

DRAFT

Engineering Log - Borehole

Client: **UPPER HUNTER VALLEY ALLIANCE**

Principal:

Project: **HEXHAM RELIEF ROADS**

Borehole Location: **HEXHAM RELIEF ROADS**

Borehole No. **HA 2**

Sheet 1 of 1

Office Job No.: **GEOTWARA21045AC**

Date started: **27.4.2012**





Date completed: **27.4.2012**

Logged by: **LR**

Checked by:

drill model and mounting: Hand Auger	Easting: 376596	slope: -90°	R.L. Surface: Not Measured
hole diameter: 50 mm	Northing: 6367139	bearing:	datum:

drilling information					material substance								
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations
HA		N	None Observed	E					FILL: Sandy CLAY, dark brown.black, sand fine to medium grained, with some gravel fine to medium grained.	M	VSt/F		FILL - No odour
				E		0.5			Hole terminated due to refusal. Borehole HA 2 terminated at 0.4m				
						1.0							
						1.5							
						2.0							

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Borehole

DRAFT

Borehole No.	HA 3
Sheet	1 of 1
Office Job No.:	GEOTWARA21045AC
Date started:	27.4.2012
Date completed:	27.4.2012
Logged by:	LR
Checked by:	


Client: **UPPER HUNTER VALLEY ALLIANCE**




Principal:

Project: **HEXHAM RELIEF ROADS**

Borehole Location: **HEXHAM RELIEF ROADS**

drill model and mounting:	Hand Auger	Easting:	376561	slope:	-90°	R.L. Surface:	Not Measured
hole diameter:	50 mm	Northing	6367121	bearing:		datum:	

drilling information				material substance								
method	penetration 1 2 3	support water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations
HA		N						FILL: Silty CLAY, low to medium plasticity, black, with trace gravel fine to medium grained.	W	St		FILL / TOPSOIL
		None Observed	E		0.5			Silty CLAY: black, low to medium plasticity.				
			E		1.0			Hole terminated as per scope. Borehole HA 3 terminated at 0.7m				
					1.5							
					2.0							

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Appendix B

PID Results

Sample ID	PID Reading
CS1	0.1
CS2	0.1
CS3	0.2
CS4	0.2
CS5	0.0
CS6	0.3
CS7	0.4
CS8	0.0
CS9	0.1
CS10	0.2
CS11	0.0
CS12	0.3
CS13	0.5
CS14	0.1
CS15	0.0
CS16	0.2
TP501A_0.1-0.2	0.2
TP501A_0.9-1.0	0.2
TP502A_0.2-0.3	0.2
TP502A_0.9-1.0	0.1
TP503B_0.3-0.4	0.0
TP503B_1.0-1.1	0.0
TP504A_0.3-0.4	0.2
TP504A_0.9-1.0	0.3
TP505B_0.5-0.6	0.0
TP506B_0.5-0.6	0.4
TP506B_1.1-1.2	0.2
TP506B_2.0-2.1	0.1
TP507B_0.1-0.2	0.3
TP507B_1.1-1.2	0.4
TP507B_2.5-2.6	0.0
TP508B_0.3-0.4	0.2
TP508B_0.4-0.5	0.1
TP508B_1.0-1.1	0.3
TP508B_2.5-2.6	0.4
TP509A_0.2-0.3	0.7
TP509A_1.0-1.1	0.1
TP510A_0.1-0.2	0.3
TP510A_0.4-0.5	0.1
TP510A_0.9-1.0	0.2
TP510A_2.0-2.1	0.2
TP511B_0.1-0.2	0.2
TP511B_0.5-0.6	1.0
TP512B_0.9-1.0	0.3
TP513B_0.1-0.2	0.1
TP513B_0.7-0.8	0.2
TP514B_0.1-0.2	0.2

TP514B_0.6-0.7	0.1
TP515B_0.9-1.0	0.2
TP516B_0.2-0.3	0.0
TP517A_0.3-0.4	0.0
TP517A_0.8-0.9	0.1
TP517A_1.5-1.6	0.2
TP518B_0.3-0.4	0.2
TP518B_1.0-1.1	0.3
TP519B_0.1-0.2	0.5
TP519B_0.8-0.9	0.0
TP519B_1.0-1.1	0.1
TP523B_0.3-0.4	0.1
TP525A_0.2-0.3	0.2
TP528A_0.2-0.3	0.3
TP529A_0.3-0.4	0.1
TP529A_1.0-1.1	0.4

A PID calibrated 12-11, 100ppm isoButylene.
[Signature]

Photolonisation Detector (PID) Results

client:	UPPER HUNTER VALLEY ALLIANCE	office:				
principal:		date:				
project:	HEXHAM RELIEF ROADS	by:				
location:	HEXHAM	checked by:				
PID serial number: MINIRAE 2000 (SN: 110-002708)		lamp voltage: 10.6eV				
PID Calibration Record						
Date / Time of Calibration: 27-04-12 9:00am		Calibration gas: 100 ppm ISOBUTYLENE				
<input checked="" type="checkbox"/> Zero Calibration (0.0ppm) Actual 0.0ppm <input checked="" type="checkbox"/> Span Calibration (100ppm) Actual Reading 100ppm						
Calibrated by: LR						
SAMPLE ID	DEPTH	DURATION (mins)	BACKGROUND READING (ppm)	MAXIMUM READING (ppm)	LAST READING (ppm)	NOTES
HA 1	0.0 - 0.1				0.5	
HA 1	0.5 - 0.6				0.2	
HA 2	0.0 - 0.1				0.3	
HA 2	0.3 - 0.4				0.2	
HA 3	0.0 - 0.1				0.1	
HA 3	0.5 - 0.6				0.5	
TP530	0.4 - 0.5				0.1	
TP530	1.4 - 1.5				0.1	
TP531	0.4 - 0.5				0.4	
TP531	1.5 - 1.6				0.1	
TP532	0.4 - 0.5				0.2	
TP532	1.4 - 1.5				0.1	
TP533	0.0 - 0.2				0.2	
TP533	0.5 - 0.6				0.0	
TP534	0.0 - 0.1				0.6	
TP534	1.0 - 1.1				1.2	

Appendix C

ProUCL Calculation Sheets

General UCL Statistics for Full Data Sets

Lead

User Selected Options

From File: WorkSheet.wst
 Full Precision: OFF
 Confidence Coefficient: 95%
 Number of Bootstrap Operations: 2000

C0

General Statistics

Number of Valid Observations: 25 Number of Distinct Observations: 21

Raw Statistics

Minimum: 5
 Maximum: 1900
 Mean: 123.9
 Median: 21
 SD: 380.8
 Coefficient of Variation: 3.073
 Skewness: 4.609

Log-transformed Statistics

Minimum of Log Data: 1.609
 Maximum of Log Data: 7.55
 Mean of log Data: 3.443
 SD of log Data: 1.298

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic: 0.32
 Shapiro Wilk Critical Value: 0.918

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic: 0.871
 Shapiro Wilk Critical Value: 0.918

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL: 254.2
 95% UCLs (Adjusted for Skewness)
 95% Adjusted-CLT UCL: 324.2
 95% Modified-t UCL: 265.9

Assuming Lognormal Distribution

95% H-UCL: 156.6
 95% Chebyshev (MVUE) UCL: 161.6
 97.5% Chebyshev (MVUE) UCL: 201.8
 99% Chebyshev (MVUE) UCL: 280.8

Gamma Distribution Test

k star (bias corrected): 0.437
 Theta Star: 283.5
 MLE of Mean: 123.9
 MLE of Standard Deviation: 187.4
 nu star: 21.85

Approximate Chi Square Value (.05): 12.23
 Adjusted Level of Significance: 0.0395
 Adjusted Chi Square Value: 11.74

Anderson-Darling Test Statistic: 3.502
 Anderson-Darling 5% Critical Value: 0.814
 Kolmogorov-Smirnov Test Statistic: 0.307
 Kolmogorov-Smirnov 5% Critical Value: 0.185

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL: 221.5
 95% Adjusted Gamma UCL: 230.7

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL: 249.2
 95% Jackknife UCL: 254.2
 95% Standard Bootstrap UCL: 241.3
 95% Bootstrap-t UCL: 1432
 95% Hall's Bootstrap UCL: 832.2
 95% Percentile Bootstrap UCL: 267.5
 95% BCA Bootstrap UCL: 354.2
 95% Chebyshev(Mean, Sd) UCL: 455.9
 97.5% Chebyshev(Mean, Sd) UCL: 599.5
 99% Chebyshev(Mean, Sd) UCL: 881.7

Potential UCL to Use

Use 99% Chebyshev (Mean, Sd) UCL: 881.7

General UCL Statistics for Full Data Sets

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

TPH C10-C36

General Statistics

Number of Valid Observations	40	Number of Distinct Observations	38
Number of Missing Values	15		

Raw Statistics

Minimum	50
Maximum	2363
Mean	794.6
Median	773
SD	532.7
Coefficient of Variation	0.67
Skewness	0.918

Log-transformed Statistics

Minimum of Log Data	3.912
Maximum of Log Data	7.768
Mean of log Data	6.378
SD of log Data	0.918

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.933
Shapiro Wilk Critical Value	0.94

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.89
Shapiro Wilk Critical Value	0.94

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	936.5
95% UCLs (Adjusted for Skewness)	
95% Adjusted-CLT UCL	946.2
95% Modified-t UCL	938.5

Assuming Lognormal Distribution

95% H-UCL	1252
95% Chebyshev (MVUE) UCL	1524
97.5% Chebyshev (MVUE) UCL	1800
99% Chebyshev (MVUE) UCL	2344

Gamma Distribution Test

k star (bias corrected)	1.697
Theta Star	468.1
nu star	135.8
Approximate Chi Square Value (.05)	109.9
Adjusted Level of Significance	0.044
Adjusted Chi Square Value	109

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Anderson-Darling Test Statistic	0.493
Anderson-Darling 5% Critical Value	0.761
Kolmogorov-Smirnov Test Statistic	0.115
Kolmogorov-Smirnov 5% Critical Value	0.142

Nonparametric Statistics

95% CLT UCL	933.1
95% Jackknife UCL	936.5
95% Standard Bootstrap UCL	932.2
95% Bootstrap-t UCL	953.3
95% Hall's Bootstrap UCL	955.9
95% Percentile Bootstrap UCL	928.9
95% BCA Bootstrap UCL	960.2
95% Chebyshev(Mean, Sd) UCL	1162
97.5% Chebyshev(Mean, Sd) UCL	1321
99% Chebyshev(Mean, Sd) UCL	1633

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	982.1
95% Adjusted Gamma UCL	989.9

Potential UCL to Use

Use 95% Approximate Gamma UCL 982.1

Appendix D

Remedial Action Plan

PROPOSED HEXHAM RELIEF ROADS, HEXHAM, NSW

REMEDIAL ACTION PLAN

Upper Hunter Valley Alliance

GEOTWARA21045AC-AK Hexham RAP Final V1
5 July 2012

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ABBREVIATIONS

AEC	Area of environmental concern
AHD	Australian height datum
ASS	Acid sulfate soils
BOD	Biological oxygen demand
C10-C36	Hydrocarbon chain fraction
CEMP	Construction environment management plan
cfu	Colony forming unit
CHA	Coffey hand auger sampling location
CMW	Coffey monitoring well
CSW	Coffey surface water sampling location
DGR	Director Generals Requirements
DP	Douglas Partners Pty Ltd
EIS	Environmental impact statement
ENM	Excavated natural material
HDPE	High density poly-ethylene
HSSE	Health, safety, security and environmental
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
µg/L	micrograms per litre
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
OEH	NSW Office of Environment and Heritage
OH&S	Occupational Health and Safety

ABBREVIATIONS

PAH	Polycyclic aromatic hydrocarbons
PID	Photo-ionisation detector
PPE	Personal protective equipment
ppm	parts per million
RAP	Remedial action plan
TBA	To be announced
TP	Test pit sampling location
TPH	Total petroleum hydrocarbons
UHVA	Upper Hunter Valley Alliance
VENM	Virgin excavated natural material

1 INTRODUCTION

1.1 Background

Upper Hunter Valley Alliance (UHVA) contracted Coffey Environments Australia Pty Ltd (Coffey) to prepare a Remedial Action Plan (RAP) for the proposed relief road construction located at Hexham, NSW (the Project Area). The location of the Project Area is shown on Figure 1.

The Proposed Project will involve the construction of five relief roads (train lines) to the west of the existing Up and Down Main Lines and between the existing Up Coal and new Down Coal Lines. Other components will include construction of new signal infrastructure and earthworks including drainage lines. The area where construction is proposed is shown on Figure 1.

Coffey has prepared a contamination assessment report (GEOTWARA21045AC-AI, dated 10 May 2012) as part of the EIS. The contamination assessment report should be read in conjunction with this RAP.

This RAP has been prepared in accordance with the relevant sections of the following:

- Contaminated Land Management Act 1997;
- The NSW Office of Environment and Heritage (OEH) (2011) *Guidelines for Consultants Reporting on Contaminated Sites*;
- NSW Department of Environment and Conservation (DEC) (2006) *Guidelines for the NSW Site Auditor Scheme 2nd edition*;
- NSW Environment Protection Authority (EPA) (1995) *Sampling Design Guidelines*;
- National Environment Protection Council (1999) *National Environment Protection (Assessment of Site Contamination) Measure*;
- NSW Department of Environment, Climate Change and Environment (DECCW) (2009) *Waste Classification Guidelines*; and,
- The respective Director-General's Requirements (DGR's) for the EIS (Reference SSI-4992 dated 14 December 2011).

This report must be read in conjunction with the attached sheet entitled "*Important Information About Your Coffey Environmental Report*", which can be found at the end of the contamination report.

1.2 Objectives

The key objectives of the RAP are to:

- Identify areas within the Project Area that require remediation;
- Discuss remedial options and select an appropriate remediation method;
- Outline the procedures for the remediation activities; and
- Outline the procedures for validation, site control and occupational health and safety (OH&S).

The RAP does not provide information on management of bulk excavated soils for the proposed development. The RAP only covers management of soils identified as being contaminated. Management of bulk excavated soils is discussed in other management plans, including, but not limited to, the acid sulfate soil management plan, waste management plan and soil and water management plan.

1.3 Scope of Works

In order to achieve the objective of the RAP, the following scope of works would be undertaken:

- A review of the contamination assessment report to assess areas of contamination that require remediation;
- Development of suitable remediation and validation strategies for the Project Area;
- A review of the environmental and safety measures to be undertaken during the remedial works to protect the health and safety of site workers, the general public and the environment;
- Development of the required validation criteria and outcomes; and
- Preparation of this RAP, in accordance with the relevant sections of the NSW OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*.

2 SITE SETTING SUMMARY

2.1 Project Area Identification and Location

The Project Area is situated between 173.800km and 177.600km on and adjacent to (west of) the Main North Line at Hexham, NSW. The Project Area is approximately 39ha. The location of the Project Area and the area where construction is proposed is shown on Figure 1. .

The Project Area is bounded by rural allotments to the west and by commercial and light industrial allotments to the east. Hexham Swamp is located to the south of the Project Area. The eastern side of the Project Area has been used as a railway corridor for about 150 years.

2.2 Project Description

The ARTC proposes to develop five Relief Roads (tracks) and associated infrastructure at Hexham in the NSW Hunter Valley (the proposed Project). The proposed Project is located approximately 16km north west of the town of Newcastle.

Key components of the proposed Project comprise:

- Five Up Relief Roads (train lines) to the west of the existing Up Main, Down Main and Up Coal including:
 - The removal of the existing Down Coal (located to the west of the Up Coal);
 - The construction of five new train lines (tracks) for the Relief Roads;
 - The construction of a new Down Coal to the west and outside of the proposed Relief Roads;
 - Each Relief Road to accommodate trains generally comprising two or three locomotives and up to 91 wagons (1,543m long) requiring a minimum standing room of 1,670m; and
 - New turnouts, return curves and associated track changes.
- Installation of new signal infrastructure for the five Relief Roads including signal location cases, huts and gantries.
- Earth and civil works of approximately 265,000 cubic metres, including cut to fill, track formation, drainage and minor structures. Approximately 105,000 cubic metres will be cut during construction of the Project, and this will include cuts to between about 0.5m and 3.5m bgs.
- Ancillary infrastructure including vehicle access tracks, temporary construction compounds and stockpile sites.
- Land acquisition and the upgrading of existing rail infrastructure and public utilities as required.

The estimated cost of the Project is approximately \$90million and it is expected to take approximately 18 months to construct.

2.3 Site Topography and Drainage

Reference to the Newcastle 1:100,000 Topographic Map indicates that the regional topography consists of broad, generally flat, low lying floodplains which appear to receive tidal flows from the Hunter River via a number of creeks. The Hexham wetlands are located generally below 5.0m AHD though imported fill mounds may be encountered above this height.

Based on field observations, the tracks and adjacent land appear to be positioned on a 1 to 2m thick layer of fill, over deep estuarine and alluvial deposits associated with the Hunter River to the east and Hexham Swamp to the west and south.

Natural drainage across the Project Area has been disrupted by the placement of the rail corridor and fill and the historical industrialisation of the western portion of Hexham Wetland. Drainage of the Hexham wetland principally occurs through Iron Bark Creek which discharges to the Hunter River about 2km to the south of the Project Area. Recently tidal gates have been removed from near the confluence of the creek and the Hunter River. In the north of the Project Area, there is also some surface water flow to the east through a series of manmade drains which direct surface water under Woodlands Close, the existing rail corridor and the Pacific Highway before discharging to the Hunter River.

Drainage within the existing rail corridor is likely to occur through either land infiltration into the surface soils or via the several drainage lines and culverts constructed along the railway corridor that shed water both to the east (Hunter River) and the west (Hexham Wetland and Ironbark Creek).

2.4 Soils and Geology

Reference to the 1:250,000 scale Newcastle Geological Map indicates that the Project Area is underlain by Quaternary deposits of gravel, sand, silt and clay. These are judged to be Estuarine/Alluvial soils associated with the flood plains of the Hunter River and the Hexham Wetland.

Within the Project Area, the subsurface conditions are broadly anticipated to comprise:

- Fill, predominately comprising coal reject and rail ballast to depths of 1 to 2m, overlying;
- Estuarine/Alluvial Soils, typically comprising deep deposits of clay, silt and sand and gravel associated with sedimentary deposition from the Hunter River to depths of about 20 to 40m, overlying; and
- Weathered Sedimentary Rock – Typically Interbedded Sandstone, Siltstone, Tuff, and Mudstone.

2.4.1 Acid Sulfate Soils

Reference to the NSW DECC (2008) Acid Sulfate Soils Risk Map for the Lower Hunter indicates that the Project Area is judged to be located within an area described as having a high probability of acid sulfate soils (ASS) within 1m of the ground surface. The Project Area is indicated to be in an alluvial plain setting with ground surface levels of between 1m and 2m AHD. Possible on-site activities such as excavations have the potential to expose the estuarine soils with a high probability of being potential ASS.

ASS testing was carried out as part of the geotechnical investigation and will be reported separately in report GEOTWARA21045AC-AL. The testing carried out comprised a field screening test on 33 samples, and chromium reducible sulfur (S_{CR}) testing on 19 samples. Each sample tested was alluvial or estuarine, with the exception of one sample of fill material.

The results showed:

- pH in water ranged from 5.77 to 8.55;
- pH in hydrogen peroxide solution ranged from 1.79 to 6.19;
- Total actual acidity (TAA) ranged from <5 to 84 mole H^+ /tonne;
- Chromium reducible sulfur (S_{CR}) ranged from <0.005 to 1.8%; and
- Net Acidity ranged from <5 to 970 mole H^+ /tonne.

The majority of the results indicated that the alluvial/estuarine soils are potential ASS. The results were variable, and it was impractical to define particular layers, areas or materials types that were, or weren't, ASS.

Based on this, Coffey consider that the alluvial/estuarine soils should be treated as potential ASS. The potential ASS will require management during construction, particularly in areas where excavations are planned, or where the water table will be lowered by dewatering.

Management measures are included in EIS Volume 1 Chapter 12 Soils and Geology, and the ASS management plan which is part of the CEMP.

2.5 Hydrogeology and Local Groundwater Usage

Similar to the surface water, groundwater characteristics such as standing water level, flow direction, seepage velocity and hydraulic conductivity have been disrupted by the placement of the rail corridor and fill and the historical industrialisation of the eastern portion of Hexham Wetland.

It is expected that groundwater would be encountered at a depth of 0.5m and 1.5m beneath the current surface level of the Project Area. Groundwater may also be encountered within fill mounds above the surrounding natural surface. Groundwater levels were measured on the Project Area between 0.65m to 1.5m below ground surface (bgs) during drilling of the monitoring wells in February 2012.

Groundwater conditions are also likely to be affected by tidal influences and will fluctuate seasonally due to periods of increased rainfall, temperature and other seasonal factors. It is noted that the area is prone to flooding during extreme and/or prolonged rainfall events.

Current groundwater flow is anticipated to be multi-directional depending on the amount of fill present and the proximity of discharge zones. There is likely to be a component of flow to the east towards the Hunter River and also west and south towards the Hexham Wetland.

Salinity of the groundwater would be variable depending on tidal effects and rainfall. It is anticipated that regional groundwater would be used mainly for domestic and industrial purposes, and is unlikely to be used for drinking water or irrigation. Douglas Partners Pty Ltd (2011) indicated that salinity varied, with water generally fresh to brackish.

3 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

The following contamination assessments have previously been reported for the site:

- Douglas Partners Pty Ltd (2011) Preliminary Contamination Assessment, Proposed Hexham Redevelopment, Maitland Road and Woodlands Close, Hexham (August 2011);
- Coffey for Upper Hunter Valley Alliance (2012) Proposed Hexham Relief Roads Project, Hexham, Contamination Assessment, Reference GEOTWARA21045AC-AI, dated 5 July 2012).

A summary of the Douglas Partners (2011) assessment is presented in Section 3 of the contamination report (GEOTWARA21045AC-AI, dated 5 July 2012). The following Section 4 provides a summary of the soil, surface water and groundwater contamination encountered during investigations by Coffey.

4 IDENTIFIED CONTAMINATION

Based on the Coffey contamination assessment (Coffey, 2012), Table 2 provides a summary of the contamination identified, and the associated area of environmental concern (AEC). The locations of identified contamination are shown on Figures 2A to 2D.

TABLE 2 – IDENTIFIED CONTAMINATION

AEC and LOCATION	CONTAMINATION
Soil	
AEC 2 TP528A 0.2-0.3m TP532 0.4-0.5	Total petroleum hydrocarbons (TPH) C10-C36 3,200mg/kg TPH C10-C36 4,732mg/kg, benzo(a)pyrene 110mg/kg, and total polycyclic aromatic hydrocarbons (PAHs) 1,300mg/kg. These samples are both located within the ARTC compound area. They may be related to fuel spills, or use of contaminated fill material.
AEC 4 CHA01 0.0-0.1, TP533 and TP534	Elevated concentrations of TPH C10-C36 were identified in CHA01 0.0-0.1m and TP533 and TP534 from 0.0m to 1.1m bgs, with concentrations ranging from 471mg/kg to 995mg/kg. The concentrations were below the adopted criteria. Trenches excavated across the area rapidly filled up with water, which was inflowing from within fill material at about 0.2m. This made observations difficult, and no observations were made below 1.1m. There were some slight indications of a backfilled excavation, with a variation in fill material in parts of the trenches. No existing fuel tanks were encountered, and no hydrocarbon odours were noted. A number of samples have been collected in this area, and each showed concentrations below the criteria. Based on this, remediation of this area is not required. However, it is noted that if excavations are carried out in this area to depths greater than 1.1m during construction, there is a possibility that contaminated soil could be encountered. This would be managed using procedures in the CEMP.

LOCATION	CONTAMINATION
Soil	
<p>AEC 2A SS30 to SS35</p>	<p>Concentrations of benzo(a)pyrene ranged from 5.6mg/kg to 28mg/kg and PAHs ranged from 59mg/kg to 270mg/kg.</p> <p>Concentrations of TPH C10-C36 ranged from 570mg/kg to 1,334 mg/kg.</p> <p>These samples are located on the surface adjacent to the paved area of Woodlands Close. The source may be associated with fill material imported to construct the road on. The concentrations of PAHs in this area are inconsistent with the rest of the Project Area, as generally PAHs were below adopted criteria.</p>
Water	
<p>AEC 8 Surface water</p>	<p>Faecal coliforms and E. Coli at concentrations ranging from 270cfu/100ml to 130,000cfu/100ml.</p> <p>Metals above the adopted criteria in the majority of samples.</p> <p>Ammonia above the adopted criteria in CSW2, CSW8 and CSW9. Elevated concentrations of nitrogen, phosphorous, and biological oxygen demand (BOD) in the majority of surface water samples.</p> <p>The source of this contamination is considered likely to be grazing cattle or effluent irrigation.</p>
<p>AEC 7 Groundwater</p>	<p>Concentrations of arsenic were identified above criteria in samples CMW1, CMW2, and CMW5 to CMW8. Concentrations of nickel were identified above the criteria in samples CMW4 and CMW5.</p> <p>Faecal coliforms were above criteria in sample CMW5.</p> <p>Ammonia was identified above the criteria in the majority of samples tested, and nitrite was identified above the criteria in samples CMW6 and CMW9. Elevated concentrations were recorded for nitrogen, phosphorous and iron in the majority of samples.</p> <p>The source of this contamination is considered likely to be grazing cattle or effluent irrigation.</p>

5 REMEDIAL GOALS

5.1 Soils

The broad remediation goal, with respect to soil contamination, will be to remediate the site to a condition that is suitable for the proposed development.

5.2 Surface Water and Groundwater

The broad remedial goal with respect to surface water and groundwater will be to construct and maintain the proposed development in such a way as to not exacerbate the existing contamination within surface water and groundwater.

It is not considered practicable to remediate the surface and groundwater contamination within the Project Area, given the widespread nature of the contamination and the already degraded state of this portion of Hexham Wetland.

Surface water and groundwater contamination is present across the Project Area, and off-site. It is considered that the surface water contamination identified is likely to be associated with either grazing of cattle or effluent irrigation that occurs to the west of the Project Area. The long history of industrialisation in this part of the Hexham Wetland has resulted in a degraded wetland system. The concentrations of faecal coliforms and E. Coli in surface water, and nutrients and metals in surface water and groundwater confirm that the Hexham Wetland is in a degraded state.

The surface water and groundwater contamination is considered to present a potential risk to human health for construction workers and appropriate management procedures will be required for the protection of site workers. During construction, site access will be restricted, and further impacts could be less severe than the current faecal coliform concentrations which have occurred when access for cattle is not restricted.

A Water Quality Management Plan would be prepared as part of the CEMP and would include, but not be limited to:

- Measures to ensure that the existing contamination in surface and groundwater is not exacerbated during construction of the Project.
- Management measures for the protection of human health and the environment during construction;
- Monitoring protocols, including frequency of monitoring, the analytes to be tested, and the adopted assessment criteria to demonstrate that contamination is not being exacerbated; and
- Contingency plans.

The water quality management plan is further discussed in Volume 1 of the EIS.

6 REMEDIATION OPTIONS

6.1 Remediation Hierarchy

The NEPC (1999) *National Environment Protection (Assessment of Site Contamination) Measure* provides a preferred hierarchy of options for site cleanup and/or management which is outlined as follows:

- If practicable, on-site treatment for the contamination so that it is destroyed and the concentrations are reduced to below the adopted site cleanup criteria; or
- Offsite treatment of contaminated material, so that the contamination is destroyed or the associated risk is reduced to an acceptable level.

If the above is not practicable:

- Consolidation and isolation of the contaminated material on site by containment within a properly designed barrier; or
- Removal of contaminated material to an approved facility followed, where necessary, by replacement with appropriate material; or
- Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.

6.2 Soil Remediation Options

A number of options are available for remediating contaminated soil. An outline of the various options available is presented below, and Table 3 provides a summary of the advantages and disadvantages of each option for this site.

6.2.1 Option 1 - Excavation and Disposal Offsite

The basic outline of the scope of work associated with excavation and off-site disposal of soil is contaminated soils would be excavated and disposed off-site to an appropriately licensed landfill. The resulting excavation would be validated by sampling and analysis to assess the effectiveness of the remediation.

The excavated materials would be tracked from excavation to landfill so that the location of soils is known and appropriate disposal can be demonstrated.

6.2.2 Option 2 - Bioremediation (Landfarming) of Excavated Hydrocarbon Contaminated Soil

Hydrocarbon contaminated soils would be excavated as per the above procedures (Option 1).

The basic outline of the scope of work associated with landfarming is:

- Hydrocarbon contaminated soils would be excavated and stockpiled. The stockpiles would be at relatively low heights to aid in volatilising contaminants.
- The stockpiles can be either "turned" periodically, and/or nutrients can be added to aid in removal of hydrocarbon contaminants.
- The stockpiles will be assessed periodically to assess if further land farming/bioremediation is required or if soils are remediated.
- Once the stockpiled soils are assessed as suitable for re-use on site, they will either be placed back into the excavation, or placed elsewhere on site.

6.2.3 Option 3 – Cap and Contain

Contaminated soils that are not volatile at daytime temperatures could be capped on site, in areas that are not flood prone. This would generally involve:

- Excavation of identified contaminated soils.
- In an area that will not be disturbed by construction, a containment cell would need to be constructed and lined with an impermeable material (e.g. compacted clay or HDPE liner). The cell would need to be above ground, to prevent flooding and mobilisation of contaminants into surface water and shallow groundwater.
- The excavated contaminated soils would be placed into the cell, and capped off with an impermeable material (e.g. compacted clay);
- A site management plan would be required, that would outline the type of contaminated material that is being managed on-site, and the location of the material. In addition, ongoing groundwater monitoring would likely be required. It is also recommended that if contaminated material is managed on site, that it is noted on the Section 149 certificate for the lot it is contained within.
- The site owner or site manager would be responsible for implementing the site management plan, and ensuring that the contaminated soil is not excavated.

6.2.4 Option 4 – Risk Assessment

A risk assessment could be undertaken to assess the risk to human health posed by the contamination. If the risk assessment indicated an acceptable level of risk to human health, remediation of the contamination would likely not be required.

It is noted that the risk assessment would only apply to the site configuration present at the time the risk assessment was carried out. Should contaminated soils be moved around the site, the risk assessment conclusions may no longer apply.

6.2.5 Option 5 – Administration Controls

There are areas that are not proposed to be disturbed during construction, for example access roads which will only be used for vehicles to drive on, and which UHVA do not own or manage.

In these areas, where contamination is present, it could be managed using protocols and monitoring outlined in the construction environment management plan (CEMP).

6.2.6 Advantages and Disadvantages of Soil Remediation Options

The design of the Project includes excavation of soils to depths of between 0.3m to 3.5m bgs within the construction area of the relief roads. No excavation or construction works are planned for Woodlands Close (AEC 2A), which will principally be used to access the site.

Generally the soil contamination identified occurs within the top 1.0m of the ground surface.

The advantages and disadvantages of the soil remediation options are outlined in Table 3 below.

TABLE 3 – ADVANTAGES AND DISADVANTAGES OF SOIL REMEDIATION OPTIONS

Material	Remediation Option	Advantages	Disadvantages
Soil	Excavation and Disposal to Landfill.	Shorter time frame. Ongoing liability reduced as contamination will be removed.	Cost. Lower option on EPA preferred hierarchy.
	Excavation and Bio-remediation (Landfarming) On-site.	Cost. First option on EPA preferred hierarchy.	Can have a longer time frame. May not successfully remediate contamination, resulting in disposal to landfill. Shallow water table could be impacted by run-off from landfarming area. Space on site is limited.
Soil	Cap and Contain.	Cost.	Need for on-going management into the future. Generally not practicable if excavations are proposed in areas of contaminated soil. Can be difficult to achieve containment with a shallow water table.
	Risk Assessment.	May be no need to remediate soil. May be cheaper than remediating soil contamination.	No guarantee that risk assessment will show remediation isn't required. Risk assessment is less likely to show remediation isn't required if construction workers are likely to come into direct contact with contaminated soils. Risk assessment will only apply to the site configuration present at the time of carrying out the assessment. The assessment will no longer apply if soils are moved to different areas on the site.
	Administration Controls	No requirement to remediate soils in areas that will not be disturbed, and that UHVA do	Not appropriate for use in areas where soils will be disturbed.

		not own or manage.	
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6.3 Surface Water and Groundwater Remediation

Surface water and groundwater contamination is present across the Project Area, and off-site. It is considered that the surface water contamination identified is likely to be associated with either cattle grazing or effluent irrigation that occurs to the west of the Project Area. The long history of industrialisation in this part of the Hexham Wetland has resulted in a degraded wetland system. The concentrations of faecal coliforms and E. Coli in surface water, and nutrients and metals in surface water and groundwater confirm that the Hexham Wetland is in a degraded state.

As the source of water contamination (cattle grazing or ongoing effluent irrigation) may continue to affect the Project Area both during and after construction, it is not considered practicable to remediate the surface and groundwater contamination within the Project Area,

It is considered that remediation of surface water or groundwater would have no net environmental benefit or would have a net adverse environmental effect (i.e. using disinfectant could cause environmental harm within Hexham Wetlands). Based on this, an appropriate management strategy would be implemented.

The remedial goal for surface water and groundwater is not to exacerbate the existing contamination.

It is proposed that surface water and groundwater would be appropriately managed during construction using a water quality management plan. The water quality management plan would include but not be limited to the following:

- Measures to protect worker health;
- Measures to prevent exacerbation of the contamination;
- Outline surface water and groundwater monitoring protocols, including frequency, adopted criteria, and the analytes to be tested;
- Outline who is responsible for implementing the plan; and
- Outline which regulatory authorities may be required to approve the plan.

7 PREFERRED SOIL REMEDIATION OPTION

Based on the advantages and disadvantages outlined in Table 3 above, and the preferred design option including cuts to between 0.3m and 3.5m depth, the preferred remediation option for soils are discussed in Table 4 below.

TABLE 4 – PREFERRED SOIL REMEDIATION OPTIONS

AEC & Contamination Location	Preferred Remediation Option	Comment
AEC 2A Sample locations SS30 to SS35	Use of CEMP (administrative controls).	UHVA do not own this land (public roadway), and are not responsible for the land. As no construction works are proposed in this area, the risk to workers is low, and therefore remediation is not considered necessary.
AEC 2 Sample locations TP528A and TP532	Excavation and disposal to landfill.	Excavations are proposed in the area of this contamination, therefore workers could be exposed to the contamination. The shallow water table and space and time constraints make bioremediation impractical.

8 PROPOSED SOIL REMEDIATION PLAN

Administrative Control of contamination in SS30 to SS35 (AEC 2A):

- Development and implementation of a CEMP;
- Training workers in the requirements of the CEMP, including awareness training of the presence of contamination;
- Monitoring to check the appropriateness and effectiveness of the controls.

The proposed remediation strategy for the contamination in TP528A and TP532 (AEC 2) will involve the following works:

- Contaminated soils will be excavated. At this stage it is anticipated about 200m³ of contaminated soil will be excavated (not including a bulking factor). The soil will be temporarily stockpiled on site, and sampled for waste classification purposes.
- A waste classification letter will be prepared and the soil will then be disposed to an appropriately licensed landfill. At this stage it is assumed the soil will classify as general solid waste.
- The excavation will be validated by collection of samples from the walls and floor of the excavation.
- Once the validation of the excavation is confirmed, the excavation will be backfilled using soils sourced from on-site. The soils used to backfill the excavation will be validated.

8.1 Adminstrative Control of AEC 2A

The contamination identified in AEC 2A is proposed to be managed using a CEMP. The measures in the CEMP should include:

- Ensuring that workers do not come into contact with the contamination soil. Management measures could include isolating the work area to foot traffic (i.e. vehicle access only), and wearing appropriate PPE;
- Workers who come in contact with contaminated soil should wash immediately;
- Tyre grids are placed across the road either side of the contaminated soil area to prevent vehicles tracking contaminated soil across the site, and off-site.

8.2 Soil Excavation

The contaminated soil will be excavated using contractors employed by UHVA. The excavation will be extended based on the results of soil analysis to date, visual and olfactory observations, and using a PID.

At this stage, it is anticipated that about 200m³ of soil will require excavation, this allows for two excavations of approximately 10m wide by 10m long by 1m deep each.

Should contamination extend further than this, an assessment of the practicality of extending the excavation will be undertaken. Further excavation to the east may be restricted by the existing rail corridor.

8.3 Excavated Soil Stockpiling and Waste Classification

Excavated soils are proposed to be temporarily stockpiled on site to assess their waste classification. The soils will be stockpiled on plastic to prevent contamination of the site surface, covered with plastic, and sediment and water run-off controls (i.e. silt fencing or hay bales) will be installed.

Samples would be collected from the stockpile at a rate of 1 sample per 100m³. The samples will be tested for TPH, BTEX, PAHs, metals (arsenic, cadmium, chromium, lead, nickel, mercury) and asbestos.

The results of the laboratory testing will be compared to NSW DECCW (2009) Waste Classification Guidelines in order for a waste classification letter to be prepared.

8.4 Validation of Soils

Validation soil sampling will be undertaken to confirm that the exposed soils following excavation of contaminated soils are not impacted. The validation sampling process is discussed in the sections below.

8.4.1 Soil Validation Assessment Criteria

The investigation levels for soil and ballast were established based on the following references:

- NSW DEC Guidelines for the NSW Auditor Scheme (Second Edition) (DEC, 2006);
- NSW EPA, Guidelines for Assessing Service Station Sites, (NSW EPA, 1994); and
- National Environmental Protection Council (NEPC) National Environmental Protection (Assessment of Site Contamination) Measure (NEPM) (NEPC, 1999).

The NSW DEC (2006) and NEPC (1999) present health based investigation levels for different land uses (e.g. industrial / commercial, residential, recreational etc.) as well as provisional phytotoxicity based investigation levels.

The future land use is proposed to be industrial (railway operations). Therefore the health-based investigation levels for *commercial or industrial land use* (Column 4 of Appendix II in DEC 2006) have been adopted as the investigation levels.

The NSW DEC (2006) Guidelines do not provide investigation levels for volatile petroleum hydrocarbon compounds. The NSW EPA (1994) Guidelines for Assessing Service Station Sites provide an indication of acceptable threshold levels for cleanup of total petroleum hydrocarbons (TPH) compounds at service station sites to be reused for sensitive land uses. For semi-volatile petroleum hydrocarbons (C16 – C35 and >C35) investigation levels are provided in the NSW DEC (2006) guidelines, however, these are based on the NEPC 1999 health-based investigation levels, which require the laboratory analysis to unequivocally differentiate between aromatic and aliphatic compounds. Therefore, the investigation levels provided in the NSW EPA (1994) guidelines have been adopted in this assessment.

The NSW DEC (2006) guidelines state that there are currently no national or NSW DEC endorsed guidelines relating to human health or environmental investigation of material containing asbestos on sites. Site Auditors must exercise their judgement when assessing if a site is suitable for a specific use in the light of evidence that asbestos may be a chemical of concern. Enhealth (2005) *Guidelines for Asbestos in the Non-Occupational Environment* provides some guidance on assessing and managing asbestos in soil although does not provide a threshold concentration or investigation level for asbestos. For this Project Area, Coffey propose to adopt conservative criteria for asbestos (both fibrous and cemented fragments) of 'no detectable asbestos present in surface soils'.

8.4.2 Waste Classification Criteria

In order to provide a waste classification for the material excavated, the results of the laboratory analysis will be compared to assessment criteria for General Solid Waste and Restricted Solid Waste in the NSW DECCW (2009) *Waste Classification Guidelines*. If the criteria for Restricted Solid Waste is exceeded, then waste is classified as Hazardous Waste.

8.4.3 Validation of Excavations

In order to validate the excavation, the following works will be undertaken:

- The excavation will be assessed using visual and olfactory (odour) evidence, and the results of screening with a PID, to confirm that potentially contaminated soil has been removed to the extent practical.
- Validation Soil Samples will be taken at a ratio of:
 - Excavation Base: 1 sample per 25m²; and
 - Excavation Walls: 1 sample per 10 lineal metres.
- Soil samples will be taken with the aid of excavators in order to prevent the need for field staff to enter excavations greater than 0.5m deep. Field staff may be able to enter shallow excavations less than 0.5m deep if there is a suitable point of entry/exit from the excavation.
- Samples will be taken from the centre of the excavator bucket in order to minimise the potential for cross-contamination.
- A clean pair of disposable gloves will be worn when collecting each sample.
- Samples will be screened with a PID in order to assess the potential presence of volatile contamination.
- Samples will be kept chilled while in the field and in transit to the laboratory.

The excavation validation samples collected will be dispatched to a NATA-accredited laboratory for analysis. The excavation validation samples would be analysed for TPH.

8.4.4 Validation of Stockpiles

In order to validate stockpiles of excavated material, the following works will be undertaken:

- Stockpile samples will be taken at a rate of 1 sample per 100m³ from each stockpile.
- Samples will be taken using available hand tools such as stainless steel shovel, trowel or hand auger. An excavator may also be used to collect stockpile samples;
- Samples will be collected at different depths within the stockpile in order to provide adequate representation of the stockpile contamination status.
- Where hand tools are used, these will be decontaminated between samples by rinsing with phosphate-free detergent and potable water.
- Where an excavator is used to collect stockpile samples, the samples will be taken from the centre of the excavator bucket in order to minimise the potential for cross-contamination.
- A clean pair of disposable gloves will be worn when collecting each sample.
- Samples will be screened with a PID in order to assess the potential presence of volatile contamination.
- Samples will be kept chilled while in the field and in transit to the laboratory.

The stockpile samples collected will be dispatched to a NATA-accredited laboratory for analysis. The stockpile samples would be analysed for TPH, BTEX, PAH, Metals and asbestos. If the stockpile material requires disposal to landfill, total characteristic leachability procedure (TCLP) testing of some samples may also be required.

8.4.5 Imported Fill

It is assumed that excavations will be backfilled using material sourced from within the Project Area. This material would be validated as suitable for use as backfill as per the guidelines outlined in Section 7.3.1.

Should imported material require importation, it would need to be:

- Virgin Excavated Natural Material (VENM) in accordance with the definition provided in the NSW DECCW (2009) Waste Classification Guidelines; or
- Excavated Natural Material (ENM) in accordance with the Protection of the Environment Operation (Waste) Regulation 2005 – General Exemption Under Part 6, Clause 51 and 51A, The excavated natural material exemption 2008.

8.4.6 Quality Control Samples

In order to assess field quality control procedures, the following quality control samples will be collected and analysed with the primary samples:

- Duplicate samples – 1 per 10 primary samples; and
- Triplicate samples – 1 per 20 primary samples.

In addition, where hand tools are used to collect samples, a rinsate blank sample will be collected at the end of the fieldwork to assess decontamination procedures. A water trip spike and blank will also be submitted to the laboratory with the soil samples.

8.4.7 Soil Data Assessment

The laboratory data will be reviewed by Coffey to assess data usability by applying the generally utilised data validation guidelines. Statistical interpretation of validation data may be used to assess whether the remediation goals have been met. Based on the assessment, areas that have been satisfactorily remediated will be identified and will be designated by Coffey as 'No Further Action Required.' Where laboratory results have indicated that the remediation criteria have not been met, Coffey will discuss with UHVA areas requiring further remediation. Further remediation may include the excavation of additional material, sampling of excavated material and validation sampling of the excavation.

8.5 Data Assessment and Reporting

Upon completion of the remedial works, a validation report will be produced summarising the results of the remediation and final validation at the site. The report will be written to comply with industry standards and relevant guidelines and will provide a statement as to the suitability of the site for the proposed future land use.

The report will be prepared in accordance with the NSW OEH (2011) *Guidelines on Consultants Reporting on Contaminated Sites*.

9 SITE MANAGEMENT PLAN DURING REMEDIATION

The soil remediation works have the potential to cause environmental or human health issues during excavation and stockpiling of contaminated soils. It is envisaged that a Construction Environmental Management Plan (CEMP) will be prepared as part of the construction of the relief roads. The following management procedures will be incorporated within the CEMP for areas that will undergo soil remediation.

Site management during remediation will need to address:

- Site Access to the remediation area;
- Stormwater and soil management;
- Noise control;
- Dust Control and Monitoring;
- Odour control;
- Occupational health and safety;
- Other issues required to be addressed.

Each of the issues to be addressed in the site management plan is briefly discussed below.

9.1 Site Access

Adequate fences or barriers will be placed around the remediation excavations and stockpiles to prevent access of unauthorised personnel to areas where contaminated material is exposed, and also to prevent the public from the hazards of excavations. The fencing will be lined with shade cloth (or similar) to prevent migration of dust from the remediation area. Adequate warning signs will also be placed around the area.

9.2 Stormwater and Soil Management

Adequate stormwater runoff, run-on and sediment control measures will be put in place for the remedial works. A Soil and Water Management Plan (SWMP) has been prepared as part of the CEMP for construction of the relief roads. Stormwater and soil management for remediation will be compatible with the SWMP.

The stockpiles would need to be managed in a way to prevent harm to the environment and general public from potentially contaminated soils within the stockpiles. The following recommendations provide guidance on managing stockpiled material:

- Access to the stockpiles of potentially contaminated material should be limited by keeping stockpiles within site fences;
- Stockpiles should be placed on level ground. If this is not possible stockpiles should not be placed on slopes greater than 5°;
- Material should be placed on either an impermeable pavement such as concrete or bitumen or on strong impermeable plastic sheeting to prevent the contamination of the underlying soils. Material should not be stockpiled more than 2m high;
- Once the soils have been stockpiled, the stockpiles should be covered by weighted polythene sheets or tarpaulins to prevent erosion of stockpiled materials. Heavy objects not containing sharp edges should be placed on the sheets to prevent them from being blown by wind;

- Adequate straw bales and/or silt fences should be placed around the perimeter of the stockpile area to filter runoff from the stockpiles and prevent overland storm water flow from affecting the base of the stockpile;
- A diversion trench should be excavated, or tightly packed sand bags placed, up-gradient of the stockpile to prevent storm water running into the stockpile.

9.3 Noise

To mitigate noise impacts which may arise as a result of remedial works, the civil contractor will undertake the works in accordance with project planning approval and/or environmental protection licenses applicable to the site.

Contractors will also need to comply with measures provided in a noise management plans which will likely be prepared as part of the CEMP for construction of the relief roads.

9.4 Dust Control and Monitoring

Dust control is required to prevent airborne dust being inhaled by human receptors. Airborne dust may be generated by wind action during remediation from loose earth left on the ground. This could cause migration of contaminated dust, as well as cause a nuisance for the surrounding area and must be controlled.

Therefore, the following dust control measures are proposed:

- Dust levels will be monitored visually during site work;
- Tarpaulins, shade cloth or similar will be used to line the inside of the remediation area site fence, which will assist by providing a wind break; and
- Soil will be kept adequately moist to reduce the generation of dust.

9.5 Odour

Odours may be generated during excavation of the hydrocarbon impacted material.

Coffey will monitor the air quality, using a PID and olfactory observations, in the vicinity of the contaminated soil excavations, and within worker's breathing zones. If PID readings exceed 10ppm then site personnel should wear half face respirators with organic vapour cartridges. If PID readings exceed 50ppm then work should temporarily cease and workers should move upwind of the excavation until the PID readings decrease. If PID readings above 50ppm persist then odour/vapour control measures should be implemented.

If PID readings outside of the excavation area exceed 10ppm or significant odours are observed then work should cease and odour/vapour control measures should be implemented.

Odour control measures could include spraying of a surfactant such as Biosolve or covering of the excavation or contaminated material.

The Contractors will properly maintain machinery to reduce engine emissions and exhaust.

9.6 Occupational Health and Safety

A Health, Safety, Security and Environmental (HSSE) Plan will be prepared by a suitably qualified and experienced environmental consultant prior to commencement of remediation work, in accordance with relevant NSW legislation.

The remediation HSSE Plan should include, but not be limited to, the following.

- Hazard Identification and Control;
- Dust and odour monitoring during excavation and stockpiling works;
- Chemical Hazard Control;
- Handling Procedures;
- Personal Protective Equipment;
- Work Zones;
- Decontamination procedures;
- Contingency Plans; and
- Incident Reporting.

The HSSE Plan should be periodically reviewed and updated prior to various project tasks being conducted.

The contractor, supporting sub-contractors and third party observers to the site will be required to work strictly to this plan. During site activities, only approved personnel should be allowed access to the remediation work area.

The HSSE Plan will identify hazards, assess the risks posed by the hazards and recommend measures to control the hazards.

9.6.1 Summary of Contamination and Exposure Pathways

Exposure of site users to contaminants could occur through:

- Dermal contact with contaminated soil;
- Ingestion of contaminated soil;
- Inhalation of hydrocarbon vapours;
- Inhalation of contaminated dust; and
- Inhalation of asbestos fibres.

9.6.2 Health and Safety Control Measures for Contamination Hazards

The following section presents some control measures that should be adopted to manage health and safety hazards posed by contamination during the remediation. These control measures include:

- Site Access;
- Personal Protective Equipment;
- Safe Work Practices.

It is important to note that this section only covers contamination issues associated with contaminated soil. It is also important to note that these procedures will need to be evaluated for effectiveness and where necessary revised and/or improved during site work.

Site Access

The excavation areas will be barricaded and only authorized personnel will be allowed entry to the excavation areas.

Personal Protective Equipment (PPE)

To minimise short and long term health risks associated with the potential exposure to contaminants, the minimum level of PPE required for persons undertaking the contaminated soil excavations include:

- Hard hats;
- High visibility clothing;
- Long sleeve shirts and trousers;
- Steel capped workers boots;
- Safety glasses;
- Chemical resistant rubber gloves for persons coming in contact with the soil; and
- Tyvek suits and face masks (when excavation and disposal of asbestos materials is being undertaken).

Safe Working Practices

Chemical resistant gloves should be changed daily or when damaged, and disposed appropriately.

The contractor should ensure that adequate signage is present around the contaminated soil excavation areas to warn unauthorised persons from entering the area.

Eating, drinking, chewing gum or tobacco, smoking or practices that involve hand to mouth transfer increases the probability of ingestion of contaminated soil or dust into the body. With respect to remediation activities, hands must be thoroughly washed after coming into contact with soil or groundwater on the site before eating, drinking or smoking.

Smoking will be prohibited in the contaminated soil excavation areas.

10 CONTINGENCY PLAN

A contingency plan is outlined in Table 5, listing potential events that may arise during the remediation and actions that will be undertaken if unexpected conditions occur.

TABLE 5 - CONTINGENCY PLAN

UNEXPECTED CONDITION	ACTION
Contaminated soil extends further than expected.	UHVA management team would be contacted to discuss options. Options could include excavating soils further.
Rainwater fills the excavation pits and visual and olfactory observations suggest that contamination could be present.	Sample water and assess options for disposal. Options could include disposal to sewer or removal by a licensed liquid contractor following sampling and analysis.
Identification of unexpected contaminated materials during excavations.	<p>Refer to UHVA's unexpected finds procedure.</p> <p>Stop work in that area, and investigate potential sources, and if remediation is required.</p> <p>Additional validation samples and analytes may be required to be collected and analysed for (depending on the nature of the material).</p>
Other	Other unexpected events which may affect the outcome of the remediation would be notified to the UHVA Project Manager. At that time potential actions to address the unexpected event will be assessed and presented.

11 LICENCES AND APPROVALS

The remediation is classed as Category 1 remediation under SEPP 55, due to the remediation area's proximity to SEPP 14 coastal wetlands. This category usually requires development consent. This RAP forms part of an EIS submitted to the Department of Planning and Infrastructure for approval. It is assumed that as part of the approval process, the Council will be notified of the proposed remediation. Therefore it is considered that a separate development consent for remediation from Council is not required.

Impacted soil requiring off-site disposal will be transported and disposed to licensed waste facility. Material leaving the site will be tracked and documented. Waste disposal dockets will be obtained and included in the validation report.

12 CONTACTS

The following contact numbers for project personnel are given for the duration of the project. In the event that project personnel change, the relevant parties will be notified.

TABLE 4 - PROJECT PERSONNEL CONTACT NUMBERS

PERSONNEL	CONTACT NUMBER
UHVA Project Manager TBA	Phone: TBA Mobile: TBA
Environmental Contamination Consultant TBA	Phone: TBA Mobile: TBA
Civil Contractor - Leightons TBA	Phone: TBA Mobile: TBA

13 COMMUNITY RELATIONS

Adjoining residents should be advised of the proposed works and Contractor contact details should be made available to them. It is recommended that truck routes for movement of contaminated soil be considered when assessing the impacts of remediation works on nearby residents.

Every effort should be made to ensure that the community is appropriately informed. Enquiries regarding environmental and contamination issues from members of the local community and neighbouring properties should be documented and referred to UHVA and Contractors.

14 REFERENCES

Division of National Mapping (2001) Newcastle 1:100,000 Topographic Map, Sheet 9232, Edition 1.

Douglas Partners Pty Ltd (2011) Preliminary Contamination Assessment, Proposed Hexham Redevelopment, Maitland Road and Woodlands Close, Hexham (August 2011).

Geological Survey of NSW (1966) 1:250,000 Newcastle Geological Series Sheet, No. 9130 First Edition.

Glen RA and Beckett J (1993) Hunter Coalfield Regional Geology, scale 1:100,000 (2nd ed)

National Environmental Protection Council (1999) National Environmental Protection (Assessment of Site Contamination) Measure 1999, Schedule B (1) – Guideline on the Investigation Levels for Soil and Groundwater.

NSW DEC (2006) Guidelines for the NSW Site Auditor Scheme (2nd ed).

NSW DECC (2008) Acid Sulfate Soil Risk Mapping for Part of the Lower Hunter River Catchment, Edition 3.

NSW DECCW (2009) Waste Classification Guidelines.

NSW EPA (1994) Guidelines for Assessing Service Station Sites. ISBN 0-7310-3712-X.

NSW EPA (1995) Sampling Design Guidelines. ISBN 0-7310-3756-1.

NSW Planning & Infrastructure (2011) Director General's Environmental Assessment Requirements, Reference SSI-4992, dated 14 December 2011.

NSW OEH (2011) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, OEH 2011/0650, ISBN 0 7310 3892 4, Office of Environment and Heritage, Sydney.

Upper Hunter Valley Alliance (2011) Acid Sulfate Soil Assessment and Management Plan, Proposed Hexham 104 Points Crossover Reinstatement, Reference GEOTWARA21045AC-AC dated 21 February 2011.

Upper Hunter Valley Alliance (2011) Proposed Hexham Relief Roads, Hexham, Preliminary Desktop Study Geotechnical Assessment, Reference GEOTWARA21045AC-AA.Hexham Relief Roads, dated 15 April 2011;

Upper Hunter Valley Alliance (2011) Hexham Relief Roads, Environmental Impact Statement, Preparation Note, Reference 2009063t Hexham Relief Roads Memo Rev0, dated 19 December 2011.

Important information about Coffey Environmental Report

Uncertainties as to what lies below the ground on potentially contaminated sites can lead to remediation costs blow outs, reduction in the value of the land and to delays in the redevelopment of land. These uncertainties are an inherent part of dealing with land contamination. The following notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report has been written for a specific purpose

Your report has been developed on the basis of a specific purpose as understood by Coffey and applies only to the site or area investigated. For example, the purpose of your report may be:

- To assess the environmental effects of an on-going operation.
- To provide due diligence on behalf of a property vendor.
- To provide due diligence on behalf of a property purchaser.
- To provide information related to redevelopment of the site due to a proposed change in use, for example, industrial use to a residential use.
- To assess the existing baseline environmental, and sometimes geological and hydrological conditions or constraints of a site prior to an activity which may alter the sites environmental, geological or hydrological condition.

For each purpose, a specific approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible, quantify risks that both recognised and unrecognised contamination pose to the proposed activity. Such risks may be both financial (for example, clean up costs or limitations to the site use) and physical (for example, potential health risks to users of the site or the general public).

Scope of Investigations

The work was conducted, and the report has been prepared, in response to specific instructions from the client to whom this report is addressed, within practical time and budgetary constraints, and in reliance on certain data and information made available to Coffey. The analyses, evaluations, opinions and conclusions presented in this report are based on those instructions, requirements, data or information, and they could change if such instructions etc. are in fact inaccurate or incomplete.

Subsurface conditions can change Interpretation of factual data

Subsurface conditions are created by natural processes and the activity of man and may change with time. For example, groundwater levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project and/or on the property.

Interpretation of factual data

Environmental site assessments identify actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from indirect field measurements and sometimes other reports on the site are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how well qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of Coffey through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered with redevelopment or on-going use of the site. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. In particular, a due diligence report for a property vendor may not be suitable for satisfying the needs of a purchaser. Your report should not be applied for any purpose other than that originally specified at the time the report was issued.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other professionals who are affected by the report. Have Coffey explain the report implications to professionals affected by them and then review plans and specifications produced to see how they have incorporated the report findings.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs

(assembled by field personnel), field testing and laboratory evaluation of field samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

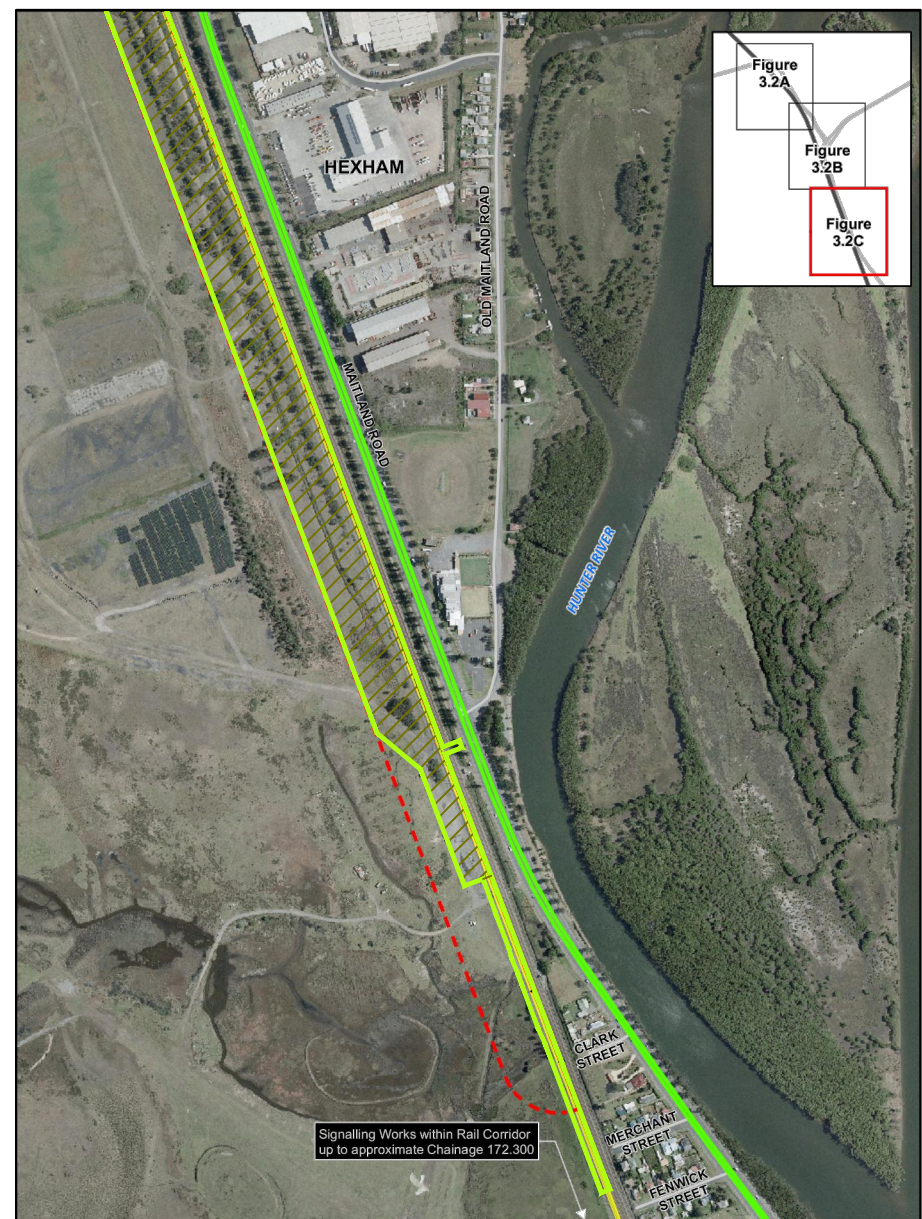
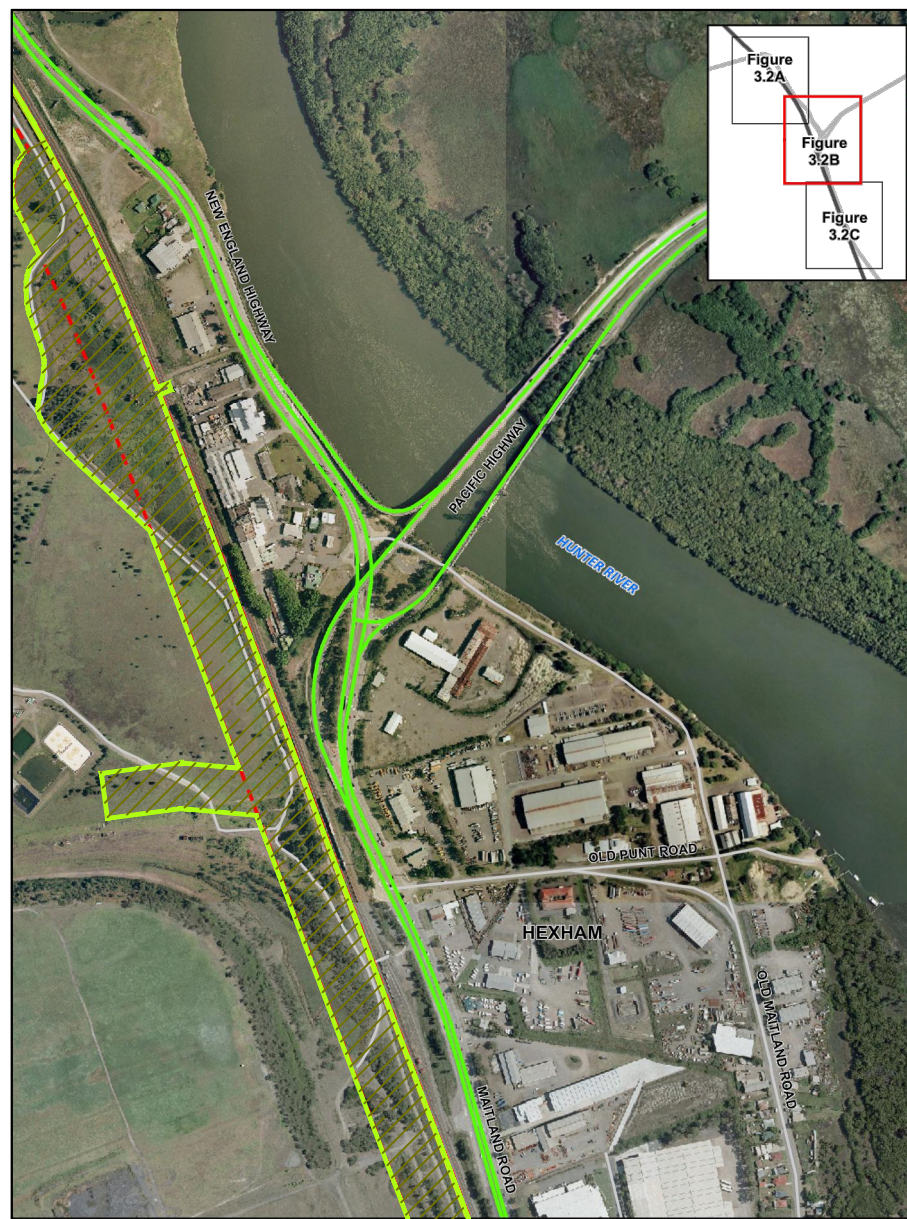
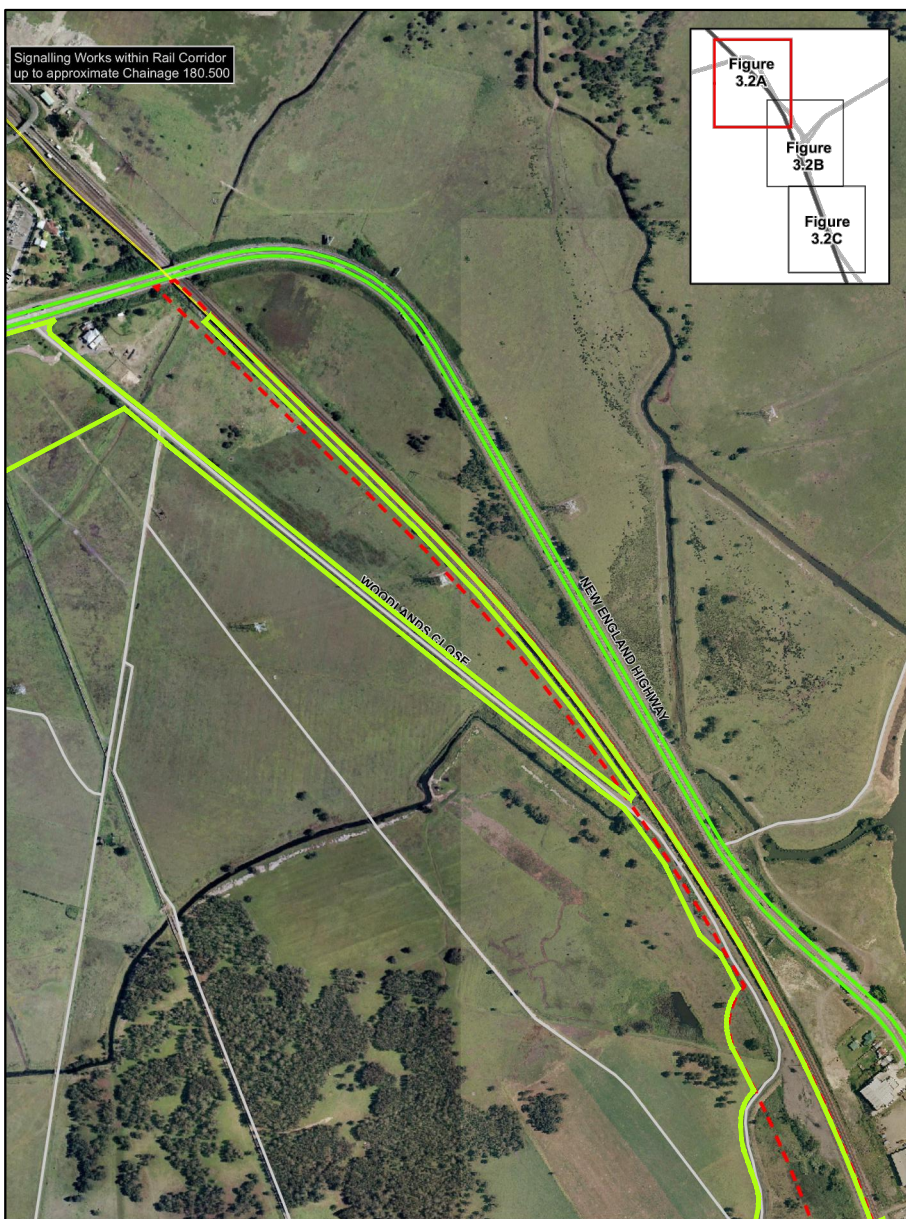
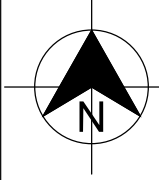
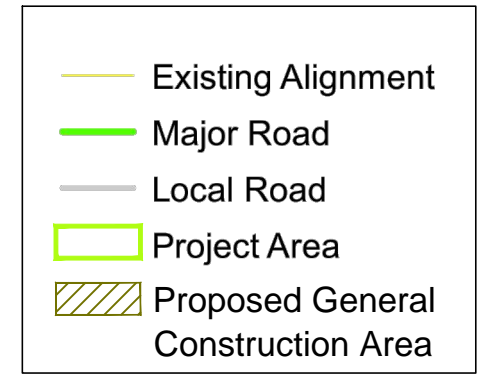
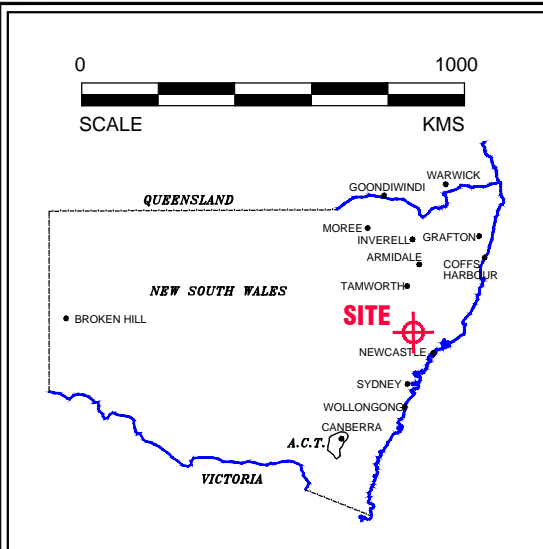
Contact Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to land development and land use. It is common that not all approaches will be necessarily dealt with in your environmental site assessment report due to concepts proposed at that time. As a project progresses through planning and design toward construction and/or maintenance, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

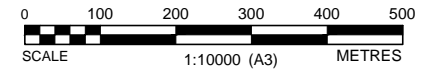
Responsibility

Environmental reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

Figures



ARTC
Hexham Relief Roads
Proposed Relief Roads



Aerial image source: Google Earth Pro 2012
Aerial image ©: Sinclair Knight Merz 2012
Image source: UHVA ARTC, Proposed Relief Roads 01/06/2011

drawn	CGT
approved	
date	05.07.2012
scale	AS SHOWN
original size	

client:	UPPER HUNTER VALLEY ALLIANCE	
project:	REMEDIAION ACTION PLAN HEXHAM RELIEF PROJECT	
title:	SITE LOCALITY PLAN	
job no:	GEOTWARA21045AC-D04	figure no: FIGURE 1



Aerial image source: Google Earth Pro 2012
Aerial image ©: Sinclair Knight Merz 2012

LEGEND

- APPROXIMATE PROJECT AREA
- SS APPROXIMATE SURFACE SAMPLE LOCATION
- + TP APPROXIMATE TEST PIT SAMPLE LOCATION
- + CMW APPROXIMATE GROUNDWATER MONITORING WELL LOCATION (COFFEY ENVIRONMENTS)
- x CSW APPROXIMATE SURFACE WATER SAMPLE LOCATION (COFFEY ENVIRONMENTS)
- + APPROXIMATE BOREHOLE LOCATION (DOUGLAS PARTNERS)
- PROPOSED GENERAL CONSTRUCTION AREA

SOIL

Soil Sample	Sample Depth (mBGS)
Analyte	mg/kg

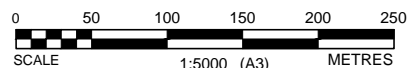
SHADED VALUES INDICATE CONCENTRATIONS ABOVE ADOPTED CRITERIA

mg/kg MILLIGRAMS PER KILOGRAM

Image source: Nearmap.com, Hypertiles, 25/06/2011



ARTC
Hexham Relief Roads
Proposed Relief Roads



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Image source: UHVA ARTC, Proposed Relief Roads 01/06/2011

drawn	CGT
approved	
date	05.07.2012
scale	AS SHOWN
original size	

client:	UPPER HUNTER VALLEY ALLIANCE
project:	REMEDATION ACTION PLAN HEXHAM RELIEF PROJECT
title:	CONTAMINATION LOCATIONS
job no:	GEOTWARA21045AC-D04
figure no:	FIGURE 2A



Aerial image source: Google Earth Pro 2012
Aerial image ©: Sinclair Knight Merz 2012

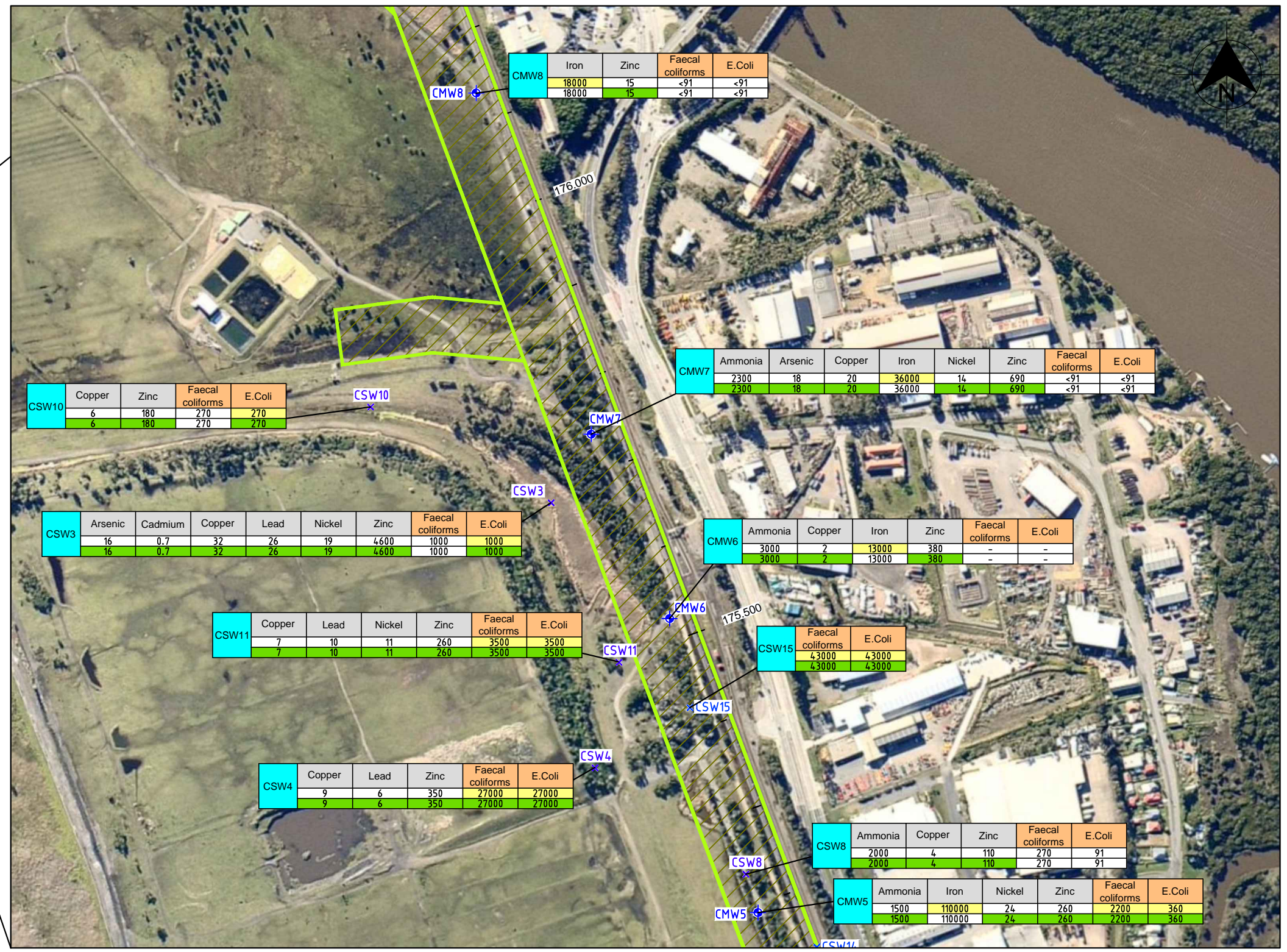


Image source: Nearmap.com, Hypertiles, 25/06/2011

LEGEND

- APPROXIMATE PROJECT AREA
- CMW APPROXIMATE GROUNDWATER MONITORING WELL LOCATION (COFFEY ENVIRONMENTS)
- CSW APPROXIMATE SURFACE WATER SAMPLE LOCATION (COFFEY ENVIRONMENTS)
- APPROXIMATE BOREHOLE LOCATION (DOUGLAS PARTNERS)
- PROPOSED GENERAL CONSTRUCTION AREA

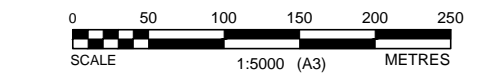
GROUNDWATER/SURFACE WATER

Sample	Analyte	Faecal coliforms	E.Coli
	µg/L	cfu/100ml	cfu/100ml

µg/L MICROGRAMS PER LITRE

- Value CONTAMINANT EXCEEDS ADOPTED CRITERIA FOR PROTECTION OF HUMAN HEALTH RISK
- Value CONTAMINANT EXCEEDS ADOPTED CRITERIA FOR PROTECTION OF ECOSYSTEMS
- Value CONTAMINANT DOES NOT EXCEED ADOPTED CRITERIA

ARTC
Hexham Relief Roads
Proposed Relief Roads



Aerial image source: Google Earth Pro 2012
Aerial image ©: Sinclair Knight Merz 2012
Image source: UHVA ARTC, Proposed Relief Roads 01/06/2011

drawn	CGT
approved	
date	05.07.2012
scale	AS SHOWN
original size	

client:	UPPER HUNTER VALLEY ALLIANCE
project:	REMEDATION ACTION PLAN HEXHAM RELIEF PROJECT
title:	CONTAMINATION LOCATIONS
job no:	GEOTWARA21045AC-D04
figure no:	FIGURE 2B



Aerial image source: Google Earth Pro 2012
Aerial image ©: Sinclair Knight Merz 2012

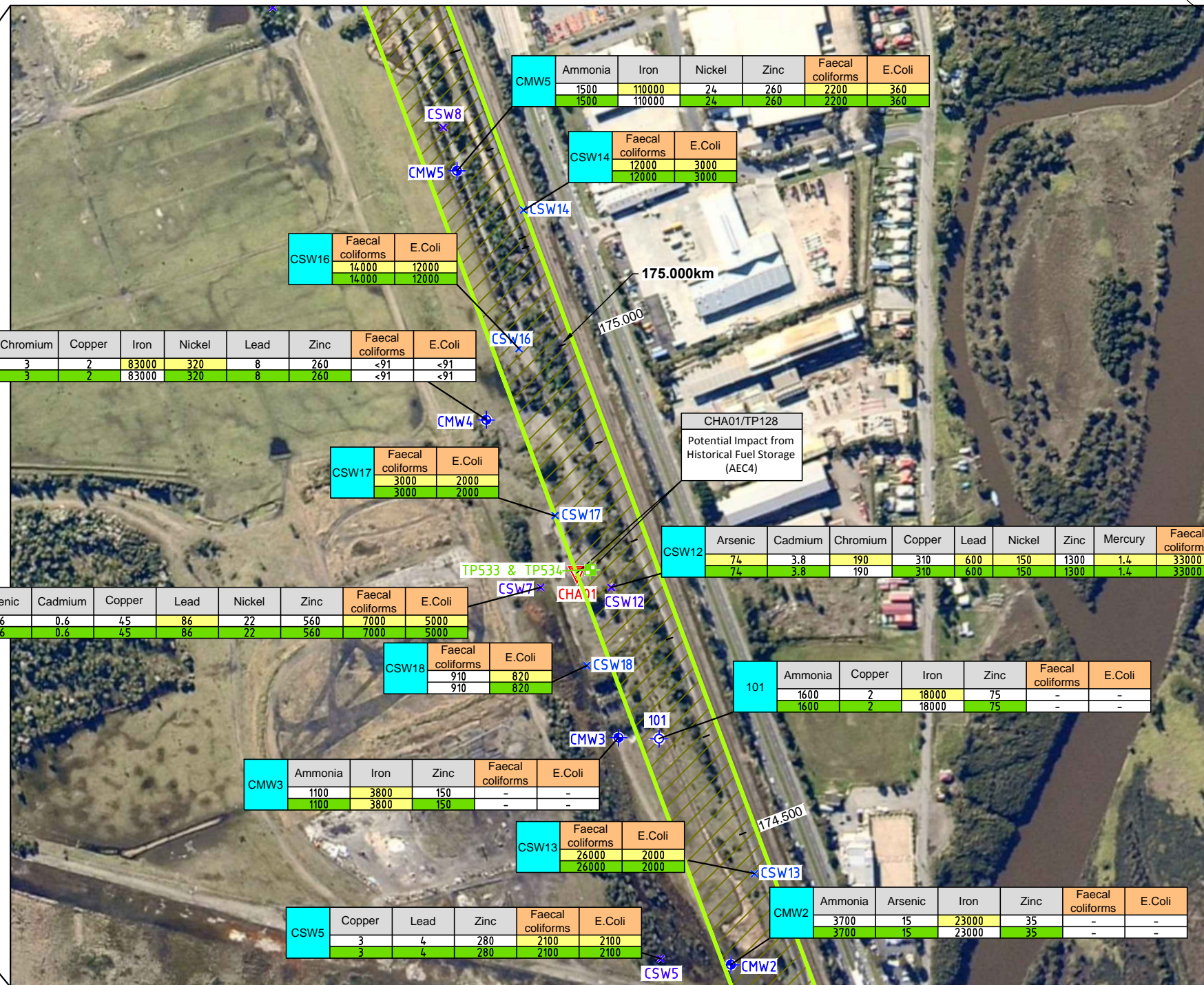


Image source: Nearmap.com, Hypertiles, 25/06/2011

LEGEND

- APPROXIMATE PROJECT AREA
- TP/CH ▼ APPROXIMATE HAND AUGER SAMPLE LOCATION (COFFEY ENVIRONMENTS)
- TP + APPROXIMATE TEST PIT SAMPLE LOCATION
- CMW + APPROXIMATE GROUNDWATER MONITORING WELL LOCATION (COFFEY ENVIRONMENTS)
- CSW x APPROXIMATE SURFACE WATER SAMPLE LOCATION (COFFEY ENVIRONMENTS)
- + APPROXIMATE BOREHOLE LOCATION (DOUGLAS PARTNERS)
- PROPOSED GENERAL CONSTRUCTION AREA

GROUNDWATER/SURFACE WATER

Sample	Analyte	Faecal coliforms	E.Coli
	µg/L	cfu/100ml	cfu/100ml

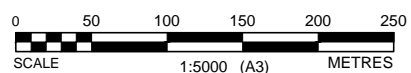
µg/L MICROGRAMS PER LITRE

- Value CONTAMINANT EXCEEDS ADOPTED CRITERIA FOR PROTECTION OF HUMAN HEALTH RISK
- Value CONTAMINANT EXCEEDS ADOPTED CRITERIA FOR PROTECTION OF ECOSYSTEMS
- Value CONTAMINANT DOES NOT EXCEED ADOPTED CRITERIA



ARTC
Hexham Relief Roads

Proposed Relief Roads



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Aerial image ©: Sinclair Knight Merz 2012
Image source: UHVA ARTC, Proposed Relief Roads 01/06/2011

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job no:	GEOTWARA21045AC-D04
figure no:	FIGURE 2C