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28 August 2025

Attention: Brad Henderson

Dear Brad

Haldon Solar Project – Assessment of Effects in relation to Flood Risk

1 Introduction

This document summarises Beca's assessment of potential and actual effects in relation to flood risk, associated with the proposed Haldon Solar Project. This assessment is based on the work reported in:

- Beca (2024) Haldon Solar Farm – Flood Risk Assessment. Revision 2. *and*
- Beca (2024) Grid Injection Point for Haldon Solar Farm – Flood Risk Assessment.

The above reports detail the work we have completed to define the flood risk posed to the site and provide the basis for designing a flood resilient solar project. These reports also detail the flood modelling which underpins the assessments.

Provided below is an assessment of proposed and actual effects as a result of the Haldon Solar Project. This assessment is underpinned by the same flood modelling.

2 Assessment of Effects

2.1 Definition of surrounding environment

The project site is located adjacent to Lake Benmore (Figure 1). The area comprises gently sloping glacial and alluvial deposits (gravel) which, to the northwest of the site, appear to have been partially reworked by the Tekapo River, prior to its damming at Lake Tekapo.

The surroundings to the site can be summarised as follows:

- To the **northeast** the gently sloping gravels continue to rise towards Grays Hills. This area is upslope of the site.
- To the **southeast** the site is bordered by Mt Maggie, which rises to 524m, approximately 150m above the site.
- To the **south** the site is bordered by a short section of river valley created by Stoney River. The lower part of this valley appears to be used for grazing.

- To the **southwest** Lake Benmore bounds the site.
- To the **northwest** Lake Benmore bounds most of the boundary, with a short section of river valley created by Tekapo River bounding the remainder. The river sits around 9m below the terrace upon which the site sits. Haldon Arm Campground sits on the river valley floor in this location.

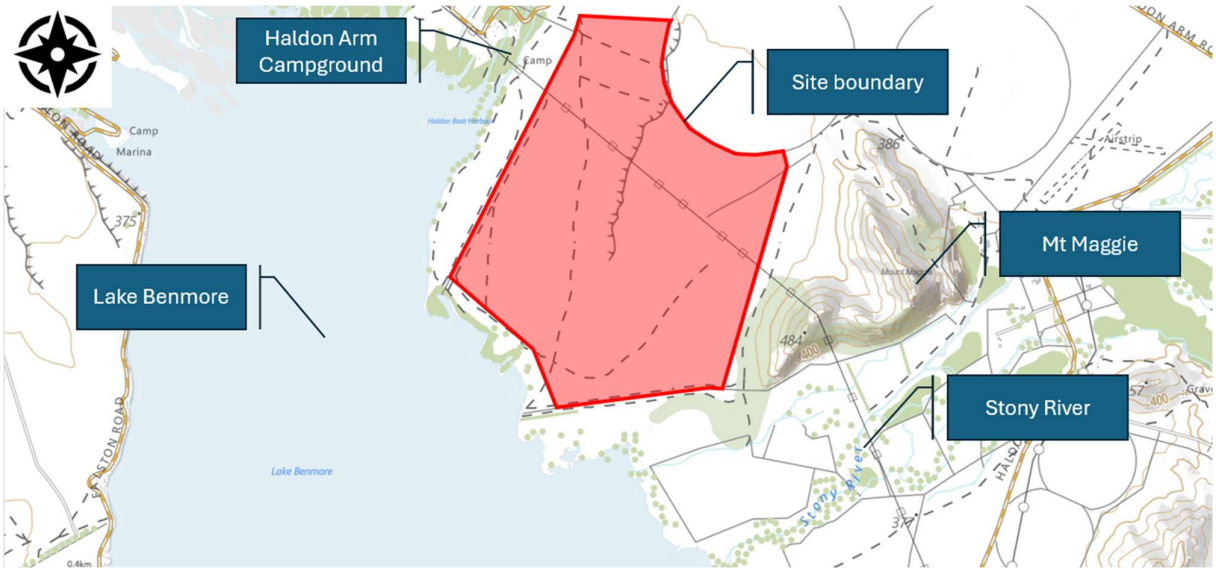

Figure 1 Surrounding environment

2.2 Pre-development flood hazard

Currently, inundation of the site is confined to overland flow paths which cross the site from north to south (Figure 2). These flow paths contain runoff generated by land to the north of the site and they convey this runoff through the site.

The site and surrounding area are underlain by glacial and river deposits, generally well-draining gravels. Significant rainfall is required to saturate the land before runoff can occur, and as a conservative assessment we have assumed this pre-saturation of the ground in the assessment. The inundation extent and water depths shown on Figure 2 therefore represent maximums in the 100-year ARI event.

The direction of flow in the overland flow channels is dictated by the slope of the land, which is from the north-northeast to south-southwest. This slope carries overland flow directly to the lake, with the exception of one overland flow path which discharges into the lower reach of Stony Creek prior to reaching the lake.

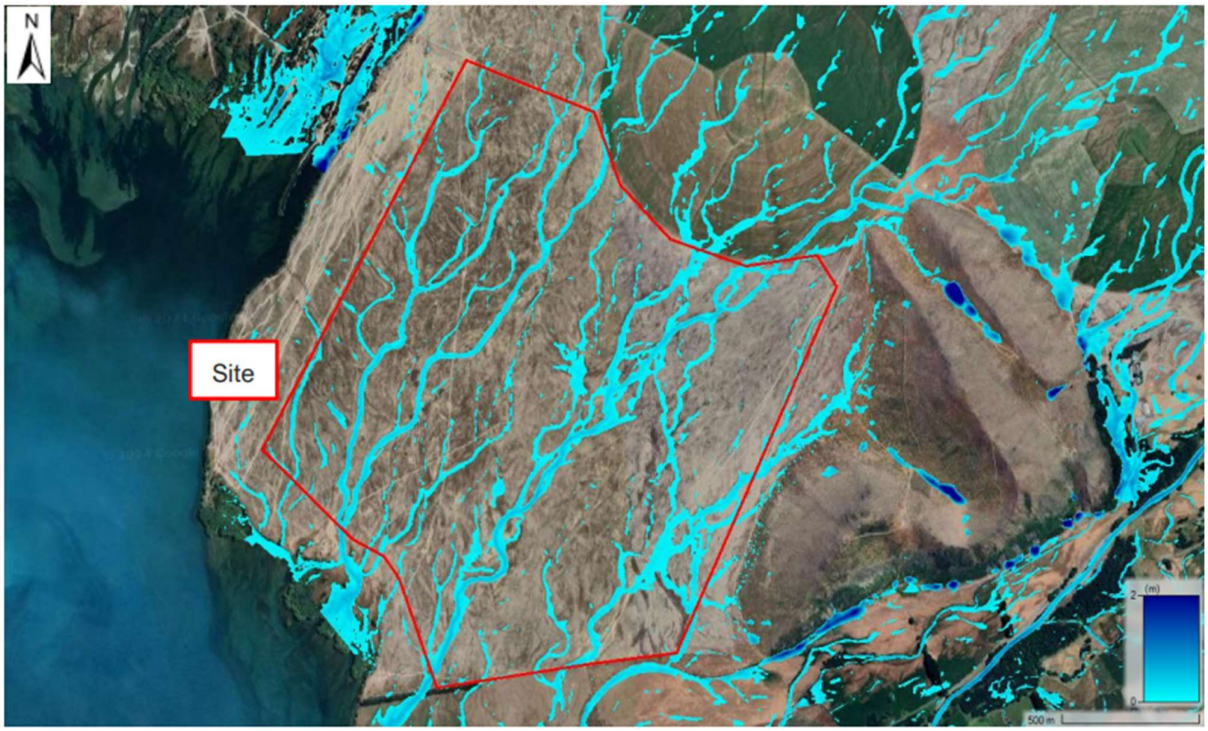

Figure 2 100-year ARI (RCP8.5 2060) inundation extent

2.3 Assessment of effects, by project component

The main components of the Solar Project (Figure 3) are solar panels, power stations, unsealed access tracks, a Grid Injection Point (substation) on an elevated platform, and a permitter security fence. The potential or actual effects of the project components are listed below (Table 1).

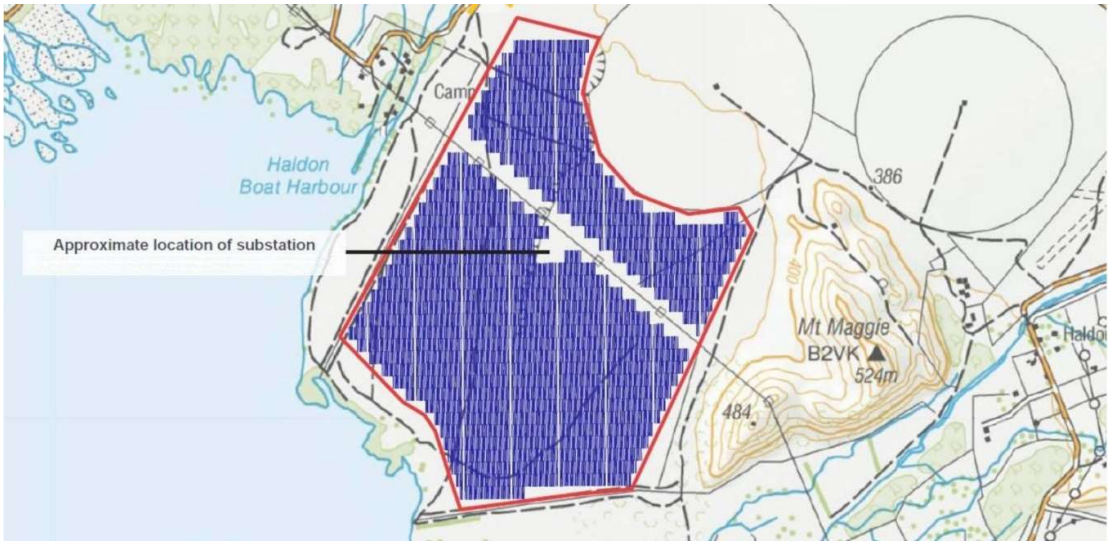

Figure 3 Site layout

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Table 1 Assessment of Effects, by project component

Component	Assessment of effects	Outcome
Solar array	Whilst the solar panels cause temporary interception of rainfall, rainfall ultimately has access to the same surface area below the panels and so rainfall will infiltrate into the ground, as it would do without the panels present. The well-draining nature of the site limits the production of surface runoff. No net increase in runoff is expected, and the piles supporting the array would not impact the direction or speed of overland flow.	No effects are anticipated.
Power stations	Power stations (equivalent to 20-foot shipping containers) will be positioned in areas not affected by overland flow. If these areas cannot be avoided the power stations would be located on elevated platforms (piled) to keep them above the overland flow paths.	No effects anticipated.
Internal roads	Internal roads will be constructed at grade with the surrounding land, and will be unsealed. Where internal roads cross overland flow paths this will be achieved using formal/informal fords, or culverts where the flow path is deep. This will mitigate any potential blockage of flow paths the roads may otherwise present. The overland flow paths typically dry so this will not impact operational access around the site.	Minor realignment of flow paths within site possible. No effects beyond the boundary are anticipated.
Grid Injection Point (substation)	The platform for the substation may require earthworks to elevate it above surrounding water levels. The platform area has been positioned between main overland flow paths so as to minimise the impact on flows. Given the central location of the substation any minor effects would be unlikely to propagate to, or beyond, the boundary. Onsite effects can be mitigated with small diversion drains around the platform.	Minor realignment of flow paths within site possible. No effects beyond the boundary are anticipated.
Perimeter security fence	A security fence is required to protect the site from unauthorised access. Where the fence crosses overland flow paths which enter the site from the north there is a risk that blockage of the fence may divert flow. We have assessed that there are no notable sources of debris in the catchment. Any debris mobilised by overland flow paths would be limited to small pieces of grass and shrub. Blockages are therefore likely to be small in extent, and limited in occurrence. Such blockages would have little impact on the overland flow paths which cross the site boundary	Blockage of the security fence by sufficient debris to impact flow paths in unlikely and therefore effects are not anticipated.

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2.4 Assessment of effects – whole site

Table 1 demonstrates that the individual components of the Solar Project do not present a risk of flooding outside the site boundary. We have assessed these components together at a whole-project level to confirm that adverse effects are not caused at the project-level.

We have not identified any adverse effects at a project level that would not be mitigated by the component-level mitigations proposed. In summary our findings are:

- Runoff from the site would not be changed by the development, neither in terms of the point at which it leaves the site boundary, or the rate at which it leaves the site boundary.
- In addition to this there are no sensitive receptors which would be impacted should any unidentified changes to flood risk occur. This can be summarised as follows:
    - Land to the north of the site is uphill, and so would not be impacted.
    - Land to the west (Haldon Arm Campground) is separated from the site by a highpoint in the landscape, with site runoff flowing away from the campground. The campground is therefore not likely to be impacted.
    - Land to east comprises Mt Maggie and so would not be impacted.
    - To the south is Lake Benmore which would be unaffected. Also to the south is Stoney River, which flows directly into Lake Benmore. Again, there are no unanticipated effects which would impact this feature.

Several onsite mitigations are proposed to manage onsite risks, and to minimise the likelihood of changes to flow paths off the site:

- Diversion drains around the substation, and positioning of the substation on high ground.
- Informal or formal fords, or culverts, where internal roads cross overland flow paths.
- Positioning of power stations on high ground, or on elevated platforms.

3 Conclusions

The work we have undertaken shows that the development of Haldon Solar Project is not likely to increase the flood risk beyond the boundary of the site. Within the site boundary flood risk relates to three main overland flow paths which cross the site from the north to the south. All site equipment can be positioned so as not to be impacted by these flow paths; either by raising panels above the predicted water levels, or by positioning items such as inverters on high ground between the main overland flow paths.

The project does not propose to change the topography of the site, and generally the solar farm infrastructure (roads, panel arrays) will follow the existing land profile. This means that the development of the project would be unlikely to change the location or scale of current overland flow paths across the site.

The exception to this general statement is the Grid Injection Point (GIP or substation) which may require the construction of a raised platform to set the substation equipment above Transpower's design standard of the 450-year ARI event. The platform has been proposed on a highpoint between the main overland flow paths

and should not interrupt the flow along these main flow paths. Should any minor flow paths be interrupted by the required platform then these will be diverted around the earthworks and be discharged into their existing flow path. Given the GIP's central location within the site the limited diversion of minor flow paths would not have an impact on the scale or location of overland flow leaving the site boundary.

The Haldon Arm Campground is the only nearby receptor that may be sensitive to changes in flood risk. The campground is set adjacent to the site, to the west. All runoff from the solar project site runs away from the campground to the south and east, with the terrace lip that separates the campground from the solar project being a high point in the landscape. As such runoff from the solar project will not impact the campground.

Yours sincerely,

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on behalf of

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