APPENDIX 7

PTA Metronet – Ranford Road Contamination Status and Remediation Options Letter Report (GHD, 2018c)

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Dear Stuart

Metronet Ranford Road
Contamination status and remediation options letter report

1 Introduction

1.1 The development

As part of the Metronet project, the Public Transport Authority (PTA) is planning the construction of the Thornlie Cockburn Link (TCL), which will provide a connection between the Thornlie and Cockburn Central Stations. The TCL project includes a new station at Ranford Road in Canning Vale, on the southern corner of the crossing of Ranford Road and the existing freight railway as shown in **Attachment 1**.

The new station will occupy parts of Lot 302 and 303 on Deposited Plan 30748 and part of Lot 500 on Plan 15262, owned by the City of Canning. For ease of reference, these areas of land are referred to in this letter report as the 'Site'. Lot 500 is currently used for the City of Canning Waste Transfer Station Disposal Facility (CCWTS). Lots 302 and 303 within the site boundary are vacant and form part of a former landfill site that was operated by the City of Canning.

The new station will cover the area of the former landfill and the waste transfer station at the Site as shown in **Attachment 2**. This will comprise the following features:

- Train station (station entry building and concourse connecting to an island platform).
- Bus interchange, including stands, seating and information facilities.
- Car parking facilities.
- Pedestrian and cycle access, including secure bicycle shelters.
- Proposed retention of existing conservation significant vegetation within the south-eastern portion of the Site (portion of Lot 500).

1.2 Contamination status of the Site

Landfill sites and associated activities are land uses which have a potential to cause contamination to land and groundwater and under the *Contaminated Sites Act 2003* (the 'CS Act'), the Site is currently classified as '*Possibly contaminated – investigation required'*.

1.3 Letter report

To support the TCL project approval process, this letter report has been prepared for the purpose of summarising the findings of investigations and recommended options for management of contamination to facilitate construction and ongoing operation of the new station.

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A summary of the following information is therefore provided in this letter report:

- Key findings from detailed site investigations concerning contamination.
- Identified contamination risks to human health and ecological receptors from the development and operation of a new station at the Site.
- Options for management of identified risks for construction of a new station at the Site.
- Options for management of identified risks for ongoing operation of a new station at the Site.
- An outline of the likely process to be followed in accordance with the Contaminated Sites Guidelines to achieve a reclassification of the developed portion of the Site with respect to the CS Act, including contractor inputs.

2 Key findings from previous investigations concerning contamination

2.1 Previous investigations

Previous investigations concerning contamination have been undertaken at the Site with reference to relevant published guidelines as part of a staged approach to the assessment and management of contaminated sites and have comprised:

- A Preliminary Site Investigation (PSI) undertaken in 2016.
- A Detailed Site Investigation (DSI) undertaken in 2017-2018.

The PSI and DSI are also subject to an independent review by a Department of Water and Environmental Regulation (DWER) accredited Contaminated Sites Auditor ('the Auditor')[1] to ensure the investigations comply with relevant published guidelines.

2.2 Preliminary Site Investigation (PSI)

The PSI (GHD 2016) comprised a desktop review of available information for the Site, a site inspection and a limited scope investigation. The limited scope investigation consisted of:

- Limited sampling for the presence of contamination in soil and groundwater, which included the installation of four groundwater monitoring wells.
- Monitoring for the presence of landfill gases and vapours associated with the former landfill, which included the installation of four landfill gas bores.

The PSI identified that landfilling activities across the Site were likely to have occurred from 1981 to 1996. Landfill waste material encountered during the PSI was predominantly putrescible in nature, with organic material indicative of household waste. The PSI concluded that:

- Areas of concern at the Site comprised the general landfill area (former landfill), a suspected settling pond area, and consideration of the entire site due to potential acid sulfate soil (ASS) material underlying the Site.
- Contaminants of concern associated with the identified areas of concern at the Site comprised metals/metalloids, hydrocarbons, pesticides, major ions, nutrients and acidity in soil and groundwater, and ground gases (carbon dioxide [CO_2], carbon monoxide [CO], hydrogen sulfide [H_2S], methane [CH_4] and vapours)

[1] Mr Nicholas Owen of Prensa Pty Ltd (Prensa).

- With respect to the identified areas of concern and potential risks to the identified receptors, data gaps existed which required further assessment to better understand potential contamination risks for future station use and the management measures needed to address them.

2.3 Detailed Site Investigation (DSI)

2.3.1 Scope of work

The DSI (GHD 2018) comprised the following scope of work:

- Preparation of a Sampling and Analysis Quality Plan (SAQP) which presented objectives to address identified data gaps (GHD 2016) and outlined the proposed sampling approach and methodologies, forming a reference document for field staff during investigation at the Site (GHD 2017). The SAQP was reviewed by the Auditor.
- Excavation of soil bores, hand auger bores, machine-excavated test pits and installation of landfill gas and vapour monitoring wells.
- Soil and groundwater sampling, laboratory analysis, a programme of landfill gas and vapour monitoring, assessment and reporting.

2.3.2 Key findings from the DSI [2]

No significant sources of contamination were identified associated with the CCWTS at the Site.

The DSI identified the following substances which represent potential sources of contamination associated with the former landfill:

- Asbestos containing materials (ACM) in the former landfill.
- Aluminium, chloride, and ammonia in groundwater beneath the Site exceeding non-potable use of groundwater (NPUG) guidelines.
- Per- and poly-fluoroalkyl substances (PFAS) in groundwater beneath the Site marginally exceeding guidelines for the protection of freshwater aquatic species (99% protection level).
- Landfill gases and vapours in the former landfill.

Waste materials in the former landfill can also be a physical hazard (e.g. due to the presence of sharp objects); an aesthetic concern due to their appearance; or a source of odours if these become exposed and are not properly managed when disturbed.

With respect to aluminium and PFAS in groundwater, it is relevant to note that these were also detected (at lower concentrations) in groundwater which flows towards the Site from the south east. This indicates that aluminium and PFAS are also present in groundwater as a result of other influences in the area unrelated to the former landfill.

With respect to Acid Sulfate Soils (ASS), the Site (which is within a Class 2 risk area, i.e. *high to moderate risk of ASS beyond 3 m of natural soil surface*) has previously been highly disturbed/modified therefore the possible presence of ASS with respect to current, natural soil surface is considered limited (except for areas outside the landfill extent). Field and laboratory analytical data obtained during the DSI (GHD 2018) did not indicate the presence of ASS in the areas investigated.

[2] Currently under review by the Auditor.

It is important to note that the presence of a source of contamination does not necessarily mean there is a risk. For a risk to exist, a complete 'pathway' must be present between the source and a 'receptor' (such as person, an ecosystem component, or an environmental value[3]) to allow exposure to occur (referred to as a complete 'source-pathway-receptor' linkage). If the linkage is incomplete, then exposure to the contamination source cannot occur and a risk cannot exist. However, a change in land use, such as proposed for the Site, has the potential to introduce and complete new linkages if contamination sources are not managed appropriately, due to:

- Disturbance of waste materials (e.g. exposing waste materials at surface).
- Potential for enhancing landfill leachate migration (and potentially generation).
- Potential for enhancing landfill gas generation and promoting migration of landfill gases/vapours, resulting in:
  - Enhanced degradation of wastes by biological processes as a result of drainage infiltration (e.g. swales and/or soak wells) receiving run-off from low permeability sealed surfaces.
  - Development of hazardous atmospheres within enclosed spaces (e.g. migration of landfill gases and/or vapours into services infrastructure and building structures and their accumulation with resultant toxic, asphyxiation and/or explosion hazard).
  - Enhanced lateral landfill gas/vapour migration (on-site and potentially off-site) due to: lower permeability surfacing and/or structures which limit surface emissions from the waste mass; compression of the waste mass by development loadings displacing gases and vapours as void spaces are reduced; presence of buried services infrastructure which may act as enhanced lateral migration pathways; removal of the current gas extraction infrastructure.
  - Cross-boundary migration towards the Site from the remainder of the landfill waste mass off-site to the south-west.
  - Vertical migration of landfill gases and/or vapours towards buildings/infrastructure associated with deep foundations such as piled foundations (if required to penetrate the remaining waste mass thickness in order to transmit development structure loadings to suitable strata beneath the remaining part of the landfill waste mass).
  - Potential vegetation die back as a result of oxygen depletion within vegetation root zones.

An assessment of risks to receptors (i.e. human health, the environment and environmental values) was undertaken as part of the DSI for the current land use and for a new station. The outcomes from this risk assessment for development and operation of a new station at the Site are summarised in Section 3.

3 Identified contamination risks to human health and ecological receptors from the development and operation of a new station at the Site.

An assessment of risks posed to relevant human health and ecological receptors undertaken in the DSI for development and operation of a new station at the Site identified the following risks (Table 1) to relevant receptors:

[3] Environmental value (as defined in DER 2014) means a beneficial use (i.e. conducive to public benefit, public amenity, public safety or aesthetic enjoyment) or an ecosystem health condition (i.e. relevant to the maintenance of ecological structure, function or process).

Table 1 Risks: development and operation of a new station at the Site

Area of concern	Contaminants of concern	Receptor (including exposure route – refer to footnotes)	Risk rating #	Risk rating (with the implementation of appropriate management measures for proposed development including construction phase)
(1) Waste inclusions in the landfill capping material (2) Landfill waste material	ACM, physical hazards (also odour and aesthetic considerations)	<u>On-site</u> • Members of the public (1, 2) • Occupants, construction and maintenance workers at the new station (1, 2) • Property ^	*Low* (ACM) *Moderate* (other)	*Very low*
(3a) General landfill area	(3b) Groundwater: aluminium, chloride, ammonia, PFAS	<u>On-site (human health)</u> • Members of the public (4) • Personnel (4) • Occupants, construction and maintenance workers at the new station (4) <u>Off-site (human health)</u> • Private bore users (3)	*Low* *Low*	*Very low* *Very low*

Area of concern	Contaminants of concern	Receptor (including exposure route – refer to footnotes)	Risk rating #	Risk rating (with the implementation of appropriate management measures for proposed development including construction phase)
		• Commercial bore users (4) <u>Off-site (ecological)</u> Down-gradient aquatic ecosystems (Canning River) (5)	*Moderate* (PFAS)* *Not significant* (other contaminants)	*Low* (PFAS)* *Not significant* (other contaminants)
	(3c) Ground gases: CO_2, CO, H_2S, CH_4 and vapours	<u>On-site (human health)</u> • Members of the public (6) • Occupants, construction and maintenance workers at the new station (6) <u>Off-Site (human health)</u> • Below ground maintenance workers (6) • Occupants of commercial buildings (6) • Inhabitants of nearby residential dwellings (6)	*Moderate* (excluding below ground maintenance workers) *High* (below ground maintenance workers) Below ground maintenance works: *moderate to high risk* City of Canning Waste transfer station visitors and site workers: *Moderate* Land to north of Site: *No credible pathway* (also a former landfill and	*Low* (excluding below ground maintenance workers) *Low* (below ground maintenance workers) Below ground maintenance works: *Very low to low* City of Canning Waste transfer station visitors and site workers: *Low* Land to north of Site: *No credible pathway* (also a former landfill and

Area of concern	Contaminants of concern	Receptor (including exposure route – refer to footnotes)	Risk rating #	Risk rating (with the implementation of appropriate management measures for proposed development including construction phase)
			assumed to have appropriate management practices in place) Residents (0.4 km to the east and south-east): *Low risk*	assumed to have appropriate management practices in place) Residents (0.4 km to the east and south-east): *Low risk*

*requires further off-site assessment to assess impact and finalise risk rating.

Management action is considered to be necessary for future redevelopment of the Site to mitigate risks posed by landfill gases and vapours at the Site for such redevelopment. It is considered that risks can be reduced to low or very low for the Site subject to implementation of appropriate management measures. Refer to column '*Risk rating (with the implementation of appropriate management measures for proposed development including construction phase*).'

^Development should consider the 'severe' exposure of concrete piles in landfill waste material.

Risk rating is based on risk matrix provided in the DSI (GHD 2018). Ratings are subject to change following finalisation of development plans.

Exposure Pathways:

1. Inhalation of asbestos fibres (via wind-blown dust) during development
2. Direct contact with waste constituents and physical hazards
3. Incidental ingestion/dermal contact of groundwater via garden irrigation (abstraction and use for non-potable purposes)
4. Incidental ingestion/dermal contact during commercial use of groundwater (abstraction and use for non-potable purposes)
5. Leaching of contaminants into groundwater and discharge of groundwater to down-gradient surface water (Canning River) and direct contact with and/or uptake by aquatic organisms

Lateral or vertical migration of gases and/or vapours and accumulation within structures to form toxic, explosive and/or asphyxiating atmospheres (i.e. hazardous atmospheres).

Risk assessment has identified a requirement for further action to manage identified risks to receptors with respect to the construction and operation of a new station due to the presence of a former landfill at the Site. Options for management of identified risks in construction phase and for the ongoing operation of the new station are presented in the following sections.

4 Options for management of identified risks - construction of new station

Appropriate management measures will be implemented in construction of the new station to ensure that contamination does not pose a risk to relevant receptors (i.e. human health, the environment or environmental values). A number of options to manage contamination risks during construction are available. These will be documented within one of the following:

- A Remedial Action Plan (RAP) which sets out the remediation strategy to manage contamination risks for the new station development, including the transient measures needed to manage risks during construction; or,
- A construction-specific Site Management Plan (SMP).

Use of a RAP or SMP will be confirmed as the station design is refined, depending upon which is most appropriate to ensure that contamination does not pose a risk to relevant receptors in construction of the new station. The RAP (or SMP) will be endorsed by the Auditor prior to the commencement of construction at the Site.

Relevant management options are summarised in Table 2. These include measures to be incorporated into the design of the new station which serve to manage risks during construction phase.

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Table 2 Options for management of identified risks - construction of new station

Area of concern	Options for management of identified risks - construction of new station
(1) Waste inclusions in the landfill capping material (2) Landfill waste material	Possible options to mitigate transient risks for construction associated with the waste materials at the former landfill comprise: a. Removal and disposal of waste materials off-site to a suitably licenced landfill facility. The viability of large-scale removal is however uncertain due to the scale of disturbance required, associated construction-phase impacts (e.g. odours, dust, vehicle movements) and available landfill capacity elsewhere in the metropolitan area that would be needed to accommodate the excavated waste. b. Treatment (e.g. screening/processing of capping and/or waste materials to separate undesirable constituents from inert materials such as sand). Undertaken to create materials suitable for re-use (e.g. as fill below the finished ground surface) and minimise the volume of material requiring off-site disposal. The viability of large-scale removal and treatment is however uncertain due to the scale of disturbance required and associated construction-phase impacts. c. Avoid development features and construction methods requiring deep excavation into the former landfill. In particular, in the design process, set development levels which are sympathetic to existing ground contours and elevations in order to minimise excavation and resulting disturbance of waste materials at the former landfill. This more effectively limits the volume of waste materials requiring management in construction (e.g. by a. or b. as identified above) to that which is unavoidable to construct the new station. d. Specification of appropriate measures for protection of foundations and other buried structures from deleterious chemical effects. It is currently expected that options c and d will be adopted for the development to minimise contamination risks and other negative impacts from disturbance of waste materials at the Site whilst achieving a final site condition which is suitable for the new station use in line with a sustainable approach to development.
(3a) General landfill area	Appropriate management measures will be implemented in accordance with an Auditor endorsed RAP; or construction-specific SMP for protection of human health (i.e. the public and construction workers), the environment, and environmental values including aesthetic concerns. Specific risks associated with working at the Site during construction will be managed through the implementation of a Construction Environmental Management Plan (CEMP). The management plans will address matters such as (but not limited to): dust, odours, noise, vibration, stockpiling, waste management, materials tracking, stormwater run-off, drainage, sedimentation, leachate management and groundwater protection, traffic management (including measures to prevent dust or mud being deposited on public roads by vehicles leaving the site), existing (protected) vegetation, contamination, unexpected finds, emergency preparedness and response, monitoring requirements, security, training. Management plans will also include community engagement requirements for relevant stakeholders such as (but not limited to): local residents, businesses and landowners, owners/operators of underground services infrastructure in the vicinity of the former landfill. Subject to finalisation of the design process and adopted construction method, possible options for such management comprise:

Area of concern	Options for management of identified risks - construction of new station
	• Application of water sprays, use of ground covers and installation of screens to act as wind breaks, to aid in the control of dust generation. • Temporarily re-covering exposed excavations from within the landfill waste mass (if disturbed) overnight and/or during periods of low excavation activity, to aid in the control of nuisance odours. • Creation of appropriate (temporary) stormwater and surface run-off drainage system (e.g. temporary bunding and collection ponds), to aid in the control of surface and stormwater run-off. • Appropriate management of excavated spoil particularly where generated from within the landfill waste mass (if disturbed), such as limiting the height of stockpiles and installation of leachate collection systems to contain potentially contaminated stockpile run-off. • Exclusion of worker access to excavations/confined spaces or other contact with waste in the former landfill area wherever possible. Implementation of controls for access which is unavoidable. • Confirm appropriate control measures are in place for below ground maintenance works undertaken by owners/operators of underground services infrastructure in the vicinity of the former landfill. • Monitoring of the above actions with respect to relevant developed 'trigger levels' to determine when and how an additional management action should be implemented (i.e. contingency measures – see below). Contingency measures, if determined to be required, should include, but not be limited to: • Re-instatement of surfaces and/or fencing. • Increased monitoring or further site characterisation, amendment of management measures. • Increased community engagement.

(3b) General landfill area - Groundwater	Design and construction phase measures can be implemented to minimise impact of construction upon leachate within the waste mass and potential mobilisation of this to impact groundwater flowing beneath the Site. Options comprise:
	
	<u>Design phase:</u>
	• Limiting the footprint area of sensitive structures (e.g. station ticket hall) to minimise bearing pressures upon the underlying soils or landfill waste. This:
	  ○ Minimises ground treatment requirements for compressible/unstable waste materials to address settlement effects.
	  ○ Minimises the need for deep foundations (e.g. piled foundations) to transmit foundation loads below the landfill which may otherwise act as a migration pathway for leachate.

Area of concern	Options for management of identified risks - construction of new station
	• Location of sensitive structures (e.g. station ticket hall) away from deeper parts of the former landfill to minimise ground treatment requirements for waste materials to address settlement effects. • Construction of a robust engineered fill cover system to form a 'stiffened raft' type foundation in surfaced areas which is less sensitive to settlement effects and reduces the need for deeper treatment of underlying waste materials. • Implementation of further assessment actions identified in the DSI (GHD 2018) to support the design process. <u>Construction phase:</u> Optimised staging of construction earthworks and ground treatment to limit the scale of disturbance to the former landfill at any one time so that induced compression of the waste mass is gradual and limits the potential for leachate migration to groundwater. Timing of the works with respect to seasonal conditions (e.g. periods of heavy rainfall which may enter the waste mass to generate leachate) will also be optimised, where practical. These measures may be supported by: • A detailed groundwater monitoring programme from a dedicated network of groundwater monitoring wells to detect any potential adverse effects upon groundwater quality that may be attributable to the construction works and allow preventative/corrective action to be implemented (e.g. adjustment to scale/nature/timing of earthworks and ground treatment). • Contingency groundwater interception measures in order to address any unavoidable and temporary adverse effects upon groundwater quality in the locality. This is expected to comprise a series of pre-installed down-gradient groundwater extraction wells and associated surface treatment infrastructure that can be implemented quickly, where required, to address any short-term adverse effects arising in construction works.
(3c) General landfill area - Landfill gases and vapours	The options which can be implemented to manage risks to groundwater (refer to 3b above) for construction phase are also valid options to mitigate the risk of increasing landfill gas and vapour migration from the former landfill (e.g. into surrounding permeable soils during construction). An expanded gas monitoring well network will also be installed to assist in monitoring of the former landfill for indications of enhanced lateral migration of landfill gases and vapours from the waste mass. Where deemed appropriate, this may include installation of continuous monitoring instruments with telemetry to provide 'real time' data at key locations to inform decision-making. If necessary, construction activities can be curtailed or modified to manage the potential for any short-term adverse effects arising in construction works. The existing landfill gas extraction system, which has a network of extraction pipework extending onto the Site, will also be modified at the commencement of construction to separate this from the majority of the network at the larger off-site portion of the landfill. This will allow

Area of concern	Options for management of identified risks - construction of new station
	the on-site part of the network to be removed to provide access for construction work and to prevent the pipework acting as a preferential migration pathway.

5 Options for management of identified risks - ongoing operation of new station

Appropriate management measures will be implemented to address risks posed by contamination for ongoing operation of the new station in two main ways:

- Protection measures included in the design of the new station and incorporated into the construction, the purpose of which is to manage contamination risks for ongoing operation.
- Control measures to be implemented for operational use which manage contamination risks for ongoing operation. These relate either to the ongoing maintenance (where needed) of the above protective measures, or to additional measures which are implemented to manage risks for ongoing operational use.

The options to address identified risks for the operation of the new station are summarised in Table 3. The selected options will be documented within and implemented by the PTA via a robust Ongoing Site Management Plan (OSMP) for the Site. The purpose of the OSMP is to manage risks for ongoing operation of the Site as a new station using appropriate measures to eliminate risks (or otherwise control activities) where a residual risk of exposure to contamination may still occur without such ongoing management (e.g. maintenance workers undertaking future excavations in an uncontrolled manner).

Table 3 Options for management of identified risks – ongoing operation of a new station

Area of concern	Options for management of identified risks – ongoing operation of a new station
(1) Waste inclusions in the landfill capping material (2) Landfill waste material	Possible options to mitigate risks associated with the presence of waste materials at the former landfill at this time comprise: a. Removal and disposal of waste materials off-site to a suitability licenced landfill facility. b. Treatment (e.g. screening/processing of capping and/or waste materials to separate undesirable constituents from inert materials such as sand) undertaken to create materials suitable for re-use (e.g. as fill below the finished ground surface) and minimise the volume of material requiring off-site disposal. c. In the design process, set development levels which are sympathetic to existing ground contours and elevations in order to minimise excavation and resulting disturbance of waste materials at the former landfill. This more effectively limits the volume of waste materials requiring management in construction (e.g. by a. or b. as identified above) to that which is unavoidable to construct the new station. d. Construction of a robust engineered cover system over the former landfill to prevent physical contact with underlying waste materials. It is expected that options c and d. will be adopted for the development to minimise contamination risks and other negative impacts from disturbance of waste materials at the Site. Options for the engineered cover system will depend upon the intended use of particular areas at the former landfill. For example, car parks and paved areas present more robust finished surfaces to restrict access to underlying soils than landscaped areas where a cover system comprises soils to support vegetation and needs to be of greater thickness. Options for a cover system comprise the following components: • Geotextile separator (to prevent mixing of waste materials with overlying 'clean' soils which have been validated to confirm suitability for use with respect to geotechnical and environmental properties) and to act as a 'warning' barrier for any future below ground maintenance works involving excavation. • Placement of engineered fill layers (i.e. imported 'clean soils') over the geotextile separator to create a suitable stiff 'raft' with properties to mitigate future settlement issues and prevent physical contact and to receive final surfaces such as roads, paved areas, landscaping. Soil imported for use within construction of the cover system are to be suitable with respect to geotechnical and environmental properties and validated to confirm suitability. • Installation of all service infrastructure within the cover system to protect future maintenance workers undertaking below-ground maintenance works for services infrastructure so that potential for contact with waste materials in any future maintenance works is minimised. • Subsoil and topsoil layers to support vegetation (landscaped areas).

Area of concern	Options for management of identified risks – ongoing operation of a new station
	• Final finished surface (e.g. low permeability sealed surfaces for roads, car parks and paved areas, grass, vegetation and other materials in landscaped areas). • Placement of buried services infrastructure (that may require future access for maintenance purposes) within the cover system.
(3a) General landfill area	Implementation of an OSMP (endorsed by the Auditor and considered acceptable to relevant stakeholders) to manage risks for ongoing operation. To include (but not be limited to): • Details of engineered management measures constructed at the Site (e.g. gas protection measures, cover system), how these operate, requirements for inspection and maintenance, and record keeping. • Maintenance of the cover system and infrastructure within the cover system to protect relevant receptors. • Institutional controls, such as restrictions on access, restrictions on use (e.g. groundwater), procedures, inspections and record keeping, ongoing monitoring requirements (e.g. periodic landfill gas/vapour and groundwater monitoring). • Responsibilities of relevant parties (including documented acceptance of these by the parties responsible for implementing the SMP). • Community engagement requirements for relevant stakeholders such as (but not limited to) local residents, businesses and landowners, and owners/operators of underground services infrastructure in the vicinity of the former landfill (e.g. to confirm appropriate control measures are in place for below ground maintenance works). • Monitoring programme (groundwater, landfill gas and vapour). The programme will be implemented on completion of construction-phase monitoring and will be implemented for a specific time-period as part of the validation programme to demonstrate the effectiveness of the management measures implemented (likely to be a minimum of one year in order to capture at least one annual cycle of seasonal variations). Results from the monitoring programme will be assessed following collection to determine if any change to the scale/frequency/duration of monitoring is required, or if any monitoring results indicate a requirement for contingency response measures to be implemented. • Contingency response measures, including triggers for implementation. • Timeframe for operation (i.e. the design life of the new station) and requirements for review/update of SMP. • Framework for reporting relevant site activities (e.g. monitoring results, ground disturbing activities).
(3b) General landfill area - Groundwater	Restriction on use of groundwater other than for the purpose of analytical testing. Specifically, groundwater abstraction for reuse (e.g. reticulation of landscaping) is not to be permitted for ongoing operation of the new station. Surface water drainage is to be constructed entirely within the cover system such that contact with any landfill waste material and/or leachate cannot occur.

Area of concern	Options for management of identified risks – ongoing operation of a new station
	Surface water drainage and low permeability surfacing is to be constructed to direct surface run-off from rainfall away from the former landfill area to limit infiltration of water into the former landfill area that may otherwise promote leachate generation or enhance production of landfill gases within the waste mass. In the longer term, these features can assist in mitigating leachate generation from the waste mass at the Site. Post-construction groundwater monitoring programme: see (3) above, using a dedicated groundwater monitoring well network to confirm groundwater quality at the Site in its developed condition (including cessation of transient influences from construction and to assist in assessing beneficial effects arising from the new station features).
(3c) General landfill area - Landfill gases and vapours	<u>Occupied structures and other enclosed spaces</u> Options to address risks are possible in the choice of new station design features to render this insensitive to risks posed by landfill gases and vapours. However, it is difficult to achieve full protection from such measures alone where a former landfill occupies a substantial part of the Site (e.g. the development cannot be located sufficiently far away from the landfill such that no other protection is needed). Whilst incorporation of certain design features may be possible which act to reduce risks, some form of gas protection measures are also typically required. Options are summarised below. *Design features:* • Location of sensitive structures (e.g. station ticket hall) away from the former landfill (if feasible) or deeper parts of the landfill to reduce exposure to landfill gases and vapours. • Limiting the footprint area of sensitive structures (e.g. station ticket hall) to minimise bearing pressures upon the underlying soils or landfill waste to minimise the need for deep foundations (e.g. piled foundations) to transmit foundation loads below the landfill which may otherwise act as a preferential pathway for landfill gases/vapours to reach structures. • Structural design features which do not permit ingress and accumulation of landfill gases and vapours (e.g. structures elevated above ground level to create an open air-gap, open-sided structures/ground floor parking, services entry points above ground level, no below ground enclosed spaces such as basements). It is also relevant to note that in the longer term, compression of the waste mass at the former landfill to address issues such as settlement would also be expected to have a beneficial effect upon landfill gas generation (reduction) due to void space reduction. *Gas protection measures:* Protection measures are expected to be necessary for occupied structures (e.g. offices, toilets, retail spaces at ticket hall) and other enclosed spaces (e.g. storage rooms, services risers). These are required to limit potential for migration of landfill gases and/or vapours

Area of concern	Options for management of identified risks – ongoing operation of a new station
	into enclosed spaces via services penetrations, floor slab joints and other openings and their accumulation to form hazardous atmospheres with resultant toxic, asphyxiation and/or explosion hazards). Subject to refinement of development proposals and structure types, typical options comprise combinations of the following barriers in conjunction with ventilation measures to form a protection system as recommended in relevant guidelines (NSW EPA 2012, BSI 2015): • Well-constructed ground floor slab (monolithic cast in-situ reinforced concrete raft foundations with as few joints as possible). Such foundation types are also likely to be needed for sensitive structures to address ground stability constraints associated with the former landfill such as settlement of compressible waste materials. • Gas and vapour resistant membrane. • Passive venting: sub-slab dispersal layer or pressure relief pathway (e.g. no-fines gravel layer and horizontal collection pipe network or proprietary void formers or open void) to provide ventilation and limit potential for accumulation of landfill gases and vapours beneath a structure. This is used in conjunction with perimeter vents at the surface or above ground. • Active measures: as for passive measures with powered extraction (fans) to remove landfill gases and vapours from a sub-slab dispersal layer or positive pressurisation (pumps) to introduce fresh air. This requires use of fail-safes (e.g. back-up power, monitoring, alarms). Development proposals are subject to refinement; however, based on current information, it is not expected that options comprising active measures will be required to manage risks posed by landfill gases and vapours to the new station development. <u>On-site areas of low permeability surfacing (e.g. roads, car parks, paved areas)</u> Likely options to manage the potential for landfill gases and vapours to accumulate below areas of low permeability surfacing at the Site comprise: • Vertical gas collection wells and vents (potentially with horizontal collection network to improve collection efficiency – subject to refinement of the new station design). • Areas of permeable surfacing to allow surface venting of landfill gases and vapours. <u>Site boundary</u> Likely options to manage the potential for landfill gases and vapours to migrate beyond the Site (or onto the Site from the remainder of the landfill to the south-west) comprise perimeter in-ground gas barriers and/or passive ventilation measures. These typically consist of gas

Area of concern	Options for management of identified risks – ongoing operation of a new station
	collection wells, horizontal collection pipes with permeable trench media and vents at critical boundaries to intercept landfill gases and vapours that migrate within the ground towards the site boundary. Subject to refinement of the new station design, similar measures can also be implemented at other boundaries if the extent of low permeability surfacing required at the Site (e.g. car parks) may restrict surface emission of landfill gases/vapours at the Site to the extent that lateral migration off-site to the north-west, north-east and south-east could occur to a significant extent. <u>Buried services infrastructure</u> Potential options to manage the potential for landfill gases and vapours to accumulate below areas of low permeability surfacing at the Site comprise the following: • Removal of existing shallow gas extraction system pipework and grouting (backfill) of deeper vertical extraction wells within the Site (to separate this from the off-site network and remove potential preferential migration pathway). Irrespective of this, the existing gas extraction system pipework (at shallow depth) is expected to require removal to facilitate access for development. • Where possible in design stage, limit the size and nature of services infrastructure needing to be placed at (or within influencing distance) of the former landfill. • Gas protection measures for buried infrastructure which must be placed at (or within influencing distance) of the former landfill to limit the potential to form hazardous atmospheres within enclosed spaces (e.g. migration of landfill gases and/or vapours into infrastructure, occupied spaces and their accumulation with resultant toxic, asphyxiation and/or explosion hazard). Typical options comprise gas barriers to limit potential for entry and/or passive ventilation measures to prevent accumulation. • Surface water drainage to be constructed as for (3b) above to direct surface run-off away from the former landfill area to limit infiltration of water into the former landfill area that may otherwise enhance production of landfill gases within the waste mass. <u>All new station development features</u> In conjunction with the above options, a landfill gas and vapour monitoring programme is expected to be implemented for the whole site or critical features: see (3a) above. The monitoring programme will utilise a dedicated gas and vapour monitoring well network and/or automated monitoring equipment for relevant features (subject to refinement of new station development design).

6 Likely process to achieve a reclassification of the Site

The likely process required to achieve reclassification of the Site with respect to the CS Act (i.e. from '*possibly contaminated – investigated required'*, to an appropriate 'end-point' classification) is considered below.

The process to achieve reclassification is currently in progress through the implementation of a staged approach to assessment and management of contamination in line with relevant published guidelines (DER 2014) and would render the Site suitable for reclassification following the completion of the construction phase. As identified above, PSI and DSI have been undertaken to identify and assess the significance of risks posed to the proposed future use as a new station. These stages of the process have identified risks associated with the presence of a portion of a former landfill at the Site which require management to ensure the Site is suitable for the intended use.

Further actions which comprise the remainder of the process to achieve a reclassification of the Site are summarised below.

Prior to construction

- Selection of options to manage risks at construction stage and for ongoing operation as a new station. The selected options will form the remediation strategy to be implemented at the Site as set out in the RAP (or SMP) as appropriate, to be endorsed by the Auditor. This will be carried out in conjunction with:
  - Refinement of the design so that opportunities to incorporate design features which act to mitigate identified risks can be incorporated where practicable.
  - Further assessment actions (as identified in the DSI [GHD 2018] or arising from Auditor review of the DSI) to support the above. Further assessment actions are to be endorsed by the Auditor.
  - Preparation of a CEMP to address specific risks associated with working at the Site during construction of the new station (following finalisation of the new station design).
- Preparation of an OSMP setting out the approach to managing contamination risks to receptors for ongoing operational use of the new station. To include acceptance of the OSMP by relevant stakeholders (i.e. confirmation of awareness, agreement to contents and to comply with its requirements) and to be endorsed by the Auditor.

Construction phase:

- Implementation of the remediation strategy (comprising the selected options to manage risks to receptors as detailed in the RAP or SMP). Validation assessment will be undertaken to verify that the construction-phase options to manage risks have been implemented appropriately. The outcomes from the validation assessment (including contractor inputs on relevant matters such as materials tracking, survey data, as-built information) will be documented in a Site Remediation and Validation (SRV) report for endorsement by the Auditor.
- Implementation of the CEMP to address risks to workers undertaking construction.

Post construction:

- Preparation of a Mandatory Auditor's Report (MAR) by the Auditor on completion of the works and submission to DWER to support reclassification of the Site to an acceptable 'end-point' classification under the CS Act to permit future use as a station. Based on a sustainable approach to development in which the former landfill remains at the Site and subject to successful implementation of

management measures, the following classifications under the CS Act would permit future station use in a sustainable and cost effective manner:

  - '*Contaminated - restricted use'*.
  - '*Remediated for restricted use'*.
- DWER evaluation of site suitability for new station use and decision concerning reclassification of the Site.

Ongoing operation of new station:

- Implementation of the Auditor endorsed OSMP to manage residual risks to receptors.

7 Key references

British Standards Institution (2015) *BS 8485: 2015 incorporating corrigendum No.1, Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*.

Department of Environment Regulation (2014) *Assessment and management of contaminated sites*.

GHD (2016) *Preliminary Site Investigation: Ranford Road Landfill.*

GHD (2017) *Sampling and Analysis Quality Plan (SAQP) for Detailed Site Investigation: Ranford Road Metronet.*

GHD (2018) *Detailed Site Investigation: Ranford Road Metronet.*

New South Wates Environmental Protection Agency (2012) *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases*.

8 Limitations

This report has been prepared by GHD for Public Transport Authority and may only be used and relied on by Public Transport Authority and the Auditor for the purpose agreed between GHD and the Public Transport Authority as set out in Section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Public Transport Authority arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Public Transport Authority and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

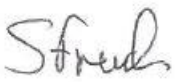
Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

9 Closing remarks

We trust this information is of assistance to the PTA in relation to the approvals process for the TCL project. Please do not hesitate to contact the GHD project team should you require any further information.

Sincerely

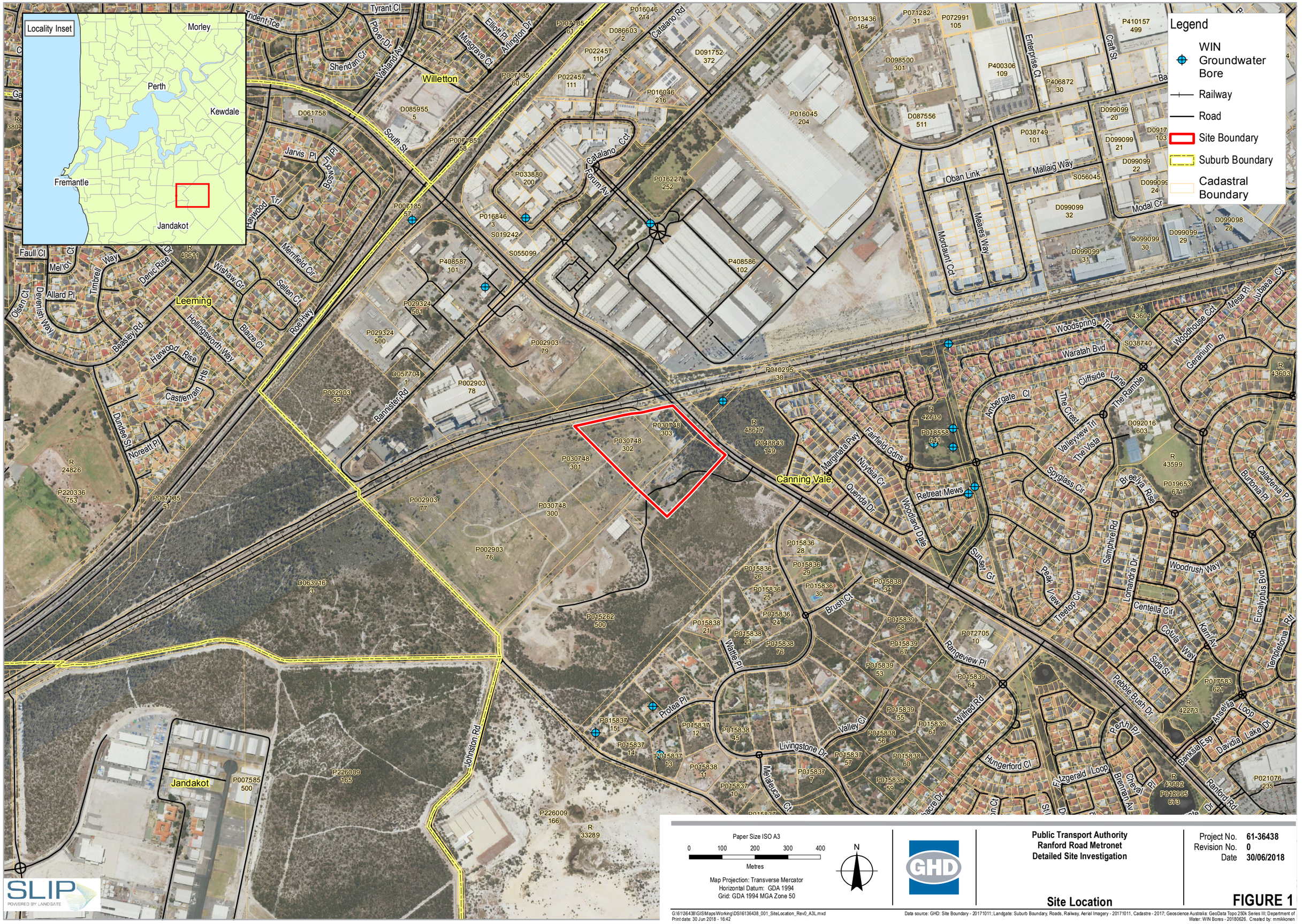
Neil Rogers (on behalf of GHD)
Environmental Scientist



Simon French (on behalf of GHD)
Technical Director

Attachment 1: Site plan
Attachment 2: Proposed station development

Attachment 1: Site location



Paper Size ISO A3

0 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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GHD

Public Transport Authority
Ranford Road Metronet
Detailed Site Investigation

Project No. **61-36438**
Revision No. **0**
Date **30/06/2018**

Site Location

FIGURE 1

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Print date: 30 Jun 2018 - 16:42

Data source: GHD: Site Boundary - 20171011; Landgate: Suburb Boundary, Roads, Railway, Aerial Imagery - 20171011, Cadastre - 2017; Geoscience Australia: GeoData Topo 250k Series III; Department of Water: WIN Bores - 20180626. Created by: mmiklonen

Attachment 2: Proposed station development

Source: https://www.metronet.wa.gov.au/Portals/26/Documents/DocumentListModule/TCL%20Ranford%20Rd%20Fact%20Sheet.pdf