10.2. Glendhu Forestry

Prepared for:	Technical Committee
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Activity:	Environmental: Water
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EXECUTIVE SUMMARY

[1] The University of Otago were contracted to report on the Glendhu forestry water quality monitoring project (a multi-year investigation into the effects of pine harvesting operations on suspended sediment yield, and the associated impacts on water clarity, and stream sedimentation) the full report is attached as Appendix 1.

[2] The report summarises the data and outcomes of the 18-month investigation into the pine forest harvesting phase in Glendhu and supports the water plan implementation programme in relation to diffuse suspended sediment and permitted activity rules.

[3] The wider receiving environment, the Waipori River, is identified in Schedule 15 of the Regional Plan for Water and with regards to nutrient, bacteriological and turbidity contaminants, with turbidity limited to 5 NTU.

[4] For this study (2016–2018) the turbidity (80th percentile) concentration for the plantation pine catchment at Glendhu was 1.5 FNU and 2.0 NTU, indicating that the harvest phase of the pine plantation catchment is within specified limits.

[5] This result supports the pilot study (Bright, 2015[1]) which examined the preliminary effects of forest clearance in the Glendhu catchments and concluded that little to no effect of forest clearance was likely (at 40% catchment clearance).

RECOMMENDATION

That the Council:

1) ***Receives*** *this report.*

2) ***Notes*** *the report.*

BACKGROUND

[6] The Glendhu paired catchments, were developed in the late 1970s in collaboration with the NZ Forestry Service to establish the effects of converting indigenous tussock grasslands to plantation pine forestry in Otago. Two catchments were set aside, one retained in indigenous tall snow tussock (*Chionochloa rigida*), and a second planted in

[1] Bright CE, 2015. Effect of forest clearance on water quantity and water quality in Otago: a paired catchment study. Unpublished Honours Dissertation, University of Otago. 135 p.

pine forestry (*Pinus radiata*) in 1982. Figure 1 shows the location of the Glendhu catchments. The tussock catchment (GH1) covers 2.16km^2 and the pine plantation catchment (GH2) covers 3.10km^2

Figure 1. Location of the Glendhu study. The 'control' Tussock catchment and the 'treatment' forest catchment are shown on the aerial photograph.

[7] Otago Regional Council used the paired catchments to monitor sediment discharge during plantation clearance to assess whether permitted activity rules (Regional Plan: Water) relating to diffuse suspended sediment were met.

METHODS

[8] Large v-notch weirs are located at the bottom of the tussock and pine catchments (Figures 1 and 2) where water level is continuously measured. A relationship between water level and discharge was used to provide an accurate estimate of flow[2].

[9] Otago Regional Council installed and maintained turbidimeters (turbidity measured at 15-minute intervals) at each weir to estimate suspended sediment concentration and when combined with flow, suspended sediment yield.

[10] Automatic water samplers were installed upstream of the concrete weirs and attached to a water level trigger to collect water samples during high flow events. Five events were sampled between July 2016 and January 2017. Samples were taken at 30-minute intervals on the ascending limb of a hydrograph.

[11] The automatic samples were supplemented by discrete grab samples (collected by the Otago Regional Council field team, and the University of Otago at one-two month intervals) both data sets were used to develop a turbidity and suspended sediment relationship.

[2] Manaaki Whenua Landcare Research (on behalf of Rayonier) support the project by maintaining the flow monitoring sites and providing ORC with a continuous record of flow for both study catchments.

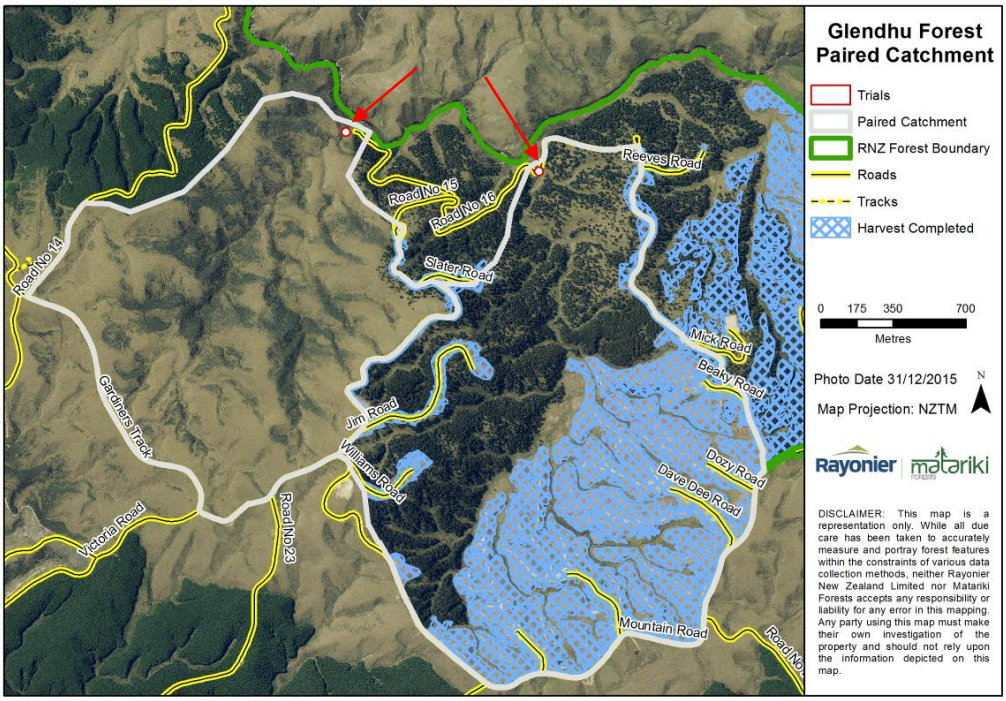

Figure 2. Aerial map (dated December 2015) showing harvesting progress on the forested catchment (right). Remaining pine was harvested by August 2018. The 'control' tussock catchment is on the left. The location of v-notch weirs indicated by the red arrows.

RESULTS AND DISCUSSION

[12] The median turbidity (July 16 to December 17) was 0.5 FNU in the tussock catchment, and 1.3 in the pine plantation catchment indicating a general trend of higher turbidity in the pine plantation catchment. The differences were greatest during high flow events, with the maximum recorded turbidity in the tussock catchment of 69 FNU compared to 453 FNU in the pine plantation catchment.

[13] There was a very strong linear relationship between field-measured turbidity and concurrent measurements of suspended sediment concentration in both catchments (R^2=0.92 tussock, R^2=0.75 pine) which enabled a conversion of in-situ turbidity to a continuous record of suspended sediment

[14] Visual clarity was determined by concurrent measurement of turbidity (in NTU) and visual clarity (in m) and plotted to determine a decay curve using regression. There was a greater decline in visual clarity observed in the pine plantation forest compared to tussock, likely attributable to greater amounts of soil particulates being disturbed in the pine catchment.

[15] Suspended sediment yield shows a different response between the two land uses, for the tussock catchment (550 days) the suspended sediment yield was 16.4 t, equivalent to 26.9 tonnes per hectare. For the pine plantation catchment (547 days) the suspended sediment yield was 80.5 t, equivalent to 132.9 tonnes per hectare.

[16] There was a very strong linear relationship between field-measured turbidity and concurrent measurements of suspended sediment concentration in both the tussock catchment and the pine plantation catchment. However, the pine plantation catchment has increased turbidity, higher suspended sediment, and reduced water clarity as a result of forest clearance.

[17] A pilot study examining the preliminary effects of forest clearance in the Glendhu catchments during 2015 concluded that little to no effect of forest clearance was likely (at 40% catchment clearance) due to extensive riparian buffer networks, forest clearance techniques, keeping roads and landings to the periphery of the catchment, and carrying harvesting out in a staggered way over a longer period of time, which reduced the effects of landscape disturbance, and any further clearance related impacts would be best mitigated by these practices in place (Bright, 2015).

[18] Schedule 15 of the Regional Plan for Water has a turbidity limit of 5 NTU (based on a five year 80th percentile when flows are at or below median flow). For the plantation pine catchment at Glendhu (for the period 2016–2018) the turbidity 80th percentile was 2.0 NTU, indicating that turbidity during the harvest phase of the pine plantation catchment did not exceed RPW limits.

POLICY CONSIDERATIONS

[19] Schedule 15 of the Regional Plan for Water has a turbidity limit of 5 NTU (based on a five year 80th percentile when flows are at or below median flow). For the plantation pine catchment at Glendhu (for the period 2016–2018) the turbidity 80th percentile was 2.0 NTU, indicating that turbidity during the harvest phase[3] of the pine plantation catchment did not exceed RPW limits.

[20] The report suggests that forest clearance in Glendhu has, and will likely continue to have, a small but measurable effect on the discharge of sediment. However, in this instance the combination of a stable schist lithology, rolling hillslope and low risk of land erosion suggest that forestry clearance is unlikely to have lasting effects on the local and downstream receiving environments.

[21] The Glendhu forestry operation is undertaken by Matariki Rayonier Forests who operate under best practice management, which is likely to reduce the discharge of contaminants at higher flows. Other forestry operations, under different operators or under less stable lithology may see a higher contaminant load when harvesting which could adversely affect the aquatic habitat downstream.

ATTACHMENTS

1. Glendhu Forestry Water Quality Monitoring Summary Report Nov 2018 **[10.2.1]**

[3] Harvesting completed in August 2018