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Subject: Gordon Road Spillway – Engineering’s Response to Key Issues

This memorandum sets out a high-level response from the ORC’s Engineering team to the issues raised in the submissions in respect of the Gordon Road Spillway Consultation. The detail in respect of these issues is largely derived from the affidavits in support of the application to undertake this consultation, and links to various documents are attached at the rear of this memorandum.

The memorandum covers the capacity and maintenance of flood protection infrastructure in the immediate vicinity of the Spillway.

Relationship of Spillway to Lower Taieri Flood Protection Scheme

The Gordon Road Spillway forms a part of the Lower Taieri Flood Protection Scheme and directs water towards the Upper Pond. The description below provides context as to how the two areas are interrelated.

The Notice of Requirement for the Lower Taieri Flood Protection Scheme (dated August 2015) provides useful context as to how the Scheme operates. This Scheme provides flood protection to an area of approximately 18,000 ha of the Taieri Plain and provides important protection to what is predominantly a farming area, along with the townships of Mosgiel, Outram, Momona, and the Dunedin Airport. The land is very low-lying, with some West Taieri farmland being slightly below mean sea level. Dunedin Airport is about one metre above sea level, and Mosgiel some 15m above sea level. Figure 1 provides an overview of the Scheme.

The Scheme provides varying standards of protection with the primary focus on the main flood hazard; the Taieri River. Flood detention is a key component of mitigating the effects of a major Taieri River flood, with the upper pond (initially) and then the lower pond (when the floodbanked conveyance is close to maximum) used to temporarily store floodwater. However the Scheme also mitigates, to varying degrees, flood hazards associated with the Silver Stream, Mill Creek, Owhiro Stream, run off from the Maungatua Range by the Contour Channel (also referred to as the West Taieri Contour Channel), the Waipori River and the Meggatburn. Each of these tributaries to the Taieri River also has a number of tributaries that could also influence (in a localised manner) the Taieri Plain flood hazard.

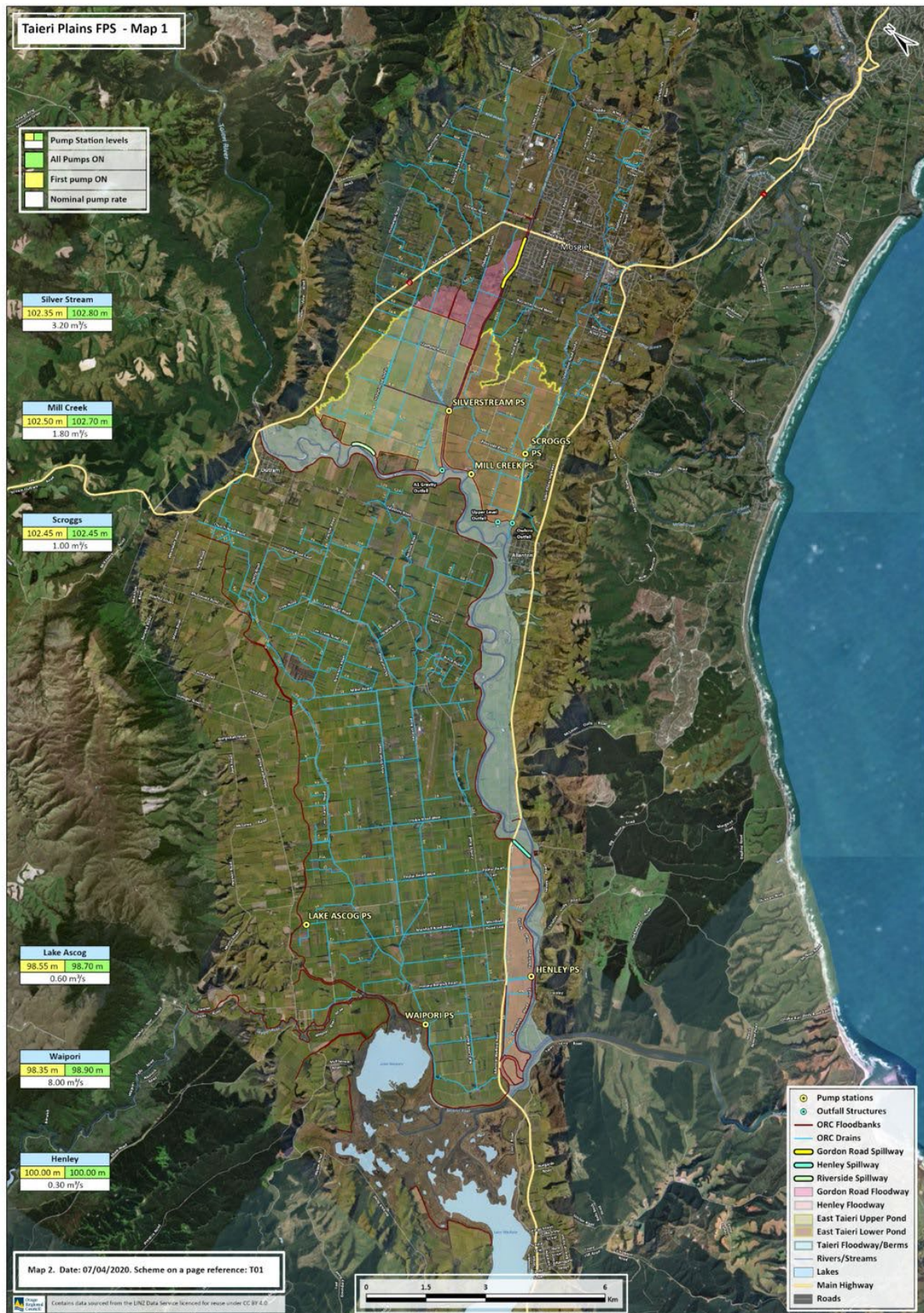


Figure 1: Map of the Lower Taieri Flood Protection Scheme

Within the Scheme there are four principal floodways, most notably including the Silver Stream Floodway and the Gordon Road Floodway. The Silver Stream consists of a channelised and a flood

banked section of the Silver Stream from just upstream of Peter Johnstone Park to the confluence with the Taieri River. The Gordon Road Floodway consists of land on the true right of Silver Stream which receives spill from the Gordon Road Spillway. The spill travels overland, accumulating in the Upper Pond via culverts through the cut off bank.

The Silver Stream right floodbank downstream of the Gordon Road bridge has been constructed with a crest lower than the adjoining left bank crest, giving preferential protection to Mosgiel. The standards of protection provided to each side were considered to be appropriate to the intended land use i.e. urban area to the left and rural land to the right.

The Silver Stream also has a direct link with the Upper Pond via a lowered section of right floodbank crest.

Capacity and performance of the Silver Stream

The Silver Stream catchment is prone to high intensity rainfall in steep catchments, which in turn generate a high level of flooding and/or increased levels in a short duration. As a result the reliable forecasting of imminent overflow (along with expected duration and peak flow) is problematic.

BBO has prepared a report, Hydraulic Support for Silver Stream and Gordon Road Floodway Modelling (the 'Modelling Report'), which is available to submitters on the DCC's Gordon Road Consultation webpage. The report undertook a flood hazard assessment to determine how North Taieri/Gordon Road floodway is impacted in flood events using the Taieri hydraulic model previously completed by ORC, with a specific focus on the area between the cut-off banks and State Highway 87. The assessment was carried out for July 2017 and 100-yr ARI events.

The modelling confirms that the overtopping of the true right bank of Silver Stream below the Gordon Road bridge (also known as Gordon Road Spillway) is the primary contributor to flooding of North Taieri/Gordon Road floodway area. For July 2017 event the depth of flood prone water is expected to range between less than 0.5m to almost 3m, while for 100-yr ARI event the flood depth is expected to range between less than 0.5m to more than 3m. For both events the velocity is expected to range between 0.5 to 1 m/s in the floodplain. To provide some background, in reality once overtopping starts it occurs as water moving through the grass and doesn't become a larger and deeper flow until a higher flow than the threshold is exceeded. That is, the current actual threshold is more like a (narrow) range of flows rather than a single precise flow.

T and T¹ has undertaken a peer review of the Modelling Report (as available to submitters on the DCC's Gordon Road Consultation webpage), which has identified that:

Based on comparison of simulated water levels and historical flood data presented in the report we consider that the model is an appropriate tool for modelling the flood hazard in the North Taieri/Gordon Road floodway.

- *Modelled flood levels are consistent with available historical monitoring data, and thus presuming that the ground survey data are accurate the flood depths will have been*

¹ https://www.dunedin.govt.nz/__data/assets/pdf_file/0003/928551/1001453.Silver-Stream-Modelling-Review.09122022.pdf

appropriately determined. While there are no available data regarding historical flood plain velocities, it is reasonable to assume that the derivative velocities are a reasonable representation of the values to be expected for the events modelled.

- *We note that the model is reliant on accurate ground survey data, that is representative at the time of the historical events modelled and the future events investigated. This is also the case for land use and ground cover assumed in the modelling scenarios.*
- *The flood hazard is dependent also on the integrity of the hydraulic controls in the system at the time of the extreme events, i.e. the flood control assets in the system such as stopbanks, spillways, etc and assuming that they will function as designed without failure*
- *The principal hydrological scenario modelled (i.e. 100 year ARI event) is consistent with the design standard for the Silver Stream flood control scheme, noting that flow over the spillway can be expected to commence at a much smaller recurrence interval - maybe between 2 year and 5 years frequency based on modelling results.*
- *As noted above, the flood hazard modelling to inform planning could also consider:*
 - *Likely effects of climate change on design flows*
 - *Possible uncertainty in terms of statistical flow frequency estimates.*
 - *And also, acceptable event frequency and risk in terms of planning for safe and sustainable communities in the future.*

The affidavit of Michelle Mifflin sets out considerations associated with the Gordon Road Spillway, as follows:

7. *The spillway is on the true right bank of the Silver Stream immediately downstream of the Gordon Road bridge at Mosgiel.*
8. *Approximately 700 metres of the true right bank is lower than the left bank.*
9. *The purpose of the spillway is to allow water to spill preferentially to the true right when the Silver Stream is in flood to ensure that the area of Mosgiel on the true left is unlikely to be flooded by the river.*
10. *Water begins to flow over the spillway when flows at the Gordon Road spillway exceed approximately 120-130 cumecs.*
11. *The channel just upstream of the Gordon Road Bridge is designed to carry approximately 340 cumecs and approximately 176 cumecs downstream of the Gordon Road bridge. Up to approximately 164 cumecs can spill into the Gordon Road Floodway.*
12. *Water spilt over the spillway generally flows overland from the spillway towards the cut-off bank as indicated by Exhibit A.*
13. *The floodway comprises of a mix of rural land, residential properties and roads.*
14. *The cut-off bank is the eastern margin of the "Upper Pond" a holding area for floodwater from the Taieri River. There are culverts through the cut-off bank to the Upper Pond.*
15. *However if there is sufficient water in the Upper Pond, the flap gates on the culverts will close preventing flood waters from the Floodway entering the pond.*

16. *Consequently, water from the Silver Stream will form a pond behind the cut-off bank, which results in some properties being rural-residential, located between Dukes Road South, Riccarton Road West and the Silverstream being flooded.*

Maintenance of the Silver Stream

The ORC's Long-Term Plan (the LTP) also details various key projects, including Gordon Road and Silver Stream improvements in 2022-24 which primarily seek to address scheme performance and growth and development. The projects reflect continued programmes of work and projects resulting from investigation and detailed design work and projects set out in the infrastructure strategy. The projects reflect a focus on on-going repairs to critical assets and the development of infrastructural renewals or upgrades because of identified issues for detailed design for solutions. Projects will be subject to community consultation and funding models where significant expenditure is signalled. Significant feedback has been received in respect of the 2023-24 Annual Plan regarding the maintenance of the Silver Stream.

The maintenance activities that occur in the East Taieri Drainage Scheme and the Lower Taieri Flood Protection Scheme which incorporates the Silver Stream include but are not limited to;

- Visual inspections of the floodbank network and associated infrastructure (integrity of the network);
- Outfall and Culvert inspections and maintenance;
- Pump station operation, inspections and maintenance;
- Observation of aggradation/erosion (channel condition and bed level);
- "Bridge Inspections";
- Pest plant and animal control of the floodbank network;
- Pest plant and drain invert spraying;
- Willow and pest plant control where flood carrying capacity is being limited;
- Fertilising of the floodbank network;
- Defect Repairs to the floodbank network; and
- Undertaking bank protection works (where the floodbank network is at risk).

Note that the NoR provides a summary of the sort of activities that might occur within the Schemes, at section 3.8. While those activities may occur, the list above is specific to the maintenance works that have occurred in accordance with appropriate Scheme Operation and Maintenance Manuals.

Management of the Silver Stream

Michelle Mifflin's advice in respect of the management approach for the floodway, spillway and the drainage network in the vicinity is contained in her affidavit as follows:

17. *Properties in the floodway area will flood when the spillway operates if there are prolonged heavy rain events of the Upper Pond and M4 drain is at capacity. The M4 drain is part of the ORC's scheduled drainage network. The drainage network consists of a combination of modified natural watercourses and artificial watercourses. The M4 is an artificial watercourse within the drainage network.*
18. *The operational philosophy of the drainage network is to provide efficient and effective land drainage to the East Taieri area. The M4 drains surface and substrate water towards the Silver Stream Pump Station. Refer to Exhibit B for the location of this drainage network.*
19. *Once the Silver Stream spillway starts spilling water, the cut-off bank restricts the movement of overland flows from the spillway into the Upper Pond. There is no mechanical infrastructure used in or associated with the operation of the floodway or spillway.*
20. *ORC provides specific flood alerts to some residents as set out in the Flood Procedures Manual.*
21. *In addition, ORC's webpages provide near real-time rainfall and flow data associated with the Silver Stream catchment. There is a Gordon Rod spillway residents group. Its members know the specific webpages to monitor during rainfall events.*
22. *Members also express concern about flooding and have made suggestions for activities which ORC can undertake to reduce the impact of the spillway operating, such as gravel extraction from or deepening of the Silver Stream.*
23. *An investigation by the ORC was carried out in 2010 to identify options to reduce the flooding hazard in on the East Taieri Plain, including in the Gordon Road Spillway. The results of the investigation report were presented to ORC Engineering and Hazards Committee on April 2010.*
24. *The investigation concluded that the preferred approach to additional flood mitigation consists primarily of small-scale, physical works supported by land-use planning and control measures. Large-scale structural works are not preferred for mitigating flood hazard to the north side of the Silver Stream (including the Gordon Road floodway area), due to the difficulty in adequately mitigating all sources of flood risk in this area, and the high cost.*

[Note: the reference at paragraph 19 above to the Silver Stream Spillway should refer to the Gordon Road Spillway]

Significant issue 6 of the Infrastructure Strategy (attached to the ORC's LTP) also deals with management issues, as shown in Figure 2 below.

Significant Issue No.6: Growth and Development



Why is it an issue?

In April 2017 changes were made to the RMA (Section 6) highlighting the increasing level of natural hazard risk and the need to ensure growth and development does not increase these risks and associated costs. While household projections for Dunedin City are estimated to decelerate, some growth is proposed in areas of high or increasing natural risk, and there is a need for information to be available to assist in decision-making and managing community expectations. For example, intensification of urban development along the right bank of the Silver Stream and some sections of the Owhiro Stream are likely to affect the runoff to, and consequently design capacity of East Taieri and Lower Taieri Schemes. Furthermore, this rising urban development is changing the public's expectations on the levels of service that should be provided.

Over the longer term there is potential to see some acceleration of land use change outside of urban areas, placing additional pressures on the flood protection and drainage services to provide protection. A better understanding is needed of the likely distribution of this growth and what additional demands this will likely place on flood management services.

Council's preferred approach to manage this issue

The preferred approach is to **maintain current practice but consider innovative approaches to addressing population growth/decline and manage demand through land use controls**. Collaboration with territorial authorities will need to continue to effectively mitigate the impact of increased runoff through land use change and development. This will include identifying areas of potential risk and may also include opportunities for innovative approaches to managing the impacts of development. There is an ongoing need to ensure sufficient information is available to assist in informing where there may be risks associated with development. Subject to further discussion and agreement with the relevant territorial authorities, Council aspires to take an integrated, multi-agency approach to land use planning.

In addition to this ORC will look to better understand what impact a failure of its assets and levels of service will have on other key infrastructure in the immediate and wider region. While ORC understands what other infrastructure surrounds its own assets, work is required to develop a sound understanding of the strategic importance that these hold socially and economically and how the performance of ORC schemes/assets may directly or indirectly affect their function.

The following options were considered in relation to this significant issue. It is noted that Council's preferred approach adopt a combination of these options.

Maintain current practice	Reactive response to demand as a result of development	Integrated multi-agency approach
Utilise existing planning controls to mitigate impact of development. Growth and development trends are monitored and forecasts incorporated into forward work programmes.	Levels of service will be increased to the current 100-year design level of protection (or standard otherwise agreed with the community). Climate change will not be allowed for.	Work with territorial authorities to take an integrated and multi-agency approach to land use planning and District Plan review.
The implications of this option are: • Similar levels of expenditure • Some reduced risks	The implications of this option are: • Increased capital/operational costs. • Difficult to forecast costs • Increased risks	The implications of this option are: • Multi-agency collaboration • Financial sustainability for schemes

Figure 2: Significant Issue 6

Matters raised in submissions

Submissions lodged in respect of this matter raise a number of recurring themes. Engineering's response to these themes is set out below:

Spillway not operating as originally designed (aggradation of the Silver Stream)

We understand this to mean "as originally constructed" in this instance.

The ORC prepared a draft report in 2019 regarding the capacity of the Silver Stream and the operation of the Spillway.

It is relevant to note that the original construction plans (circa 1972-73) may not reflect what has actually been constructed at the Silver Stream Floodway. The plans held by the Council are the original design plans, however there are no as built drawings held. Accordingly, any difference between the current threshold of operation and the threshold as originally constructed is not necessarily linked with reduced channel capacity due to bed aggradation.

The 2019 investigation of the capacity of the Silver Stream channel and the operation of the spillway was to inform the broader investigation of the Lower Taieri Flood Protection Scheme performance which is currently underway. As such the 2019 report was never formalised or considered by the Council. Notwithstanding this, the report has highlighted a number of matters that may require consideration to determine whether they impact on the operation of the Gordon Road Floodway. These matters include any gravel aggradation and any areas of the Spillway that may require levelling. The Council is presently scoping these matters for inclusion in the next Long Term Plan; the funding that has been included in the current LTP will be used for the completion of this scoping and may also allow some low cost works to be undertaken. It is intended that this work will be undertaken this Summer (subject to resource consenting), and work will continue over successive years to restore appropriate capacity.

It is key to note that regardless of any remediation or on-going maintenance work carried out within the Silver Stream channel and/or ORC scheduled drains, the area is designed to act as a floodway. The floodbank has a feature of a natural (non-mechanical controlled) spillway which is designed to spill water into the floodway under weather circumstances. It is on this basis that the prohibition of natural hazards sensitive activities within the area is sought.

Floodway infrastructure issues (undersized culvert, M3 and M4 pipe capacity, maintenance issues, height of roads acting as a barrier etc)

The M3 and M4 drains are shown in Figure 3 below.

The section above (Maintenance of the Silver Stream) sets out the typical maintenance activities that occur in the East Taieri Drainage Scheme and the Lower Taieri Flood Protection Scheme on a routine basis. These maintenance activities are appropriate to ensure the continued effectiveness of the flood protection scheme, including the Silver Stream Floodway. In terms of concerns with the drainage network including infrastructure adequacy (size of culverts), the drainage scheme is designed to a rural standard, meaning it is for land drainage purposes, not storm drainage.

The ORC initiated a preliminary assessment of Drains M3 and M4 in 2019. This was not intended to be a comprehensive review of the drainage system. It provided preliminary recommendations based around 1D hydraulic modelling which suggested minor constrictions and some improvements that could be undertaken to structures within these Drains.

ORC, Engineering is looking to develop a comprehensive modelling of its drainage network in future years (future LTP), which will assist in identifying pressure points in the scheme, including the preliminary recommendations in the 2019 assessments.



Figure 3: Map of the area showing Drain Names (source: Flood Protection Management Bylaw). Pink shading denotes Gordon Road Floodway, blue shading denotes Excavation Sensitive Areas.

Bund proposal in 2012/2022 ORC Draft Long-Term Plan

A concept project was included in the Draft 2012/2022 LTP regarding the establishment of a bund within the Floodway area. Internal conceptual advice regarding the bund was that a 1.7km bund of 1 metre in height would direct water within the Floodway towards the west. This conceptual advice resulted in a concept project being included in the Draft 2012/2022 LTP regarding the establishment of the bund, however the project did not continue through the LTP decision making process to be implemented. Therefore, it was not included in the final version of the 2012/2022 LTP.

Effect of increased development in Mosgiel

Aside from noting the comments and work highlighted in the sections above, this is a question more appropriately directed to the Dunedin City Council, noting that the Otago Regional Council only has a consenting function in respect of this matter.

Height of roads

Any reconstruction of the roads in the area would have been undertaken by the DCC. It is expected that the design of the work would have necessarily included a consideration of the sizing required to ensure the effective and appropriate conveyance of flood waters within the Floodway, however this should be verified with the consents team at both Councils.

It is noted that the height of the road provides for improves egress from the area within the Floodway.

References

NoR for the Lower Taieri Scheme (2GP)

https://2gp.dunedin.govt.nz/2gp/documents/Schedule_Designations_Applications/A1.4.18%20Otago%20Regional%20Council/NOR%20Lower%20Taieri%20Scheme.pdf

The Modelling Report:

https://www.dunedin.govt.nz/_data/assets/pdf_file/0005/928553/Silver-Stream-Modelling-Report_FINAL_19102022-REVISION_22112022.pdf.

Michelle Mifflin's Affidavit:

https://www.dunedin.govt.nz/_data/assets/pdf_file/0004/927697/06.-ENV-2018-CHC-290-Affidavit-of-M-Mifflin-sworn.pdf

Infrastructure Strategy (part of Long Term Plan):

<https://www.orc.govt.nz/media/10139/orc-longtermplan-web-144dpi.pdf>