Discharge Option: Deep Bore Injection

Description

Deep Bore Injection (DBI) is the purposeful injection of treated wastewater to the subsurface; whereby the intention is that the applied water ultimately permeates the subsurface and enters groundwater or an aquifer(s). The practice can harness an aquifer(s) storage, transmission/dissipation, and filtration properties whilst potentially providing water quality improvement benefits.

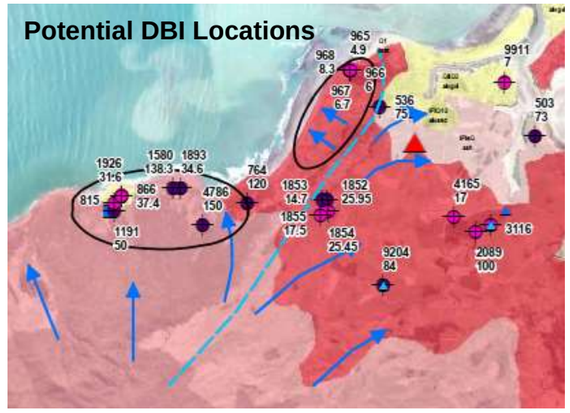
Treated wastewater (TSS removal) would be injected into an array of deep bores that extend below groundwater level. The upper section of the borehole has a solid casing to contain the water while the lower section has a screen casing to discharge the treated wastewater into the subsurface where it disperses through fractures in the rock. The favourable volcanic geology of the Raglan area suggests that DBI may be a possible option for treated wastewater discharge.

Options for deep bore injection include two main geological options, based around injection into two different volcanic formations, being the older volcanic Okete Formation and the more recent volcanic Karioi Formation.

Location

The potential deep bore injection sites have been based around accessing the Karioi Formation or the Okete formation but vary depending on where the treated wastewater will ultimately migrate. In western areas, migration to the coastal marine environment is more likely.

It may be possible to inject into the Karioi or Okete Formations further east and south of Raglan, though ultimate migration of the injected wastewater via fresh water and harbour pathways needs to be considered.



DBI Option	Description
Okete Formation - marine migration (Wainui Reserve)	This incorporates injection into an older and thinner Okete volcanic layer, potentially accessed via the Wainui Reserve (public land). Positioning of the bores would likely be along the western extent of the reserve, spaced to promote even distribution. Migration of the injected treated wastewater would likely be westward, towards the coastal marine environment. Consideration would need to be given to mitigating potential break out on Ngarunui Beach. The existing wastewater treatment system, with membrane filtration tertiary treatment would likely be suitable for this option.
Karioi Formation - marine migration	This option would incorporate injection into the more recent Karioi volcanic layer, which is thicker than the Okete formation. The bore location would be at a suitable location near Manu Bay or Whale Bay, with migration of injected treated wastewater being north and north west, to the coast. The existing wastewater treatment system, with membrane filtration tertiary treatment would likely be suitable for this option.
Karioi/Okete Formation - freshwater/harbour migration	This option would incorporate deep bore injection into either the Okete or Karioi formations but at a location east of the coast, where injected treated wastewater would likely flow north to north east, potentially breaking out at surface water locations (freshwater) and migrating to the harbour. Consideration would need to be given to potential groundwater and surface water users. Additional wastewater treatment, potentially to a potable standard, including improved nutrient removal and tertiary membrane filtration and/or reverse osmosis would likely be required for this option.

Options Assessment Criteria

Criteria	Issue/Topic	Description/Explanation
Public Health	Microbiological quality of treated wastewater	Risk of public exposure to waterborne pathogens through:
		- Direct contact with the conveyance or treatment process
		- Direct contact with the receiving environment, for example through contact recreation
		- Indirect exposure, through food gathering (such as shellfish, fish, watercress, etc) and groundwater use.
	Health effects from irrigation	Risk of public exposure to pathogens from irrigation.
	Treated wastewater re-use	Risk of contamination from treated water for non-potable re-use.
Environment	Water quality	Potential effects on freshwater (surface and ground) and coastal/marine receiving environments
	Aquatic ecology	Potential effects on aquatic ecosystems
	Terrestrial ecology	Potential effects on terrestrial ecosystems and soils
	Coastal environment and resources	Potential effects on significant coastal and marine areas, existing harbour and coastal processes, and physical footprint within the harbour and coastal marine area.
Cultural	Mauri	Potential effects on mauri of land, water and air
	Kai moana	Potential effects on kai moana and the kaitiaki management of customary fishing
	Cultural values	Potential effects on the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu and other taonga
	Health and Wellbeing	Potential effects on the ability of the land, sea and air to support wairua in order to maintain health and wellbeing for Maori
Social and community	Amenity value and aesthetics	Potential effects on the natural and built environment (e.g. visual, odour, noise)
	Urban development	Extent to which the option enables residential and commercial development within the projected timeframe
	Recreation	Extent to which the project enhances or detracts from local recreational activities and opportunities
	Food gathering	Extent to which the project enhances or detracts from people's ability to collect food within the area
	Access to the coast	Extent to which an option effects access to the coastal marine area.
	Re-use potential of option	Extent that treatment by-products can be utilised beneficially now and into the future (i.e. irrigation/nutrients for food production)
Sustainability	Carbon footprint	Potential embodied and operational carbon footprint
Constructability	Geology, soil, groundwater conditions	Option suited to local environmental conditions
	Land availability, accessibility	Adequate and secure land must be available for the required infrastructure, timescales that fit within project timing
	Existing infrastructure	Potential to maximise use of existing infrastructure that has a valuable remaining economic life, e.g. power supply, treatment plants, pumps, conveyance pipes and existing sites.
Technology	Reliable, proven and robust technology	To be sustainable, an option should be based on proven technology and have adequate redundancy (spare operational capacity to provide back-up in case of failure)
	Adaptable and flexible	Due to the uncertainty associated with future growth, a feasible option must be able to adapt to changing conditions such as increased flows and loads, discharge quality requirements, input requirements, and energy availability.
	Able to be staged	The extent to which an option could be staged (e.g. through modularised components).
	Operational and engineering resilience	The option must be sufficiently resilient to natural hazards and operational failure.
Financial Implications	Capital cost	Is the cost of the project appropriate for the project area and the population served?
	Operating and maintenance cost	Can the capital infrastructure be maintained and operated in a cost-effective manner?
	Whole of life cost	How do the whole of life costs pf the various options compare?
	Financial risk	Is the option affordable even if growth does not occur as predicted?
Opportunities and Benefits	Opportunity for resource recovery	The provision of beneficial reuse of treated wastewater. (i.e. with emphasis on food production)
		The potential for beneficial reuse of biosolids. (i.e. with emphasis on food production)
Statutory Policy Considerations	Consistency of the option with National Policy Statements (NPS)	Includes consistency with the New Zealand National Coastal Policy Statement (NZCPS), National Policy Statement for Freshwater Management (NPS-FM) and any other relevant NPS
	Consistency of the option with any other relevant legislation outside of the Resource Management Act	Includes consistency with the Reserves Act, and any other relevant Act

Options Assessment

Deep Bore Injection options are assessed based on the above criteria in the following table.

Key: Red – Largely fails to meet the criteria, Amber - Marginally meets the criteria, Green - Meets criteria well												
DBI Option	Public Health	Environment	Cultural	Social & Community	Sustainability	Constructability	Technology	Financial Implications	Opportunities and Benefits	Statutory Policy Considerations	Comments	Carry forward to short list?
Okete Formation - marine migration (Wainui Reserve)	Low risk of public contact. WWTP treatment to include disinfection and loading rate to reduce risk of break out on beach	Disposal location selected to avoid environmental effects.		Need to consider community perception of migration to coastal area. Potential for recreational issues in terms of community perception	Initial carbon footprint increase associated with drilling	Required confirmation of geology and soakage rates (Thickness of basalt layer potentially a limiting factor)	DBI not common but example in NZ (Russell). Common oversees with numerous examples in Hawaii. Treatment technologies common.	Moderate cost. Higher risk of cost increase depending on soakage rates (TBC).	Potential for all year round disposal option.	Potential for discharge to coastal waters if located in proximity to the coast. Policy 23(2)(b)(ii) of the New Zealand Coastal Policy Statement 2010 (NZCPS) has relevance -see notes Unlikely to have significant adverse water quality effects on coastal waters.	Potentially carried forward due to potential location within Wainui Reserve, low public health risk and close location to WWTP.	No/Yes (ELT advice needed)
Karioi Formation - marine migration	Low risk of public contact. WWTP treatment to include disinfection.	Disposal location selected to avoid environmental effects.		Need to consider community perception of migration to coastal area. Potential for recreational issues in terms of community perception	Initial carbon footprint increase associated with drilling.	Required confirmation of geology and soakage rates	DBI not common but example in NZ (Russell). Common oversees with numerous examples in Hawaii Treatment technologies common.	Moderate cost. Higher risk of increase depending on soakage rates (TBC).	Potential for all year round disposal option.	Potential for discharge to coastal waters if located in proximity to the coast. Policy 23(2)(b)(ii) of the New Zealand Coastal Policy Statement 2010 (NZCPS) has relevance -see notes Unlikely to have significant adverse water quality effects on coastal waters.	Potentially carried forward due to potentially for favourable geology and low public health risk.	No/Yes (ELT advice needed)

Key: Red – Largely fails to meet the criteria, Amber - Marginally meets the criteria, Green - Meets criteria well

DBI Option	Public Health	Environment	Cultural	Social & Community	Sustainability	Constructability	Technology	Financial Implications	Opportunities and Benefits	Statutory Policy Considerations	Comments	Carry forward to short list?
Karioi/Okete Formation - freshwater/harbour migration	Potential risk of migration towards known and unknown groundwater supplies.	Potential migration of nutrients to freshwater bodies. Improved nutrient removal required at WWTP.		Need to consider community perception of migration via freshwater and harbour. Potential for food gathering and recreational issues in terms of community perception	Initial carbon footprint increase associated with drilling.	Required confirmation of geology and soakage rates	DBI not common but example in NZ (Russell). Common oversees with numerous examples in Hawaii.	High costs, including cost for treatment plant upgrade (TBC). Higher risk of increase depending on soakage rates (TBC).	Potential for all year round disposal option. Potential for non-potable reuse as an add on.	Potential for adverse effects on freshwater quality as a result of nutrient migration and migration to groundwater supplies. Further work required to assess consistency with the NPS-FM.	Not carried forward due to potential risk to groundwater supplies.	No

Notes

In reference to Policy 23(2)(b)(ii) of the New Zealand Coastal Policy Statement 2010 (NZCPS), a clear understanding from Raglan tangata whenua after engagement is that the present treated wastewater marine discharge is offensive to their values, with a substantial adverse effect resulting. Any alternative discharge method that enables satisfactory whenua contact and re-use potential, should have in principle support.