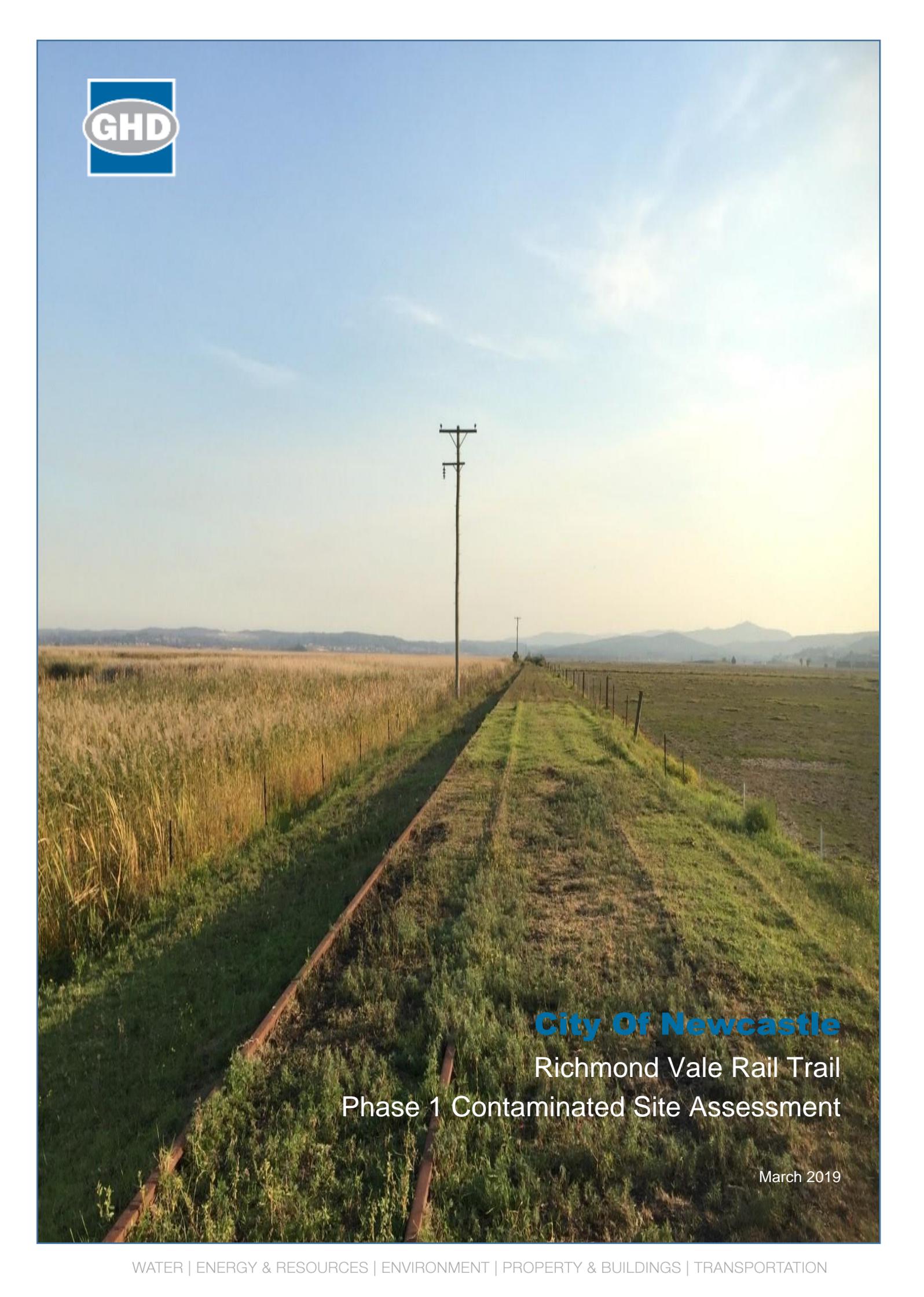


Appendix F – Contaminated site assessment

The background of the entire page is a photograph of a rural landscape. A dirt path or rail trail runs from the bottom center towards the horizon. To the left of the path is a field of tall, golden-brown grasses. To the right is a field of shorter, green grasses. In the distance, there are rolling hills and a utility pole stands prominently on the left side of the path. The sky is a clear, pale blue with some light clouds.

City Of Newcastle
Richmond Vale Rail Trail
Phase 1 Contaminated Site Assessment

March 2019

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Appendices

- Appendix A – Figures
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List of abbreviations

ACM	Asbestos Containing Material
AEC	Areas of Environmental Concern
AHD	Australian Height Datum
ASS	Acid Sulfate Soils
BaP	Benzo(a)pyrene
BTEX	Benzene, Toluene, Ethyl benzene, Xylenes
BA	Building Applications
CLM Act	Contaminated Land Management Act 1997
CSA	Contamination Site Assessment
CSM	Conceptual Site Model
DA	Development Application
DP	Deposited Plan
DLWC	Department of Land and Water Conservation
EPA	NSW Environment Protection Authority
ERM	Environmental Resources Management
ha	Hectare
km	Kilometre
LEP	Local Environment Plan
LGA	Local Government Area
Mbgs	Metres below ground surface
mbgl	Metres below ground level
NEPC	National Environment Protection Council
NEPM	National Environment Protection (Assessment of Site Contamination) Measure
OCP	Organochlorine Pesticide
OPP	Organophosphate Pesticide
OEH	Office of Environment and Heritage
PACM	Potential Asbestos Containing Material
PAH	Polycyclic Aromatic Hydrocarbon
PASS	Potential Acid Sulfate Soils
PCB	Polychlorinated Biphenyl
POEO Act	Protection of the Environment Operations Act 1997
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons

1. Introduction

GHD Pty Ltd (GHD) was engaged by the City of Newcastle (Council) to undertake a Phase 1 Contaminated Site Assessment (CSA) and provide preliminary advice on the presence of contamination and the potential risk to human health or the environment for the proposed Richmond Vale Rail Trail shared pathway (hereafter referred to as the “RVRT”).

The RVRT is proposed as a 34 kilometre (km) shared pathway from Pelaw Main to Hexham, generally following the alignment of the former Richmond Vale Railway including the existing embankment, cuttings and tunnels and utilising minor roads and other available routes where use of the rail corridor is not possible. Existing dilapidated bridges over water courses are proposed to be replaced. The proposed route traverses Cessnock, Newcastle and Lake Macquarie local government areas (LGA). Figure 1 in Appendix A presents the location of the proposed RVRT.

The alignment as included in the current concept design is presented in Figure 2, Appendix A.

1.1 Objectives

The objectives of the CSA are as follows:

- To describe the existing environmental conditions at the site
- To assess the potential for contamination within the proposed alignment of the RVRT

1.2 Scope of work

The scope of work for the Phase 1 CSA comprised a desk top investigation of available information pertaining to the potential for contamination along the proposed route including the following:

- A review of soils, geology, hydrology and topography information for the site.
- A search of the NSW Office of Water groundwater database for records of nearby registered groundwater bores.
- A site history review including:
 - A review of historical aerial photographs covering the alignment
 - Review of any available investigations for the RVRT
 - Database search of NSW Environment Protection Authority (EPA) Contaminated Sites Register (notifications or incidents)
 - Database search of EPA, Protection of the Environment Operations (POEO) Licence Register
 - Council database search regarding relevant development applications and building applications and 149 Certificates (where required)
- A site inspection to gain an understanding of current site conditions, the surrounding built and natural environment and how these influence the potential for site contamination, and to identify areas of potential environmental concern.
- Preparation of this report with reference to the *Guidelines for Consultants Reporting on Contaminated Sites* (OEH, 2011) and the *National Environmental Protection (Assessment of Site Contamination) Measure 1999* (NEPC, 2013) summarising the works undertaken, results of the desktop reviews and site inspection and provision of recommendations for further investigations (as required).

1.3 Limitations

The assessment was limited to the scope described in Section 1.2 and the limitations outlined in Section 8. The works were restricted to a desktop review of site contamination issues and a site inspection. The desk top study did not include a review of historic land titles, Section 149 certificates or dangerous goods licences.

2. Site information

2.1 Site identification

The study area is located in the Cessnock, Newcastle and Lake Macquarie LGAs, extending throughout the suburbs of Pelaw Main, Richmond Vale, Stockrington, Minmi, Tarro, Hexham and Shortland.

The trail is primarily located within the Cessnock LGA but also traverses the Lake Macquarie and Newcastle LGAs, facilitating a linkage between Newcastle and Lake Macquarie's beaches with the coalfields and vineyards of Cessnock and its surrounding communities. The proposed 34 km track encompasses a vast range of land uses including residential areas, commercial land use, recreational land use, dense bushland and marsh and wetland areas.

The proposed RVRT is predominantly aligned with the former Richmond Vale Railway and along the former Chichester water main pipeline (between Shortland and Tarro) and will generally be constructed at existing levels. However the following works are proposed that will may impact on the existing ground surface:

- Preparation of a suitable pavement surface with removal (where required) of unsuitable material.
- Minor fill/cut works to prepare a suitable surface (where required).
- Construction of new bridges and boardwalks over waterway crossings.

2.2 Site description

The former Richmond Vale Railway is approximately 40 km in length and comprises a main alignment from Shortland to Kurri Kurri, a 2 km spur to Tarro from Hexham, and a two km spur from Minmi to 1 km east of Lenaghans Drive, and a 2 km spur to the Wetland Centre from Ironbark Creek. The Sandgate to Tarro section comprises a relatively straight low embankment that varies from ground level, to approximately 1.5 metres (m) high above the surrounding surface. From Hexham the rail corridor continues to the southwest along the Hexham swamp for approximately 5 km before turning west, through the Sugarloaf Range and across to Kurri Kurri. The rail corridor west of the M1 motorway to Richmond Vale is characterised by tunnels and cuts through low lying hills and fill embankments to traverse the many gullies and valleys. From Richmond Vale to Kurri Kurri the alignment crosses a number of watercourses via dilapidated bridges and undulating open woodland.

2.3 Ownership of the rail corridor

The former rail corridor is owned by a range of entities and individuals including Coal and Allied Operations Pty Ltd (Rio Tinto), State Government, the Crown, Councils, Hunter Water and private land owners. Table 2-1 provides a site description, surrounding land uses and zoning of land parcels along each segment of the RVRT.

A site walkover was completed on 26 May 2016 by GHD. The main site features observed during the walkover are summarised in Table 2-1 below and shown in Figures 3-1 to 3-10, Appendix A with reference to selected photographs as provided in Appendix B.

Table 2-1 RVRT – Site description, surrounding land uses and zoning

Segment number	Segment length	Description	Relevant LEP	Zoning
1	4 km (0-4)	<p>Segment 1 begins at the 'Log of Knowledge Park' on the corner of Mulbring and Stanford Streets, Pelaw Main. The segment is situated within a residential area before extending into primarily undisturbed bushland of the Werakata State Conservation Area, approximately 0.7 km from the beginning of the trail. At 3.4 km and 3.8 km from the start, the proposed track intersects with pre-existing dirt roads extending to Stanford Merthyr and Kurri Kurri-Mulbring Road. The area incorporates Lot 502 of DP1200716, Lot 239 of DP 755259, Lot 502 of DP1200716, Lot 7016 of DP1021277 and Lot 1001 of DP1148414 (The State of NSW).</p> <p>The site inspection revealed that the majority of the bushland was untouched. Illegal dumping in the bushland was noted, particularly in the cutting east of Pokolbin Street which could be a potential source of contamination. The RVRT route is being designed to avoid this cutting due to the geotechnical instabilities and presence of unknown depths of miscellaneous rubbish. Illegal dumping was also noticed near culverts and other brick infrastructure. Items dumped include plastic and rubber debris.</p>	<i>Cessnock Local Environment Plan 2011</i>	<ul style="list-style-type: none"> • RU2 Rural Landscape • R2 Low Density Residential • RE1 Public Recreation • SP2 Infrastructure
2	2 km (4-6)	<p>This segment extends into Lot 18 & 19 of DP1061633 (Stephen John Wile), Lot 1 of DP438379 (J & A Brown), Lot 1 of DP1140694 (J&A Brown) and Lot 9 of DP 755260 (unknown). The land primarily consists of cleared farmland, with rural properties and associated farming infrastructure north of the trail. At approximately 4.85 km, the track crosses Wallis Creek. At approximately 3.8 km, the track crosses George Booth Drive and turns to run parallel with and north of George Booth Drive through bushland.</p> <p>The Wallis Creek bridge was found to be dilapidated, with timber and metal debris (pylons and nails). Some components of the bridge were noted to have dark staining on them. Furthermore, brickwork was found on the bank beside the bridge, half of which was buried in the ground. Disused pumping infrastructure was also found.</p>	<i>Cessnock Local Environment Plan 2011</i>	<ul style="list-style-type: none"> • RU2 Rural Landscape • SP2 Infrastructure • E2 Environmental Conservation

Segment number	Segment length	Description	Relevant LEP	Zoning
3	9 km (6-15)	The majority of this segment of the route runs through undisturbed bushland. From 6 km to 12 km the track runs adjacent to George Booth Drive and passes north of the Kurri Orica Technical Centre (approximately 480 m from proposed track location). The Pace Farm access road intersects with the track at approximately 6.75 km. At 9.3 km -9.55 km the track passes a large water body that may be a disused gravel quarry. From 10-12 km the track runs generally adjacent to the Hunter Expressway where it crosses the boundary from Cessnock City Council to Lake Macquarie City Council LGA at 11.8 km. The track intersects the Hunter Expressway at 12.6 km with the area from 12.5-12.7 km covering Lot 51 of DP1095513 (Coal and Allied Industries Limited). The track continues into dense, undisturbed bushland before aligning with Seahampton Road and passing the Buttai Quarry (approximately 600 m north west of the proposed track). The track passes beneath transmission lines at 14.85-14.9 km. This segment also lies within Lot 8 of DP1140257, Lot 1 of DP1039968, Lot 3 and 4 of 977096, Lot 82 and 125 of 755260, Lot 3 of 250339 and Lot 2 of 124209. Rusted fencing and an abandoned rusted out car were found in this segment. Other small pieces of debris were also observed. Located below the Surveyors Creek bridge were broken bricks and steel fencing.	<i>Lake Macquarie Local Environment Plan 2014</i>	<ul style="list-style-type: none"> • SP2 Infrastructure • E2 Environmental Conservation
4	4 km (15-19)	This area comprises rural residential, farmland and agricultural land use. From 15.4-17.6 km lies Lot 21 of DP1195619 (Rio Tinto). The segment then intersects with Cedar Hill Drive, the Pacific Motorway and Lenaghans Drive. The area from 17.7-19 km is encompassed by Lot 1 of DP1007615 (Black Hill Land Pty Ltd). The Pambalong Nature Reserve lies to the south-west of the trail. The water running below the Surveyors Creek bridge was a bright orange colour, suggesting the precipitation of iron. Dumped debris was also found including furniture and plastic. A piece of dumped concrete and broken bottles were also found.	<i>Newcastle Local Environmental Plan 2012</i>	<ul style="list-style-type: none"> • SP2 Infrastructure • E1 National Parks and Nature Reserves • E2 Environmental Conservation

Segment number	Segment length	Description	Relevant LEP	Zoning
5	~2.25 km (19.25 to Minmi)	Segment 5 is the spur to Minmi and begins from 19.25 km and extends south west to the residential area within Woodford Street, Minmi via farmland and bushland. The trail in this segment covers areas from Lot 1 of DP1007615, Lot 10 of DP119449, Lot of 148 DP840897 (Hunter Water Corporation), Lot 2 of DP1193703 (Minmi Land Pty Ltd) and Lot 3 of DP1111997 (Sterling Property Services). No obvious signs of illegal dumping or potential signs of contamination.	<i>Newcastle Local Environmental Plan 2012</i>	<ul style="list-style-type: none"> • R2 Low Density Residential • E1 National Parks and Nature Reserves • E2 Environmental Conservation
6	5.8 km (Fletcher to 24)	The segment extends to the north east and covers an area comprising bushland and farmland before transitioning into the Hexham Swamp Nature Reserve. The trail begins with a connection to the township of Fletcher before intersecting with the Hunter Water Pipeline (Lot 147 DP1143414) at 19.25 km whilst the straight component of the trail from 19.25-24 km lies within Lot 10 of DP119449 (Coal & Allied Industries Limited). This area also encompasses Lot 1 of DP90465 (The State of New South Wales). Disused pumping and piping infrastructure was found throughout this segment.	<i>Newcastle Local Environmental Plan 2012</i>	<ul style="list-style-type: none"> • E1 National Parks and Nature Reserves • E2 Environmental Conservation
7	~2.5 km (24-Tarro /Beresfield)	This area consists of low-lying swampy terrain and intersects with Purgatory Creek approximately 360 m from Anderson Drive. From here the track transitions to the residential area of Tarro whereby the trail crosses the New England Highway and ends at the corner of Anderson Drive. The trail encompasses Lot 1 of DP128309 and Lot 1 & 2 of DP171105 owned by Hunter Water Corporation as well as Lot 102 of DP1084709 and Lot 10 of DP735235 (Aurizon Operations Limited). No obvious potential sites of contamination identified.	<i>Newcastle Local Environmental Plan 2012</i>	<ul style="list-style-type: none"> • SP2 Infrastructure • R2 Low Density Residential • E2 Environmental Conservation
8	5 km (24-29)	Segment 8 extends generally south along the boundary with the Hexham Swamp Nature Reserve (to the west). This area is primarily swampy marshlands on the western side of the track, whilst to the east lies the existing train line, the New England Highway and industrial areas. The segment includes Lot 1 of DP90465, Lot 3 & 4 of DP805274 and Lot 302 of DP1141267, all of which are under the ownership of the State of New South Wales, as well as Lot 2 of DP611518 (Hunter Water Corporation). No obvious potential sites of contamination identified.	<i>Newcastle Local Environmental Plan 2012</i>	<ul style="list-style-type: none"> • IN3 Heavy Industrial • E1 National Parks and Nature Reserves • E2 Environmental Conservation

Segment number	Segment length	Description	Relevant LEP	Zoning
9	1.9 km (29-30.9)	The beginning of segment 9 extends over Ironbark Creek (Crown land) on the outskirts of the Hexham Swamp Nature Reserve. The trail intersects with Ironbark Creek at 29.2 km Following this, the trail enters the suburban residential area of Shortland and runs adjacent to King Street before finishing at Sandgate Road at 30.9 km. The segment is located within Lot 1 of DP611441, Lot 1 & 2 of DP805274 and Lot 302 of DP1141267 owned by Hunter Water Corporation. No obvious potential sites of contamination identified.	<i>Newcastle Local Environmental Plan 2012</i>	<ul style="list-style-type: none"> • RE1 Public Recreation • R2 Low Density Residential
10		Segment 10 begins at the southern end of Segment 8 and extends along the north-eastern boundary of the residential properties of Blanch Street. The trail continues towards the Hunter Wetland Centre generally in a south eastern direction, traversing the low-lying swampy terrain and ending at the Wetland Centre building. The trail includes Lot 50 DP 1201513 and Lot 5 DP 233520. The former Shortland Tip also known as the Astra Street Landfill is located to the east of the wetlands, adjacent to Sandgate train station.	<i>Newcastle Local Environmental Plan 2012</i>	<ul style="list-style-type: none"> • E2 Environmental Conservation

3. Environmental setting

The following section provides an overview of the environmental setting of the site obtained from publically available information.

3.1 Topography

The RVRT route encompasses a range of topographies, all of which are measured with respect to the Australian Height Datum (AHD) (Six Maps, NSW Government, <https://maps.six.nsw.gov.au/>, accessed 31 May 2016).

Elevations of the surrounding terrain in segments 1 and 2 range from 20 -50 m with gradual inclines and declines in topography. Conversely, the terrain in segments 3 and 4 is much steeper, with gullies and peaks of 120 m occurring at approximately 12 km. The surrounding hills then flatten out as the route approaches the Pambalong Nature Reserve before crossing the Pacific Motorway and Lenaghans Drive, where the elevation ranges from 10-30 m. From segment 5 onwards, the landscape is primarily flat and low lying with an elevation of approximately 10 m as the RVRT route approaches and then passes through the Hexham Swamp region. For the final 2.31 km of the trail, the elevation ranges from 10-20 m before again reaching the low lying wetlands of 10 m elevation.

3.2 Geology and soils

Reference to the 1:100,000 scale Regional Geology Maps for Newcastle indicates that the subsurface geology along the RVRT alignment varies between the Greta Coal Measures, Maitland Group, Newcastle Coal Measures, Tomago Coal Measures and Quaternary deposits.

Reference to the 1:100,000 scale Soil Landscape Map and Report for Newcastle and Singleton shows that the RVRT lies within numerous soil landscapes including Heddon Greta, Bolwarra Heights, Wallis Creek, Beresfield, Killingworth, Cedar Hill, Stockrington, Seaham, Rivermead, Hexham Swamp, Bobs Farm and Millers Forest. Human activity has also caused mapped "Disturbed Terrain".

Reference to the 1:25,000 scale Acid Sulphate Soil (ASS) Risk Map for Newcastle indicates that the majority of the segments that lie within Hexham Swamp have a high risk of encountering ASS conditions within 1 m or between 1 m and 3 m below the ground surface. It is noted that ASS is indicated to occur approximately 4 km downstream (north) of Willis Creek, and hence there is potential for encountering ASS on the section of the alluvial plain traversed by the rail corridor.

The following ASS risks were noted within the RVRT and their occurrence by segment is presented in Table 3-1:

- EK1 estuarine back swamp soils of elevation 1-2 m - high probability of occurrence of ASS throughout the soil profile within 1 m of the ground surface. Severe environmental risk is possible if ASS materials are disturbed by activities such as shallow drainage, excavation or clearing.
- Ap1 Alluvial plain soils of elevation 1-2 m - high probability of occurrence of ASS exists throughout the profile within 1 m of the ground surface. Potential for severe environmental risk if ASS materials are disturbed by activities such as shallow drainage, excavation or clearing.

- Em Estuarine bottom sediments - High probability of occurrence of ASS below water level. Severe environmental risk is a possibility if ASS materials are disturbed by activities such as dredging.

Table 3-1 shows a summary of the geological units, soil landscape and ASS risk that the RVRT passes through by each segment. Table 3-2 provides further description of the soil landscapes.

Table 3-1 Subsurface materials by segment

Segment	Geological unit	Soil landscape	ASS
1	Greta Coal Measures – coal seam, siltstone, sandstone Maitland Group – Branxton Formation – Conglomerate, sandstone, siltstone	Heddon Greta	N/A
2	Maitland Group – Branxton Formation – Sandstone, siltstone, tillitic conglomerate	Bolwarra Heights Wallis Creek	N/A
3	Maitland Group – Branxton Formation – Sandstone, siltstone, tillitic conglomerate	Wallis Creek Beresfield.	N/A
4	Newcastle Coal Measures – Conglomerate, sandstone, tuff, shale, coal	Killingworth Cedar Hill Stockrington Seaham	N/A
5	Newcastle Coal Measures – Conglomerate, sandstone, tuff, shale, coal	Killingworth Cedar Hill Beresfield Rivermead	N/A
6	Quaternary Period – gravel sand, silt, clay, “Waterloo Rock” Marine siltstone & freshwater deposits Tomago Coal Measures – Shale, mudstone, sandstone, tuff, coal	Hexham Swamp (minor area of Millers Forest and disturbed terrain) Beresfield Bobs Farm (Landscape Variant)	Ap1 Ek1
7	Quaternary Period – gravel sand, silt, clay, “Waterloo Rock” Marine siltstone & freshwater deposits	Hexham Swamp (minor area of disturbed terrain) Millers Forest Beresfield	Ap1 Ek1
8	Tomago Coal Measures – shale, mudstone, sandstone, tuff, coal Quaternary Period – gravel sand, silt, clay, “Waterloo Rock” Marine siltstone & freshwater deposits	Disturbed terrain Hexham Swamp Millers Forest	Ap1 Ek1
9	Tomago Coal Measures – shale, mudstone, sandstone, tuff, coal Quaternary Period – gravel sand, silt, clay, “Waterloo Rock” Marine siltstone & freshwater deposits	Hexham Swamp Beresfield Disturbed Terrain	Em Ek1
10	Tomago Coal Measures – shale, mudstone, sandstone, tuff, coal Quaternary Period – gravel sand, silt, clay, “Waterloo Rock” Marine siltstone & freshwater deposits	Hexham Swamp Beresfield Disturbed Terrain	Em Ek1

Table 3-2 Summary of soil landscapes

Soil landscape	Description
Heddon Greta	Characterised by gently undulating rises on shallow windblown sand deposits which blanket Permian sediments in the East Maitland Hills region. Slopes are 2-10%, elevation is up to 30 m and relief is up to 20 m. Soils include moderately deep, moderately well to imperfectly drained Yellow Podzolic Soils and Red Podzolic Soils with some deep, moderately well to imperfectly drained Siliceous Sands.
Bolwarra Heights	Consisting of low hills on Permian sediments in the centre-west of the East Maitland Hills region. Slopes are 5-20 %, whilst elevation is up to 100 m and local relief to 80 m. The landscape contains cleared tall open-forest.
Wallis Creek	Comprising narrow to moderately broad, level to gently undulating floodplains on Quaternary alluvium. Local relief is up to 2 m, slopes are 0-3% and elevation to 20 m. Soils are deep, well to imperfectly drained Alluvial Soils and Siliceous Sands on floodplains with some imperfectly to poorly drained, deep Alluvial Soils on back swamps and ox-bows. Development limitations include flooding, permanently high water tables, high run-on, high stream bank erosion hazard, ground water pollution hazard, non-cohesive soils of low fertility.
Beresfield	Characterised by undulating low hills and rises on Permian sediments, typically including fine-grained organic sands, silts and clay soils derived from the weathering of siltstone and sandstone.
Killingworth	Consists of undulating rolling hills and low hills on the Newcastle Coal Measures of the Awaba Hills region. Elevation is 50-160 m with local relief of 30-100 m with slopes of 3-20%. It predominantly consists of open forest.
Cedar Hill	Characterised by rolling to steep rises on siltstones and sandstones in the Awaba Hills and Sugarloaf Range. Local relief is up to 100 m, elevation is up to 100 m and slopes are 15 – 40%. Soils are moderately deep to deep, well to imperfectly drained Brown Podzolic Soils and Yellow Podzolic Soils, with presence of some deep well-drained Non-calcic Brown Soils and moderately deep, well-drained Structured Loams. Limitations include its potential to be a high mass movement hazard, its high foundation hazard, steep slopes, acid soils and presence within a Mine Subsidence District.
Stockrington	Characterised by steep rises on conglomerates of the Newcastle Coal Measures with steep slopes with gradients of 25 - >40% and benches of 15 – 20%. Generally, elevation up to 160 m, local relief up to 180 m and uncleared tall open-forest are common. Soils are moderately deep to deep, rapidly draining Earthy Loams and Friable Loams on upper slopes with deep, well drained Red Podzolic Soil, red Soloths, brown Soloths and yellow Soloths on mid-slopes and benches. Limitations of the soil include steep slopes, mass movement hazard, water erosion hazard and its potential to be a foundation hazard.
Seaham	Consists of undulating low hills to rolling hills on Carboniferous sediments in the Paterson Mountains region. Slopes are 3-15% whilst the local relief is 30-120 m and elevation 40 -300 m. The landscape predominantly consists of cleared and uncleared tall open-forest. Soils tend to be shallow to moderately deep, well to imperfectly drained yellow Soloths and brown Soloths. Some shallow to moderately deep well drained Bleached Loams and Lithosols are present. Limitations include its potential to be a high water erosion hazard, high localised run on, the presence of the localised rock outcrop, seasonal waterlogging potential and the presence of strongly acidic soils of low fertility.

Soil landscape	Description
Rivermead	Consists of undulating alluvial terraces in the Hunter Plain and Paterson Mountains regions. Slope are commonly 0-4%, whilst elevation is 5-20 m and local relief is 5-10 m. Soils are deep, well drained Yellow Earths and Red Earths and shallow to deep moderately well to imperfectly drained Brown Podzolic Soils, with some Chocolate Soils and deep, moderately well-drained Brown Clays. Limitations include a localised flood hazard and high foundation hazard, tendencies for waterlogging on imperfectly drained terraces.
Hexham Swamp	Characterised by broad swampy estuarine back plains on the Hunter Delta, with local relief less than 2 m and variable shallow water table. Dominant soil materials include highly plastic organic silty clays and organic clays with noted associated soil materials including fibrous peats and loose pale sand. Limitations include permanently high water tables, seasonal water logging, flooding, foundation hazards, saturated and saline soils and potential ASS.
Bobs Farm	Comprises of low remnant lake shore deposits. Relief of up to 1 m relief, 15 m width and 200 m in length is present.
Millers Forest	Characterised by extensive alluvial plain on recent sediments in the Lower Hunter Plain region, with elevations 6 - <3 m. Local relief is <1 m whilst the slope gradients are <1%. Cleared tall open forest with deep, imperfectly to poorly drained Prairie Soils are prominent. Limitations include permanently high water tables, seasonal water logging, flooding, foundation hazards, saturated and saline soils and potential ASS.
Disturbed Terrain	Characterised by level plains to hummocky terrain, and is extensively disturbed by human activity, which may include complete disturbance, removal or burial of soil. Local relief slopes are highly variable, with soil types also being highly variable. The areas are generally completely cleared of original vegetation and replaced with turf or grassland.

3.3 Hydrology

The RVRT falls primarily within the Hunter catchment whilst a number of the creeks flow to the Heaton State Forest covering both Hunter and Lake Macquarie catchments. Table 3-3 outlines the main hydrological features that intersect or run adjacent to the RVRT.

Table 3-3 Hydrological features

Hydrological feature	Segments affected	Description
Wallis Creek	2	Wallis Creek, a tributary of the Hunter River, intersects the RVRT at approximately 4.85 km and continues to flow in a north-easterly direction before reaching the Hunter River between East Maitland and Lorn.
Pace Farm Dam	3	There is a small creek that crosses the RVRT at approximately 6.5 km. Originating from small tributaries located between Richmond Vale and Mount Sugarloaf, this creek flows in a northerly direction to a dam located north of the Pace Farm complex. During high flows, this dam has the potential to discharge into Surveyors Creek, which in turn flows downstream of the RVRT into Wallis Creek.

Hydrological feature	Segments affected	Description
Surveyors Creek	3	The RVRT crosses Surveyors Creek at approximately 10.6 km and 10.8 km. This creek originates in the vicinity of the RVRT crossing before flowing downstream into Wallis Creek at Buchanan and continuing into the Hunter River near Maitland.
Blue Gum Creek	3, 4	Blue Gum Creek runs adjacent to the RVRT from 12 km to 16 km and intersects at 11.6 km, 11.85 km, 12.75 km, 13.4 km, 14.85 km and 15.4 km. This creek originates near the RVRT and flows in an east north east direction before discharging into Long Gully at Stockrington.
Burnt Creek	3	At approximately 12.3 km the trail crosses Burnt Creek, flows downstream into Blue Gum Creek.
Minmi Creek	5	The trail intersects with Minmi Creek approximately 970 m from Woodford St. From this intersection to the residential area, the RVRT runs adjacent to the creek. Minmi Creek flows directly north of Segment 5 in a north easterly direction, which then in turn discharges into Fishery Creek, Ironbark Creek and the South Channel of the Hunter River, respectively.
Purgatory Creek	7	At approximately 300 m south of the New England Highway at Tarro, a tributary of Purgatory Creek intersects with the RVRT. The tributary flows in a north east direction and flows into Purgatory Creek, east of Tarro, before discharging into the Hunter River.
Hunter Wetlands National Park	6, 8, 9, 10	The Hunter Wetlands National Park runs adjacent to the rail trail from 21.4 km to 24.4 km and to 29.15 km. It covers an area of approximately 9 km ² and predominantly consists of Hexham Swamp wetlands. Tidal connectivity exists between the Hunter Wetlands National Park and the Hunter River.
Fishery Creek	6	Originating in Fletcher, Fishery Creek crosses the RVRT at approximately 21.8 km. It flows north east through the Hunter Wetlands National Park and into Ironbark Creek before discharging into the Hunter River.
Ironbark Creek	9, 10	The northern portion of segment 9 and 10 intersects with Ironbark Creek at approximately 29.2 km. This tributary of the Hunter River originates in Elermore Vale and extends through Shortland towards the southern end of the Hunter Wetlands National Park before discharging into the Hunter River at Hexham.

The length of the RVRT is predominantly unsealed (with the exception of sealed roadways) so surface water is expected to either be directed to existing drainage structures that convey water courses beneath the alignment, infiltrate into soils or run off following topographic gradient into drainage channels and eventually water courses.

3.4 Hydrogeology

GHD obtained database information from the NSW Office of Water groundwater database on 7 June 2016. The search was conducted to identify registered groundwater boreholes in close proximity to the site and to record information such as groundwater use and standing water level. The results of this search indicated that there were thirteen registered groundwater wells within 2 km of the RVRT. Summary information is presented in Table 3-4. Further details of the groundwater search are provided in Appendix C.

Table 3-4 Summary of groundwater database search

Bore ID	Standing water level (mbgl)	Water bearing zones (mbgl)	Final depth (mbgl)	Salinity (mg/L)	Intended purpose
Groundwater wells within approximately 2 km radius of Study Area					
GW0693992 Latitude: 32°52'17.3"S Longitude: 151°41'03.1"E	-	17-19	24.4	1001-3000	Stock, Domestic
GW080250 Latitude: 32°52'44.2" Longitude: 151°42'07.7"E	-	-	-	-	Test Bore
GW080251 Latitude: 32°52'39.8"S Longitude: 151°41'37.5"E	2	2-4.5	4.5	-	Test Bore
GW200626 Latitude: 32°52'10.6"S Longitude: 151°37'30.3"E	-	-	4.2	-	Test Bore
GW200627 Latitude: 32°52'06.0"S Longitude: 151°37'34.0"E	-	-	4.2	-	Test Bore
GW200628 Latitude: 32°55'43.3"S Longitude: 151°45'44.1"E	-	-	4.2	-	Test Bore

Bore ID	Standing water level (mbgl)	Water bearing zones (mbgl)	Final depth (mbgl)	Salinity (mg/L)	Intended purpose
Groundwater wells within approximately 2 km radius of Study Area					
GW200629 Latitude: 32°52'00.9"S Longitude: 151°37'38.8"E	-	-	4.2	-	Test Bore
GW201660 Latitude: 32°50'01.8"S Longitude: 151°40'40.9E	-	-	3.1	-	Monitoring Bore
GW201661 Latitude: 32°50'15.3"S Longitude: 151°40'45.4"E	-	1.7-2.8	2.8	-	Monitoring Bore
GW201662 Latitude: 32°50'15.2" Longitude: 151°40'45.4"	-	1.7-6.3	6.3	-	Monitoring Bore
GW201663 Latitude: 32°55'46.3" Longitude: 151°45'33.1"	-	-	5.3	-	Monitoring Bore
GW201664 Latitude: 32°49'51.1" Longitude: 151°40'36.5"	-	-	1.2	-	Monitoring Bore
GW201941 Latitude: 32°51'45.2" Longitude: 151°36'24.7"	-	-	72	-	Stock, Domestic

Based on site observations and GHD's understanding of the environmental setting of the RVRT, regional groundwater would generally be expected to flow in an easterly and south easterly direction towards the Hunter River, and range from very shallow (<1 m below ground level (mbgl)) within the areas of Hexham to moderately deep (>5 mbgl) in the more mountainous western reaches of the RVRT.

Given the nature of the RVRT and surrounding land uses, it is possible that groundwater in the area could be used for a variety of purposes including domestic use (including potential drinking water), stock watering, irrigation purposes or monitoring purposes.

4. Desktop information

4.1 Rail construction and operation

The Richmond Vale Railway is a former rail line that runs from Hexham to Pelaw Main in the Lower Hunter region of NSW. The first section of the railway was opened in 1857 and originally ran from Hexham to Minmi. In 1905 the line was extended from Minmi to the Richmond Main and Pelaw Main Collieries, near Kurri Kurri. A number of small branch lines were also established from the 1920s to the 1950s to service collieries in the Stockrington area to the east of Pelaw Main. Industrial operation of the railway ceased in 1987 following the closure of the collieries in the region. In 1991, a direct passenger line was re-opened along a section of railway from the former Richmond Main Colliery to the former Pelaw Main Colliery. This passenger line continues to operate as a tourism facility managed by the Richmond Vale Railway Museum. The balance of the line has remained closed since 1987 (*Newcastle City Council – Richmond Vale Rail Trail Concept Design Report (DRAFT)*. 2218317. December 2016).

Sections of the rail corridor have been used for access, such as to Stockrington Quarry, and construction access between Seahampton Road and the Hunter Expressway. The section of the RVRT across Hexham Swamp utilises a disused section of the former Chichester to Newcastle water main corridor - the Chichester Trunk Gravity Main (CTGM).

The embankment and formation were constructed using waste rock from Pelaw Main Colliery, presumably to as far south as Surveyors Creek; cut to fill through the Sugarloaf Range; and imported fill, such as coal reject, building rubble and rock fill, across Hexham Swamp (*Newcastle City Council – Richmond Vale Rail Trail Geotechnical Assessment Report*. 2218317. December 2016).

4.2 Historical aerial photographs

A selection of historical aerial photographs were obtained from NSW Land and Property Information (a division of the Department of Finance, Services and Innovation) and examined in order to assess past activities and land uses at the site. Photographs were reviewed from the years 1966, 1976, 1984, 1993 and 2004, along with a current aerial photograph from Six Maps (NSW Government, <http://maps.six.nsw.gov.au/>) accessed on 21 November 2016. Due to the size and complexity of the trail, the aerial photography investigation was undertaken as per the trail segments outlined in Table 2-1. Results of the aerial photograph review are summarised in Table 4-1.

Table 4-1 Review of historical aerial photographs

Segment	Year of photograph	Description
1	1966	Low density residential areas lie between Pelaw Main and Kurri Kurri. Further land clearing is evident, potentially to make way for further residential developments. As the trail route extends south towards Buchanan and Stanford Merthyr, the land remains as undeveloped bushland, except for some minor road and rail infrastructure.
	1976	Further residential developments have occurred within Kurri Kurri and Pelaw Main where the RVRT commences. The remainder of the segment consists of undisturbed bushland however land clearing has occurred on a portion of land to the south west of the trail for quarrying. A number of dirt roads within the bushland have become more well defined since previous photographs. Minor land clearing has also occurred to the south of the trail (at the end of the segment), however no structures were built.
	1984	The townships of Pelaw Main and Kurri Kurri have developed further, with expansion of the residential zones. The bushland appears to have remained unchanged from previous photographs, whilst the quarry pits that were located to the south-west of the RVRT have been backfilled.
	1993	No major changes have occurred since the 1984 photograph.
	2004	No major changes have occurred since the 1993 photograph was captured.
	Current Source: Six Maps (accessed 21/11/2016)	The landscape has changed little from the 2004 image, with land comprising of low-medium density residential use and primarily undisturbed bushland.
2	1966	As the RVRT crosses into Richmond Vale, bushland changes to pastoral land and some small scale farming. Approximately half way through this segment, Wallis Creek intersects the RVRT.
	1976	The rail and road infrastructure along the RVRT has become more defined. Further bush clearing has occurred for an increase in pastoral land, although there do not appear to be any additional structures built since 1966. Wallis Creek narrows with an apparent build-up of sediment. A bridge has been constructed over Wallis Creek where the rail line intersects it.
	1984	This segment remains unchanged from the 1976 photograph, with Wallis Creek still being affected by a build-up of sediment.
	1993	No major changes have occurred in this segment since the 1984 photograph.
	2004	Further development associated with the farming infrastructure in this segment has occurred on both the northern and southern sides of the RVRT.
	Current Source: Six Maps (accessed 21/11/2016)	As per previous photos, the land is mostly undisturbed bushland and pastoral land with some residential properties to the north and south of the RVRT.

Segment	Year of photograph	Description
3	1966	The segment comprises mostly undisturbed bushland with unsealed tracks.
	1976	Further land clearing has occurred mostly north of the RVRT for pastoral land. A minimal amount of farming infrastructure associated with this pastoral land has been constructed.
	1984	George Booth Drive is now visible in conjunction with significant farming infrastructure north of the RVRT. The RVRT intersects George Booth Drive before running parallel to the road.
	1993	Minimal changes have occurred, except for a small loop of land clearing north east of the RVRT. The purpose of this is unclear. South east of this loop however a quarry-like structure has been developed, containing a small dam (Stockrington Quarry).
	2004	The Pace farm site and access road which intersects with the RVRT has been cleared. The Kurri Orica Technical Centre has been constructed. The quarry structure north east of the trail is still visible, with the location of the dam moving slightly west of its previous location.
	Current Source: Six Maps (accessed 21/11/2016)	Much of this area contains undisturbed bushland, however further land clearing has made way for George Booth Drive and infrastructure such as the Pace Farm factory and associated infrastructure as well as the Kurri Orica Technical Centre. Small residential and farming infrastructure has also been constructed. The quarry structure to the north east of the RVRT is now almost entirely filled with water.
4	1966	There is minimal development in this area, with some pastoral land and associated farming infrastructure present in alignment with minor road networks. The current Pacific Motorway is present to the north east of the trail; however, Lenaghans Drive is yet to be constructed. The Pambalong Nature Reserve and surrounding land north of the trail remains undeveloped.
	1976	In this segment, John Renshaw Drive is now present some distance to the north of the RVRT. A significant portion of land to both to the north and south of the trail has been cleared to develop pastoral land. A new piece of significant farming/industrial infrastructure has been constructed to the north east of the trail between John Renshaw Drive and Black Hill Road. No significant infrastructure exists within close proximity to the trail.
	1984	There are no major changes from the 1976 photograph, except for a minor extension of the farming/industrial infrastructure to the north of the RVRT.
	1993	No major changes have occurred since the 1984 photograph.
	2004	Land clearing has occurred for the Pacific Highway and Lenaghans Drive. However, the Pambalong Nature Reserve to the north of the trail has remained undisturbed.
	Current Source: Six Maps (accessed 21/11/2016)	Land clearing and the construction of infrastructure associated with the Hunter Expressway has taken place.

Segment	Year of photograph	Description
5	1966	Land clearing has occurred to develop the township of Minmi. Minimal residential properties have been constructed, however Woodford Street (that the RVRT segment follows) is well defined in this photograph.
	1976	No extensive land clearing has occurred, however more residential properties have been constructed to the east and west of Woodford Street.
	1984	Land clearing has occurred in the township of Minmi for low density residential area. Land has also been cleared to the east of this segment for pastoral land.
	1993	Significant land clearing has occurred to the south east of Woodford Street to make way for quarry or mining-like infrastructure.
	2004	More residential properties have been constructed along Woodford Street. Approximately a third of the land clearing south east of Woodford Street appears to have been rehabilitated, with the areas having been replaced with grassland.
	Current Source: Six Maps (accessed 21/11/2016)	Extensive land clearing has made way for residential and commercial zones extending towards the southern portion of this segment. These built up areas are surrounded by National Parks and Reserves which have remained largely unchanged.
6	1966	This segment primarily consists of the Hexham Swamp Nature Reserve. At the beginning of the segment some minor residential and farming development is present to the north and south of the RVRT.
	1976	No major changes have occurred since the 1966 photograph.
	1984	No major changes have occurred since the 1976 photograph.
	1993	No major changes have occurred since the 1984 photograph.
	2004	Some land clearing to the north of the segment has occurred to make way for pastoral land and associated infrastructure. No other major changes to the land within close proximity of the RVRT have occurred.
	Current Source: Six Maps (accessed 21/11/2016)	Minor land clearing has been due to the development and maintenance of the Hunter Water Pipeline and associated infrastructure. The remainder of the land to the south of the RVRT is part of the Hexham Swamp Nature Reserve.
7	1966	The township of Beresfield, north the of the RVRT, has been established. Apart from this low density residential area, the majority of clearing is for pastoral land. The New England Highway at Tarro and Pipeline Road have both been constructed.
	1976	Further development of the Beresfield residential areas has occurred; however no other major changes were noted.
	1984	The townships of Beresfield, Woodberry and Tarro have been developed significantly. In addition, much of the land south of the A1 Highway has been cleared and is now grass land and pastoral land.
	1993	No major changes have occurred since the 1984 photograph.
	2004	No major changes have occurred since the 1993 photograph.

Segment	Year of photograph	Description
	Current Source: Six Maps (accessed 21/11/2016)	Further development of the low density residential areas and commercial areas has occurred. Other land clearing may be due to upgrades of roads, most notably Anderson Drive, Pipeline Road and the New England Highway. Woodberry, a township north of the RVRT has also been developed extensively.
8	1966	There are a number of small industrial areas present to the east of the RVRT and to the west of the Hunter River, just prior to the river dividing into the North and South Channels. Some residential properties exist along Old Maitland Road. Major industrial areas exist on each side of the Pacific Highway and residential properties exist east of the RVRT where the Pacific Highway merges into Maitland Road. Well defined tributaries of the Hunter River intersect the RVRT, connecting to the Hexham Swamp Nature Reserve.
	1976	At the northern end of this RVRT segment, rail infrastructure is visible to the east and potentially also consist of coal loading facilities. As the RVRT continues south, the tributaries to the South Channel of the Hunter River intersect with the trail, connecting with the Hexham Swamp Nature Reserve.
	1984	Further industrialisation has occurred to the east of the RVRT, particularly within the southern portion of the segment, towards Ironbark Creek. A number of the tributaries to the South Channel of the Hunter River have become thinner and less defined in comparison to the 1976 photograph.
	1993	No major changes have occurred since the 1984 photograph.
	2004	Tributaries to the South Channel of the Hunter River appear more well defined than the 1993 image. Further industrialisation has occurred, particularly to the north and south of Sparke Street, Hexham, at the One Steel Recycling facility.
	Current Source: Six Maps (accessed 21/11/2016)	Minimal land clearing and development has occurred to the western side of the RVRT, however significant development has occurred to the east of the trail. These developments include Aurizon Operations Limited rail infrastructure and small heavy industrial businesses. The current aerial photograph shows that the area to the north of Ironbark Creek is orange/red in colour, potentially indicative of iron staining.
9	1966	The northern portion of this segment consists of low density residential areas and pastoral land. The southern portion of the RVRT in this area remains mostly undeveloped.
	1976	Further residential development has occurred at the northern end of the trail segment within the suburb of Shortland.
	1984	A cricket field has been constructed to the east of King Street. The residential area has continued to develop.
	1993	Residential housing has become slightly denser; however, no other major changes were noted.
	2004	There are minimal changes to this segment from previous photographs. The Hunter Water Pipeline to the west of King Street has become more well defined.

Segment	Year of photograph	Description
	Current Source: Six Maps (accessed 21/11/2016)	The beginning of this segment remains relatively undeveloped, with Ironbark Creek intersecting the proposed RVRT at the northern end of the segment. The remainder of this segment comprises low density residential area in the township of Shortland. To the east of the trail lies the Shortland Wetlands Centre. Further commercial and residential development has occurred within the Shortland and Sandgate areas, particularly to the east and west of King Street and to the west of Sandgate Road.
10	1966	The northern portion of this segment consists of low density residential areas and rural or undeveloped land. The southern portion of the Segment 10 in this area remains mostly undeveloped.
	1976	Further residential development has occurred at the northern end of this trail segment within the suburb of Shortland. A large part of the wetland site has been converted to a complex of football fields (former Marist Park) and a club building. The Shortland landfill is visible to the north east of the wetlands near Sandgate railway station.
	1984	There are minimal changes to segment 10 from previous photographs. The football fields appear no longer in use.
	1993	Residential housing has become slightly denser in the north. The former football fields have been redeveloped and two ponds constructed north of the current converted wetlands building. The site has been further developed for recreation and conservation purposes with new wetland channels and walking trails constructed.
	2004	The wetland centre site has changed little from the previous photograph. The Shortland tip has ceased operations and has been sealed.
	Current Source: Six Maps (accessed 21/11/2016)	Further commercial and residential development has occurred within the Shortland and Sandgate areas. The wetland segment of the trail remains the same.

Based on the review of historical aerial photographs, it appears that while the majority of the proposed route of the RVRT was previously developed for rail use, the immediate surrounds predominantly consisted of undisturbed bushland, nature reserve, residential or agricultural land use. The exceptions to this included the Kurri Orica Technical Centre, quarries, the Hunter Water CTGM and the industrial areas of Hexham and Shortland including the former Shortland/Astra Street Landfill.

4.3 Previous investigation reports

GHD, 2013 Newcastle City Council - Tarro to Shortland Shared Path, Limited Soil Investigation Report No. 22/16640/1103197. August 2013

GHD was engaged by Council to complete a Phase 1 CSA with limited soil sampling and analysis for the proposed shared pathway between Tarro and Shortland, which follows the previous alignment and access road of a section of the former Hunter Water Corporation (HWC) above ground CTGM through Hexham Swamp, NSW.

As part of the GHD 2013 investigations, several previous reports were reviewed as summarised in the table below.

Table 4-2 Summary of previous investigations

Report	Description of works	Relevant findings
RCA 1999	Geotechnical investigation along the previous and proposed options for the CTGM pipeline easement over Hexham Swamp	<ul style="list-style-type: none"> Subsurface conditions comprised roadway embankment fill (0.5 to 1.0 m bgl and consisting of sandstone, clay, builder's rubble and coal reject) overlying estuarine soils (clay and silt with occasional sand layers). Depths to bedrock were in the order of 3-5 m at Ironbark Creek and 15-20 m at Fishery Creek south. Contaminant testing indicated slightly elevated zinc, chromium and nickel (at one location), lead (at one location) and TPH (at one location). ASS testing indicated that soils and fill types along the majority of the route were potential ASS.
RCA 2000	Geotechnical investigations along an alternative route following the Great Northern Railway and Pacific Highway which included the northern section of the existing pipeline.	<ul style="list-style-type: none"> Results indicated the presence of PASS in the majority of soils. All major soil and fill types were found to be acid producing, including coal reject fill layers.
GHD 2007	The investigation consisted of a Phase 1 CSA covering the northern portion of the Site along a proposed route option for the CTGM.	<p>Potential for contamination on the site was reported to include:</p> <ul style="list-style-type: none"> Fill materials for construction of the existing pipeline embankment and adjacent roadway Former rail sidings and chpp and former railway activities Former agricultural activities Former Astra street landfill.
GHD 2008	A contamination investigation comprising 41 bores within Route B Segment 3, Segment 5, Segment 6, Segment 7 and Segment 8.	The majority of fill/soil tested along Route B was not considered to pose a human health risk for installing or maintaining the pipeline. The exceptions included TPH, total PAH and/or benzo(a)pyrene hotspots detected in Segments 3 (railway embankment), 6 (route) and 8 (Astra St land fill and route) exceeding the selected criteria. Contaminants were mostly associated with surface fill, the presence of slag and surface staining. The contamination was considered to be relatively limited in extent.
GHD 2008a	GHD undertook a desktop review and subsurface ASS investigation along the then proposed (and now current) CTGM pipeline alignment over Hexham Swamp.	Typical ASS depth profiles comprised PASS from between 0.5 m and 1.5 m depth to greater than 2 m depth. The profile above was generally likely non ASS, except along a section of the southern half of the Site just west of the rail line from Ironbark Creek to Astra Street landfill which encountered actual ASS.

Report	Description of works	Relevant findings
Hunter Water 2012	A letter to Council as owner of several properties along the pipeline corridor from Hunter Water as notification of the potential presence of lead contamination in surface soils immediately beneath or adjacent to the CTGM.	Tarro and Millers Forest – soil sampling revealed that south of Brookfield the concentrations of lead in soil are generally above the normal criteria for residential land use and that, in general, lead concentrations reduce at 2 m from the pipeline. Shortland – Upgrades have included a new steel pipeline laid underground and old CTGM pipeline removed. The restoration of the pipeline corridor has included capping of the ground with soil and laying of turf. Soil testing completed after the restoration indicated that concentrations of lead are now generally below the residential land use criteria along the pipeline corridor.

Potential areas of environmental concern were identified including:

- Imported fill for construction of the former CTGM pipeline access track containing coal washery reject and building rubble.
- Past weed and pest control.
- Former CTGM pipeline with leaching of lead from pipe collars.
- Spill over/blow over from the former Tuxford Park Landfill.

In addition to the Phase 1 CSA, GHD undertook limited soil sampling in conjunction with the geotechnical investigation targeting areas of fill along the pipeline embankment and the portion of the Site adjacent to the rail loop and former coal handling and preparation plant (CHPP) at Hexham. Soil samples were collected from a total of seven of the thirty geotechnical test pits along the route. Anthropogenic fill observed during the test pitting included coal fines, road base gravels and building rubble (concrete and timber). No potential asbestos containing materials (PACM) were noted.

Concentrations of zinc exceeding the ecological investigation level (EIL) for urban residential and public open space for a pH level of 5.0 were identified in surface materials at one location and were considered to result from the presence of reworked fill. The impacts were not considered to indicate significant zinc contamination of surface soils. Total Recoverable Hydrocarbon (TRH) contamination was identified in surface materials at one location and was considered to result from the presence of clayey gravel fill containing coarse coal rejects. No fuel or oil odours or staining were detected. The impacts were not considered to indicate significant TRH contamination. Field observations and analytical results from test pits adjacent to the former CHPP and rail loop did not indicate the presence of odorous or stained soils and did not indicate contamination concentrations in excess of selected health investigation levels.

The potential for significant contamination of the soils proposed to be disturbed as part of construction of the shared pathway from the former CGTM, the former CHPP and rail loop was considered to be low.

4.4 Council search

Based on the linear nature of the RVRT and the large number of lots involved, review of Council 149 certificates was not undertaken. Further, searches of the relevant Council databases for development applications to assess the type of development/land use that may have occurred either on or within the vicinity of the RVRT were restricted to areas of significant industrial activity.

No relevant applications were identified within the vicinity of the site that would affect the proposed RVRT.

4.5 NSW Environment Protection Authority

As part of the desktop study, information was obtained from a number of sources to enable a greater understanding of the potential for contamination along the alignment and includes a review of database regulatory information from the following sources:

- EPA, Contaminated Sites Register (notifications or incidents)

Under provisions of the NSW Contaminated Land Management Act (1997, Section 58, Subsection 2 'CLM' Act) a public register of current NSW declarations and orders in force is maintained by EPA.

- EPA, Protection of the Environment Operations (POEO) Licence Register

Under the NSW Protection of the Environment Operations Act (1997, the 'POEO Act') a register of current and surrendered licences is also maintained by EPA.

GHD undertook a search of both the Contaminated Land: 'Record of Notices' and the 'List of NSW contaminated sites notified to the EPA' databases for the areas of Kurri Kurri, Pelaw Main, Richmond Vale, Stockrington, Minmi, Tarro, Hexham and Shortland on 26 April 2016. The findings of the search are summarised below.

Contaminated land record of notices

A site will be on the Contaminated Land: Record of Notices only if the EPA has issued a regulatory notice in relation to the site under the CLM Act. The following notices were found:

- One notice under Section 35 of the Environmentally Hazardous Chemical Act 1985 at Woodland Farm, Tarro for asbestos contamination in fill.
- Three current notices at the Caltex Service Station at 279-281 Lang Street Kurri Kurri.
- One current notice at the Forgacs Site on Sparke Street, Hexham.
- One notice under Section 35 of the Environmentally Hazardous Chemical Act 1985 at the Trojay Pty Ltd site at 64 Old Maitland Road, Hexham for asbestos contamination in fill.
- Four current notices at the former Astra St Landfill site on 1, 2 & 28 Astra Street, Shortland.

Based on the distance to the RVRT, the potential for contamination from these sites to impact on the proposed RVRT is considered to be low.

List of NSW contaminated sites notified to EPA

The sites appearing on the EPA "List of NSW contaminated sites notified to the EPA" indicate that the notifiers consider that the sites are contaminated and warrant reporting to EPA. However, the contamination may or may not be significant enough to warrant regulation by the EPA. The EPA needs to review information before it can make a determination as to whether the site warrants regulation.

The search identified eleven sites that have been notified to the EPA within suburbs traversed by the proposed RVRT. Details are provided below.

Hexham

- QR National – 179 Maitland Road, Hexham – Regulation not required
- Cummins Newcastle – 21 Galleghan Street, Hexham – under assessment
- Caltex Bogas Warehouse – 239 Old Maitland Road, Hexham – under assessment
- Industrial Galvanisers – 312 Pacific Highway – Currently regulated under the POEO Act
- Caltex Service Station – 300 Old Maitland Road, Hexham – under assessment
- BP Service Station – Corner of Pacific Highway and Old Maitland Road, Hexham – under assessment

Shortland

- Tuxford Park Landfill – 10 King Street, Shortland – Regulation not required. Within 110 m of the RVRT
- BP Service Station – 298 Sandgate Road, Shortland – regulation not required
- Former Lorna Street Landfill – 475 Sandgate Road, Shortland – regulation not required

Beresfield

- Koppers Timber Treatment Site - 56-58 Glen Street.
- BP Beresfield Truck Stop Service Station – Cnr Kinta Drive and John Renshaw Drive – under assessment.

Based on the distance to the RVRT, the potential for contamination from these sites to impact on the proposed RVRT is considered to be low.

POEO licence register

The POEO register identifies premises that are licensed for certain activities under the POEO Act. Information of particular relevance to this assessment, which is listed on the Register, includes site location, activity type, relevant clean up notice and non-compliance information. Each licence provides information on potential point and non-point sources of soil and groundwater contamination that may be generated on-site through standard operations, accidental spills and leaks.

A search of the POEO Public Register on 30 May 2016 indicated several businesses and operations with environmental protection licences including the following:

- Kurri Kurri – Central Waste Plant Pty Ltd, Kurri Kurri Hospital, Kurri Kurri Sewage Treatment Works and J R Burnett Pty Ltd (abattoir). All these locations are over 2 km from the RVRT trail head at Pelaw Main.
- Richmond Vale – Orica Australia Pty Ltd (explosive production) is within 1 km of the RVRT corridor.
- Stockrington - Buttai Gravel Pty Ltd (gravel quarry) is within 1 km of the RVRT corridor.
- Minmi – Former Minmi STP – is adjacent to the Minmi Spur of the RVRT corridor.

- Hexham – Aurizon Operations Limited, Brancourts Manufacturing, Hexham Bowling Club are located within 1 km of the RVRT corridor. Community Association in DP 270447, CPB Contractors Pty Ltd (rail corridor), CREI Industrial Nominees No. 2 Pty Ltd, Cummins South Pacific, Industrial Galvanisers, McDonalds Australia, OneSteel Recycling Plant, Sanchez Group Property Pty Ltd and Slattery Auctions Australia Pty Ltd are all industries located over 1 km from the RVRT corridor.
- Shortland – BHP Billiton Innovation Pty Ltd, Hunter Water Corporation (sewage treatment works), The Hunter Valley Private Hospital and the Shortland Wetland Centre Pty Ltd are located within 1 km from RVRT.

Of these sites detailed above, Orica Australia Pty Ltd, Minmi STP, Aurizon Operations and the Shortland sewage treatment works are located within 1 km of the RVRT. However, based on either the minimum distance to the RVRT or the nature of the activities requiring a licence, the potential for contamination from these sites to impact on the proposed RVRT is considered to be low.

5. Conceptual site model

A conceptual site model (CSM) was developed to provide an understanding of the potential for exposure to contaminants and impacts to beneficial uses from potential contamination within the site. The CSM draws together historical data, specific and regional geological, hydrogeological, hydro-geochemical and contamination information to identify potential contamination sources, migration and exposure pathways and sensitive receptors for the site.

5.1 Sources

Based on the desktop review and site inspection, the following potential contamination sources have been identified:

- Historical use of significant portions of the proposed RVRT route as a railway corridor with potential impacts from fuels, oils and grease along the former tracks and surrounding areas.
- Historical construction of the Richmond Vale Railway including use of coal rejects, building rubble and rock fill.
- Historical use herbicides or pesticides throughout the proposed RVRT route, particularly along the rail corridor and roadsides and associated with agricultural land.
- Use of land adjacent to the RVRT for roads with accumulation of run-off and residues from bitumen coatings, fuel and oil spills potentially directed to road verges and drainage lines.
- Potential for poor demolition practices and illegal dumping along the proposed route of the RVRT and presence of waste materials including scrap metal, timber, concrete and including potential asbestos containing materials.
- Dilapidated timber bridge structures and coatings including potential use of lead based paint, pesticides and timber treatment chemicals.
- Historical and current industrial/commercial practices within 1 km of the RVRT including Orica Technical Centre (Segment 3), Stockrington Quarry (Segment 3), former Minmi STP (Segment 5), Hunter Water Pipeline (Segment 6), Aurizon Operations (Segment 7), Shortland STP (Segment 9) and Shortland/Astra Street Landfill (Segment 10).
- Potential for lead contamination to surface soils in the portion of the RVRT associated with the CTGM from use of lead collars and solder.
- Potential for the presence and disturbance of ASS.

5.2 Exposure pathways

The primary pathways by which current and future receptors could be exposed to the potential sources of contamination are considered to be:

- Direct contact (including ingestion) with potentially contaminated soil.
- Inhalation of potential contaminants in soil, if disturbed (particularly asbestos if present).
- Volatilisation to outdoor air and subsequent inhalation of potential hydrocarbon impacted soil or groundwater.
- Lateral migration of potential contaminants to nearby surface water.
- Vertical and horizontal migration of potential contaminants within the groundwater.

5.3 Receptors

When evaluating potential adverse health/environmental effects from exposure to a contaminated site, all potentially exposed populations should be considered. For the site, the key populations or receptors of interest are considered to include:

Human health receptors

- Workers and contractors and visitors to the site during further investigations and construction.
- Future users of the RVRT (e.g. members of the public).
- Current and future occupants of surrounding properties (e.g. residents, workers and visitors).

Environmental receptors

- Flora and fauna within the site and surrounding land
- Surface water systems throughout the proposed route of the RVRT
- Groundwater beneath the proposed route of the RVRT

5.4 Potential for contamination

Table 5-1 summarises the potential areas of environmental concern based on the results of the desk-top review and site inspection.

Table 5-1 Potential areas of environmental concern and perceived risks

Description	Rationale/detail	Potential contamination	Risk level
Rail corridor	Contamination associated with long term railway use.	Heavy Metals, TPH, BTEX, PAHs, OCPs, asbestos.	Low to moderate
Road ways and verges	Contamination associated with run off from roads containing fuel and oil residues.	Heavy Metals, TPH, BTEX, PAHs	Low
Historical use of pesticides	Use of pesticides and herbicides for weed and insect control. Particularly along the rail corridor, road ways and farming land.	Arsenic, OCPs and OPPs.	Low
Presence of building and other waste materials	Historical demolition and waste disposal practices including burial of wastes and illegal dumping.	TRH, BTEX, PAHs, phenols, heavy metals, OCPs and OPPs, asbestos.	Low to moderate
Timber bridges	Potential coatings including use of lead based paint, pesticides and timber treatment chemicals.	TRH, PAHs, heavy metals, OCPs and OPPs	Low
Industrial properties	Contamination associated with industrial practices within the vicinity of the RVRT route.	Heavy Metals, TPH, BTEX, PAHs, phenols, OCPs, OPPS, PCBs, asbestos.	Low

Description	Rationale/detail	Potential contamination	Risk level
Fill materials	Fill materials from unknown sources. Potential use of fill during initial development of the railway and development of surrounding areas.	TRH, BTEX, PAHs, phenols, heavy metals, OCPs, OPPs PCBs and asbestos.	Low
CTGM	Contamination associated with historical use of lead collars and joints in the water pipeline.	Lead	Low to moderate

TPH – Total Petroleum Hydrocarbons.

BTEX – Benzene, Toluene, Ethyl-benzene and Xylenes.

PAH – Polycyclic Aromatic Hydrocarbons.

OCP – Organochlorine Pesticides.

OPP – Organophosphate Pesticides.

PCB – Polychlorinated biphenyls.

Based on the results of the desktop assessment, the overall likelihood for significant chemical contamination to be present along the proposed RVRT route is considered to be low.

6. Conclusion and recommendations

GHD was engaged by Council to undertake a Phase 1 CSA as part of the specialist input into an EIS, to provide preliminary advice on the presence of contamination and the potential risk to human health or the environment for the proposed RVRT.

At the time of the Phase 1 CSA, the proposed route of the RVRT predominantly followed the disused Richmond Vale Railway alignment and minor roads and tracks and utilised existing tunnels, embankments and cuttings. Existing dilapidated bridges over water courses are proposed to be replaced. The proposed 32 km RVRT route passes through Cessnock, Newcastle and Lake Macquarie LGAs and encompasses a vast range of land uses including residential areas, commercial land use, recreational land use, dense bushland and marsh and wetland areas.

Based on the historical desk top reviews, the Richmond Vale Railway was constructed in 1904 and 1905 and linked Pelaw Main and Richmond Vale Collieries to Minmi and then Hexham and Newcastle. The embankment and formation were generally constructed using waste rock, coal reject and building rubble. While the majority of the proposed route of the RVRT was previously developed for rail use, the immediate surrounds predominantly consisted of undisturbed bushland, residential or agricultural land use. The exceptions to this included development of the Kurri Orica Technical Centre, various quarries, the Hunter Water Chichester Trunk Gravity Main (CTGM) and the industrial areas of Hexham.

The site inspection did not identify any significant areas of environmental concern along the length of the route. Potential isolated contamination sources observed included areas of illegal dumping (including burnt out vehicles, furniture, glass and plastic), dilapidated timber bridges, and the presence of wastes (timber, metal, equipment, bricks) particularly near tunnels, bridges and culverts.

Based on the available information on the historical use of the RVRT, the inspection, and subject to the scope of works in Section 1.2 and the limitations presented in Section 8, the following conclusions were made.

There is the potential for diffuse or isolated chemical contamination associated with:

- Historical use of the proposed RVRT route as a railway corridor with potential impacts from fuel, oil and grease residues along the former tracks, sleepers and surrounding areas (diffuse – along the length of the former railway).
- Historical construction of the Richmond Vale Railway including use of coal rejects, building rubble and rock fill (diffuse – along the length of the former railway).
- Historical use herbicides or pesticides throughout the proposed RVRT route, particularly along the rail corridor and roadsides and associated with agricultural land (diffuse – along the length of the former railway).
- Use of land adjacent to the RVRT as roadways with accumulation and runoff containing fuel and oil residues potentially directed to road verges and drainage lines (isolated to areas adjacent to roads).
- Dilapidated timber bridge structures and coatings including potential use of lead based paint, pesticides and timber treatment chemicals.
- Potential for poor demolition practices, burial of wastes and illegal dumping along the proposed route of the RVRT including the potential for PACM (isolated to areas where dumping or building rubble are observed).

- Historical and current industrial/commercial practices within 1 km of the RVRT including Orica Technical Centre, Buttai Gravel Pit, former Minmi STP, Aurizon Operations, Shortland STP and former Shortland/Astra Street Landfill (isolated to areas where these industries are close to the route of the RVRT).
- Potential for lead contamination to surface soils in areas surrounding the former/current CTGM from use of lead collars and solder (isolated to areas where these industries are close to the route of the RVRT).

Based on the findings of the investigation and the current and historical land use of the site and surrounding area, the overall risk of significant contamination being encountered during works that disturb the ground surface or by future site users is considered to be low.

It is considered that the risks from disturbance of contaminated soils within the RVRT can be managed during the proposed works, and the site can be made suitable for the intended use, by implementation of the following:

- Development of a Contaminated Soil Management Plan (CSMP) to manage any contamination encountered during the construction of the RVRT and to ensure the completed works are suitable for the intended land use. The CSMP should include the following:
 - Provision for further detailed assessment where appropriate to confirm the conclusions of this preliminary assessment and to determine whether any specific remediation or management of areas is required. The further assessment should be based on the following:
 - potential areas and types of contamination identified in this assessment; and
 - the potential for exposure to workers and to end-users based respectively on the nature of the proposed construction works and the final design of the RVRT.
 - Appropriate management controls to minimise the potential for exposure of contamination to workers and recreational users within the RVRT both during and post construction.
 - Description of appropriate excavation, validation, management and/or disposal requirements for potentially contaminated materials, if identified by further assessment or encountered during the construction of the RVRT.
 - Sampling and analysis requirements for assessment of potentially contaminated soils for re-use or for waste classification prior to offsite disposal.
 - Contingency plans including unexpected finds protocols for potentially contaminated soils (if encountered) including landfill or anthropogenic waste and PACM.

Any future contamination reports should be prepared or reviewed and approved by an appropriately qualified and certified environmental consultant accredited under a scheme recognised by the EPA and Council.

7. References

- Contaminated Land Management Act 1997 (CLM Act).
- Department of Land and Water, 1997, Acid Sulfate Soils Risk Map for Newcastle (Edition Two).
- GHD 2013, *Newcastle City Council - Tarro to Shortland Shared Path, Limited Soil Investigation* Report No. 22/16640/1103197. August 2013.
- GHD 2016, *Newcastle City Council – Richmond Vale Rail Trail Concept Design Report (DRAFT)*. 2218317. December 2016.
- GHD 2016, *Newcastle City Council – Richmond Vale Rail Trail Geotechnical Assessment Report*. 2218317. December 2016.
- Mathei, L.E (1995), *Soil Landscapes of the Newcastle 1:100 000 Sheet*, Published by the NSW Department of Conservation and Land Management.
- NEPC (2013). National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 1999. National Environment Protection Council, as amended in May 2013.
- NSW EPA (2017). Contaminated land management: Guidelines for the NSW Site Auditor Scheme, (3rd Edition). New South Wales Environmental Protection Authority. October 2017.
- NSW Land and Property Information. Spatial Information Exchange.
<https://maps.six.nsw.gov.au/>.
- NSW OEH (2011). Contaminated sites: Guidelines for Consultants Reporting on Contaminated sites. New South Wales Office of Environment and Heritage, 2011.
- Protection of the Environment Operations Act 1997.
- Regional Geology, Geological Survey of NSW (1966), Newcastle 1:250, 000 Geology Series Sheet S1 56-2, published by the NSW Department of Mines.

8. Limitations

This Phase 1 CSA (“Report”):

1. Has been prepared by GHD Pty Ltd (“GHD”) for the City of Newcastle (Council).
2. May be provided to other third parties but such third parties’ use of or reliance on the Report is at their sole risk.
3. May only be used for the purpose as stated in Section 1.1 of the Report (and must not be used for any other purpose).

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than Council arising from or in connection with this Report.

No representation or warranty, express or implied, is made as to the relevance, accuracy, completeness or fitness for purpose of this document in respect of any particular user’s circumstances. Users of this document should satisfy themselves concerning its application to, and where necessary seek expert advice in respect of, their situation.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- Were limited to those specifically detailed in Section 1.2 of this Report and GHD proposal dated 2 February 2016.
- Were undertaken in accordance with current profession practice and by reference to relevant environmental regulatory authority and industry standards, guidelines and assessment criteria in existence as at the date of this Report.
- Did not include the collection of samples for the purpose of laboratory analysis or verification of information obtained from the site history review.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking the services mentioned above and preparing the Report (“Assumptions”), as specified throughout this Report.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation of this Report and are relevant until such times as the Site conditions or relevant legislations changes, at which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

GHD has prepared this Report on the basis of information provided by Council, various councils, NSW Office of Water and EPA among others, which GHD has not independently verified or checked (“Unverified Information”) beyond the agreed scope of work.

GHD expressly disclaims responsibility in connection with the Unverified Information, including (but not limited to) errors in, or omissions from, the Report, which were caused or contributed to by errors in, or omissions from, the Unverified Information.

Inspections undertaken in respect of this Report are limited to visual inspections only and are constrained by the particular site conditions, such as locations of buildings, services or vegetation.

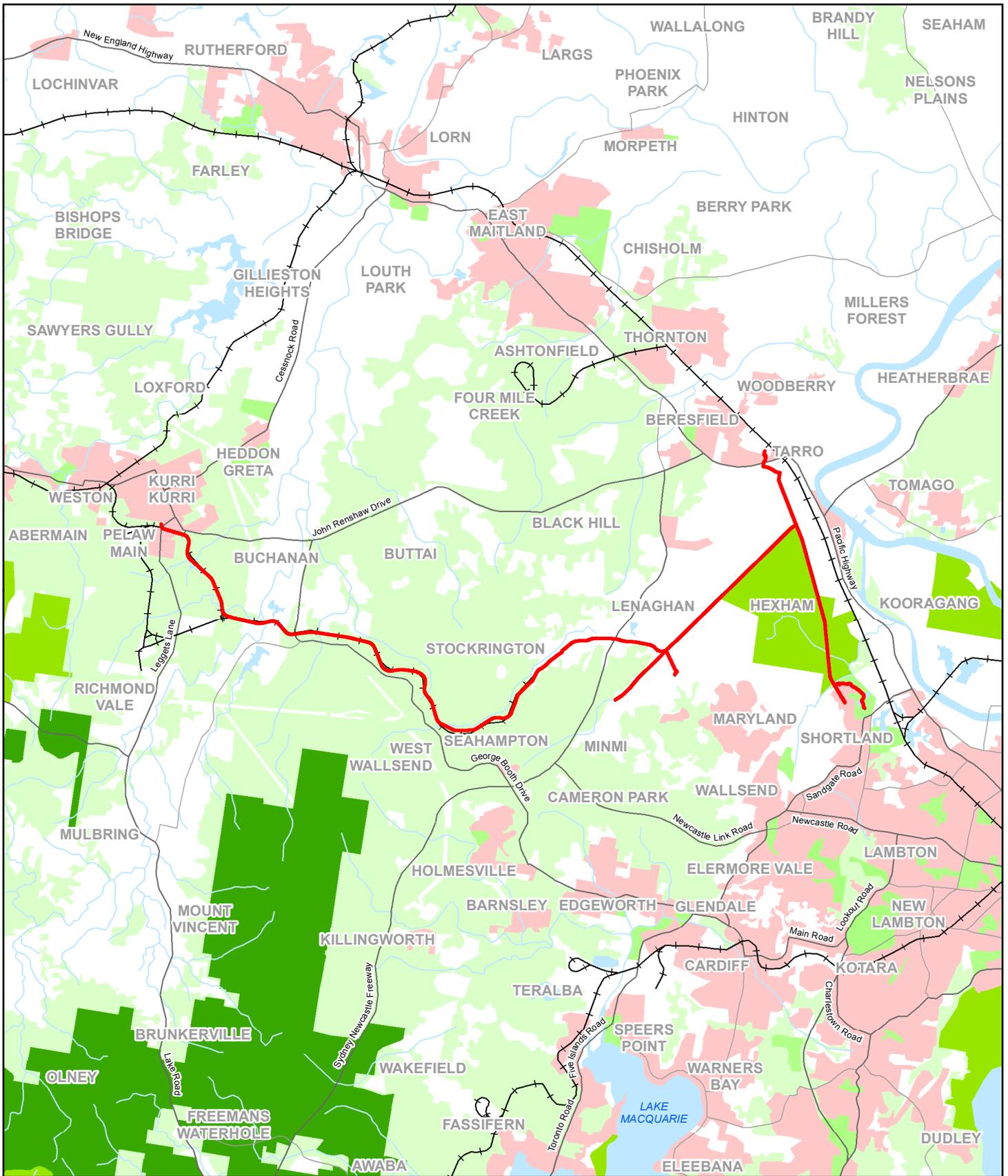
Except as otherwise expressly stated in this Report, GHD makes no warranty or representation as to the presence or otherwise of asbestos and/or asbestos containing materials ("ACM") on the site. If fill material has been imported on to the site at any time, or if any buildings constructed prior to 1970 have been demolished on the site or material from such buildings disposed of on the site, the site may contain asbestos or ACM.

Except as otherwise expressly stated in this Report, GHD makes no warranty, statement or representation of any kind concerning the suitability of the site for any purpose or the permissibility of any use, development or re-development of the site.

These Disclaimers should be read in conjunction with the entire Report and no excerpts are taken to be representative of the findings of this Report.

Appendices

Appendix A – Figures



LEGEND

- Proposed route
- Major Road
- Secondary Road
- Railway
- Waterbody
- Watercourse
- + Built Up Area
- + Recreation Area
- + State Forest
- + National Park
- + Forest

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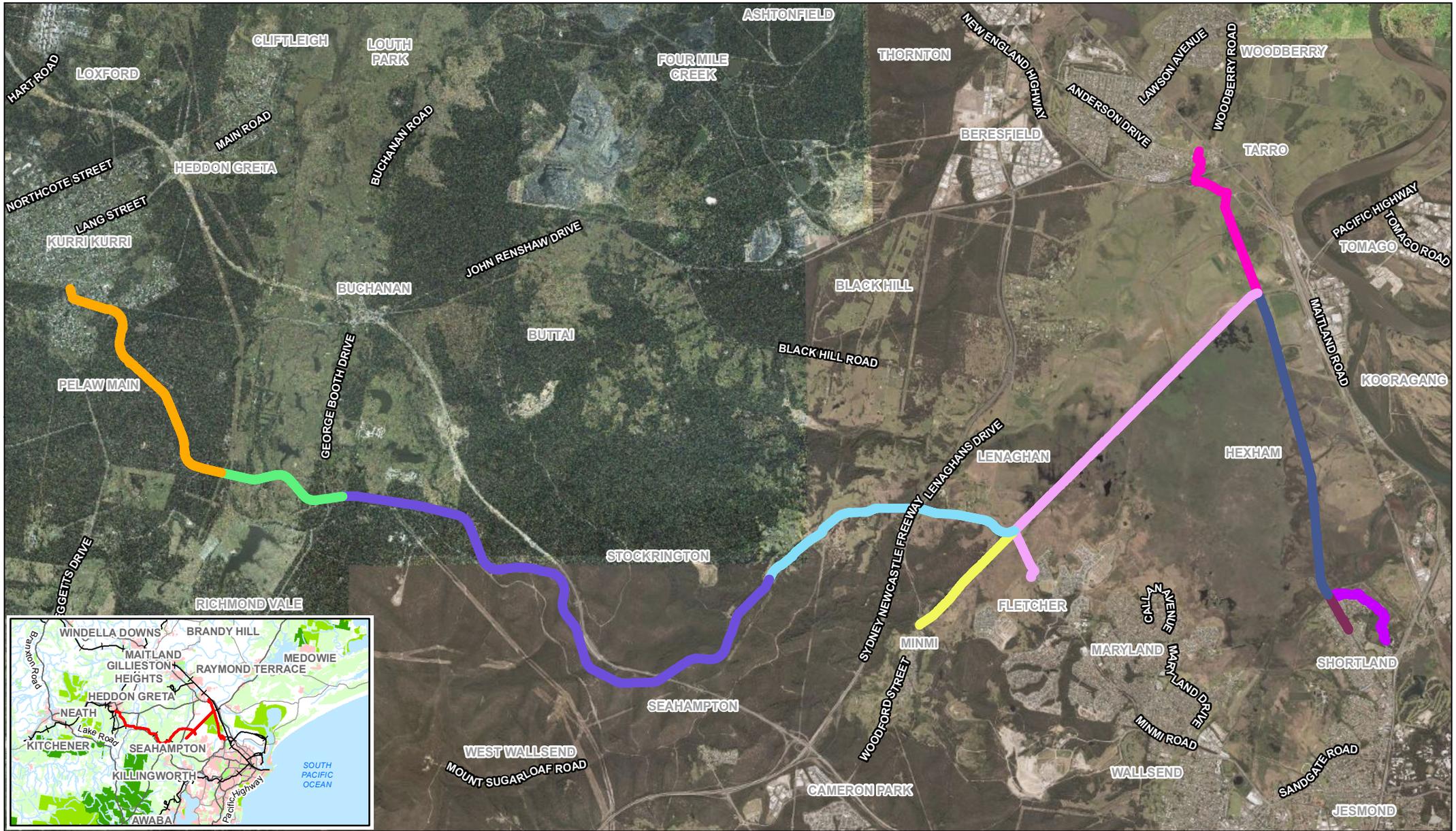


City of Newcastle
 Richmond Vale Rail Trail
 Phase 1 Contaminated Site Assessment

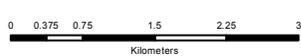
Job Number | 22-18317
 Revision | 0
 Date | 24 Jan 2019

Site location

Figure 1



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Segment 1
- Segment 2
- Segment 3
- Segment 4
- Segment 5
- Segment 6
- Segment 7
- Segment 8
- Segment 9
- Segment 10



City of Newcastle
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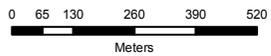
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Revision	0
Date	24 Jan 2019

Proposed RVRT Route

Figure 2



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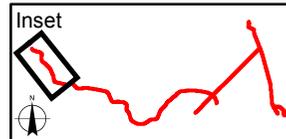


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LEGEND

- Segment 1
- Segment 2



City of Newcastle
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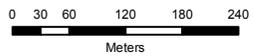
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Revision	0
Date	24 Jan 2019

Segment 1 - RVRT Route

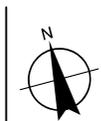
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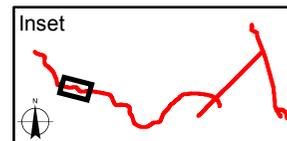


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LEGEND

- Segment 1
- Segment 2
- Segment 3

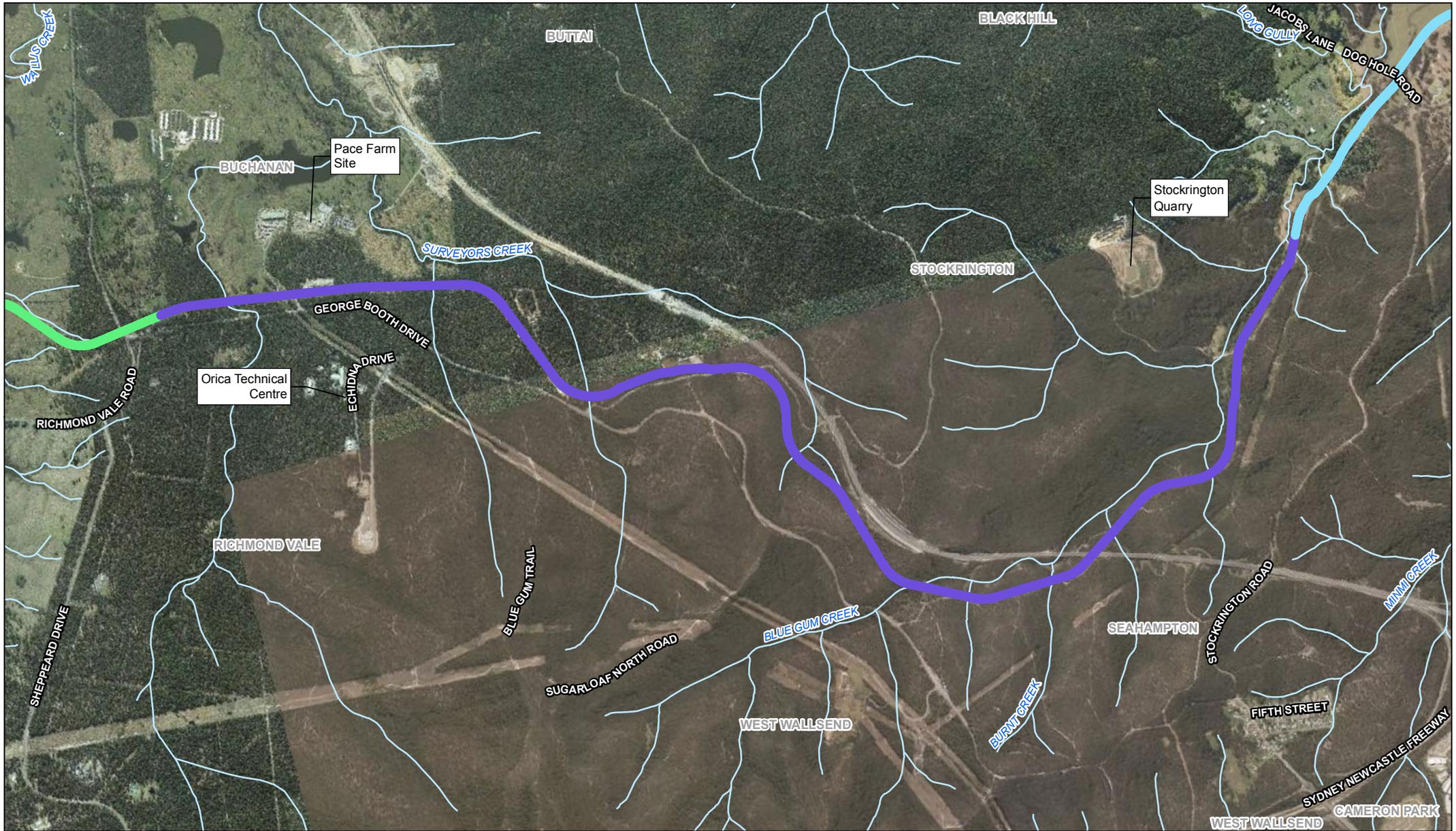


City of Newcastle
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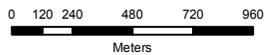
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Date	24 Jan 2019

Segment 2 - RVRT Route

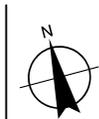
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Map Projection: Transverse Mercator
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LEGEND

- Segment 2
- Segment 3
- Segment 4



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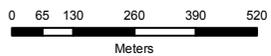
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Revision	0
Date	24 Jan 2019

Segment 3 - RVRT Route

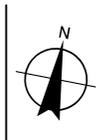
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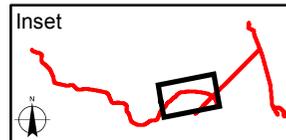


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Grid: GDA 1994 MGA Zone 56



LEGEND

- █ Segment 3
- █ Segment 4
- █ Segment 5
- █ Segment 6



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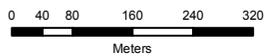
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Date	24 Jan 2019

Segment 4 - RVRT Route

Figure 3-4



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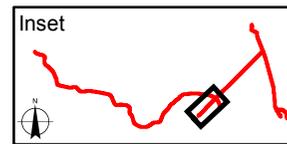


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LEGEND

- Segment 4
- Segment 5
- Segment 6

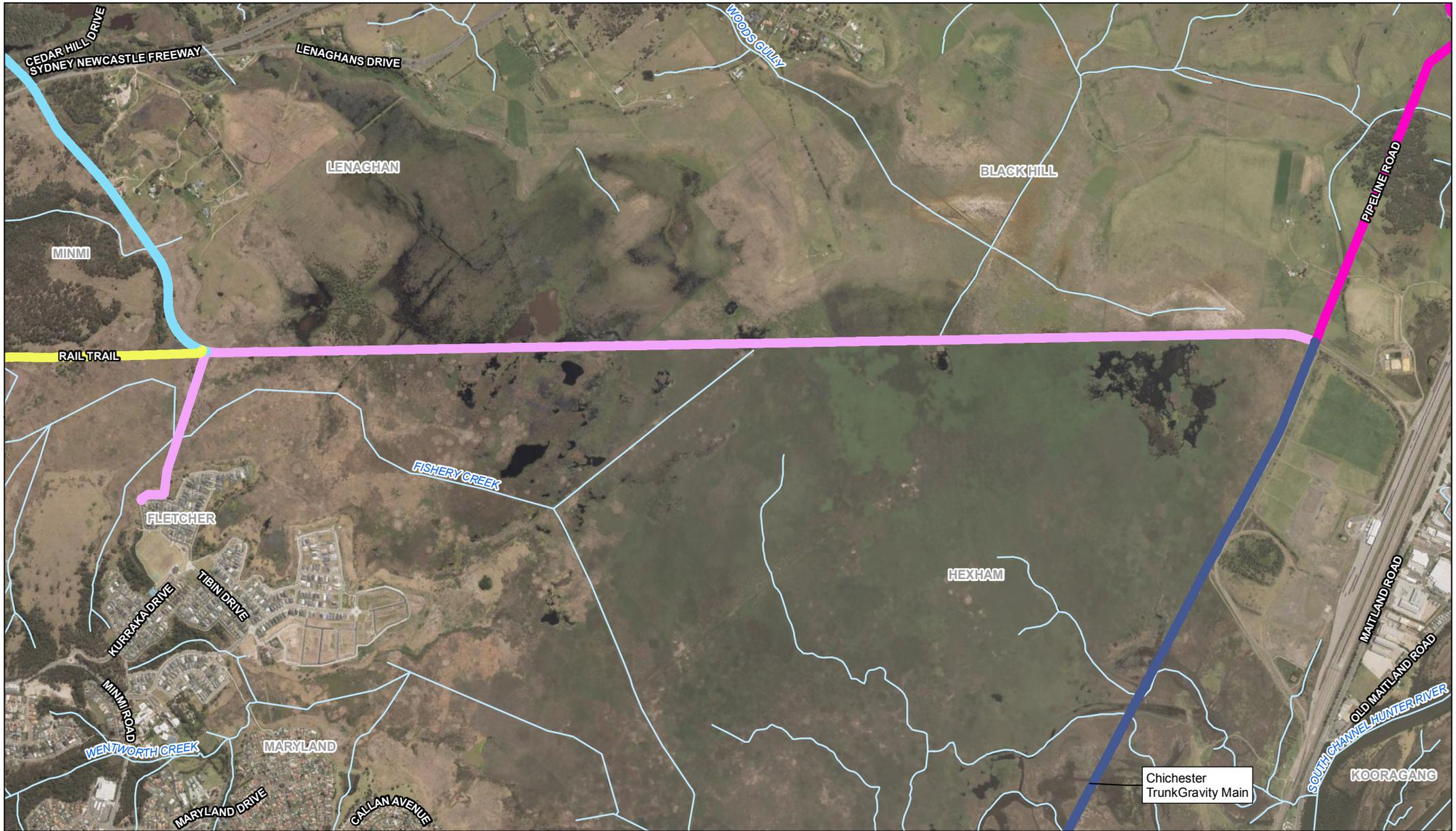


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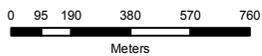
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Revision	0
Date	24 Jan 2019

Segment 5 - RVRT Route

Figure 3-5



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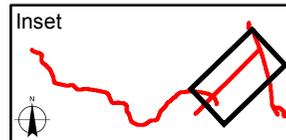


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LEGEND

- █ Segment 4
- █ Segment 5
- █ Segment 6
- █ Segment 7
- █ Segment 8

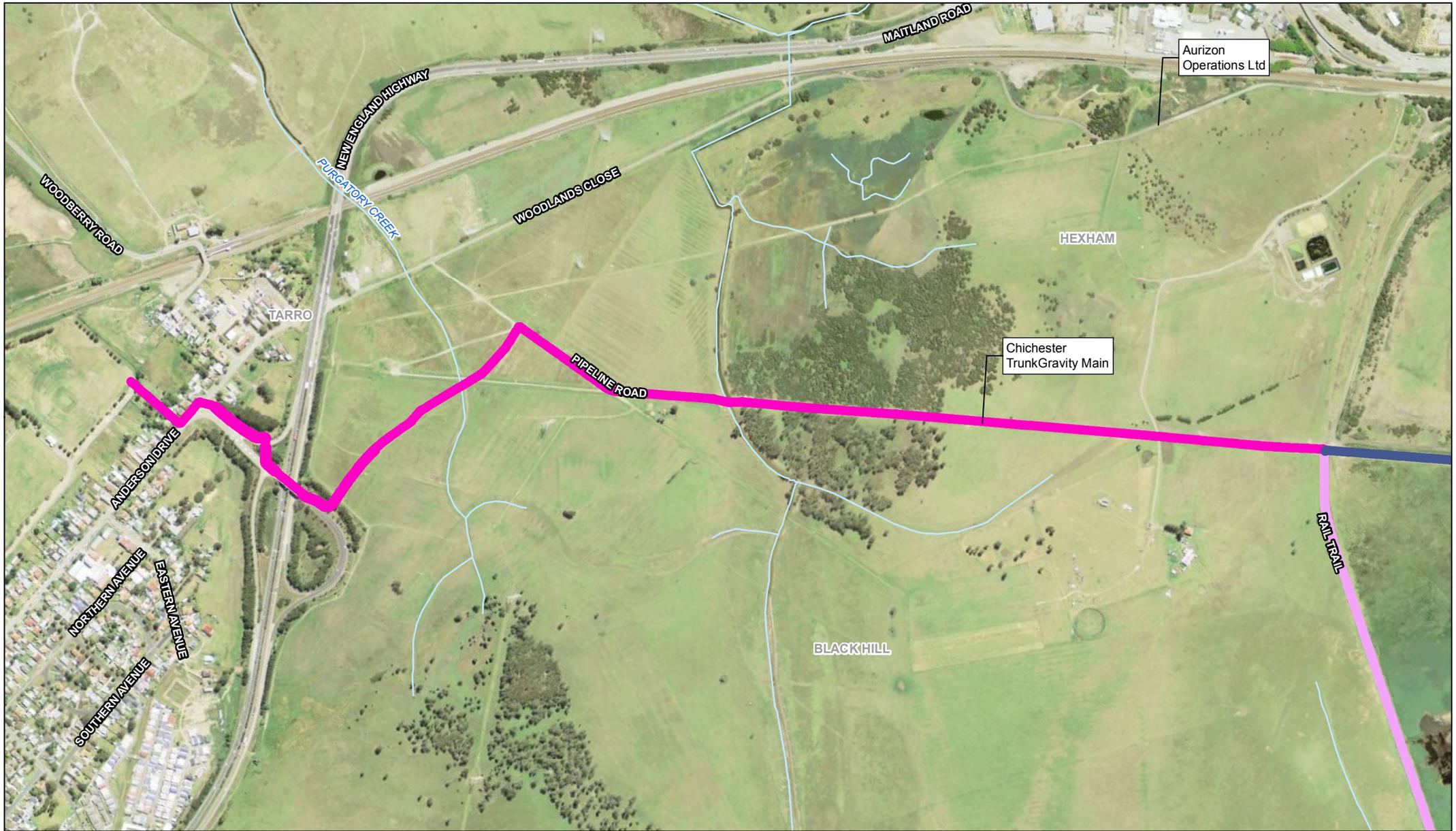


City of Newcastle
Richmond Vale Rail Trail
Phase 1 Contaminated Site Assessment

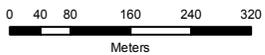
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Revision	0
Date	24 Jan 2019

Segment 6 - RVRT Route

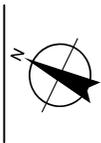
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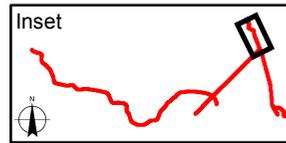


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LEGEND

- Segment 6
- Segment 7
- Segment 8

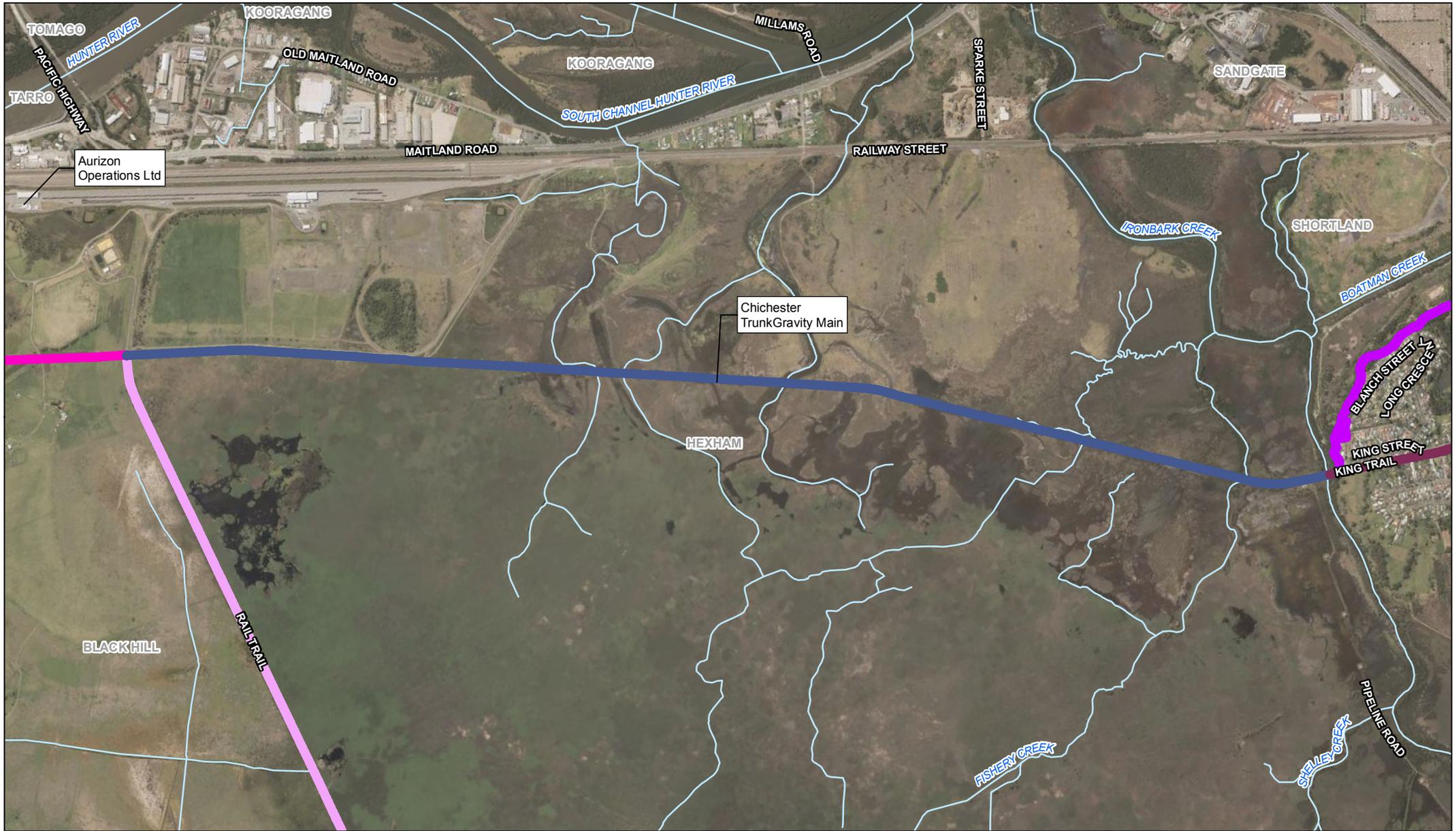


City of Newcastle
Richmond Vale Rail Trail
Phase 1 Contaminated Site Assessment

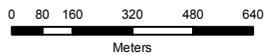
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Revision	0
Date	24 Jan 2019

Segment 7 - RVRT Route

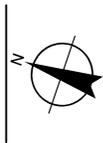
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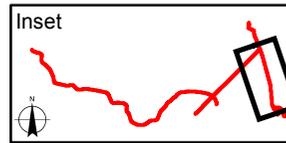


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LEGEND

- Segment 6
- Segment 7
- Segment 8
- Segment 9
- Segment 10

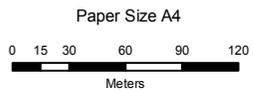


City of Newcastle
Richmond Vale Rail Trail
Phase 1 Contaminated Site Assessment

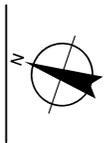
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Revision	0
Date	24 Jan 2019

Segment 8 - RVRT Route

Figure 3-8

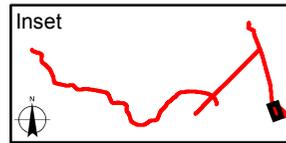


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LEGEND

- Segment 8
- Segment 9
- Segment 10



City of Newcastle
 Richmond Vale Rail Trail
 Phase 1 Contaminated Site Assessment

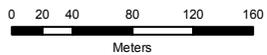
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Revision	0
Date	24 Jan 2019

Segment 9 - RVRT Route

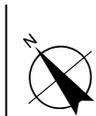
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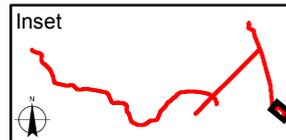


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Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Segment 8
- Segment 9
- Segment 10



City of Newcastle
Richmond Vale Rail Trail
Phase 1 Contaminated Site Assessment

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Segment 10 - RVRT Route

Figure 3-10

Appendix B – Photographic log

Segment 1



Log of Knowledge Park



Log of Knowledge Park

Segment 1



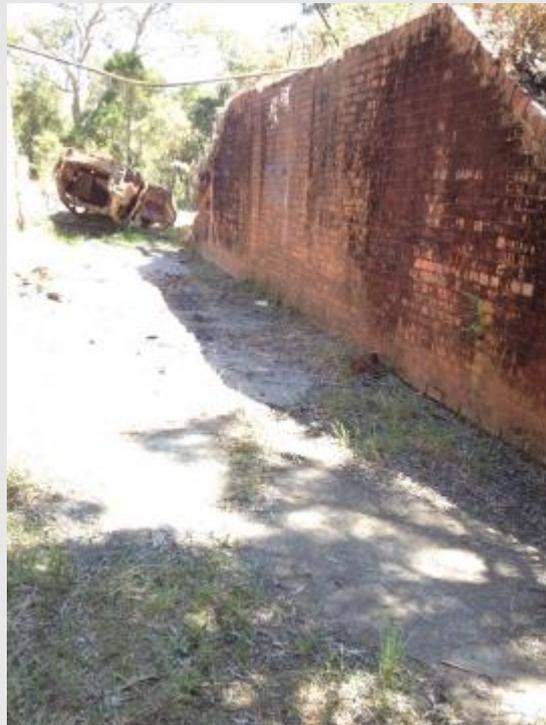
Existing Gate at the boundary of Kurri Kurri Conservation Area



Nature Reserve in Kurri Kurri Conservation Area



Overbridge at Log of Knowledge Park at Kurri Kurri



Werakata Bridge site at the Kurri Kurri Conservation Area



Werakata Bridge site at the Kurri Kurri Conservation Area



Existing Culverts at the Kurri Kurri Conservation Area

Segment 1



Werakata Bridge site at the Kurri Kurri Conservation Area



Cutting near Pokolbin Street which has been used for illegal dumping

Segment 1



Cutting near Poklbin Street which has been used for illegal dumping

Segment 2



Eastern Abutment of Wallis Creek



Cutting 200m east of Wallis Creek Site



Existing Culvert at Richmond Vale between Tunnel 3 and Wallis Creek



Existing Culvert at Richmond Vale west of Wallis Creek



View of Eastern Abutment of Wallis Creek



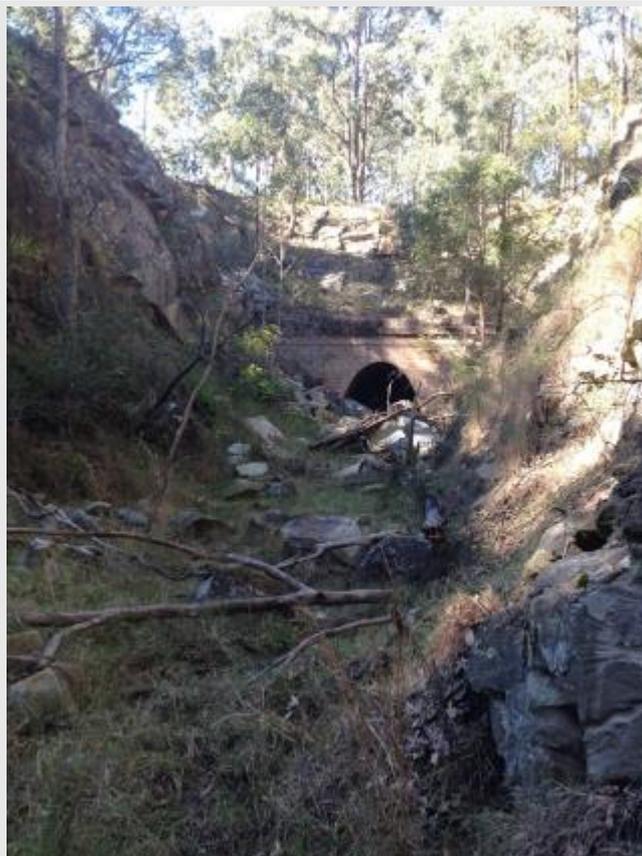
View of the existing bridge over Wallis Creek



View of the existing brick abutments at Wallis Creek



View of timber pier on the eastern abutment of Wallis Creek



View of the western portal of Tunnel 3



View of the eastern Portal of Tunnel 3



Western Abutment of Existing bridge at surveyors creek



Surveyors Creek

Segment 3

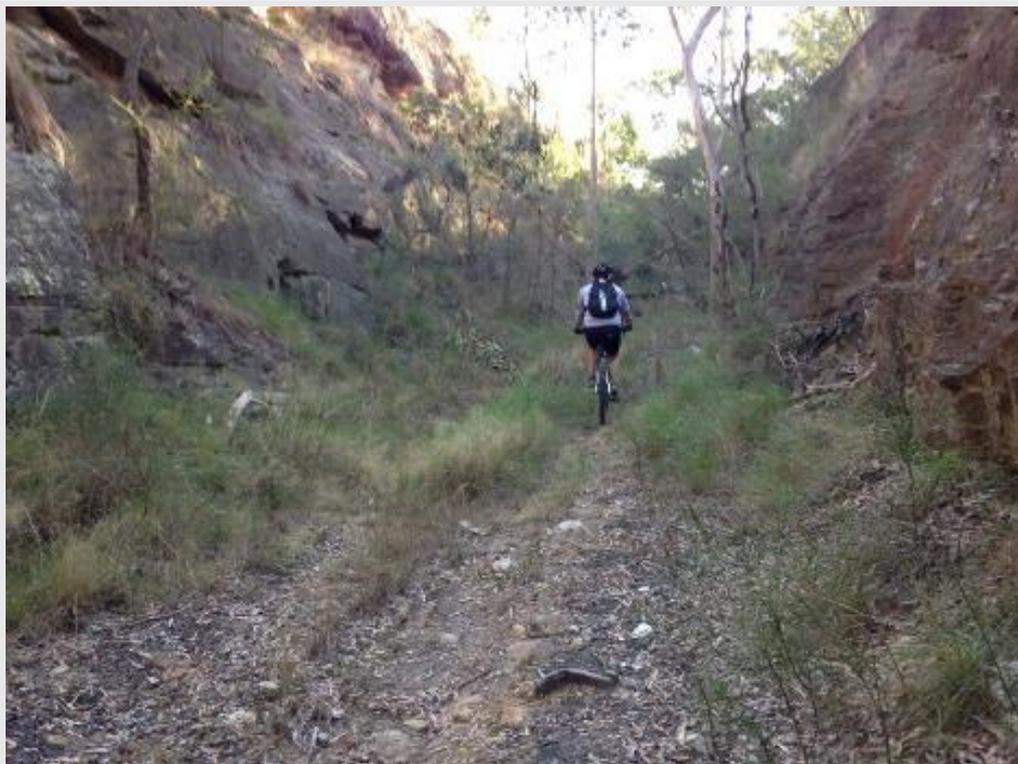


Existing Access track off George Booth Drive

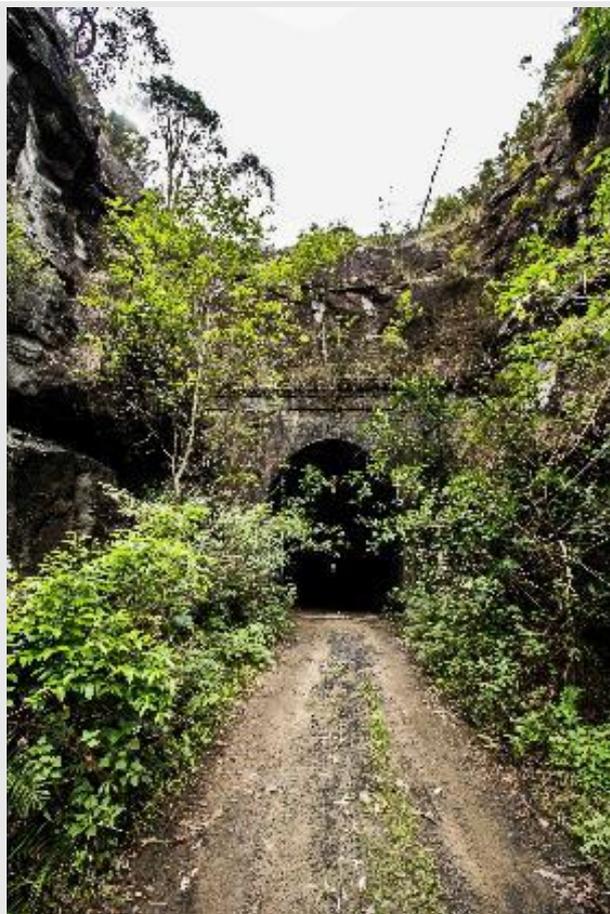


Trail between Daracon Quarry Access and Surveyors Creek

Segment 3



Rock Cutting along the trail between Daracon Quarry and Surveyors Creek



View of the western Portal at Tunnel 2



Wester Portal of Tunnel 2



Trail between tunnel 1 and 2



View of Eastern portal of Tunnel 1



View of the tunnel 1 from the western side



Existing over bridge near Seahampton Road.



Existing dam near the hunter expressway approximately 200m from the RVRT

Segment 3



View of the gate at Seahampton Road at Dog Hole Road



View of the proposed access point between Tunnel 1 and 2



View of the gate at Dog Hole Road



Seahampton Road

Segment 4



Overbridge near Dog Hole Road



Tunnel under Lenaghans Drive



Tunnel under Lenaghans Drive

Segment 5



View of the trail at Minmi looking toward minmi



View of cleared area around the Minimi Junction.

Segment 6



Looking along the proposed route to Fletcher



Existing Rail lines at Hexham



View of small bridge at hexham



View of Small timber girder bridge at Hexham



View of small bridge at Hexham Swamp



View of intersection at Anderson Drive



View of culverts at Aurizon entrance



View of crossing at Puragotory Creek

Segment 8



View between Fishery Creek and Hexham Junction



View of Culvert between Fishery Creek and Hexham



View of paddock near Fishery Creek

Segment 9



View of Ironbark Creek from Shortland



View of submerged trail between Ironbark Creek and Fishery Creek



View of existing pathway at the Wetland Centre Cafe



View of existing mulch along the side of the trail



View of connection into the Wetland centre along existing properties



View of existing steel bridge along the trail connection to the wetland centre



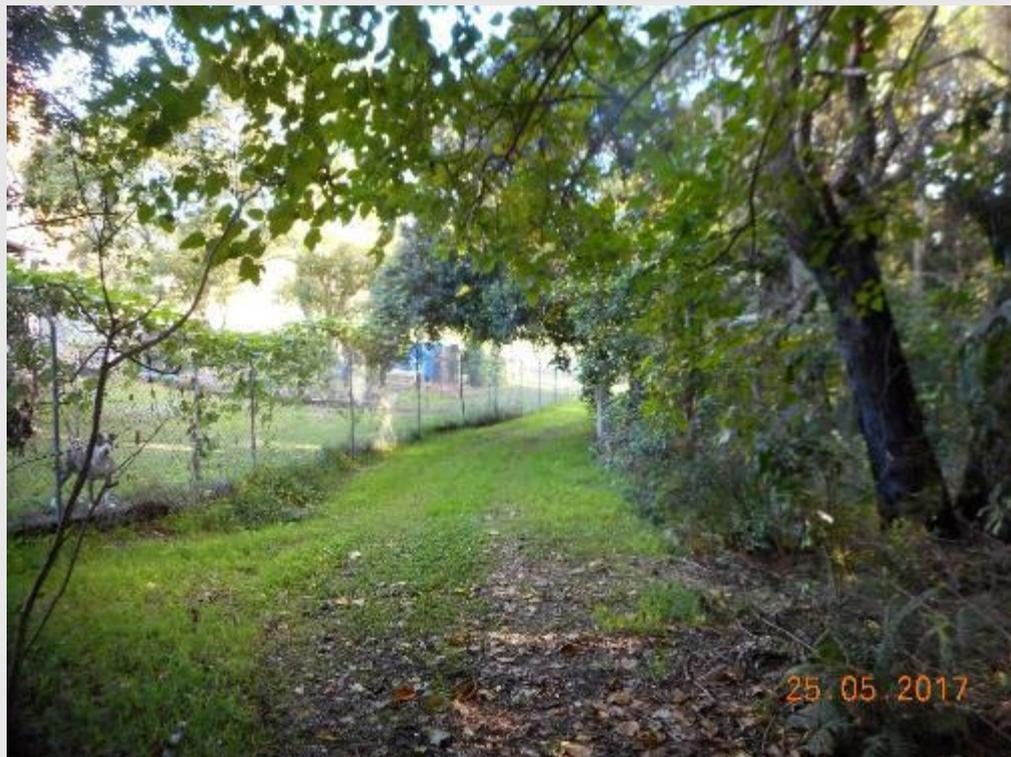
View of existing seat along the path connection at the Wetland Centre



View of connection into the wetland centre along boundary fence



View of proposed location for gate entry into the Wetland Centre



View along rear of residences close to Ironbark Creek connection

Appendix C – Groundwater bore searches

NSW Office of Water

Work Summary

GW063992

Licence: 20BL135899

Licence Status: ACTIVE

Authorised Purpose(s): STOCK,DOMESTIC
Intended Purpose(s): STOCK, DOMESTIC

Work Type: Bore

Work Status:

Construct.Method: Rotary Air

Owner Type: Private

Commenced Date:
Completion Date: 01/12/1986

Final Depth: 24.40 m
Drilled Depth: 24.40 m

Contractor Name:

Driller: John Rose

Assistant Driller:

Property: N/A NSW

Standing Water Level
(m):

Salinity Description: 1001-3000 ppm
Yield (L/s):

GWMA: -
GW Zone: -

Site Details

Site Chosen By:

County	Parish	Cadastre
Form A: NORTH	NORTH.029	L20 DP16703 (25)
Licensed: NORTHUMBERLAND	HEXHAM	Whole Lot 20//16703

Region: 20 - Hunter

CMA Map: 9232-3N

River Basin: 210 - HUNTER RIVER
Area/District:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation (Unknown)
Source:

Northing: 6362194.0
Easting: 376900.0

Latitude: 32°52'17.3"S
Longitude: 151°41'03.1"E

GS Map: -

MGA Zone: 0

Coordinate Source: GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	P.V.C.	0.00	24.40	150			Seated on Bottom
1	1	Opening	Slots - Vertical	15.00	24.00	150		1	Plastic

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
17.00	19.00	2.00	Consolidated	1.20		0.37			

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	6.00	6.00	Clay Grey Silty	Clay	
6.00	13.00	7.00	Shale Grey	Shale	
13.00	17.00	4.00	Siltstone Grey	Siltstone	
17.00	19.00	2.00	Sandstone Weathered Water Supply	Sandstone	

19.00	24.38	5.38	Sandstone	Sandstone
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Remarks

08/05/1990: TDS = 2040 MG/L

***** End of GW063992 *****

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW080250

Licence: 20BL168280

Licence Status: ACTIVE

Authorised Purpose(s): TEST BORE
Intended Purpose(s):

Work Type: Bore

Work Status:

Construct.Method:

Owner Type:

Commenced Date:
Completion Date: 01/01/2002

Final Depth:
Drilled Depth:

Contractor Name:

Driller: Brian Richard Atkins

Assistant Driller:

Property: N/A 8/475 SANDGATE ROAD
SHORTLAND 2307

GWMA: -
GW Zone: -

Standing Water Level
(m):

Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

County	Parish	Cadastre
Form A: NORTH	NORTH.044	LT 2 DP 997796
Licensed: NORTHUMBERLAND	NEWCASTLE	Whole Lot 2//997796

Region: 20 - Hunter

CMA Map:

River Basin: 210 - HUNTER RIVER
Area/District:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Unknown
Source:

Northing: 6361387.0
Easting: 378589.0

Latitude: 32°52'44.2"S
Longitude: 151°42'07.7"E

GS Map: -

MGA Zone: 0

Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

08/08/2002: Total of four bores installed for groundwater monitoring only. All bores are fitted with magnetic locking caps to minimise the risk of unauthorised access.

Bores installed between 3.0 and 4.5 metres

***** End of GW080250 *****

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW080251

Licence: 20BL168281

Licence Status: ACTIVE

Authorised Purpose(s): TEST BORE
Intended Purpose(s):

Work Type: Bore

Work Status:

Construct.Method:

Owner Type: Local Govt

Commenced Date:
Completion Date: 01/04/2002

Final Depth:
Drilled Depth:

Contractor Name: Total Drilling

Driller:

Assistant Driller:

Property: N/A 10 KING STREET SHORTLAND
2307

GWMA: -
GW Zone: -

Standing Water Level
(m):

Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

County
Form A: NORTH
Licensed: NORTHUMBERLAND

Parish
NORTH.029
HEXHAM

Cadastre
LT 2 DP 12700
Whole Lot 2//12700

Region: 20 - Hunter

River Basin: 210 - HUNTER RIVER
Area/District:

CMA Map:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Unknown
Source:

Northing: 6361511.0
Easting: 377804.0

Latitude: 32°52'39.8"S
Longitude: 151°41'37.5"E

GS Map: -

MGA Zone: 0

Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

08/08/2002: Total of five bores installed for groundwater monitoring only. all bores are fitted with magnetic locking caps and have been located below ground level and buried, minimising the risk of unauthorized access

Bores installed between 4.0 mtrs and 10.50 metres

***** End of GW080251 *****

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW200626

Licence: 20BL168824

Licence Status: ACTIVE

Authorised Purpose(s): TEST BORE
Intended Purpose(s): TEST BORE

Work Type: Bore

Work Status: Supply Obtained

Construct.Method: Rotary - Water

Owner Type: Private

Commenced Date:
Completion Date: 22/11/2002

Final Depth: 4.20 m
Drilled Depth: 4.20 m

Contractor Name: Total Drilling

Driller: Christopher David Kiernan

Assistant Driller:

Property: NOT KNOWN LENAGHANS DRIVE
MINMI 2287

Standing Water Level:

GWMA:
GW Zone:

Salinity:
Yield:

Site Details

Site Chosen By:

County: NORTH
Form A: NORTH
Licensed: NORTH.29
Parish: NORTH.29
Cadastre: 148/840897

Region: 20 - Hunter

CMA Map:

River Basin: - Unknown
Area/District:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown

Northing: 6362331.0
Easting: 371366.0

Latitude: 32°52'10.6"S
Longitude: 151°37'30.3"E

GS Map: -

MGA Zone: 0

Coordinate Source: GPS - Global Positioning System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	4.20	100			Rotary - Water
1		Annulus	(Unknown)	0.30	1.20				Graded
1	1	Casing	Pvc Class 18	0.00	1.20	60	50		Screwed
1	1	Opening	Slots	0.00	1.20	60		1	Stamped, PVC Class 18, SL: 3000.0mm, A: 0.20mm
1	1	Casing	Pvc Class 18	1.20	4.20	60	50		Seated on Bottom, Screwed

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	2.25	2.25	silt (sandy, gravelly, dark brown, slightly	Silt	

			moist, no evidence of contamination, earthy musty odour)		
2.25	4.20	1.95	clay (silty, dark brown, grades to a sandy clay at bottom of SPT, very moist, moderate plasticity, dense, no evidence of	Clay	

Remarks

*** End of GW200626 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW200627
Licence: 20BL168824

Licence Status: ACTIVE

Authorised Purpose(s): TEST BORE
Intended Purpose(s): TEST BORE

Work Type: Bore

Work Status: Supply Obtained

Construct.Method:
Owner Type: Private

Commenced Date:
Completion Date: 22/11/2002

Final Depth: 4.20 m
Drilled Depth: 4.20 m

Contractor Name: Total Drilling
Driller: Christopher David Kiernan

Assistant Driller:
Property: NOT KNOWN LENAGHANS DRIVE
 MINMI 2287

Standing Water Level:
GWMA:
GW Zone:
Salinity:
Yield:

Site Details

Site Chosen By:

County	Parish	Cadastre
Form A: NORTH	NORTH.29	148/840897
Licensed:		

Region: 20 - Hunter

CMA Map:
River Basin: - Unknown
Area/District:
Grid Zone:
Scale:
Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown

Northing: 6362472.0
Easting: 371461.0

Latitude: 32°52'06.0"S
Longitude: 151°37'34.0"E

GS Map: -

MGA Zone: 0

Coordinate Source: GPS - Global Positioning System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	4.20	0			Unknown
1		Annulus	(Unknown)	0.70	4.20				Graded
1	1	Casing	P.V.C.	0.00	1.20	60	50		
1	1	Opening	Slots	1.20	4.20	60		1	PVC, SL: 40.0mm, A: 0.20mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	2.50	2.50	silt (sandy, dark brown, hard, dry, somewhat crumbly, no evidence of	Silt	

			contamination)		
2.50	4.20	1.70	sand (gravelly, dark brown with red, orange, white and black fine gravel fragments, very moist, moderately dense, no evi	Sand	

Remarks

*** End of GW200627 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW200628

Licence: 20BL168824

Licence Status: ACTIVE

Authorised Purpose(s): TEST BORE
Intended Purpose(s): TEST BORE

Work Type: Bore

Work Status: Supply Obtained

Construct.Method: Rotary - Water

Owner Type: Private

Commenced Date:
Completion Date: 22/11/2003

Final Depth: 4.20 m
Drilled Depth: 4.20 m

Contractor Name: Total Drilling
Driller: Christopher David Kiernan

Assistant Driller:

Property: NOT KNOWN LENAGHANS DRIVE
MINMI 2287

Standing Water Level:

GWMA:
GW Zone:

Salinity:
Yield:

Site Details

Site Chosen By:

County: NORTH
Form A: NORTH
Licensed:

Parish: NORTH.29

Cadastre: 148/840897

Region: 20 - Hunter

CMA Map:

River Basin: - Unknown
Area/District:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown

Northing: 6362453.0
Easting: 371384.0

Latitude: 32°52'06.6"S
Longitude: 151°37'31.0"E

GS Map: -

MGA Zone: 0

Coordinate Source: GPS - Global Positioning System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	4.20	0			Rotary - Water
1		Annulus	(Unknown)	0.00	0.70				Graded
1	1	Casing	P.V.C.	0.00	1.20	60	50		
1	1	Opening	Slots - Horizontal	1.20	4.20	60		1	PVC, SL: 40.0mm, A: 0.20mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	2.50	2.50	silt (sandy, gravelly, pale brown, dry, crumbly, no evidence of contamination)	Silt	

2.50	2.70	0.20	clay (sandy, dark brown, very moist, moderate plasticity, no evidence of contamination)	Clay	
2.70	4.20	1.50	sand (pale grey and orange, cemented, moist, no evidence of contamination)	Sand	

Remarks

*** End of GW200628 ***

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NSW Office of Water

Work Summary

GW200629

Licence: 20BL168824

Licence Status: ACTIVE

Authorised Purpose(s): TEST BORE
Intended Purpose(s): TEST BORE

Work Type: Bore

Work Status: Supply Obtained

Construct.Method: Rotary - Water

Owner Type: Private

Commenced Date:
Completion Date: 22/11/2002

Final Depth: 4.20 m
Drilled Depth: 4.20 m

Contractor Name: Total Drilling

Driller: Christopher David Kiernan

Assistant Driller:

Property: NOT KNOWN LENAGHANS DRIVE
MINMI 2287

Standing Water Level:

GWMA:
GW Zone:

Salinity:
Yield:

Site Details

Site Chosen By:

County: NORTH
Form A: NORTH
Licensed:

Parish: NORTH.29

Cadastre: 148/840897

Region: 20 - Hunter

CMA Map:

River Basin: - Unknown
Area/District:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown

Northing: 6362633.0
Easting: 371585.0

Latitude: 32°52'00.9"S
Longitude: 151°37'38.8"E

GS Map: -

MGA Zone: 0

Coordinate Source: GPS - Global Positioning System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	4.20	0			Rotary - Water
1		Annulus	(Unknown)	0.70	4.20				Graded
1	1	Casing	P.V.C.	0.00	1.20	60	50		
1	1	Opening	Slots - Horizontal	1.20	4.20	60		1	PVC, SL: 40.0mm, A: 0.20mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	sand (gravelly, dark brown with orange and grey gravel fragments, dry, no evidence of	Sand	

			contamination)		
1.00	2.50	1.50	clay (dark grey, moderate plasticity, moist)	Clay	
2.50	4.20	1.70	clay (sandy, dark brown, grey, with white shell fragments, very moist, dense, low plasticity, no evidence of contaminati	Clay	

Remarks

*** End of GW200629 ***

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW201660

Licence: 20BL173000

Licence Status: ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore

Work Status: Equipped

Construct.Method: Auger - Solid Flight

Owner Type: Private

Commenced Date:
Completion Date: 11/10/2011

Final Depth: 3.10 m
Drilled Depth: 3.10 m

Contractor Name: Fullbore Drilling
Driller: John Robert Morris
Assistant Driller: David Gulliver

Property: N A 3/67 MAITLAND ROAD
HEXHAM 2322 NSW
GWMA:
GW Zone:

Standing Water Level:
Salinity:
Yield:

Site Details

Site Chosen By:

County: NORTH
Form A: NORTH
Licensed:
Parish: NORTH.29
Cadastre: 311/583724

Region: 20 - Hunter
River Basin: 210 - HUNTER RIVER
Area/District:

CMA Map: 9232-3N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown

Northing: 6366361.0
Easting: 376272.0

Latitude: 32°50'01.8"S
Longitude: 151°40'40.9"E

GS Map: -

MGA Zone: 0

Coordinate Source: GPS - Global Positioning System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	3.10	115			Auger - Solid Flight
1		Annulus	Bentonite	0.00	0.10	115	58		PL:Poured/Shovelled
1		Annulus	Waterworn/Rounded	0.10	3.10	115	58		Graded, PL:Poured/Shovelled
1	1	Casing	Pvc Class 18	0.00	0.10	58	50		Seated on Bottom, Screwed
1	1	Opening	Slots - Horizontal	0.10	3.10	58		1	Casing - Drilled Holes, PVC Class 18, Screwed, SL: 30.0mm, A: 0.50mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.10	1.10	Clay	Clay	

1.10	3.10	2.00	Clay/Silty Clay	Clay
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Remarks

11/10/2011: Form A Remarks:
Nat Carling, 1-May-2012; GPS provided by the driller/client.

***** End of GW201660 *****

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW201661

Licence: 20BL173000

Licence Status: ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore

Work Status: Equipped

Construct.Method: Auger - Solid Flight

Owner Type: Private

Commenced Date:
Completion Date: 11/10/2011

Final Depth: 2.80 m
Drilled Depth: 2.80 m

Contractor Name: Fullbore Drilling

Driller: John Robert Morris

Assistant Driller: David Gulliver

Property: N A 3/67 MAITLAND ROAD
HEXHAM 2322 NSW

Standing Water Level:

GWMA:
GW Zone:

Salinity:
Yield:

Site Details

Site Chosen By:

County
Form A: NORTH
Licensed:

Parish
NORTH.29

Cadastre
311/583724

Region: 20 - Hunter

CMA Map: 9232-3N

River Basin: 210 - HUNTER RIVER
Area/District:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown

Northing: 6365946.0
Easting: 376393.0

Latitude: 32°50'15.3"S
Longitude: 151°40'45.4"E

GS Map: -

MGA Zone: 0

Coordinate Source: GPS - Global Positioning System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	2.80	115			Auger - Solid Flight
1		Annulus	Bentonite	0.00	0.20	115	58		PL:Poured/Shovelled
1		Annulus	Waterworn/Rounded	0.20	2.80	115	58		Graded, PL:Poured/Shovelled
1	1	Casing	Pvc Class 18	0.00	0.20	58	50		Seated on Bottom, Screwed
1	1	Opening	Slots - Horizontal	0.20	2.80	58		1	Casing - Drilled Holes, PVC Class 18, Screwed, SL: 30.0mm, A: 0.50mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
1.70	2.80	1.10	Unknown						

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
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0.00	2.80	2.80	Clay	Clay	
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Remarks

11/10/2011: Form A Remarks:
Nat Carling, 1-May-2012; GPS provided by the driller/client.

***** End of GW201661 *****

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

0.00	3.10	3.10	Clay	Clay	
3.10	6.30	3.20	Silty Clay	Silty Clay	

Remarks

11/10/2011: Form A Remarks:
Nat Carling, 1-May-2012; GPS provided by the driller/client.

***** End of GW201662 *****

Warning To Clients: This raw data has been supplied to the NSW Office of Water by drillers, licensees and other sources. The NOW does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

NSW Office of Water

Work Summary

GW201663

Licence: 20BL173000

Licence Status: ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore

Work Status: Equipped

Construct.Method: Auger - Hollow Flight

Owner Type: Private

Commenced Date:
Completion Date: 11/10/2011

Final Depth: 5.30 m
Drilled Depth: 5.30 m

Contractor Name: Fullbore Drilling

Driller: John Robert Morris

Assistant Driller: David Gulliver

Property: N A 3/67 MAITLAND ROAD
HEXHAM 2322 NSW

Standing Water Level:

GWMA:
GW Zone:

Salinity:
Yield:

Site Details

Site Chosen By:

County
Form A: NORTH
Licensed:

Parish
NORTH.29

Cadastre
311/583724

Region: 20 - Hunter

CMA Map: 9232-3N

River Basin: 210 - HUNTER RIVER
Area/District:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown

Northing: 6366706.0
Easting: 376167.0

Latitude: 32°49'50.5"S
Longitude: 151°40'37.1"E

GS Map: -

MGA Zone: 0

Coordinate Source: GPS - Global Positioning System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	5.30	135			Auger - Hollow Flight
1		Annulus	Bentonite	0.00	1.75	135	58		PL:Poured/Shovelled
1		Annulus	Waterworn/Rounded	1.75	5.30	135	58		Graded, PL:Poured/Shovelled
1	1	Casing	Pvc Class 18	0.00	2.25	58	50		Seated on Bottom, Screwed
1	1	Opening	Slots - Horizontal	2.25	5.30	58		1	Casing - Drilled Holes, PVC Class 18, Screwed, SL: 30.0mm, A: 0.50mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.50	1.50	Clay	Clay	

1.50	5.30	3.80	Silty Clay	Silty Clay
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Remarks

11/10/2011: Form A Remarks:
Nat Carling, 1-May-2012; GPS provided by the driller/client.

***** End of GW201663 *****

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NSW Office of Water

Work Summary

GW201664

Licence: 20BL173000

Licence Status: ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore

Work Status: Equipped

Construct.Method: Auger - Solid Flight

Owner Type: Private

Commenced Date:
Completion Date: 11/10/2011

Final Depth: 1.20 m
Drilled Depth: 1.20 m

Contractor Name: Fullbore Drilling
Driller: John Robert Morris
Assistant Driller: David Gulliver

Property: N A 3/67 MAITLAND ROAD
HEXHAM 2322 NSW
GWMA:
GW Zone:

Standing Water Level:
Salinity:
Yield:

Site Details

Site Chosen By:

County
Form A: NORTH
Licensed:

Parish
NORTH.29

Cadastre
2//611518

Region: 20 - Hunter
River Basin: 210 - HUNTER RIVER
Area/District:

CMA Map: 9232-3N
Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown

Northing: 6366689.0
Easting: 376154.0

Latitude: 32°49'51.1"S
Longitude: 151°40'36.5"E

GS Map: -

MGA Zone: 0

Coordinate Source: GPS - Global Positioning System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	1.20	115			Auger - Solid Flight
1		Annulus	Bentonite	0.00	0.10	115	58		PL:Poured/Shovelled
1		Annulus	Waterworn/Rounded	0.10	1.20	115	58		Graded, PL:Poured/Shovelled
1	1	Casing	Pvc Class 18	0.00	0.10	58	50		Seated on Bottom, Screwed
1	1	Opening	Slots - Horizontal	0.10	1.20	58		1	Casing - Drilled Holes, PVC Class 18, Screwed, SL: 30.0mm, A: 0.50mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.20	1.20	Clay	Clay	

Remarks

11/10/2011: Form A Remarks:
Nat Carling, 1-May-2012; GPS provided by the driller/client.

***** End of GW201664 *****

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NSW Office of Water

Work Summary

GW201941

Licence: 20BL171211

Licence Status: ACTIVE

Authorised Purpose(s): DOMESTIC,STOCK
Intended Purpose(s): STOCK, DOMESTIC

Work Type: Bore

Work Status: Supply Obtained

Construct.Method:

Owner Type: Private

Commenced Date:
Completion Date: 07/05/2007

Final Depth: 72.00 m
Drilled Depth: 72.00 m

Contractor Name: DHT DRILLING

Driller: David Hall Thomson

Assistant Driller: G Anderson

Property:
GWMA:
GW Zone:

Standing Water Level:
Salinity:
Yield:

Site Details

Site Chosen By:

County
Form A: NORTH
Licensed:

Parish
NORTH.57

Cadastre
951//600488

Region: 20 - Hunter

CMA Map: 9232-3N

River Basin: 210 - HUNTER RIVER
Area/District:

Grid Zone:

Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown

Northing: 6363089.0
Easting: 369653.0

Latitude: 32°51'45.2"S
Longitude: 151°36'24.7"E

GS Map: -

MGA Zone: 0

Coordinate Source: GIS - Geographic Information System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	72.00	200			(Unknown)
1		Annulus	Waterworn/Rounded	2.00	72.00	200			Graded
1	1	Casing		0.00	72.00	200	182		
1	1	Opening	Slots - Horizontal	66.00	72.00	200		1	SL: 150.0mm, A: 2.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
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Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	Shale, black	Shale	
1.00	3.00	2.00	Sandstone, weathered, yellow	Sandstone	
3.00	5.00	2.00	Tuff, white	Tuff	

5.00	6.00	1.00	Coal, oxidised	Coal	
6.00	13.00	7.00	Tuff, white	Tuff	
13.00	14.00	1.00	Shale, blue	Shale	
14.00	19.00	5.00	Tuff, white	Tuff	
19.00	22.00	3.00	Coal	Coal	
22.00	72.00	50.00	Shale, blue grey	Shale	

Remarks

07/05/2007: Form A Remarks:

Nat Carling, 15-May-2012; Coordinates based on location map provided with the Form-A. No flow - seepage only

***** End of GW201941 *****

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	E Griffin	A Monkley I Gregson L King K Rowe		P Youman		13/03/2019

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