Adani Mining

DRAFT Subsidence Management Plan

November 2013

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1. Introduction

1.1 Project overview

Adani Mining Pty Ltd (Adani, the Proponent), commenced an Environmental Impact Statement (EIS) process for the Carmichael Coal Mine and Rail Project (the Project) in 2010. On 26 November 2010, the Queensland Office of the Coordinator General declared the Project a 'significant project' and the Project was referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (referral No. 2010/5736). The Project was determined to be a controlled action on 6 January 2011 under section 75 and section 87 of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The controlling provisions for the Project are:

- World Heritage properties (sections 12 & 15A)
- National Heritage places (sections 15B & 15C)
- Wetlands (Ramsar) (sections 16 & 17B)
- Listed threatened species and communities (sections 18 & 18A)
- Listed migratory species (sections 20 & 20A)
- The Great Barrier Reef Marine Park (GBRMP) (sections 24B & 24C).
- Protection of water resources (sections 24D & 24E)

The Queensland Government's EIS process has been accredited for assessment under Part 8 of the EPBC Act in accordance with the bilateral agreement between the Commonwealth of Australia and the State of Queensland. The Proponent prepared an EIS in accordance with the Terms of Reference (ToR) issued by the Coordinator-General in May 2011 (Queensland Government, 2011). The EIS process is managed under section 26(1) (a) of the State Development and Public Works Act 1971 (SDPWO Act), which is administered by the Department of State Development, Infrastructure and Planning (DSDIP).

The EIS, submitted in December 2012, assessed the environmental, social and economic impacts associated with developing a 60 million tonne (product) per annum (Mtpa) thermal coal Mine in the northern Galilee Basin, approximately 160 kilometres (km) north-west of Clermont, Central Queensland, Australia (Figure 1).Coal from the Project will be transported by rail to existing Goonyella and Newlands rail systems, operated by Aurizon Operations Limited (Aurizon). The coal will be exported via the Port of Hay Point and the Port of Abbot Point over the 60 year (90 years in the EIS) Mine life. The Carmichael Rail will be operational for a period of 90 years, catering for third party operations as identified in the Carmichael Coal Mine and Rail EIS.

Project components are as follows:

- The Project (Mine): a greenfield coal Mine over EPC 1690 and the eastern portion of EPC 1080, which includes both open cut and underground mining, on Mine infrastructure and associated Mine processing facilities (the Mine), and the Mine (offsite) infrastructure including a workers accommodation village and associated facilities, a permanent airport site, an industrial area and water supply infrastructure

- The Project (Rail): a greenfield rail line connecting the Mine to the existing Goonyella and Newlands rail systems to provide for the export of coal via the Port of Hay Point (Dudgeon Point expansion) and the Port of Abbot Point, respectively including:
  - Rail (west): a 120 km dual gauge portion running from the Mine site (in the west) east to Diamond Creek
  - Rail (east): a 69 km narrow gauge portion running east from Diamond Creek connecting to the Goonyella rail system south of Moranbah
  - Quarries: five local quarries to extract quarry materials for construction and operational purposes.

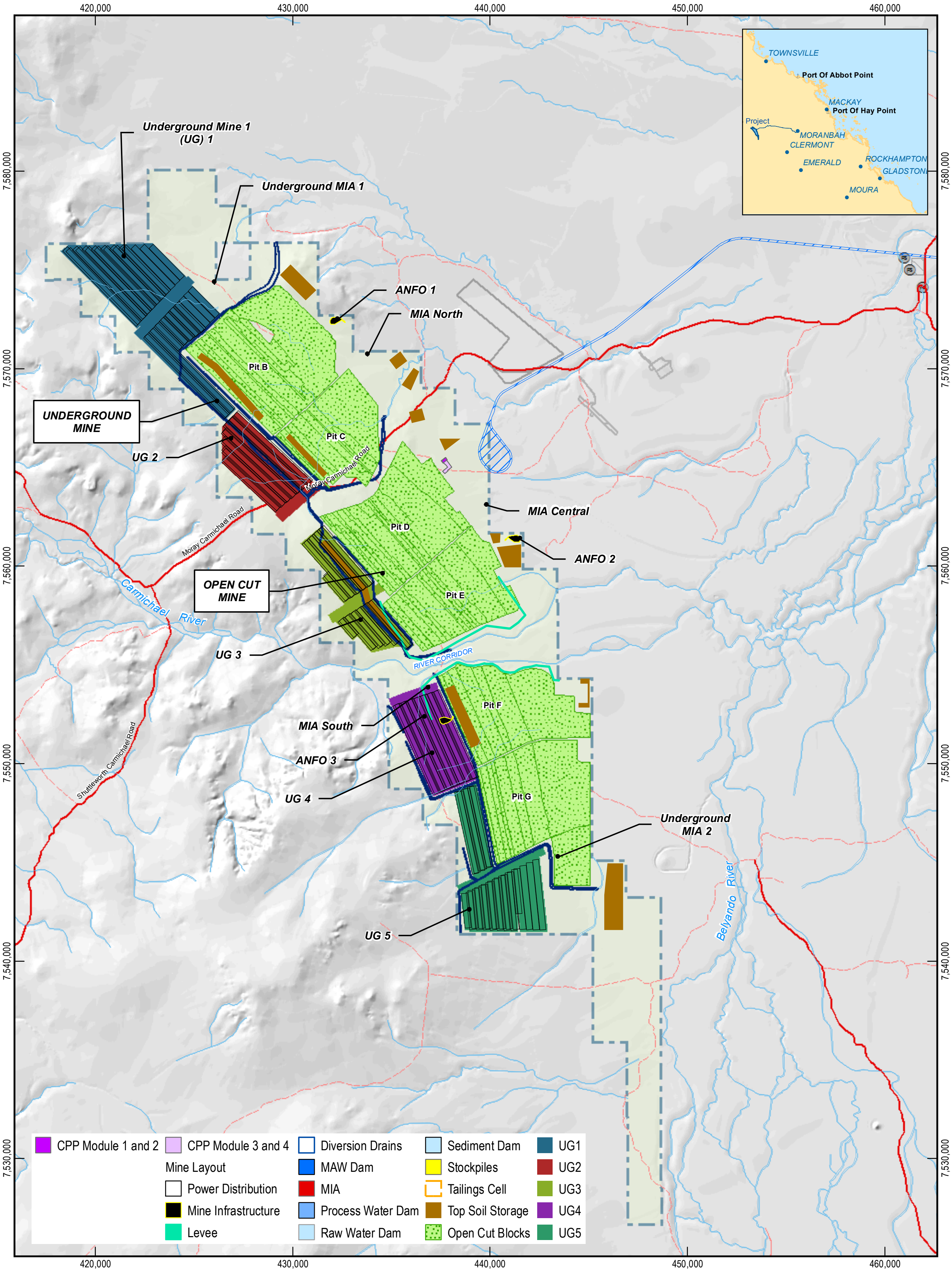
Figure 1 shows the mine plan layout.

1.2 Purpose of this report

The Subsidence Management Plan (SMP) has been developed as part of the Supplementary EIS to provide control, mitigation and management measures for subsidence impacts from the underground operations of the mine on State Significant Biodiversity Values (SSBV) and matters of National Environmental Significance (MNES), as follows:

- Threatened flora
- Threatened fauna
- Migratory birds
- Regional Ecosystems/Threatened Ecological Communities
- Watercourses
- Connectivity

The SMP has also been developed in response to submissions received from the Department of Environment and Heritage Protection (DEHP) and Department of the Environment (DotE) on the SEIS. This is a working draft document that will be updated as the project progresses to Detail Design Phase. A finalised SMP will be developed for approval prior to the commencement of underground mining activities.



LEGEND

- Minor Road
- Track
- Watercourse
- Project (Rail)
- Mine Site
- Pump Station
- Accomodation Village
- Airport
- Industrial Area
- Storage Facility

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number	41-26422
Revision	A
Date	17-10-2013

General Project (Mine) layout

Figure 1

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Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine Layout / Infrastructure (2013), Mine (Offsite) (2013). Created by: MS

1.3 Mine production

The Mine plan is based on achieving the production objective of 60 Mtpa (product) as quickly as possible and then maintaining a relatively steady rate of production over the life of the mine. Figure 2 outlines the coal production schedule of open cut ROM, underground ROM and total product tonnes for the operational life of 60 years.

Figure 2 Mine (product coal) production

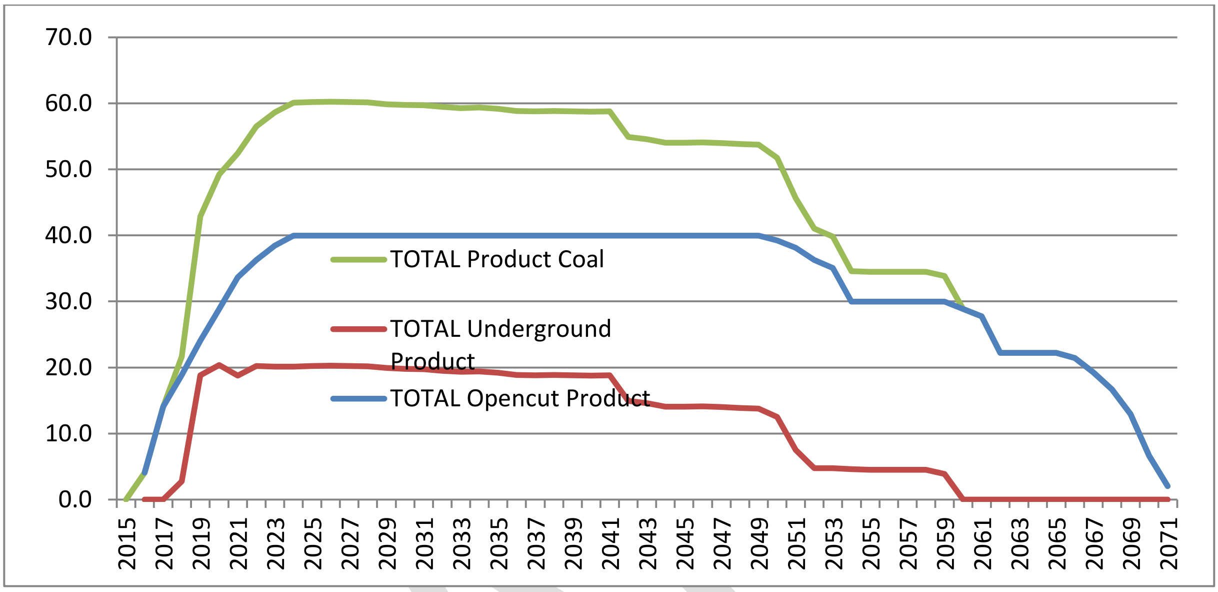


Table 1 outline the quantities of coal and mine waste that will be moved over the life of the Project (Mine), from the open cut and underground mining respectively. In order to maintain the target throughout the life of the Project (Mine), the annual production levels from the open cut will remain around 40 Mtpa (product).

Table 1 Open cut and underground ROM coal and product coal

Period (years)	ROM Coal Mt			Product Coal Mt
	Open Cut	Underground	TOTAL	TOTAL
2015	0	0	0	0
2016	5.5	0	5.5	4.1
2017	19.0	0	19	14.1
2018	25.5	2.8	28.3	21.6
2019	32.5	18.8	51.3	42.9
2020 - 2024	239.5	99.7	339.2	276.9
2025 - 2029	270	100.8	370.8	300.6
2030 - 2034	270	97.7	367.7	297.5
2035 - 2039	270	94.6	364.6	294.4
2040 - 2044	270	81.2	351.2	281.0
2045 - 2049	270	69.9	339.9	269.7
2050 - 2054	241.4	34.2	275.6	212.8
2055 - 2059	162	21.9	183.9	137.9
2060 - 2064	166.5		166.5	123.2
2065 - 2069	134.1		134.1	92.6
2070 - 2074	29.2		29.24	21.6

1.4 Mine staging

The Project (Mine) life cycle consists of preconstruction, construction, operation and closure and decommissioning. Rehabilitation will occur progressively throughout the mine life. The mine sequencing allows for operational activities to commence prior to the completion of construction of the mine; this facilitates a positive cash flow during early stages of the mine life. Table 2 provides an overview of the Project (mine) stage plan.

Table 2 Mine stage plan overview

Year(s)	Activities
2014	Commence construction of workers accommodation village stage 1 & 2
	Commence construction of permanent airport
	Commence construction of power, construction water supply and other external services
	Construction of flood harvesting infrastructure
	Commence construction of open cut facilities including Pits B/C and D/E MIA's, Site Fencing, Water Storage Dams and Temporary Roads.
2015	Commence B, D & E Pit box-cut
	Complete Pit B Diversion Drains
	Construct Carmichael River Northern Flood Protection Levies
	Commence construction of workers accommodation village stage 3 & 4
	Complete construction of Permanent Airport
	Construct Additional Stages of Flood Harvesting Facilities
2016	Commence C Pit box cut
	Produce first coal from open cut B, D & E Pits
	Complete open cut facilities for Pit B/C and D/E MIA, ROM and Overland Conveyors
	Complete B,D & E Pits HV Roads and HV Power Distribution
	Complete Coal Handling and Processing Plant Modules 1 & 2 and Tailings Cell
	Complete Product Handling and Train Load-out Facility
	Commence construction of workers accommodation village stage 5
2017	First Coal Production from open cut C Pit
	Construct Underground Mine 1 MIA facilities
	Complete C Pit water diversion drain and HV Roads
2018	**Commence development and longwall operations of underground mine UG 1**
	Complete Coal Handling and Processing Plant Modules 3 & 4
2019	**Complete development operations in UG1 and commence Longwall operations**
	Construct coal processing plant (CPP) Bypass systems
2020 – 2024	2021– Construct Carmichael River southern flood protection levee
	2021 – Construct Carmichael River Crossing
	2021 – Commence development of underground mine UG 5
	2021 – Mining commences in D Pit
	2021 – Commence G Pit
	2021 – Commence minor rehabilitation of out of pit spoil emplacement
	2022 – Commence development of underground mines UG 4 and 5
	2022 – Commence open cut facilities for Pit F/G and UG 4, MIA, ROM and Overland Conveyors

Year(s)	Activities
	2023 – Complete open cut facilities for Pit F / G, Water Management
2025 – 2029	2026 – Commence F Pit
	2026 – Commence longwall operation of underground mine UG 5
	2026 – Complete UG 5 MIA
	2027 – Commence longwall operation of underground mine UG 4
	2027 – Complete UG 4 overland conveyors and facilities
	2028 – Commence development of underground mine UG 3
	2028 – Complete expansion of Pit D/E MIA for UG 3
	2029 – Rehabilitation works on Pits B, C, D, E out of pit spoil emplacement
2030 – 2034	**2030 – Complete UG 5 Infrastructure**
	2030 – Complete UG 1 Longwall Operations
2035 – 2039	**2035 – Commence development of underground mine UG 2**
	2035 – Commence UG 2 MIA
	2036 – Commence longwall operation of underground mine UG 3
	2036 – Complete UG 3 Infrastructure
2040 – 2044	**2040 – Commence longwall operation of underground mine UG 2**
	2040 – Complete UG 2 Infrastructure
	2040 – Complete UG 4 Longwall Operations
2045 – 2049	No additional Pits Commenced
	2045 – Complete UG 5 Longwall Operations
2050 – 2060	**2051 – Complete UG 3 Longwall Operations**
	2051 – Complete mining in C Pit commence final rehabilitation.
	2053 – Complete mining in E Pit commence final rehabilitation.
	2059 – Complete UG 2 Longwall Operations
2061 – 2072	2061 – Complete mining in D Pit commence final rehabilitation
	2068 – Complete mining in G Pit commence final rehabilitation
	2069 – Complete mining in F Pit commence final rehabilitation
	2070 – Decommission Southern ROMs
	2071 – Complete mining in B Pit commence final rehabilitation
	2071 – Decommission Southern ROMs
	2071 + – Rehabilitate mine site

1.5 Underground mining method

The objective of the underground mines is to increase resource recovery beyond the economic open cut mining limit and produce a low ash coal in AB1 and D1 seams to improve the blend from the open cut without washing, or reduce the amount of washing required.

The underground mine consists of:

- Underground mine 1: installed with up to four longwall units
- Underground mine 2: installed with up to four longwall units
- Underground mine 3: installed with up to four longwall units
- Underground mine 4: installed with two longwall units

- Underground mine 5: installed with two longwall units

The longwall mining method will be used because of its ability to deliver a safe, high production rate and high resource recovery. The typical extraction height in the longwalls will be approximately 3 to 4.5 metres (m).

Figure 3 and Figure 4 provide a schematic of underground longwall mine operations. Longwall mining involves the use of a shearer, which is a coal cutting machine with rotating drums. The shearer moves back and forth across a wide part of the coal seam called the longwall face. The cut coal falls and is loaded onto the chain conveyor by the shearer. The chain conveyor then transports the coal to the conveyor belt for removal from the work area. Longwall systems have in-built hydraulic roof supports, which advance as mining progresses. The supports make possible high levels of production and ensure the safety of the operators. As the longwall mining equipment moves forward, overlying rock that is no longer supported by coal/hydraulic roof supports is allowed to fall behind the operation in a controlled manner. This is known as goaf.

The underground mines will be developed as separate operations, operating independently of the open cut pits. The proposed conceptual layout is based around longwall panels extending out on both sides of a centrally located set of main headings.

Access to the underground mines will be located beyond the final highwall for the open cut, and each will have separate drift entry to both seams, and separate surface facilities. All coal from the underground mines will be transported from the pithead to the central coal handling plant (CHPP) by overland conveyor. Seam access for each mine will be via two inclined drifts, one providing drive in-drive out diesel vehicle access for personnel and materials and the other housing the conveyor coal clearance system.

Figure 3   Underground longwall mine operations – plan view

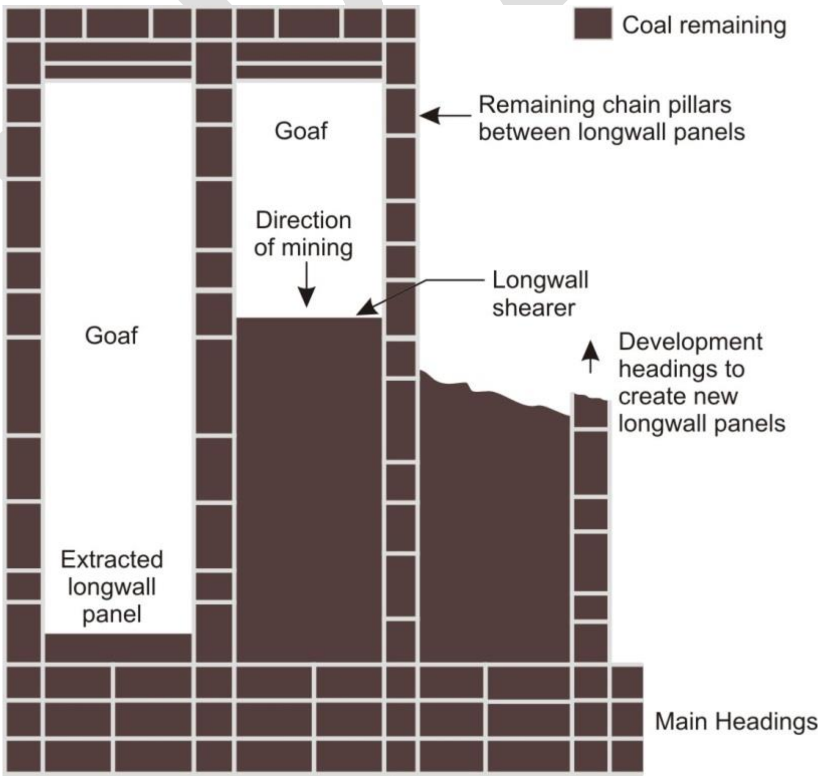
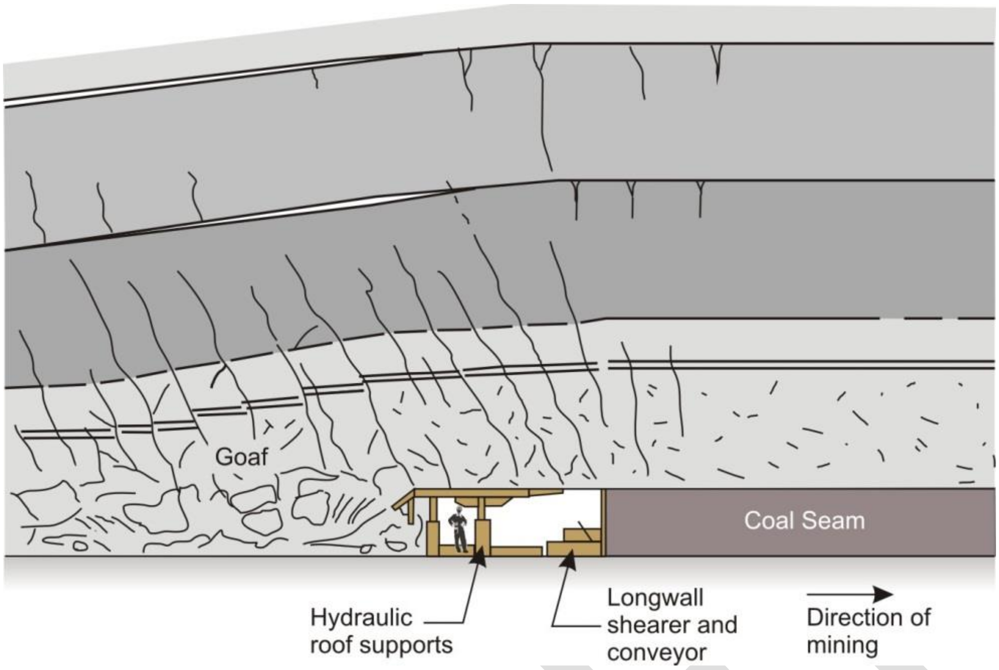


Figure 4 Underground longwall mine operations – section view



Initial development of the mine involves the construction of a tunnel, known as a drift from the surface to intersect the target seams. Once the target depth has been reached, the main entrance to the mine, known as pit bottom, will be established and transportation and ventilation systems installed. Conveyors will be installed in the drift to bring coal to the surface, and roadways and other infrastructure requirements will also be established. The main heading will then be driven in a north-east to south-west direction, following the seam and thus becoming deeper as it progresses.

The longwall panels are then developed progressively by driving parallel headings perpendicular to the main heading. These headings allow mining equipment to be introduced and the ventilation and conveyor systems to be installed. Mining of the longwall panels then progresses from the furthest extremity, back towards the main heading.

As two seams are targeted by underground mining, the upper AB1 seam will be targeted first and then a second layer of headings and longwall panels will be developed about two to three years after the upper layer has been mined to target the D1 seam. This will allow for subsidence from mining of the AB1 seam to have occurred and settled adequately.

Longwall mining will extend over approximately 45 km north to south with conceptual longwall lengths up to approximately 6 km and widths up to 310 m. Cutting heights are approximately 2.75 m in the upper seam and 3.25 m in the lower seam. The proposed multi-seam panel offsets and mains are proposed to be in a staggered arrangement. The proposed 110 longwall panels are located within the mining lease (MSEC, 2013).

The depth of cover to the AB1 seam varies within the proposed mining area from approximately 120 to 440 m. The thickness of the AB1 and D1 seams varies from approximately 4 to 11.5 m. The proposed extraction height for all longwalls is 2.75 m in the AB1 Seam and 3.25 m in the D1 Seam (MSEC, 2013).

2. Management framework

This section provides the Management Framework within which subsidence will be managed and which will form the basis for the SMP. A finalised SMP will be developed for approval prior to the commencement of underground mining activities.

2.1 Legislative framework

The requirement for subsidence management arises from:

- Requirements under the Mineral Resources Act 1993 and Environmental Authority issued under the EP Act to restore mining sites such that a stable and sustainable landform is created.
- Obligations under the EP Act and environmental authority to prevent environmental harm.
- Requirement of the Carmichael Coal Mine and Rail EIS Terms of Reference to predict subsidence related impacts and to present a management response to the avoidance, mitigation or offsetting of these impacts.

As required by the continual improvement approach to environmental management, this management plan is a dynamic document and will be updated as required to reflect:

- Changes in legal and other obligations.
- Any changes in mine planning and hence potential impacts
- Learnings and corrective actions from subsidence monitoring activities.
- Final approval conditions in relation to this management plan.

2.2 Training

All employees and contractors other than short term visitors will receive environmental induction training on commencement of work and then annual environmental awareness training.

This training will include a brief introduction on the key site management conditions and requirements in regards to subsidence management. Training will also provide guidance on the reporting process for any observations and incidents relating to subsidence.

Targeted training will be undertaken in regards to employees and contractors that will have a regular interface with subsidence areas above the underground mine workings, including the preconstruction, construction and operational phases of the Project.

2.3 Communication and reporting

2.3.1 External

External reporting is expected to be required in response to Project approvals requirements. The key agencies to be consulted with for ongoing subsidence matters are the DEHP and Department of Natural Resources and Mines (DNRM).

2.3.2 Internal

Within the Carmichael Coal Mine, communications regarding subsidence matters will be included in:

- Environmental compliance, incidents, initiatives, and corrective actions as agenda items in management meetings

- Regular toolbox talks on environmental matters
- Environmental inductions and other training
- Incorporation of environmental risk assessment and management into all risk assessment activities
- Posting of information on environmental issues, impacts and performance on noticeboards
- Inclusion of environmental performance and issues in weekly, monthly and annual reports.

2.4 Monitoring and reporting

Monitoring of the subsidence areas will be undertaken during the underground mining operations starting in 2018.

2.4.1 Checks and inspections - design and preconstruction

During the design and pre-construction phase, a design checklist will be developed to document how design and preconstruction requirements have been met.

2.4.2 Checks and inspections - construction and operations

A site inspection will be conducted weekly by the Project environmental team. Inspections will be carried out to assess project activities against compliance requirements set out in the Environmental Authority, the EMP and the subsidence management plan.

Inspections will be documented on a checklist that will record whether the performance requirement for each item was achieved and corrective actions required to achieve the performance requirement.

Where the non-conformance does not present a significant risk of environmental harm, and can be corrected promptly, the corrective action will be closed out on the checklist. Where the risk of environmental harm is more significant and/or the corrective action cannot be undertaken promptly, the action will be recorded in the corrective action register.

Where an incident or near miss is observed during checks as a result of subsidence, the incident investigation and reporting procedure will be followed.

Environmental inspection processes will meet the requirements of Adani's HSE Management Standard HSE-ST-18 Reviews, Audits and Inspections.

3. Environmental values

The majority of the land above the proposed mining area consists of undeveloped land, with sparse vegetation, previously used for grazing. The surface areas above the proposed longwalls are relatively flat.

The Carmichael River is the regional drainage line in the area, which flows towards the east in the southern part of the mining lease area. It is not intended to cause subsidence within a 500 m buffer either side of the Carmichael River.

A number of small drainage lines in the Carmichael Creek and Eight Mile creek catchments traverse the mining footprint, mostly running roughly perpendicular to the longwall orientation. These are ephemeral creeks with small catchments. For the northern mining area (north of Carmichael River), a ridgeline runs just west of the mining lease boundary and hence, watercourse catchments upstream of the underground mining area are small. Streams in this section drain largely towards Eight Mile Creek.

South of the Carmichael River, streams are somewhat discontinuous due to flatter topography and drain towards the Carmichael River and Belyando River.

Adani has conducted a number of studies for the EIS and Supplementary EIS to determine baseline environmental values on site and to inform impact assessment in regards to subsidence. These include:

EIS

- EIS Volume 4, Appendix J, MNES Report
- EIS Volume 4, Appendix N1, Mine Terrestrial Ecology Report
- EIS Volume 4, Appendix N2, Doongmabulla Springs Report
- EIS Volume 4, Appendix N3, Black-throated Finch Report
- EIS Volume 4, Appendix O1, Mine Aquatic Ecology Report
- EIS Volume 4, Appendix P1, Mine Hydrology Report
- EIS Volume 4, Appendix P2, Preliminary Water Balance
- EIS Volume 4, Appendix Q, Mine Water Quality Report
- EIS Volume 4, Appendix R, Mine Hydrogeology Report

Supplementary EIS

- SEIS Volume 4, Appendix H, MNES Report
- SEIS Volume 4, Appendix I1, Revised Subsidence Assessment
- SEIS Volume 4, Appendix J1, Revised Ecological Assessment Report
- SEIS Volume 4, Appendix J2, Black-throated Finch Monitoring Report
- SEIS Volume 4, Appendix J3, Doongmabulla and Mellaluka Springs Report
- SEIS Volume 4, Appendix J4, Population Survey of Waxy Cabbage Palm Report
- SEIS Volume 4, Appendix J8, Great Barrier Reef Wetland Protection Areas Report
- SEIS Volume 4, Appendix K1, Revised Mine Hydrogeology Report
- SEIS Volume 4, Appendix K2, Water Balance Report

- SEIS Volume 4, Appendix K3, Water Quality Report
- SEIS Volume 4, Appendix K4, Flood Mitigation and Creek Diversion Design
- SEIS Volume 4, Appendix K5, Revised Mine Hydrology Report

4. Underground mining

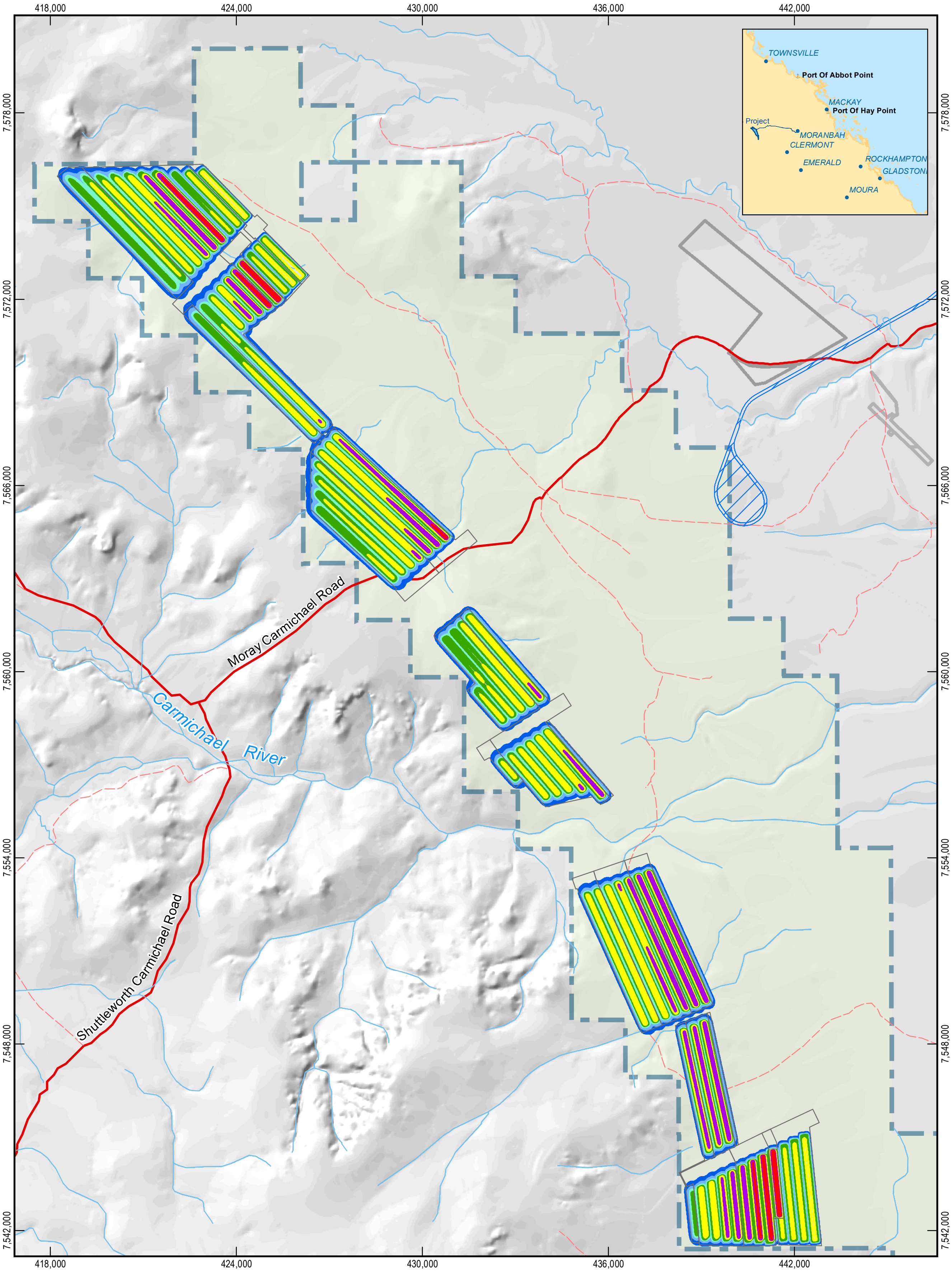
4.1 Surface subsidence

Surface subsidence will occur in two stages as first the AB1 seam and then the D1 seam is mined with the panels offset. The maximum predicted total subsidence for the proposed longwalls after extraction in the AB1 seam is 2,625 mm and the maximum predicted total subsidence for the proposed longwalls after extraction in the AB1 and D1 seams is 5,550 mm (MSEC, 2013), as shown in Table 3. As subsidence depends on a range of geological and geotechnical factors, there could be some variation from this estimate and subsidence may not be even across the footprint.

The predicted subsidence contours are provided in Figure 5.

Table 3 Maximum Predicted Total Conventional Subsidence, Tilt and Curvature after the Extraction of the Proposed Longwalls

Maximum Predicted Total Conventional Parameters in AB1 Seam					Maximum Predicted Total Conventional Parameters in D1 Seam				
Longwall	**Subsidence (mm)**	**Tilt**	**Hogging curvature (1/km)**	**Sagging curvature (1/km)**	**Longwall**	**Subsidence (mm)**	**Tilt**	**Hogging curvature (1/km)**	**Sagging curvature (1/km)**
ABLW101N to ABLW107N	2,575	55	2.28	2.52	DLW101N to DLW110N	5,225	95	>5.00	>5.00
ABLW101S to ABLW107S	**2,625**	95	3.93	3.26	DLW101S to DLW110S	**5,550**	>100	>5.00	>5.00
ABLW201 to ABLW207	2,575	55	2.13	2.22	DLW201 to DLW207	5,175	95	3.06	3.02
ABLW301N to ABLW305N	2,425	35	0.86	0.89	DLW301N to DLW305N	4,100	50	1.15	1.07
ABLW301S to ABLW306S	2,600	45	1.38	1.42	DLW301S to DLW306S	4,650	70	1.66	1.82
ABLW401 to ABLW407	2,575	45	1.60	1.62	DLW401 to DLW407	5,000	70	1.84	1.92
ABLW501N to ABLW503N	2,575	40	1.16	1.21	DLW501N to DLW503N	4,650	50	1.26	1.28
ABLW501S to ABLW508S	2,625	>100	>5.00	>5.00	DLW501S to DLW512S	5,450	>100	>5.00	>5.00



LEGEND

Minor Road	Project (Rail)	Accomodation Village	Predicted Subsidence	200 to 800	3000 to 3800
Track	Mine Site	Airport	Contours (mm)	1000 to 1800	4000 to 4800
Watercourse	Underground Mine	Industrial Area	20 to 100	2000 to 2800	5000 to 5400

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

Predicted subsidence contours

Figure 5

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Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine Layout / Infrastructure (2013), Mine (Offsite) (2013), MSEC: Predicted Subsidence Contours (2013). Created by: MS

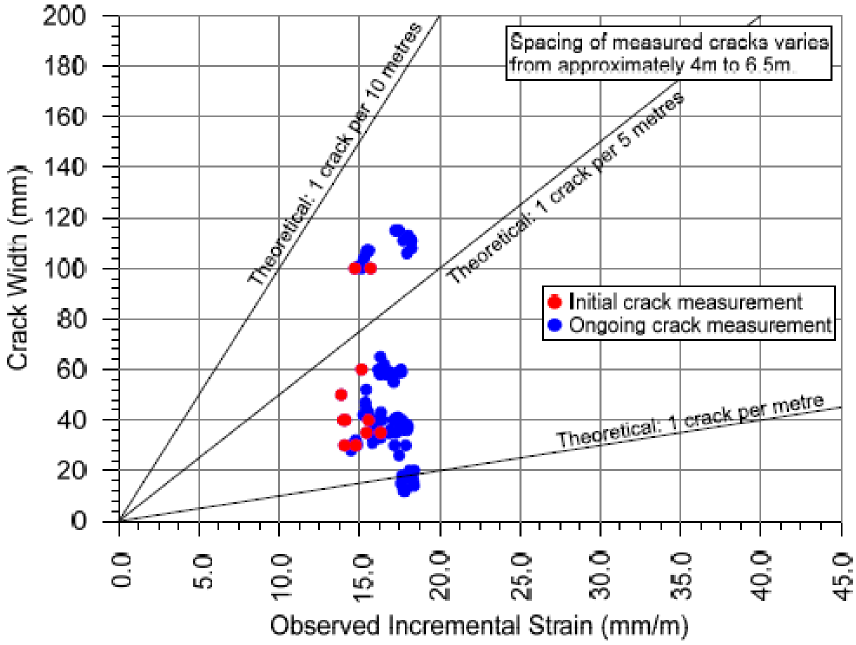
4.2 Cracking

The SEIS Subsidence Assessment established a relationship between predicted curvature and potential crack width (SEIS Volume 4, Appendix I1 (MSEC, 2013)). Prediction of surface crack widths are often undertaken using theoretical values of crack widths based on crack spacing and predicted ground strain. The conservative assumption is made that surface cracking in tensile zones represent 100% of the tensile strain resulting from extraction of the longwall. For example, for an average tensile ground strain of 5 mm/m and a crack spacing of 10 m, the theoretical maximum crack width is 50 mm. For an average tensile ground strain of 5 mm/m and a crack spacing of 1 m, the theoretical maximum crack width is 5 mm. The development of surface cracking is seen as being highly variable and while the use of theoretical crack widths is useful as a guide to zones of cracking, it is not considered to accurately predict the width of cracks. Empirical data available on surface cracking is limited to anecdotal evidence of surface cracking with some detailed mapping cases.

Subsidence parameters were measured at the commencing end of a longwall in the Bowen Basin along monitoring lines at the centreline of the longwall and diagonally through one corner of the longwall. Along each of these monitoring lines, several cracks developed in the ground surface and these cracks were monitored with each survey epoch. The longwall (280 m void width) was extracted in a single seam (approximately 4.5 m extraction height) at a depth of cover of approximately 220 m. Maximum observed subsidence was approximately 3,200 mm. The results of this monitoring are summarised in Table 4 and plotted in Graph1.

Table 4 Summary of observed crack width, observed incremental curvature, observed incremental strain and theoretical crack widths

Crack ID	Crack width at initial measurement (mm)	Crack spacing (m)	Observed curvature (1/km)	Observed strain	Theoretical Crack width based on 1 m crack spacing (mm)	Theoretical Crack width based on 5 m crack spacing (mm)	Theoretical Crack width based on 10 m crack spacing (mm)
1-D	50	-	0.9	13.9	14	**70**	139
2-D	40	5.1	1.0	15.6	16	**78**	156
3-D	100	4.5	1.1	15.7	16	**79**	157
4-D	35	2.5	1.1	15.4	15	**77**	154
5-D	30	5.7	1.1	14.8	15	**74**	148
6-D	40	-	0.6	14.1	14	**71**	141
7-D	35	6.5	0.7	16.3	16	**82**	163
8-D	60	4.2	0.7	15.1	15	**76**	151
9-D	40	4.4	0.8	14.0	14	**70**	140
10-D	100	4.5	0.8	14.7	15	**74**	147
11-D	30	4.8	0.8	14.1	14	**71**	141



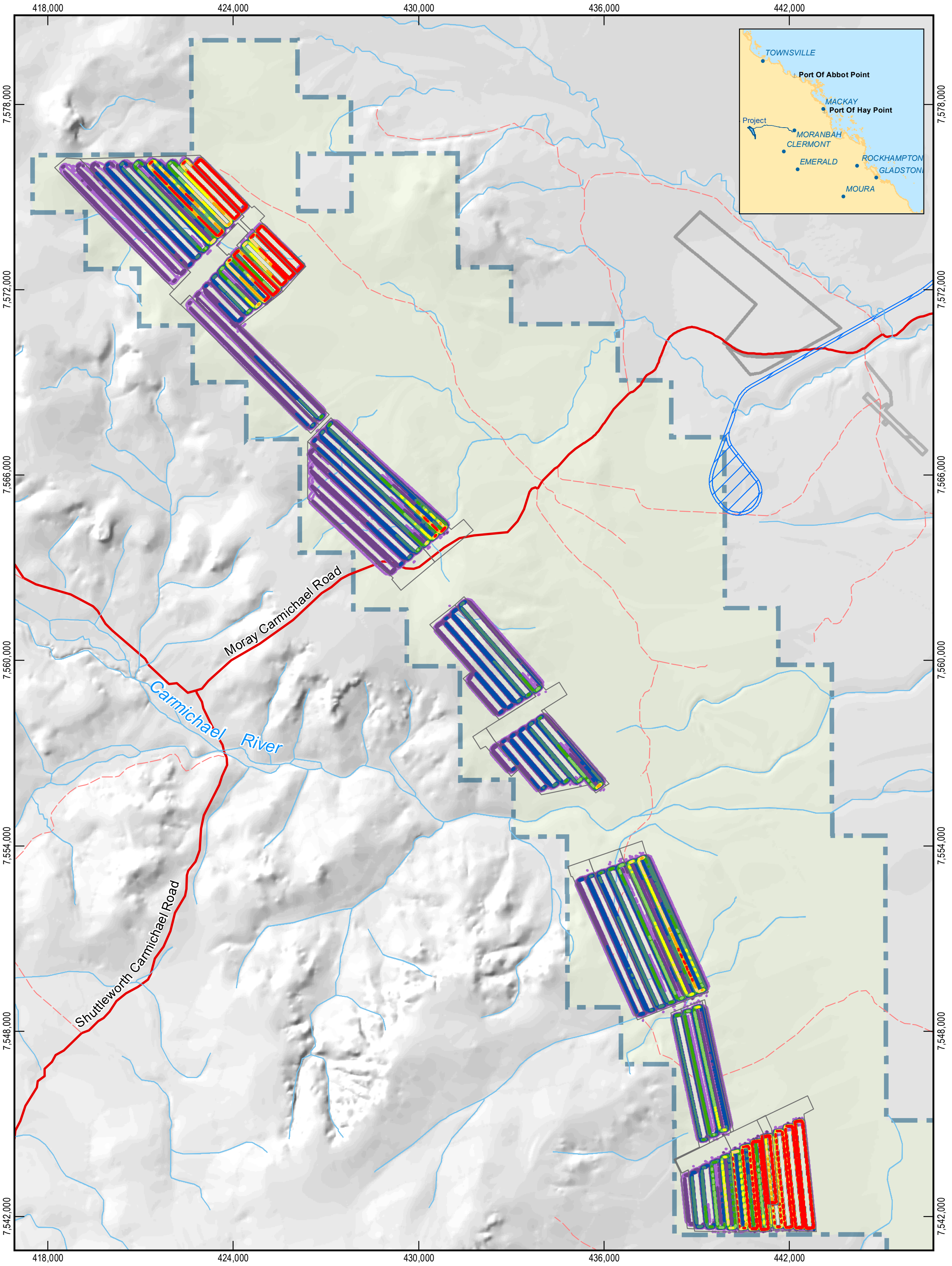
Graph1 Observed crack width vs observed incremental strain

It can be seen from Table 4 that the observed crack spacing is an average of approximately 5 m. A plot of theoretical crack widths based on a spacing of 5 m is shown in Graph1 and it can be seen that there is some scatter in the crack widths above and below this theoretical line. The majority of the observed crack widths do however sit below the theoretical crack width line based a 5 mm crack spacing and all of the observed crack widths sit below the theoretical crack width line based on a 10 m crack spacing. It is considered reasonable to use a theoretical 5 m crack spacing as a conservative indicator of potential crack width with an upper and lower limit of potential crack widths based on a theoretical 10 m and 1 m crack spacing respectively. The cumulative widths of the observed cracks measured along the two monitoring lines represent approximately 45% to 60% of the total ground extension in the area of cracking. The cumulative widths of the crack between each set of survey marks, which are approximately 10 m apart, represent percentages of ground extension between the marks varying from 20% up to 90% at the location of peak tensile strain. The theoretical crack widths assume that 100% of the predicted tensile strain at the ground surface is represented as open cracking, therefore there is some degree of conservatism in the theoretical crack widths.

It should be recognised that crack widths greater than the theoretical values based on a 5 m crack spacing can still occur and isolated cracks greater than the theoretical values based on a 10 m crack spacing can occur. Greater variability of crack width and potential for isolated larger cracks is anticipated where depth of cover is shallow. Surface cracks can develop as a result of causes other than conventional subsidence movements. It is also noted that the surface soil thickness and plasticity is an important factor contributing to the formation of surface cracks during longwall extraction. The surface soils at the location of the observed crack monitoring comprised approximately 15 m thickness of alluvial deposits which are considered to have contributed to a relatively uniform distribution of cracking, consistent with current understanding of crack formation.

The predicted cracking for the Project is similar to or less than the values presented in Table 4 for the majority of the Project underground area. Higher values of cracking are predicted to occur primarily at the eastern margin of the underground areas, where the depth of cover is shallowest, particularly at underground mine 1 and underground mine 5. As the depth of cover reduces, the degree of surface disturbance is expected to increase and the variability in the width and spacing of surface cracks is also expected to increase. However it is to be noted that more permanent tensile cracks are usually located in the final tensile zones around the perimeters of the longwalls, i.e., zones having hogging curvature.

The predicted cracking contours are provided in Figure 6. The theoretical crack widths are based on an assumed crack spacing of 5 m with the crack width ranges based on crack spacing of 1 m and 10 m. Cracks are expected to develop, particularly around the sides and end of longwall panels at depths cover less than 300 m as shown in Figure 6.



LEGEND

Minor Road	Project (Rail)	Accomodation Village	Predicted Cracking Contours (mm)
Track	Mine Site	Airport	5, 20, 35, 50, 65, 80, 95, 110, 125, 140
Watercourse	Underground Mine	Industrial Area	

Based on or contains data provided by the State of QLD (DERM) [2010]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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GHD adani

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Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

Predicted cracking contours

Figure 6

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Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), MSEC: Predicted Cracking Contours (2013). Created by: MS

5. Subsidence impact assessments

5.1 Overview

The subsidence assessment undertaken by MSEC (2013) indicated that the levels of impact that have been assessed on the natural features and surface infrastructure could be managed by the preparation and implementation of a range of management and mitigation strategies. It is expected that where sufficient depth of cover and thickness of Triassic and and/or Tertiary deposits are present, there will be a low risk of direct hydraulic connection from the surface to the seam.

Table 5 presents a summary of the potential impacts that could occur as a result of the altered topography from the underground mining activities.

Table 5 Overview of potential subsidence impacts

Activity	Potential Subsidence Impacts
Altered topography	• Maximum subsidence will be up to 5.5 m, however as the mine layout for the two seams is offset, the final pattern of subsidence will be a series of parallel troughs 2 - 5 m deep and about 400 m wide. Length of the troughs will be variable.
	• Alteration in drainage patterns due to altered topography. Bed profiles of streams will be affected by the subsidence profile.
	• There will be a small reduction in downstream flows due to capture of water in the subsidence troughs.
	• Tension cracks in the ground surface. The width and depth of tension cracks will depend on the underlying geology and also the speed at which subsidence occurs. As subsidence will be staged, this may reduce the formation of tension cracking.
	• Root zones of vegetation may be affected either by the relatively rapid change in ground surface or by tension cracks. Altered hydrology may also result in wetter or dryer conditions for plants.
	• Changes in hydrology of streams and overland flows may exacerbate erosion, however sediment mobilisation will be into the centre of the subsidence troughs and little if any sediment will be carried downstream.
	• Depending on the size and depth of tension cracks, these may present a hazard to humans and possibly other ground dwelling native animals.
	• Boundary fences located across the mine site could be affected by subsidence.

The existing Carmichael-Moray Road will be relocated prior to commencement of mining as such there are no predicted impacts of subsidence on road infrastructure.

5.2 Potential for hydraulic connectivity from surface water to seam

The discussion provided below on the potential for hydraulic connectivity is based on broad facts and observations provided in published literature (ACARP C5016, 2000; ACARP C13009, 2006;

ACARP C14033, 2007; Forster & Enever, 1992; Kendorski et al, 1979; Wyong Strategic Review Inquiry, 2008). The difficulty in assessing the likely height of fracturing and height of hydraulic connectivity at this Project is due to the geological setting being significantly different from the geological settings in almost all the published literature on subsidence, likely height of fracturing and height of hydraulic connectivity in Australia. The models published in literature have been developed for locations with predominantly sandstone overburden or using data from cases with significant sandstone overburden.

MSEC studied fracture zone models from a number of mines in an attempt to apply to the Project. The height of fracture zones and development of constrained/dilated zones based on seam thickness varied from approximately 85 m to 120 m. Given the geological setting and the greater predicted subsidence for the Project, it is uncertain that the fracture networks resulting from the extraction of the proposed longwalls would conform to the zones identified in the published literature. The study by Klenowski (ACARP C5016, 2000) is based on data from Oaky Creek and German Creek and suggests that remedial works are generally not required where depths of cover are greater than 160 m.

It is expected that where sufficient depth of cover and thickness of Rewan formation and /or tertiary clay are present, there will be low risk of direct hydraulic connection from surface to the seam. Conservatively adopting 160m based on Klenowski (ACARP C 5016, 2000) would be considered a reasonable height for the preliminary modelling of the height of direct hydraulic connection. Above this height, it is anticipated that there will be increase in the strata permeability due to fracturing through beds and dilation of bedding planes. It must be stressed, however, that the anticipated height of fracturing does not imply that hydraulic connectivity will extend to the same height, especially since the overburden materials at the Project contain layers such as the Rewan formation which behave as aquicludes or aquitards (GHD, 2012a). In addition, there are significant thicknesses of clay, claystone, mudstone, tuff, siltstone and several kaolinitic layers (Xenith, 2009), which may behave as aquitard or aquiclude layers.

Based on the above discussion, it is expected that where sufficient depth of cover and thickness of Rewan formation and/or Tertiary clay are present, there will be a low risk of direct hydraulic connection from the surface to the seam.

5.3 Impact on Great Artesian Basin

The proposed longwalls are located close to the eastern margin of the GAB recharge beds. The Rewan formation forms the basement confining layer of the GAB and the base or bottom confined aquifer of the GAB is contained within the overlying Clematis sandstone. Hence the Clematis sandstone outcrops to the west of EPC1690 and forms part of the recharge beds at the eastern margin of the GAB.

Based on a review of available information (Great Artesian Basin Consultative Council, 1998; Geoscience Australia, 2010) and the geological information available for the Project, there are no identified GAB aquifer units outcropping within the proposed longwall footprint. The nearest GAB aquifer unit to the proposed longwalls is the Clematis Sandstone. The nearest mapped outcrop of Clematis sandstone is approximately 2 km to the west of EPC 1690 (GHD, 2012b). At this distance from the proposed longwalls, no measureable conventional subsidence movements and hence no impacts are expected to result from the extraction of the proposed longwalls. It is possible, however, that the area would experience small far-field horizontal movements, which are discussed in Section 4.4 of the MSEC report (SEIS Volume 4, Appendix I1).

5.4 Impacts on vegetation and fauna

A review was conducted on available published literature and previous projects (Hancock Galilee Pty Ltd, 2012; Hancock Galilee Pty Ltd, 2013; Iowa State University, 2008; South Galilee Coal Project, 2012; Sinclair & Lyon, 1987; Waratah Coal Pty Ltd, 2013) to determine potential impacts from subsidence on vegetation and fauna. It was determined that impacts on vegetation can be divided into 4 categories depending on source of changes: subsidence, cracking, hydrology and gas release. Key impacts are highlighted in each of the sections below. It is important to note that the review returned very little to no sources for understanding impacts of the changes to fauna.

Most of the potential impacts identifies in the following sections can be addressed using a monitoring program.

5.4.1 Impacts from surface movement

The main potential impacts from surface movement on vegetation are as follows:

- Surface movement due to subsidence may lead to areas of destabilisation causing vegetation slumping, tree falls, erosion and root exposure.
- Localised and variable impacts for mine sites may occur under native vegetation and under cropping land. Because of site variability of impacts and the lack of scientific data it is difficult to predict impacts of surface movement on vegetation.
- Vegetation stress from surface movement may result in foliar discoloration, partial defoliation or increased susceptibility to pathogenic attack.

5.4.2 Impacts from cracking

The main potential impacts from cracking on vegetation are as follows:

- Tension cracks may leave soil vulnerable to erosion and strain affects the soil profile.
- Movement of soil profiles and the formation of vertical cracks and fissures may lead to the below ground stress on roots of trees and shrubs.
- Severance of lateral roots being from the main tap root may lead to decline and death of trees/shrubs.
- Cracking may damage root systems by exposing the roots to heat stress.
- For individual trees and shrubs, disturbance of the root ball by tension cracking, mechanical shaking during active subsidence or ground tilt may result in rapid in situ tree mortality or tree fall.
- Vegetation stress form mechanical disturbance may lead to foliar discoloration, partial defoliation or increased susceptibility to pathogenic attack.
- The effect of environmental perturbations may sometimes not be apparent for several years and are more apparent in riparian corridors.

5.4.3 Impacts from changes in hydrology

The main potential impacts from changes to hydrology on vegetation are as follows:

- Ground fractures may cause significant changes to hydrology properties of soils and promote desiccation or inundation that can directly impact vegetation. A breakdown in soil structure may lead to erosion which may in turn lead to increased movement of sediment downstream during rainfall events, therefore reducing water quality.

- Substantial cracking of stream beds and tributaries may cause the loss of flow and redirection through the subsurface.
- Changes to surface hydrology may have indirect effects on vegetation communities through alteration of water availability and flood frequency. For example, altered flows could affect dispersal and replenishment of aquatic species
- Depression of the surface due to subsidence may lead to water ponding after rain and can become permanent. Impacts may include inundation of vegetation causing death if ponding happens for substantial periods. If ponding is periodic it may impact on a gradual selection of species such as weed (e.g. buffel grass or parthenium) and pests (e.g. cane toad).
- Many tree species can survive months of flooding as long as their canopies remain above the water. Mature, well-established trees are more tolerant of flooding than over-mature trees or seedlings of the same species. Short periods of flooding can be tolerated by most trees, but if flooding is recurrent or uninterrupted and keeps soils saturated, serious damage to trees may occur. Roots of trees and shrubs in saturated soils often die of oxygen deficiency.
- Trough like depressions may increase soil moisture content in some locations which may potentially lead to an increase in weed abundance.
- Ponding of water may also create new water resources which may support ecological values of the system. Those species with a noted affiliation to water (squatter pigeon (southern), black-throated finch (southern) and ornamental snake in particular) may be able to take advantage of the creation of additional ponded surface water areas as a result of subsidence, even where this resource is temporary, though the destructive impact on surface habitat might negate this effect.

5.4.4 Impacts of gas releases

When subsurface water levels decline due to subsidence related changes to groundwater flow pathways, gases (if present) can become mobile and migrate to the root zone and surface. When methane seeps through the soil it creates anaerobic conditions and can result in death to vegetation.

6. Impact assessment methodology and outputs

6.1 Overview

Adani proposes the following methodology to assess the severity of impacts due to underground mining operations causing surface subsidence, cracking and ponding and land disturbance due to proposed infrastructure as presented in Table 6. An impact ranking was developed based on outcomes of the subsidence assessment report (MSEC, 2013: SEIS Volume 4 Appendix I1), outcomes of the ponding modelling (GHD, 2013: SEIS Volume 4 Appendix K5) and a review of relevant literature.

Table 6 Ranking of impacts for assessment of subsidence

Impacts	Ranking of impacts	
Subsidence	High:	slope change of more than 2% (>5 m)
	Low:	slope change of less than 2% (<5 m)
Cracking	High:	> 100 mm (width)
	Low:	< 100 mm (width)
Ponding	High:	duration of ponding greater than 2 days
	Low:	duration of ponding less than 2 days
Infrastructure	High:	impacted by infrastructure
	Low:	not impacted by infrastructure

6.2 Subsidence

The depth of subsidence is predicted to range from 20 mm to 5,400 mm (5.4 m) across the site. These values are an average across a 310 m wide panel, where subsidence is likely to be greatest in centre of that panel. A 5.4 m deformation in surface at the centre of a panel equates to a slope angle of 2 degrees, a change in grade of 1 in 30, or a slope change of 2.2% across that panel.

A review of subsidence impacts associated with watercourse slopes determined that a change in slope of up to 0-1.5% was assessed as being a low-level impact (Wright Water Engineers Inc., 2013).

Based on a review of literature regarding the impacts of subsidence on vegetation and due to the lack of existing data in the region, a conservative estimate of the impacts of the Project (Mine) has been made. Subsequently, for the purpose of this assessment, it was determined that a change of less than 2% to slopes across each panel is unlikely to result in structural damage to most vegetation communities, only to individual plants within localised areas.

Taking the above into consideration, a slope change of less than 2% across 150 m of naturally undulating terrain has been classified as low impact subsidence, which equates to up to 5 m of deformation. A change of more than 2% (5 - 5.4 m) has been classified as high impact subsidence.

Please refer to Figure 7 for the predicted impact ranking for subsidence.

6.3 Cracking

A revised draft Subsidence Prediction and Subsidence Impact Assessment Report (MSEC, 2013) has been prepared for the Project (Mine). The report indicates that surface cracking as a result of the Project (Mine) is predicted to range from widths of 10 mm to 280 mm; this modelling represents a conservative estimate given the lack of existing data in the region.

The Subsidence Management Plan for the Kevin's Corner mine indicated that cracks greater than 100 mm have the potential to result in damage or shearing of major root systems. Additionally, according to the NSW Scientific Committee, cracks of less than 10 mm wide may eventually reseal without active intervention.

Subsequently, taking the above into consideration, areas of cracking of more than 100 mm in width have been classified as high impact cracking; anything less than 100 mm will be classified as low impact cracking.

Please refer to Figure 8 for the predicted impact ranking for cracking in subsidence areas.

6.4 Ponding

Ponding duration is predicted to range from less than a day to several months; this is discussed in detail in Section 9 of the Carmichael SEIS Volume 4, Appendix K4 Flood Mitigation and Creek Diversion Design. The ponding assessment was undertaken on the basis of a typical wet year, that is, a total annual rainfall volume. Additionally, the assessment allowed for an infiltration rate of 50mm/hr associated with rainfall and any ponding. In regards to impacts to surfcae water due to cracking, it should be noted that the areas where ponding is predicted are predominantly under sagging zones (compression zones) at the bottom of the subsidence trough where large tensile tracks are not anticipated. Hence there will be a low risk of direct hydraulic connection from the ponding surface areas to the seams. Vegetation communities that are fully submerged under standing water (such as native grasslands) will start to dieback within a number of days as they are unable to photosynthesise and saturated soils will be depleted of oxygen within 48 hours of inundation (Sinclair & Lyon, 1987; Iowa State University, 2008).

Where ponding associated with the Project (Mine) is anticipated to exceed duration of 2 days, mitigation strategies will be implemented to minimise the likelihood of ponding occurring particularly in areas where sensitive vegetation is likely to be impacted. In general, measures will be put in place to divert water around the areas of predicted subsidence. There is however some areas of predicted subsidence where diversions are not practical and water will pass through these areas generating pools; to address this, a series of low flow connection channels through the ridges are proposed to link depressed areas and provide an outlet at the downslope extent of the subsided affected areas.

Taking the above into consideration, ponding duration of less than 2 days has been classified as having a low impact on vegetation and inundation areas present for more than 2 days as having a high impact on vegetation.

Please refer to Figure 9 for the predicted ponding impact ranking (pre and post mitigation measure) in subsidence areas.

6.5 Infrastructure

Mine infrastructure will be developed across the mining lease area including the underground mine area. This infrastructure will have a direct impact on the environmental values considered within the subsidence management plan area and therefore have been identified as part of this process and listed below:

- Hardstand areas
- Underground areas access points
- Topsoil storage areas
- Drains
- Power
- Roads
- Additional infrastructure (such as vent shafts) within the boundary of the underground

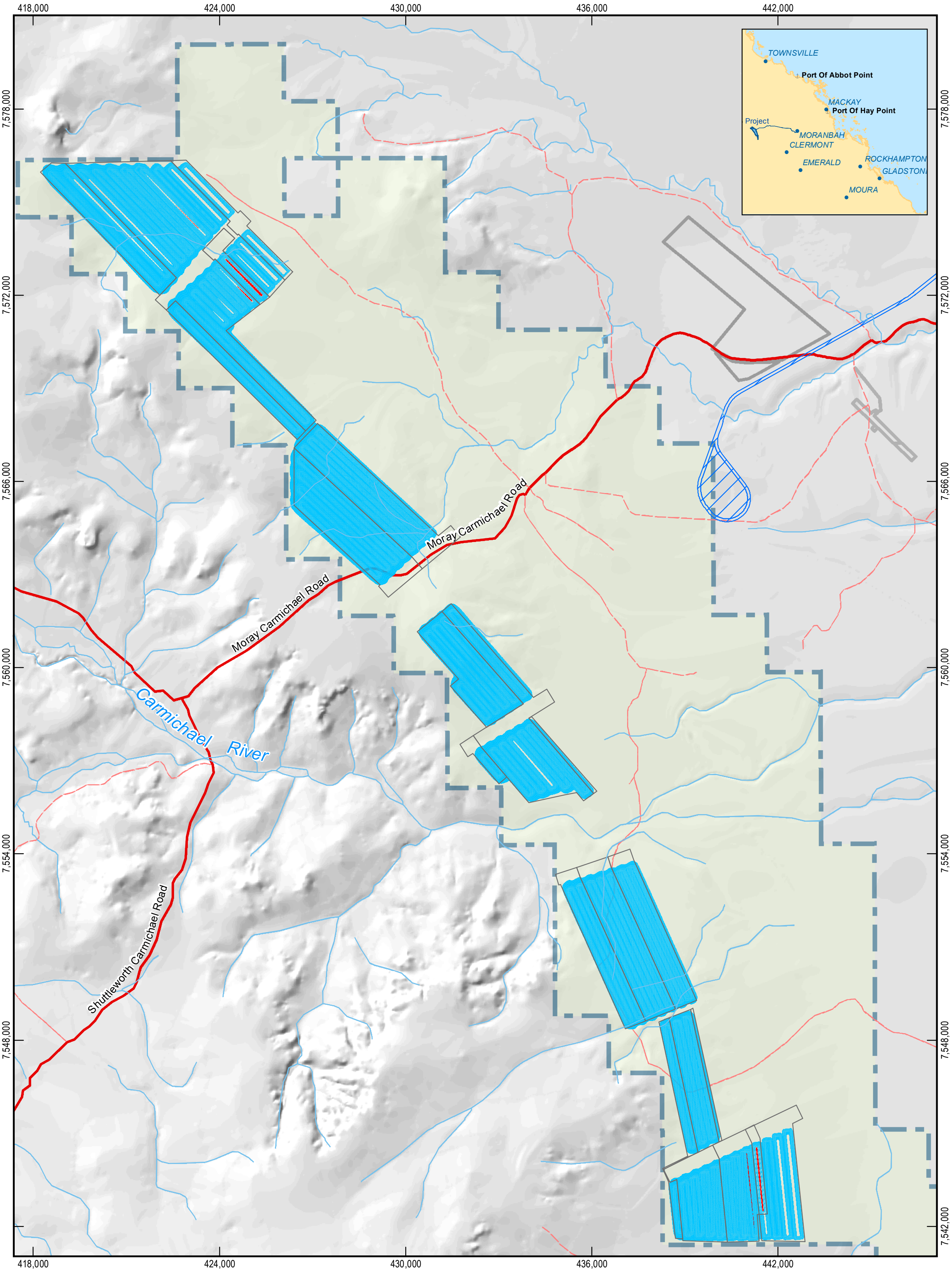
Infrastructure impacts have been identified by directly overlaying infrastructure over subsidence impact areas on the infrastructure map. All areas impacted by infrastructure will be assessed as high impact areas and these areas have been reported through the SEIS within the total disturbance noted for On Lease impacts.

6.6 Cumulative impact

The cumulative impact was determined from a combination of subsidence, cracking and ponding (post mitigation) layers resulting in a high or low impact. This assessment excludes the direct infrastructure impacts (which are already determined as having a high impact). The cumulative impacts are as follows:

- High cumulative impact = high subsidence + high cracking + high ponding
- Low cumulative impact = low subsidence + low cracking + low ponding

These high/low impact rankings are then applied to the state and federal environmental values to determine high and low impacts on these values. High impact areas have been considered as residual impacts that require offsetting under state and federal policies. Management and mitigation measures are proposed in regards to low impact areas and hence have not been considered as residual impacts for the purpose of offsetting.



LEGEND

- Minor Road
- Track
- Watercourse
- Subsidence (High) Greater than 5000mm
- Subsidence (Low) Less than 5000mm
- Project (Rail)
- Mine Site
- Underground Mine
- Accomodation Village
- Airport
- Industrial Area

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Carmichael Coal Mine and Rail Project SEIS

Predicted subsidence
contour impact ranking

Job Number 41-26422
Revision A
Date 17-10-2013

Figure 7

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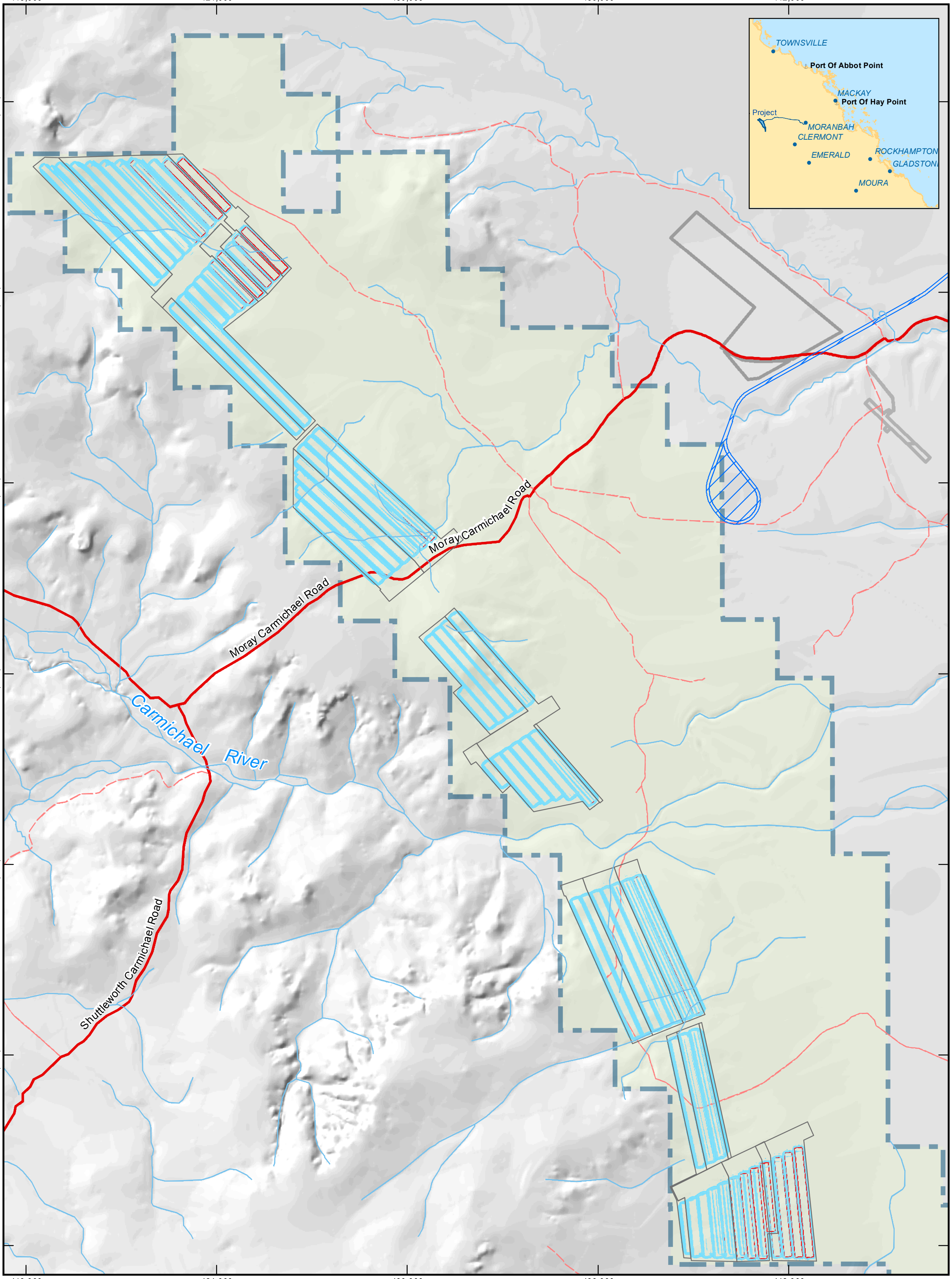
Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), MSEC: Predicted subsidence contours (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Crack width (High) Greater than 95 mm
- Crack width (Low) Up to 95 mm
- Project (Rail)
- Mine Site
- Underground Mine
- Accomodation Village
- Airport
- Industrial Area

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Predicted cracking impact ranking

Job Number	41-26422
Revision	A
Date	17-10-2013

Figure 8

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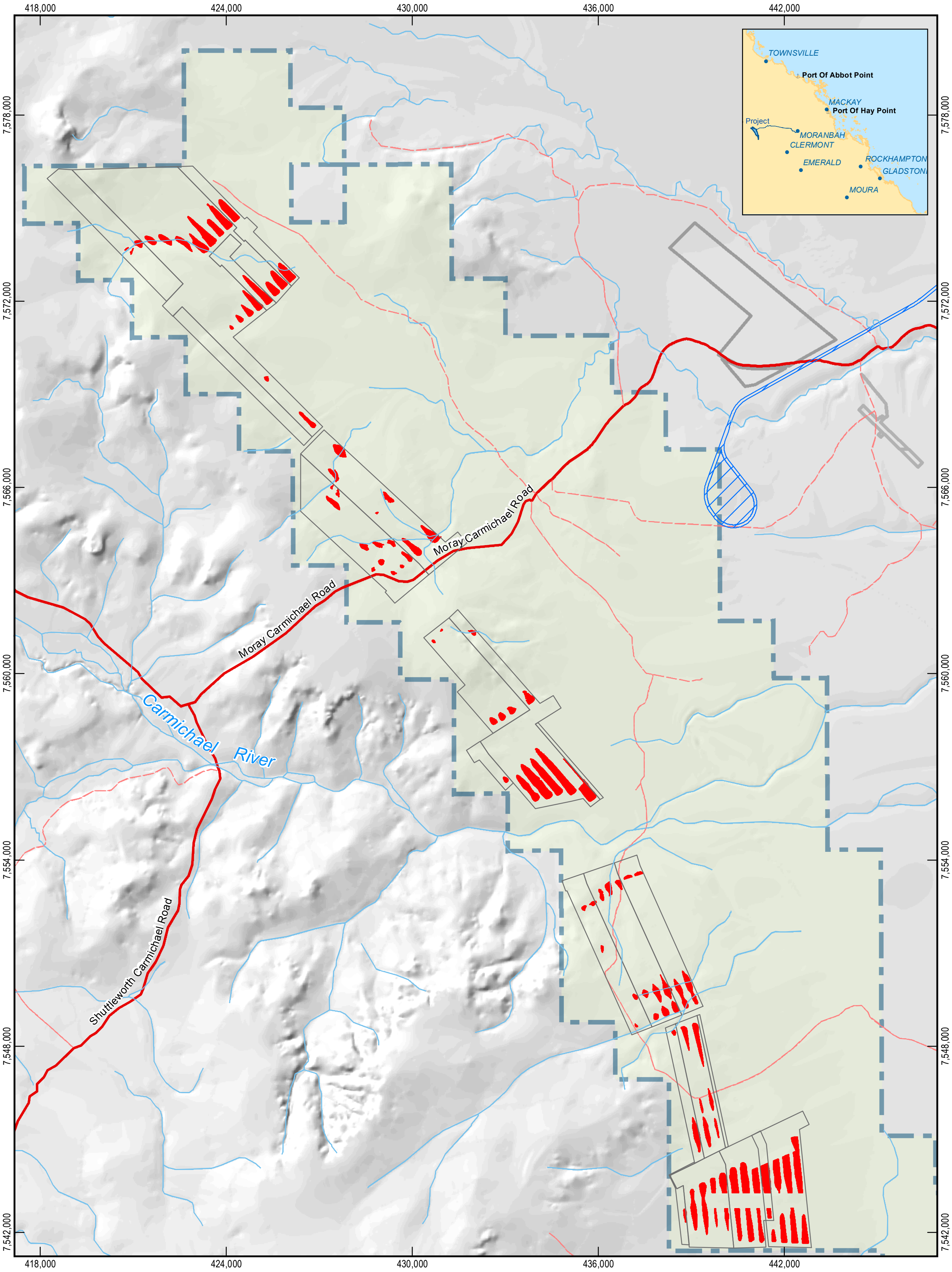
Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013),
MSEC: Predicted Cracking Contours (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Ponding - (High) duration greater than two days
- Project (Rail)
- Mine Site
- Underground Mine
- Mine (Offsite)

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number: 41-26422
Revision: A
Date: 17-10-2013

Predicted ponding in subsidence areas
Impact ranking (pre-mitigation)

Figure 9
Sheet 1

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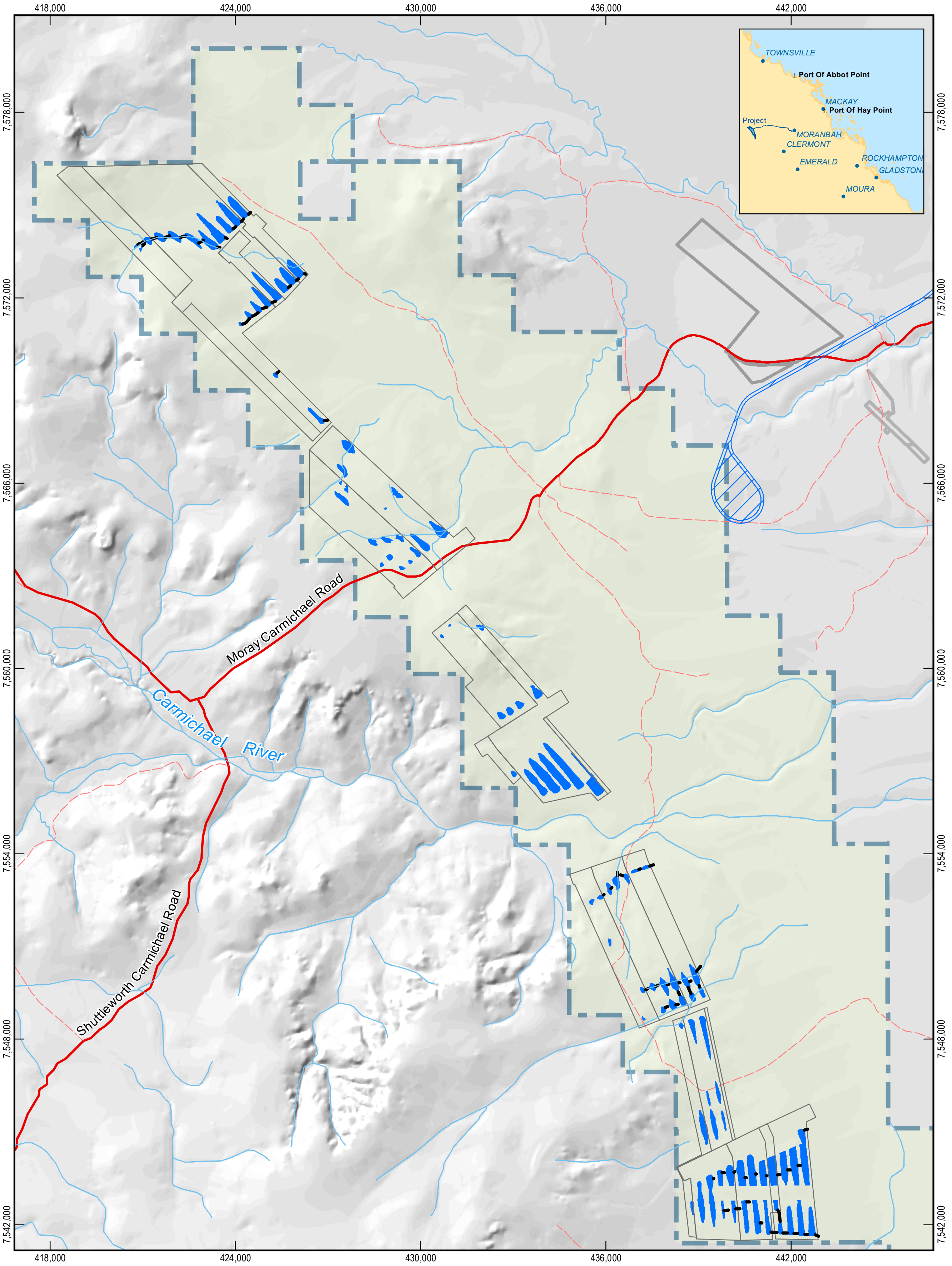
Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), GHD: Ponding (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Ponding Link
- Ponding - (Low) duration less than two days
- Project (Rail)
- Mine Site
- Underground Mine
- Mine (Offsite)

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

Predicted ponding in subsidence areas
Impact ranking (post-mitigation)

Figure 9
Sheet 2

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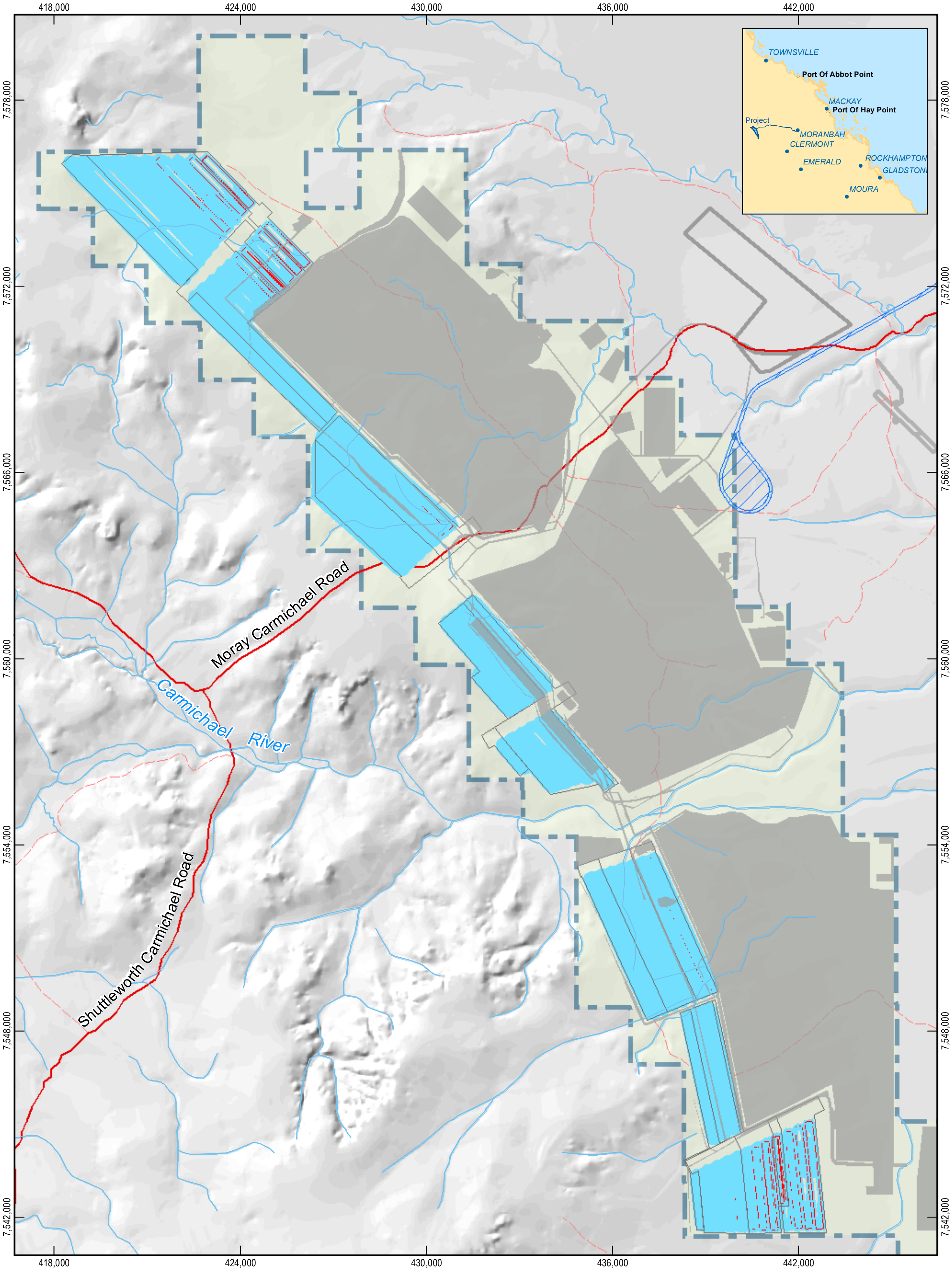
Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), GHD: Ponding, Links (2013). Created by: MS



LEGEND

Minor Road	Cumulative Impact Ranking - High	Project (Rail)	Mine (Onsite)
Track	Cumulative Impact Ranking - Low	Mine Site	Underground Mine
Watercourse			Mine (Offsite)

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Carmichael Coal Mine and Rail Project SEIS

Combined impact mapping for subsidence, cracking, ponding and infrastructure

Job Number 41-26422
Revision A
Date 17-10-2013

Figure 10

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Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), MSEC: Cumulative Impact Ranking (2013). Created by: MS

6.7 Predicted impact assessment outputs

Table 7 details the total areas impacted for each subsidence type (subsidence, cracking, ponding and surface infrastructure).

Table 8 shows the total cumulative impact layer. This layer is the combined subsidence, cracking, ponding impact ranking and only includes areas impacted by the underground mine footprint. It does not include the surface infrastructure layer. The values for subsidence, cracking, and ponding have been used to calculate subsidence high impact ranking areas for each environmental value as detailed in Table 9.

Table 7 Total subsidence impacted areas

Impacts	Area (ha)		
	High impact	Low impact	Total
Subsidence	25.99	7,896.32	7,922.32
Cracking	140.42	4,085.01	4,225.43
Ponding	0	851.02	851.02
Surface infrastructure (direct habitat clearing)	30.02	1,197.30	1,227.32

Table 8 Cumulative impact ranking layer

Impacts	Area (ha)			%high impact
	High impact	Low impact	Total	
Cumulative impact ranking layer*	166.15	7,917.20	8,083.84	2.05%

*The cumulative impact ranking layer does not include surface infrastructure areas as these areas are already included within the Carmichael Coal Mine and Rail Project Environmental Offset Package 2013.

Table 9 details the subsidence impact areas for each environmental value which intersect with the total cumulative layer from Table 10 (excluding surface infrastructure). Figures 11-25 for each of the environmental values are provided in Appendix A.

Table 9 Subsidence impact areas for environmental values

Environmental value	Status		Subsidence Impact Area (ha)			
	EPBC Act	NC Act	High impact	Low impact	No impact	Total
Squatter pigeon (Figure 11)	V	V	163.32	6,373.69	376	**6,913**
Fork-tailed swift (Figure 11)	M	SLC	163.32	6,546.86	234	**6,944**

Environmental value	Status		Subsidence Impact Area (ha)			
White-throated needletail (Figure 11)	M	SLC	163.32	6,546.86	234	**6,944**
Rainbow bee-eater (Figure 12)	M	SLC	163.32	6,546.86	234	**6,944**
Black-chinned honeyeater (Figure 13)	-	NT	162.50	4,757.25	189	**5,109**
Satin flycatcher (Figure 14)	M	SLC	0	3.06	0	**3**
Black-throated finch (Figure 15)	E	E	163.32	6,145.39	574	**6,883**
Square-tailed kite (Figure 16)	-	NT	162.50	4,757.25	189	**5109**
Little pied bat (Figure 17)	-	NT	163.32	6,546.86	234	**6,944**
Koala (Figure 18)	-	SLC	163.32	5,559.12	542	**6,264**
Yakka skink (Figure 19)	V	V	162.50	5,775.25	224	**6,162**
Brigalow scaly-foot (Figure 20)	-	V	96.62	2,391.73	461	**2,949**
Ornamental snake (Figure 21)	V	V	0	3.00	0	**3**
Waxy cabbage palm (Figure 22)	V	V	0	0	0	**0**
RE10.7.4 (BVG 12a) (Figure 23)	-	OC	0.00	36.60	0	**36.6**
Watercourse (stream order 2) (Figure 24)	-	-	2.58	78.57	180	**260.85**
Connectivity (Figure 25)	-	-	121.39	4,729.15	2,093	**6,944**

M= Migratory; OC= Of Concern; NT= Near Threatened; SLC= Special Least Concern; V= Vulnerable

Table 10 Total cumulative environmental impact value

Impacts	Area (ha)
Total cumulative environmental impact ranking – High (excludes surface infrastructure)	163.32
Total cumulative environmental impact ranking – Low (excludes surface infrastructure)	6,550.14
Total cumulative environmental impact ranking – Total (excludes surface infrastructure)	**6,713.47**
No impact	609.62
Total Subsidence Footprint identified in the SEIS Offset Strategy (excludes surface infrastructure)	**7,323**

7. Proposed control

7.1 Design and pre-construction proposed controls

Table 11 Subsidence – Design and preconstruction controls

Control	Responsibility	Timing	Evidence
Develop a numerical model based on site geological data to refine predicted cracking and subsidence impacts. The modelling is to inform the finalisation of the subsidence management plan impact methodology and outcomes. The revised plan to be finalised and submitted for approval 6 months prior to the commencement of underground mining activities.	Underground Mining Manager	During design and prior to commencement	Numerical Model Subsidence Management Plan
If mining infrastructure is to cross the underground mining footprint, design infrastructure to be resistant to the effects of subsidence	Design manager	During detailed design of infrastructure	Design checklist
Design creek diversions around the open cut areas to remain functional after subsidence	Design manager	Prior to development of diversions	Design checklist

7.2 Operations proposed controls

Table 12 Subsidence – Operational controls

Control	Responsibility	Timing	Evidence
Establish monitoring locations including: • One point immediately upstream, one mid point and one point immediately downstream of underground footprint on waterway diversions • Vegetation characteristics and health monitoring transects and control points • Habitat value transects • Topographical survey transects • Photo-monitoring points corresponding with each of the above monitoring locations	Environmental Manager	One year prior to commencement of underground mining	Subsidence Management Plan
Determine detailed monitoring methodologies for vegetation health,	Environmental Manager	One year prior to	Subsidence Management

Control	Responsibility	Timing	Evidence
habitat value and characteristics, stream condition and photo monitoring, drawing on established methodologies.		commencement of underground mining	Plan
Establish exclusion zones and remove cattle from underground mining footprint. Construct fences outside subsidence footprint to keep cattle from the subsided area.	Environmental Manager	Prior to underground mining	Visual inspection

8. Performance, monitoring, management and reporting

8.1 Performance outcome

A stable and sustainable landform is created over subsided areas which maximises opportunities for the subsided areas to retain and support native vegetation and fauna.

8.2 Monitoring and management

Table 13 Subsidence monitoring and management

Monitoring action	Frequency and duration	Performance Requirement	Management Responses	Timing
Determine baseline conditions for: • Stream characteristics • Vegetation health and characteristics • Habitat features and values • Topography.	At least four stream and vegetation health surveys prior to commencement of underground mining over a minimum period of one year.	Baseline conditions are documented.	None	Prior to commence-ment of construction
Inspect subsided areas for new and existing tension cracks. Document locations and size of cracks and changes in crack size.	Annually until performance requirements have been achieved (more frequently if there is a risk to humans or infrastructure).	Cracks do not present a safety risk two years after forming. Water is not preferentially flowing into cracks and underlying strata.	Grade and/or fill cracks with inert material, cover with topsoil and revegetate. Use small scale equipment to minimise damage to intact vegetation and soils.	During operation
Monitor vegetation health and changes in vegetation characteristics in subsided areas using established transects. Monitor habitat characteristics and values. Establish reference and monitoring sites of equivalent size. Monitor for: • Foliar discolouration • Partial defoliation • Increased pathogenic	Annually until no further changes.	Regional ecosystem classifications have not changed. Habitat suitability for native fauna species is retained. Weed presence is not increasing.	Management responses may include: • Weed control • Revegetate with suitable native species • Leave any fallen trees on site to provide habitat for fauna species.	During operation

Monitoring action	Frequency and duration	Performance Requirement	Management Responses	Timing
attack • Tree death				
Monitor extent of ponding in subsidence troughs.	Annually each year until performance requirements are achieved.	Ponding is not causing a safety risk. Ponding is not causing adverse environmental impacts. Water is not flowing into underground workings.	Partially or fully drain ponds.	During operation
Monitor groundwater	Quarterly for water levels Annually for full chemical analysis Or after heavy rain events	Groundwater not impacted indirectly by cracking.		During operation
Check stream diversions adjacent to subsided areas.	First wet season post subsidence of longwalls adjacent to diversions.	Diversions remain stable and effective.	Relocate or stabilise diversions.	During operation

8.3 Rehabilitation

A rehabilitation strategy for the Project (Mine) (including subsided areas) is included in the SEIS (Volume 4 Appendix R1). Post mining rehabilitation of the subsided areas in regards to ongoing water management could be achieved by a number of methods:

- Retaining a series of low flow connection channels to provide a continuous path for flows to pass through the areas of predicted subsidence and into a diversion channel and/or existing waterway (GHD, 2013a).
- Re-profiling subsided areas to prevent future ponding of water (EMM, 2013).
- Filling of cracks, where possible.

The low flow connection channels will be assumed to:

- Run at a nominal grade of 0.2 percent from the base of the subsided terrain within the permanent pool until it re-joins the surrounding terrain.
- Consist of a trapezoidal section with a nominal base width of 1 m and side slopes of 1 in 3 (GHD, 2013a).

8.4 Reporting

A report will be prepared annually following commencement of underground mining activities. The purpose of the report will be to detail mining activities, management, monitoring and rehabilitation activities undertaken as part of the Subsidence Management Plan.

The report will present the results and interpretation of monitoring activities and recommendations for any required remedial works. As a minimum, the report will address:

- Assessment against subsidence predictions in accordance with the methodology adopted in this impact assessment.
- The condition of vegetation and habitat in areas of subsidence in relation to the environmental values assessed in this report.
- Physical surface cracking and curvature.
- Ponding extent, watercourse conditions and geomorphic processes.

The report will also include updates on the integrity and effectiveness of the pre-subsidence mitigation measures.

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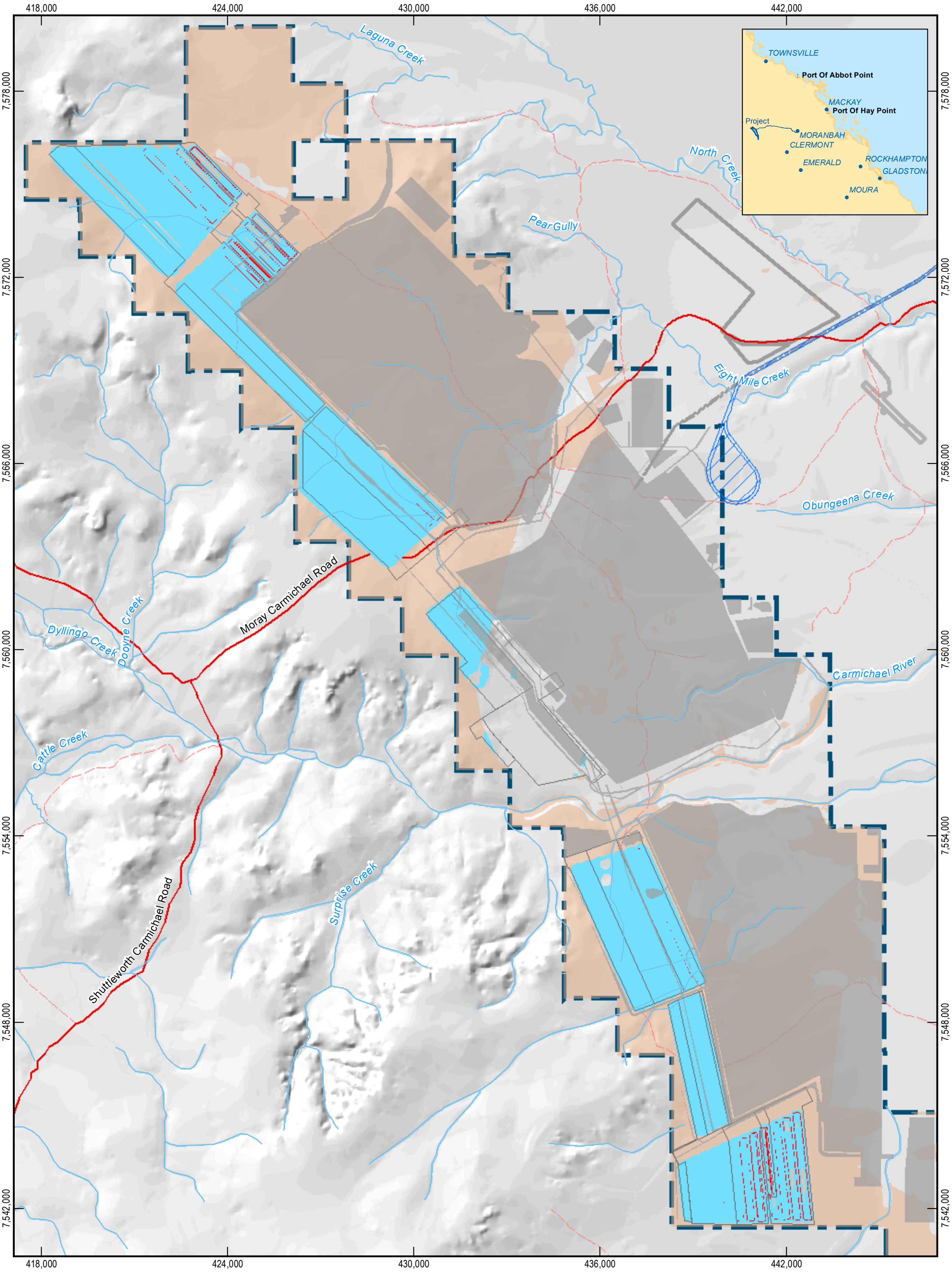
APPENDIX A

Subsidence impact maps on environmental values



LEGEND

- Minor Road
- Track
- Watercourse
- Potential squatter pigeon habitat - based on DNRM certified Regional Ecosystems version 6.0b
- Rail (Project)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)

Habitat Impact Ranking

- High Impact
- Low Impact

Based on or contains data provided by the State of QLD (DERM) [2010]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

Squatter pigeon habitat impacted by subsidence

Job Number	41-26422
Revision	A
Date	17-10-2013

Figure 11

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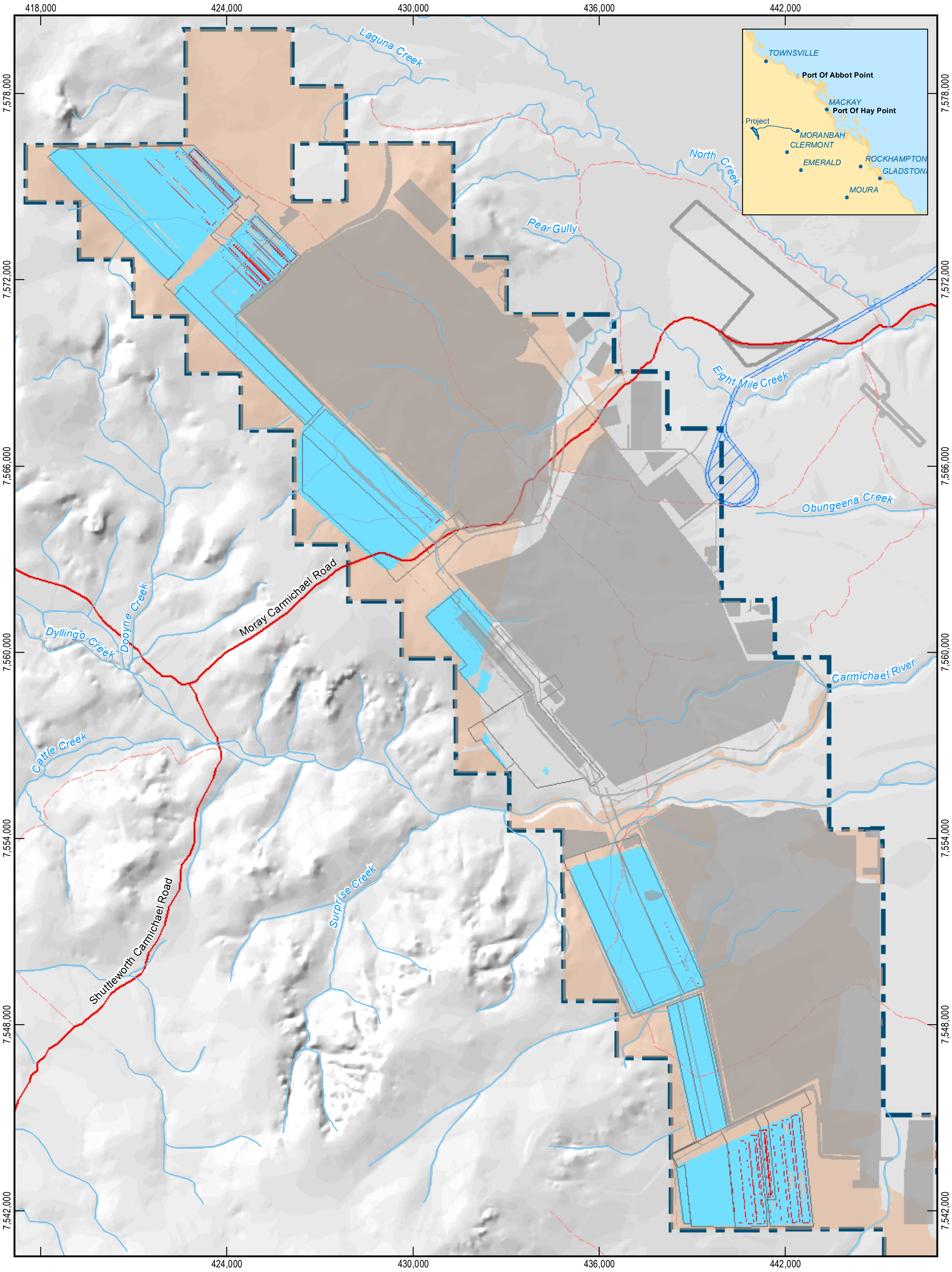
Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013); MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Forked-tailed swift habitat - based on DNRM certified Regional Ecosystems version 6.0b
- Project (Rail)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)

Habitat Impact Ranking

- High Impact
- Low Impact

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1:175,000 (at A4)

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

Fork-tailed swift impacted by subsidence

Figure 12

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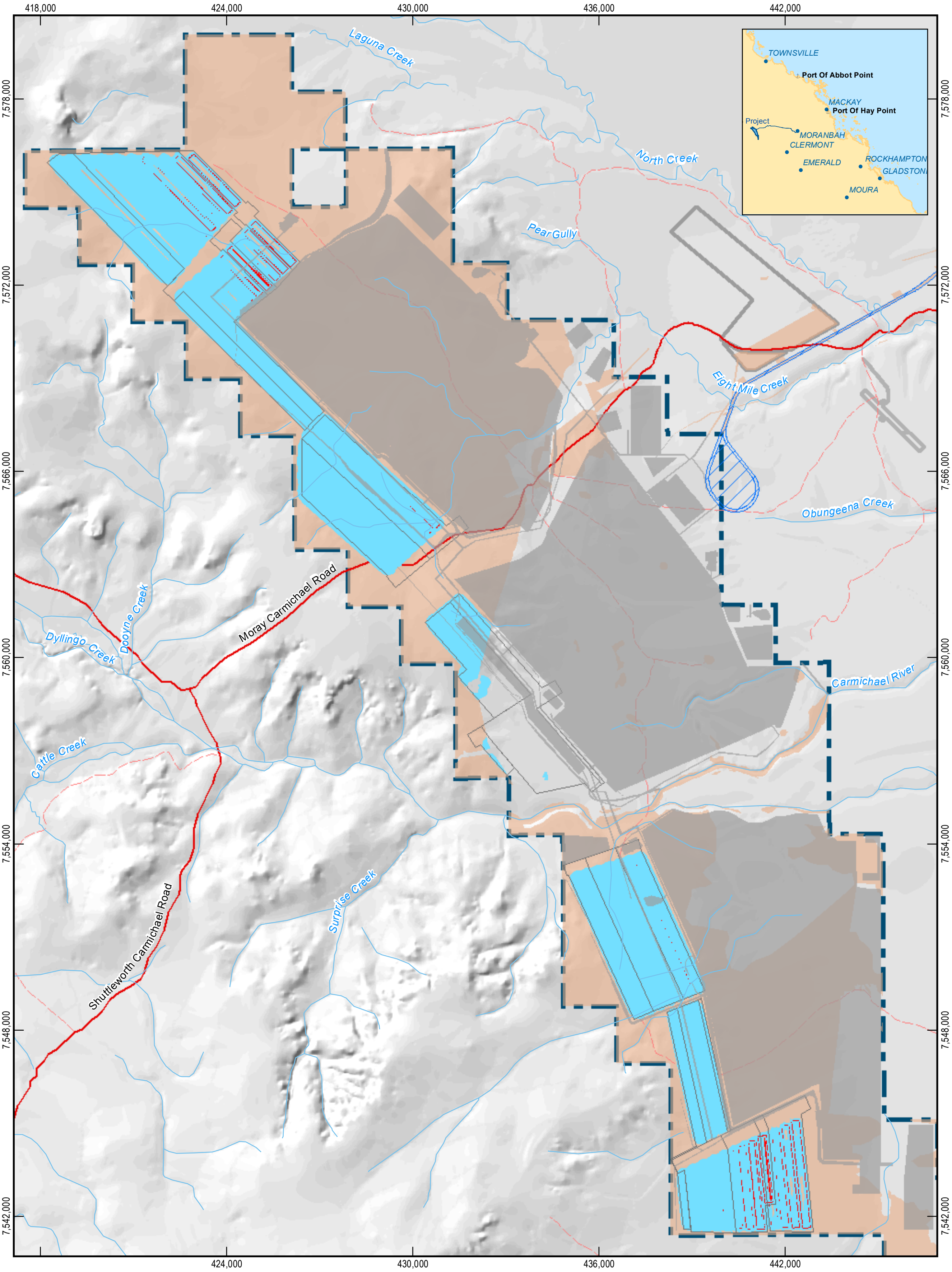
Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013); MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- White-throated needletail habitat - based on DNRM certified Regional Ecosystems version 6.0b
- Project (Rail)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)

Habitat Impact Ranking

- High Impact
- Low Impact

1:175,000 (at A4)

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

White-throated needletail habitat impacted by subsidencel

Job Number	41-26422
Revision	A
Date	17-10-2013

Figure 13

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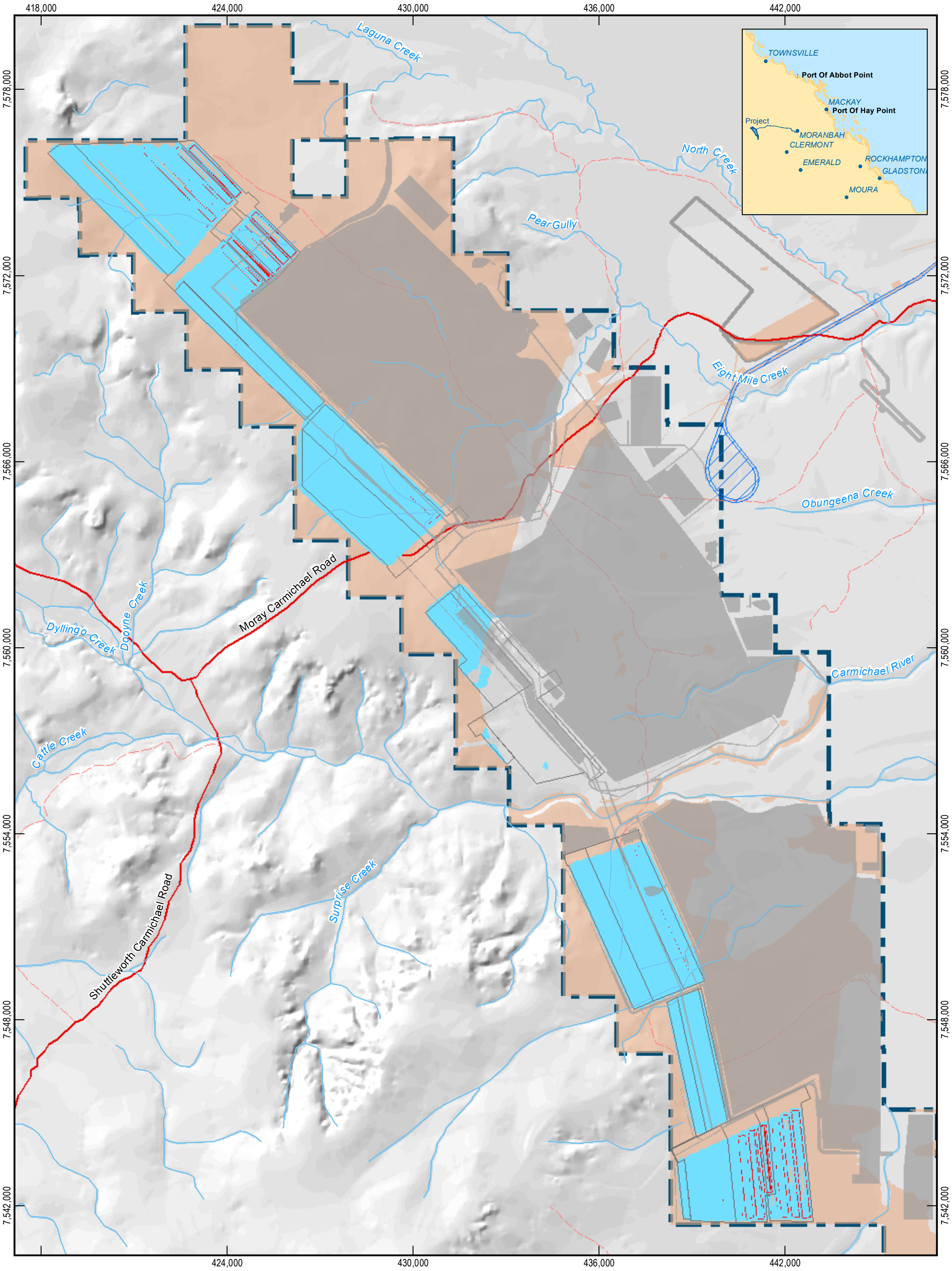
Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013); MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Rainbow bee-eater habitat - based on DNRM certified Regional Ecosystems version 6.0b
- Project (Rail)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)

Habitat Impact Ranking

- High Impact
- Low Impact

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1:175,000 (at A4)

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

Rainbow bee-eater habitat impacted by subsidence

Figure 14

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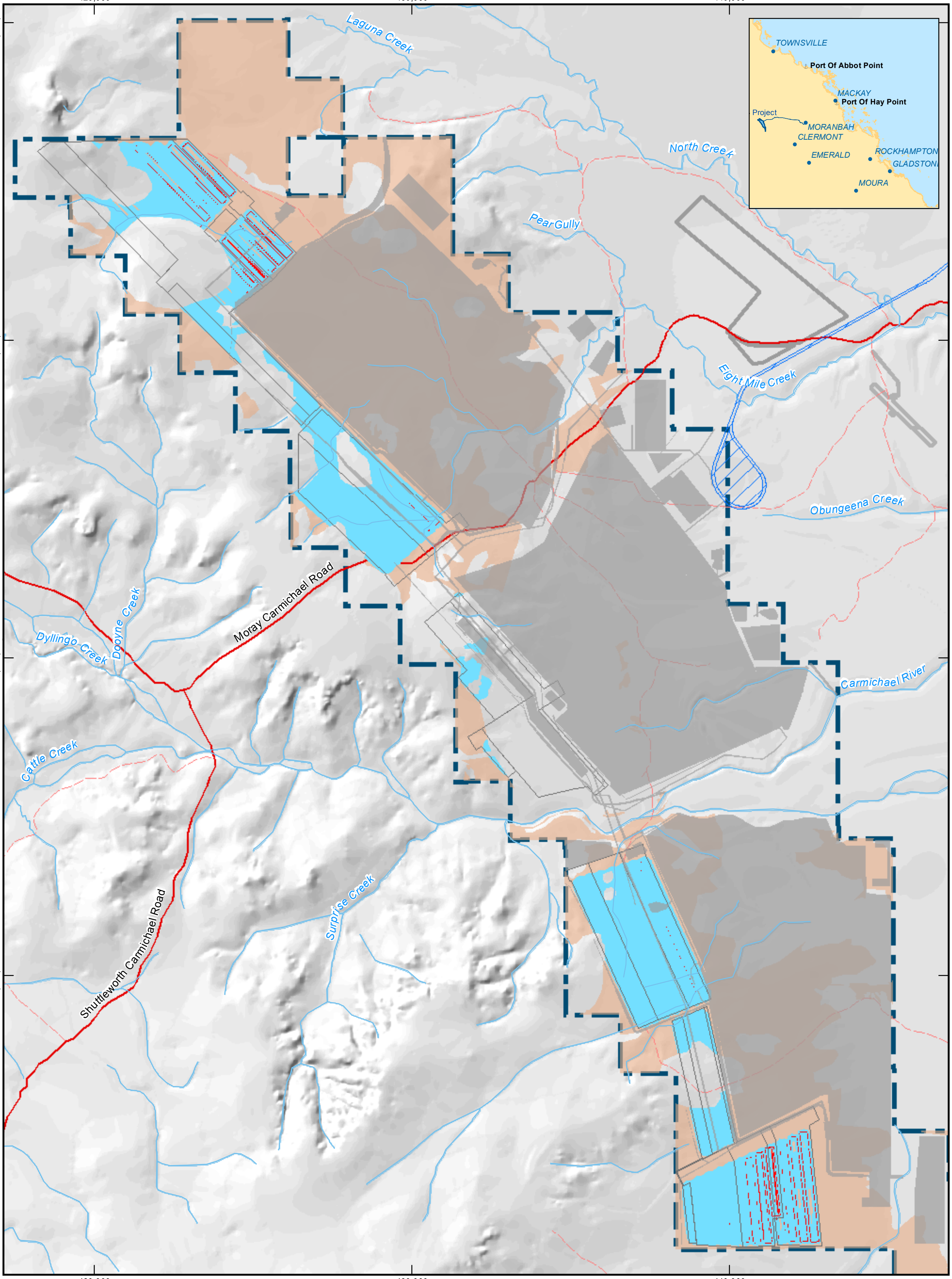
Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013); MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Black-chinned honeyeater habitat - based on DNRM certified Regional Ecosystems version 6.0b
- Project (Rail)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)

Habitat Impact Ranking
- High Impact
- Low Impact

1:175,000 (at A4)

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number	41-26422
Revision	A
Date	17-10-2013

Black-chinned honeyeater habitat impacted by subsidence

Figure 15

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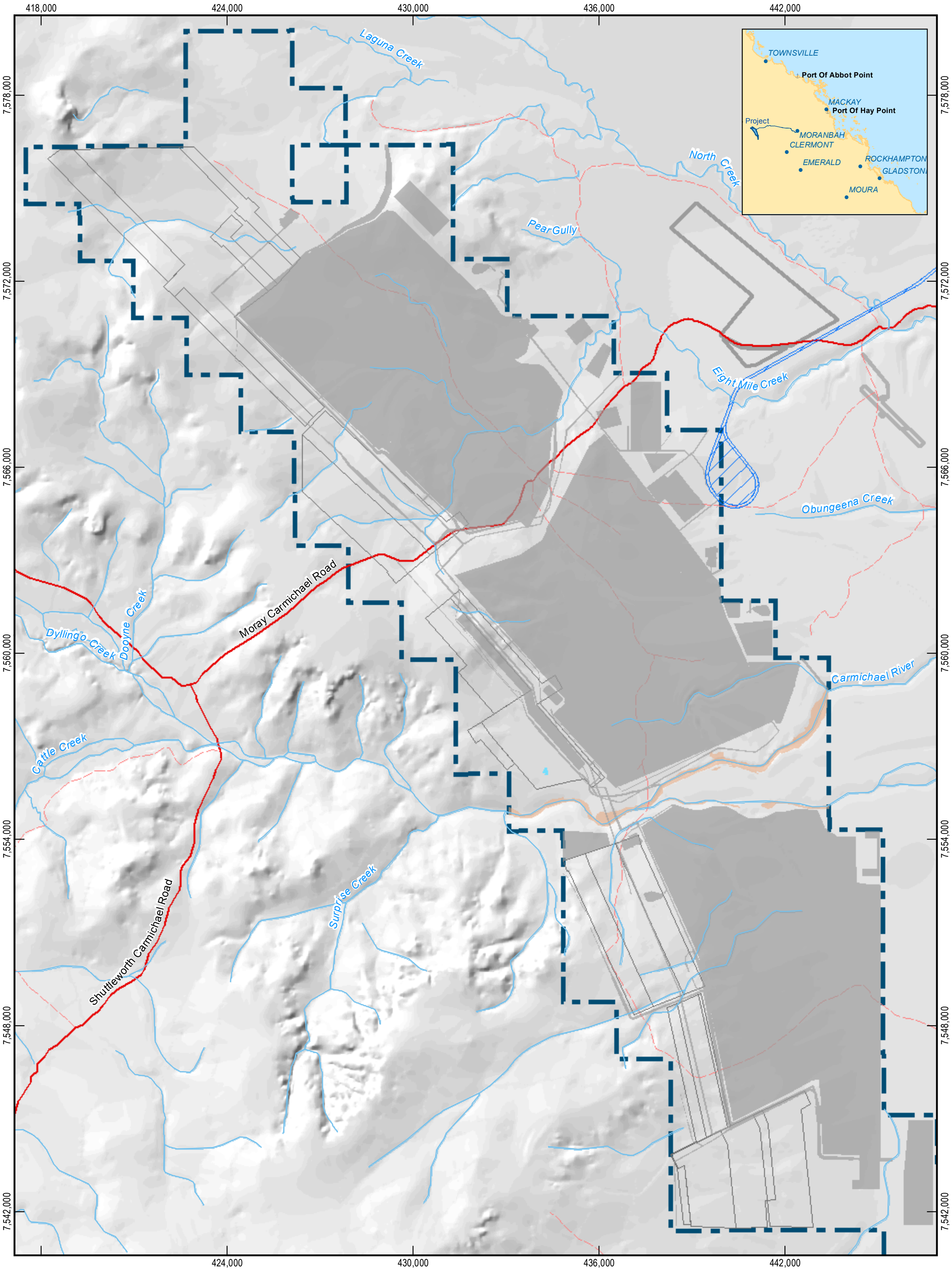
Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013);
MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Satin flycatcher habitat - based on DNRM certified Regional Ecosystems version 6.0b
- Project (Rail)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)
- Habitat Impact Ranking
- Low Impact

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1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

Satin flycatcher habitat impacted by subsidence

Figure 16

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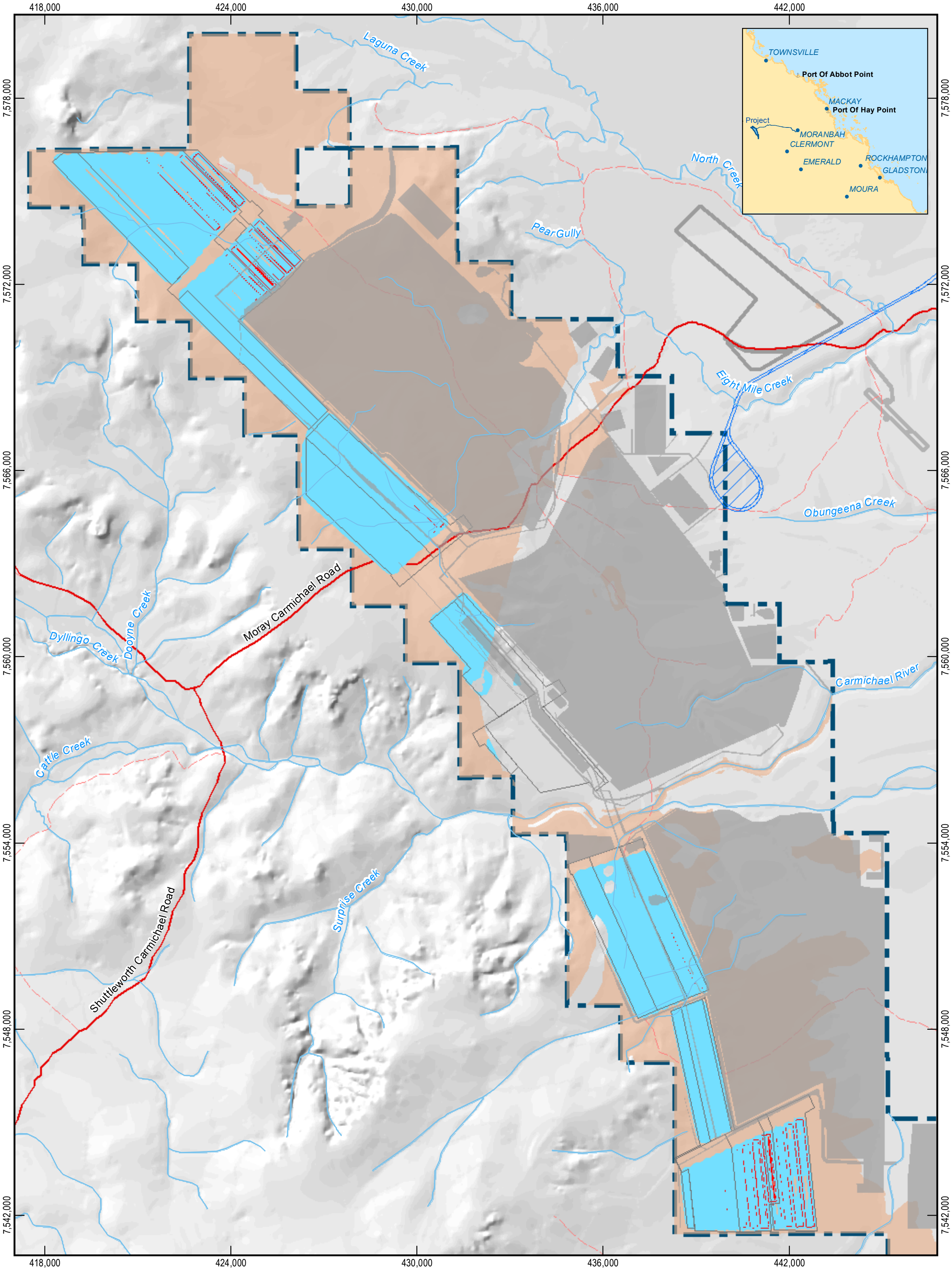
Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013); MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Black-throated finch habitat - based on DNRM certified Regional Ecosystems version 6.0b
- Project (Rail)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)

Habitat Impact Ranking

- High Impact
- Low Impact

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

Black-throated finch impacted by subsidence

Figure 17

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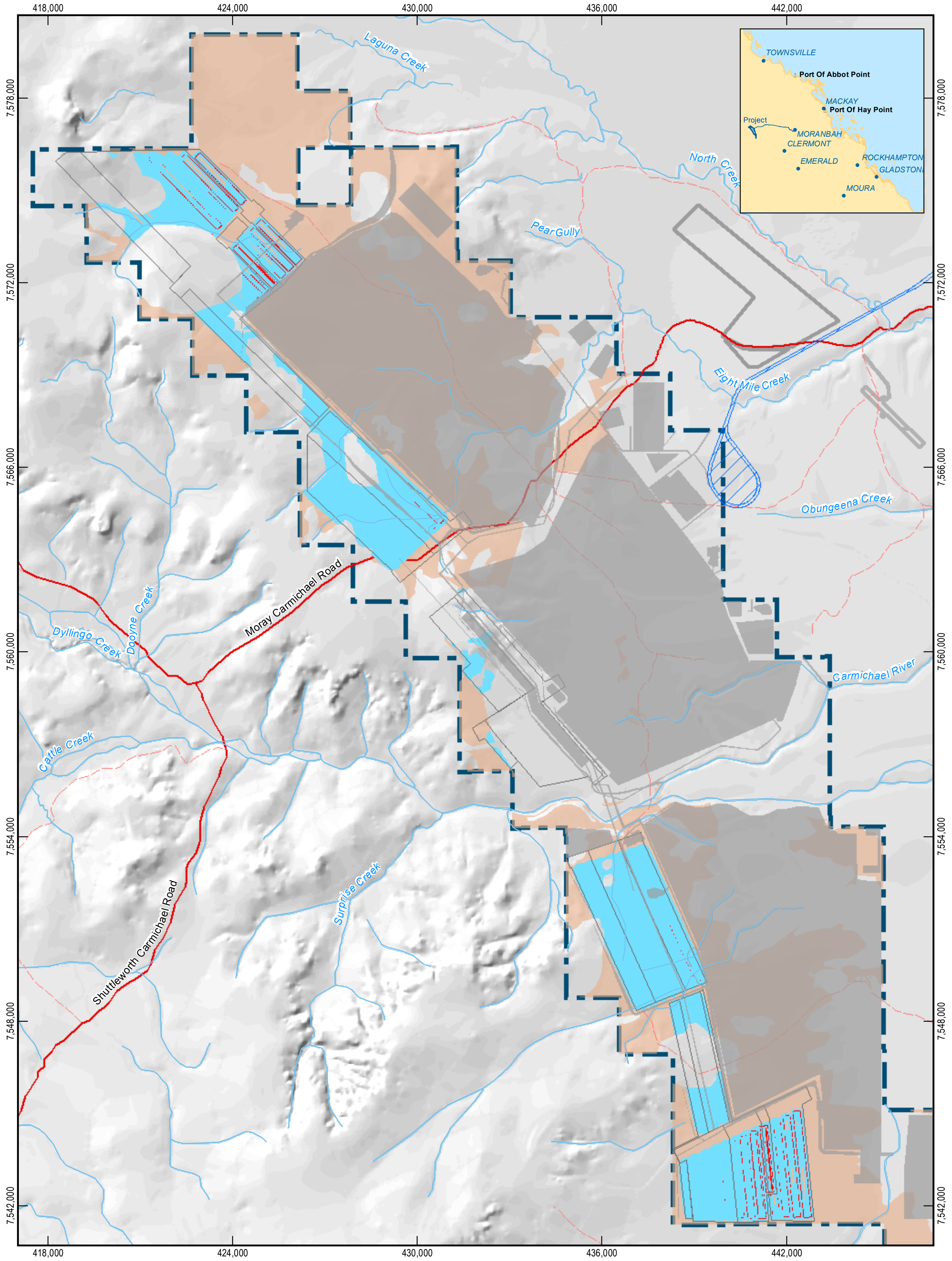
Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013); MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Square tailed kite habitat - based on DNRM certified Regional Ecosystems version 6.0b
- Project (Rail)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)

Habitat Impact Ranking

- High Impact
- Low Impact

Based on or contains data provided by the State of QLD (DERM) [2010]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

Square tailed kite habitat impacted by subsidence

Figure 18

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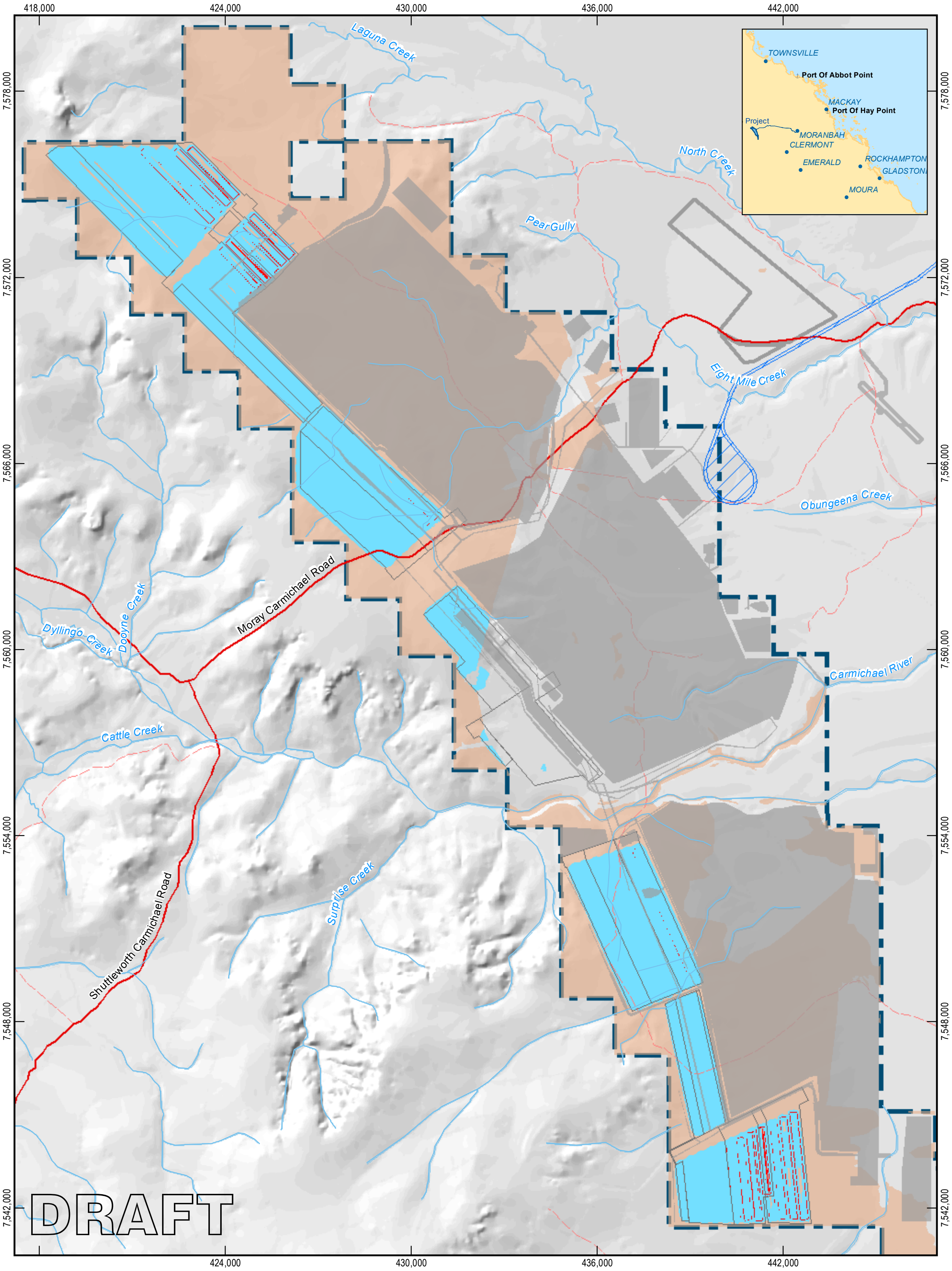
Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013);
MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Little pied bat habitat - based on DNRM certified Regional Ecosystems version 6.0b
- Project (Rail)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)

Habitat Impact Ranking

- High Impact
- Low Impact

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number	41-26422
Revision	A
Date	17-10-2013

Little pied bat habitat impacted by subsidence

Figure 19

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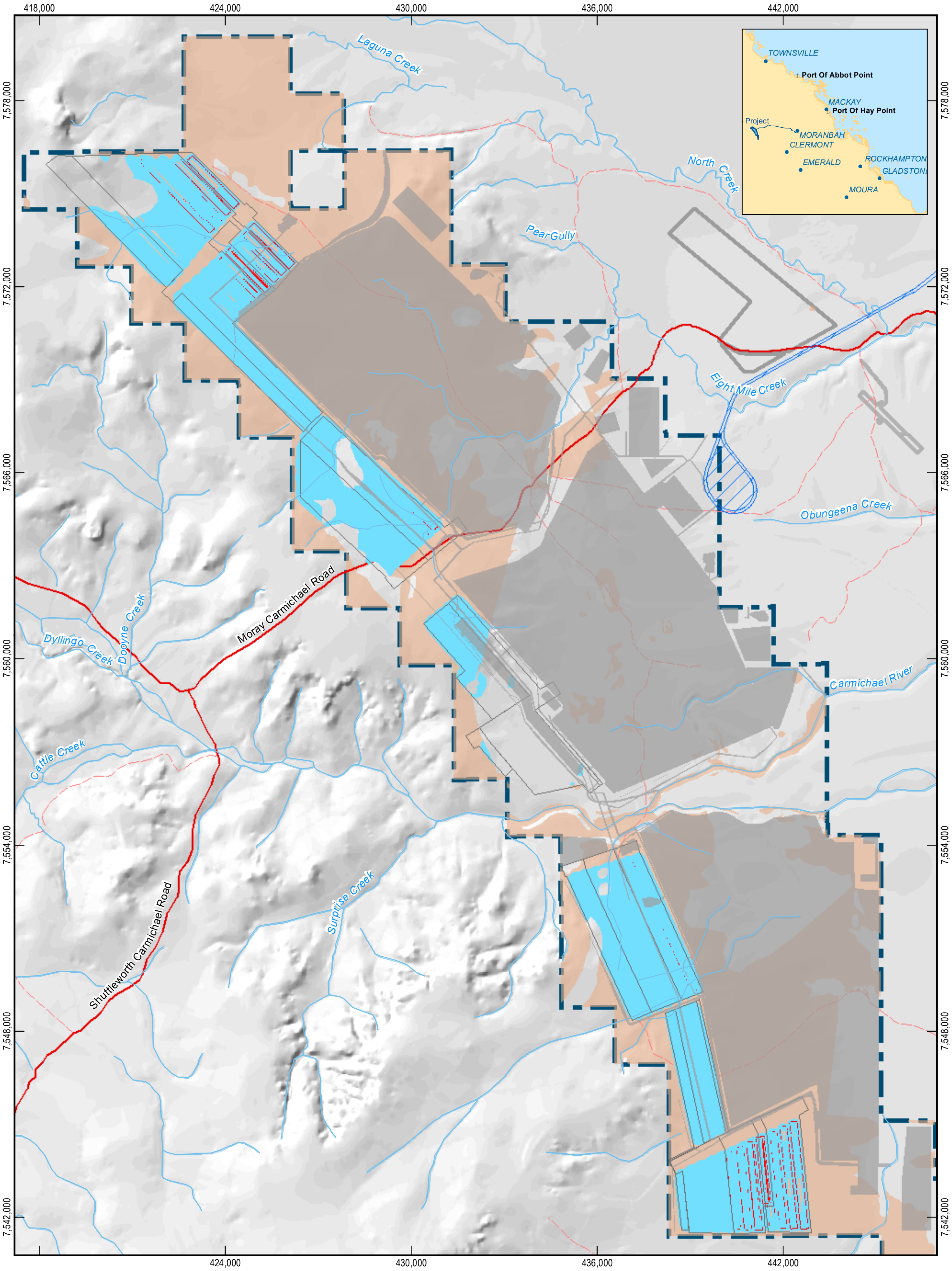
Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013); MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Koala habitat - based on DNRM certified Regional Ecosystems version 6.0b
- Project (Rail)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)

Habitat Impact Ranking

- High Impact
- Low Impact

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

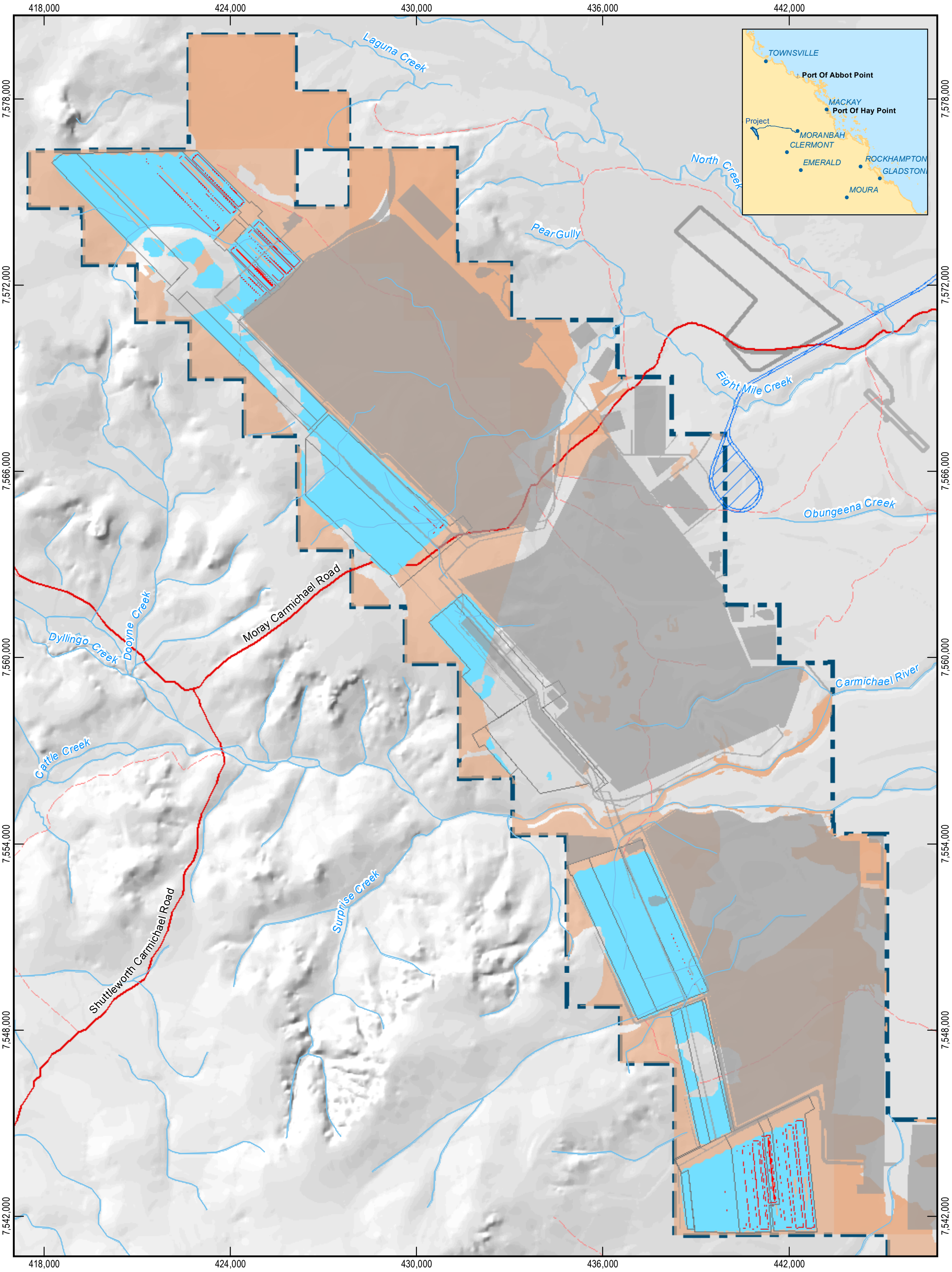
Koala habitat impacted by subsidence

Figure 20

G:\41\26422\GIS\Maps\MXD\0800_Subsidence\41_26422_0818_rev_a.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013); MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Potential Yakka Skink Habitat - Based on DNRM Certified Regional Ecosystems Version 6.0b and CDM Smith Habitat Suitability
- Project (Rail)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)

Habitat Impact Ranking

- High Impact
- Low Impact

Based on or contains data provided by the State of QLD (DERM) [2010]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

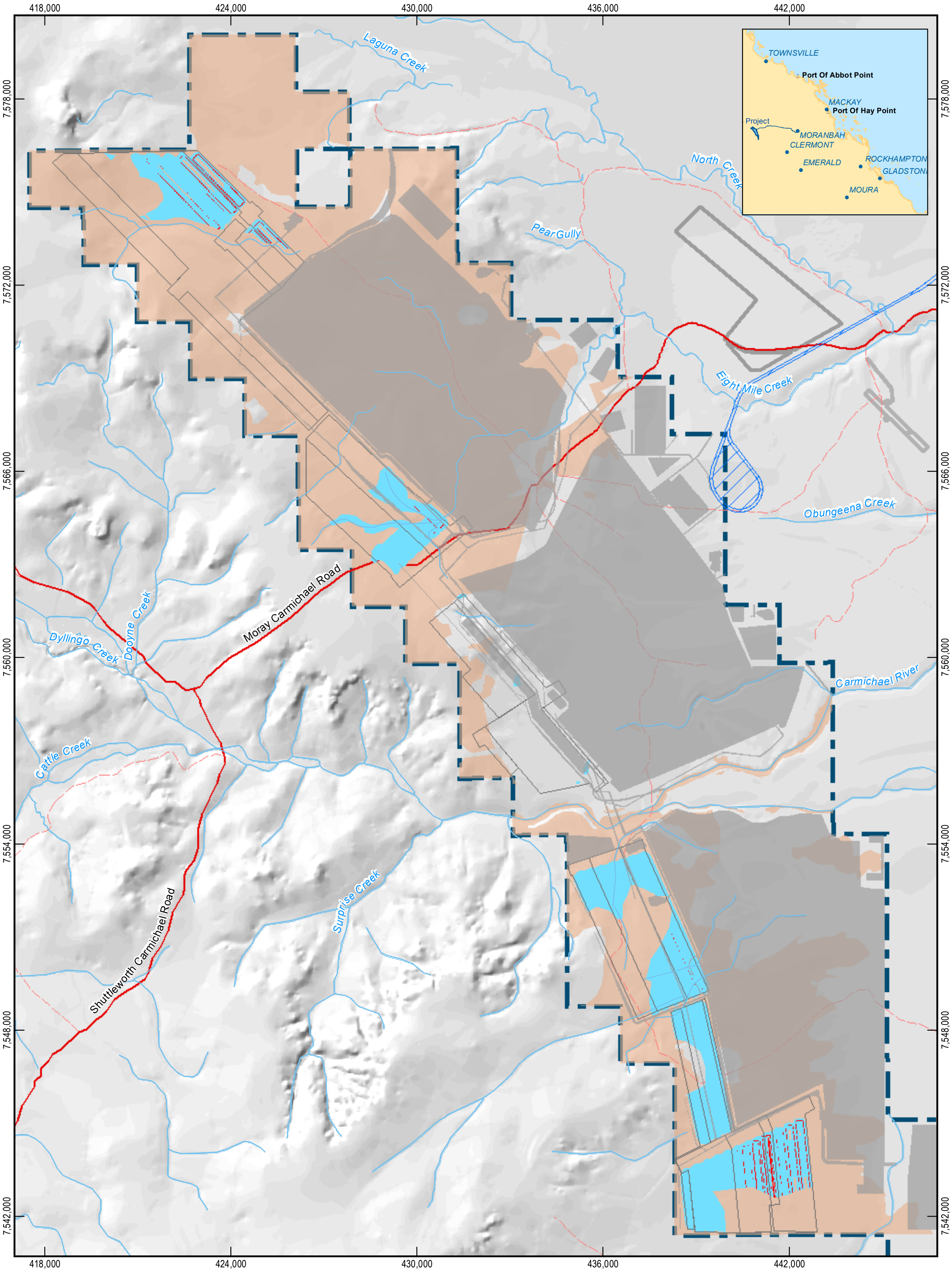
Yakka skink habitat impacted by subsidence

Figure 21

G:\41\26422\GIS\Maps\MXD\0800_Subsidence\41_26422_0825_rev_a.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013); MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- Brigalow scaley-foot habitat - based on DNRM certified Regional Ecosystems version 6.0b
- Project (Rail)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)

Habitat Impact Ranking

- High Impact
- Low Impact

Based on or contains data provided by the State of QLD (DERM) [2010]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

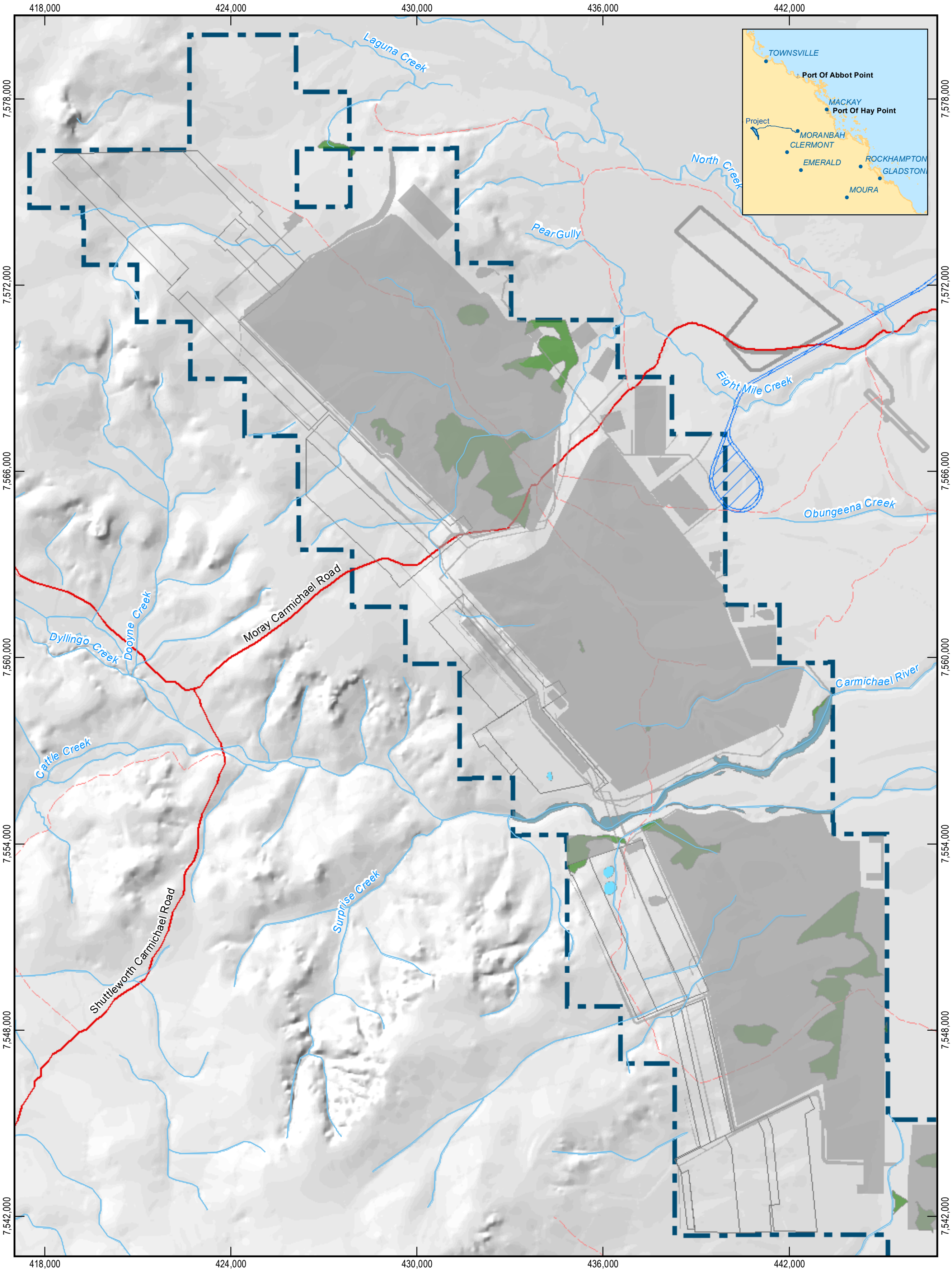
Brigalow scaley-foot habitat impacted by subsidence

Figure 22

G:\41\26422\GIS\Maps\MXD\0800_Subsidence\41_26422_0827_rev_a.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013);
MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

Minor Road
Track
Watercourse

Potential Ornamental Snake Habitat Type
Gidgee and brigalow woodland on clay plains
Open forest and woodland fringing streams and on flood plains

Project (Rail)
Mine Site
Mine (Onsite)
Underground Mine
Mine (Offsite)

Habitat Impact Ranking
Low Impact

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

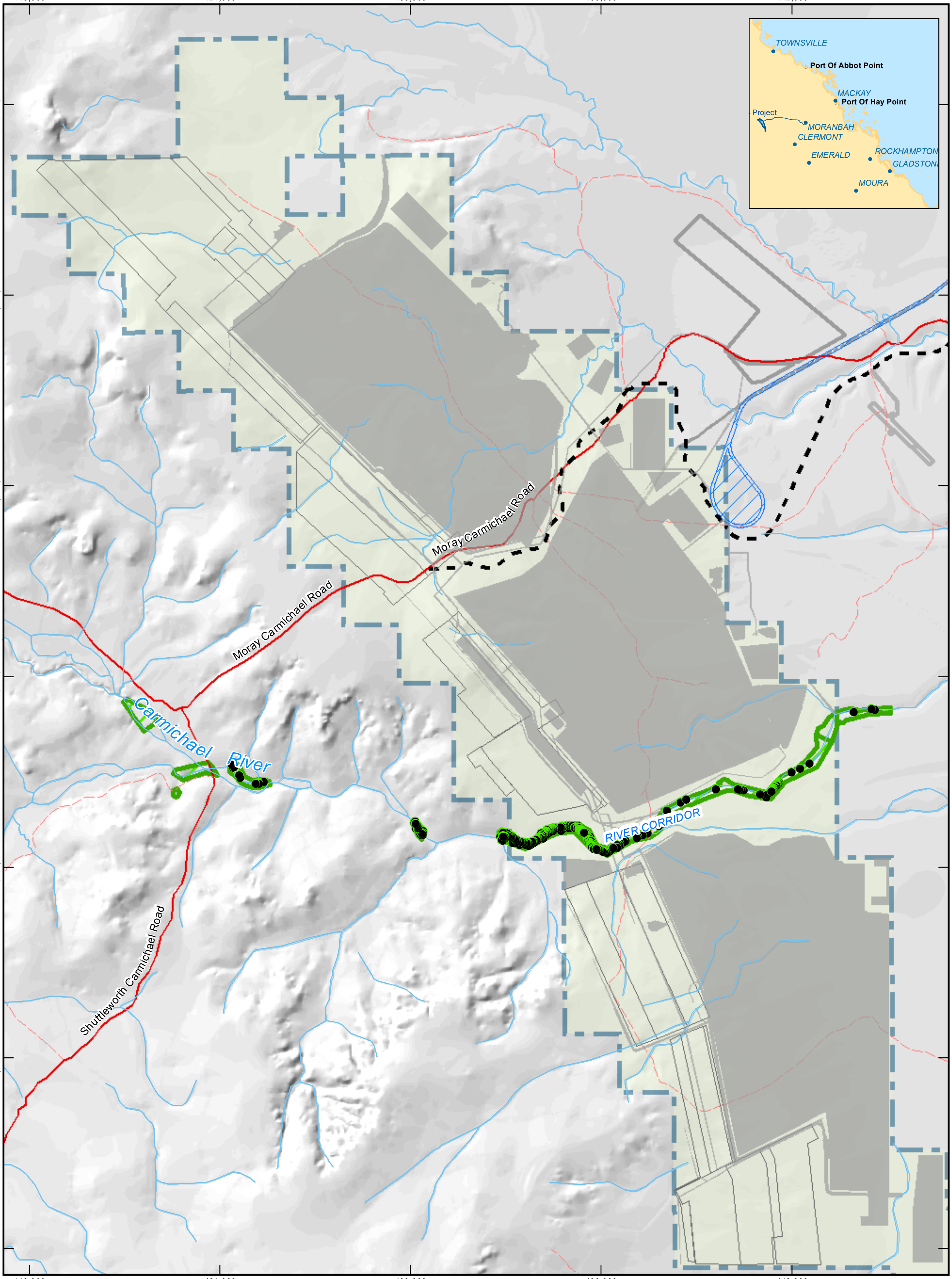
Ornamental snake habitat impacted by subsidence

Job Number	41-26422
Revision	A
Date	17-10-2013

Figure 23

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013);
MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Waxy Cabbage Palm Population
- Minor Road
- Track
- Watercourse
- Livilanu Areas Surveyed
- Rail Corridor
- Mine Site
- Mine (Onsite)
- Underground Mine
- Road Corridor
- Road Corridor (EPC)
- Accomodation Village
- Airport
- Industrial Area

Based on or contains data provided by the State of QLD (DERM) [2010]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

Waxy cabbage palm habitat impacted by subsidence

Job Number	41-26422
Revision	A
Date	17-10-2013

Figure 24

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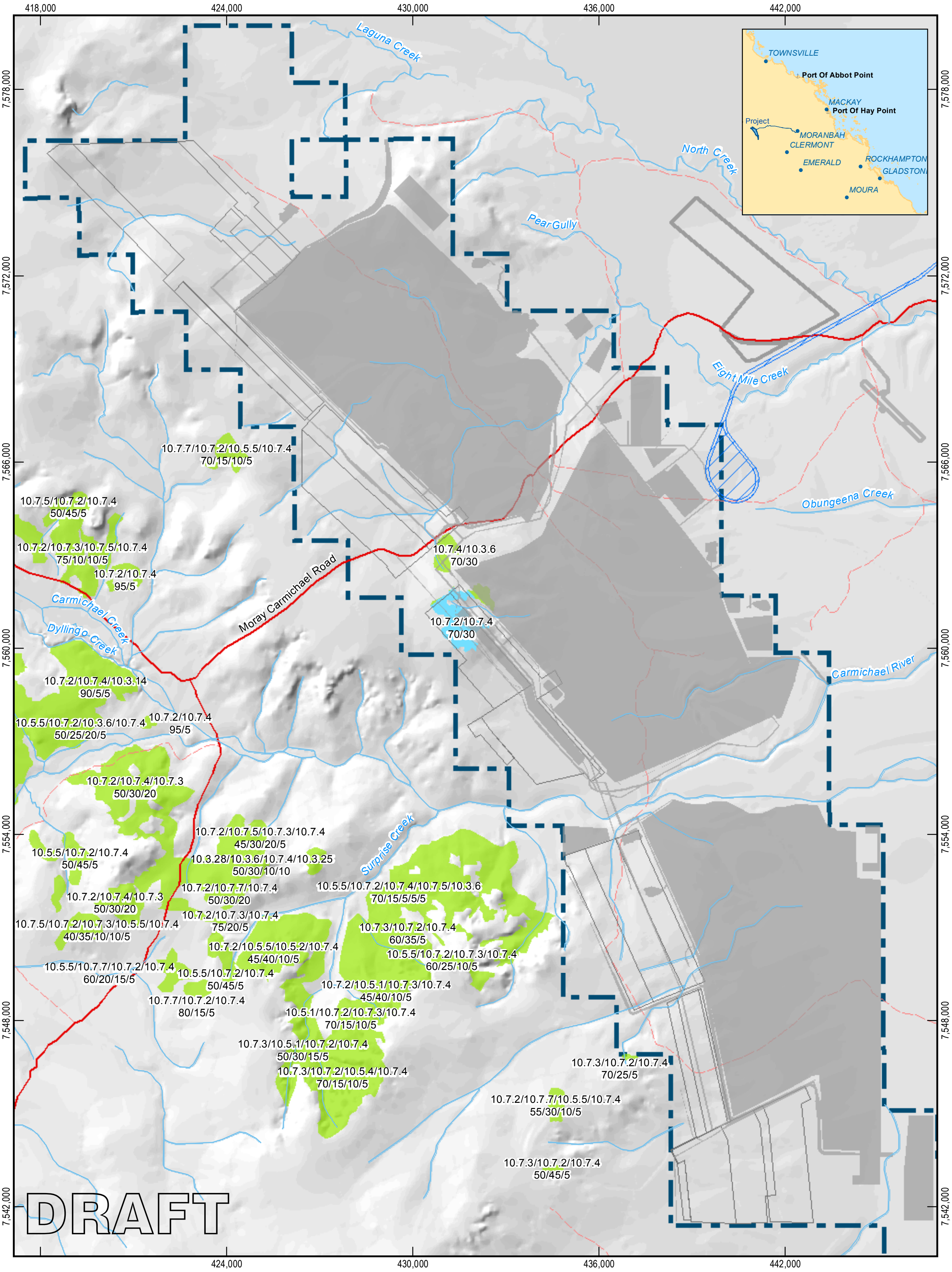
Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013);
msec: Predicted Cracking Contours (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

- Minor Road
- Track
- Watercourse
- *Eucalyptus persistens* low open-woodland on pediments below scarps
- Project (Rail)
- Mine Site
- Mine (Onsite)
- Underground Mine
- Mine (Offsite)

Habitat Impact Ranking
- High Impact
- Low Impact

1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

Eucalyptus persistens low open-woodland on pediments below scarps impacted by subsidence

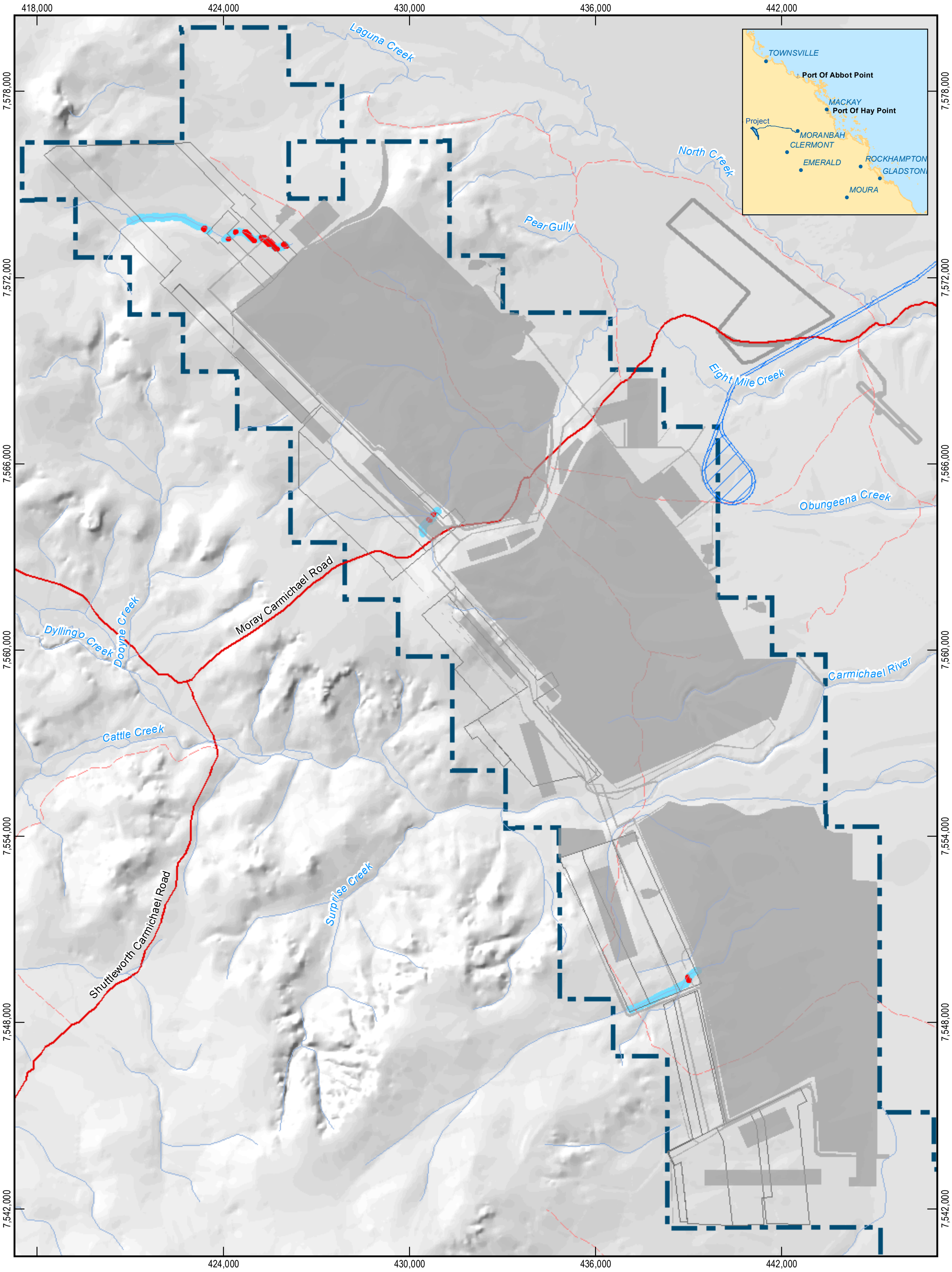
Job Number	41-26422
Revision	A
Date	17-10-2013

Figure 25

G:\41\26422\GIS\Maps\MXD\0800_Subsidence\41_26422_0821_rev_a.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013); MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: RE 10.7.4 (2011). Created by: MS



LEGEND

Minor Road	Watercourses (stream order 2 only)	Project (Rail)	Mine (Onsite)	Habitat Impact Ranking
Track		Mine Site	Underground Mine	High Impact
Watercourse			Mine (Offsite)	Low Impact

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1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

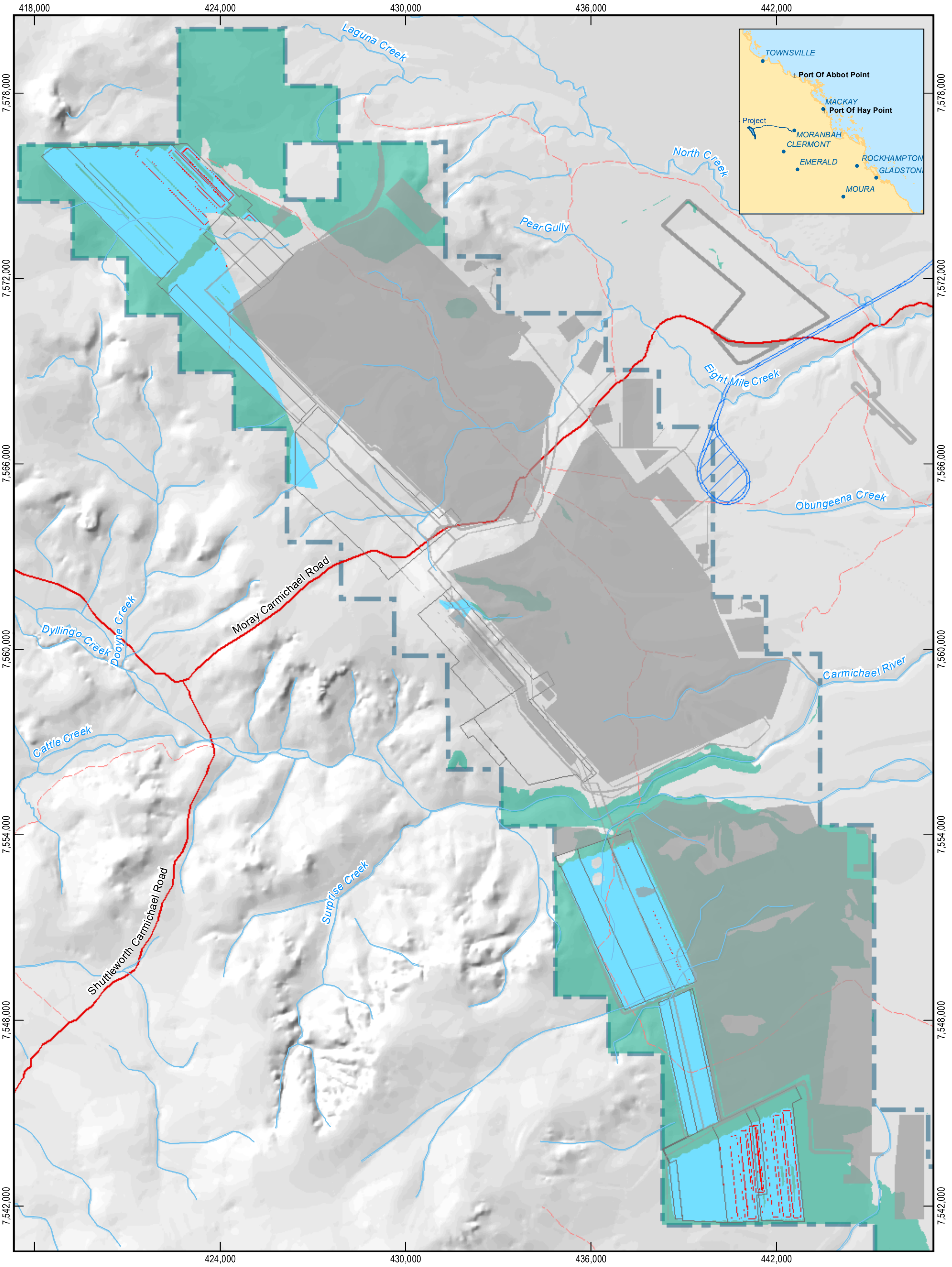
Watercourses impacted by subsidence

Figure 26

G:\41\26422\GIS\Maps\MXD\0800_Subsidence\41_26422_0822_rev_a.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013);
MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Potential Habitat (2013). Created by: MS



LEGEND

Minor Road
Track
Watercourse
Connectivity
Project (Rail)
Mine Site
Mine (Onsite)
Underground Mine
Mine (Offsite)
Habitat Impact Ranking
High Impact
Low Impact

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1:175,000 (at A4)

0 2 4 6

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number 41-26422
Revision A
Date 17-10-2013

Connectivity impacted by subsidence

Figure 27

G:\41\26422\GIS\Maps\MXD\0800_Subsidence\41_26422_0823_rev_a.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Mine (Offsite) (2013), Mine (Onsite) (2013); MSEC/GHD: Cumulative Impact Ranking (2013); DNRM: Biodiversity Planning Assessment (2010). Created by: MS