representative and experimental basins. *Proceedings of I.A.S.H. Symposium on the Results of Research on Representative and Experimental Basins,* Wellington.

Also well under way is the development of a cheap and versatile multi-channel recorder which is also based on the Fischer and Porter system.

14. New Zealand Hydrological Services Depot

This depot supplies and services hydrological instruments and equipment for the Ministry of Works and catchment authorities throughout the country. The work is handled by a staff of 12 including instrument technicians, storemen, wage workers and administration staff. The depot is controlled by the District Commissioner of Works, Christchurch, with technical direction from the Water and Soil Division, Head Office.

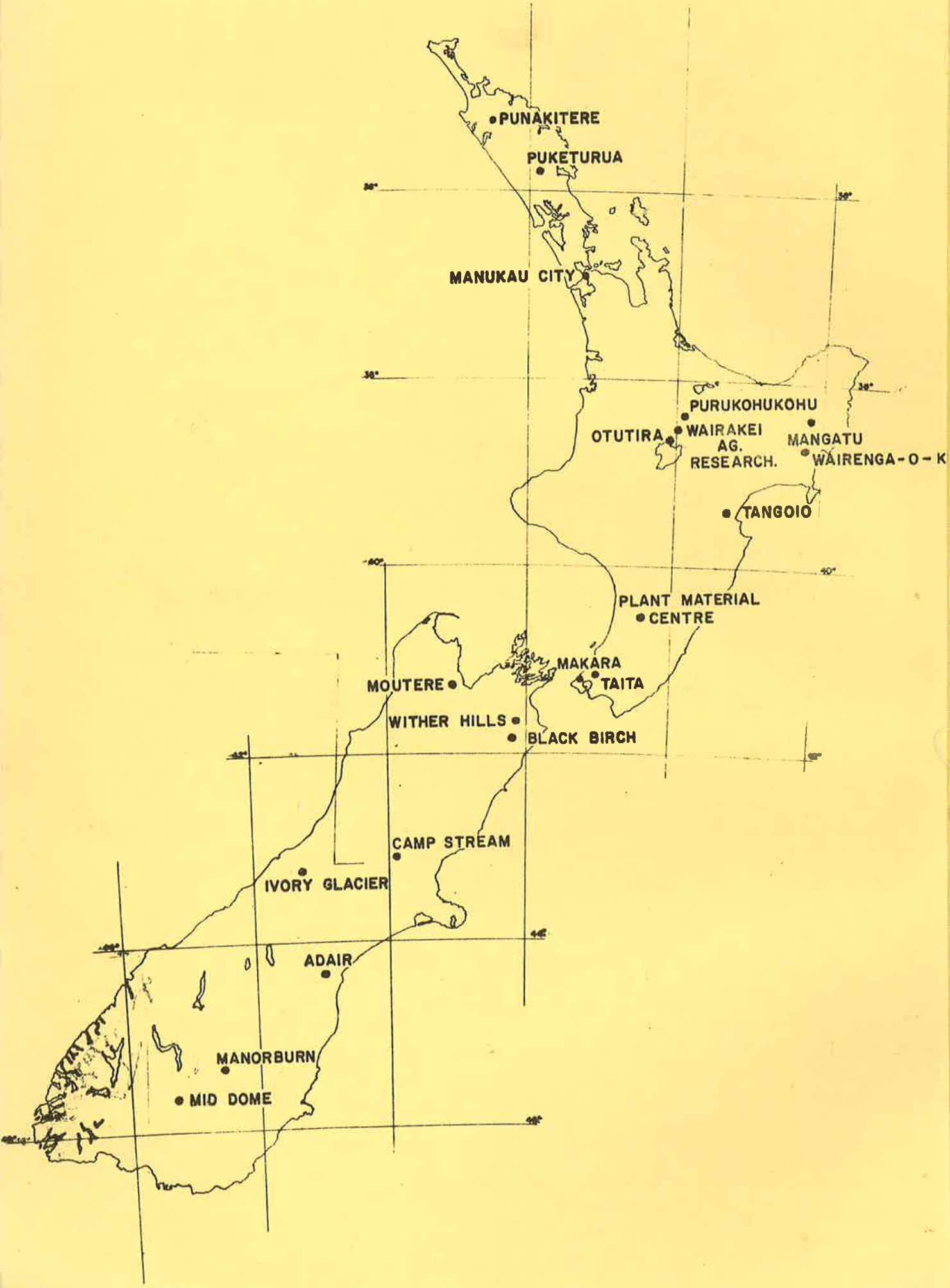
Approximately $110,000 annually is spent on instruments and equipment, with stocks and spare parts in store valued at $100,000. The replacement value of all instruments and equipment in the field excluding gauging installations would be close to $1,000,000.

15. Water Quality Surveys

Investigations have continued on the quality of water in New Zealand rivers. The previously mobile laboratory is now permanently stationed at Hamilton District Office with one full-time technician staffing it. Work is concentrated on the rivers in this area. Rivers for which surveys were carried out on a routine basis are the Waikato, Waipa, Tarawera, Kaituna and Piako. A special survey was undertaken on the Mangapiko Stream at the request of the Civil Division, and a report prepared.

Planning continues for the extension of this work in the form of a base-line survey of existing water quality of all rivers throughout New Zealand.

The National Water and Soil Conservation Organisation has set up an inter-organisational Water Quality Working Group to co-ordinate all technical aspects of water quality and pollution investigations in New Zealand.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