Amuri Irrigation Company Limited

Application to be listed in Schedule 2 of the FTA Bill: Balmoral Water Storage Facility and to Replace the existing Fish Screen at the Balmoral Irrigation Race Intake

Extract from AEE: Adverse Effects

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EXTRACT FROM THE ASSESSMENT OF ENVIRONMENTAL EFFECTS

The key environmental effects associated with the Proposal that were assessed and presented in the AEE in support of the RCA were broadly classified into the following:

a. Terrestrial ecology effects;
b. Aquatic ecology effects, including proposed BSWF water quality effects;
c. Hydrogeology effects;
d. Natural character and landscape values effects;
e. Recreation and tourism values effects;
f. Cultural values effects;
g. Civil safety effects;
h. Dust effects;
i. Noise effects;
j. Traffic effects; and
k. Positive effects.

1. EFFECTS ON TERRESTRIAL ECOLOGY

Paula Godfrey of Tipu has undertaken an assessment of the potential effects of the BWSF on terrestrial ecology. A full copy of the assessment is available on request.

Ms Godfrey highlights that development of the BWSF will result in the loss of terrestrial land. The BWSF will affect an area of over 134ha. This change of land use presents a potential effect on terrestrial species. Ms Godfrey acknowledges that the Site, and the surrounding area is already extensively modified and retains little to no natural habitat, or indigenous terrestrial communities.

Ms Godfrey acknowledges that if the BWSF is not developed, the Site would continue to be significantly modified by plantation forestry, and as such would not regenerate into any resemblance of a natural state. The conversion of terrestrial land into a body of water will result in the loss and alteration of the existing baseline conditions of the Site, with the post-development character and terrestrial attributes of the Site fundamentally changed in terms of fauna and vegetation.

For avifauna, Ms Godfrey advises that it is unlikely that the development will have an impact on their ability to move across the Site, although smaller species such as fantails are unlikely to fly across a large body of water.

For herpetofauna, Ms Godfrey advises that the population at the Site is likely to have been isolated for a long period of time and may be a relict population that is at risk, or functionally extinct. Ms Godfrey highlights that lizard species that may be present at the Site are already geographically constrained, due to the presence of the Balmoral irrigation race which, in Ms Godfrey's opinion, presents an impassable barrier. Ms Godfrey notes that the Balmoral race is dewatered for several months (May-September), however, this is a time when lizards are less active. While recording that the Proposal will result in the loss of active lizard habitat, Ms Godfrey advises that with appropriate management of the adverse effects on resident

lizard populations can be managed to ensure 'no net loss' on ecological values, and effects post construction are minimised.

To minimise the effects on lizard species potentially present within the Site, Ms Godfrey recommends two management measures be undertaken, including lizard salvage and habitat remediation / restoration. In this regard, Ms Godfrey recommends that an area of lizard habitat needs to be established prior to works beginning outside of the project footprint, so that any lizards captured within the Site have suitable habitat to be relocated to. The area will include rock piles and native plantings of species known to provide food sources. Prior to any salvage, a lizard management plan will be prepared by a qualified herpetologist. The plan will follow the Department of Conservation guidelines for lizard salvage and translocation, and will detail methods for salvage and transfer, release sites and ongoing management. The plan will be adhered to at all times to ensure the protection of lizard species that may be present at the Site. Ms Godfrey also recommends that the new habitat be controlled for predators for at least 5 years. Amuri has accepted all of these recommendations.

Ms Godfrey also recommends that a 5-hectare area of native rehabilitation planting be established to, for all intents and purposes, offset the loss of the terrestrial values that are to be replaced by the BWSF. Ms Godfrey states that the lack of habitat and indigenous biodiversity within the project area and immediate surrounds, provides an opportunity to reintroduce native plant species to improve habitat quality for local populations of lizards and avifauna around the BWSF. A soil disposal area to the west and directly south of the BWSF will be planted in suitable restoration plants after works have been completed. The area will greatly increase habitat available at the Site and increase biodiversity within the Site, and wider surrounds. Remediation / restoration works will include appropriately planted indigenous species, fencing, weed control, pest control, and legal protection. As such, Ms Godfrey is of the opinion that the salvage operation and habitat restoration will result in an increase of ecological value for lizard species overall. A lizard habitat will also be created within this area, which will include rock piles and native plantings such as creeping pohuehue (*Meuhlenbeckia axillaris*) and *Coprosma* species. This enhanced lizard habitat will greatly increase the carrying capacity of lizard species and increase the local population of lizards. Weed control is recommended within the plantings for a 5-year period. Amuri has accepted all of Ms Godfrey's recommendations in relation to this replanting proposal.

Conclusion – effects on terrestrial ecology

Overall, Ms Godfrey opines that all but the areas of Mixed Open Scrub habitat within the Site do not have significant ecological values. With the acceptance and implementation of her recommended effects management measures, Ms Godfrey also has advised that the Proposal can be advanced in a manner that will minimise avifauna and lizard mortality. She also is of the opinion that the Proposal will generate a net ecological gain by improving and reintroducing indigenous biodiversity back to the local area. Any adverse effects will be, in Ms Godfrey's opinion, minor to less than minor.

2. EFFECTS ON AQUATIC ECOLOGY

Jacquie Pallard of Enspire has undertaken an assessment of the potential effects of the BWSF on aquatic ecology. A full copy of the assessment is available on request. Ms Pallard notes that the Hurunui River diversion on the true left bank is not screened and advises that fish (including Chinook salmon fry) are diverted into the head race. Ms Pallard notes, however,

that there is an existing fish screen within the Balmoral irrigation race, at the downstream end of the settlement pond and upstream of the point where water will be pumped from the race into the proposed BWSF. Therefore, the water that is abstracted into the race is screened before being pumped into the BWSF. The existing fish screen has design limitations which preclude it from effectively and consistently excluding all fish species. As such, At Risk indigenous fish species are currently known to be present within the race.

Ms Pallard records that water pumps, such as those proposed in the design for the BWSF, can cause injury and death to fish. Furthermore, the BWSF is likely to be an unsuitable habitat for fish species. The pumped inlet could remove fish from their natural lotic habitat to a lentic environment without habitat, food, or cover. While the existing fish screen would screen some fish from the race and BWSF, a moderate number of indigenous fish could potentially pass through the screen and, therefore, be vulnerable to the effects of the BWSF pump. Ms Pallard explains that longfin eels (threat status 'At Risk - Declining'), shortfin eels, and Chinook salmon have migratory components to their life history. As such, all species require access to the ocean for completion of their life cycles. For fish migrating downstream, such as adult eels and salmon fry, the BWSF presents a significant migration barrier unless they can make it back into the Balmoral irrigation race, and from there to the Pahau and Hurunui Rivers.

In evaluating the level of the BWSF's effect on aquatic ecology, and more specifically At-Risk indigenous fish, Ms Pallard weighed the threat status (At Risk – Declining) of the fish species along with their likely existing low densities within the race and the pre-existing challenges associated with inhabiting the artificial race environment (i.e., dewatering events, other infrastructure associated with the race and irrigation). Ms Pallard therefore concluded that the potential effects on aquatic ecology are 'Low'.

To avoid the effects of the BWSF on aquatic ecology, Amuri have proposed to replace the existing fish screen at the Balmoral intake with a high-quality fish screen that represents best screening practice and is in line with recommendations from NIWA fish screening specialists. While Amuri is also seeking to divert an additional 1.5 m^3/s of water from the Hurunui River, this additional diversion is to increase flow through the bypass to ensure fish interacting with the screen are returned to the mainstem. Based on the NIWA fish screening report, Ms Pallard is of the opinion that the potential effects on fish discussed above will be avoided. She has also expressed the opinion that the installation of an upgraded fish screen will ultimately result in a significant improvement from the existing conditions for fish interacting with the Balmoral irrigation infrastructure.

In evaluating the effects of the BWSF storage facility, Ms Pallard notes that large water storage facilities often need to manage depleted oxygen levels, nutrient accumulation, cyanobacterial blooms, and increased faecal bacterial blooms. She notes, however, given the circumstances (e.g., intended use of the waters for irrigation, its lack of use for recreation and drinking water supply, the artificial nature of the irrigation race, and the proposed fish screen), the effects of water quality on aquatic ecology are deemed negligible. Ms Pallard also notes that while the invasive alga, Didymo (*Didymosphenia geminata*) is present in the Hurunui River and can cause problems to irrigation infrastructure by blocking intakes, pumps, and water pipe, Didymo is not currently an issue for these systems. Therefore, Ms Pallard concludes that Didymo will not likely be problematic within the proposed BWSF.

Ms Pallard notes that the proposed earthworks associated with the construction of the BWSF have the potential to generate sediment runoff during construction and up until the Site has been stabilised. As we have previously recorded, Ms Pallard's advice is that the Balmoral

irrigation race and the fish species within it are of 'Moderate' ecological value. Ms Pallard notes that generally, sediment loadings within waterways decrease water clarity and can impact ecosystems by preventing aquatic plant growth, smothering invertebrates, damaging fish gills, and decreasing the ability for fish to find food and avoid predators. Sediment deposits can also significantly alter and degrade freshwater habitats, burying stony substrates and woody debris and filling channels.

In considering the effects of construction on surface water quality and ecology, Ms Pallard acknowledges the presence of At Risk - Declining fauna. Ms Pallard notes that no direct discharges of untreated stormwater are proposed to the Balmoral irrigation race and given there are no surface water features within the Site, construction related effects from the BWSF are unlikely to result. Ms Pallard notes that construction of the fish screen will occur within 50m of the Hurunui River prior to construction of the BWSF when the irrigation scheme is not operating. This has the potential to generate sediment runoff until an area is stabilized which can impact water clarity, aquatic plant growth, invertebrates, and food availability. However, with appropriate erosion and sediment controls and management (such as that recommended by Riley and, therefore, proposed by Amuri), the effects of construction on surface water quality and ecology will be less than minor.

Conclusion - effects on aquatic ecology

Based on Ms Pallard's assessment, the construction of the proposed BWSF is not anticipated to affect any existing surface water features or aquatic biota within the construction envelope, as there are no surface water features within the area of the BWSF footprint. While the Balmoral irrigation race is inhabited by At Risk - Declining indigenous fish species and sport fish, the proposed, high-quality fish screen replacement at the Balmoral intake and the increased flow past the screen through the bypass will prevent fish from entering the race and thereby the BWSF. This will minimise any potential effects on fish and provides a significant improvement for the aquatic community in the Hurunui River. The effects on water quality from storage facility itself and construction of the BWSF and fish screen can be minimised (where it cannot be avoided) with appropriate controls and monitoring as outlined in Riley's Construction Methodology Plan (**Annexure 1**) and Ms Pallard's report. Therefore, Ms Pallard has concluded that overall, the Proposal will have a positive effect for aquatic ecology values.

3. EFFECTS ON HYDROGEOLOGY

Brydon Hughes of LWP has undertaken a hydrogeological assessment of the potential effects of the BSWF on groundwater. A full copy of the assessment is available on request.

Based on the observed depth of groundwater across the Site, Mr Hughes is of the opinion that it is highly unlikely the water table will be encountered during construction. Mr Hughes also concludes that potential effects on surface water are expected to be less than minor, as there are no hydraulically connected surface waterways down-gradient of the Site, other than the Hurunui River, which he advises is approximately 1.4km from the BWSF at its closest point. Given these findings, Mr Hughes advises that the Proposal's groundwater (quantity) effects are principally limited to groundwater mounding due to potential leakage from the BWSF and the potential effects of elevated groundwater levels (above the reservoir invert) on liner integrity.

Mr Hughes notes that the BWSF will be lined with a low permeability clay or geomembrane liner to prevent leakage, which significantly reduces the potential for stored water to affect the surrounding environment. Mr Hughes also records, however, that geomembranes are not totally impermeable, and installation across a large surface water body can have several flaws. Given this, Mr Hughes has completed an assessment of the effects of reservoir leakage to estimate the magnitude and extend of mounding associated with the three different leakage scenarios, being:

- Scenario 1 (most likely) - A total leakage loss of 6 L/s assuming excellent installation quality (seam defects at a rate of 1 defect per ha).
- Scenario 2 (moderate leakage) - Total leakage loss of 15 L/s assuming good installation quality (small defects at a rate of 2.5 defects per ha).
- Scenario 3 (extreme case) - Total leakage loss of 15,700 L/s assuming poor installation quality (large defects at a rate of 2.5 defects per ha).

Of the modelled scenarios, Mr Hughes states that Scenario 3 would be unlikely to be realistic, other than in the event of mechanical damage to the geomembrane liner. As such, the extent of this defect would be identified through routine checks and would be identifiable from the water balance. Results indicate water table mounding of between 0.5 and 1.25 metres under the central area of the BWSF under Scenario 1, increasing to between 1.3 and 3.1m under Scenario 2. Under both scenarios, the calculated rise in the water table does not exceed 1m at distances greater than 50m from the reservoir margin, reflecting the localised nature of mounding that is likely to result from any leakage.

As noted above, Mr Hughes states that elevated groundwater levels have the potential to affect the linear integrity of the BWSF. Although Mr Hughes notes that this would infrequently occur, he several options to mitigate these effects including: (1) construction of a cut-off drain around the perimeter of the reservoir; (2) installation of under-drainage under the reservoir liner; and (3) management of reservoir storage during periods of high groundwater levels to maintain sufficient hydrostatic pressure on the liner to prevent uplift.

Mr Hughes notes that the closest bore to the BWSF Site recorded on the ECan wells database website is BV24/0070 located approximately 380m south of the Site. He records that this well is used for domestic and stock water purposes. The next closest bore (BV24/0075) is located 1.7km south-east of BV24/0070. All other bores recorded on the ECan Wells database within 3km of the Site are either located on the true right (southern) bank of the Hurunui River or upgradient of the BWSF Site and are therefore, in Mr Hughes opinion, unlikely to be affected by the BWSF. Mr Hughes also states that any mounding effect would be largely limited to the BWSF Site, with water table rise at BV24/0070 less than 0.2m under the modelled leakage in Scenario 1 and 2. As such Mr Hughes concludes that mounding will not adversely impact the operation of the bore and may result in increase of available water.

Mr Hughes also assessed the potential for groundwater breakout along the base of the 'Q2 terrace', which forms the geology of the Site. The Q2 terrace riser that runs south of the BWSF is generally between 10 to 12m in height. Bore BV24/0070 is located approximately 30m South of this terrace. Groundwater measurements for Bore BV24/0070 taken on four occasions between October 2016 and August 2017 indicated static groundwater levels at the top of the casing ranging between 4.78m in October 2016, to 3.79m in August 2017. Mr Hughes indicates that assuming similar temporal variation to that observed in the Balmoral area, the level measured in August 2017 is inferred to be close to the multi-year peak in groundwater due to consecutive months with signfiicantly above average rainfall. Under the modelled leakage Scenarios 1 and 2 from the position of the Q2 riser (250m from the BWSF magin),

predicted groundwater modelling ranges between 0.13m (Scenario 1 with low transmissivity) to 0.45m (Scenario 2 with high transmissivity). Relying on observed groundwater levels, Mr Hughes opines that mounding could potentially cause groundwater breakout along the base of the Q2 riserduring periods of naturally high groundwater levels. It is therefore recommended that monitoring of groundwater levels along the base of the terrace should occur, along with appropriate triggers for the implementation of mitigation options established in the Dam Safety Management System for the reservoir. This may include requirements for regular monitoring of groundwater levels in one or more piezometers situated along the base of the Q2 terrace riser, along with high groundwater level triggers which initiate specified measures to mitigate nuisance effects associated with ponding along the northern margin of the lower terrace.

The BWSF will be filled using water from the Hurunui River using the existing Balmoral irrigation race reticulation system. Once the BWSF is operational, the BWSF embankments will prevent runoff from surrounding land from entering the reservoir. The two sources of inflow into the reservoir will be water from the AIC reticulation system, and rainfall. Mr Hughes has reviewed water quality data trends for the Hurunui River (between 2010 and 2019) as they relate to Nitrate-N, DRP and *E. coli* concentrations. He advises that the data shows low contaminant concentrations that are well within specified standards. He also reported that low concentrations of indicator *E. coli* bacteria indicate microbial quality as 'High'[1]. Mr Hughes is of the opinion that water stored in the BWSF will contain low nutrient concentrations with a low microbial loading, which will be reduced further by reservoir retention time and sunlight. Drawing on these findings, he advises that should leakage from the BWSF occur, nutrient concentrations (Nitrate-N and DRP) within the BWSF are anticipated to be lower than those in underlying groundwater, and microbial contaminants will likely be attenuated within a short distance of the Site. We understand this to mean that the leakage will not alter, in an adverse way, groundwater quality.

Mr Hughes notes that the additional 1.5 m^3/sec diversion of water through the river intake will increase the operating stage height in the headrace and settlement pond. He notes that this may marginally increase the rate of flow loss to groundwater, however, this is unlikely to result in any appreciable mounding of the water table due to the permeability of the Q1 alluvium. Resultantly, Mr Hughes is of the opinion that diverted water lost to ground water will ultimately be returned to the Hurunui River, as it currently does, through existing processes from individual braids within the natural river channel. As detailed design plans of the foundations required for the proposed fish bypass are preliminary, Mr Hughes notes it is uncertain whether groundwater will be encountered during construction of the fish screen.

Conclusion – hydrogeology

Mr Hughes is of the opinion that it is unlikely the water table will be encountered during construction of the BWSF. Groundwater level observations indicate that significant rises in groundwater level may occur across the BWSF Site following large rainfall events. Consequently, the potential exists for groundwater levels to reach the proposed reservoir invert across the north-western section of the reservoir footprint. It is therefore recommended by Mr Hughes, and resultantly incorporated into the design, that appropriate measures (such as under-drainage) are considered as part of reservoir design to mitigate against potential liner uplift across this section of the Site. As there is uncertainty as to whether groundwater will be encountered during construction of the fish screen, Mr Hughes notes that dewatering may occur as a permitted activity and its associated processes will be

[1] Sufficient to fall within the A-band attribute state for *E. coli* specified in the NPS-FM 2020.

addressed in a detailed Construction Management Plan. Mr Hughes advises that potential leakage from the BWSF is unlikely to result in adverse water quality effects in underlying groundwater, with it being more likely a net benefit will be achieved due to the dilution of contaminant concentrations across the wider aquifer system. With operational measures such as regular monitoring of cyanobacteria and dissolved oxygen to identify stratification, aeration if required to improve vertical mixing, and management of waterfowl, the quality of stored water will be maintained and will not have adverse effects on groundwater. Furthermore, significant mounding of the water table due to the extra diversion is expected to be unlikely and existing processes of water loss through the Q1 alluvium are expected to continue. We understand Mr Hughes to ultimately advise that while adverse hydrogeological effects may arise as a consequence of the Proposal, any effects can be effectively monitored and as needed, managed to the point where they are acceptable, minimised, and minor or less.

4. EFFECTS ON NATURAL CHARACTER AND LANDSCAPE VALUES

Stephen Brown of Brown NZ has undertaken an assessment of effects of the proposed BWSF on natural character and landscape values. A full copy of the technical report is available on request.

The Site and surrounds displays a high degree of utility and rural productivity, with an interplay between farm paddocks, shelterbelts, and pine forest creating a working rural landscape largely without any natural elements or features. In considering potential effects on natural character and landscape values, Mr Brown has employed three different viewing perspectives to the BWSF, including:

- Viewpoint 1 (**'VP1'**) approaching the BWSF down Tekoa Road from the east (from the direction of SH7);
- Viewpoint 2 (**'VP2'**) approaching the BWSF down Tekoa Road from the west; and
- Viewpoint 3 (**'VP3'**) looking towards the BWSF from the end of Bishells Road (across the Hurunui River).

The following effects assessment will be based on these three viewpoints.

4.1 Receiving environments and audiences

Mr Brown states that the area around the BWSF Site is tightly enclosed by pine forestry next to Tekoa road, which extends through to McKays Road, and the rising landforms of Tekoa range. He observes that any views to the BWSF are likely to be confined to motorists, local farmers and workers, and forestry workers along Tekoa Road, and the farms directly north of the Site, being 724 and 828 Tekoa Road.

Mr Brown notes that at least one farmhouse at 828 Tekoa Road will overlook the river terrace where the BWSF will be sited, approximately 1.3km from the Site. There is also one farmhouse located off McKays road, closer to the BWSF Site. It is noted that both houses will largely be screened from the completed Balmoral storage by shelterbelts, amenity planting and intervening pine trees. For the house off McKays Road, the eastern embankment (after it turns north towards Tekoa Road) would be visible from the driveway and areas near the house. However, expansive views from the residence towards the Hurunui River and over intervening farmland would be unaffected by the BWSF.

Mr Brown also noted that the proposed fish screen replacement will be even more visually discrete than the proposed BWSF. The site of the proposed replacement screen is very isolated from the Hurunui River's main channel and margins, being some 350 m or more away. Therefore, Mr Brown is of the opinion that passing boaties, kayakers, canoeists, or anglers would be at great difficult to try and spot the screen from the river. The fish screen site will be even more completely screened from the south of the river corridor, and from the north of the screen site.

Figure 1: Farmhouse off McKays road, directly South of the BWSF

4.2 Visibility

Mr Brown notes the development of the BWSF would result in cut back of pine forest for all three vantage points, to varying degrees. For VP1, the construction of embankments up to 9.5m high adjacent to the existing Balmoral irrigation race would be visible. In this regard, Mr Brown opines that features such as the removal of some of the existing pine forest and the BWSF embankments would be clearly visible from VP1, but that it would be lower than the existing pines at the Site. With regard to the construction works and disposal areas, Mr Brown notes that the designated locations for these activities would be offset from the road at the 'far' end of the BWSF footprint. As a result, he states that the works would be incrementally screened by emerging embankments. Mr Brown goes on to record that the proposed 20m setback of the embankments from the existing Balmoral irrigation race, with a sloping profile and chamfered crests, softens the visual incursion of the existing embankments, without making them disappear completely from the landscape. Mr Brown concludes that the BWSF would have a moderate level of visibility both short and long term at VP1.

Figure 2: The view down Tekoa Road from the east – towards existing forestry, farming and Balmoral irrigation race

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For VP2, much like VP1, the introduction of the BWSF into the landscape would result in a reduced area of pine forest near Tekoa Road, with the emergence of the embankments down the roadside. Mr Brown records that the embankments start approximately 2.5m above the road level, which sits lower than the existing pine forest, and has the appearance of a harvested break within the existing cover. He then opines that the proposed 20m setback of the embankments from the existing Balmoral irrigation race, with a sloping profile, would make the BWSF appear quite recessive.

Mr Brown also notes that the proposed truck turning area, set down site, and vehicle and fuel storage compound would combine with tree clearance around the stockpile location, resulting in the area of operations being visible to passing motorists. Tree clearance west of the BWSF footprint would also result in visibility, however this would have a low profile. Mr Brown concludes that the BWSF from VP2 would have a moderate-high level of visibility during the construction period, shifting to a low-moderate level long term.

Figure 3: The view down Tekoa Road from the west – towards existing forestry, farming and Balmoral irrigation race.

Mr Brown states that when viewed from VP3, the BWSF would sit within the body of the pine forest on the far side of dairy farmland, directly north of the Hurunui River. He records that the dairy farm within this stretch contains housing, sheds, yards and three pivot irrigators, creating a highly modified environment. From a distance, the BWSF would appear to be an area of clearance from forestry harvesting. Depending on the amount of pine trees retained on the southern side of the BWSF footprint, the BWSF would either disappear within the existing plantation or remain visible as an area of partial clearance.

In regard to the visibility of the proposed replacement fish screen, Mr Brown states that the screen will be entirely 'lost' amid the array of vegetation cover and gravel banks.

Figure 4: Photo showing the Hurunui River and margins further up the river

4.3 Natural character effects

Mr Brown records that when viewed from both VP1 and VP2, the Hurunui River is not visible and the BWSF therefore will have no impact on the natural character of the river from these locations.

For VP3, Mr Brown states that the distance of the Hurunui River from the Site (which he records as being approximately 1.2km), a strip of existing forestry, and a much wider band of farmland provides a buffer between the river and the BWSF. He also notes that the northern riverfront near the BWSF Site is already highly modified and compromised from a natural character standpoint. Mr Brown opines that the BWSF would sit behind these elements, recessive within the existing pine forest, appearing more as a natural riverbank or terrace, rather than an artificial structure. He goes further to state that while the presence of the BWSF and replacement fish screen may change the 'context' of the Hurunui River, they would have minimal effect on the river's natural character values. As a result, Mr Brown advises that the effects of the BWSF on natural character would be 'low' in the short and long term from VP3.

4.4 Landscape effects

Mr Brown highlights that for VP2, during the construction phase of the BWSF, the clearance of the area on the west of the Site including the construction of the embankments, the truck turning, laydown area, and storage compound would be directly adjacent to Tekoa Road. These activities when compared to the existing landscape would appear out of place.

In terms of the character and aesthetic appeal around Tekoa Road, Mr Brown notes that the embankments of the BWSF would be large but have a recessive profile. Moreover, he states that the embankments will be 'grassed' with brown top and excavated rock, which will blend within the sequence of terrace landforms near the Hurunui River. Mr Brown is of the opinion that the functional qualities of the left-hand side of Tekoa Road would not be altered to a significant degree.

Mr Brown opines that from VP3, the development of the BWSF would be a recessive component of the landscape background above and beyond the Hurunui River. The south facing embankment of Balmoral storage would sit within the existing river landscape that is already highly modified due to rural production, such as pivot irrigators. Mr Brown believes that the BWSF will have a low, linear profile much like a natural riverbank or terrace. As such, based on Mr Browns assessment, the BWSF would have no impact on the Hurunui River or hill ranges that create the aesthetic appeal and naturalness of views. For completeness,

we note that Mr Brown is of the opinion that the new fish screen will have even less of an effect than the BWSF, as it will integrate in with existing vegetation and shingle banks.

Mr Brown concludes that during construction, landscape effects from VP2 would be 'moderate', decreasing to low in the long term. Overall, the landscape effects be 'low' for VP1 and VP3 during construction, and in the longer term.

4.5 Amenity effects

In terms of amenity effects from VP2 during the construction phase, Mr Brown advises that a certain degree of visual intrusion is anticipated. These effects are classified as 'low to moderate' in the short term, until construction of the BWSF is completed.

In terms of amenity effects from VP1 in the short and long term, and VP2 in the longer term, based on Mr Brown's assessment the BWSF would not impact on any key views from Tekoa road, or otherwise be intrusive. If anything, the BWSF would affirm the highly modified nature of the surrounds. Even though the physical characteristics of the landscape are anticipated to change, Mr Brown advises that no significant impacts are anticipated on the character or identity of the area. He also notes that the nearest dwellings are over 1.7km from the BWSF, which will largely be screened from viewing the BWSF by shelterbelts and vegetation.

As a consequence of his findings, Mr Brown advises that the Proposal's adverse amenity effects will be 'low to moderate' during construction, decreasing to 'low' in the longer term for VP2, and 'low' in the short and long term for VP1. He is also of the opinion that the adverse amenity effects associated with the BWSF, as well as the proposed replacement fish screen, will be very low in relation to VP3.

4.6 Effects management measures

Mr Brown highlights that there is a degree of sensitivity with the location of the BWSF, with it being within 1.2 km of the Hurunui River. As such, it is highly desirable to maintain all of the pine trees south of McKays Road, between it and a farmhouse located in this area. It is noted however that this is not guaranteed, and Amuri has no control over this block of land. Mr Brown opines that it would be logical for the landowners to maintain this strip of 'buffer planting' between their farm, farmhouse and the proposed BWSF. Mr Brown also notes that in Ms Godfrey's report, native revegetation behind this strip of pines is proposed as per **Appendix 6**. However, this planting would not screen nor reduce the profile of the BWSF and its embankments.

Next to Tekoa Road, native revegetation is proposed across the stockpile and soil disposal areas, storage compound and truck turning area. This will 'bed' the BWSF into the wider production forestry setting, but however will not offer significant visual mediation or mitigation. As such, a strip of new pine planting is proposed outside of the native vegetation proposed, extending down Tekoa Road to the north-western corner of the BWSF. This will actively screen the BWSF and limit its visibility to the road corridor and nearby farms within a short period of time, estimated by Mr Brown as 8 to 10 years at the most.

In terms of the BWSF itself and the reservoir liner, Mr Brown details that Riley have considered the possibility of using a white reservoir liner, with smooth or textured surfaces

on either side. Mr Brown opines that the BWSF is too elevated for public viewing of its surface, and all of the liner and its side surfaces should be contained by the dam embankments.

4.7 Conclusion – natural character and landscape values effects

Mr Brown concludes that the BWSF (including the new fish screen) will generate less than minor adverse landscape, visual amenity, and natural character effects, although the landscape and amenity effects will be elevated during construction.

In order to achieve this outcome, Mr Brown recommends that forestry on the western side of the Site (in the vicinity of the proposed stockpile area, storage compound, and truck turnaround area) is reinstated as soon as possible with native revegetation and a pine buffer to help blend the BWSF into the wider, production forestry setting. Amuri has confirmed that it will implement the recommended mitigation once the BWSF has been constructed and is operating.

Mr Brown concludes that for the area south of the BWSF near McKays Road, effects management is not necessary to protect landscape and natural character values. It is noted that this area is currently in pines.

5 EFFECTS ON RECREATION AND TOURISM VALUES

Mr Greenaway of Greenaway and Associates has undertaken an assessment of effects on recreation and tourism values as a result of the BWSF. A full copy of the technical report is available on request.

Mr Greenaway has noted that angling, kayaking, rafting, and jetboating are all recreational activities that occur within the surrounds of the BWSF and Hurunui River.

Referencing the assessment undertaken by Ms Pallard, Mr Greenaway notes that sports fish are present within the Balmoral irrigation race upstream of the existing fish screen. The BWSF will rely on the existing consents to abstract the water that is required to fill the BWSF but will require up to an additional 1.5m^3/s of water to operate the proposed fish screen. While dewatering of the race is required for the construction of the proposed fish screen, Mr Greenaway's notes dewatering is a regular existing activity and as such its construction will not increase the duration that the scheme is dewatered. As such, Mr Greenaway notes that no additional effects on angling in the Hurunui River are anticipated. In this regard, we understand his advice to be that any effect will be in accordance with an existing resource consent and thus forms part of the existing environment. In terms of surface water quality and aquatic ecology features within the project area, Mr Greenaway also states that there are no surface water features within the construction footprint. He records those conclusions are based on Ms Pallard's assessment.

With respect to water quality, Mr Greenaway notes that no direct discharges of untreated water to the Balmoral irrigation race or the Hurunui River will occur, and all water will be discharged to land. In accordance with Ms Pallard's assessment (Pallard (2023)), the BWSF will be used for irrigation purposes through the irrigation race and will not be released to the Hurunui River. As such, Mr Greenaway opines that any effects on surface water quality related to construction or operation of the BWSF will be less than minor.

In terms of water availability for in-water recreation (which would occur on the Hurunui River), Mr Greenaway again highlights that any water used to fill the BWSF will be taken in accordance with existing resource consents associated with the Balmoral irrigation scheme. Regarding the additional 1.5m^3/s fish diversion flow, Mr Greenaway notes that this could affect the 2000m stretch of river downstream of the Balmoral scheme's diversion. However, due to the low level of use by kayakers and jet boaters in this reach of the river, Mr Greenaway concludes that the effects are less than minor and recommends that a 'no entry' sign be placed at the confluence of the diversion channel and the Hurunui River to prevent water users from entering the scheme. Further, Mr Greenaway's consultation with White Water New Zealand and Jet Boating New Zealand revealed little in the way of the potential for any effects on recreation activities on the Hurunui River. In assessing the potential effects on recreational hunting, Mr Greenaway states that hunting will not be permitted on the BWSF due to the need to protect the integrity of the reservoir liner and structure. He suggests that gamebird hunting on the waterbodies within the Hurunui catchment could suffer if the BWSF becomes a safe haven for waterfowl during the hunting season. Mr Greenaway recommends monitoring waterfowl numbers and implementing measures should nuisance level be reached to support hunting in other settings. Mr Greenaway notes that any deterring devices should be carried out in consultation with North Canterbury Fish & Game.

Based on the foregoing, Mr Greenaway concludes that construction of the storage facility will not adversely affect local and regional recreation and tourism values. Mr Greenaway states, based on the aquatic ecology assessment, that effects on water quality can be addressed through management options should they be required. Waterfowl numbers should be monitored to ensure that the BWSF does not become a haven for birds, and thereby the effects on gamebird hunting are able to be managed to the point where they are minimised. As such, it is concluded that the effects of the construction and operation of the BWSF will minor or less, and that positive effects on the Hurunui River sports fishery will arise.

6 CULTURAL EFFECTS

The Site of the BWSF is within the area of interest of Ngāi Tahu, Ngāi Tuahuriri Rūnanga, and Rūnanga o Kaikoura. To assess potential cultural effects and ensure they are appropriately managed, we have assessed the Proposal against effects highlighted as issues in the relevant Iwi Management Plans ('**IMP**').

Te Rūnanga o Ngāi Tahu Freshwater Policy

Te Rūnanga o Ngāi Tahu Freshwater Policy was published in 1999 and describes Ngāi Tahu's association with freshwater resources, the ways in which Ngāi Tahu wish to participate in freshwater management, and environmental outcomes sought.

Among the issues highlighted in the policy statement are effects on cultural values due anthropogenic modifications. In particular, abstractive activities can put pressure on water quantity. In addition, wetlands that were once rich in mahinga kai have, in the past, been drained for agricultural and horticultural purposes. However, the Proposal is not expected to have any effect wetlands, insofar as none will be drained to enable the construction and operation of the BWSF and no abstraction of water beyond what has already been consented is proposed (only an additional diversion is proposed for operation of the fish screen).

In addition to this, the policy statement identifies adverse effects on the diversity and abundance of mahinga kai resources and adverse on traditional harvesting activities as

particular issues. Overall, the Proposal is expected to have a positive effect on mahinga kai and traditional food gathering practices as there is the intention to install a fish screen that will be designed according to the most up-to-date scientific and engineering advice and the environmental flow limits that apply to AIC's take will be increased. This is, therefore, anticipated to ultimately have positive effects on the aquatic fauna of the Hurunui River and, therefore, positive effects for mahinga kai.

Mahaanui Iwi Management Plan ('MIMP')

Ngāi Tuahuriri Rūnanga is one of the six Rūnanga that make up Mahaanui Kurataio Limited, an iwi environmental management group. Mahaanui Kurataio published a manawhenua planning document, Mahaanui Iwi Management Plan, in 2013. Herein, we assess the Proposal against the issues and adverse effects identified in this IMP in order to evaluate any potential cultural effects that may arise from the proposed activities.

Firstly, the Mahaanui Iwi Management Plan recognises the potential for there to be increasing pressure on the Hurunui River and its cultural values due to water storage and irrigation proposals. Policy H3.1 of the plan requires the critical evaluation of the implications of any water storage proposal for the Hurunui River catchment, having particular regard to potential effects on outstanding characteristics associated with the river, as well as potential cultural and environmental effects.

The Hurunui River possesses characteristics that are considered to be outstanding for spiritual, cultural and environmental reasons. Amuri is cognisant of this and, therefore, commissioned Mr Brown to ensure potential effects on the river's outstanding characteristics will be appropriately managed. After undertaking a thorough assessment of amenity, natural landscape, natural character, and receiving environments and audiences, Mr Brown was able to conclude that the BWSF will generate less than minor adverse effects. In regard to potential effects on the Hurunui River, Mr Brown found that from two viewpoints, the Hurunui River was not visible and the BWSF therefore will have no impact on the natural character of the river from those locations. For the third viewpoint, Mr Brown found that the distance of the Hurunui River from the Site (1.2km), a strip of existing forestry, and a much wider band of farmland, provides a buffer between the river and the BWSF.

With regard to potential cultural and environmental effects, Policy WM9.4 provides guidance on the evaluation of the effects of water infrastructure:

"*To critically evaluate the cultural implications of any damming, on-farm storage, community water enhancement schemes, or water storage proposal that may have adverse effects on resources and values of importance to tāngata whenua, with particular regard to:*

a. *How the proposal aligns with Ngāi Tahu priorities for water use, as per Policy WM3.1;*
b. *Consistency with Ngāi Tahu initiatives to restore waterways and their mahinga kai values;*
c. *The nature and extent of transfer and mixing of waters between and within catchments;*
d. *The effects of increased water availability and subsequent land use change on surface and groundwater;*
e. *Measures to avoid non-point source pollution;*
f. *The effects on cultural landscape sites, features and values;*
g. *The effects on coastal ecosystems and processes, including hāpua;*
h. *The potential for loss of mahinga kai resources and opportunities (e.g., disruption of fish passage);*

i. *Interruption of continuity of flow Ki Uta Ki Tai; and*

j. *The cultural imperative to leave the natural environment, including waterways, in a better state for future generations than its current or inherited state.*"

Amuri is proposing a number of methods by which to manage potential adverse effects associated with the Proposal. These include:

- The installation of a new fish screen designed according to the most up to date scientific and engineering advice;
- Measures to manage water quality within the BWSF, thereby mitigating any downstream effects;
- An ecological betterment plan to offset any residual effects on terrestrial ecological values;
- Planting of buffers to minimise the visibility of the BWSF;
- The commissioning of an assessment of potential groundwater effects, which concluded that it is likely a net benefit will be achieved as a result of the dilution of contaminant concentrations across the wider aquifer system;
- A "Dam Safety Management System" has been developed to ensure human safety;
- Erosion and sediment controls have been proposed to mitigate any potential effects associated with the construction phase of the BWSF; and
- An increase in minimum flows.

It is also clear from the preceding sections of this AEE that potential effects can be managed effectively and be avoided, remedied, or mitigated and, where a residual effect remains, be offset. With regard to Policy WM9.4, the aspects that are the most relevant to the Proposal are potential effects on mahinga kai and fish passage, as well as the imperative to leave the natural environment in a better state. We are of the opinion that the proposed mitigation measures, especially the proposed fish screen upgrade and ecological betterment plan, have the potential mitigate these potential effects and could result in an overall net positive effect for the natural environment.

AIC accepts, however, that direct engagement Tangata Whenua is needed over the Proposal, its effects and the proposed remediation, minimisation and offsetting / ecological betterment proposals. The Company has sought to engage, and will continue to do so over both the BWSF and the replacement fish screen.

Te Poha o Tohu Raumati - Te Rūnanga o Kaikōura Management Plan ('TRoKEMP')

The TRoKEMP was published in 2005. It is an environmental management plan and a statement of values and policies in regard to natural resource management. Herein, we assess the Proposal against the issues identified in the TRoKEMP.

The TRoKEMP highlights a number of issues specific to the Hurunui River. Among them, are "Future water demands, and the ability of the river to support demand". We are of the opinion that the Proposal aligns well with addressing potential effects associated with water demands. Amuri is not proposing to take an increased volume of water above what is already authorised (an increased diversion is proposed, but the water diverted will be directed back to the Hurunui River at the proposed fish screen which is upstream of the point of take). The establishment of the BWSF is expected to enable a more efficient use of abstracted water in order to support increasing demand.

In addition, "Cumulative impacts of water takes on the natural character of the river" are identified as a key issue in regard to the Hurunui River, and Policy 3 of Section 3.5.14 is "To

ensure that the value of the Hurunui River as a cultural and natural landscape is recognised and provided for in management decisions throughout the catchment." Previous sections of this AEE have addressed potential effects on the outstanding natural landscape and character values of the Hurunui River. Mr Brown carried out an assessment of effects on amenity, natural character, natural landscape, and receiving environments and audiences. He was able to conclude that the BWSF will generate less than minor adverse effects. In regard to potential effects on the Hurunui River, Mr Brown found that from two viewpoints, the Hurunui River was not visible and the BWSF therefore will have no impact on the natural character of the river from these locations. For the third viewpoint used for the assessment, Mr Brown stated that the distance of the Hurunui River from the Site (which he records as being approximately 1.2km), a strip of existing forestry, and a much wider band of farmland provides a buffer between the river and the BWSF.

In conclusion, we have not identified any aspect of this Proposal that is inconsistent with the TRoKEMP.

Summary

While we have assessed the Proposal against the provisions of the relevant iwi planning documents, Amuri accepts that only Tangata Whenua can identify their associations with an area, and the cultural values that the area supports. Amuri also accepts that only Tangata Whenua can identify the nature and magnitude of any cultural effects that are associated with the Proposal. Given this, Amuri has begun engaging Ngati Kuri and Ngāi Tūāhuriri with a view of understanding the greater values that exist, the effects that could be generated by the Proposal, and the types of responses that could be advanced to address any adverse cultural effects. Amuri has confirmed that it is committed to working with Tangata Whenua to effectively resolve its concerns, and that it will be pursuing a net cultural benefit if that outcome can practicably be achieved. We will report back to the CRC once the consultation has advanced to a point whereby further meaningful information can be conveyed.

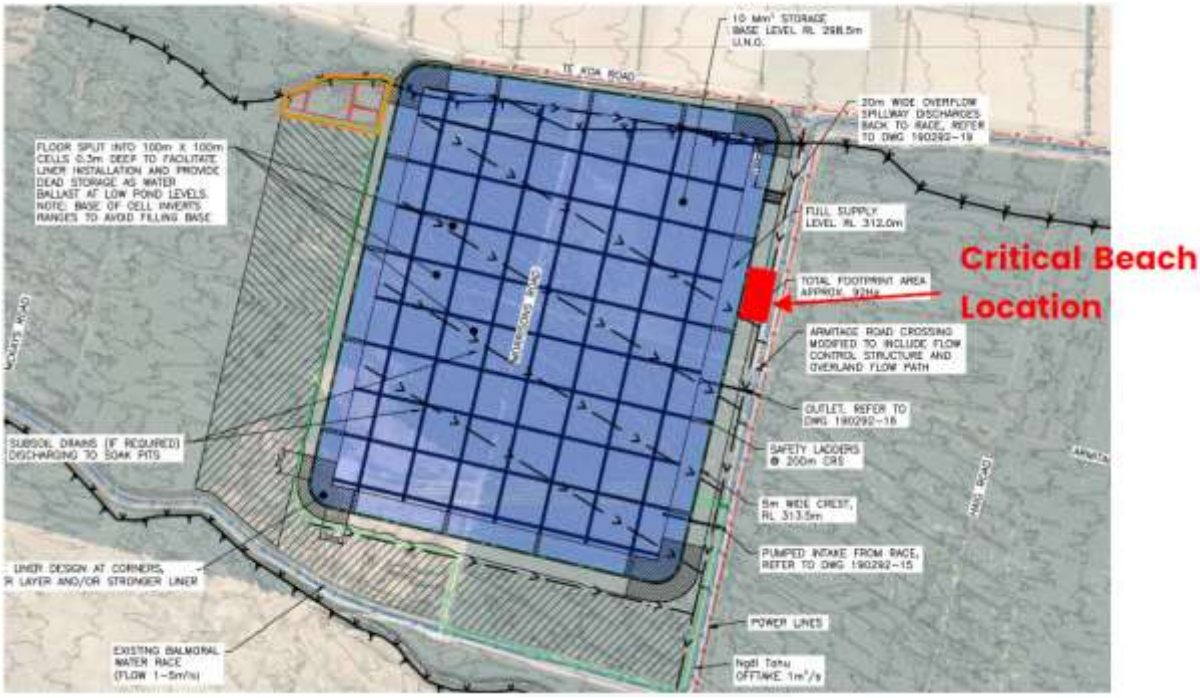
7. CIVIL EFFECTS

Large dams, like other pieces of major infrastructure (such as buildings and bridges) are designed on the basis that the higher the consequences of failure, the higher the design standards for the structure. This approach means that the level of risk associated with higher consequences of failure is kept at the same level as lower consequences of failure. Riley has undertaken a dam break, flood hazard consequence assessment and PIC for the BWSF to determine the potential effects of a breach should the BWSF fail. A full copy of the assessment is available on request.

7.1 Dam break, flood hazard consequence, and PIC

Using a computer model developed from a hydraulic modelling tool, a 'dam breach' location was selected, where dam height was close to maximum and a large portion of water would be directed east and north (that is towards populations at risk ('**PAR**'), and not directly south-east into the Hurunui River). The critical breach location that was chosen is shown in **Figure 5** below. The resulting water depths were estimated across the Canterbury plains and the Hurunui River using the hydraulic model so that the damage and population at risk could be estimated.

Figure 5: Critical breach location modelled for the BWSF.



In order to determine the PAR, Riley reviewed the aerial photography applying to the Site and the adjacent environs. Having done so, Riley identified 36 buildings that could be inundated by at least 0.5m of water should a breach occur at the BWSF. The review of the aerial photography also indicated that five of these buildings are likely to be inhabited houses, and the other 31 are an assortment of farm sheds, farm dumps, dairy sheds, concrete slabs, and water tanks. The houses inundated by at least 0.5m water depth are 540 Te Koa Road, 770 Balmoral Station Road, and three dwellings at 826 Balmoral Station Road, giving a PAR of 12.5. Riley also advises that vehicles travelling SH7 are at risk should a breach associated with the BWSF occur, with approximately 4,500m of SH7 potentially inundated. As such the vehicular PAR is 15. The flood hazard consequence assessment evaluated the potential damage level overall to be moderate to major, based on the modelled aspects and consequential damage levels detailed in **Table 1** below.

Table 1: Flood hazard consequence assessment damage levels

Aspect	Damage level
Residential houses	Moderate to major
Critical infrastructure	Moderate
Natural environment	Minimal
Community recovery time	Moderate

Riley have also calculated the PIC rating for the BWSF. Based on the modelled dam failure scenarios, the maximum assessed damage level was 'moderate to major'. A PAR ranging from 11 to 100 was calculated, and the potential loss of life was set at 'more than 10 people'. Given these findings, Riley advised that the PIC rating was 'high' (as detailed in **Table 2**).

Table 2 Determination of Potential Impact Classification for Balmoral Reservoir Sunny Day

Assessed Damage Level	Population at Risk			
	0	1 to 10	11 to 100	More than 100
Catastrophic	High potential impact	High	High	High
Major	Medium potential impact	Medium/High (see note 4)	High	High
Moderate	Low potential impact	Low/Medium/High (see notes 3, and 4)	Medium/High (see note 4)	Medium/High (see notes 2 and 4)
Minimal	Low potential impact	Low/Medium/High (see notes 1, 3, and 4)	Low/Medium/High (see notes 1, 3, and 4)	Low/Medium/High (see notes 1, 3, and 4)

Notes: 1. With a PAR of five or more people, it is unlikely that the potential impact will be low.

2. With a PAR of more than 100 people, it is unlikely that the potential impact will be medium.

3. Use a medium classification if it is highly likely that a life will be lost.

4. Use a high classification if it is highly likely that two or more lives will be lost.

The assessment has also considered alternative breach locations. Riley states that a breach from another location could induce downstream effects slightly different to what has been modelled from the critical breach location. A breach on the southern or western embankments would result in a larger proportion of water flow into the Hurunui River, and less on the floodplain. Damage or destruction to residential locations at Balmoral Station Road may still occur, however the velocity of water inundating SH7 would be lower, and the flow within the Hurunui River of up to 1300m^3/s is comparable to a 1 in 50-year annual exceedance probability (‘**AEP**’) flood event.

If a breach were to occur on the northern embankment, Riley advises that the breach height would be reduced by at least 5m, with a lower volume of water released from the breach. Inundation would occur at the southwestern property(s) at 618 Tekoa Road in addition to those properties inundated by the selected breach location. The depth and velocity of water inundating SH7 would be similar to the modelled critical breach location, and the inundated stretch of road would be the same, if not slightly shorter, when compared to the selected breach.

7.2 Balmoral storage safety management

In response to the scale of the BWSF and the resulting high PIC rating discussed in Section 8.7.1, plans and systems have been prepared by Riley to ensure that risks associated with the BWSF can be mitigated. The following measures are proposed in response safety management:

- An Emergency Action Plan (‘**EAP**’): the purpose of the EAP is to minimise the potential for Balmoral Storage failure by implementing both preventative and emergency actions should a potential safety emergency arise. If failure cannot be prevented, the purpose of the EAP is to limit the effects of the failure on people, property, and

the environment downstream of the BWSF. A draft copy of the EAP is available on request and the EAP will be updated as the project progresses with the feedback from relevant parties considered.

- A Dam Safety Management System ('**DSMS**'): the purpose of the system is to provide Amuri with a timetable to complete dam safety management activities. It also provides a risk-based decision-making framework for addressing dam safety issues should they arise. To implement the DSMS, a network of instruments, deformation survey marks and visual inspection points will be installed during construction to allow for performance monitoring once operational. Design of the network will be undertaken during the detailed design phase to allow for modification during construction, as necessary. The system will be robust and be able to be monitored by non-specialist personnel within AIC. A draft copy of the DSMS is also available on request and the DSMS will be revised prior to and following commissioning.

In addition to the safety management procedures that will be undertaken by AIC, a dam safety inspection by a suitably qualified and experienced dam engineer will be undertaken annually. A comprehensive dam safety review by an independent and suitably qualified expect will be undertaken every five years. The proposed safety inspection and review are consistent with recommendations in the NZSOLD guidelines.

Given the foregoing, we understand Riley's advice to be that any civil safety effects associated with the BWSF can be minimised to the point required by the applicable legislation, and to a level that they consider to be minor or less.

8. DUST EFFECTS

The potential for dust to be generated during the construction works, and its possible discharge off the Site has been considered by Riley. For the purposes of this Proposal, dust will be managed during construction phase works in accordance with a CMP, as detailed in Section 5.1 of this AEE. A preliminary CMP is available on request.

The Proposal will result in the excavation of up to 1.87Mm^3 (approximate) of land, and the stockpiling of 186,000m^3 of topsoil, and cut to fill of 1,654,500m^3. Areas will be stabilised as soon as practical, and stockpile areas will be managed so as reduce the potential for dust effects to occur. The works will occur within the construction footprint, which is not located in close proximity to dwellings, or sensitive areas.

The preliminary CMP includes the following dust management methods:

- Limit Site traffic speed to a level to reduce the production of dust into the atmosphere.
- Stabilised entrance at the entry/exit points of the Site with provision of a wheel wash facility. Wet suppression via water trucks and/or the inclusion of polymers can assist with stabilising accessways if required.
- Phasing of earthworks to isolate and/or reduce the area of exposed earthworks, including limiting earthwork activities in specific areas during periods of high wind.
- Minimise drop heights when loading and unloading vehicles.
- Limiting stockpile heights and sheltering them if necessary.
- Placement of mulch or granular fill over exposed surfaces as soon as practical.

It is also noted that stockpiled material has the potential to create dust nuisance. The following management methods area proposed to control dust from stockpiles:

- Protection or covered storage in sensitive locations.

- Reduced/controlling stockpile height and slopes (reduce wind entrainment).
- In the extreme event that remedial measures are found to be ineffective for the control of dust, works may be suspended as a precautionary measure until conditions are suitable for resumption.
- Stabilisation of stockpile areas away from the Site boundary.

Overall, Riley advises that with the proposed management methods in place, any adverse effects resulting from dust can be appropriately managed and any actual and potential effects minimised to the point that they are, at worst, minor in magnitude.

9. NOISE EFFECTS

Tthe preliminary CMP states that the contractor will manage noise emitted from the Site to comply with the limits specified in NZS 6803:1999 'Acoustics Construction Noise' as well as those specified in all permits, agreements, and authorisation for the works. The nearest dwelling is located to the south of the Site, on the lower terrace approximately 350m away. Other dwellings are located north, east, and west on the upper terrace above the Site at distances greater than 1.3km away.

The following management measures are proposed to minimise noise effects associated with the Proposal:

- A client representative will be available to respond to any noise complaints should they arise, with a procedure implemented to address complaints accordingly. The client representative details will be made available on the sign at the Site entrance; and
- Works will be limited to between the hours of 6am to 7pm Monday to Saturday. No work will be undertaken on Sunday's or public holidays.

Overall, we understand Riley's advice to be that with the proposed management measures in place, any adverse noise effects can be appropriately minimised to the point that they are, at worst, minor in magnitude.

10. TRAFFIC EFFECTS

Most traffic associated with the Proposal will be contained within the Site. Some traffic will, however and as we have already recorded, use the public road network.

The following management measures are proposed to reduce and minimise the traffic effects associated with the Proposal:

- Location of the access road in a practical location to minimise traffic nuisance,
- Traffic movements using the public road network will be scheduled to occur during 'business hours' (6am to 7pm Monday to Saturday) where practicable, and;
- The provision of sufficient parking within the Site to ensure that vehicles do not idle on roadsides.

Overall, we understand Riley's advice to be that with these measures in place, any traffic effects associated with Proposal can be managed in a manner that is appropriate to the roads that service the Site. In order words, we understand Riley's advice to be that any adverse effects that cannot be avoided, will be minimised to the point that they are, at worst, minor.

11. POSITIVE EFFECTS

The development of the BWSF will be a significant investment for Amuri, which is expected to contribute positively to both the Hurunui and Canterbury economies. The construction of the BWSF will benefit those organisations, and their suppliers, that are engaged to build the BWSF. While Amuri will only appoint a contractor(s) after it has completed a competitive tender process, it is reasonable to expect that several local entities will be engaged in the construction of the BWSF. This will benefit their social and economic wellbeing and is expected to generate economic multiplier benefits for the surrounding community.

In addition to the economic benefits associated with the efficiencies gained by the proposal, the Proposal will enable water to be stored for use when it is required. In that regard, the Proposal will provide for storage for AIC shareholders, which allows the environmental flows in the Hurunui and Waiau Uwha Rivers to be increased to the flows set in the HWRRP without any significant reduction in reliability of supply.

This will, in turn, contribute to people and communities providing for their economic and social wellbeing, thereby, enabling a lawfully established abstraction of water to become even more efficient than it already is. The development of the BWSF for irrigation purposes is considered to be regionally significant infrastructure.

As discussed in the preceding sections, Ms Godfrey is of the opinion that the construction and operation of the BWSF will result in less than minor effects on terrestrial ecological values with lizard salvage, and the establishment of a habitat restoration area. Both mitigations will increase the quality of habitat for lizard and avifauna species, and both improve and reintroduce indigenous biodiversity back to the Site and surrounds. This, we understand, results in a net terrestrial ecological benefit.

Ms Pallard has concluded that the impact of the construction and operation of the BWSF will be less than minor on aquatic ecology. When carried out in combination with the construction and operation of a new, high quality fish screen, and increased environmental minimum flows, as is proposed here, she is of the opinion that the overall outcome of the project for aquatic ecology will be positive.

12. CONCLUSION: EFFECTS

Amuri has engaged the services of a number of respected experts to assess the potential effects of the BWSF and the replacement fish screen and then, as necessary, to recommend measures to mitigate the Proposal's potential ecological, hydrogeological, natural character and landscape, recreation, and civil safety effects. In each instance, the technical assessments have concluded that the potential effects of the Proposal are able to be appropriately addressed, subject to specific management measures / methods. The great majority of the technical assessments conclude that the adverse effects are less than minor in magnitude. Some technical assessments consider with management measures in place, effects will be minimised to the point where they are, at worst, minor. **Importantly, no 'more than minor effects' are predicted**. The recommended management measures include:

- The development of a finalised CMP, incorporating an ESCP, followed by the installation of erosion and sediment control devices surrounding and within the work areas;

- Limiting construction activities to the identified footprint only;
- Lizard salvage prior to construction works, and the establishment of a lizard habitat restoration area;
- The stabilisation and re-establishment of vegetation following the completion of the construction activities;
- Measures to control sediment, capture runoff, and prevent discharges of uncontrolled suspended sediment into waterways; and
- Monitoring for adverse water quality effects and taking responsive actions should it be needed; and

In addition to these management measures, NIWA has provided a list of recommendations for the replacement of the fish screen. These recommendations are as follows:

- The existing water diversion, on a side braid of the Hurunui River, is the most appropriate location for the diversion;
- An average approach velocity of ≤0.12 m/s, measured in front of the screen;
- A sweep velocity several times greater than the approach velocity;
- The fish bypass is expected to be easily locatable for all screened fish species. The water velocity will be increasing as screened fish get closer to the bypass to reduce the likelihood they remain in the sediment pond;
- Retaining the existing bypass channel is appropriate if it is maintained, as proposed, to preserve the current channel slope. This maintenance should ensure slow velocity, pool habitats do not develop over time whilst aiming to retain high channel shading;
- A screen aperture ≤2 mm;
- A barrier to upstream migration into the bypass channel (e.g., concrete weir, perched culvert, etc.) is necessary and should be located as close to the confluence with the mainstem river as practicable;
- When the scheme is shut-down a fish salvage along the length of the bypass should be undertaken to capture and relocate fish that are present; and
- A regular maintenance programme for the new intake/screen.

Amuri considers these approaches as appropriate. A number of positive effects are also anticipated. While they are not determinative in their own right, they do, in our opinion, weigh in favour of the BWSF. Importantly, a net ecological gain is expected should the BWSF and proposed replacement fish screen are advanced in the proposed manner.

TECHNICAL REPORTS AND PLANS:

Report	Who
Balmoral Pond Infrastructure Development Plan	Amuri
Landscape & Natural Character Effects Assessment Balmoral Pond	Brown – Stephen Brown
Aquatic Ecology Impact Assessment: Proposed Balmoral Water Storage Facility	Enspire – Jacquie Pallard
Amuri Irrigation Limited: Balmoral Water Storage Facility Hydrogeological Assessment	LWP – Brydon Hughes
Fish-related design requirements for upgrading water diversion infrastructure on the Hurunui River	NIWA – Phillip Jellyman
Balmoral Water Storage Facility Recreation Assessment	RG&A - Rob Greenaway

Preliminary Design Report Balmoral Water Storage Facility, North Canterbury	Riley
Fish Screen Option Report	Riley – Paul Morgan
Balmoral Pond Fish Screen Concept	Riley – Paul Morgan
Preliminary Construction Methodology Plan Balmoral Water Storage Facility North Canterbury	Riley
Preliminary Dam Safety Management System Balmoral Water Storage Facility North Canterbury	Riley
Preliminary Emergency Action Plan Balmoral Water Storage Facility North Canterbury	Riley
Dam-break and potential impact classification balmoral pond north canterbury	Riley
Geotechnical Investigation Report Balmoral Pond North Canterbury	Riley
Assessment of Terrestrial Ecological Effects, Balmoral Water Storage Facility	Tipu – Paula Godfrey