Memorandum

To	Watercare Services Limited
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Office	Auckland
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Subject	Memo summarising the assessment of alternative positions of Shaft 1

Schedule 4, clause 6 of the RMA provides that where it is likely that an activity will result in any significant adverse effect on the environment, a description needs to be provided of any possible alternative locations or methods for undertaking the activity.

The Integrated Traffic Assessment (ITA) for the proposed Herne Bay Tunnel project has determined that there will be a temporary significant adverse traffic effect on Emmett Street and Curran Street for approximately 100 days (3 months) as a result of redirected traffic during the full closure of Sarsfield Street (refer AEE Section 4.5 and 8.4). The closure of Sarsfield Street is required for the construction of proposed Herne Bay Trunk Sewer (HBTS) Shaft 1. This memorandum therefore provides an assessment of alternative options for locating the proposed HBTS Shaft 1.

This memo:

- Outlines the proposed sewer route relative to Shaft 1;
- Identifies the design, constructability and consenting criteria affecting the position of Shaft 1 and summarised in a multi-criteria analysis, and;
- Justifies the tunnel alignment proposed, which affects the Shaft 1 position.

1 Proposed Herne Bay Trunk Sewer Route

The proposed HBTS route is along Marine Parade, Upton St, Herne Bay Rd, Argyle St, Wallace St and then along Sarsfield St to then connect to the proposed Pt Erin Central Interceptor (CI) Control Chamber.

The location of the proposed CI Control Chamber (CICC) is a fixed location in Pt Erin Park and this has been provided to the design team as the point where the HBTS must connect into the southern face of the CICC. Given the operational need for the HBTS to connect to the proposed CICC in Pt Erin Park, there are no other practical or constructable route options for the HBTS, with the only another road reserve option of constructing it along Jervois Rd requiring a significantly longer route for the HBTS and EOP connection pipes, with all being significantly deeper and requiring shafts in the higher traffic volume Jervois Rd. The HBTS would still require a shaft in or around Sarsfield St/Curran Rd intersection to make the connection to the CICC.

Therefore, an alignment along Jervois Road is not considered a viable alternative.

2 Shaft requirements and construction methodology

As the tunnel boring machine ('TBM') is unable to form trenchless bends, shafts are required at each change in direction of the HBTS. These will also provide access to the HBTS network for operations and maintenance purposes, as per Watercare standards DP-07. Refer to Appendix J for further details of the proposed construction methodology.

The proposed route is set on the road corridor to minimise temporary disruption to property owners during construction and also to facilitate any future maintenance and access requirements. With the size of the construction shafts being up to 13 m in diameter, and the support facilities required to support the TBM, there will unavoidably be disruption to traffic in the area around the shaft.

As noted, the TBM will form straight alignments between shafts. With the straight alignment between Shaft 1 and 2, Shaft 2 is positioned southeast of the corner of Sarsfield St and Wallace St. This proposed position is located further away from heritage building at 58 Wallace.

3 Construction Criteria influencing the location of Shaft 1

Construction space around the shaft is required to allow sufficient space for crane lifting requirements, including for lifting loads up to 20 m above ground. Furthermore, space is required to move other construction equipment around the site. This allows safe working space to operate equipment without the risk of endangering the construction crew and the public (vehicle movements and pedestrians).

The Sarsfield St formed carriageway is 10 - 10.5 m wide and the shaft is 13 m diameter, therefore full lane closure would be required for Option A and D for longer durations compared to Option B & C shown in Figure 3.

4 Criteria used for assessing position of Shaft 1

The considerations used for determining the proposed position of Shaft 1 are listed in Table 1 below.

Table 1 Summary of key criteria used for selecting Shaft 1 position

Criteria	Consequence
Location relative to the 4.5 m diameter proposed Central Interceptor Tunnel	Thrust pressures from tunnelling resulting in loading on the 4.5 m proposed CI tunnel or HBTS, depending on which pipe is installed first.
Location of the proposed Central Interceptor Control Chamber (CICC)	The location of the CICC is fixed by the CI project and is not able to be moved.
Tunnel alignment minimises crossing under private property	Cost and programme delays obtaining approval for easement or LoA from property owners.

Criteria	Consequence
Maintaining access for Curran St access to on-ramp to Auckland Harbour Bridge (SH1 motorway), along with other local traffic disruption	Closure would cause significant effects and delays to traffic network and surrounding residents and businesses. Consideration of availability of alternative routes for impacted residents
Hydraulics approach through Shaft 1 and into the CI Control Chamber	Reducing the deflected angle through Shaft 1 reduces the turbulence of flows through the shaft with odour and wear benefits in bends with lower deflected angles. WSL require deflected to not exceed 90 deg where possible
Minimising construction in unstable ground (valley in Point Erin)	Construction safety risk, operation construction equipment in steep terrain. More excavation works and extended construction programme.
Minimise removal of trees in Point Erin Park	Potential for loss of amenity and ecological values within Point Erin Park if mature trees are to be removed, noting that some tree removals are already required to enable the construction of the proposed CI.

5 Options assessment for Shaft 1 location

The options for the location of Shaft 1 are shown in Figure 1 below.

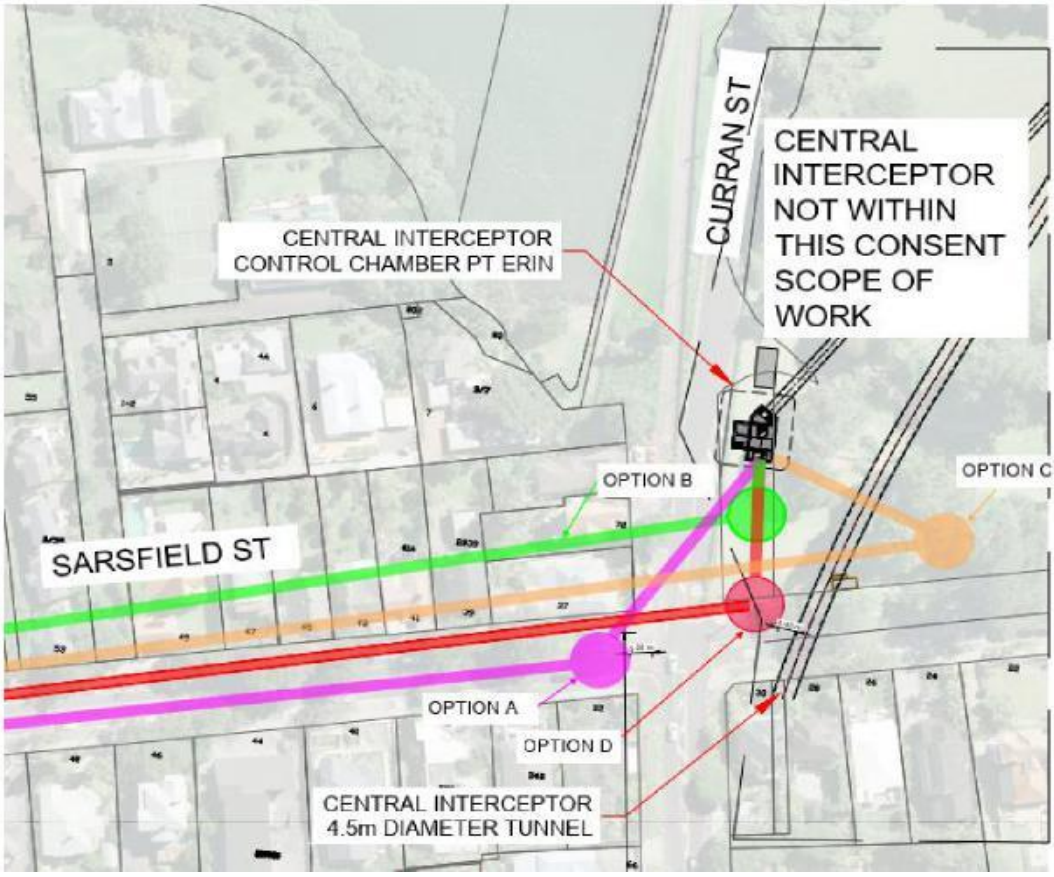

Figure 1 Shaft 1 locations considered

A summary of considerations and features of the relative site locations for Shaft 1 as per Figure 1 and the criteria given in Table 1, is given below.

Option A (Pink) – Shaft 1 is positioned across Sarsfield St (opposite 32 and 37 Sarsfield St) and taking up majority of the Sarsfield St carriageway width. Closure of access to Curran St from Sarsfield St (west of Curran St), and vice versa, would be required. Traffic travelling from the west wishing to use the Curran St onramp would need to detour via Jervois Rd, a significant additional distance. The temporary relocation of the vehicle accessway to #32 Sarsfield St during construction is also required. The shaft is setback far enough from Curran St to not require closure of Curran St on-ramp. The HBTS would likely pass under the corner of #37 Sarsfield St requiring an easement or LoA. While hydraulically this provides the best alignment of all the options as it is well clear of the CI tunnel, the shaft is the closest to houses of all the options thereby increasing the potential for damage and adverse noise and vibration effects to nearby dwellings. On the basis of the above, this location is not the preferred option.

Option B (Green) – Shaft 1 is positioned further north and within Point Erin Park. This will reduce traffic disruption effects of the Shaft 1 construction as no roads will be closed. The alignment will require easements and/or LoA under at least thirteen properties along Sarsfield St. This will have a significant disruption on Curran St where daily site traffic will need to enter/exit off Curran St. This is well clear of the CI. On the basis of the above, this location is not the preferred option.

Option C (Orange) – Shaft 1 is positioned in Point Erin Park to the east of the 4.5 m diameter proposed CI tunnel. This has benefits to minimise traffic disruption on Sarsfield St (between Curran and Shelly Beach Rd). The tunnelling pressures during construction of the HBTS approx. 2 m over top of the CI creates risk to the 4.5 m diameter proposed CI tunnel and vice versa depending on which is constructed first. The flows would need to turn through more than 90 deg, which is hydraulically undesirable. Additional removal of trees would be required in the reserve. The shaft would be located in steep terrain within Point Erin Park, resulting in limitations on constructability such as H&S concerns and flooding risk. Given the above, this location is not the preferred option.

Option D (Red) – Shaft 1 is positioned on the north side of Sarsfield to the west of the proposed CI tunnel. It still requires road closure on Sarsfield St east of Curran St, and prevents access onto Curran St from Shelly Beach Rd, but noting that a close by alternative route is available. Consideration of effects on the proposed CI tunnel during construction is required. **Option D is the preferred and recommended location** which balances the effects on traffic disruption, alignment under properties, can be located to mitigate impacts on the CI tunnel, hydraulics and limits effects on tree.