

Nick Holden, Tom Scott

Route and Asset Optimisation for the Western Dams: Raw Water Supply Infrastructure

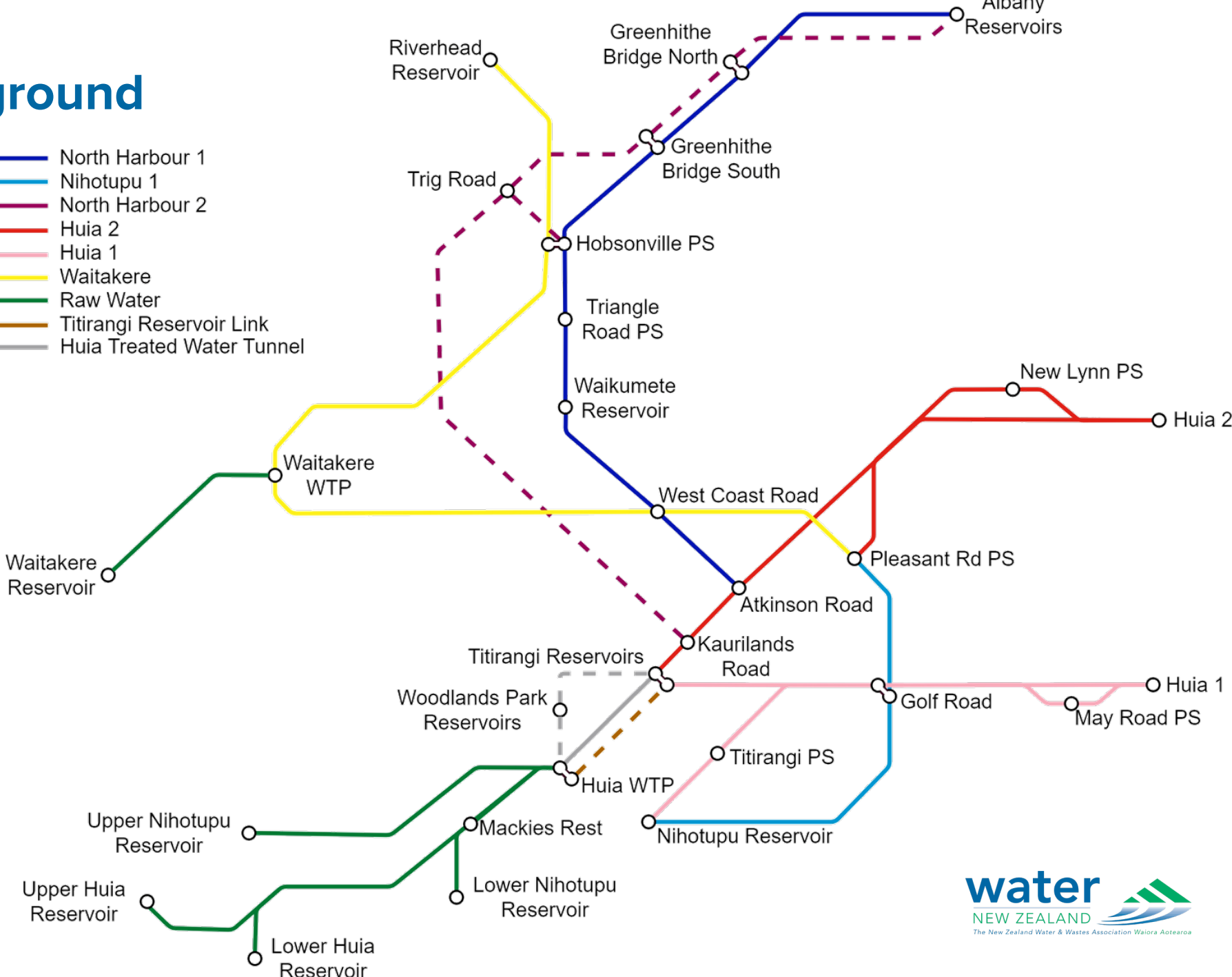
Watercare & Aurecon



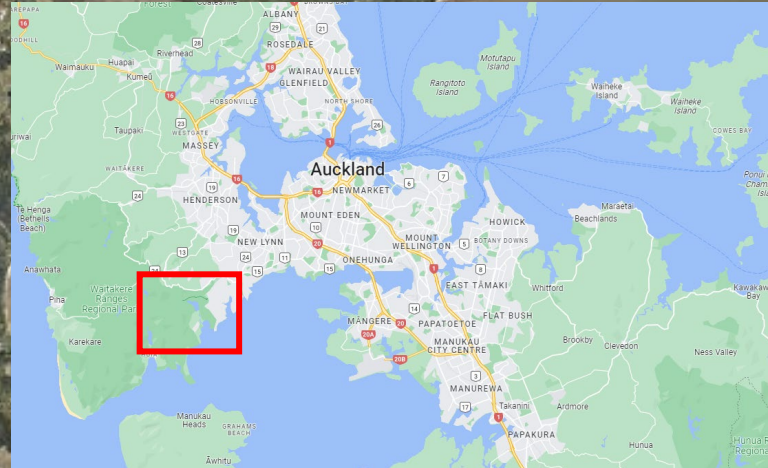
water
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Tākina, Te Whanganui-a-Tara Wellington

Background

- North Harbour 1
- Nihotupu 1
- North Harbour 2
- Huia 2
- Huia 1
- Waitakere
- Raw Water
- Titirangi Reservoir Link
- Huia Treated Water Tunnel



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Upper Huia

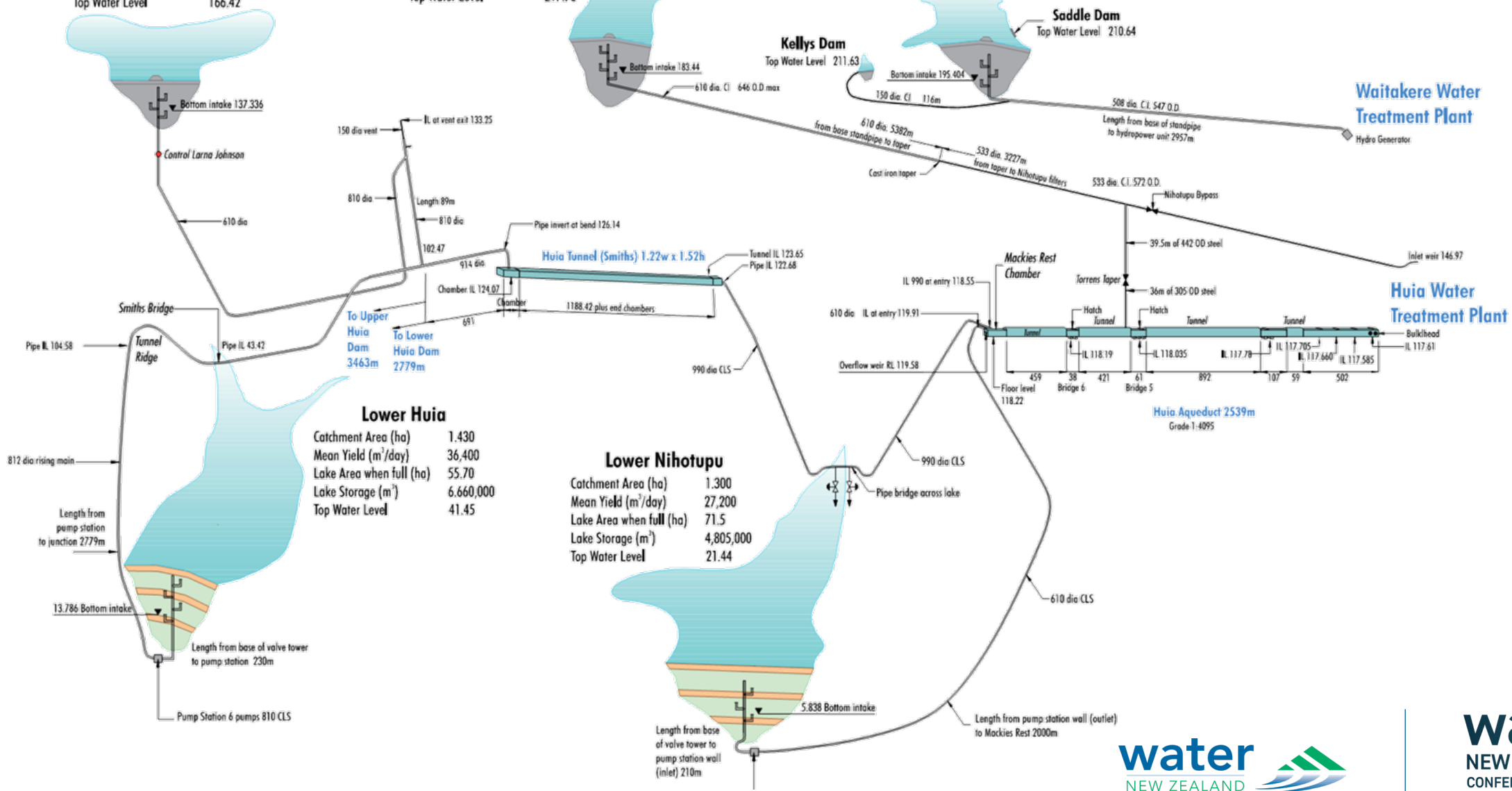
Catchment Area (ha)	790
Mean Yield (m ³ /day)	18,200
Lake Area when full (ha)	21.4
Lake Storage (m ³)	2,436,000
Top Water Level	166.42

Upper Nihotupu

Catchment Area (ha)	1000
Mean Yield (m ³ /day)	22,700
Lake Area when full (ha)	14.5
Lake Storage (m ³)	2,363,000
Top Water Level	217.78

Waitakere

Catchment Area (ha)	820
Mean Yield (m ³ /day)	15,900
Lake Area when full (ha)	27.8
Lake Storage (m ³)	1,850,000
Top Water Level	210.69



Lower Huia

Catchment Area (ha)	1,430
Mean Yield (m ³ /day)	36,400
Lake Area when full (ha)	55.70
Lake Storage (m ³)	6,660,000
Top Water Level	41.45

Lower Nihotupu

Catchment Area (ha)	1,300
Mean Yield (m ³ /day)	27,200
Lake Area when full (ha)	71.5
Lake Storage (m ³)	4,805,000
Top Water Level	21.44

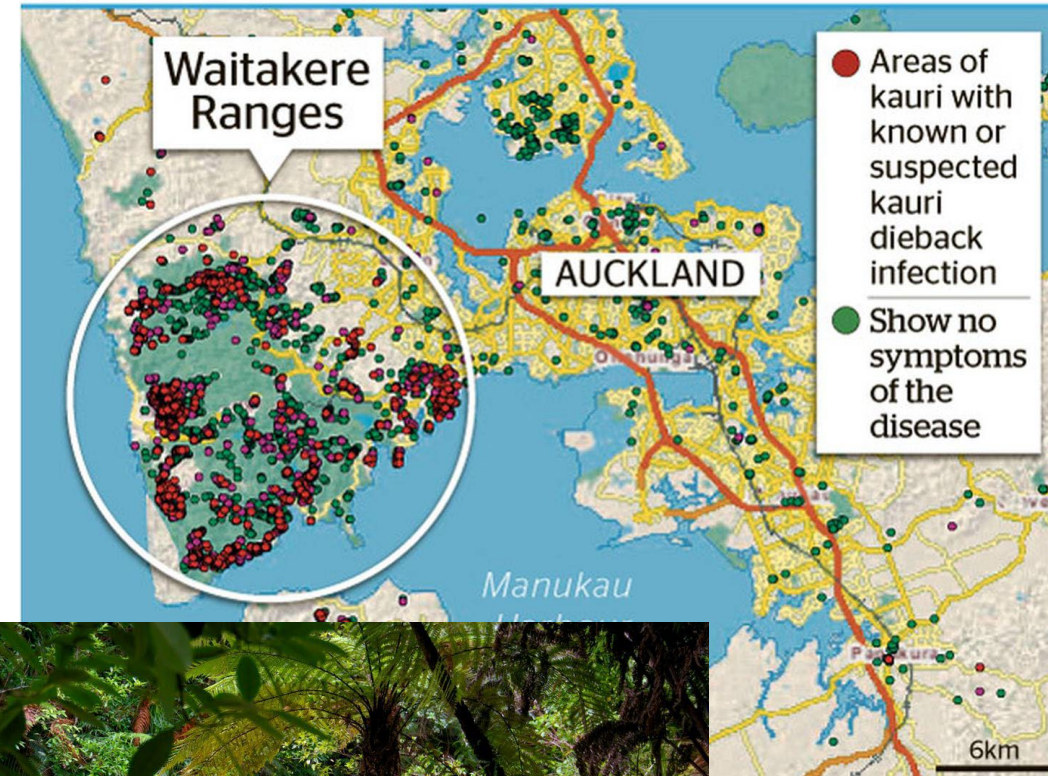
Context & Requirement



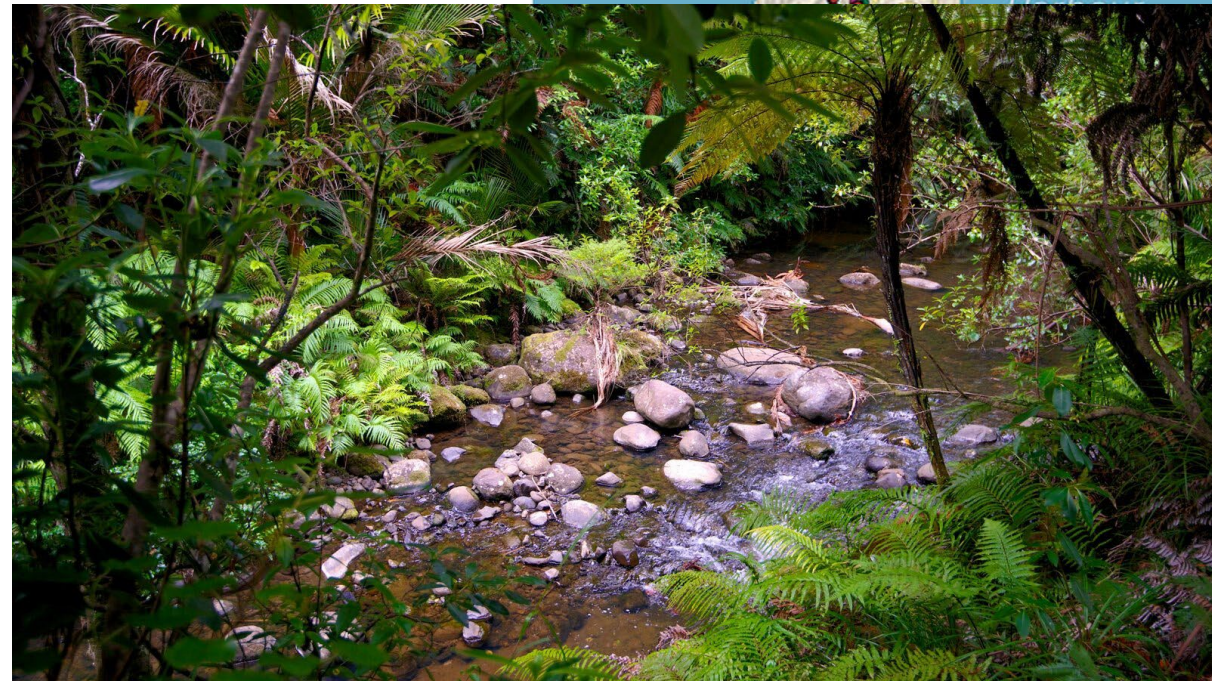
Kauri dieback

Constraints

- High environmental value to Tangata Whenua and public
- Kauri Dieback
- Steep topography
- Rock fall – above ground pipe
- High levels of land instability
- 40 Acre Slip – active slip
- Major weather events in 2023
- Auckland Anniversary Floods
- Cyclone Gabrielle
- Timelines

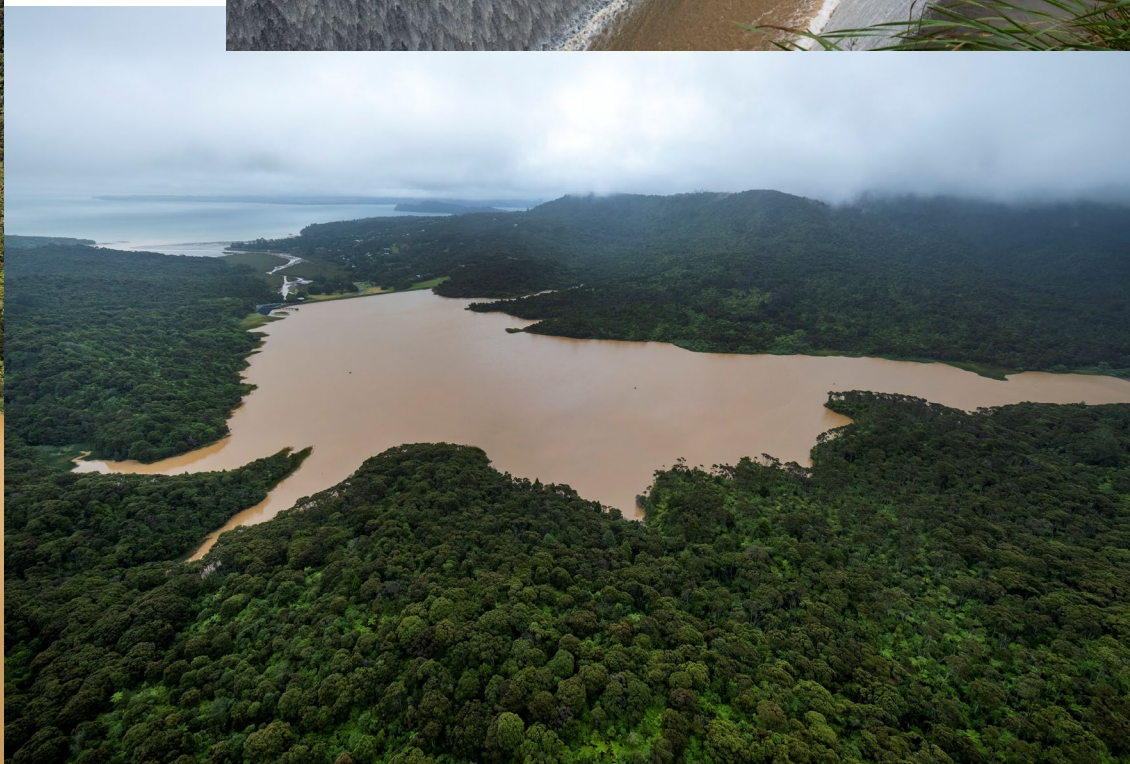


Source: Auckland City



2023 Weather Events

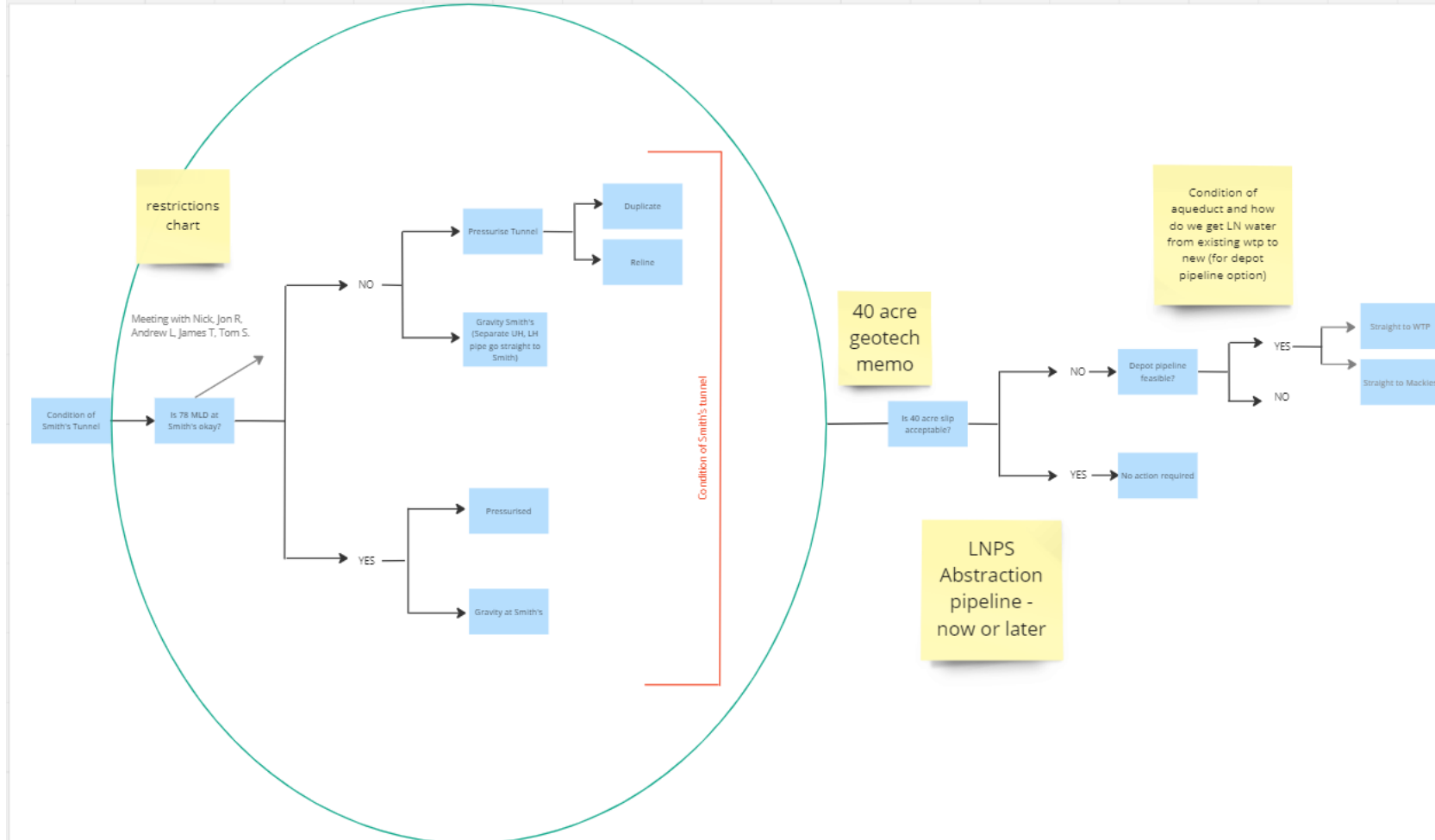
- Auckland Anniversary Floods
- Cyclone Gabrielle





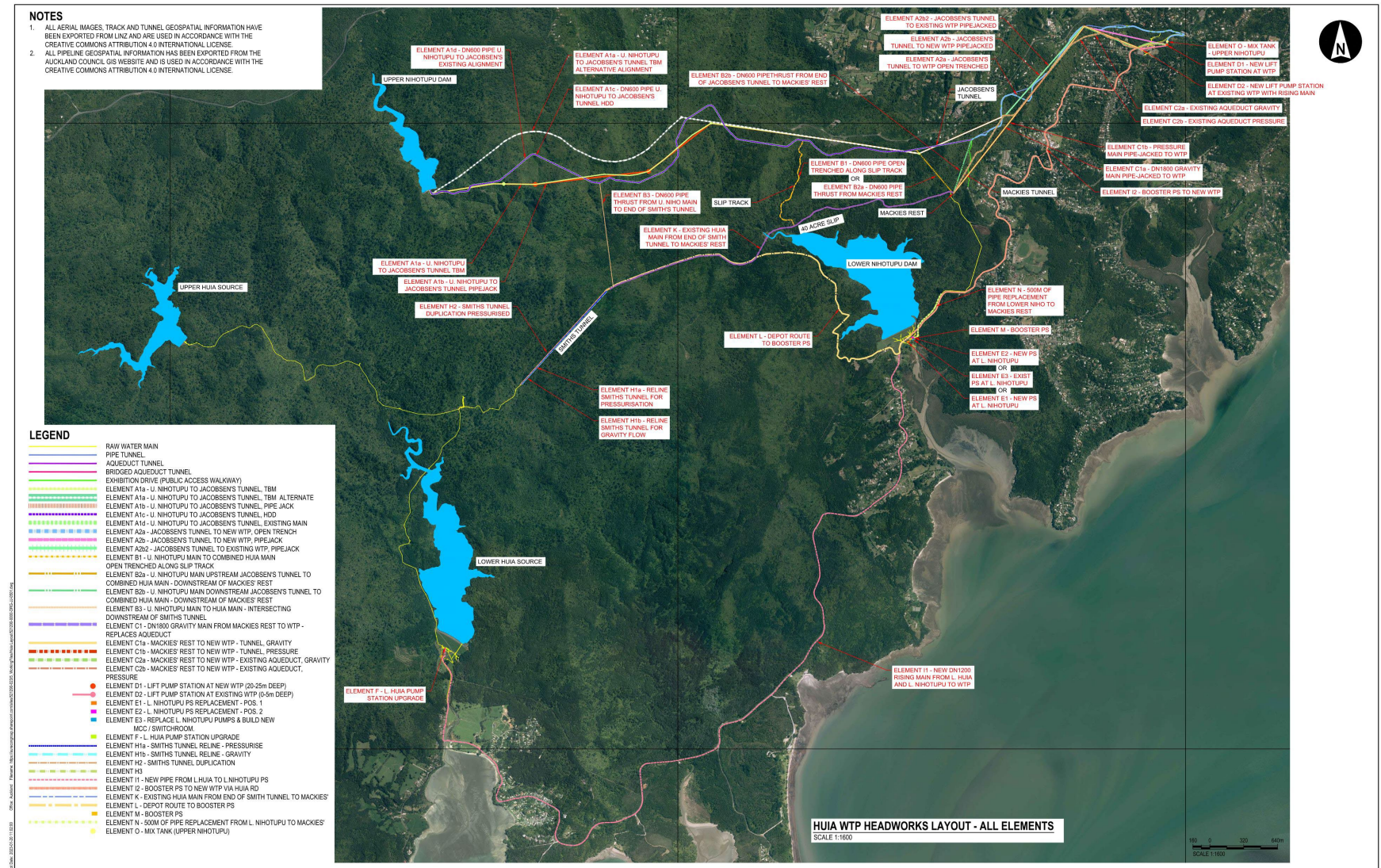
Adaptive Planning

Huia Raw Water System Optimisation Process Map



Assessment Approach

- Option 1 - Gravity with lift station at new WTP
- Option 2 – Pressurising the existing system
- Option 3 – Pressure via Hui Road
- Option 4 - 40 Acre Slip bypass



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Watercare

REV	DATE	REVISION DETAILS	APPROVED
A	2023-04-06	ISSUED FOR OPTIONS ASSESSMENT WORKSHOP	N.HOLDEN
B	2023-10-06	RE-ISSUED FOR OPTIONS ASSESSMENT WORKSHOP	N.HOLDEN

SCALE	SIZE	PRELIMINARY
AS NOTED	A1	NOT FOR CONSTRUCTION
DRAWN	S.PARK	APPROVED
DESIGNED	S.BRANDT	DATE
REVIEWED	A.GRAY	N.HOLDEN

PROJECT	TITLE	DRAWING No	PRODUCTION	DATE	SCALE	STATUS
WATERCARE HUIA RAW WATER OPTIMISATION	HUIA HEADWORKS RAW WATER TRANSMISSION MAINS LAYOUT - ALL ELEMENTS	521290	0023	DRG	LAY	0514

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The New Zealand Water & Wastes Association Waiora Aotearoa

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Assessment Approach

- Traffic Light' assessment

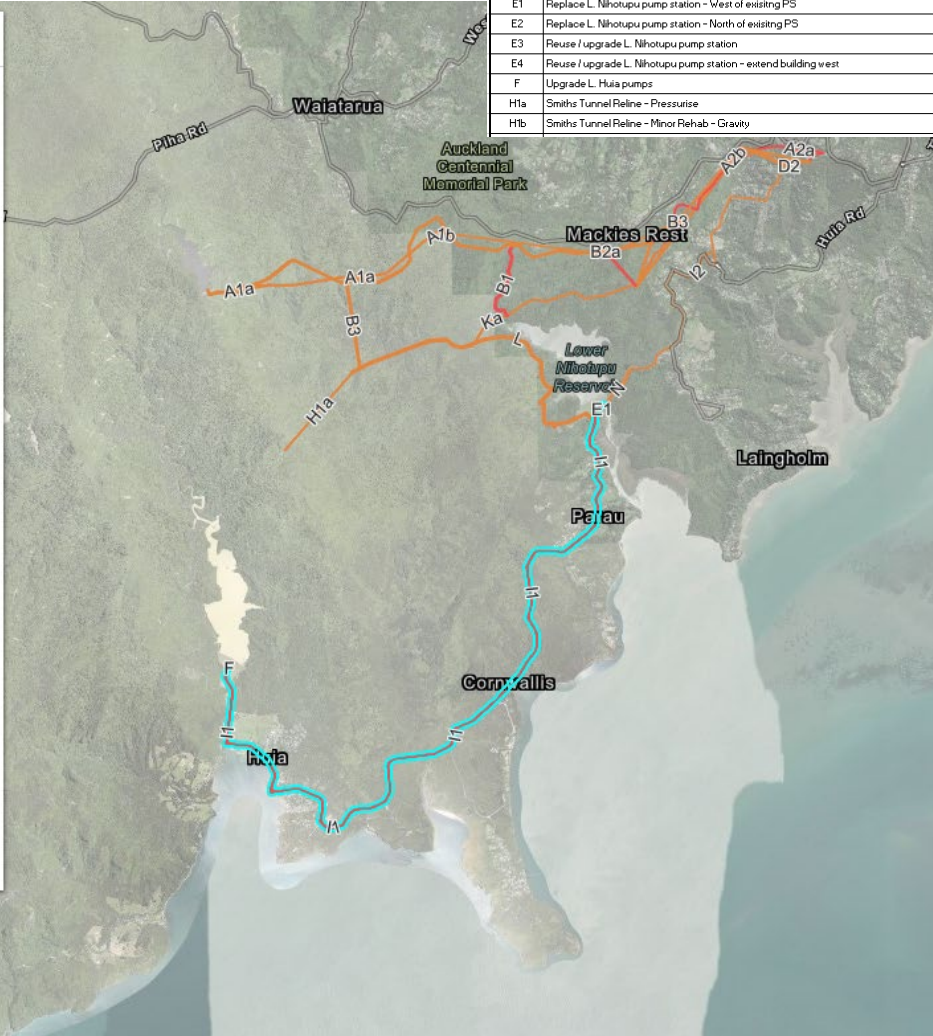
Element	Description	Contaminated Land	Stakeholder Relationships / Consenting	Kauri Dieback	Hydraulics	Structural / Tunnelling	Geotechnical	Planning	Overall Rating
A1a	U. Nihotupu Dam to Greenwoods Corner - TBM	3	3	2	3	3	3	2	2
A1b	U. Nihotupu Dam to Torrens Taper via Greenwoods Corner - Pipejack	3	3	2	3	3	3	2	2
A1c	U. Nihotupu Dam to Jacobsen's Tunnel - HDD	3	3	2	3	2	2	2	2
A1d	U. Nihotupu Dam to Jacobsen's Tunnel - Existing alignment	3	3	2	3	2	2	2	2
A2a	Exhibition Drive section, from Jacobsen's tunnel to new WTP	3	3	2	3	3	2	2	2
A2b	Exhibition Drive - Pipejack	3	3	2	3	3	3	2	2
B1	U. Nihotupu crossover to Huia combined main	3	3	2	3	1	1	1	1
B2a	U. Nihotupu main upstream Jacobsen's tunnel to combined Huia Main - downstream of Mackie's Rest	3	3	2	2	1	1	1	1
B2b	U. Nihotupu main downstream Jacobsen's tunnel to combined Huia Main - downstream of Mackie's Rest	3	3	2	2	2	2	2	2
B3	U. Nihotupu main to Huia Main - intersecting downstream of Smiths Tunnel	3	3	2	2	2	2	2	2
C1a	Mackie's Rest to new WTP - Tunnel to replace aqueduct - Gravity	3	3	2	3	3	3	2	2
C1b	Mackie's Rest to new WTP - Tunnel to replace aqueduct - Pressure	3	3	2	3	3	3	2	2
C2a	Mackie's Rest to new WTP - Use existing aqueduct - gravity main - minor amendments	3	3	2	2	2	2	2	2
C2b	Mackie's Rest to new WTP - Use existing aqueduct - pressure main	3	3	2	3	2	2	1	1
D	Lift pump station at new WTP (20-25m)	3	3	2	3	3	3	2	2
D2	Lift pump station at end of existing aqueduct (existing WTP) (0-5m deep)	3	3	3	3	3	3	2	2
E1	Replace L. Nihotupu pump station - West of existing PS	3	3	2	3	3	3	2	2
E2	Replace L. Nihotupu pump station - North of existing PS	3	3	2	3	3	3	2	2
E3	Reuse / upgrade L. Nihotupu pump station	3	3	2	3	2	3	2	2
E4	Reuse / upgrade L. Nihotupu pump station - extend building west	3	3	2	3	2	3	2	2
F	Upgrade L. Huia pumps	3	3	2	3	3	3	2	2
H1a	Smiths Tunnel Reline - Pressurise	3	3	2	3	3	3	2	2
H1b	Smiths Tunnel Reline - Minor Rehab - Gravity	3	3	2	2	3	3	2	2

Edit Zoom to

Element I1: New pipe from L. Huia to L. Nihotupu PS

Overall Rating: Unacceptable / Not Feasible

contaminated_land	Acceptable / Feasible
stakeholder_relationships_consenting	Unacceptable / Not Feasible
kauri_dieback	Potential
hydraulics	Acceptable / Feasible
structural_tunnelling	
geotechnical	Potential
planning	Potential
location	Lower Huia to new Lower Nihotupu Pump Station Size: 1200NB Length: ~10km
modification	Independent watermain to be constructed from Lower Huia Dam to Lower Nihotupu Dam (Element E1 or E2) along local roads. In conjunction with Element I2, this will provide resilience to the new water network



Edit Zoom to 2 of 3

Element H1a: Smiths Tunnel Reline - Pressurise

Overall Rating: Potential

contaminated_land	Acceptable / Feasible
stakeholder_relationships_consenting	
kauri_dieback	Potential
hydraulics	Acceptable / Feasible
structural_tunneling	Acceptable / Feasible
geotechnical	Acceptable / Feasible
planning	Potential
contaminated_land_assessment	Contamination assessment not applicable for this option as no soil disturbance works proposed for Element H.
geotechnical_observation_advice	1. portals of existing tunnel are located at landslip-prone area. it induces maintenance issue. 2. landslip preventive measures to be advised when site access is available. 3. no inspection was made inside the tunnel, existing condition remains unknown.

Edit Zoom to 2 of 3

Element H1a: Smiths Tunnel Reline - Pressurise

constructability	remains unknown. 4. inspection via drone in subsequent stage? Restricted by timeframe of temporary closure for construction Need to be able to make live at very short notice during construction Potential for manual labour in remote and confined space (depending on re-lining methodology) Bespoke solution
hydraulics_piping	Even if this could be sealed, the confluence chamber at the end has quite a large volume, and will tend to accumulate pockets, from entrained air when the pump pressure is lost. Then large air valves may be required. Previous reports and SCADA data indicate that the maximum capacity of the Smith tunnel is approximately 78 MLD. Once the Smith Tunnel is pressurized, the vent stack can be removed, and the LH pipeline can be connected directly to the Huia main line.

Edit Zoom to 2 of 3

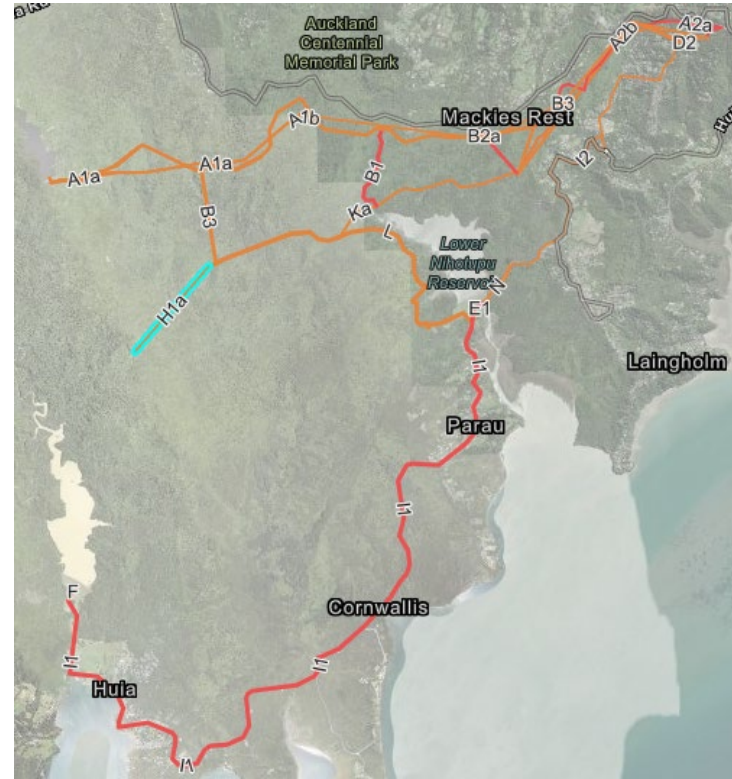
Element H1a: Smiths Tunnel Reline - Pressurise

location	Smiths Tunnel Reline Size Current: 1.22w x 1.52h (~1220NB) Length: 1188m + end chambers
modification	Relining of Smiths Tunnel would be needed to allow the pressurisation of the system. The current capacity of the tunnel is 78 ML/d, the resulting capacity post modification would need to be determined after hydraulic modelling
resource_consenting	Designations - 9322, Water Supply Purposes - Headworks Service Land Waitakere Ranges, Designations, Waterecare Services Ltd Designations: Designations - 418, Regional park (Waitakere Ranges Regional Parkland), Designations: Auckland Council

Edit Zoom to 2 of 3

Element H1a: Smiths Tunnel Reline - Pressurise

structural_tunneling_requirements	- Outstanding Natural Features Karamatura, Marama catchments & Mt Donald McLean - WRHAA - all water supply infrastructure in the catchment is identified for it's national significance. - Stream reclamation/diversion? - Need confirmed location of pipework to rule out need for stream reclamation/diversion. - Kauri dieback containment
model_in_gis	Model in GIS
actions	Keep



Edit Zoom to 1 of 3

Element H1b: Smiths Tunnel Reline - Minor Rehab - Gravity

Overall Rating: Potential

contaminated_land	Acceptable / Feasible
stakeholder_relationships_consenting	
kauri_dieback	Potential
hydraulics	Potential
structural_tunneling	Acceptable / Feasible
geotechnical	Acceptable / Feasible
planning	Potential
location	Smiths Tunnel Reline - Minor Rehab - Gravity
modification	
model_in_gis	Model in GIS
actions	Keep

Assessment Approach

- Multi Criteria Assessment
- Originally planned to score each element within an option
- GIS would be used to combine and display scores to provide aggregate weighting

Option 1 [Gravity + Lift Station]

Element C - Aqueduct	Element D	Element H1b	Weighted Criteria Score for combined elements	Weighted Criteria Rating
Element C1a				
Mackie's Rest to new WTP - Tunnel to replace aquaduct - Gravity	Lift pump station at new WTP (20-25m)	Smiths Tunnel Reline - Minor Rehab - Gravity		

Option 2 Option 2 [Pressure pipelines]

Element C - Aqueduct	Element H - Smiths Tunnel		Element N - Lower Niho. Rising Main	Weighted Criteria Score for combined elements	Weighted Criteria Rating
Element C1b	Element H1a	Element H2			
Mackie's Rest to new WTP - Tunnel to replace aquaduct - Pressure	Smiths Tunnel Reline - Pressurise	Smiths Tunnel Duplication - HDD	500m of Lower Niho to Mackies pipeline, in road		

Option 4 [Depot Pipeline]

Element C - Aqueduct	Element D2	Element H1b	Element I2	Element L	Element M	Weighted Criteria Score for combined elements	Weighted Criteria Rating
Element C2a							
Mackie's Rest to new WTP - Use existing aquaduct gravity main - minor	Lift pump station at end of existing aquaduct (existing WTP) (0-5m deep)	Smiths Tunnel Reline - Minor Rehab - Gravity	Lower Nihotupu to new WTP via Huia Road	Depot route to booster pump station	Booster PS near Lower Niho PS		

Assessment Approach

- However:
- Weighting per element is hard to define/defend
- Same element would have different weighting in different options
- Reduces amount of potential user bias

Option 1 Gravity + Lift Station	Option 2 Pressure	Option 4 Depot Pipeline
Element C1a - Mackies Rest to new WTP - Tunnel to replace aquaduct (Gravity) Element D - Lift pump station at new WTP Element H1b - Smiths Tunnel Reline - minor rehab (Gravity)	Element C1b - Mackies Rest to new WTP - Tunnel to replace aquaduct (Pressure) Element H1a - Smiths Tunnel Reline (Pressure) Element H2 - Smiths Tunnel Duplication - HDD Element N - Lower Nihotupu Rising Main - 500m of Lower Nihotupu to Mackies pipeline	Element C2a - Mackies Rest to new WTP - Use existing aquaduct - Gravity main Element D2 - Lift pump station at end of existing aquaduct (existing WTP) (0-5m) Element H1b - Smiths Tunnel Reline - Minor rehab (Gravity) Element I2 - Lower Nihotuptu to new WTP via Huia Road Element L - Depot route to booster pump station Element M - Booster PS near Lower Niho PS
R Wx%	R Wx%	R Wx%

Assessment Approach

Key for assessment criteria

		Assessment Scale Guidelines								
Category	Criteria	-4	-3	-2	-1	0	1	2	3	4
Project Objectives	Average and peak supply performance / purpose of element	Desired average and peak supply cannot be achieved based on current scenarios	Indications that average and peak supply may not be achieved based on current scenarios	Average and peak supply can most likely be achieved based on current scenarios	Desired average and peak supply can be achieved based on current scenarios	Desired average and peak supply can be exceeded based on current scenarios				
Cultural values	Effects on mauri	Perceived permanent negative effects from construction and new asset on the mauri of the land, water, and air.	Perceived short-term negative effects from construction and new asset on the mauri of the land, water, and air.	Negligible combined effects from construction and new asset on the mauri of the land, water, and air.	No effect of construction and new asset on the mauri of land, water, and air	Perceived positive effects from construction and new asset on the mauri of the land, water, and air.				
	Effects on sites of significance for Māori or sacred areas	One or more sites of significance in the area that will be notably impacted by the asset or construction	Single site of significance that will be minimally impacted by construction	Sites of significance in the area that are not impacted by the construction or asset, surveys and impacts assessment required	Sites of significance in the area that are not impacted by the construction or asset	No sites of significance in the construction and wider project area				
Built heritage	Effects on heritage areas	One or more heritage sites in the area that will be notably impacted by the asset or construction, approvals / authority to disturb may be declined	Single heritage site that will be minimally impacted by construction, approvals / authority to disturb required	Heritage site in the area that are not impacted by the construction or asset, surveys and documentation required	Heritage site in the area that are not impacted by the construction or asset	No heritage sites in the project vicinity				
Social Impact	Land requirement	Private land and / or public land to be acquired and pushback expected	Private and/or public land to be acquired and chance of pushback	Private and/or public land to be acquired with no pushback expected	All WSL land, brownfields development	All vacant Watercare land				
	Impact post completion on the community and community groups	Community pushback is almost certain, with potential for legal challenge, prolonged media attention, and project delay	Community pushback is possible, with potential for short-term media attention	Community is unlikely to react negatively to the option	Possible that the community may be in support of the proposed option	Community and/or community groups provide verbal approval or are in support of the option				
Environmental	Visual impacts of option	Option is obtrusive and reduces the visual amenity of the area	Option has an increased negative visual impact on that of existing infrastructure in the area	Option has the same visual impact as existing infrastructure in the area	Option has a slight improvement on the relative visual impact of existing infrastructure in the area	Option in a large improvement on relative visual impact of existing infrastructure in the area				
	Impact on ecology	Irreversible and significant negative combined impact from construction and infrastructure upon local and/or catchment ecology, likely to lead to community upset or legal challenge	Some negative impact from combined overall impact of construction and infrastructure upon local and/or catchment ecology, which may lead to community upset or legal challenge	No notable impact upon local and catchment ecology from combined overall impact of construction and infrastructure.	Combined overall impact of construction and infrastructure provide a small opportunity to improve local and catchment ecology.	Combined overall impact of construction and infrastructure provides a notable opportunity to improve catchment ecology				
	Adaptability to climate change	Asset is not future proof, natural hazards are likely to impact the asset	Asset is future proof to expected standards with no extra resilience to climate change scenarios	Asset is future proof to expected standards with moderate climate change resilience	Asset is future-proof and can adapt to expected climate change scenarios	Asset is future-proof and can adapt to adverse climate change scenarios				
	Contaminated Land	High levels of contamination which will require significant additional measures	Notable contamination which will require additional measures	Some contamination which will require few additional measures	Very little contamination which requires no additional measures based on current testing	No contamination based on current testing				
	Geotechnical Conditions	High uncertainty on geotechnical conditions and/or highly concerning geotechnical conditions that may impact the construction or asset once in place	Some uncertainty on geotechnical conditions and/or some concern that geotechnical conditions may impact the construction or asset once in place	Fair certainty on geotechnical conditions and little concern of geotechnical conditions impacting upon the construction or asset once in place	Moderate certainty on geotechnical conditions and no known concern of geotechnical conditions impacting upon the construction or asset once in place	High certainty on geotechnical conditions and no known concern of geotechnical conditions impacting upon the construction or asset once in place				
	Groundwater conditions	High uncertainty on groundwater conditions and/or highly concerning groundwater conditions that may impact the construction or asset once in place, including settlement potential	Some uncertainty on groundwater conditions and/or some concern that groundwater conditions may impact the construction or asset once in place, including settlement potential	Fair certainty on groundwater conditions and little concern of groundwater conditions impacting upon the construction or asset once in place, including settlement potential	Moderate certainty on groundwater conditions and no known concern of groundwater conditions impacting upon the construction or asset once in place, including settlement potential	High certainty on groundwater conditions and no known concern of groundwater conditions impacting upon the construction or asset once in place, including settlement potential				

Conclusions and Where to Next

- Complex project made up of multiple individual projects
 - With more than 1 viable and realistic outcome
- Large amount of dialog and openness to change required
- Project taken several twists and turns throughout
- Outputs/GIS tool not what was initially envisaged

- Further develop construction areas of potential options
- To allow more detailed ecological assessments



Thank you all for your time.

Questions?