Fluvial Geomorphology Assessment - Hexham Relief Roads

April 2012

UHVA

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26 April 2012

Mr Jonathan Dowling
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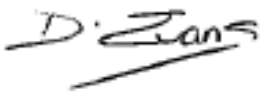
Dear Mr Dowling

Fluvial Geomorphology Assessment - Hexham Relief Roads

Please find attached the final draft fluvial geomorphology technical note for the Hexham Relief Roads Environment Impact Statement, addressing comments supplied from you on 21/02/2012, 01/03/2012, 13/03/2012, 20/03/2012, 10/04/2012 and 23/04/2012.

Yours sincerely



Dr Dan Evans
Senior Environmental Scientist
Parsons Brinckerhoff Australia Pty Limited

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CEMP	Construction Environmental Management Plan
DGRs	Director General Requirements

Executive summary

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 (Figure 1.1).
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.
- 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 proposed Project is approximately $90million and it is expected to take approximately 18 months to construct.

Baseline fluvial geomorphology conditions in the Study Area were reviewed. The combination of low, flat land leads to canalised drainage systems with low geomorphic diversity. Soil types present are stable until disturbed under these environmental conditions. In-depth analysis showed that these channels were a sediment store and that bank stability risk was highest in the Southern portion of the Study Area and at infrastructure crossings.

Potential impacts during construction included soil / bank / instream erosion with resulting increases in sediment load, change in sediment type and siltation in over-widened channels. During operation minor increases in sediment load, compared to baseline conditions, were predicted with some localised bank erosion. Mitigation measures were suggested to address these potential impacts based on guidelines from Office of Water, Hunter-Central Rivers Catchment Management Authority and good site practice. This reduced residual impacts to a short term increase in sediment load during construction. Cumulative impacts from the Hunter Water trunk main and Hexham Train Support Facility are not envisaged to be significant, providing mitigation measures suggested for these schemes are applied, an integrated drainage strategy for the Hexham Train Support Facility and this proposed Project is conceived and application of the Construction Environmental Management Plan (CEMP) and bank erosion monitoring is run in parallel with all stages of the construction phase works.

1. Introduction

This technical note considers fluvial geomorphology, as part of the wider assessment for the EIS relating to the Hexham Relief Roads development. The fluvial geomorphology assessment will review the legislative context to this work and summarise the information sources to be used in this assessment (Section 1). The baseline condition will then be summarised, firstly in terms of large-scale catchment characteristics and then, with particular emphasis on the potential receptors of as a result of the development, in more detail at the Study Area scale (Section 2). The potential impacts of the development, recommended mitigation measures and residual impacts will be identified in Sections 3, 4 and 5, respectively. Each of these sections will be separated into construction and operational phases of the proposed Project. Potential cumulative impacts will also be identified at the residual impacts stage. For any residual impacts noted, Section 6 will recommend what additional monitoring is recommended in order to manage these risks.

1.1 Project summary

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 (Figure 1.1).

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.
- 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 proposed Project is approximately $90million and it is expected to take approximately 18 months to construct.

1.2 Assessment methodology

The following objectives have been adopted for this investigation:

- Assessment of existing catchment characteristics.
- Definition of potential receptors and detailed fluvial geomorphological description of these channels.
- Identification of potential impact of the proposed Project on fluvial geomorphology.
- Development of mitigation measures to minimise any adverse impacts on the surrounding environments. Mitigation measures will be developed for both the construction and operational phase of the proposed Project.
- Assessment of residual impacts, after application of the mitigation measures, including cumulative impacts.
- Development of any additional monitoring required during construction and operation phases in order to measure the extent of these impacts.

In order to achieve these goals, the legislative context for the proposed Project will be reviewed, with particular focus on the Director General Requirements (DGRs) and subsequent Agency letters. The information sources to be utilised in this assessment will also be identified.

1.3 Legislative context

Specific guidance incorporated into this report includes:

- Managing Urban Stormwater: Soils and Construction (Landcom) guidelines.
- Australian Runoff Quality: Australian Rainfall and Runoff (Institution of Engineers Australia, 1998).
- Water Management Act 2000: Considered best practice including development constraints and riparian setback for controlled activities occurring within 40m of a watercourse.
- Hunter-Central Rivers Catchment Action Plan.

1.3.1 Addressing DGRs and Agency Letters

The Director General Requirements and Agency Responses relevant to fluvial geomorphology are listed in Table 1-1 along with the location in the report where it is addressed.

Table 1-1 Director General's Environmental Impact Statement Requirements' or Comments in Agency letters

Requirement / comment	Section addressed in
Surface and stormwater management, including consideration of water quality (sedimentation), watercourses (including ephemeral), riparian and receiving areas (including Hexham Swamp Nature Reserve) (DGRs)	Section 4
Whether the proposal will cause avoidable erosion, siltation or a reduction in the stability of river banks or watercourses (Flooding & Coastal Erosion, Pg18, Attachment A, Office of Environment & Heritage)	Sections 2, 3, 4 and 5
State any locally specific objectives, criteria or targets which have been endorsed by the NSW Government (Water, Pg18, Attachment A, Office of Environment & Heritage)	Section 1.3
Stream bank stability (Impact Assessment, Pg19, Attachment A, Office of Environment & Heritage)	Sections 2.3.4, 3, 4, 5 and 6
NSW State Rivers and Estuaries Policy, NSW Coastal Policy and NSW Wetlands Policy (State Government Technical & Policy Documents, pg3, Attachment A, Office of Water)	Section 1.3
Controlled activities Guidelines (State Government Technical & Policy Documents, pg3, Attachment A, Office of Water)	Section 4
Details of stream order (using the Strahler System) (State Government Technical & Policy Documents, pg5, Attachment A, Office of Water)	Section 2.3.1
A detailed description of all potential environmental impacts of any proposed development in terms of sediment movement (State Government Technical & Policy Documents, pg5, Attachment A, Office of Water)	Section 3 and 5

1.4 Information sources

Numerous reports relating to aspects of fluvial geomorphology have previously been produced for Hexham Swamp and the surrounding environment. These are utilised in the report baseline section and are referenced in Section 7.

A drainage strategy for the proposed Project (UVHA, 2012) was incorporated into the potential impacts and mitigation measures sections of this report.

1.4.1 Data

The following information was used as part of this investigation:

- Bank height and angle measurements.
- Stream velocity point measurements.
- GPS handheld readings for grid references and spot heights.
- Site inspection observations and photographs.

This information was gathered during a site visit on 02/09/2011.

2. Baseline conditions

The proposed Project Area is defined as the area containing the existing Down Coal, south and west of the Newcastle Highway and west of the Hexham industrial area. The Project Area boundaries are showed in Figure 2-1.

Hexham is directly to the east of the Project Area and the town of Tarro is to the north. Newcastle lies approximately 12km to the South East of the Project Area. The Project Area lies within the Hunter River Catchment and potential receptors within this catchment are defined in Section 2.2.

Figure 2-1 Hexham Relief Roads proposed Project general location

2.1 Study Area characteristics

This section considers the physical characteristics that control fluvial geomorphology in the wider Study Area and then defines the potential receptors within this area that could potentially be affected by this proposed Project. This provides a geographical focus for more detailed investigation of channel geomorphology in the Study Area using River Classification tools (Section 2.3.1), a rapid fluvial geomorphology walkover assessment (Section 2.3.2), sediment sources and transport mechanisms (Section 2.3.3) and a bank stability assessment (Section 2.3.4).

2.1.1 Landscape evolution and topography

The lower Hunter River is a barrier estuary formed by the deposition of sediments in swamps and flats lying between the inner and outer coastal barrier sands. These barriers demonstrate the evolution of the coastline during changes in sea level during the Pleistocene and Recent geological periods as a result of world-wide glacial cycles, with the latest most significant event occurring some 6000 years ago when the sea level rose over 100 metres to its present level (NPWS, 1998).

The Project Area is located on a back plain on the true right bank of the Hunter River (south arm) and lies within the extensive river floodplain (maximum width approximately 8km). Consequently, the topography is both flat and low lying (Figure 2-2). Low elevation hills of <RL20m frame the Project Area to the north and west, but at a minimum distance of 2km from the Project Area boundary. In between this are the Hexham wetlands. The Project Area itself is dominated by a large coal stockpile, located 2km south of the Woodlands Close turn off from the New England Highway. This measures approximately 850m long (north-south) and 500m wide (east-west) and ranges up to RL13.6m (up to 12m above surrounding levels) (Worley Parsons, 2011[b]).

2.1.2 Geology and soils

Beneath the undifferentiated Quaternary alluvial sediments, at depths of between 10 and 40 metres, lie older bedrocks composed of fine to medium grained massive sandstone and siltstone interspersed with shales and coal (Figure 2-3). Although the bedrock slopes upwards to the north there are no outcrops within the Project Area. To the north of the Project Area, however, the Tomago coal measures are at surface level.

Soil unit Gb10 peaty and organic dermosol soils over acid clays predominate in the Hunter floodplain around the Project Area (Figure 2-4). The areas surrounding Hexham Swamp comprise residual clay soils and weathered rock associated with the Tomago Coal Measures (NPWS, 1998). These are hard acidic yellow mottled Tb40 and Tb42 soil units.

2.1.3 Hydrology and flooding

The Study Area is framed to the east by the Hunter River and is separated hydrologically into two major parts by the abandoned Minmi to Hexham railway embankment. The area to the north-west is drained by Purgatory Creek, a tributary of the Hunter River. The area to the south-east of the embankment is drained by a number of small intertidal streams.

The proximity of the Hunter Estuary (60 – 900m) makes the Study Area vulnerable to both fluvial and tidal surge flooding, particularly at the northern end (PWD, 2004). Water levels in the Hunter River at high tide are only between 0.0-0.7m lower than the ground (UHVA, 2011).

2.1.4 Land use

The two main land uses in the Study Area have been conservation and grazing. The focus for conservation is the Hexham Swamp Nature Reserve and a SEPP 14 wetland. Grazing has focussed on a small number of commercial beef cattle operations, particularly when other areas within the region experience drought conditions. Other minor land uses include small hobby farms (horses) and residential (backyard) use.

2.1.5 Implications of catchment characteristics for fluvial geomorphology conditions and climate change impacts

The combination of low and flat lying land located next to the Hunter River mean that the Study Area acts as a hydrological store and sediment sink. The resulting low gradient creeks with low energy and dampened hydrological response to rainfall events mean that the drainage channels have homogenous flow type and character with resulting lower habitat diversity (UHVA, 2012[a]). The tidal incursion into drainage channels in the south portion of the Study Area lead to a plug of fine sediment moving back and forth in the channel and inherent lower flushing rates result, especially with the bed material composed of fine silts and clays. The peat and acid clays in the Study Area are stable but highly erodible if the soil matrix is disturbed. The livestock present in the catchment have access to the creeks for watering and will damage the bank structure, liberating sediment into the channels. The highway and rail transport infrastructure in the Study Area provide rapid and concentrated drainage lines into the creeks, leading to increased supply of sediments generated by vehicles and more erosion due to higher flow velocities. The dirt tracks that criss-cross the area liberate further sediment and provide a conduit for sediment movement into the creeks.

Climate change is predicted to exacerbate sediment impacts on river systems (HCRCMA, 2007). For NSW, climate change model projections indicate the following percentage changes in annual rainfall:

- Wetter summers: -8% to +22% in 2030; -24% to 40% in 2070.
- Similar autumns: -8% to +7% in 2030; -24% to +24% in 2070.
- Drier winters: -8% to +2% in 2030; -24% to +8% in 2070.
- Much drier springs: -13% to +2% in 2030; -40% to +8% in 2070.

This increase in extreme events will exacerbate sediment delivery to the river channels during high rainfall events (due to increased rainfall erosivitiy and runoff) and channel degradation (due to increased flow entrainment capacity and bank erosion). However, due to lower flushing in sustained dry periods, this additional sediment will also remain within the channel rather than being exported downstream, causing siltation and degraded habitat.

Figure 2-2 Study Area topography

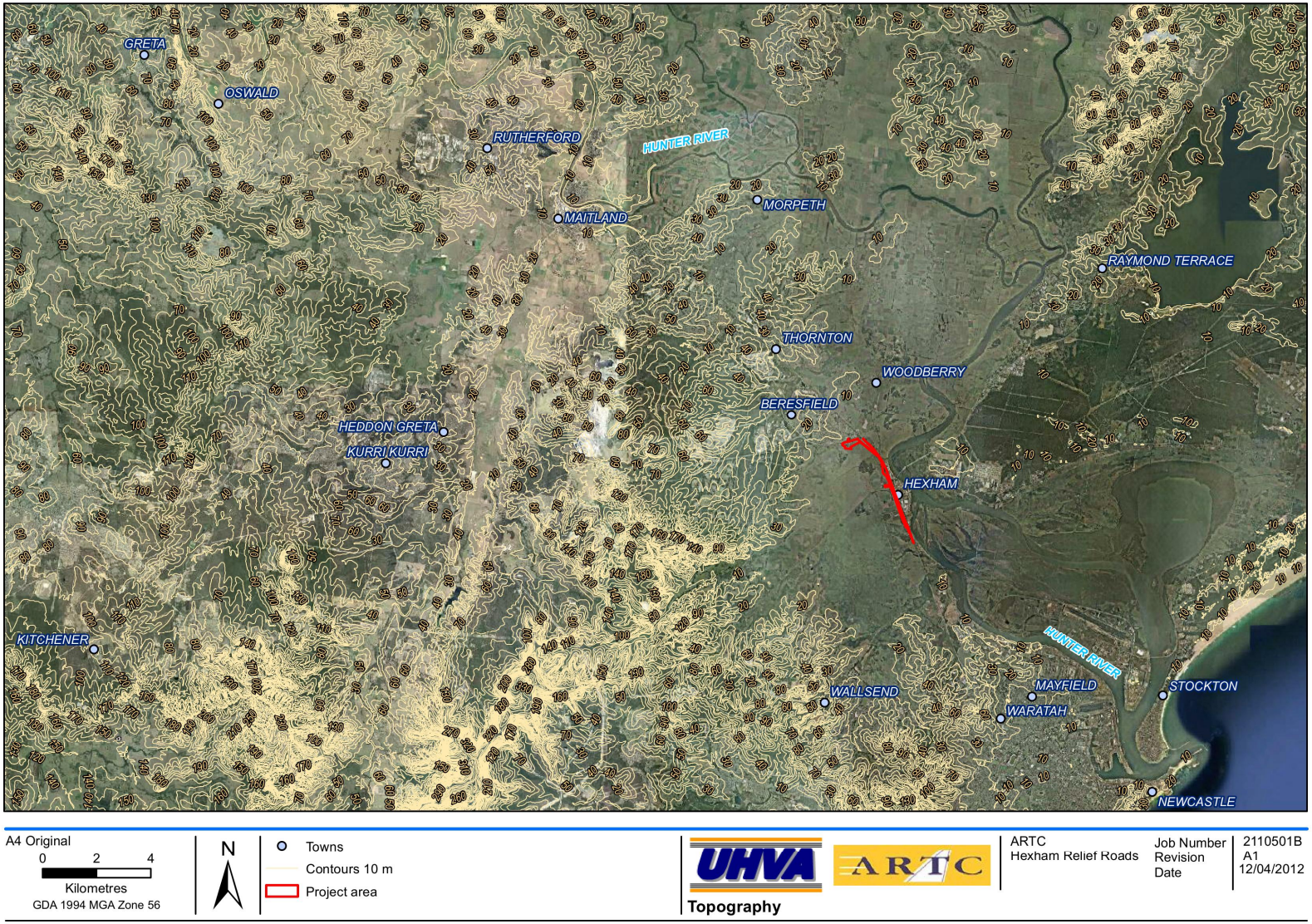


Figure 2-3 Study area geology

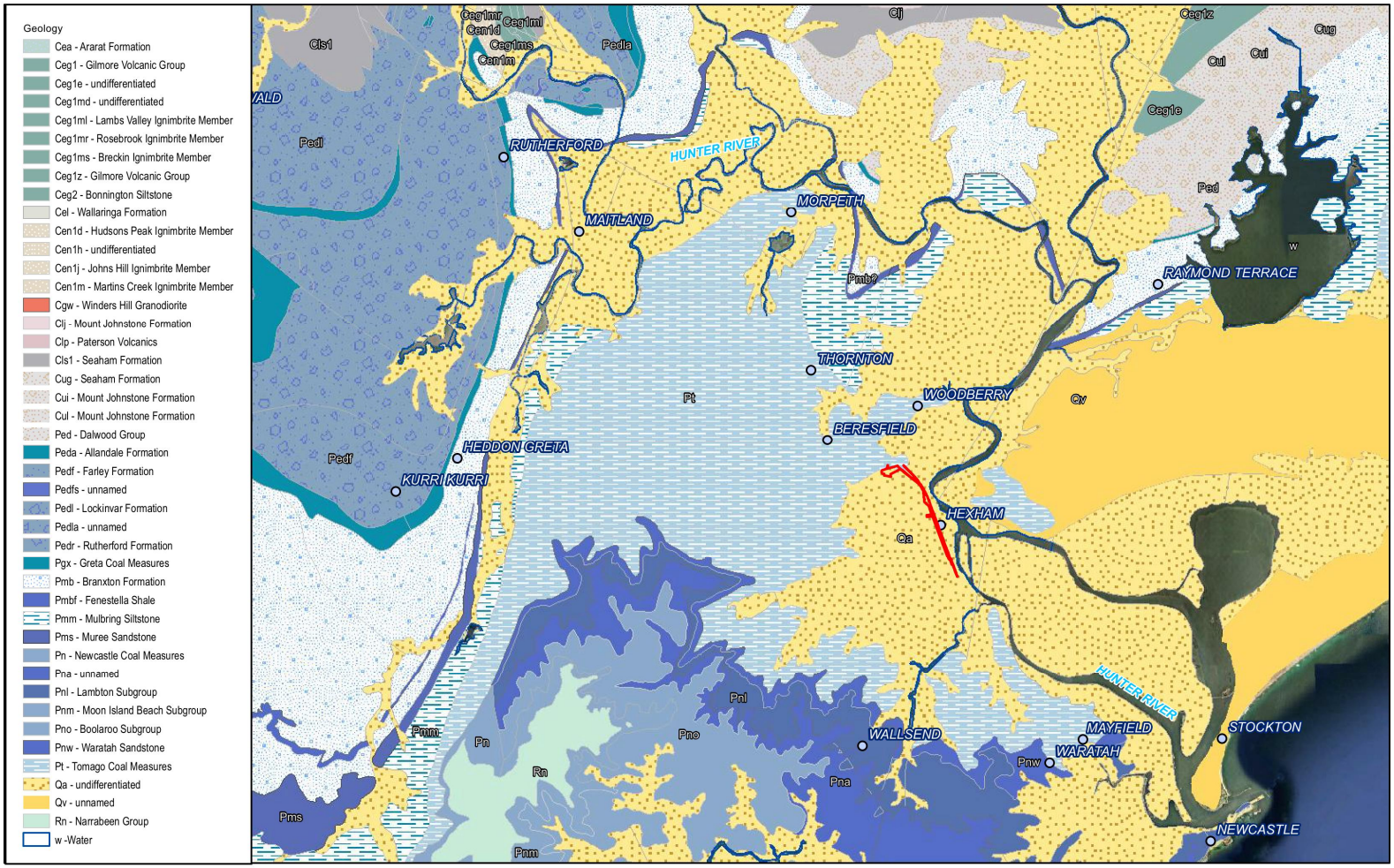
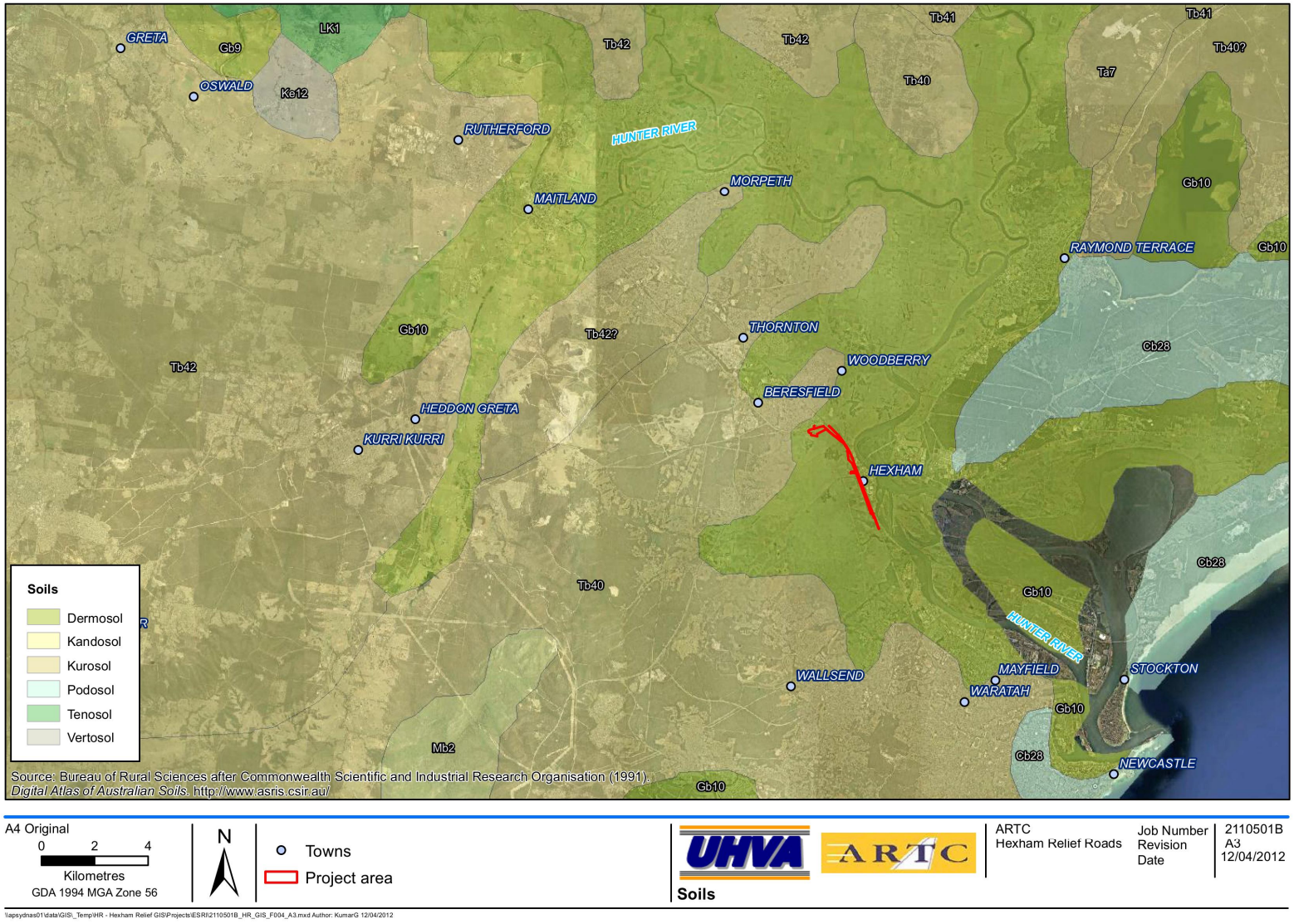


Figure 2-4 Study Area soils



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