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Hawke's Bay Regional Investment Company Limited

**Ruataniwha Water Storage Scheme**

**Landscape and Visual Effects Assessment (Final)**

May 2013

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CONTENTS

## 01 EXECUTIVE SUMMARY

**Potential Project Effects**

Potential landscape effects of the Ruataniwha Water Storage Scheme include the following:

a) Potential effects on the **natural character** of the following rivers and their margins:
   - The Makaroro River and its tributaries (Dutch Creek and Donovan's Gully) as a result of construction of the dam and inundation of the existing river;
   - The Makaroro, Waipawa and Tukituki Rivers downstream of the dam as a result of changes to natural flow regimes;
   - The Waipawa River at the location of the upstream and downstream water intake structures as a result of changes to the river bank; and
   - Smaller streams and watercourses in the Ruataniwha Plains where traversed by the primary distribution system headrace, as a result of construction of culverts or inverted siphons.
   - Papanui Stream as a result of changes to the flow regime, modifications to the stream channel, and proposed fencing and revegetation of the stream banks.

b) Potential effects on the **outstanding natural landscapes** of the Ruahine Ranges as a result of the nearby reservoir lake.

c) Potential effects on **landscape amenity** including:
   - Visual effects of the dam and reservoir lake;
   - Visual effects of the primary distribution system head-race (from both private and public views);
   - Visual effects of the power station and transmission line; and
   - Effects on the character of the Ruataniwha Plains and Zone M as a result of increased irrigation (including pasture 'greening' and additional use of pivot irrigators);

d) Effects on the biophysical landscape including effects of earthworks on landforms, watercourses, or vegetation; and

e) Temporary construction effects.

**Assessments Undertaken**

Hawke's Bay Regional Council initially commissioned Isthmus in November 2011 to undertake a 'Baseline Landscape Assessment' and to provide input to the refinement of the Scheme design. The 'Baseline Landscape Assessment' report (Final 23 January 2012) assessed the existing landscape values, scoped potential landscape effects, appraised alternative headrace types and alignments, and proposed a series of principles or guidelines for the detailed design of the headraces. Isthmus participated in site visits and workshops that addressed appraisal of alternative headrace options (types of headrace and alternative alignments) and remediation / mitigation measures with regard the dam and reservoir.

The subsequent Landscape and Visual Assessment addressed the following matters:

a) A description and appraisal of the existing landscape including;
   - Its physical, perceptual and associative factors,
   - The nature and degree of natural character of the rivers and their margins; and
   - Identification of outstanding natural features and landscapes.

b) An analysis of the effects on natural character of the rivers, including effects on both biophysical and perceptual aspects of natural character, taking into account the inundation of

the existing river by the dam, modification of downstream flows, and the construction of the primary distribution system including the intake and outfall structures and crossing of smaller streams by the headrace canal;

c) An analysis of the effects of the dam and reservoir on the values of the nearby Ruahine Ranges (being the only Outstanding Natural Landscape potentially affected);

d) An analysis of the effects of landscape amenity and biophysical effects. Given the dispersed nature of the Scheme this was dealt with by dividing the project into its components as follows:
   - Dam and Reservoir
   - Primary Distribution System including the Water Intake Structures, Headrace Canal and Buried Pipelines
   - Secondary Distribution System and Changes to Land Use Patterns
   - Downstream Intake Structure and changes to the Papanui Stream
   - Hydro-electric (add-on) Station
   - Transmission Line

e) An assessment of potential temporary construction effects.

**Results of Assessments**

*Natural Character*

The main adverse landscape effect will be on natural character of the Makaroro River in the vicinity of the dam and reservoir, and on the downstream flows below the dam. Natural character will clearly not be preserved in the vicinity of the dam and within the reservoir footprint, and it will be diminished to some extent on the Makaroro River (and to a lesser extent the Waipawa River) downstream of the dam as a result of changes in flow regime and sediment load. Such effects are common to any in-river dam. Factors to take into account when considering the appropriateness in relation to such effects include the following:

a) The modified 'working rural character' of the adjacent land;

b) The low visibility of the dam (and hence low effects on the appearance (visual aspects) of natural character);

c) The naturalistic appearance of the reservoir;

d) Proposed measures as described in the 'Proposed Integrated Mitigation and Offset Approach' report which will enhance the biophysical and visual aspects of natural character of the reservoir including establishing a fenced and planted margin around the reservoir, and measures to enhance habitat and control predators in the reservoir catchment;

e) Proposed management of the downstream flow regime to provide minimum low flows in the Makaroro River, regular flushing during summer months, and biodiversity enhancement measures in the downstream sections of the Makaroro and Waipawa Rivers;

f) Beach replenishment at the mouth of the Tukituki River to replace the reduction in sediment load - to be carried out in a location and manner that will not create any new adverse landscape effects apart from the temporary effects of the replenishment activity;

g) The low impacts of the intake and outfall structures on natural character because of their low profiles, low visibility locations, and modified rural settings;

h) Positive effects on the lower Tukituki River as a result of increased summer flows and flushing 'freshes'; and

i) Positive effects on the natural character of the Papanui Stream because of increased flows which will partly restore historic flows, and the associated fencing and margin restoration; (partly restoring the historic diversion of water from the previous course of the Waipawa River).

*Outstanding Natural Features and Landscapes*

The only outstanding natural feature or landscape in the area is the Ruahine Ranges. The Scheme will have negligible effects on the landscape values of the Ranges because the dam and reservoir will be in a working landscape that is clearly separate from the Ruahine Ranges, the dam itself will not be visible from the ONL (except in very long distance views from the mountains) or from roads providing access to the Ranges, and the upstream end of the reservoir will not be visible from where the Makaroro River emerges from the Ranges.

*Landscape Amenity and Biophysical Effects*

Adverse landscape amenity effects will be low for a project of this type for the following reasons:

a) The dam, which is the feature with the greatest potential adverse amenity effects, will have very low visibility. To most intents and purposes it will have no public visibility except for future users of the reservoir;
b) Similarly the 6.5MW hydro power station will be a minor adjunct to the dam, and will essentially have no public visibility. The associated 33kV transmission line will be an unremarkable element carried on power poles along the road reserve;
c) While there will be some potential adverse amenity effects resulting from the seasonal bare zone around the reservoir margins, a range of measures is proposed to mitigate such effects;
d) The upstream water intake structure on the Waipawa River will be tucked against a bank in an unobtrusive location with low visibility, and similarly the downstream intake structure will have a low profile, and will be in a low visibility location at the toe of a stopbank;
e) The primary distribution system headrace canal, which forms part of the primary distribution system, will not be out-of-place in a working rural landscape (it will continue a tradition of community water races in the area). The selected route follows the contours and traverses relatively subdued topography so that earthworks will have low profile. The selected route also avoids houses;
f) While there will be changes in land-use, field patterns and associated structures (such as pivot irrigators), such land uses will not be dissimilar to existing activities and they will continue a pattern of change and evolution that has characterised the landscape over the last 150 years.

There will be some positive landscape amenity effects:

a) The reservoir will have high amenity as a 'lake' taking into account its serpentine form, tributary reaches, bold hill backdrop, and the revegetation proposed around its margins;
b) The primary distribution system head race canal may also be perceived as a positive and interesting feature; and
c) The use of the Papanui Stream to convey irrigation water will partly restore the watercourse, and the fencing and replanting of its banks will enhance its natural character.

The main potential biophysical landscape effects are subsumed under the topic of 'natural character' above. Any adverse biophysical effects in addition to those addressed under that topic will be low for the following reasons:

a) The Scheme will be within a modified working rural landscape;
b) Most of the water distribution network will be by means of buried pipelines; and
c) The primary distribution system headrace canal has been aligned to follow flat to rolling topography which will minimise the scale of the earthworks, and it traverses open farmed country.

*Temporary Construction Effects*

The dam and its ancillary structures present the main potential for construction effects. However such effects will be confined to a relatively small area with visibility essentially restricted to private farmland.

There will be some adverse construction effects associated with the contouring and armouring of the reservoir margins, primary distribution system headrace construction, laying of distribution system pipelines, installing the transmission line, and constructing such elements as the intake structure and inverted siphons. Such effects will, however, be temporary in nature, short term in duration (construction and earthworks will be rehabilitated as the Scheme progresses), limited in scale, and will not be out-of-place in a cultivated rural landscape.

*Summary of Effects Assessment*

In summary the project will not be out-of-place in the landscape, the main elements have been appropriately designed and located, and the degree of residual adverse landscape or visual effects will be relatively modest for a project of this type.

**Suggested Mitigation Approach for Effects Identified**

Measures that are already incorporated within the Scheme design will avoid or minimise potential adverse landscape effects. Such measures include the selected dam site and footprint of the reservoir, the location and design of the primary distribution system including the intake structures, headrace type and alignment, and proportion of the water distribution network that will be buried.

Suggested further measures to mitigate residual adverse effects (and enhance amenity) include planting around parts of the lake margin, measures (such as armouring and contouring) to ameliorate the fluctuating water level bare zone, public amenity facilities adjacent to the lake, and implementing the landscape principles and guidelines for the detail design of the headrace. Landscape measures should be incorporated into an integrated design, along with measures relating to other disciplines, as described in the parallel document 'Ruataniwha Water Storage Scheme –Proposed Integrated Mitigation and offset Approach' (HBRIC 2013f).

## 02 INTRODUCTION

The proposed Ruataniwha Water Storage Scheme (the 'Scheme') entails damming part of the Makaroro River (a tributary of the Waipawa River) to store winter flows for summer irrigation use on the Ruataniwha Plains and an area east of Otane. The purpose is two-fold: Firstly to improve agricultural productivity in a fertile area prone to summer drought, and secondly to address unsustainable extraction of water from the artesian basin and specifically to enhance summer flows in the lower Tukituki River which is currently being reduced to unacceptably low flows by extraction from the artesian basin.

This assessment of the landscape and visual effects of the Scheme is organised as follows:

a) Description of the existing landscape;
b) Identification of the landscape issues;
c) Analysis of the actual and potential landscape and visual effects;
d) Recommendations to avoid remedy or mitigate potential adverse effects.

## 03 DESCRIPTION OF EXISTING LANDSCAPE

### RUATANIWHA PLAINS

**Geomorphology/Topography**

The Ruataniwha Plains are outwash gravels in a long valley bordered on one side by the Ruahine / Wakarara greywacke mountain range and on the other by the Turiri / Raukawa limestone hills.

The valley contains a series of terraces and flood plains: The higher terraces and foothills under the shadow of the Ruahine Ranges are mostly pastoral farms and are regarded as 'summer safe' because of their higher rainfall. Such terraces are more dissected and characterised by rolling surfaces and deeply entrenched streams which often contain corridors of regenerating manuka and remnant native bush. The terrace levels generally rise from about 250m asl overlooking the plains to about 500m asl against the toe of the ranges.

The plains themselves comprise the active floodplains and lowest terraces and fall from roughly the 220m contour in the west to around 150m asl against the hills on the east.

A series of parallel rivers and streams cross the valley in a eastward direction and are gathered into either the Waipawa or Tukituki Rivers which flow through separate gorges in the Turiri / Raukawa hills. The Waipawa and Tukituki Rivers join below the gorges to form the main Tukituki River which turns sharply to the north to follow parallel valleys between ranges of 'limestone'[1] hills to Hawke Bay.

[1] Calcareous sandstones and siltstones

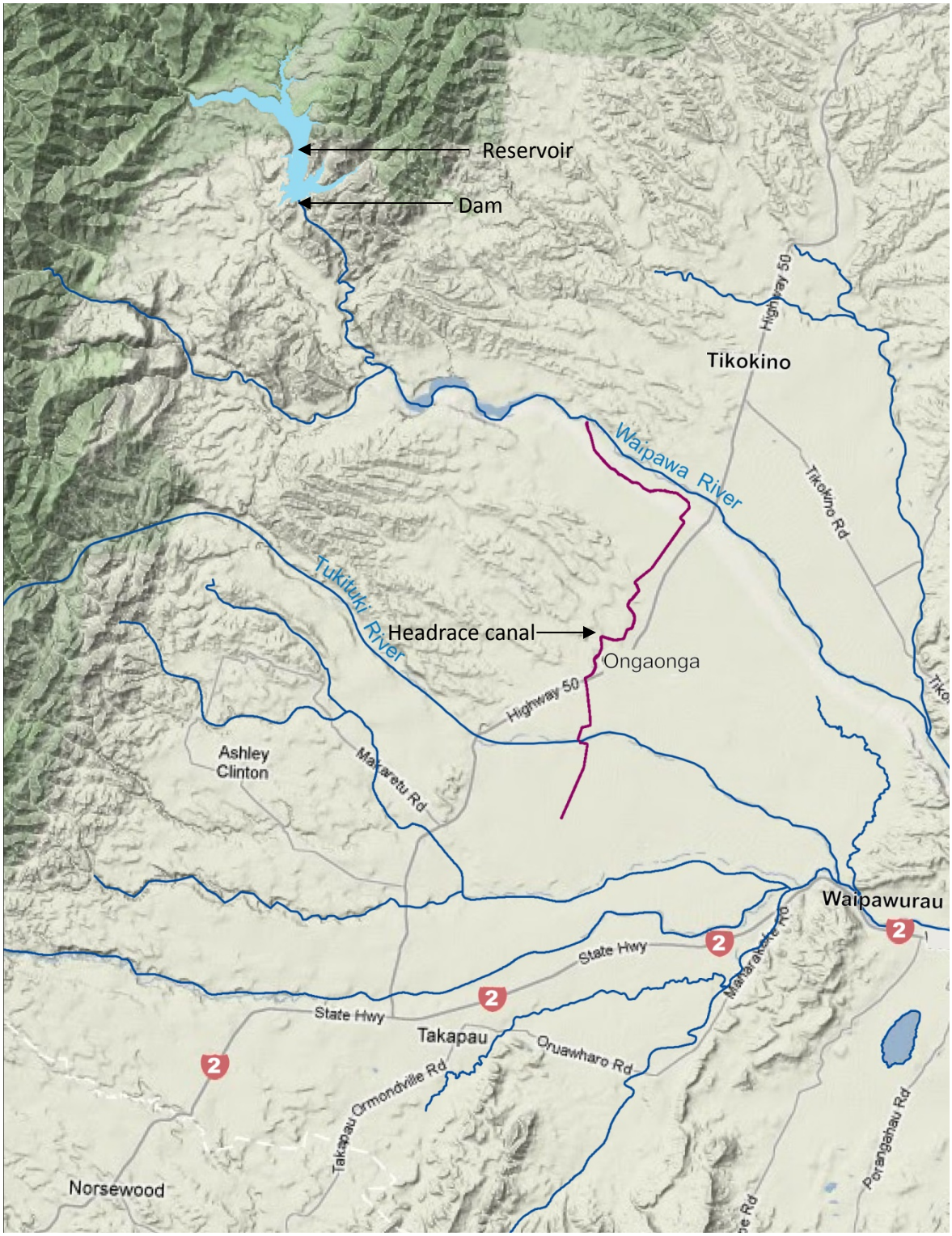



*Figure 1: Landscape Context Map*

**Natural Vegetation Patterns**

Prior to European settlement the Ruataniwha Plains was native tussock grassland bordered in the south by the 'Seventy Mile Bush'. The bush also extended along the higher terraces on the western side of the plains, and there were other outlier stands within the plains such as at Tikokino (Hampden Bush). The lowland forest was podocarp (matai, miro, rimu, kahikatea, totara), transitioning to beech forest at higher elevations on the ranges. Sawmilling operated on the lowland forest for approximately 100 years, reflected by such landscape features as the 'Sawyers Arms Hotel' at Tikokino and the timbers of the historic homesteads. There are virtually no remnants of lowland forest on the plains themselves, but there are occasional reserves in the valleys amongst the higher terraces, fingers of remnant or regenerating bush on river scarps and gorges, and scattered totara trees on the hills inland of Tikokino.

**Land Use**

The plains were taken up as large sheep runs in the 1850s, initially on the native grasses. The runs were gradually subdivided into smaller farms and the pasture progressively improved to exotic species. The plains have traditionally been used for pastoral farming (especially for finishing stock), cropping, some dairying (there was an historical dairy factory at Ongaonga), and orchards in some locations such as Maharakeke.

There is a geometric pattern of paddocks and shelter belts, and a patchwork of different land uses. The area is drought-prone in the summer, so there were a number of small community water races (although they have mostly been abandoned), and there are now large pivot irrigators drawing on artesian water.

**Road and Settlement Pattern**

The road and settlement pattern reflects the topography: SH50 follows the top of the plains (i.e. the 220m contour more or less) between Takapau and Gwavas, and continues north to the Heretaunga Basin. The two settlements (Ongaonga and Tikokino) are adjacent to SH50, as are most of the earliest historic homesteads. The main SH2 and railway line, on the other hand, cross the southern end of the plains and pass through the Tukituki River Gorge to Waipukurau and north to Hastings. The larger towns (Waipukurau, Waipawa and Otane) are on the SH2/railway in the parallel valley to the east.

Ongaonga and Tikokino were planned rural villages, but have never developed to their intended size, so that both settlements are characterised by houses scattered amongst empty sections. Ongaonga in particular has an historic character with several C19th buildings.

*Appendix 4.1: Broadscale Vegetation and Land use Patterns*

**Aesthetics**

Aesthetically the Ruataniwha Plains is a 'working' landscape with a geometric patchwork of different crops. The plains have a productive, fertile appearance set against the dry hills characteristic of Hawke's Bay. It has a settled character with historical associations which are discussed further below. Against this benign character is the erosion-scarred wilderness backdrop of the Ruahine Ranges.

The Ruahine Ranges are the main orientating feature: There is a legible pattern of mountains, foothill-terraces, plains, and the eastern limestone hills. The rivers and twin gorges are secondary landmark features which cut across the main underlying pattern.

**Associations with Tangata Whenua**

The area is part of the Ngati Kahungunu rohe, and falls within the Tamatea Taiwhenua area. There are five marae in the vicinity of the project area at Waipawa (2), Waipukurau and in the Takapau area (2).

Tangata whenua values are an integral aspect of landscape values. A Cultural Impact Assessment (CIA) has been undertaken by Dr Benita Wakefield ( Taiwhenua o Tamatea & Taiwhenua o Heretaunga (June 2012).

The name 'Ruataniwha' derives from a legend that helps bring to life the basin-like nature of the plains and the significance of the Waipawa and Tukituki River gorges through the Turiri / Raukawa range of hills. The legend tells of two taniwha who inhabited a lake in the Ruataniwha basin. During a fight their lashing tails cut the two gorges which drained the basin and created the Tukituki and Waipawa Rivers.

**Historical Associations**

The area has historical associations with the sheep runs established in the 1850s and 1860s, including grand homesteads and gardens. Notable homesteads in the vicinity of the Scheme include Gwavas, Springhill, Forest Gate and Ashcott.

The area was also on the fringes of the Scandinavian settlement of southern Hawke's Bay. While such settlement was centred mainly at Norsewood, Dannevirke and further south, there was also some Scandinavian settlement in the 1870s in the bush areas at Ashley Clinton and Makaretu[2].

**Recreational Settings**

Landscape characteristics of the Ruataniwha Plains that lend themselves to recreation include its rural and historical character, enjoyed through such things as farm-stays. The streams crossing the plains are used for picnic spots by locals. There is also the occasional reserve (such as A'Deanes Reserve, Monckton Reserve, and Inglis Reserve) but these tend to be in the valleys inland of the plains.

The Ruahines, by contrast, provide a wilderness landscape experience with a number of tracks and backcountry huts. Yeoman's Track is a gentler walk through regenerating native forest on an old logging road at the foot of the Ruahines. Recreation is addressed in detail in a separate report by Opus consultants (Opus May 2013a).

[2] MacGregor, M., 1975, 'Pioneer Trails of Hawke's Bay, p.35

## MAKARORO VALLEY

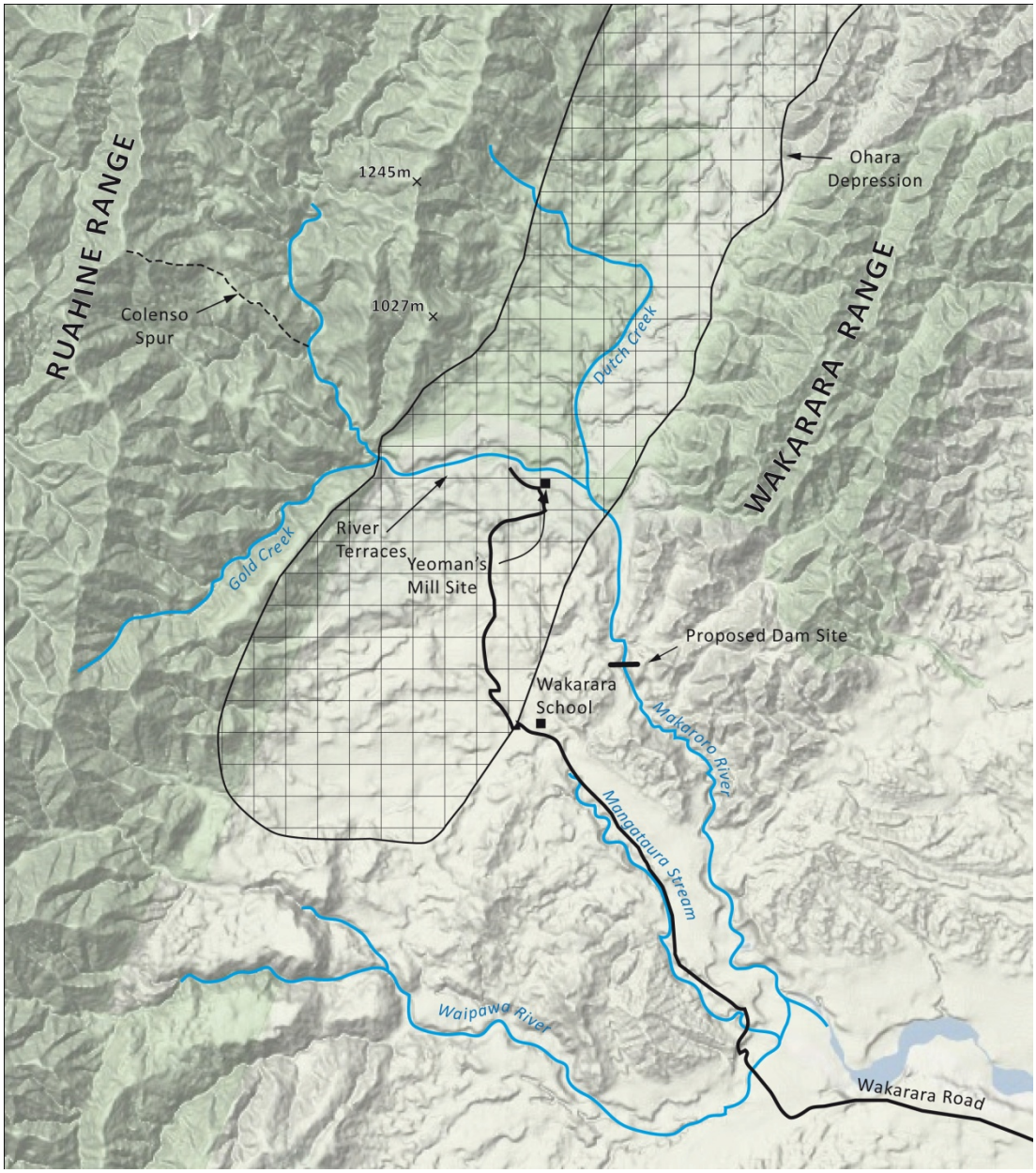



*Figure 2: Makaroro Valley Landscape Context Map*

**Topography**

The western edge of the Ruataniwha valley is marked by outlier ranges of hills parallel to the main Ruahine Range, the most distinctive of which is the Wakarara Range which rises to around 1000m inland of Tikokino. The Maori meaning, 'waka thrown broadside on', is an apt description of the Wakarara Range's relationship to the Ruahines. The long valley between the Wakarara and Ruahine Ranges is referred to as the O'Hara depression. This area was logged by the Yeoman's Mill and much has been replanted in exotic plantation as part of Gwavas Forest. Dutch Creek, a tributary of the Makaroro River which will become part of the reservoir, follows the valley.

The Wakarara Range is terminated at its southern end by the Makaroro valley, whose river terraces extend to the toe of the main Ruahine Range, the highest terraces reaching approximately 500m asl.

The Makaroro valley is unusual in that it is drained by two parallel tributaries: The Makaroro River follows the northern edge of the valley, while the Mangataura Stream follows the southern edge. Both are deeply entrenched and have regenerating (or remnant) native bush on the river scarps. The separating tongue of land is a high terrace with steep to rolling hills. There is a distinctive line of 'rim rock' north-east of Rangimarie homestead near the proposed dam site.

*Figure 3: View to the north looking towards O'Hara depression/ Dutch Creek between Ruahine and Wakarara Ranges.*

**Land use**

The Makaroro valley is extensive pasture (sheep and cattle) farming, characterised by typical features such as farmsteads, yards and exotic woodlots and macrocarpa shelter belts.

*Figure 4: View to the north up Makaroro River showing nature of landform and land use patterns.*

**Historical Associations**

The valley is associated with William Colenso's explorations of the Ruahine Ranges. On his first expedition Colenso's party was guided along a Maori route, walking along the Makaroro River bed into the Ruahines, and climbing 'Colenso Spur' to the open tops. He used this route on a number of subsequent explorations into the Ruahines and central North Island.

Samuel Fletcher was granted land in this area in 1862 and established the Pendle Hill station. The land was subsequently subdivided and sold as part of the Makaretu Crown Grant. Names of a number of the families who took up these grants are still associated with the district, including the

Peers, Mathews, Barlows, Douglas, etc. [3] The former one-roomed Wakarara School is now used as an outdoor education camp.

The former Yeoman's mill site is on the south bank of the Makaroro River at the end of the formed Wakarara Road[4]. The mill operated for some 30 years between 1926 and 1956. At the time there was a small attached settlement and a bridge across the river to the podocarp forest in the O'Hara valley. The only remnants apparent on the site are a boiler and some concrete foundations. The former mill site is open grassland used as a picnic area, with high amenity on account of the river, enclosing hills, and the looming Ruahine Range backdrop. It is also a starting point for several tracks into the Ruahines (for instance the walk to Colenso Spur), and Yeoman's track which follows one of the old logging roads on the opposite side of the river through an area of regenerating bush. Historical and archaeological matters are covered in detail in a separate report by Clough and Associates.

## OTANE BASIN (AREA 'M')

While most of the land to be irrigated is in the Ruataniwha Basin, a smaller area (referred to as Area 'M') on the eastern side of the Turiri / Raukawa Hills is also included in the Scheme. Area 'M' is a basin which makes up part of a valley aligned SW/NE between Waipukurau and the Heretaunga Plains.

The landscape is modified, productive farmland. The valley floor comprises a mix of cropping, sheep and beef farming, and dairying. The rolling hills surrounding the basin are mostly used for sheep and beef farming. Otane village is located on the western side of the basin on the railway line and adjacent to SH2.

The main natural feature within the basin is the former course of the Waipawa River which was diverted in the 1880s to join the Tukituki River which flows through the adjacent valley to the east. The former river course through the Otane basin is now a residual 'creek' (Papanui Stream) which is generally in a degraded condition.

## NATURAL CHARACTER OF MAKARORO AND WAIPAWA RIVERS

### Makaroro River

The section of the river within the Ruahine Forest Park (upstream from the proposed reservoir) has **very high** natural character. Although modified by past land management, the Ranges are essentially a natural wilderness: The natural landform is overwhelmingly dominant, the headwaters are steep and the river has a wild-river character. The ranges are clothed in dense first-growth native bush, and the few human features are very subordinate.

[3] http://ketechb.peoplesnetworknz.info/site/topics/show/41-wakarara, retrieved 10/1/12.
[4] The legal road continues on the opposite side of the river, and 4WD vehicles can ford the river when it is not in flood.

*Figure 5: View to the west looking towards gorge at foot of Ruahine Range from southern edge of reservoir.*

The degree of natural character in the lower parts of the Makaroro River below the confluence with Gold Creek is still **moderately high**. The natural landform on these sections of the river is dominant, the river is a prominent feature, its natural processes are obvious in the landscape's geomorphology, there is native vegetation in places on the banks above the river, and human structures are subordinate. On the other hand the surrounding landscape is modified pasture, there are exotic pine plantations bordering the river in the vicinity of Yeoman's Mill site, stock have access to the river, and although they are visually subordinate there are nevertheless human structures such as roads, fences and farm buildings.

The stretch of the river below Gold Creek can be divided into two sections:

a) In the vicinity of Yeoman's Mill site the valley is relatively open, and the river grade is less steep compared to the ranges upstream. The river is braided with deep banks of gravel. There are wide terraces on the inside bend of the river and low cliffs on the outside bend. There is also a distinctive stack-like 'island' at the confluence of Dutch Creek which I understand from Dr Kessels is a nesting site for a pair of native falcon.

b) From about three kilometres downstream of the Yeoman's mill site to the confluence with the Waipawa River, the Makaroro River is entrenched in the surrounding terraces and hills, with some gorge-like sections and some distinctive ox-bow lagoons and cliffs. There are areas of native vegetation, albeit modified, on some of the steep banks.

*Figure 6: View to the south looking down river towards dam site from southern edge of reservoir.*

Dutch Creek also has **moderately high** natural character. It has a gorge-like course and native forest (albeit modified) on both banks. The surrounding land-use on the east bank is exotic pine plantation. I understand from Dr Kessels that Dutch Creek has relatively high ecological values.

**Waipawa River**

The Waipawa River has **moderately high** natural character for a short distance downstream of its confluence with the Makaroro River, but downstream of about Alderwood Farm it has only a **moderate** degree of natural character. From this point the river is flowing in a relatively broad flood plain with less pronounced landform. It is flowing through a 'working' landscape with a patchwork mix of activities, with obvious human presence in the form of buildings and roads. The river banks are lined by exotic trees (especially silver poplars), and the braided river bed is colonised by weeds such as lupins. The large quantities of gravel being brought down the river are excavated and stored at certain places such as near the SH50 bridge. Downstream of the SH50 bridge the river is enclosed by stop-banks.

*Figure 7: View to the south looking across Waipawa River from Makaroro Rd.*

**Other Rivers and Streams**

Other rivers and streams crossing the Ruataniwha Basin also generally have a **moderate** degree of natural character. Some, such as the Mangaoho Stream, have a slightly higher degree of natural character (and higher amenity). Some of the smaller streams have been dammed for farm ponds. They all flow through a 'working' landscape, stock generally has access to the stream banks, and there is little native vegetation.

The Papanui Stream through 'Zone M' has a **moderate-low** degree of natural character. While the landforms associated with the former course of the Waipawa River remain, the stream itself has been reduced to a residual 'creek'. The surrounding landscape is 'working' farmland, stock has access to the stream banks, and there is little riparian vegetation.

## OUTSTANDING NATURAL FEATURES AND LANDSCAPES

Central Hawke's Bay District Plan is silent in identifying outstanding natural features and landscapes. The Plan does list a number of 'outstanding landscape views' from particular viewpoints, but these cannot be considered ONFs or ONLs in terms of s6(b) of the RMA - rather they would fall within amenity provisions under s7(c). An assessment was therefore made to determine if there are any ONF/ONLs in the study area.

**Ruahine Ranges**

The obvious candidate is the Ruahine Ranges. That portion of the Ruahine Ranges which fall within neighbouring Hastings District is mapped as an ONL. The Ranges have obvious significance in terms of their natural science, aesthetic and associative values.

The Hastings District Plan mapped boundary of the ONL in the vicinity of the Scheme is where the steep bush clad escarpment meets the pastured terraces (about 700m west of the head of the proposed reservoir) and outside of the project footprint. At this location the Makaroro River emerges from a narrow gorge to an open and modified valley.

**Wakarara Range**

The Wakarara Range is not considered sufficiently 'eminent' to be an ONL. While it has moderately high biophysical values as a landform feature, much of the range is given over to exotic forestry. In terms of aesthetics, while prominent from places such as Tikokino, the skyline is not particularly distinctive and the range is subordinate to the Ruahine Range. We are not aware of particular tangata whenua, historical or recreational attributes that would elevate the range to greater significance.

It is also considered the Wakarara Range is separate from the Ruahine Range because of the intervening O'Hara depression (valley) which is managed as exotic pine forest.

**Other Potential Candidates**

There are no other obvious candidates within the Study Area:

a) The Ruataniwha Plains are too modified to be considered an ONL;
b) The Turiri / Raukawa Ranges are similarly modified and not sufficiently bold or distinctive;
c) The Waipukurau Gorge is interesting in geomorphic terms and is framed by two reasonably pronounced hills, but it is not sufficiently bold or distinctive, and the gorge and surrounding hills are quite modified;
d) The Waipawa Gorge is similarly interesting in geomorphic terms and is reasonably picturesque, but the gorge is open and the hills defining the gorge are not pronounced.

**Features with High Amenity**

Nevertheless there are areas with high landscape amenity to which particular regard should be given. These include some of the historic homesteads and their grounds, the historic village of Ongaonga, and some of the streams.

As discussed, the CHBDP lists 'outstanding landscape views', six of which are in the study area as follows:

| | ***'Outstanding Landscape Views'*** | ***Relevance to Proposal*** |
|---|---|---|
| SV1 | View of Waipawa River from Makaroro Road | The viewpoint is on the north side of the river downstream of Caldwell Road. Parts of the headrace and Waipawa River inverted siphon may be visible on the opposite side of the river upstream of the viewpoint, although the effects on the view would be minor. The headrace on the northern bank of the Waipawa River will be on the northern side of the Makaroro Road at this location (i.e. outside SV1 on the opposite side of the road and in the opposite direction than the view). |
| SV2 | View of Waipawa River from Makaroro Road | The viewpoint is near Evertree homestead, with a slightly elevated view from a terrace down the river |

| | | |
|---|---|---|
| | | valley. The water inlet point is approximately 4.7km away, and will be mostly tucked behind a terrace. Changes on the river flow from this location would need to be considered, although it is understood the effect will be to moderate the flows (i.e. less in winter, more in summer). Any effects on the view would be minimal. |
| SV3 | View from Hardy Road | Panoramic view on the high terrace country that takes in the Ruahine Ranges and Ruataniwha Plains. Elements of the RWSP are unlikely to be perceptible. At most the Scheme may influence the land use patterns in distant views of the plains. |
| SV4 | View down Petit Valley from Blackburn Road | View down valley in high terrace country. |
| SV5 | View up Tukituki Valley from Blackburn Road | View is in opposite direction from RWSP. |
| SV6 | View from Pukeora Road | The view is over the gorge of the Tukituki River at Waipukurau. At most, the Scheme may influence the land use patterns in distant views of the plains. |

## 04 DESCRIPTION OF PROPOSAL

The assessment of landscape and visual effects in this report is based on the proposed Ruataniwha Water Storage Scheme (the 'Scheme') as described in the report prepared by Tonkin and Taylor Limited entitled 'Ruataniwha Water Storage Scheme: Project Description', (dated May 2013a), referred to in this report as the Project Description (PD). By way of summary, the features of the Scheme most relevant to the assessment of landscape and visual effects include the following:

a) A dam (Concrete Faced Rockfill Dam (CFRD)) on the Makaroro River approximately 6.4km upstream of the confluence of the Makaroro and Waipawa Rivers (just downstream of the confluence with Donovan Gully). The dam will be approximately 83m high[5] and 505m wide[6]. . There will be a concrete line spillway on the true right side of the dam, and an unlined auxiliary spillway on the left side;

b) A reservoir with a Full Supply Level (FSL) of RL 469.5m[7] which will inundate the existing Makaroro River for approximately 7km.[8] The reservoir will:
   - Extend upstream of the Yeoman's Mill site;
   - Extend some distance up tributary streams of Dutch Creek and Donovan Gully;
   - Have a seasonally fluctuating water level which will result in bare margins within the fluctuating zone. The reservoir will be full for most of the winter and spring in most years, but will drop during summer and will typically reach its lowest level in late autumn at the end of the irrigation season. It is estimated that the water level will be within the range of 0 – 25m below maximum operating level approximately 90% of the time.[9]

c) Modification to the flow regime of the Makaroro River and Waipawa River downstream of the dam (generally moderating the flows, lower than natural in winter, higher in summer), and reduction in sediment load below the dam;

d) An upstream water intake structure on the Waipawa River near Caldwell Road connecting to the water distribution network (the Makaroro and Waipawa Rivers will be used to convey irrigation water between the reservoir and the intake structure);

e) A primary distribution system across the top of the Ruataniwha Plains from the upstream intake structure entailing :
   - A primary distribution system headrace canal that follows (more or less) the 220m contour to the vicinity of Ashcott Road where it will transition to a primary distribution system pipeline (a large diameter buried pipeline)
   - A primary distribution system headrace canal from a siphon under the Waipawa River, where it will transition to a primary distribution system pipeline following more or less the 220m contour on the north bank of the Waipawa River before heading north along State Highway 50.
   - Earthworks associated with the headrace canals including: cut and fill batters at 2H in 1V, and including box cuts and fill embankments;
   - Eight inverted siphons to carry the headrace canals under major roads, rivers and streams (SH50, Pettit Valley Road, Waipawa River, Kahahakuri Stream (twice), Ongaonga Stream (twice) and Tukituki River), and culverts over watercourses and smaller streams;

[5] Above the existing river bed at its deepest point, Project Description page 14.
[6] Across its crest
[7] Note that the datum used for this figure is mean sea level + 10m
[8] Measured along the existing river course
[9] Refer Section 3 of Tonkin &Taylor (May 2013a).

- Three road bridges over the headrace canals ( Caldwell Road, Ngaruru Road, Wakarara Road), and several farm bridges (an assumption has been made of eleven farm bridges);
- Five 'drop structures' (concrete water ramps or 'chutes' to negotiate changes in elevation of between 5m – 8m)

f) A secondary distribution system of buried pipes mainly following road reserves or parallel to streams;

g) Two outfall structures from the secondary distribution system, on the Mangaonuku and Kahahakuri Streams respectively;

h) Supply of irrigation water to five areas –namely Zones A-D in the Ruataniwha Plains and Zone M in the Otane basin.

i) A downstream water intake structure on the banks of the Waipawa River a short distance upstream of the confluence of the Waipawa and Tukituki Rivers, feeding into the Papanui Stream which is to be used to convey irrigation water for Zone M (Otane basin area). There will be modifications to parts of the Papanui Stream channel and/or stopbanks;

j) A small 6.5MW hydro-electric station adjacent to the dam site, including penstocks and outlet channel, small power house and substation; and

k) A 26.5km transmission line between the power station and a tie-in to the Transpower Grid at the Ongaonga Substation. The line will comprise a 33kV circuit carried on ordinary power poles within the road reserve (mainly Makaroro Road).

*Figure 8: Rock fill dam at Opuha -similar construction to that proposed*

*Figure 9: Rangitata Diversion Race –similar to type of head race proposed*

## 05 RELEVANT STATUTORY AND NON-STATUTORY PLANS

A detailed analysis of relevant planning provisions is provided in EMS (May 2013c). The following is a preliminary summary of those matters that appear most relevant to this landscape assessment:

**Hawke's Bay Regional Resource Management Plan (RRMP)**

There are no objectives, policies or rules within the RRMP that are particularly relevant to landscape matters. There are provisions addressing earthworks and natural character of streams but these relate to managing sedimentation and maintaining water quality standards.[10]

**Central Hawke's Bay District Plan (CHBDP)**

The vast majority of the proposal is located within the Central Hawke's Bay District with only a small portion of the proposed reservoir located in the Hastings District.

Aside from the general requirement to maintain rural amenity and avoid the exposure of rural dwellings to adverse effects resulting from activities[11], the District Plan has few objectives and policies relevant to landscape matters.

The main exception is Objective 4.4.1 which includes:

1) Identification and protection of outstanding landscape views; and
2) Preservation of natural character in accordance with Section 6(a) of the RMA.

The outstanding landscape views within the study area and their relevance to the proposal are tabulated in section 2.4 above. The two relevant to the Scheme are SV1 and SV2. Rule 4.8.2 (c) covers controls on vegetation and buildings within the view shaft. The main focus appears to be preventing the views being obstructed.

**Hastings District Plan**

As mentioned, only a small portion of the northern edge of the proposed reservoir is located within Hastings District. This part of the reservoir will require earthworks and inundation resulting in both landform modification and vegetation loss. None of the policies under the Rural Zone provisions appear particularly relevant to landscape matters.[12]

The Ruahine Ranges[13] are identified as an ONL (Section 12.2), but the boundary of the ONL is the Ruahine Forest Park which is outside the project footprint.

Objective LSO2 and Policy LSP6 under Section 12.2 – Landscape Areas Resource Management Unit focus mainly on adverse visual and landscape effects resulting from subdivision and earthworks, with the use of guidelines as a management tool. Section 13.4 – Earthworks District Wide Activity may also be relevant. Policies EWP1 And EWP2 seek to 1) limit significant adverse effects by limiting the scale and location of earthworks and 2) re-pasture or re-vegetate land where vegetation has been removed as a result of earthworks.

[10] See Objective 38 & Policy 67 and Objective 45 & Policy 79
[11] See Objective 4.2.1 and Policies 4.2.2 (1) & (2)
[12] RUP7 has general relevance to landscape and visual matters but it is primarily focussed on cross boundary issues and the use of setbacks as one method to control conflicts. This relates to only a small portion of the reservoir.
[13] Hastings District Plan (2003). Appendix 12.2-1. Outstanding Natural Features and Landscapes. ONF8.

# 06 LANDSCAPE AND VISUAL EFFECTS

## POTENTIAL PROJECT EFFECTS

The following potential landscape and visual effects were identified in terms of Sections 6(a), 6(b), 7(c) and 7(f) of the RMA:

a) Effects on natural character of the following rivers and their margins as follows:
   - Makaroro River and its tributaries (Dutch Creek and Donovans Gully) as a result of the dam and inundation;
   - Makaroro, Waipawa and Tukituki Rivers downstream of the dam as a result of changes to their natural flow regimes;
   - Waipawa River as a result of the upstream and downstream intake structures;
   - Rivers and streams in the Ruataniwha Plains where traversed by the primary distribution system headrace; and
   - Papanui Stream as a result of changes to the flow regime, modifications to the stream channel, and proposed fencing and revegetation of the stream banks.

b) Effects on the outstanding natural landscapes of the Ruahine Ranges as a result of the nearby reservoir;

c) Effects on amenity values including:
   - Effects of the dam and reservoir on landscape amenity including outlook from adjacent properties and from the publicly accessible area at the end of Wakarara Road;
   - Effects of the primary distribution system head-race and associated earthworks on public views and private property (including outlook from houses);
   - Visual effects of the power station and transmission line;
   - Effects on the character of the Ruataniwha Plains and Zone M as a result of increased irrigation (including changes in land use, pasture 'greening' and additional use of pivot irrigators);
   - Temporary effects during construction of the Scheme; and

d) Effects on landscape quality including:
   - Effects of earthworks on landforms, watercourses, or native vegetation.

Avoiding, remedying and mitigating adverse effects might take account of the following:

- The design of the dam and associated infrastructure (tail race, power station, access, spoil disposal);
- Rehabilitation of the construction works;
- The extent of inundation;
- Offsetting the loss of inundated vegetation and habitat;
- Treatment of the lake edge;
- Landscape enhancement of public areas around the reservoir lake;
- Design and location of the two water intake structures; and
- Type, alignment and design details of the head race.

## EFFECTS ON NATURAL CHARACTER

The most significant adverse effects of the Scheme in landscape terms are likely to be those in relation to s6(a) (natural character of rivers and their margins). For analysis these are divided into effects relating to:

a) The dam and reservoir;
b) Changes to the downstream river flow
c) Changes to sediment load (including mitigation beach replenishment);
d) The upstream water intake at Caldwell Road;
e) The downstream water intake at the Papanui Stream; and
f) The outfall structures

Although dividing the effects in this manner is useful for the sake of analysis, the natural character effects should be considered in conjunction with each other in a holistic manner.

**Dam and Reservoir**

As discussed, the dam will be approximately 505m wide across its crest between the valley sides and 83m high. Associated structures at the dam site will include the tail race, spillway, diversion channel, power house, substation, access road, and transmission line connection. The impounded reservoir will inundate approximately 6.2km of the Makaroro River and up to 1.5km of 5 main tributary streams (the most notable being Dutch Creek and Donovan's Gully).

The Scheme will result in the following biophysical and perceptual effects on natural character:

a) The character of the area in the vicinity of the dam will be dominated by human structures. Perceptions of natural character will obviously be substantially diminished within this area;
b) Some natural river features will be inundated including the picturesque gorge-like section of the river for approximately 1.5km upstream of the dam and the more open sections of river bed in the upper parts of the reservoir footprint. This will include the river bed features such as the braided meandering channels and wide areas of gravel, cliffs on some outside bends and river terraces on inside bends;
c) Areas of natural vegetation will be flooded: This is addressed in more detail in the ecology report (Kessels & Associates May 2013), but it includes regenerating and remnant bush on the steep slopes for most of the north bank of the reservoir, and margins of bush on the banks of Dutch Creek;
d) Natural geomorphic processes will be interrupted: The quantities of gravel brought down from the Ruahine Ranges will be deposited in the reservoir, curtailing the supply of gravel and sediment to stretches of the Makaroro River downstream of the dam; and
e) The fluctuating inundation zone will result in a bare zone surrounding the reservoir.

In summary, as with any in-river dam and reservoir, the existing natural character of the river will not be preserved. However, the following landscape factors should be taken into account in weighing up the significance of these effects:

a) The natural character is already modified in the section of river to be inundated: As discussed above, while the river has moderately high natural character the surroundings are nevertheless a working rural landscape comprising pasture and pine plantation. In terms of the continuum from 'pristine' to 'highly modified'[14] the site can be best described as 'modified but appears natural';

[14] See 'Long Bay' Environment Court decision (A078/08).

b) The reservoir will be reasonably naturalistic in appearance, resting within natural contours;
c) The dam itself will have low visibility and therefore will be less likely to influence perceptions of the reservoir's naturalness: The visual catchment of the dam is restricted to a very small part of the valley in the vicinity of the dam. The dam will not be visible from future public areas at the end of Wakarara Road, and there will be no public visibility apart from future users on the lake who approach the southern end of the reservoir. Otherwise, views will be restricted to parts of the adjacent farms (Smedley Station to the north and the 'Preston property' to the south); and
d) The main feature detracting from the naturalistic appearance of the reservoir will be the bare margins exposed by the fluctuating operating level. One would normally expect a natural lake to have relatively stable water levels and for riparian vegetation to develop around the margins. The potential extent of the bare zone will be reduced to some degree by the extent to which the lake margins comprise cliffs and steep slopes. The bare zone will be most pronounced where the margin overlaps shelving terrace, such as east of the Wakarara Road end, and at the head of the lake where a gravel delta will form.

The following measures are recommended to remedy or mitigate these effects:

a) Measures to offset the loss of vegetation and habitat that will be inundated. This is addressed primarily in the ecological assessment by Kessels & Associates (May 2013), and the report 'Ruataniwha Water Storage Scheme: Proposed Integrated Mitigation and Offset Approach ((HBRIC May 2013f). ). The proposed measures include a 20m fenced and planted buffer around the approximately 3/4 of the reservoir margin that falls within farmland pasture (there is an overlap with amenity effects -see below);
b) Measures to help integrate the dam into the surroundings:
    - The dam will be cradled in the valley by surrounding spurs. Construction effects should be managed (by way of construction management plan or similar mechanism) to minimise scarring of the spurs so there is a clean junction between dam and natural topography;
    - The infrastructure below the dam (power station, substation, etc) should be designed to minimise visual clutter (so the dam reads as a simple form in scale with the hills). Such measures would entail attention to the design of the ancillary structures, and the design and rehabilitation of the surrounding ground surface; and
    - Measures to reduce the impact of construction such as thoughtful location of the construction yards and construction access, and design of foundation excavations.
c) Measures to remedy and mitigate the bare margins within the fluctuating inundation level including:
    - Re-vegetating the upper margins to visually soften the edge as discussed above. This will include revegetation with tree species characteristic of lake margins (kahikatea, totara) above the maximum operating level, and planting shrub and sedge species in the upper inundation margins that are tolerant to both dry conditions and occasional inundation (for example flax, cabbage tree, knobby club grass [Ficinia nodosa], manuka, coprosma species).
    - Armouring margins of the reservoir with river gravel prior to inundation to avoid muddy margins and provide ready access to the fluctuating water edge. Such gravel areas are characteristic of the existing Makaroro River and other rivers in the region. Such a measure would be focused on public access areas.

Erosion and deposition will commence around the shoreline of the reservoir once it is filled, leading to new perimeter landforms such as beaches and banks. The form of some existing river-cut scarps

may also change (e.g. the gradient of the scarps may be reduced). Such erosion and deposition processes are essentially natural (albeit the consequence of artificial construction of the reservoir), and the features produced will have a naturalistic appearance which will add to the visual amenity of the reservoir.

**Changes to Downstream River Flow**

Modifications to natural water flow and sediment load will have some effect on natural character below the dam. The effects will be greater in the Makaroro River and less in the Waipawa and Tukituki Rivers because the changes in flow regime will make up a smaller proportion of the flow of the latter rivers. (i.e. they are also fed by unaffected tributaries). The proposed flow regime is described in section 2.3 and 3 of the Project Description. In summary the regime will include the following:

a) Natural river flows at such times when the reservoir is full;
b) A minimum residual flow below the dam when the reservoir is filling, which will comprise 1.23 cumecs, equivalent to 90% of the 7-day mean annual low flow;
c) The water for irrigation which will be conveyed by the Makaroro and Waipawa Rivers between the reservoir and the upstream water intake at Caldwell Road;
d) Up to four 'flushing flows' with a total of up to 4million cumecs to be released during the irrigation season between 15 December and 30 April. Each flushing flow will last 9.25 hours, will be scheduled so that there is a maximum 30 day interval between 'freshes' [15], and will be timed where possible to 'piggy-back' on small natural freshes. The quantity of water released for 'piggy back' flushing will be managed so that the combined natural and flushing flow is 50 cumecs.

In general the intended operation of the Scheme will reduce the average winter flows and will moderate the flood peaks (except when floods occur when the reservoir is full). Conversely it will increase downstream water volume during summer at times that the rivers would otherwise have a low flow. Excepting those times when floods overspill the dam, changes to the discharge rate from the dam (and downstream flow patterns) are likely to be gradual and not noticeable to a casual observer. As discussed, the flushing flows are to be timed to coincide with small natural 'freshes'.

There will be positive natural character effects on the lower portions of the Waipawa River and Tukituki River as a result of the proposed regime to restore summer flows to an environmentally sustainable level, offsetting the effects that artesian ground-water extraction is having on such river flows.

Similarly there will be positive natural character effects on the Papanui Stream. The stream is a residual creek that traces the former course of the Waipawa River which is was artificially diverted in the 1880s. The proposal, outlined in the report ' Ruataniwha Water Storage Scheme: Zone M Primary Distribution Concept and Assessment' EMA (May 2013a) is to use the Papanui Stream to convey irrigation water for Zone M, plus an additional 5 litre/sec residual flow that would be permanently added to the stream. The proposal also entails fencing the stream and re-vegetating the stream margins. Some modification works will be required to the stream bed in places to accommodate the increased water flow. The proposal will partially restore the natural flow that was diverted in the 1880s and improve the natural character of the stream in both biophysical and appearance terms. In landscape terms the proposal is preferable because of these positive effects compared to the alternative of buried pipelines for the primary distribution system. .

[15] Measured as 50 cumec flows at Red Bridge on the Tukituki River

**Changes to Sediment Load (including Mitigation Beach Replenishment)**

The reservoir will also reduce the downstream sediment load. It is understood the main area of concern in this regard is potential effects on the coastline near the mouth of the Tukituki River. To compensate for loss of sediment it is proposed to 'enrich' the coast near the river mouth with river gravel extracted from the Tukituki River upstream of Black Bridge. The material will come from an existing extraction allocation. In other words, it would be extracted anyway but it is proposed to divert a portion of the gravel to beach replenishment rather than have it lost to the system. Black Bridge is approximately 1.5km from the river mouth, so the gravel will be similar to that which would naturally contribute to the beach at the mouth.

The enrichment is to entail 3.400$m^3$ annually, a quantity twice the predicted reduction in sediment load as a result of the dam, to be divided north and south of the river mouth. The method of enrichment will involve trucks accessing the beach crest, and the dumped material being spread by bulldozer on the beach face within the tidal range. It will entail adding like-for-like material to the beach, and it is envisaged that the gravel will be re-worked by the tides so that it quickly becomes indistinguishable from the rest of the beach.

To provide an impression of quantity and area, the 1,700$m^3$ to be added annually each side of the river mouth might be spread 1m deep over some 100m of beach to a width of just over 15m below the beach crest. Such areas comprise a relatively discrete part of the coast. With regards duration of works, the work is to be carried out once a year. It is envisaged that the enrichment on both beaches might be completed within a week using three truck and trailer units.

The enrichment locations are appropriate in landscape and natural character terms for the following reasons:

The area **north of the Tukituki River mouth** will be accessed from Richmond Road adjacent to the sewerage treatment plant and outfall pipe. The natural character of the beach is already modified by the nearby plant and adjacent outfall structures and there is existing access to the beach adjacent to the outfall. The only houses in the vicinity are at the southern end of the replenishment area at Bridge Street (i.e. furthest from the Richmond Road access), and such houses are separated from the beach by a stop bank and a distance of some 100m. There will be some visual effects of trucks and machinery on the beach during the enrichment exercise, but such effects will be temporary and limited in duration.

The area **south of the Tukituki River mouth** will be accessed from Domain Road adjacent to the grassed reserve area. The natural character of the beach is already modified by the river groyne and adjacent car park, and there is existing access to the beach. Similarly, the nearest houses in the vicinity are in the southern half of the enrichment area (i.e. furthest from the beach access) and separated from the beach by a stop bank, planting (mainly ngaio, karo and coprosma) on the inland side of the bank, and a distance of some 100m, although in this case trucks will pass these houses to access the coast. As above, there will be some temporary visual effects of limited duration while the enrichment is carried out.

In summary, the effects of the reduction in sediment load as a result of the dam will be mitigated by beach enrichment either side of the Tukituki River mouth. The enrichment will involve adding like-for-like material to the beach in a manner whereby the gravel will be reworked by the tide so that it is indistinguishable from the rest of the beach within a short time. The quantities involved mean the enrichment will be restricted to a small part of the beach. The locations are appropriate

because the natural character in both locations is modified, there is existing road access onto the beach in both locations, and the locations are reasonably separated from the nearest dwellings.

**Upstream Intake Structure**

The **upstream water intake structure** for the irrigation distribution system will be on the banks of the Waipawa River 1.6km upstream of Caldwell Road. (As discussed, the Makaroro and Waipawa Rivers will be used to convey water for irrigation between the reservoir and intake). The intake location is adjacent to a terrace and rock outcrop approximately 10m high which will physically and visually anchor the structure. The works will comprise a settlement pond on the river bed at the toe of the terrace. The settling pond will be contained by a rocky infiltration bund on its outer edge. A new braided channel is to be constructed parallel to the rock infiltration bund, through which water will flow to the settling pond. The entrance from the pond to the distribution canal will be controlled by a radial gate within a concrete channel. The rock infiltration bund and settling pond will be approximately 200m long by 80m wide.

The upstream intake structure will reduce natural character to some degree by introducing a human structure on the riverbed but the following factors will reduce the potential significance of such effects:

a) The existing degree of natural character of this section of river is only moderate. The adjacent terraces have a patchwork of farming and cropping activities, there are houses overlooking the river, roads on both banks, and a gravel extraction operation downstream of the location of the intake structure. There are also exotic weeds on the river margins; and
b) The site has low visibility from public roads. Apart from a glimpse from Makaroro Road on the opposite side of the river, the intake structure is only likely to be experienced by people who walk along the river bed. The upstream water intake will have a low profile and will be tucked against a river terrace scarp, reducing potential prominence. The adjacent river bed is colonised by lupins and other exotic weeds which will reduce the prominence of the stopbank enclosing the settlement pond. In other words the effects on perceptions of natural character will be low.

**Downstream Intake Structure**

The downstream intake structure is adjacent to a stop-bank (known as 'Bishop's Bank' in reference to Arch Deacon Williams who was responsible for the works in the 1880s) on the Waipawa River bed near Walker Road. Two alternative locations in proximity to each other have been proposed – in landscape terms any difference between the alternatives is negligible.

The works will include a new channel in the gravel river bed to connect the existing river braid channel to the intake structure. The structure will comprise a settling pond approximately 90m by 70m excavated in the river bed with perforated pipes buried in a gravel filter bed, discharging to the head of Papanui Stream on the opposite side of the stop-bank. The effects of the downstream intake structure on natural character will be low for the following reasons:

a) The existing degree of natural character of this section of river is only moderate. The river is lined with an artificial stop-bank which diverted the river from its previous natural course, and the surrounding land comprises modified productive farmland; and
b) The structure will have low visibility. It will be excavated below the existing level of the river bed, will be located at the edge of the river at the toe of the stop-bank, it will not be visible from public roads, and the existence of weed vegetation in the river bed will further restrict visibility.

**Outfall Structures**

Two outfall structures are proposed as follows:

a) An outfall structure on Mangaonuku Stream, a tributary of the Waipawa River, is to discharge water from the Zone A distribution network for subsequent use in Zone M. Such water will be conveyed by the Mangaonuku Stream and Waipawa River to the lower water intake. It is to comprise a stilling basin which is a concrete basin with baffles, from which water will discharge to the stream by way of a rip-rap lined channel.
b) An outfall structure on Kahahakuri Stream is to discharge surplus water from the distribution network. It is to comprise a 'plunge pool' which is a rip-rap lined basin into which water discharges from the secondary distribution pipeline, before flowing to the adjacent stream.

Both outfall structures will be relatively minor features, located in productive rural landscapes, and both will be in low visibility locations.

Notwithstanding the 'low' degree of effects, it is recommended that landscape input be included in the detail design of both intake structures and the outfall structures as part of the overall design of the Scheme.

**Summary of Natural Character Effects**

Natural character will clearly not be preserved in the vicinity of the dam and within the reservoir footprint, and it will be diminished to some extent on the Makaroro River (and to a lesser extent the Waipawa River) downstream of the dam as a result of changes in flow regime and sediment load. Such effects are common to any in-river dam. Factors to take into account when considering the appropriateness in relation to such effects include the following:

a) The modified 'working rural character' of the adjacent land;
b) The low visibility of the dam (and hence low effects on the appearance (visual aspects) of natural character);
c) The naturalistic appearance of the reservoir;
d) Proposed measures as described in the 'Proposed Integrated Mitigation and Offset Approach' report which will enhance the biophysical and visual aspects of natural character of the reservoir including establishing a fenced and planted margin around the reservoir, and measures to enhance habitat and control predators in the reservoir catchment;
e) Proposed management of the downstream flow regime to provide minimum low flows in the Makaroro River, regular flushing during summer months, and biodiversity enhancement measures in the downstream sections of the Makaroro and Waipawa Rivers;
f) Beach replenishment at the mouth of the Tukituki River to replace the reduction in sediment load - to be carried out in a location and manner that will not create any new adverse landscape effects apart from the temporary effects of the replenishment activity;
g) The low impacts of the intake and outfall structures on natural character because of their low profiles, low visibility locations, and modified rural settings;
h) Positive effects on the lower Tukituki River as a result of increased summer flows and flushing 'freshes'; and
i) Positive effects on the natural character of the Papanui Stream because of increased flows which will partly restore historic flows, and the associated fencing and margin restoration; (partly restoring historic diversion of water from the previous course of the Waipawa River).

## EFFECTS ON OUTSTANDING NATURAL FEATURES AND LANDSCAPES

The only 'Outstanding Natural Feature' or 'Outstanding Natural Landscape' in the vicinity of the Scheme is the Ruahine Ranges. The reservoir will not encroach into the Ruahine Ranges so there will be no direct landscape effects.[16]

The question arises whether an artificial reservoir near one of the entrances to the Ranges would **indirectly** affect perceptions of the ONL. However it is considered such effects would be negligible for the following reasons:

a) The reservoir will be within an already modified 'working' landscape that is clearly separate from the Ruahine Ranges;
b) The dam itself will not be visible from within or adjacent to the ONL. (except in very long distance views from on the mountains), or from roads used to access the Ranges; and
c) The upstream end of the reservoir will not be visible from where the Makaroro River emerges from the Ranges (i.e. the 'entrance' to the Ranges).

**Summary of Effects on Outstanding Natural Features and Landscapes**

There will be no effects of any significance at all on outstanding natural features and landscapes.

## LANDSCAPE BIOPHYSICAL AND VISUAL AMENITY EFFECTS

**Dam and Reservoir**

Several photomontages have been prepared from locations with views to the proposed dam and reservoir. The location of these viewpoints is illustrated in **Appendix 4.4** and the photomontages are attached as **Appendix 4.5, 4.6 and 4.7.**

Adverse landscape amenity effects in addition to those discussed above in relation to natural character include the following:

a) The reservoir will inundate the picnic area and river access at the end of Wakarara Road, an area which also has historical values as the site of Yeoman's sawmill;
b) The reservoir will also cut off access across the river to Yeoman's Track, and routes along the river to the Ruahines.

On the other hand, the reservoir lake will have its own amenity.

a) It will be reasonably wide (approximately 500m) and have generous proportions at the road end;
b) The serpentine form of the reservoir will add to its picturesque qualities, drawing the eye along the lake. This will be accentuated by the prominent hills that will frame the lake downstream of the Wakarara Road end.
c) The reservoir will have a strong backdrop landscape setting including the Wakarara Range and other hills downstream. The margins will include a number of features including cliffs and terraces; and
d) There are several arms in tributary valleys which will add to the lake's interest.

[16] There may be some fish passage and other ecological effects on the headwaters of the Makaroro River which are beyond the expertise of this report.

The main aspect that is likely to detract from visual amenity of the lake is the seasonal bare margins within the annual operating level, which will be within the range of 0 – 25m below maximum operating level for approximately 90% of the time. The reservoir will fill during winter, and be drawn down during the summer irrigation season (15 December to 30 April), so that the low levels will occur during late autumn. This partly coincides with periods when recreational use is likely to be highest. Several measures are recommended under the 'Natural Character' heading above, including revegetation of the margins above the operating level, and armouring with river gravel within the operating margins so that the reservoir is ringed with a gravel beach in those parts frequented by the public. Such gravel beaches are a common feature of Hawke's Bay's braided rivers. Trees within and just above the inundation area will be drowned. If they are not removed, such trees can remain for many decades as trunks protruding above the water. It is considered that such dead trunks are likely to detract from amenity of the lake, and it is recommended that the trees be felled prior to filling of the reservoir.

There is a small hill or 'stack' (a outlier remnant of the river terrace) at the confluence of Dutch Creek and the Makaroro River, the flat top of which is just above the proposed maximum operating level of the reservoir. From a landscape perspective it is recommended that the maximum operating level be fine-tuned to ensure the top of the stack remains as a distinct island which would add to the amenity value of the lake. It is also understood from Mr Kessels that the feature has ecological value.

A public access point is proposed in the middle section of the reservoir.[17] This is considered a part of the 'lake' that will have high visual amenity because it will be relatively wide, will be opposite the Dutch Creek arm of the lake, and views down the lake will be back-dropped by the Wakarara Range. The area is to be developed as a picnic and camping area, and will include a boat ramp.

Other reports (Clough & Associates (May 2013), HBRIC May 2013f) address historical effects of inundating the historical sawmill site, and access to Yeoman's Track and the Ruahine Ranges. In summary, a new track is proposed around the head of the reservoir to give access to routes along the river into the Ruahine Ranges and to tracks (such as Yeomans Track) on the opposite side of the river. Investigation and interpretation of the mill site will be carried out.

**Hydro-electric Station**

A small hydro-electric station will be constructed as an adjunct to the water storage project. The power station will be constructed at the base of the dam and integrated with the tail-race. The main elements will comprise a short penstock up to approximately 2.1m diameter, and a power house for two turbines generating 6.5MW. The preliminary design is for the power house to be a circular concrete structure 9.5m diameter. There will be a small adjacent switchyard and switchgear.

The visual amenity effects of the hydro-electric 'add-on' will be low for the following reasons:

a) The site has very low visibility. To all intents and purposes the only people who will see the power station will be people on the three adjacent farms;
b) The power station elements will be small scale and subsumed by the adjacent dam. The Opuha Water project has a similar hydro-electric add-on which illustrates the likely appearance. That example has the scale of a farm building, and an unremarkable appearance. The switchyard is small and ancillary in appearance to the power house.

[17] Ruataniwha Water Storage Scheme: Proposed Integrated Mitigation and Offset Approach, page 12

Notwithstanding the low effects, it is recommended (as part of a 'best practice' approach) that there be aesthetic input to the power station elements to integrate it with the dam design and minimise any 'visual clutter'.

**Transmission Line**

The power station will be connected to the national grid at the Ongaonga Substation by means of a 33kV transmission line constructed along roads between the dam and the substation. Such 33kV circuits are not uncommon and are typically carried on power poles above the local 11kV circuit(s). In other words the power poles would be a little higher than standard poles and would carry an additional cross-arm, but in other respects would appear like ordinary road-side power lines. It is understood such transmission is a permitted activity within road reserves.

**Effects Resulting from Changes to Land Use Patterns**

Changes in rural activities on the Ruataniwha Plains and in Zone M as a result of irrigation may include the following:

a) Change in type of land use;
b) Increase in greenness of landscape during summer;
c) Increase in number of pivot irrigators; and
d) Removal of shelter belts.

However, the changes are unlikely to result in a fundamental change in landscape character for the following reasons:

a) The anticipated land uses (as a consequence of irrigation) include a mix of pastoral, dairying and cropping activities. This is in keeping with the existing mixed of activities and relatively intensive pattern of land-use. While the relative proportion may change (for instance there may be greater proportion of dairying or cropping), the changes will not result in any fundamental change in the visual character of the Ruataniwha Plains and Otane basin. Such evolving changes in land use have been part of the area's (and wider Hawke's Bay) character for the last 150 years.
b) Similarly the potential enlargement of paddocks and removal of shelter belts could change the scale and degree of openness in parts of the plains, but it is unlikely to lead to fundamental change. Rather, the mix of activities is likely to mean a range of paddock sizes and shelter belts.
c) Pivot irrigators themselves are light structures which, from a distance, appear as tracery, and are not out-of-place in a working rural environment. Because they have thin elements they lose visibility quickly with distance.

**Primary Distribution System**

The Scheme entails a primary distribution system across the Ruataniwha Plains and Otane Basin connecting the five irrigation zones as follows:

| *Irrigation Area* | *Description* |
|---|---|
| Zone A | Mangamauku Stream to Waipawa River (Tikokino area) |
| Zone B | Waipawa River to Tukituki River (Ongaonga area) |

| | |
|---|---|
| Zone C | Tukituki River to Makaretu River |
| Zone D | Makaretu River to Takapau |
| Zone M | Otane Basin |

The primary distribution system for Zones A – D will run from the upstream intake structure near Caldwell Road. The system is to entail an open trapezoidal headrace canal in Zone B and part of Zone C. The remainder of the primary distribution for Zones A-D, and all the secondary distribution, will be by buried pipeline.

The primary distribution system for Zone M will adopt the Papanui Stream to convey irrigation water from the downstream intake structure on the Waipawa River near Walker Road.

With regards the headrace canal in Zones B and C, three main components were analysed to select the best design from a landscape point of view:

a) Type of headrace;
b) Corridor and general alignment;
c) Detailed alignment and design;

**Type of 'Head-race'**

The effects of three different head-race types were considered, as detailed in a memo attached as Appendix 1 to the Baseline Assessment. In summary:

a) A plastic-lined timber aqueduct was least preferred: Although it would have a smaller footprint compared to a traditional canal it would be the most visually prominent (it would have strong shadow lines and contrast in appearance with adjacent land), and more likely to be perceived as an 'industrial' feature.
b) A buried pipeline option was regarded as neutral in landscape terms: It would have minimal effects either adverse or positive. The pipeline is less sensitive to contour so could be aligned along roads.
c) An open canal (open trapezoidal head-race) was regarded as potentially adverse or positive depending on its alignment and design. Such a canal would have a greater footprint compared to the other options and require greater earthworks (i.e. box cuts, fill embankments, benched cut and fill batters) particularly in rolling topography. However a well designed canal is likely to be regarded as a benign feature because:
    - It would follow the topography, and comprise a low profile and 'soft' forms,
    - It would be in keeping with a farmed and cultivated landscape;
    - It is likely to be generally regarded as a pleasant and interesting feature; and
    - There is a history of community water races in the Ruataniwha area.

The plastic-lined timber aqueduct option was discarded. The trapezoidal water-race was analysed more closely in terms of potential corridors and alignments.

Two potential corridors were analysed following the 240m and 220m contours respectively.

In summary both corridors could have accommodated acceptable alignments. The main differences in landscape effects would occur in Zone B where the 240m corridor follows a hillier route across higher terraces compared with the 220m corridor which largely skirts the base of the hills. The 240m corridor would wind in and out of several valleys, and would require more prominent and substantial earthworks. The 220m corridor, on the other hand, skirts the hills south of Wakarara.

While it would require several 'drop structures' (concrete chutes) to negotiate the change in level to the lower elevation route, it would require less substantial earthworks.

The option selected for the Scheme entails an open headrace canal following the 220m corridor (more or less) as far as Ashcott Road, where it transitions to a buried pipe. In summary, this option avoids most potential landscape or visual effects. The option alignment was further fine-tuned following consultation with owners of land traversed by the alignment.

**Head-race Design Principles**

An inspection was made of existing irrigation infrastructure on the Rangitata Diversion Race and the Opuha Water project in Canterbury as a means of examining detailed alignment and design principles that would maximise the 'fit' of the head race with the landscape and avoid any adverse effects. The Canterbury landscape is somewhat similar to Hawke's Bay and the Rangitata and Opuha projects contain elements similar to those proposed for the Ruataniwha Scheme.

Detail design matters to take into account include micro-tuning the alignment (in relation to houses/homesteads, stream crossings, road crossings, the location of siphon sinks/resurgences), design of earthworks to reduce their prominence, and consideration of land management adjacent to the headrace canal. A set of 'best practice' design principles was developed for the headrace canal, which are attached as **Appendix 2.** The principles were applied in the refinement of the design.

**Buried Pipelines (Primary and Secondary Distribution)**

The remainder of the primary distribution system in Zone C, all of the primary distribution system in zones A and D, and all of the secondary distribution, will entail buried pipelines. The pipelines will include minor structures such as manholes, pressure release valves, booster pumps, and take-off points. Landscape and visual effects will be mainly confined to the construction period. Any permanent landscape and visual effects are likely to be negligible.

**Summary of Landscape Amenity and Biophysical Effects**

Adverse landscape amenity effects will be low for a project of this type for the following reasons:

a) The dam, which is the feature with the greatest potential adverse amenity effects, will have very low visibility. To most intents and purposes it will have no public visibility except for future users of the reservoir;
b) Similarly the 6.5MW hydro power station will be a minor adjunct to the dam, and will essentially have no public visibility. The associated 33kV transmission line will be an unremarkable element carried on power poles along the road reserve;
c) While there will be some potential adverse amenity effects resulting from the seasonal bare zone around the reservoir margins, a range of measures is proposed to mitigate such effects;
d) The upstream water intake structure on the Waipawa River will be tucked against a bank in an unobtrusive location with low visibility, and similarly the downstream intake structure will have a low profile, and will be in a low visibility location at the toe of a stopbank;
e) The primary distribution system headrace canal, which forms part of the primary distribution system, will not be out-of-place in a working rural landscape (it will continue a tradition of community water races in the area). The selected route follows the contours and traverses relatively subdued topography so that earthworks will have low profile. The selected route also avoids houses; and

f) While there will be changes in land-use, field patterns and associated structures (such as pivot irrigators), such land uses will not be dissimilar to existing activities and they will continue a pattern of change and evolution that has characterised the landscape over the last 150 years.

There will also be some positive landscape amenity effects:

a) The reservoir will have high amenity as a 'lake' taking into account its serpentine form, tributary reaches, bold hill backdrop, and the revegetation proposed around its margins;
b) The primary distribution system head race canal may also be perceived as a positive and interesting feature; and
c) The use of the Papanui Stream to convey irrigation water will partly restore the watercourse, and the fencing and replanting of its banks will enhance its natural character.

The main potential biophysical landscape effects are subsumed under the topic of 'natural character' above. Any adverse biophysical effects in addition to those addressed under that topic will be low for the following reasons:

a) The Scheme will be within a modified working rural landscape;
b) Most of the water distribution network will be by means of buried pipelines; and
c) The primary distribution system headrace canal has been aligned to follow flat to rolling topography which will minimise the scale of the earthworks, and it traverses open farmed country.

## TEMPORARY CONSTRUCTION EFFECTS

### Dam and Associated Works

The dam and its ancillary structures present by far the greatest potential for adverse landscape and visual effects from the construction phase. Works in this area will be large scale, cover an extensive area, and will span the construction period. Works will include construction of access roads, a construction yard and laydown areas, diversion of the Makaroro River, excavation to key the dam into the surrounding land, excavation of borrow material, disposal of surplus spoil, and construction of the dam and ancillary structures. There will clearly be significant adverse landscape and visual effects during the construction period. However, such effects will be confined to a topographically confined area with visibility essentially restricted to private farmland.

### Borrow Material

Most of the borrow material will be won from the construction zone itself, mostly within the footprint of the reservoir. Zone 1A borrow site is outside the reservoir footprint, but is in a low visibility location at the head of a small tributary arm of the future reservoir, and adjacent to the construction zone. It appears rehabilitation of the site would be straightforward.

Three potential sites are identified for Zone 2B material.

a) The site nearest the dam is within the reservoir footprint so presents no issues;
b) A second site further upstream on the right bank of the reservoir is within the fluctuation zone and near an area where public access is recommended. The effects of such a borrow area would depend on details of the rehabilitation of the reservoir edge. There would be opportunities to re-contour such an area in such a way that would add to amenity and public use; and

c) A third site is on the left bank of the reservoir on a terrace that is currently forested. While least favoured from a landscape point of view, the site could be screened by retaining existing trees or carrying our new planting.

**Spoil Disposal**

Five potential sites are identified for spoil disposal, all within the vicinity of the dam. The sites are in pastoral farmland and have low visibility. Effects could be minimised by configuring the detail design of the spoil disposal to avoid existing watercourses.

**Landslip Rehabilitation**

Works may be required to stabilise an unstable hillside (former landslip site) on the right bank of the reservoir approximately 500m upstream of the dam. Such works may require re-contouring the hill face to reduce its slope, and possible drainage and planting. While it is recommended that there be landscape input into the detail design and rehabilitation of such works as part of a 'best practice' approach, the effects are not likely to be significant. The site has low visibility, will be part of the visual catchment of the dam and construction area, and is modified farmland.

**Farm Tracks**

Replacement farm tracks will be required on the left (north) bank of the reservoir to replace tracks that will be inundated. The tracks will be visible across the reservoir, and will follow (more or less) the contours around relatively steep hill faces. Such farm tracks are common features of farmland. The visual effects will depend mainly on the extent of the cut batters. However, it is understood the greywacke material in the area will support relatively steep batters (1V: 0.5H) which would limit potential size. As above, while it is recommended that there be landscape input into the detail design and rehabilitation of such works as part of a 'best practice' approach, the effects are not likely to be significant.

**Distribution Network and Other Works**

Apart from the dam area, there will also be adverse landscape effects associated with the construction of the primary distribution headrace canal, laying of primary and secondary distribution system pipelines, installing the transmission line, and constructing such elements as the intake structure and inverted siphons. Such effects will be:

a) Temporary in nature and short term in duration: Works on pipelines and headrace canal will be progressive and the earthworks will be rehabilitated as the project progresses;
b) Limited in scale: The earthworks associated with the headrace canal will be reasonably modest given the subdued nature of the terrain. Other elements, such as the upstream and downstream intake structures, inverted siphons, fall structures, and outfall structures, are all relatively modest in scale given the nature of the landscape, and most are in low visibility locations; and
c) The earthworks and modest structures will not be out-of-place in a cultivated rural landscape.

**Summary of Temporary Construction Effects**

The dam and its ancillary structures present the main potential for construction effects. However such effects will be confined to a relatively small area with visibility essentially restricted to private farmland.

There will be some adverse construction effects associated with the contouring and armouring of the reservoir margins, primary distribution system headrace construction, laying of distribution system pipelines, installing the transmission line, and constructing such elements as the intake structure and inverted siphons. Such effects will, however, be temporary in nature, short term in duration (construction and earthworks will be rehabilitated as the Scheme progresses), limited in scale, and will not be out-of-place in a cultivated rural landscape.

## 07 SUGGESTED APPROACH TO AVOID, REMEDY AND MITIGATE EFFECTS

Measures incorporated into the Scheme design to avoid or minimise potential adverse effects including the following:

a) Selection of a low visibility location for the dam site;
b) Restricting the reservoir to a modified working landscape, avoiding encroachment into Ruahine Forest Park;
c) Selection of unobtrusive locations for the upstream and downstream intakes from the Waipawa River;
d) Discarding of the timber aqueduct option for the primary distribution network; and
e) Alignment of primary distribution headrace canal to minimise adverse effects.

Recommended measures to mitigate remaining adverse effects and to enhance amenity include the following:

a) Planting for the margins and surroundings of the reservoir;
b) Removal of standing trees within inundation area;
c) Provision of public access to the reservoir lake, with associated picnic areas and boat ramps. The recommended location for such access is in the middle reaches of the lake opposite the Dutch Creek arm;
d) Measures to mitigate the effects of the bare fluctuation margin zone including armouring with gravel beaches where public access is focussed;
e) Redesigning access to existing tracks to the Ruahine Ranges and to the Yeoman's Track area;
f) Instituting design principles to guide the detailed design of the primary distribution headrace canal as set out in Appendix 2 covering such matters as fine-tuning alignment, earthworks, fencing, siphons and culverts.

A workshop was held on 6 March 2012 to scope an integrated approach to mitigation and offset measures. Participants included representatives from DOC and Iwi and the authors of the Recreation, Landscape, Traffic, Archaeology and Terrestrial Ecology Reports. The recommendations listed above were discussed at the workshop. HBRC have subsequently prepared a separate report *"Ruataniwha Water Storage Scheme –Proposed Integrated Mitigation and Offset Approach"* (HBRIC May 2013f ) which incorporates most of the recommendations into a coordinated plan. In particular the landscape recommendations relating to the reservoir and its surroundings are incorporated in **'Project A: Ruataniwha Reservoir Restoration Buffer and Catchment Enhancement Zone'**.

Other recommendations are included in the *'Ruataniwha Water Storage Scheme Construction Environmental Management Plan',* (May 2013). Section 4.9 contains methods for revegetation of earthworks and section 4.10 contains methods to reduce visual impacts of the proposed earthworks.

## APPENDIX 1: PRIMARY DISTRIBUTION HEADRACE CANAL SECTION-BY-SECTION ANALYSIS

The analysis looks in detail at the proposed alignment of the headrace canal within Zones B and C.

**Zone B: Waipawa River to Tukituki River**

*Waipawa River Valley*

From the water inlet site the corridor follows the edge of the first terrace east passing beneath Caldwell Road. The alignment follows the toe of terrace scarp. Such an alignment would echo the topography, and cross Caldwell Road at unobtrusive location at base of scarp (It would also avoid the abandoned Lindsay Water Race which is aligned on top of scarp).

The corridor continues following the edge of the terrace for approximately 3km east of Caldwell Road. That section of the canal that will be parallel to the Waipawa River will be some distance from the river, and screened by extensive vegetation including an olive plantation and wilding vegetation. The alignment follows the topography (reducing the potential earthworks), has low visibility, and is remote from houses. Four of the five drop structures (concrete ramps 5m-6m high) will be located on this section of the canal, but will all have low visibility. They are remote from public roads and houses and some distance from the Waipawa River.

*Waipawa River to Wakarara Road*

The corridor turns at right angles to the south, approximately 1.5km from SH50. The terrain is relatively flat so the headrace canal earthworks will have a low profile. Passersby on SH50 are only likely to notice the canal if they know what they are looking for. The corridor passes approximately 800m behind Riverside station farmstead, and approximately 700m and 400m behind two other dwellings on SH50 respectively. The corridor is approximately 200m south-east of a house at the point where it meets Wakarara Road. There is intervening shelter vegetation east of the house. The flat terrain also means the canal earthworks will have low profile.

*Wakarara Road to SH50 Crossing (south of Ongaonga)*

The corridor follows Wakarara Road for approximately 600m to the south-east, crossing beneath the road. It then turns to south-west to follow the toe of the terraces, crossing four major streams (two tributaries of the Kahahakuri Stream and two tributaries of the Ongaonga Stream) and several minor watercourses. The landscape is a series of flat to rolling terraces, and is characterised by geometric pasture paddocks. The corridor crosses two local roads (Ngaruru Road and Pettit Valley Road).

Between Wakarara Road and Ngaruru Road the head-race canal needs to negotiate Cottesmore and Purunui homesteads which are in the vicinity of the corridor:

a) The Cottesmore main homestead and second house are accessed from SH50 and appear oriented to NE. A third house accessed from Wakarara Road is also oriented to NE. The proposed alignment is just beyond farm buildings west of the farmstead (i.e. 'behind' the farmstead).
b) Purunui has one house which appears oriented north and east. The proposed alignment runs immediately east of the house. This alignment was refined following consultation with the owners.

The proposed alignment crosses beneath Ngaruru Road at the location where there is a sharp bend. The alignment passes between two houses on Ngaruru Road of which the closer is no. 57 Ngaruru Road. While the house is oriented to the east in the direction of the canal there is intervening screening vegetation and the corridor will be approximately 100m away. An 8m drop structure will be required to negotiate the fall to the Kahahakuri Stream from the adjacent terrace. The proposed location for the drop structure has low visibility. The ramp will be oriented towards the south-west, away from views from SH50 to the south-east. The views will be mostly confined to an area of farmland in the Kahahakuri Valley.

The alignment across the Ongaonga Stream tributary, Pettit Valley Road and SH50 is in a potentially sensitive area from a landscape point of view. The area has high visibility, the Ongaonga Stream is reasonably significant, and the natural and human features in this area converge at awkward angles. The proposed alignment has been fine-tuned in response to earlier recommendations. It avoids the convergence of the stream and road. Rather, the alignment crosses both the Ongaonga Stream and Pettit Valley Road separately and at close to right angles in each instance. The alignment also follows the less sensitive flat terrain closer to SH50.

*SH50 to Tukituki River*

The proposed alignment crosses SH50 at right angles. Immediately south of SH50 the alignment follows a shelter belt in a south-west direction. It is separated from the Forest Gate Domain by a combination of distance and the large shelter belt on its western boundary. There is a house (No. 1713 SH50) west of the alignment, but it is separated by the shelter belt and utility buildings on the east side of the house in the direction of the headrace alignment.

The corridor crosses a low flood plain terrace between SH50 and the Tukituki River. The area has a geometric pattern of fields and shelter belts, and a mix of land uses including cropping and pasture. The canal corridor is aligned to follow the existing shelter belt pattern.

The canal will cross the Tukituki River by means of an inverted siphon. The crossing point has low visibility, and the siphon sink and resurgence will be located behind margin vegetation so that it is likely to be screened from views from the river itself (for instance from people fishing the river).

**Zone C: Tukituki River to Makaretu River (note: headrace extends only to Ashcott Road)**

*Tukituki River to Ashcott Road*

The corridor crosses open plains which are characterised by a geometric pattern of fields and shelter belts aligned roughly NE-SW, with some pivot irrigators. There is a mix of pasture and cropping. The corridor will have low public visibility until it approaches Ashcott Road. The gentle terrain also means the canal earthworks will have low profile.

The canal corridor alignment follows the alignment of an existing farm road, minimising impacts on field pattern.

There are two houses potentially affected at the end of a very long drive on the north side of Ashcott Road. The nearest (northern-most house) appears oriented NE towards head-race canal and has an open outlook. However, the proposed alignment is some distance from this house and the canal earthworks will have a low profile.

The transition from canal to buried pipeline will be adjacent to Ashcott Road. Attention should be given to aesthetic matters in the detail design of the transition.

## APPENDIX 2: HEADRACE DESIGN PRINCIPLES

The following principles were developed as a guide to fine-tuning the alignment and design details. They are informed in part by an inspection of existing headraces on the Rangitata Diversion Race and Opuha Water projects. The principles were taken into account when considering the alternative headrace corridors, and modifying the preferred corridor. Such principles are to be used as a guide: It may not be possible to apply every principle in every instance.

**Contours**

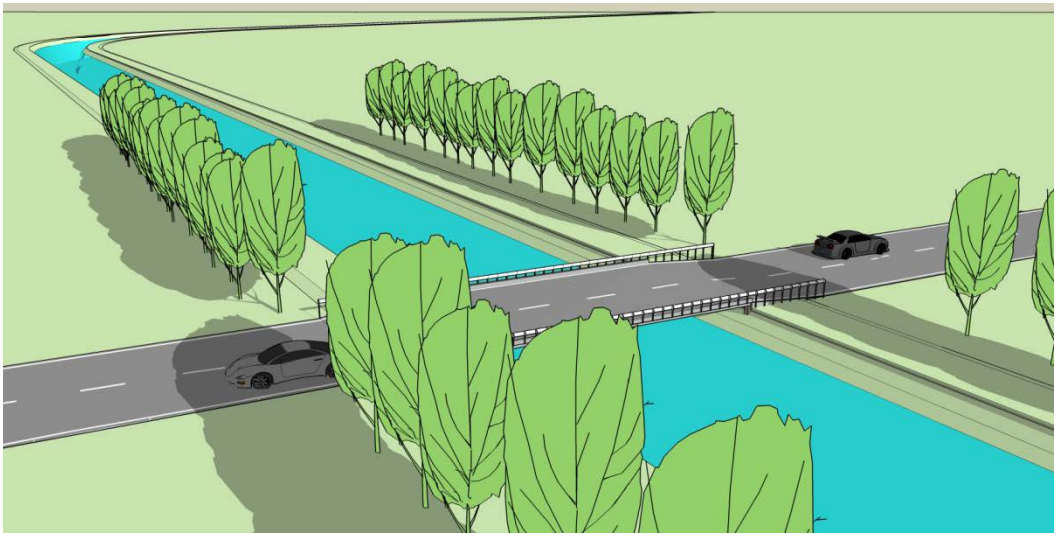
- Follow contours (within reason) to avoid large cut batters and embankments (by comparison side fill batters tend to be less visually prominent and easier to remediate)

**Streams**

- Cross streams and watercourses at right angles, preferably in a straight section of stream (avoid meanders)
- Use best practice culvert design (oversized culverts, horizontal grade, invert level located so as to enable the stream bed to re-establish through the culvert)
- Reinstate and replicate adjacent vegetation patterns where the headrace passes adjacent to and under streams

**Roads**

- Cross at right angles (more or less)
- Consider opportunities to locate vegetation (or use existing vegetation e.g. shelter belts) to visually anchor the headrace at road crossings as shown below

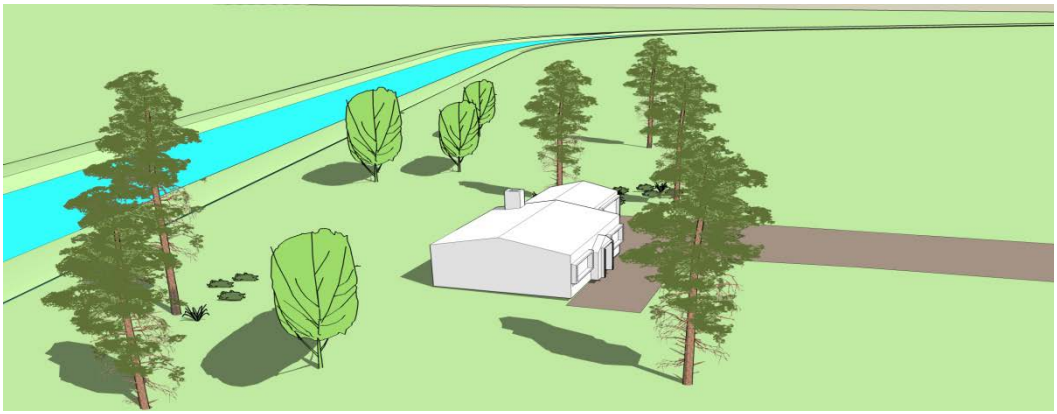


- Ensure consistency in materials used for structures like barriers, fences and gates located at roads crossings
- Pay particular attention to reducing visual impact of cut batters and box cuts in vicinity of roads. This might include attention to alignment and earthwork design, rehabilitation of earthworks, and/or screening with vegetation

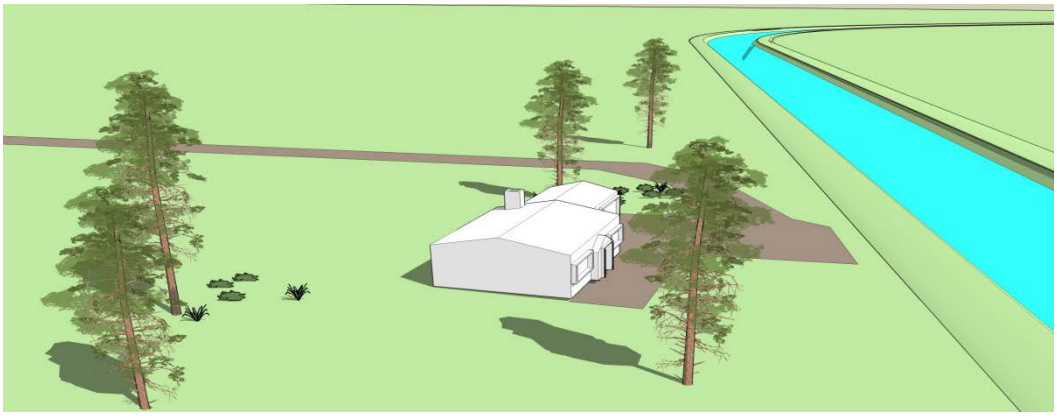
**Houses**

Analyse the particular effects for each house in vicinity of headrace. In general it is preferable to:

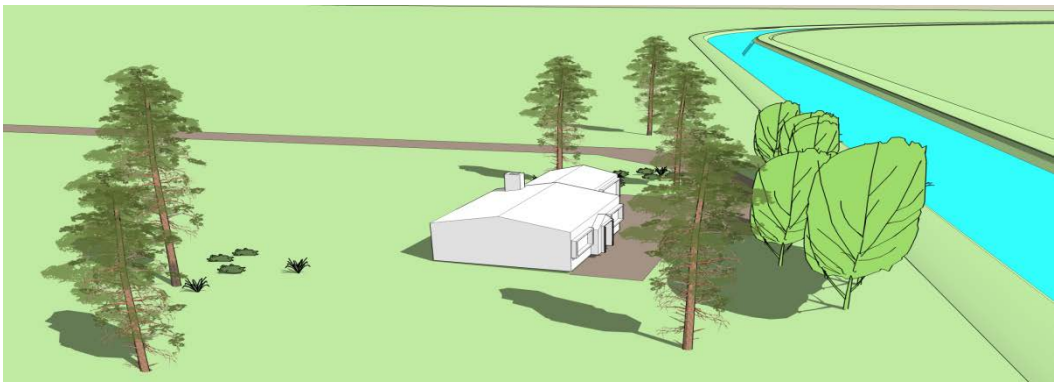
- Align the headrace ‘behind’ houses (e.g. beyond farm buildings, yards, and in the opposite direction from which the house is oriented) as shown below



- Avoid design that might dominate house, such as high embankments or elevation of headrace on slopes above the house

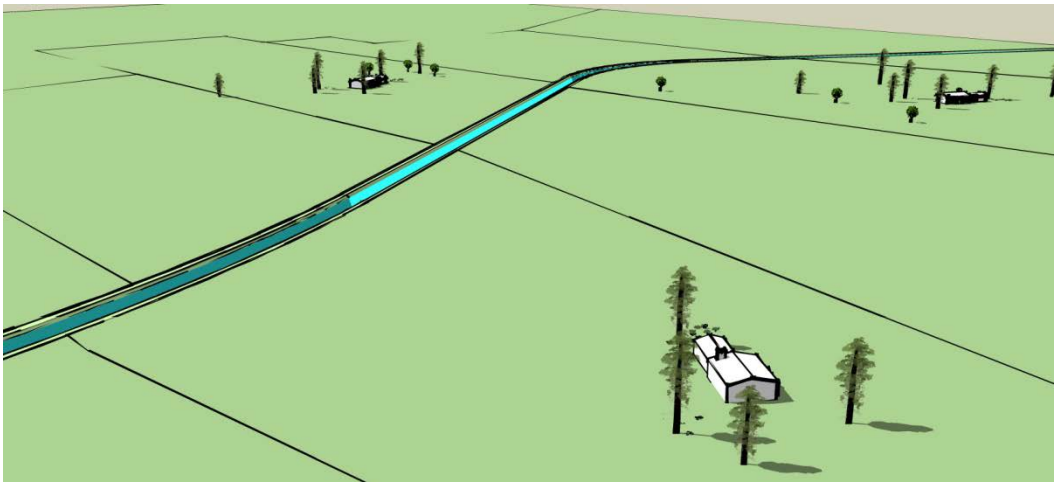


- Make use of existing trees for screening
- Plant additional trees if necessary to increase perspective distance between house and headrace if it is considered there is an adverse visual effect

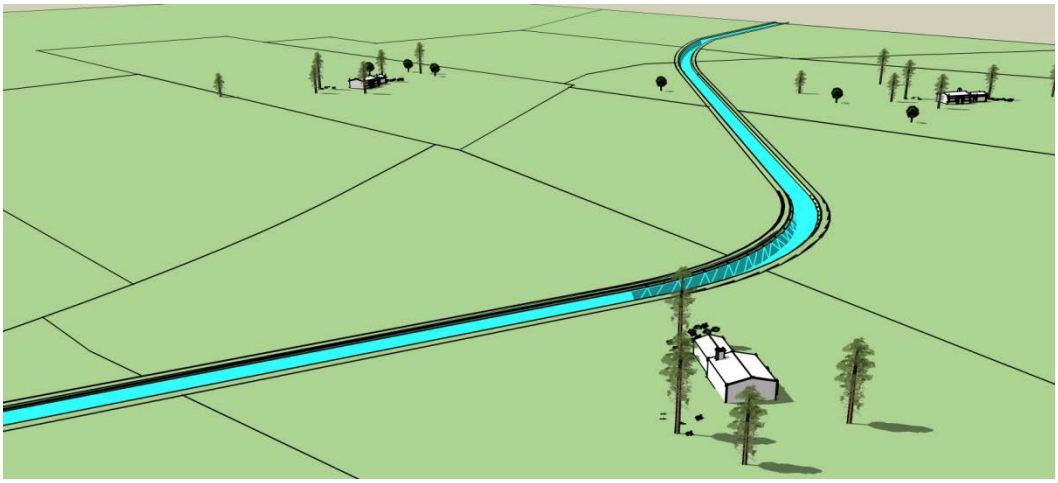


**Property and field/ paddock boundaries**

- Align headrace, where possible, to property boundaries and along or parallel with existing field/ paddock boundaries (this is most relevant on the plains where there is a geometric pattern rather than on the pastoral hills)



- Avoid cutting across existing paddocks and creating small unusable fields/ paddocks



**Landscape Features**

Avoid significant landscape features including:

- Landmark or visually distinctive landforms (for instance distinctive terrace scarps, stream confluences)
- Stands of bush or other native vegetation
- Amenity vegetation
- Historic features (such as historic homesteads and their landscape/garden settings)
- Community facilities (e.g. parks, golf course)

**Cut Batters**

- Grade small side cuts back to merge with adjacent topography, re-topsoil and re-grass
- Establish inventory of the larger cut batters and focus attention on the detail design of the potentially most obtrusive batters
- Minimise height of larger batters by fine-tuning the alignment or steeping batter face where this can be achieved

- Grade the top edge of batters to avoid edge frittering
- Avoid benching batters (monoslope batters have a less 'engineered' appearance and are more in keeping with natural landforms)
- Rehabilitate batters through best practice hydro-seeding techniques (scarify and roughen surface, use appropriate species, glue matrices)

**Fill Batters**

- Overfill batters with surplus spoil where appropriate (i.e. where it does not encroach on streams) to:
    - soften appearance
    - limit surface water run-off and avoid erosion
    - aid establishment of pasture for management reasons
    - Re-spread topsoil stripped from site and re-grass canal fill batters;
    - Provide gates and fences that enable sensible periodic grazing of canal corridor to control weeds

**Culverts**

- Minimise extent of encroachment into streams and significant watercourses
- Follow best practice culvert design (oversize culvert and set invert level so that natural stream bed re-establishes through culvert)
- Re-vegetate margins to streams adjacent to culverts to stabilise banks and visually screen pipes (where culverts have high visibility)

**Surplus Spoil Disposal**

- Locate spoil disposal sites as follows:
    - Broad hill top areas or sloping ground at head of valleys
    - Avoid filling watercourses, and seepages
    - Merge with natural landforms (e.g. by extending a natural terrace, or contouring on a spur)
    - Spoil may be lost by over-filling batters so long as it does not encroach into streams or watercourses

**Siphons**

- Look for opportunities to anchor siphons with existing vegetation
- Design security fencing to ensure a good level of amenity