CONSERVATION
TE PAPA ATAWHAI

CONSERVATION ADVISORY SCIENCE NOTES

No. 89

HYDROLOGICAL MANAGEMENT OF THREE WETLANDS

(Short Answers in Conservation Science)

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Department of Conservation, P 0 Box 10-420, Wellington, New Zealand

ISSN 1171-9834

Reference to material in this report should be cited thus:

Jackson, R.J., 1994.
Hydrological management of three wetlands.
Conservation Advisory Science Notes No. 89, Department of Conservation, Wellington. 5p.

Commissioned by: West Coast Conservancy
Location: NZMS

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HYDROLOGICAL MANAGEMENT OF THREE WETLANDS

Three wetlands were visited on 16-17 February 1994 accompanied by Craig Murdoch, Field Centre Manager, Punakaiki . The objective was to assess hydrological aspects of these wetlands and provide advice to Department of Conservation on options for management of these wetlands in order to preserve or enhance ecological values.

The sites were:
- Bullock Creek;
- Nikau Scenic Reserve, Hibernia Creek meander area;
- Maher Swamp.

Objectives:
1. Provide advice regarding hydrological restoration of these wetlands;
2. Suggest management options for these wetlands in the eventuality of ilmenite mining in the area.

Both Bullock Creek and the Hibernia Creek meander area adjacent to Nikau Scenic Reserve have had changes in their hydrological regime as a result of drainage or flood control measures undertaken to improve or protect agricultural use of land. In both cases the issue is options for restoration of the original water regime. Maher Swamp has recently been excluded from the land that may be mined for ilmenite at some future date, and the issue here is whether the swamp will remain vulnerable to hydrological change if surrounding land is mined.

Bullock Creek is the simplest case because the former drainage activities on Bullock Creek Farm are on land that has lapsed from agricultural use and the drained area and its surroundings are entirely on land managed by West Coast Conservancy. There does not appear to be any conflict between management for conservation purposes and other land uses; selection of cost-effective remedial work is needed. The Hibernia Creek meander is a central feature of the Nikau Scenic Reserve, but a cut was made by Westland Catchment Board in 1978 in order to reduce flooding on farmland owned by the Coates Family Trust. Any change to the present flow regime of Hibernia Creek undertaken to restore the former water regime of the reserve would have to be made on the farmland and would have impacts on the drainage of that farmland; ilmenite mining may impact on the reserve. Maher Swamp also may be influenced by mining on adjacent land and management may need to be on that land unless modification of the peripheral part of the reserve is acceptable.

Bullock Creek

The extensive wetland area on Bullock Creek Farm was intensively drained to enhance agricultural use of the land by its former owner. A grid of linear open drains was dug and

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is now the dominant visual feature on aerial photographs. The soils of the swamp are mapped as Rotokohu series (Laffan 1980), but the representative profile described by Laffan is from the Mokihinui-Orikaka region. There does not seem to be any information on soil conditions in the back swamp at Bullock Creek that could provide a guide to how extensively the drains have modified the hydrology of the land.

Three steps are recommended:

Investigate the effect of the open drains on the water table in adjacent land

The purpose is to determine whether a change in drainage conditions extends far from the drains. Dipwells, made by hand-augering a vertical hole and inserting a close-fitting length of slotted plastic field drain, should be installed to a depth of about 1 metre. They should be on a transect between two parallel drains, spaced logarithmically (i.e., at 1, 2, 4, 8,..., 8, 4, 2, 1 m) from the drains. The nature of the material should be noted during installation, especially the degree of decomposition of the peat (raw fibrous,..., well decomposed, D1-D8 scale) and mineral soil content. The rim of the slotted plastic tube should be about 5 cm above ground surface and should be used as the reference level for measuring depth to water table. The transect should be surveyed to obtain the absolute elevation of the tops of the tubes and a ground-surface profile. The most useful data will come from a sequence of data collected during a period of 1 to 2 weeks with little rainfall, as this will show how far drawdown extends from the drains. The distance of drawdown is expected to depend on the permeability of the peat: if it is poorly decomposed and fibrous it will be more permeable than if well decomposed and amorphous. For example, in slowly permeable pakihi soils drawdown extends only a short distance (ca. 1 m) from a drain.

Control of the water table

If the drawdown of the water table extends several metres from the drains, there is the prospect that in time a significant change in soil and vegetation will occur. The simplest treatment is to block drains at a few strategic points to control the water table. There are two disadvantages to this approach to restoration of the hydrological regime:

(1) The open drains are up to a metre deep and are usually concealed by overhanging vegetation; if filled with water by blocking the drains they would be a hazard to anyone walking across the swamp. However, the main track used by trampers skirts around the swamp and it appears that few chose to traverse the swamp.

(2) The main impact of the construction of the drains, apart from the unknown change of the water table, was the creation of linear raised mounds of spoil. These linear mounds are strong feature of the landscape and carry a largely exotic vegetation of "improved" pasture grasses and lotus, with a little gorse and ragwort. They may continue to be a habitat for weeds. These spoil sites probably differ from the main part of the swamp in their better drainage as they are elevated and probably have some nutrient gains from mixing of mineral soil. Lotus will raise the N status of the soil and possibly permit other plants to invade.

Restoration of the spoil from the drains

In the long run, returning the spoil to the drains may be the only sure way to restore the site to near its original condition. This may be essential if woody weeds begin to colonise the mounds. Any mineral soil should be buried as deeply as possible. This treatment is the most costly initially, but should have low maintenance costs in later years. A small trial could determine the costs and any adverse effects of disturbance if a digger is used for backfilling. It may be sufficient to remove the higher mounds, use the returned spoil to partly block the drains, and rely on the raised water table to produce the return to pre-drainage vegetation.

Nikau Scenic Reserve, Hibernia Creek meander area

There has been a long period of investigation and debate over the conservation of this reserve. It contains a cross-section of the postglacial shorelines of the Barrytown coastal lowland (Suggate 1989). A series of ridges alternates with present and former stream channels, forming a zig-zag pattern which developed as streams were locked into their positions when each ridge was formed. Vegetation on the ridges reflects their age, but the flood-plain communities are influenced by water and sediment inputs by streams. Thus, while the reserve may contain a good sequence of vegetation on ridges that can be sustained without large management inputs, the vegetation in the riparian zones is open to the impact of changes in stream regimes outside the reserve. From a hydrological point of view the reserve does not extend far enough either to the north or to the south to contain a representative and sustainable hydrological regime. Streams entering the reserve at both edges have been modified for farm drainage or flood control purposes. The suggested approach to conservation management recommended here is to concentrate on restoring a segment of the original hydrological regime and the associated floodplain communities of this coastal lowland.

South of the reserve there is a drain, which was cut in 1978 to reduce flooding on the Coates' farm. This allows most of the flow in Hibernia Creek to bypass former channels in the reserve. After inspecting the site, I concluded that any modification of the present weir to allow more water to enter the reserve will not achieve a full restoration of the natural hydrological regime including both flood flows and low flows that are important for floodplain ecosystems. I therefore recommend that Department of Conservation should seek full restoration of the water regime by closure of the cut and opening of the previous channels by which water in Hibernia Creek flowed into and out of the reserve.

Ilmenite mining of the land to the south of the reserve would have the potential to drastically alter the surface water regime and sediment load. It is recommended that Department of Conservation seek an arrangement with the landowners that would retain the present Hibernia Creek and Lyddys Creek unmodified from where they cross SH6 to where they enter the sea (apart from proceeding with closing the cut and restoration of the original channel through Nikau Scenic Reserve as discussed above).

At the northern end of the reserve an "elbow" bend in the stream channel extends beyond the reserve boundary. As a buffer strip is proposed to be retained in this area north of Nikau Reserve it should be possible to protect the integrity of the stream channel at this "elbow". Maps show a small stream entered the Hibernia Creek channel at this elbow. However, as this stream is likely to be modified in the course of ilmenite mining and may carry excessive sediment, I recommend that it be prevented from entering the Hibernia Creek system, at least until mining is completed. The proposed buffer area is expected to provide protection of the groundwater regime.

The two proposals made here - restoration of the Hibernia Creek regime to the south of the reserve and protection from undesirable inputs at the northern edge of the reserve - are considered to be sustainable once they are implemented. Both actions will require cooperation of owners of land adjacent to the reserve. The widespread modification of coastal wetlands already on the Barrytown Flat, and the complete destruction of natural drainage patterns that will result from ilmenite mining, provide good reasons for attempting restoration of this small segment of the hydrology and ecology of the region.

Maher Swamp

This site was visited under relatively dry conditions when surface water was much less extensive than it is most of the time. The issue considered here is the possible effect of mining ilmenite sands on the hydrological regime of the swamp. Johnson (1992) described the botany of Maher Swamp. Beach and low dune ridges represent a succession of shorelines (Suggate 1989) and swamp occurs where peat has accumulated in poorly drained broad hollows and old sand plains between the ridges. The peat and swamp are continuous through gaps in the dune ridges.

Lawson Creek to the north of Maher Swamp and Maher Creek near the southern edge are in partly artificial channels, but formerly may have flowed across the swamp during floods. At present the main sources of water that maintain the wetness of the swamp are rainfall, subsurface flows and shallow groundwater, and surface flow across the peat. From the point of view of the possible effects of mining on adjacent land on the hydrology of the Maher Swamp it is the effects on lateral surface and subsurface flows that may have greatest impacts. Two extreme cases may occur:

1. Wetness is of local origin within the swamp and arises because the near-surface peat and sand are slowly permeable. Excess rainwater flows slowly across the land surface, which has a very low gradient. Runoff from dune ridges contributes to the surface water flow.

2. Wetness is of external origin and arises from subsurface inflows from hillslopes and fans upslope or from intersection of the ground surface by a water table that is fed from upslope.

In the first case mining would have little effect on the hydrology of the swamp. In the second case mining could intercept inflows and/or lower the water table causing drying of the swamp. Reality is probably a mixture of the two cases.

The hydrological investigations carried out on the Banytown Flat would tend to suggest that intersection of the ground surface by a water table occurs at least near the coast (Fig. 9 in Evidence of Timothy Daniel Sullivan in support of Westland Ilmenite Limited application for water permits). In other parts of New Zealand, such as the Manawatu coastal plain and the coastal sands near Christchurch, the land surface on a sand plain is also close to the water table. In both of those regions the seasonal variation of depth to water table, by about 0.5 m, reflects the seasonal balance of rainfall and evaporation. The much higher rainfall at the Maher Swamp site would be expected to lead to infiltration and percolation down to the water table at all times of the year unless the surface soil or peat is a barrier to infiltration.

Because the gradient towards the coast is very low it seems likely that the rate of water movement is slow (e.g., a hydraulic conductivity of 3 m/day, a gradient of 1%, and porosity of 33% would give lateral movement over a distance of 10 m in 100 days or about 35 m/year). Mining to the east of Maher Swamp would have little effect on these flows unless it is dry mining requiring drawdown of groundwater and much deeper than proposed.

The data available do not suggest a major cause for concern about effects on groundwater if mining occurs close to Maher Swamp. If surface-water flows are the main origin of wetness in the swamp, consideration needs to be given to effects of mining on these flows. A natural boundary of the area to be protected would be the crests of ridges rather than a line determined by fencelines or land tenure. It is recommended that DoC attempt to define such a boundary, preferably one with few areas where the swamp is continuous through gaps in the dune ridges. Management would then be able to focus on minimal modification of flow through the gaps. Care will be needed to ensure that sediment does not enter the swamp from the mining area. The most useful additional investigations would be measurements to define the near-surface hydrology within the swamp (upper 1 m) and the role of flow through the gaps, and to determine to what extent the peat and rainfall control the water regime. It may be possible to determine the contribution of outflow from groundwater by analysis of natural isotopes of hydrogen and oxygen in water samples.

References

Laffan, M.D. 1980: Soils of the Charleston-Punakaiki region, South Island, New Zealand. *N.Z. Soil Survey Report 47.*

Suggate, R.P. 1989: The postglacial shorelines and tectonic development of the Barrytown coastal lowland, North Westland, New Zealand. *New Zealand Journal of Geology and Geophysics 32:* 443-450.

Johnson, P.N. 1992: Maher Swamp: Botany and Conservation Assessment. Unpublished contract report, Landcare Research, Dunedin.

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30/6/94