Attachment A

Photograph from Auckland Regional Authority File for the “Green Stream” Pollution Incident 1988 (URS, 2010)



# NZ Transport Agency and Auckland Transport

# East West Connections Project: Contaminated Land Assessment to Support Option Selection

October 2014

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# 1. Introduction

The East West Connections project is responding to the immediate and growing freight access issues at either end of the Neilson Street/Church Street corridor caused by inefficient transport connections and a lack of response to changes in the industry's supply chain strategies. The project is also addressing the inadequate quality of transport choices between Māngere, Ōtāhuhu and Sylvia Park.

The long list of options was developed in a 2-stage process. The option identification process began with identifying changes at a component level (e.g. lane widening; interchange improvements) across the geographical area. To ensure a full spectrum of components was considered, the study area was separated into segments. All components were then assessed through a multi-criteria analysis. Where broadly equivalent components (in terms of either transport performance or social, environmental or cultural outcomes) were identified, the best alternative proceeded to the development of the long list options. If no broadly equivalent alternative component existed, the component was progressed to the development of long list options. All options were assessed through a multi-criteria analysis, which considered a full range of impacts and performance against the project's objectives and the East West Connections outcomes. Six options were identified to progress to the short list for the Onehunga-Penrose connection. These options range from low investment to high investment.

These 6 options are the subject of this assessment and a detailed description of each are held in the Detail Business Case. The following summarised descriptions have been used as the basis of the following assessment.

## 1.1 Option A (Long List Option 1): Existing route upgrade.

This option looks to upgrade the existing roads. This includes improving capacity on SH20, Neilson Street and Church Streets. It also provides freight lanes.

- Auxiliary lanes / capacity improvements on SH20 (Queenstown Road to Gloucester Park)
- Some widening of Onehunga Harbour Road at Gloucester Park (e.g. around the Onehunga Port area, beneath SH20 and potential to increase this from 2 to 3 lanes up to Neilson Street / Onehunga Mall intersection).
- Upgrading of the intersection at Onehunga Mall / Neilson Street intersection (potentially including widening of bridge over the rail line) to provide for dedicated movements between Onehunga Mall / Neilson Street.
- Capacity improvements on Neilson St, for example extending the 4-laning from Alford St to Church St (potential impact on some road frontages, but looking to minimise)
- New signalised intersection to provide access to Metroport (for example, providing for dedicated turning median).
- Cycleway uses Hugo Johnston Road (within the road corridor), may impact on tree planting etc in existing road reserve, will then connect to Church Street East and Great South Road (level crossing) to connect to existing cycle path to Sylvia Park.
- Freight lane priority at Mt Wellington Interchange where this can fit beneath existing bridge constraints.

## 1.2 Option B (Long list Option 2): Upgrade with South Eastern Highway Ramp.

This option proposes an upgrade of existing roads with new ramp connections from Church Street to SH1 and South Eastern Highway.

- Auxiliary lanes / capacity improvements on SH20 (Queenstown Road to Gloucester Park).
- Some widening of Onehunga Harbour Road at Gloucester Park is likely (e.g. around the Onehunga Port area, beneath SH20 and potential to increase this from 2 to 3 lanes up to Neilson Street / Onehunga Mall intersection.
- At Onehunga Mall / Neilson Street intersection, upgrading of intersection is required (potentially including widening of bridge over the rail line) to provide for dedicated movements between Onehunga Mall / Neilson Street.
- Looking at capacity improvements on Neilson St, for example extending the 4-laning from Alford St to Church St (potential impact on some road frontages, but looking to minimise).
- New signalised intersections and upgrades to intersections at Metroport (for example: providing for a dedicated turning median), Church St, Hugo Johnston Drive and Great South Road (grade separation at Hugo Johnston Drive and Great South Road may be considered).
- Cycleway using Hugo Johnston Road (within the road corridor), may impact on tree planting etc in existing road reserve, will then connect to Church Street East and Great South Road (level crossing) to connect to existing cycle path to Sylvia Park.
- New connections for 'southern' traffic on SH1, with ramps from the South Eastern Arterial (looking at ramps of 2-lanes in each direction to connect from interchange to tie in with SH1 at Mt Wellington). This requires an auxiliary lane extension on SH1 down to Princes Street interchange.

## 1.3 Option C (Long List Option 5): Upgrade with new Galway Street and inland connections.

This option proposes a new connection from Onehunga Harbour Road to Galway Street, and upgrade of Neilson and Angle Streets and Sylvia Park Road, and a new connection for Angle Street to Sylvia Park Road and to SH1.

- Auxiliary lanes / capacity improvements on SH20 (Queenstown Road to Gloucester Park)
- Some widening of Onehunga Harbour Road at Gloucester Park is likely (e.g. around the Onehunga Port area, beneath SH20.
- New connection from Onehunga Harbour Road onto Galway Street (may impact on traffic movements / access to SH20 from Onehunga Mall / Onehunga Harbour Road)
- 4-lanes on Galway Street with upgraded intersection to Neilson Street, upgrading of intersection required (potentially including widening of bridge over the rail line) and to address increased traffic from Onehunga Mall to Galway Street.
- Looking at capacity improvements on Neilson St, for example extending the 4-laning from Alford St to Angle St and upgrading of Angle Street (e.g. up to 4-lane, which may require some additional land).
- New connection from Angle Street to Great South Road for between 2 and 4 lanes, and where practicable on land between Transpower towers and foreshore (not reclamation).

- At Sylvia Park Road, increasing capacity of some of Sylvia Park Road (e.g. additional lanes) and may require land take and relocation of Transpower towers.
- Ramps over Mt Wellington Highway to connect onto SH1, serving the south, with increased capacity (e.g. auxiliary lanes) on SH1 down to Princes St.
- Waikaraka Cycleway maintained and extended alongside new road sections to connect to Sylvia Park.

## 1.4 Option D (Long List Option 8): Upgrade with Gloucester Park interchange and new Galway Street and inland connections.

This option proposes an upgrade at Gloucester Park Interchange and a new connection from Onehunga Harbour Road to Galway Street. It also proposes an upgrade of Neilson and Angle Streets and Sylvia Park Road, and a new connection for Angle Street to Sylvia Park Road and to SH1. Auxiliary lanes / capacity improvements on SH20 (Queenstown Road to Gloucester Park).

- New interchange at SH20 at Gloucester Park, to restrict access to Neilson Street and divert all traffic onto Onehunga Harbour Road (widening requirements for Onehunga Harbour Road, e.g. 3+ lanes).
- New connection from Onehunga Harbour Road onto Galway Street (may impact on traffic movements / access to SH20 from Onehunga Mall / Onehunga Harbour Road).
- 4-lanes on Galway Street with upgraded intersection to Neilson Street, upgrading of intersection required (potentially including widening of bridge over the rail line) and to address increased traffic from Onehunga Mall to Galway Street.
- Looking at capacity improvements on Neilson St, for example extending the 4-laning from Alford St to Angle St and upgrading of Angle Street (e.g. up to 4-lane, which may require some additional land).
- New connection from Angle Street to Great South Road for between 2 and 4 lanes, and where practicable on land between Transpower towers and foreshore (not reclamation).
- At Sylvia Park Road, increasing capacity of some of Sylvia Park Road (e.g. additional lanes) and may require land take and relocation of Transpower towers.
- Ramps over Mt Wellington Highway to connect onto SH1, serving the south, with increased capacity (e.g. auxiliary lanes) on SH1 down to Princes St.
- Waikaraka Cycleway maintained and extended alongside new road sections to connect to Sylvia Park.

## 1.5 Option E (Long List Option 13) New foreshore Connection

This option proposes a new connection from SH20 to SH1 along the foreshore.

- Auxiliary lanes / capacity improvements on SH20 (Queenstown Road to Gloucester Park).
- New interchange at SH20 at Gloucester Park, with access to Neilson Street and onto Onehunga Harbour Road (may require some changes to traffic movements from Onehunga Harbour Road onto SH20).
- New connection from Gloucester Park along foreshore to Captain Springs Road and then inland to Great South Road.

- New intersections at Captain Springs Road, Southdown (Metroport) and Great South Road (may require relocation of Transpower towers).
- At Sylvia Park Road, increasing capacity of some of Sylvia Park Road (e.g. additional lanes) and may require land take and relocation of Transpower towers.
- Ramps over Mt Wellington Highway to connect onto SH1, serving the south, with increased capacity (e.g. auxiliary lanes) on SH1 down to Princes St.
- Waikaraka Cycleway maintained and extended alongside new road sections to connect to Sylvia Park.

## 1.6 Option F (Long List Option 14): New foreshore and inland connection

This option proposes a new connection form SH20 to SH1 (partly along the foreshore and partly inland).

- Auxiliary lanes / capacity improvements on SH20 (Queenstown Road to Gloucester Park).
- New interchange at SH20 at Gloucester Park, with access to Neilson Street and onto Onehunga Harbour Road (may require some changes to traffic movements from Onehunga Harbour Road onto SH20).
- New connection from Gloucester Park along foreshore to Captain Springs Road and then inland to Great South Road.
- New intersections at Captain Springs Road, Southdown (Metroport) and Great South Road (may require relocation of Transpower towers).
- At Sylvia Park Road, increasing capacity of some of Sylvia Park Road (e.g. additional lanes) and may require land take and relocation of Transpower towers.
- Ramps over Mt Wellington Highway to connect onto SH1, serving the south, with increased capacity (e.g. auxiliary lanes) on SH1 down to Princes St.
- Waikaraka Cycleway maintained and extended alongside new road sections to connect to Sylvia Park.

# 2. Methodology of the Assessment

This assessment of the six short-listed options was completed by:

- conducting a walkover of the site area using publically accessible land
- holding meetings with the Auckland Council closed landfill management team
- reviewing historic aerial photographs from Auckland Council and the National Library to provide context regarding activities in the study area, including reclamation and landfilling along the Onehunga foreshore
- collating readily available reports for contaminated sites in the study area, based upon our knowledge of projects undertaken since the 1990's and information held by key organisations including Auckland Council and the Transport Agency
- reviewing and summarising each technical report for the sites. All reports were shared with the groundwater and geotechnical assessment specialists
- plotting the physical boundaries of known landfill features on the spatial Project database (Teamview) and representing these features and other known contaminated sites in Figure 1
- summarising the options in terms of potential effects on the environment related to contaminated land (contaminated soil; groundwater; and gas). We have also commented on contaminated sediments for the foreshore options.
- The extensive study area encompassed by the six options precluded a full contaminated land database search for all properties directly affected or adjacent to the alignments. The area comprises a highly industrialised zone with a documented history of heavy industries, reclamation and waste disposal. As such, all alignments that pass adjacent to current or historic industrial sites have been treated as likely to classify as Hazardous Activities and Industries List (HAIL) category H (adjacent land) or category I (land subject to intentional or accidental releases) pursuant to the National Environmental Standard for Contaminated Soil (NES, 2011).
- Although a full contaminated site search of the Auckland Council database will reveal more information regarding specific sites, many sites are expected to have little or no environmental information and as such will need to be classified as "potentially contaminated" on the basis of HAIL activities/landuse until proven otherwise. In accordance with the NES, a preliminary site investigation (PSI) and detailed site investigation (DSI) will need to be completed prior to construction of the preferred Option, due to soil disturbance and the change in land use. An adequate level of characterisation will also be required to support the resource consent applications.

# 3. Background Information and Existing Environment

## 3.1 References and Reliance

The references reviewed for this assessment are listed in Section 8.0.

A conceptual groundwater model for the study area has been prepared in the Groundwater Assessment and has been relied upon for this assessment.

Effects of the Options on surface water and sediment quality are addressed separately in the Ecology Assessment. The effects of the Options on groundwater flow are addressed in the Groundwater Assessment, and we address effects on groundwater quality.

## 3.2 Existing Environment

The study area represents one of the most heavily industrialised parts of Auckland. The legacy of contamination is widespread, and includes the industrial sites themselves; impacts from discharges to soil, groundwater, air, stormwater and the coastal marine environment; and the coastal reclamation sites that were used for landfills and uncontrolled filling. The former Southdown freezing works site has been largely redeveloped although asbestos contamination is prominent there and across the study area, partly due to waste materials derived from the James Hardie manufacturing site in Penrose. The marine sediment quality in the area is generally highly degraded, although at least the shallow sediment quality has been gradually improving (as documented in the Ecology Assessment).

The groundwater conceptual model presented in the Groundwater Assessment shows that the groundwater and stormwater system is interconnected, and this affords the potential for contaminants in groundwater to enter the reticulated stormwater system, as in the case of the plume sourced from the former New Zealand Farmers Fertiliser site (**Figure 1**) that links to stormwater and the stream located near Miami Parade (URS, 2010).

Across the majority of the study area, seasonally saturated volcanic ash deposits (tuff) overlies the basalt flows that discharge south to the Onehunga Inlet. Further east, groundwater flows to the east in the vicinity of the Mt Wellington SH1 interchange (based upon a URS environmental investigation at the former Mazda site, now the Turners and Growers site). At that site (Figure 1) the permeability of the tuff unit is low and acts as an aquiclude (barrier) overlying the basalt aquifer, which inhibits vertical contaminant migration into the deeper groundwater. Stormwater soak holes throughout the area provide a source of groundwater contaminants and influence local groundwater levels. The permeability of the basalt aquifers is highly anisotropic (spatially variable) and influenced by the degree and nature of fracturing.

Groundwater is used as a resource for a range of industrial purposes and by Watercare Services Ltd for potable supply. Historically, springs were prevalent in the Onehunga area although most have been intercepted by stormwater drains and the natural flow has been disturbed by development and abstraction. Along the margin of the southern Onehunga foreshore there is a leachate interception drain for the closed Pikes Point landfills, for which Auckland Council is responsible.

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Royal Oak
Oranga
Penrose
Mount Wellington
Onehunga
Te Papapa
Southdown
Westfield
Mangere Inlet
Mangere Bridge
Favona
Otahuhu
Middlemore

1 Gloucester Park
2 Reclaimed Land
3 Onehunga Borough council Landfill
4 Waikaraka Cemetery
5 Pikes Point West Landfill
6 Pikes Point East Landfilll
7 One Tree Hill Borough Landfill
8 NZR Landfill Area
9 Church Street Landfill
10 Former NZ Farmers Fertiliser Site
11 Mount Smart Landfill
12 Former Southdown Freezing Works
13 Former Westfield Freezing Works
14 Former Mazda Site
15 Former Tannery (Pengelly Site)

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Map intended for distribution as a PDF document. Scale may be incorrect when printed.


Basemap source: Eagle Technology Group & LINZ.



File: P:\381\381868\3TGIS\5_Workspaces\01_mxd\GIS-3818683-030_ContaminatedSites.mxd Author: BecaGIS Date: 20/10/2014

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Client: NZ Transport Agency and Auckland Transport

Project: East West Connections

Title:

# Figure 1

## Potentially Contaminated Sites

EAST WEST CONNECTIONS
INDICATIVE AND DETAILED BUSINESS CASES

Discipline: GIS

Drawing No: GIS-3818683-030

A summary description for each of the known landfills in the study area is provided below. These sites are found from west to east and their locations are illustrated in **Figure 1**. The boundaries of the sites shown in Figure 1 should be regarded as only approximate.

**Galway Street Landfill**

The Galway Street Landfill was historically known as the "75 Acre Reclamation" and was operated by the Onehunga Borough Council (Earthtech 1993). The landfill covers an area of 30 ha that extends from the eastern side of Alfred Street / Waikaraka Park through to Onehunga Mall in the west. It is bounded by Neilson Street and the Onehunga foreshore to the south.

The landfill was operated from some time after the Second World War (Earthtech 1993) through to 1978 (T&T 2007). The Auckland Council 1986 aerial photograph show earthworks were occurring on the site, which may include clean filling or capping of the landfill (Auckland Council GIS website). The waste included domestic waste and commercial wastes and the filling operations were uncontrolled (T&T 2007). After closure the landfill was capped with demolition waste (Earthtech 1993). A rock bund forms the southern margin, with the bund height varying from 2.5-3.5 m. The waste at the Alfred Street end of the bund extends above the bund by approximately 2 m, with the refuse near surface. Other areas of the landfill are generally well covered (ibid).

Investigations undertaken in 1994 by Tonkin & Taylor Ltd (T&T 1994) showed that the capping layer was 0.3-2 m thick, followed by 4-5 m of moderately decomposed domestic waste, followed by basalt (0.3 to 3 m thick) and East Coast Bays formation. The capping material was reportedly 1-2 m thick on the western side and 0.2-0.3 m thick on the eastern side, comprising gravelly silt.

The T&T (2007) assessment of soil contamination at the site subsequently developed for Visy Ltd as a recycling facility identified elevated concentrations of metals and "total petroleum hydrocarbons" in soil, although concentrations were compliant with human health protection criteria adopted for the planned industrial land use. Some soil Polycyclic Aromatic Hydrocarbon (PAH) concentrations exceeded human health criteria. These investigations also measured landfill gas. Methane concentrations ranged up to 41% by volume (v/v). Although flows indicated that landfill gas production was relatively low, these methane levels correspond to an explosive / flammability risk. It is understood that the Visy building was subsequently constructed with a vapour barrier in accordance with the T&T (2007) recommendations.

**Church Street Closed Landfill**

According to Earthtech (1993) a landfill was present in an area south of Church Street, near the O'Rorke Road junction. Little information was available on this landfill, however, it is understood that the filling occurred in a quarry that was owned by Stevensons.

**Pikes Point West Reclamation and Closed Landfill**

The Pikes Point West Landfill was established in 1973 and commenced with an earth filled rip-rap sea wall that extended out approximately 250 m from the original coast line. A second sea wall was constructed in 1974, and this extended 100 m further south of the original sea wall. No purpose built leachate collection system was installed, however leachate was recovered from the scoria filled annulus of a 1.8 m diameter stormwater pipe that passed through the landfill (Earthtech 1993).

The land filling included both domestic and industrial wastes and continued through to late 1977. The fill depth varied between 1 – 9 m and leachate pumping was terminated in 1984 (Earthtech 1993). It is understood that the leachate interception system was subsequently recommissioned and it is currently operational (Mark Crooks Auckland Council, pers comm).

As with Pikes Point East Closed Landfill (Babbage 2006), it is unlikely that Pikes Point West Closed Landfill would be lined and as such it is presumed to be founded on marine sediments.

**Pikes Point East Reclamation and Closed Landfill**

Pikes Point was a peninsula that comprised the present day Miami Parade, Angle Street, Pukemiro Street and Edinburgh Street. The Pikes Point East landfill was located immediately east of Pikes Point. The landfill footprint is currently occupied by Green Vision Recycling, the Heliport, and part of Metroport.

The construction of the landfill and reclamation commenced with the construction of the sea wall including a leachate collection system and an impervious “clay cone” in 1977. The landfill was founded directly on the marine sediments (Babbage 2006a). Landfilling operations continued through to 1984. Earthtech (1993) reported that the landfill was capped with a 100-200 mm layer of clay and scoriaceous tuff after 1984, leachate production was minimal and the recovery system was abandoned in 1984.

In a letter to ARC, Babbage (2006b) reported that due to public pressure regarding leachate discharges the leachate recovery system was recommissioned by Northern Disposal Systems Ltd in the early 1990’s. It is understood that the leachate interception system remains operational (Mark Crooks Auckland Council, pers comm).

**Mt Smart Closed Landfill**

Earthtech (1993) documented the former Mt Smart Landfill, located at the current location of Mt Smart Regional Park / Mt Smart Stadium and bounded by Church Street to the south, Maurice Road to the East, Rock Ridge Avenue to the North and O’Rorke Road to the West. They reported that Mt Smart was a former basalt scoria cone that was quarried through to the 1960’s, at which point backfilling of the pit commenced. The Mt Smart Landfill operated from the 1960’s through to May 1984. The landfill was used for the disposal of municipal refuse, industrial waste, and towards site closure clean fill was used to complete reinstatement.

**Former New Zealand Rail landfill**

Earthtech (1993) reported that the former New Zealand Rail landfill lies in the piece of land that is currently occupied by Metroport, and is situated between Neilsen Street and Hugo Johnston Drive, immediately north of the Pikes Point East Landfill. Refuse was reportedly placed at about the same time as the Pikes Point East Landfill (1975 to 1984). The landfill also included clean fill and hard fill especially in the northern portion of the site.

**Former One Tree Hill Borough Council Tip Site**

Earthtech (1993) identified this tip site within the southern portion of the NZ Rail property, adjacent to the Pikes Point East landfill. The landfill operations are largely undocumented, however based upon a review of historical aerial photos undertaken by Earthtech it is evident that the landfill was operational in 1961 and 1975.

**Asbestos Contamination**

Woodward Clyde (1999) undertook investigations of asbestos in soil along the northern Manukau Inlet foreshore in 1999. The investigations extended along the entire northern foreshore of the Inlet and comprised a combination of test pitting and surface soil inspection.

The investigations did not visually identify asbestos in the foreshore through to the current Heliport location (eastern extent of Pikes Point East landfill), however the asbestos was identified at every location west of this area. The asbestos material identified included fibrolite, asbestos cement pipes, “super 6” corrugated roofing, and white asbestos “filler”. This asbestos material coincided with the presence of house hold and demolition waste material.

The report also identified that the Mighty River Power Southdown Co-Generation Facility (power station) and Southdown Reserve, both located at the southern end of Hugo Johnstone Drive, are sites with known asbestos contamination.

**Gloucester Reserve**

Gloucester Reserve comprises the former Hopua Tuff Ring that historically was tidally inundated (von Hochstetter 1859). It is understood that this area was reclaimed using refuse and other waste materials (Opus 2006).

Historic aerial photos available on Auckland Council GIS viewer shows that in 1940 Hopua Tuff Ring had been reclaimed and appears to be used as a dirt racing track. The surrounding area at that time was dominated by residential housing. The 1959 aerial photo still shows a dirt track with surrounding residential land use, with some commercial / industrial land use commencing. Subsequent developments represent a shift to commercial/industrial land use.

# 4. Key Design Assumptions

Our assessment has adopted the alignments articulated in the Indicative Business Case EWC Long List Summary, with the following key design amendments that have been adopted since then:

- Along the north shore of Mangere Inlet the proposed design of the foreshore options E and F calls for an embankment approximately 60 metres wide to accommodate a four lane road carriageway and a shared path and cycle way with swales for stormwater treatment. The embankment is separate from the existing foreshore and as such it will create area between the two that can be used for additional treatment and containment of any leachate etc. The intended construction could include pre loading and in situ wick drainage to reduce long term settlement and the finished road carriageway elevation will be 4.5 m above mean sea level (amsl). It is anticipated that some 'headland' features would be constructed to provide a more natural coastal edge. Existing drainage to the Inlet will be provided for using culverts.
- Option F has an inland alignment through the current MetroPort area.
- We have assumed that the alignments that follow existing roads (including widening of the road carriageway and intersection improvements) require only shallow (unsaturated soil/rock) excavations.
- The construction works for all terrestrial Options only require temporary dewatering, not permanent groundwater dewatering.

# 5. Environmental Assessment

Our assessment of the effects of each Option on the environment in relation to contaminated land is provided below.

## 5.1 Assessment of Option A

The effects of Option A on the environment are relatively minor with regard to contaminated land discharges because this Option utilises the existing road corridors. The Option proposed will involve limited soil disturbance or effect upon groundwater. There is some potential that shallow soil within the road corridor may be contaminated from adjacent HAIL sites, although more likely the soil is impacted with lead and hydrocarbons (PAHs) from vehicle emissions and any surplus spoil would require disposal to an appropriately licensed facility. The alignment utilises roads that skirt the periphery of the Gloucester Reserve, Galway, Pikes Point West, NZ Rail Fill Site, Mt Smart and Church Street landfills.

## 5.2 Assessment of Option B

The effects of Option B on the environment are relatively minor with regard to contaminated land discharges because this Option utilises the existing road corridors and as proposed will involve limited soil disturbance or effect upon groundwater. Compared to Option A, the risk of encountering contaminated soil is somewhat higher because the proposed earthworks to widen SH1 from SEART south to the crossing at Otahuhu Creek extends the corridor of the soil disturbance to a range of additional industrial sites. Sediment in the vicinity of the SH1 Otahuhu

Creek bridge is contaminated by copper and chromium from a former tannery[1]. The location of the tannery site is shown in Figure 1.

There is some potential that shallow soil within the footprint of Option B may be contaminated from adjacent HAIL sites, although more likely the soil is impacted with lead and hydrocarbons (PAHs) from vehicle emissions and any surplus spoil would require disposal to an appropriately licensed facility. The alignment utilises roads that skirt the periphery of the Gloucester Reserve, Galway, Pikes Point West, Mt Smart and Church Street landfills and the NZ Rail Fill Site.

## 5.3 Assessment of Option C

The effects of Option C on the environment are potentially significant with regard to contaminated land. The magnitude of effects primarily depends upon the method of construction adopted for the sectors that cross landfills at MetroPort (Pikes Point East landfill and the NZ Rail Fill Site) and at the new connection from Onehunga Harbour Road onto Galway Street where the alignment adopts a route through the Galway Street landfill.

At the Gloucester interchange the alignment utilises roads that skirt the periphery of the Gloucester Reserve, and along Neilson Street the alignment skirts the Pikes Point West landfill. Further east the alignment also crosses areas around the former Southdown freezing works including Southdown reserve and industrial sites where asbestos is prevalent in soil. At 36 and 38 Miami Parade, the alignment skirts to the south of the former Dominion Oil Refinery which has a discharge to ground and groundwater. Other HAIL sites along the alignment at Angle Street and Miami Parade include metal treatment enterprises, a demolition yard and a hazardous chemical treatment facility. At SH1 the alignment intersects a partially remediated HAIL site with chlorinated solvents in groundwater (the Former Mazda site, Figure 1).

Construction across the landfills could comprise one of the following methods:

1. Excavation of the refuse beneath the alignment prior to construction. Based on likely depths to original harbour sediments, excavation may need to extend to 8 metres below grade, although depths will be variable. This method would have the beneficial effect of removing refuse to a secure disposal site. However, this method would effectively bisect each landfill site, creating a barrier to shallow (landfill) groundwater migration with a permanent change to the drainage pattern of the landfill leachate. The landfill cap would need to be reinstated to manage landfill gas and leachate generation properly.
2. Development at-grade or on-embankment that relies upon ground improvement by dynamic compaction or pre-loading. The primary effect of these techniques is upon groundwater, because the compaction will cause transient discharges of contaminants and a long-term reduction in the shallow aquifer (landfill) permeability that could cause leachate breakouts upgradient from the alignment. Modelling these effects reliably would be problematic. Similarly, the compaction would disturb the landfill gas equilibrium and create unintentional gas migration.
3. Construction on piles that extend to bedrock (either Waitemata series or basalt). This method would require removal of contaminated soil and groundwater from within the pile caissons for off-site disposal, thereby benefiting the environment in relation to those materials. Depending upon the spacing of the piles, effects on groundwater flow may be limited because flow between the piles will be uninterrupted. Therefore, effects on groundwater quality could be managed to avoid leachate breakouts. Most of the refuse volume in the landfill would remain undisturbed, which would also limit the effects on

[1] Former Pengelly Transport site, 38 Luke Street Otahuhu; remediated c 2005 prior to redevelopment as sports fields for Otahuhu Intermediate school

landfill gas. This construction technique is therefore most favourable in respect to contaminated land effects.

## 5.4 Assessment of Option D

This Option is the same as for Option C, with additional works in the Gloucester Reserve to provide the upgrade at Gloucester Park Interchange. The alignment across Gloucester reserve introduces an increased risk of encountering landfill material in this area. Otherwise, the assessment of contaminated land effects for Option D is the same as for Option C (including the considerations regarding construction techniques through the landfills).

## 5.5 Assessment of Option E

The alignment of Option E has already been influenced by contaminated land considerations for the foreshore component of the Option. The design response was to provide for a new embankment separate from the existing foreshore, so that this Option does not impinge upon the landfills and the existing leachate interception trench.

The effects of this Option on the environment are dominated by the extensive embankment in the coastal marine area. The Ecology Assessment responds accordingly. In terms of contaminated land, the positive effect of this Option is that the embankment will permanently cap and contain the contaminated sediment *in situ*.

Option E includes the Gloucester reserve considerations, and also extends across industrial land to the east of Ann's Creek. Most of the eastern industrial zone is relatively recent (post 1990's) with the exception of the Westfield Freezing Works and Westfield Chemical Fertiliser Works (Figure 1). Overall, the potential effects of this Option on the environment with respect to contaminated land are considered to be moderate.

## 5.6 Assessment of Option F

The alignment of the western sector of Option F has already been influenced by contaminated land considerations for the foreshore component of the Option, which provided for a new embankment separate from the existing foreshore to avoid the landfills and the existing leachate interception trench. However, the eastern sector crosses the Pikes point East landfill and NZ Railways fill area. The alignment also encompasses Miami Parade and as such runs adjacent to the HAIL sites in that area that are recorded above.

The potential effects of Option F are significant with regard to contaminated land.

# 6. Recommended Mitigation Required

The design of Options that traverse the landfills should adopt a piled construction methodology.

Foreshore Options including Option F should be built on a separate embankment to avoid effects on landfills.

# 7. Conclusion and Recommendation

The Options range in scale in terms of complexity and intervention, and as such a range of contaminated land effects is to be expected.

Landfills represent the major constraint for construction. They also pose the greatest environmental risks. A piled design is preferred.

The majority of the land across the entire study area is potentially or actually contaminated, based upon HAIL considerations. Further investigations will be needed to provide a full assessment.

On the basis of existing information, the preferred Option should be selected on the basis of network performance provided that the alignment either avoids known landfills or adopts a construction method that minimises effects on the landfill(s).

The Options are ranked below in order of preference, in terms of potential effects related to contaminated land:

| | |
|---|---|
| Option A (ranking #1) | minor effects |
| Option B (ranking #2) | minor effects |
| Option E (ranking #3) | moderate effects |
| Option F (ranking # 4) | potentially significant effects |
| Option C (ranking #5) | potentially significant effects |
| Option D (ranking # 6) | potentially significant effects |

# 8. References


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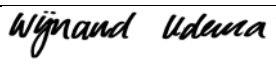
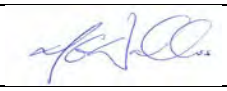
| Draft 3/10/2014 | Murray Wallis (balance of report) | Wijnand Udema |  | | | |
| Final | | | | Murray Wallis |  | 16/10/2014 |

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