BEFORE THE FRESHWATER COMMISSION

UNDER	the Resource Management Act 1991 (the **Act** or **RMA**)
IN THE MATTER	of an original submission on the Proposed Regional Policy Statement for Otago 2021 (**PRPS**)
BETWEEN	**OTAGO WATER RESOURCE USER GROUP**
	Submitter FPI043
	FEDERATED FARMERS NZ INC
	Submitter FPI026 and FSFPI026
	DAIRY NZ
	Submitter FPI024 and FSFPI024
AND	**OTAGO REGIONAL COUNCIL**
	Local Authority

EVIDENCE IN CHIEF OF BRENDAN JAMES SHEEHAN: ADDITIONAL EVIDENCE FOR FRESHWATER PARTS

GALLAWAY COOK ALLAN LAWYERS
Bridget Irving / Phil Page
bridget.irving@gallawaycookallan.co.nz
phil.page@gallawaycookallan.co.nz

P O Box 143
Dunedin 9054
Ph: (03) 477 7312
Fax: (03) 477 5564

EVIDENCE IN CHIEF OF BRENDAN JAMES SHEEHAN: ADDITIONAL EVIDENCE FOR FRESHWATER PARTS

1. This brief of evidence is the same as the brief filed in relation to the Otago Regional Policy Statement 2021 - non freshwater parts. New evidence not previously provided to the non-freshwater panel is added in text that is shaded grey for ease of identification.

2. I have been given a copy of the Environment Courts code of conduct for expert witnesses. I have reviewed that document and confirm that this evidence has been prepared in accordance with it and that all opinions that I offer in this evidence are within my expertise. I have not omitted to refer to any relevant document or evidence except as expressly stated. I agree to comply with the code and in particular to assist the Commissions in resolving matters that are within my expertise.

Introduction

3. My full name is Brendan James Sheehan, I am a Civil Engineer and I hold a New Zealand Certificate in Engineering (Civil) from AAVA, a Bachelor of Civil Engineering Degree from Canterbury University and a Master of Science (MSc - Civil) from Virginia Technical and State University, USA.

4. I am a member of the New Zealand Society of Large Dams (NZSOLD).

5. I am self-employed as a civil engineer specialising in dam engineering. My company (established in 2008) is called Mt Aurum Engineering Consultants Ltd, and I have clients in both Australia and New Zealand, including multiple irrigation companies and hydro power companies. Many of my clients have multiple dams in their asset portfolios which I have worked on in various dam engineering capacities.

6. Key areas of engineering expertise relating to dams include;

(a) Design and construction of new dams

(b) Design upgrades and construction of existing dams

(c) Dam safety assessments including inspections and preparation of reports; Comprehensive Dam Safety Reviews, Intermediate Dam Safety Reviews, Operation, Maintenance & Surveillance, Emergency Action Plans, Incident reports and development of Dam Safety Assurance Programmes.

(d) Technical advisor i.e., client representative, expert witness

(e) Project management on multiple dams and other civil engineering projects.

7. I am a Certified Hearings Commissioner having completed the 'RMA Making Good Decisions Programme'.

Code Of Conduct for Expert Witnesses

8. I have read and agree to comply with the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence is within my area of expertise, except where I state that I am relying upon material produced by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of Evidence

9. The purpose of this evidence is to provide the reader with an understanding of irrigation storage and water distribution in the Maniototo Irrigation Scheme, in the Maniototo Catchment, and Ida Valley Irrigation Scheme, in the Manuherikia Catchment.

MANUHERIKIA CATCHMENT

10. Ida Valley Irrigation Company Ltd (IVICL) own and operate two large storage reservoirs, three diversion weirs and 110km of irrigation races including; open channel races, syphons, culverts, bridges, gate

structures and turnouts. The total area irrigated by IVICL Shareholders is 8,205 hectares.

11. IVICL shareholders fund all operational and maintenance costs related to the five dams and irrigation network that it owns.

12. Maximum water storage in the dams and weirs for irrigation is as follows:

    (a) Upper Manorburn Dam = 51,000,000m^3

    (b) Poolburn Dam = 26,500,000m^3

    (c) Poolburn Weir = 60,000m^3

    (d) Upper Bonanza Weir = 12,000m^3

    (e) Moa Creek Weir = 38,000m^3

13. Upper Manorburn reservoir and Poolburn reservoir water is released by IVICL according to irrigation demand and water availability. There is no residual flow released from either reservoir.

14. There is no other irrigation water source available to IVICL shareholders e.g., pumping from Manuherikia River, once Upper Manorburn and Poolburn reservoirs are depleted.

15. IVICL's operational regime for stored water in Upper Manorburn reservoir and Poolburn reservoir includes;

    (a) Keeping both large reservoirs as full as possible to mitigate risk in a dry year.

    (b) Setting a yearly water quota based on reservoir levels. This is set as a percentage of maximum allowable take per season for each Shareholder.

    (c) The Weirs to be kept full to balance water distribution and ensure consistent water flow in the irrigation network.

    (d) All equipment to be used and maintained correctly.

16. Historical water usage from Upper Manorburn and Poolburn reservoir since they were commissioned (1914 and 1931 respectively) can be described as cautious. Water availability is not taken for granted in these catchments and historical reservoir records support this statement.

17. IVICL Board set a water quota for its Shareholders each irrigation season. Water quota is tentatively set in September each year based on reservoir levels and long term weather forecasts and confirmed in November. Historically, water quota very rarely changes once set.

18. IVICL's water quota methodology is based on historical experience including extreme dry periods over multiple seasons which have resulted in maximum water extraction from both reservoirs, leaving barely enough to provide for stock water. As you might imagine setting the quota is a combination of science and art.

19. Below I set out the key operational parameters for each of the large dams. This gives a sense of the scale and variability that is experienced between seasons.

Upper Manorburn Dam – Historical reservoir records

(a) 108 years of reservoir records (**1914 to 2022**)

(b) Irrigation season extends from 1 September to 30 April.

(c) Dam crest level (**maximum live storage**)

= RL746.15m = 51.0Mm^3 → **reservoir = 100% full**

(d) Average reservoir level, over 108 years, at the start of the irrigation season (September).

= RL742.50m = 26.0Mm^3 → **reservoir ≈ 51% full**

(e) Average reservoir level, over 108 years, at the end of the irrigation season (April).

= RL739.04m = 19.0Mm^3 → **reservoir ≈ 37% full**

(f) Driest irrigation season on record (1951) → **reservoir ≈ 2% full**

Poolburn Dam – Historical reservoir records

(a) 91 years of reservoir records (**1931 to 2022**)

(b) Irrigation season extends from 1 September to 30 April.

(c) Spillway crest level (**maximum live storage**)

= RL813.05m = 26.5Mm^3 → **reservoir = 100% full**

(d) Average reservoir level, over 91 years, at the start of the irrigation season (September).

= RL809.80m = 18.0Mm^3 → **reservoir ≈ 67% full**

(e) Average reservoir level, over 91 years, at the end of the irrigation season (April).

= RL807.76m = 8.0Mm^3 → **reservoir ≈ 30% full**

(f) Driest irrigation season on record (1951) → **reservoir ≈ 0% full**

Upper Manorburn Dam - structure

20. Upper Manorburn Dam is a concrete circular arch dam that was constructed in 1914. The entire dam crest forms a free overflow spillway which spills during floods onto natural schist rock on both abutments and into an unlined pool at the toe of the dam. Approximately 30m of the right hand side of the arch dam was replaced in 1955 with a concrete gravity thrust block.

Photo One: View of Concrete Arch Dam

Photo Two: Spilling over Dam Crest

21. Outlet Conduits:

    (a) A circular concrete intake tower is located immediately upstream of the centre of the arch dam. This is a separate structure from the dam and controls flow released from the reservoir.

Photo Three: View of upstream Concrete Intake Tower

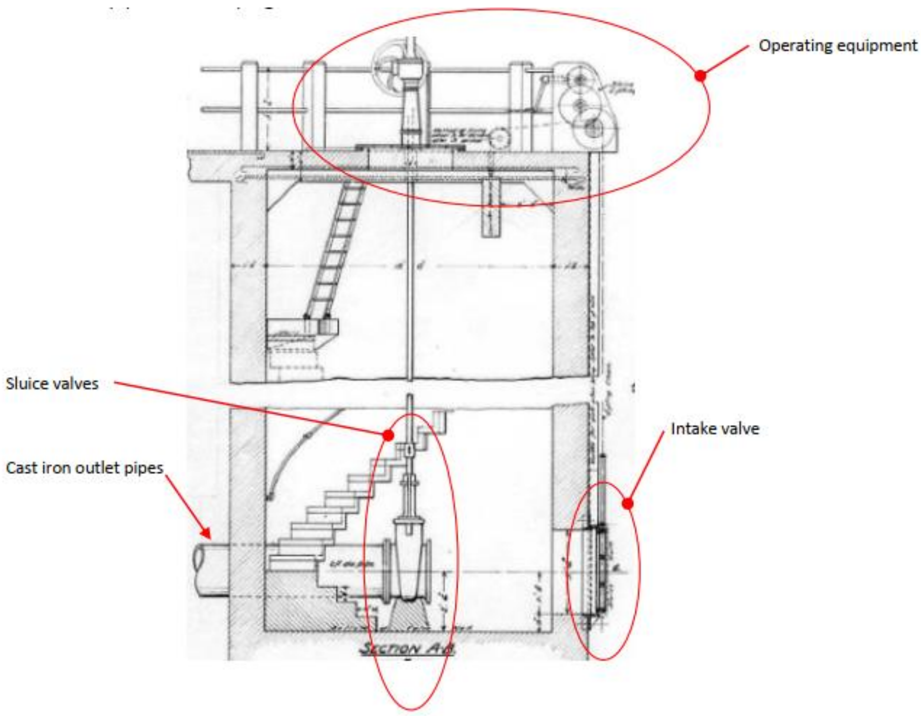

Figure One: Intake Tower Schematic

(b) The original 24” diameter sluice valves (x2) are located internally at the bottom of the intake tower, and these are manually operated using mechanical controls on top of the intake tower.

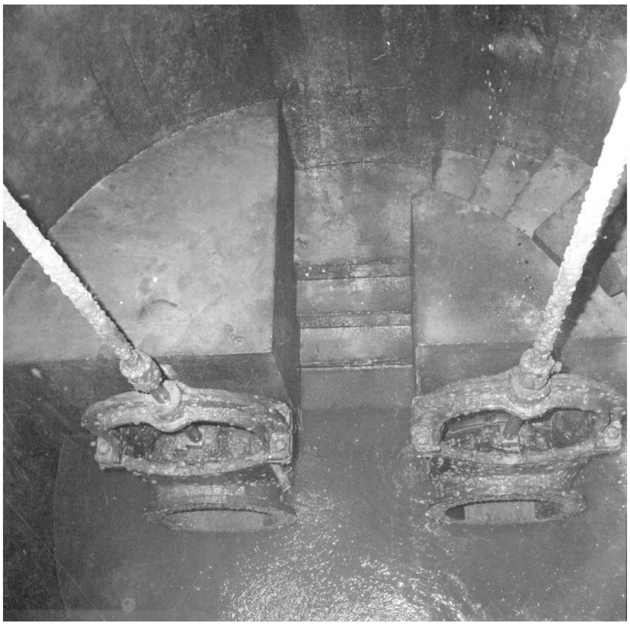

Photo Four: View of Sluice Valves inside the Intake Tower

(c) In 1987 two 450mm diameter Butterfly valves, with 375mm reducers, were installed at the outlet end of the conduit pipes to regulate discharges to the downstream catchment.

(d) An upgrade was completed in April 2017 which included installation of 2 x 450mm double flanged Plug valves complete with 24v DC electric actuators. Both valves are normally operated remotely but can also be remotely and manually operated on site.

(e) There are no other outlets at Upper Manorburn Dam

22. Consents allow a maximum of 79.5 heads (2,150 l/s) to be released from Upper Manorburn reservoir. IVICL historically releases up to 65 heads (1,905 l/s) during the dry parts of the irrigation season.

23. The existing plug valves (x2) are not designed to operate for extended periods at high flows (100% discharge is approximately 2.5m^3/s when the reservoir is full). In addition, the plug valves are connected to original cast iron conduit pipes that extend through the arch dam and into the inlet tower. Both conduit pipes have known maintenance issues, caused by cavitation, which occurred in the early days of reservoir operation. Larger releases from Upper Manorburn reservoir will only exacerbate this issue.

24. A condition assessment inspection in September 2022 confirmed that the original outlet sluice valves have deteriorated beyond repair. The outlet conduit pipes have incurred significant cavitation damage and the proposed repair is to sleeve both outlet pipes with new steel pipes. This will reduce the outflows slightly but will ensure the long term serviceability of these outlets.

25. Upper Manorburn Dam is a very old structure (108 years old) which comes with unique engineering challenges. Installation of a new outlet conduit through the body of this dam, capable of releasing 1m^3/s or greater, would be a very expensive and extremely challenging. A new outlet would need to be installed with the reservoir levels operating over normal levels to accommodate continuing irrigation demand.

26. Installation of a new outlet pipe would need to be managed while the reservoir is full (or there abouts) to minimise the impact to irrigators whose reliance on irrigation water is critical to their farms ongoing viability. Completing the works outside the irrigation season i.e. during winter, is not really feasible because the site isn't accessible in the winter months due to snow/ice. Winter reservoir levels will be slightly lower, but the engineering complexity doesn’t really change i.e. This involves using divers to install temporary watertight formwork on the upstream dam face and cutting through the body of the dam to allow a new outlet pipe to be installed. The costs would run into the multi millions. The existing outlet drains are not big enough to draw the reservoir down to complete a new outlet pipe installation and/or in an

emergency event when the dam might be damaged e.g. cracked following an earthquake event and requiring repair work.

Upper Bonanza Weir - structure

27. Controlled discharges released into the Manor Burn Stream from the Manorburn reservoir are diverted into the Upper Bonanza open channel race at the Upper Bonanza Weir, approximately 4km downstream of the Upper Manorburn Dam.

Photo Five: View of Upper Bonanza Weir – Concrete Arch Dam

28. Upper Bonanza Weir is a concrete circular arch dam that was constructed in 1914 (at the same time as Upper Manorburn Dam) to divert irrigation water into the Upper Bonanza Race network. The Upper Bonanza Weir provides 12,000m^3 of water storage but more importantly raises the reservoir level to a height that allows water to flow into the Upper Bonanza Race network.

29. Outlet Conduits:

(a) There is a single metal outlet gate (0.9m wide x 1.2m high) at the bottom of the upstream dam face which allows drainage of the reservoir.

(b) Upper Bonanza Race inlet on the right abutment of the Upper Bonanza Weir is a 4m to 5m high concrete structure with three gated outlets (wooden gates: 1.0m wide x 1.1m high) that release flows along this irrigation race. The gates are manually controlled from the inlet structure crest.

Photo Six: View of Outlet Gates at Upper Bonanza Weir and the start of the Upper Bonanza Open Channel Race

(c) There are no other outlet conduits at Upper Bonanza Weir.

Upper Bonanza Race - structure

30. Upper Bonanza Open Channel Race invert is 1.0m below Upper Bonanza Weir crest height so the Upper Bonanza reservoir needs to be full (to weir crest height) to operate the irrigation race effectively.

31. Upper Bonanza Race allows water to be distributed around the Ida Valley irrigation race system via the Moa Creek Weir and to Blacks

Irrigation Race; or, towards the Syndicate Irrigation Race and Crawford Hills area.

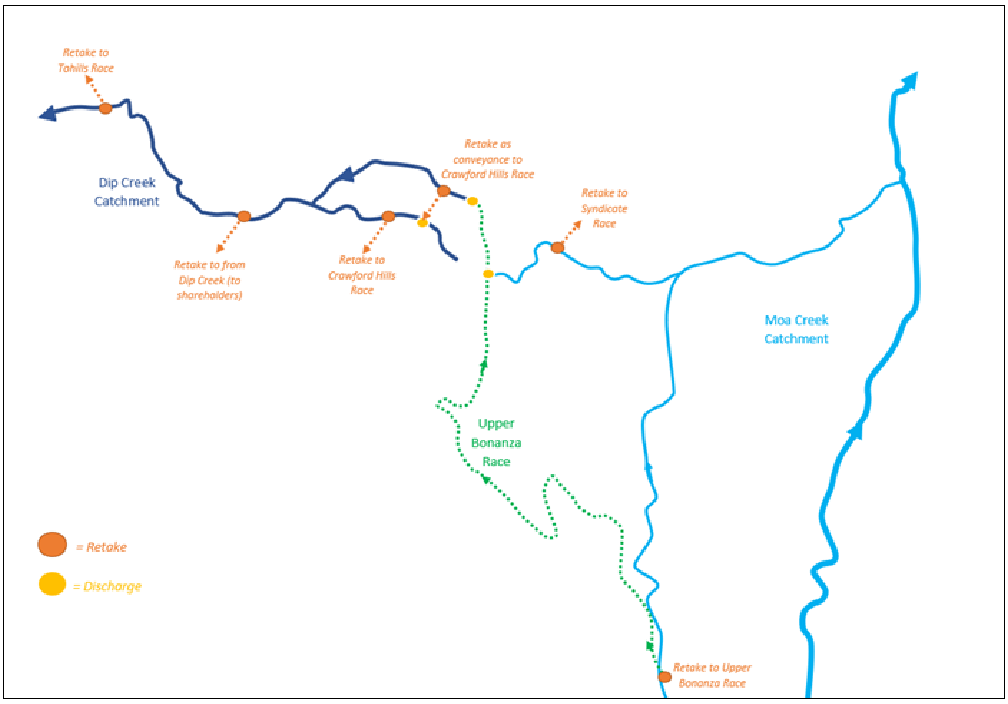

Figure Two: Scheme Map of Upper Bonanza Race

32. Upper Bonanza Race diverts water into three race systems including;

(a) Crawford Hills Race = 12 heads (340 l/s)

(b) Syndicate Race = 11.5 heads (326 l/s)

(c) Lower Bonanza Race = 41 heads (1160 l/s)

Total losses in these race networks are approximately 10%

33. Upper Bonanza Race is a predominantly unlined open channel cut through rock bluffs, gullies, and open rolling countryside. It is a feat of engineering for its time but is need of continuous annual maintenance and emergency repair work, which are an ongoing cost for the irrigators.

34. Upper Bonanza Race can accommodate a maximum of 72 heads (2,308 l/s). IVICL normally restrict flow to 65 heads (1,905 l/s) as the

Upper Bonanza Race is over 100 years old and very susceptible to leakage and failure at high flows.

35. Significant maintenance has been carried out on the Upper Bonanza Race since first construction including alignment diversions, impermeable liners, and repairs in failed areas.

Moa Creek Weir - structure

36. Moa Creek Weir is a concrete circular arch dam that was constructed in 1914 (at the same time as Upper Manorburn Dam). The Moa Creek Weir has a water storage capacity of 38,000m^3.

Photo Seven: View of Moa Creek Weir – Concrete Arch Dam

37. Moa Creek Weir was constructed of very poor quality concrete and has required significant repair work during its life due to substantial cracking in the upstream and downstream dam faces. Extensive concrete repairs were completed to half of the upstream dam face in

1997. Any structural changes e.g. increasing storage volume, would have significant engineering challenges and costs.

38. Outlet Conduits:

(a) There is a single metal outlet gate (0.9m wide x 1.2m high) at the bottom of the upstream dam face, allows drainage of the reservoir.

(b) Moa Creek Race inlet on the left abutment is a 4m to 5m high concrete structure with three gated outlets (wooden gates: 1.0m wide x 1.1m high) that release flows along this irrigation race. The gates are manually controlled from the inlet structure crest.

(c) There are no other outlet conduits at Moa Creek Weir.

39. Moa Creek Race invert is 1.0m below Moa Creek Weir crest height so the Moa Creek reservoir needs to be full (to weir crest height) to operate the irrigation race effectively.

40. Moa Creek Race allows water to be distributed around the Ida Valley irrigation race system via the Blacks Race area and Poolburn Race.

41. Moa Creek Race diverts water into two race systems including;

(a) Blacks Race = 30 heads (849 l/s)

(b) Poolburn Race = 13 heads (368 l/s) total release

→ 3 heads (85 l/s) to Shareholders on route

→10 heads (283 l/s) into Poolburn Weir

Total losses in these race networks are approximately 10%

Poolburn Weir - structure

42. Poolburn Weir is a concrete circular arch dam that was constructed in 1931 (at the same time as Poolburn Dam) to augment and distribute

irrigation water along the eastern side of the Ida Valley irrigation scheme. Poolburn Weir has water storage capacity of 60,000m^3.

Photo Eight: View of Poolburn Weir – Concrete Arch Dam

43. Poolburn Weir was constructed of very poor quality concrete and has required significant repair work during its life due to substantial cracking across the upstream and downstream dam faces. Further costly repairs to both dam faces are planned in April 2023. Any changes e.g. increasing storage volume, to this structure would have significant engineering challenges and costs.

44. Outlet Conduits:

(a) There is a single metal outlet gate (0.3m wide x 0.3m high) at the bottom of the upstream dam face, allows drainage of the reservoir.

(b) Two outlet gates (1.0m wide x 1.2m high) on the right abutment of Poolburn Weir control flow into the German Hill Race. The gates are manually controlled from the inlet structure crest.

(c) There are no other outlet conduits at Poolburn Weir.

45. Poolburn Weir diverts water into a single race system;

(a) German Race = 33 heads (934 l/s) *

At flows greater than 33 heads water spills over the open channel race profile causing multiple blow outs. Irrigation distribution needs to be shut down while repairs are completed.

46. German Hill Race allows water to be distributed along the Eastern side of the Ida Valley.

Poolburn Dam - structure

47. Poolburn Dam is a concrete circular arch dam that was constructed in 1931. A concrete gravity thrust block was constructed on the right hand side of the dam during original construction to provide support on this side of the dam. The abutment geology is lower on the right hand side of the dam which explains the need to construct a concrete gravity thrust block.

48. A free overflow spillway is located on the right abutment, beyond the right-hand end of the concrete gravity thrust block. Water flows down an unlined rock channel.

Photo Nine: View of Poolburn Dam – Concrete Arch Dam and Overflow Spillway on RHS of Dam

Photo Ten: View of Poolburn Dam – Concrete Arch Dam

49. Outlet Conduits:

(a) Two 24” (610mm) diameter sluice valves were installed as part of the original outlet conduits. Flow is controlled from the downstream side with a needle valve fitted to one of the outlet conduits and a butterfly valve fitted to the other outlet. Both valves are manually controlled.

- Needle Valve = 26 head (736 l/s) fully open
- Butterfly valve = 6 heads (170 l/s)

(b) There are no other outlets at Poolburn Dam

Photo Eleven: View of Poolburn Dam – Outlet Conduits (x2)

50. Consents allow a maximum of 40 heads (1,132 l/s) to be released from Poolburn reservoir. IVICL historically releases up to 32 heads (906 l/s) during the dry parts of the irrigation season.

51. The existing outlet valves (x2) are not designed to operate for extended periods at high flows (100% discharge is approximately 1.5m^3/s when the reservoir is full). Both outlet valves are connected to original cast iron conduit pipes that extend through the arch dam. Larger flows released from the reservoir are to be avoided to minimise cavitation issues in the cast iron pipes.

52. Poolburn Dam is a very old structure (91 years old) which comes with unique engineering challenges. Installation of a new outlet conduit through the body of this dam, capable of releasing 1m^3/s or greater, would be a very expensive and extremely challenging. A new outlet would need to be installed with the reservoir levels operating over normal levels to accommodate continuing irrigation demand.

53. Installation of a new outlet pipe would need to be managed while the reservoir is full (or there abouts) to minimise the impact to irrigators whose reliance on irrigation water is critical to their farms ongoing viability. Completing the works outside the irrigation season i.e. during winter, is not really feasible because the site isn't accessible in the winter months due to snow/ice. Winter reservoir levels will be slightly lower, but the engineering complexity doesn’t really change i.e. This involves using divers to install temporary watertight formwork on the upstream dam face and cutting through the body of the dam to allow a new outlet pipe to be installed. The costs would run into the multi millions.

54. The existing outlet drains are not big enough to draw the reservoir down to complete a new outlet pipe installation and/or in an emergency event when the dam might be damaged e.g. cracked following an earthquake event and requiring repair work.

Farm Storage in the catchment

55. There is only one sizeable farm storage pond in the Ida Valley with a storage capacity of approximately 700,000m^3.

56. There are numerous smaller on farm ponds which have been built in the past 100 years, but these are mainly used to provide stock water in dry periods.

57. Storage ponds built and funded by individual farmers within the last 10 to 20 years are normally sized to ensure there is irrigation water available for on farm use outside the periods when water is rostered to each Shareholder. Typically, these storage ponds range in size from 20,000m^3 to 50,000m^3.

58. Traditional dry land farmers can manage their farming practices through dry periods whereas cropping and dairy farmers are much more at risk at certain times of the season. Storage ponds help alleviate this risk but at a significant cost to farmers.

59. The benefits of building more on farm storage ponds are dependent on water availability i.e., irrigation shares are already allocated, and a farmer’s financial position to invest in irrigation storage and type of irrigation system being used.

60. Engineering design and construction of storage ponds in the Ida Valley is particularly challenging as the local soils make it difficult to locate suitable impermeable materials to line the ponds. Additional costs are incurred by farmers if manmade HDPE plastic liners are used.

Floods

61. Upper Manorburn and Poolburn reservoirs normally have sufficient storage capacity to store flood events. If the reservoirs are full, then flood water is diverted over the dam crest for the Upper Manorburn Dam or down a spillway structure at Poolburn Dam. Outlets at both dams are normally closed to maximise flood storage in the reservoirs. Limited outlet capacity at both dams means there is no point in opening them in large flood events.

62. The three weir structures (Upper Bonanza, Moa Creek and Poolburn Weirs) are kept full during normal operation, so flood events tend to flow over these structures and on down their respective catchments. IVICL can utilise a small quantity of flood flow water by diverting water (harvesting) down their race networks and into on farm storage ponds. This is known to be helpful to minimise flood damage downstream of the weir structures.

63. The existing IVICL race network (approximately 110km) is not designed to carry large flood flows. These unlined open channel races are very temperamental and excess water down the race system can very quickly result in breaches which are costly to fix and impact on water available for irrigation.

Farm Irrigation

64. Flood and border dyke irrigation type were the historical means of delivery of irrigation water on farm. These systems have rapidly been replaced by pivot, lateral, travelling gun, fixed grid and k-line irrigation systems.

65. Modern on farm irrigation methods e.g. variable rate irrigation - pivot irrigators are designed to deliver optimum irrigation water required depending on soil type, crops grown and weather patterns. On farm irrigation systems are the farmers responsibility.

66. Delivery of irrigation water to farms is much more critical with the installation of modern irrigation methods. Crops will fail if water demand does not keep up, which has a flow on effect for livestock reliant on this supplement feed.

67. Changes to IVICLs race network to increase flow for on farm irrigation demand would be costly i.e.,

    (a) Capacity of the 110km of race network would need to be increased.

    (b) Heights and storage of the three diversion weir structures would need to be altered

    (c) Outlet flows from Poolburn Dam and Upper Manorburn Dam would need to be increased

68. Leakage losses in the unlined race networks have been estimated at around 10%. There are a couple of remedial options to capture the losses:

    a. Line the race networks

    b. Convert the race network to a piped scheme.

    A combination of both options is likely to be the preferred leakage loss solution but is unaffordable for the irrigation company.

    Minor leaks in the race network are fixed annually as they occur.

MANITOTO IRRIGATION SCHEME

69. Maniototo Irrigation Company Ltd (MIC) own and operate the Loganburn reservoir which provides water for the Maniototo irrigation scheme situated in the Maniototo basin.

70. MIC shareholders 100% fund all operational and maintenance costs related to Loganburn Dam.

71. Loganburn reservoir water augments water harvested for irrigation from Taieri River and is released when flows drop in the Taieri River, and irrigation demand is high. There is no residual flow released from Loganburn Reservoir.

72. MIC's operational regime for stored water in Loganburn reservoir includes;

    (a) Keeping Loganburn reservoir as full as possible to mitigate risk in a dry year.

    (b) Ensure there is enough stored water in a dry year to avoid irrigation restrictions.

    (c) Reservoir water will be released on irrigation demand.

    (d) Shareholders will be put on irrigation restrictions if there are low storage reserves in Loganburn reservoir. MIC assesses this at the beginning of each irrigation season.

    (e) All Loganburn equipment to be used and maintained correctly.

73. Below I set out the key operational parameters for the Maniototo infrastructure.

Loganburn Dam – Historical reservoir records

(a) 39 years of reservoir records (**1983 to 2022**)

NB: early reservoir records in this period are spasmodic

(b) Irrigation season extends from 15 September to 30 April.

(c) Spillway crest level (**maximum live storage**)

= RL924.55m = 95.0 Mm^3 → **reservoir = 100% full**

(d) Past five season average water usage;

= 24.0Mm^3 → **water storage used ≈ 25%**

(e) Maximum reservoir abstraction to date;

= 43.0Mm^3 → **water storage used ≈ 45%**

Occurred in 2009/2010 irrigations season.

(f) Loganburn reservoir storage was designed to allow MIC to draw down its full reserves over two consecutive dry seasons.

74. Water use in neighbouring catchments with irrigation dams that have a much longer history show that similar dry periods over multiple years have occurred in 20 yearly cycles (approximately). Loganburn reservoir has the capacity to provide irrigation water to shareholders over multiple dry years if water restrictions are managed carefully.

75. Loganburn Dam is a concrete face rockfill dam built in 1983 to hold 84,000,000m^3 of usable water for irrigation purposes. Two subsequent dam raises have increased this total to 95,000,000m^3 usable water stored.

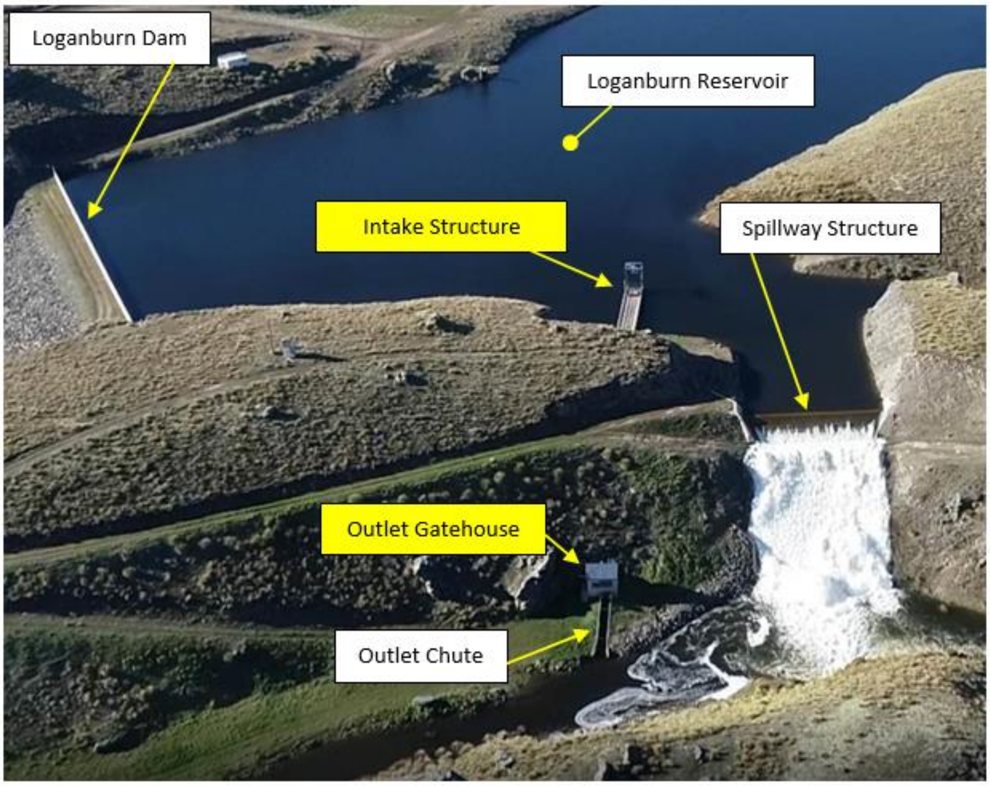

Photo Twelve: View of Loganburn Dam and Infrastructure

76. Loganburn reservoir level and rainfall data are electronically monitored, and data recorded in the Loganburn gatehouse PLC. Upgrades to the Control System in 2018 enable MIC to accurately monitor water discharge rates, volumes and calculate remaining reservoir storage volume.

77. Loganburn reservoir level and Loganburn gate openings can be controlled and viewed remotely using the PLC and Ewon control system. Daily discharge is measured and recorded, and this information is easily downloaded for 'real time' tracking of available storage and water usage.

78. Water released from the Loganburn reservoir is via an outlet tunnel which has a design capacity of 8m^3/s. Typically the release for irrigation demand during the season (September to April) is in the order of 2m^3/s to 4m^3/s with releases upwards of 5.0m^3/s (peak

demand) for short periods when the Taieri River is very low. There are no other outlets at Loganburn Dam.

79. The maximum outlet flow to date has been $7m^3/s$ which I initiated as part of an Annual Dam Safety Inspection, in 2021. The purpose of this trail release was to test the outlet gate operating capabilities – remote and manual controls, mechanical and electrical systems, and was only undertaken for a short period (20 minutes) to avoid any damage.

80. Maximum daily water usage recorded at Loganburn reservoir to date was in December 2017. A daily total volume of $481{,}000m^3$ was released which equates to a discharge rate of $5.57m^3/sec$.

81. While the Loganburn outlet tunnel is designed to release $8m^3/s$, the long-term repercussions of high flow releases are unknown. Operating the outflow at maximum capacity, or there about, for extended periods would place a huge strain on the existing outlet tunnel infrastructure. Failure of the gate mechanism would be catastrophic as the intake bulkhead, which allows the outlet tunnel to be drained, is not designed to be installed under full lake pressure.

82. Design and construction of an alternative water outlet from the Loganburn reservoir, capable of releasing $1m^3/s$ or greater, would be a very expensive and challenging exercise. A new outlet would need to be installed with the reservoir levels operating over normal levels to accommodate continuing irrigation demand. Tunnelling and underwater construction require specialist equipment and highly trained operators likely to make such a project unaffordable.

83. Water released from Loganburn reservoir flows down the Logan Burn stream for approximately 15km before meeting the Taieri River in the Styx Basin, just upstream of the Paerau Weir.

84. MIC’s current consent condition requires that $0.85m^3/s$ passes over the Paerau Weir and on down the Taieri River. The remaining water is diverted into the Patearoa-Paerau Power Scheme and then

distributed into the Maniototo irrigation race network that covers a significant portion of the highly productive Maniototo basin.

Farm Storage

85. The largest storage pond in the Maniototo has a storage capacity of 1.0Mm^3. This was built and funded by a large dairy farming business with multiple dairy platforms.

86. Storage ponds built and funded by individual farmers within the last 10 to 20 years are normally sized to ensure there is irrigation water available for on farm use outside the periods when water is allocated or rostered to each Shareholder. Typically, these storage ponds range in size from 50,000m^3 to 400,000m^3.

87. Traditional dry land farmers can manage their farming practices through dry periods whereas dairy farmers are much more at risk. Storage ponds help alleviate this risk but at a significant cost to farmers.

88. The benefits of building more on farm storage ponds are dependent on water availability i.e., irrigation shares are already allocated, and a farmer’s financial position to invest in irrigation storage and type of irrigation system being used.

Floods

89. Loganburn reservoir normally has sufficient storage capacity to store reasonable size flood events. When Loganburn reservoir becomes full, water is diverted over a designated ogee spillway and into the Logan Burn Stream. The spillway is a free overflow spillway which doesn’t require human intervention.

90. Loganburn tunnel outlet is normally closed during flood events to maximise storage. Limited outlet capacity also means there is no point in opening the outlet gate in large flood events.

Flood storage in the Loganburn reservoir is known to assist with reducing the size and peak of Taieri River flooding which can have dire consequences for those living in the lower catchment.

Farm Irrigation

91. Modern on farm irrigation methods e.g., pivot irrigators, are designed to deliver the optimum irrigation water required depending on soil type, crops grown and weather patterns. On farm irrigation systems are the farmers responsibility.

92. Delivery of irrigation water to farms is much more critical with the installation of modern irrigation methods. Crops will fail if water demand does not keep up, which has a flow on effect for livestock reliant on this supplement feed.

93. MICs PLC Control System enables water delivery to be accurately controlled to the three irrigation company Shareholders.

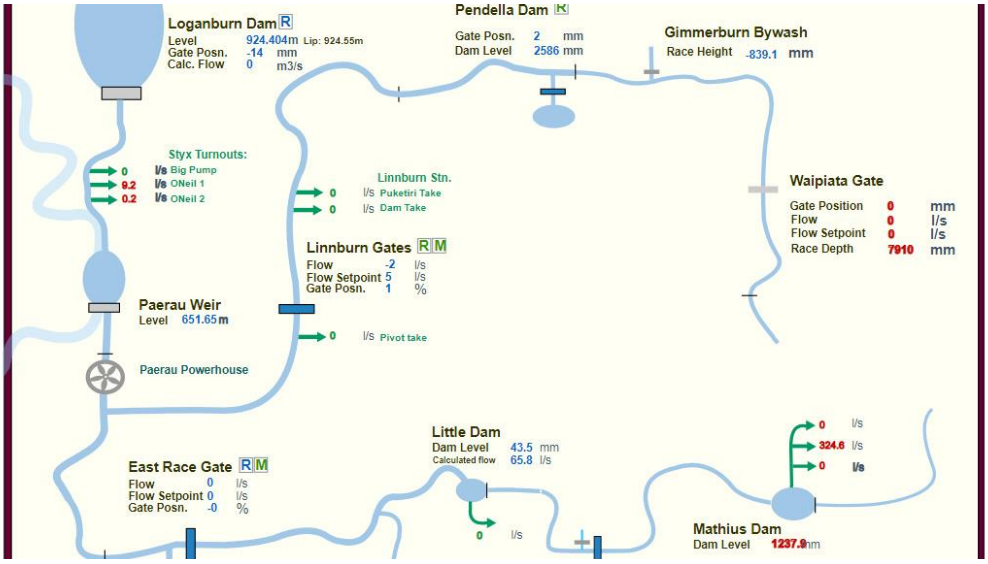

Figure Three: Maniototo Irrigation Scheme Schematic

Conclusion

94. The irrigation infrastructure within Otago is complicated due to its size, age and complexity. The reality is that the ability to significantly alter or upgrade is severely constrained by both practical difficulties and cost. Retrofitting old infrastructure is very expensive with no

guarantees that the desired outcomes e.g. changing minimum flows, residual flows, rates of take etc, will be achieved without serious time delays, additional cost incurred and negative impact on irrigators.

95. Any new operational requirements for an existing Otago irrigation scheme will take a very long time to plan for and fund as major engineering works would be necessary.

96. The infrastructure is heavily relied upon by the farmers and their ongoing business viability making it impossible to contemplate maintenance or upgrade work that would prevent the operation of the scheme.

97. This does place some limitations on what can be achieved. Further, many farmers have completed on farm upgrades that rely on the scheme as it is. Any changes to those operations will require wide ranging changes on farm. Potentially, reduced irrigation areas, establishment of buffer storage and the likes. This will inevitably take time.

98. Construction of supplementary on farm storage in Ida Valley has some significant engineering challenges due to soil types and on farm preferred locality which is normally dictated by existing irrigation infrastructure. Cost of on farm storage has increased considerably over the past two years, and not all farmers are in a financial position to meet this cost.

99. The existing irrigation scheme infrastructure has developed over a long time with upgrades being undertaken in an iterative way. There are physical limits to the existing infrastructure which mean that potential changes may require substantial investment or even replacement which can only be managed across sufficiently large timeframes.

B Sheehan

Date: 28 June 2023