

Appendix J

Soils, contamination and groundwater assessment
and addendum

Environmental impact statement

Murrumbidgee River to Googong Water Transfer Project

Soils, Contamination and Groundwater Assessment

June 2009

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Abbreviations

ACT	Australian Capital Territory
ACTEW	ACTEW Corporation Limited
Ba	Burra Soil Landscape Unit
bgl	Below Ground Level
Ca	Campbell Soil Landscape Unit
CEMP	Construction Environmental Management Plan
CLM Act	<i>Contaminated Land Management Act 1997 (NSW)</i>
Cza	Cainozoic Sediments Geological Unit
DCLM	Department of Conservation and Land Management
DECC	Department of Environment and Climate Change
DP	Part of a lot and DP number (development)
DWE	Department of Water and Energy
EP Act	<i>Environment Protection Act 1997 (ACT)</i>
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i>
EPA	Environment Protection Agency
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
ft	Feet
GHD	GHD Pty Ltd
Go	Murrumbidgee Gorge Soil Landscape Unit
GW	Groundwater bore number
H:V	Horizontal by Vertical linear slope
HLPS	High Lift Pump Station
km	Kilometre
LGA	Local Government Area
LLPS	Low Lift Pump Station
LPI	Land and Property Information
m	metre
M2G	Murrumbidgee to Googong Water Transfer Project
ML / d	Mega Litres per day
NC Act	<i>Nature Conservation Act 1980 (ACT)</i>

NES	National Environmental Significance
NSW	New South Wales
PD Act	<i>Planning and Development Act 2007 (ACT)</i>
pH	Potential Hydrogen
POEO Act	<i>Protection of the Environment Operations Act 1997 (NSW)</i>
Q1	Flood level of a 1:100 year flood
Sb	Colinton Volcanics (Bransby Shear Zone) Geological Unit
Sc	Colinton Volcanics Geological Unit
Sd	Deakin Volcanics Geological Unit
Sp	Intrusions Geological Unit
Wi	Williamsdale Soil Landscape Unit
WR Act	<i>Water Resources Act 2007 (ACT)</i>

1 Introduction

1.1 Purpose of this report

ACTEW Corporation Limited (ACTEW) proposes to undertake the Murrumbidgee to Googong (M2G) Water Transfer Project (referred to in this report as 'the project'). This report has been prepared to provide an assessment of the topography, geology, soil and groundwater impacts of the project as an input to the environmental impact assessment. The environmental impact assessment is being prepared in accordance with the requirements of Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and the ACT *Planning and Development Act 2007* (PD Act).

The report addresses the requirements of the Director-General of the NSW Department of Planning (the Director-General's Requirements) dated 7 October 2008 and the Final Scoping Document prepared by the ACT Planning & Land Authority (the Scoping Document) dated 16 December 2008.

1.2 Project overview

In recent years the Australian Capital Territory (ACT) region has been experiencing severe drought conditions coupled with increased demand for water. Canberra and Queanbeyan have been subject to level three water restrictions since 2006. The current drought, together with predicted climate change and population growth, is driving the search for a more reliable water supply for the ACT. In response to this need, the ACT Government developed the Water Security Program, which identified a range of new water supply projects.

The project is one of the preferred options for delivering improved security to the ACT's water supply. It involves pumping water from the Murrumbidgee River (within the ACT) and transferring it via a pipeline to the Googong Reservoir via Burra Creek (in NSW). The Googong Reservoir supplies water treated to drinking quality standards to the ACT.

The project involves construction and operation of infrastructure for the transfer of approximately 100 ML / day of water a distance of approximately 13 km from the Murrumbidgee River to Burra Creek.

The infrastructure required to transfer the water includes an intake / low lift pump station (LLPS); a high lift pump station (HLPS) and associated power supply; an underground pipeline; and a discharge structure.

1.3 The location of the project

The intake / LLPS would be located on the east bank of the Murrumbidgee River, in the ACT, approximately 34 km south of Canberra. It would be located in an area known as Angle Crossing, approximately 4 km west of Williamsdale on the Monaro Highway. The HLPS would be located within the ACT, approximately 290 m to the east of the intake / LLPS.

The pipeline would cross rural land in an east / north-east direction for approximately 13 km. It is located in the vicinity of Williamsdale and Burra Roads, within the districts of Williamsdale and Burra. The majority (approximately 10.2 km) of the pipeline would be located in NSW, with approximately 2.8 km located in the ACT.

Water transferred from the Murrumbidgee River would discharge at the discharge structure, located on the banks of Burra Creek, just downstream of an existing flow measuring station, approximately 10 km south of Googong Reservoir. The discharge structure is located within land known as the Googong Foreshores, which is Commonwealth land within NSW.

The project location is shown in Figure 1.1.

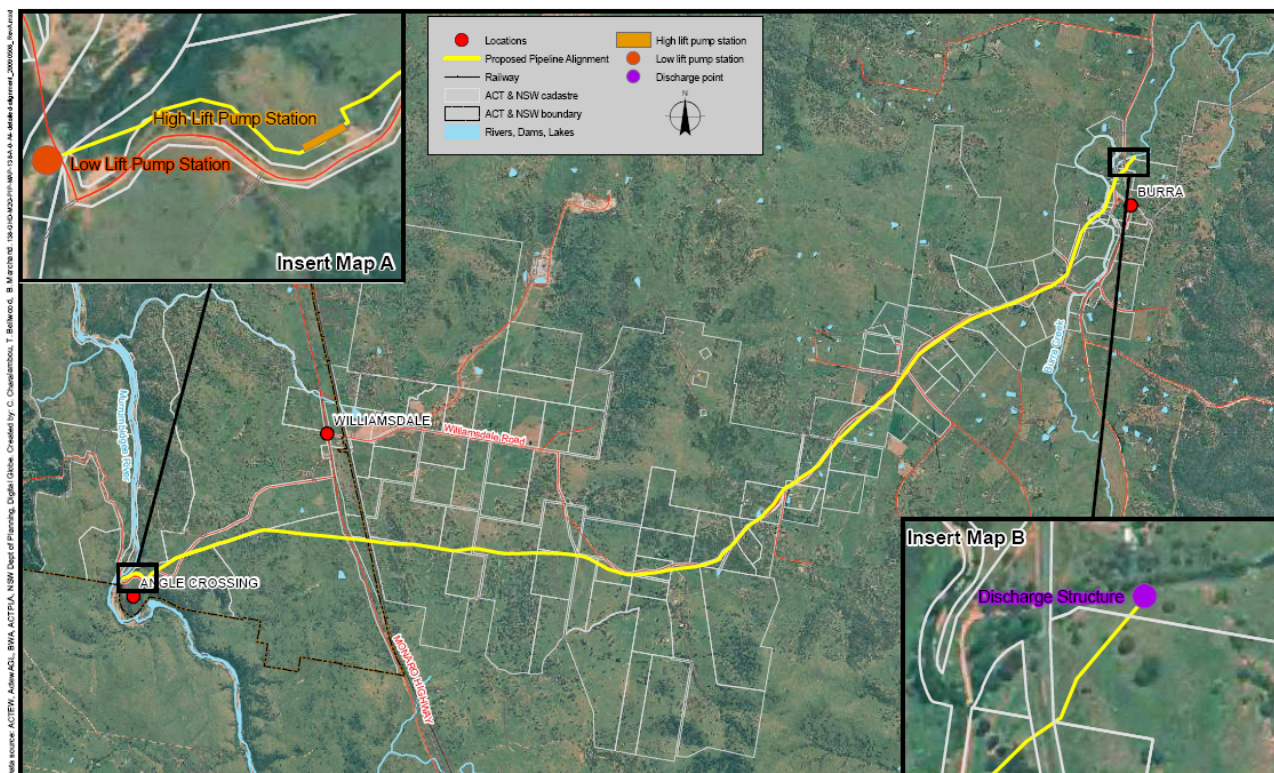


Figure 1.1 Project site

1.4 Scope of work

This impact assessment report involved the following scope of work:

- Preparing an overview of the proposed development;
- Identifying the likely activities that would be undertaken to construct and operate the proposed development;
- Undertaking a desktop assessment to investigate the existing environmental setting in terms of landscapes, geology, soil, groundwater and potential contaminated land. The desktop assessment included a review of available information such as soil and geological maps, topographical plans, aerial photographs, searches of online databases and a walkover survey of the proposed alignment;
- Assessing the potential impacts of the proposed development on the landscapes, geology, soil, and groundwater and the impact of potentially contaminated land on the proposed development; and
- Recommending mitigation measures to minimise or eliminate potential impacts.

1.5 Limitations

This impact assessment report:

- Has been prepared pursuant to a Bulk Water Alliance contract;
- Has been prepared on the basis of published geological and soil landscape maps, aerial photographs and information held in groundwater bore and contaminated sites databases, which GHD has not independently verified or checked;
- Has been prepared based on the proposed pipeline route current at the time of writing (the pipeline route may change);
- Is for the purposes of providing information for the preparation of environmental impact assessment documents;

- Must not be used (1) by any person other than the Bulk Water Allowance, or (2) for a purpose other than for providing information for the preparation of environmental impact assessment documents; and
- Must not be copied without the prior written permission of the Bulk Water Alliance.

GHD, its servants, employees or officers accept no responsibility to any person other than the Bulk Water Alliance in connection with the document.

2 Proposed development

2.1 Expected construction activities

2.1.1 ACT

Angle Crossing Intake Structure / Low Lift Pump Station

The proposed intake structure / LLPS would be situated on the east bank of the Murrumbidgee River at Angle Crossing, upstream from the existing causeway (Angle Crossing Road river crossing). The water intake structure would take the form of a 'box-in bank' cast insitu concrete structure similar to that shown in Figure 2.1 and Figure 2.2.

The structure would likely require an excavation of 4 m to 5 m depth (totalling approximately 2,000 m³) in the river bank and therefore a coffer dam is proposed to create a dry work zone for construction (BWA 2009). This coffer dam would be designed to withstand a Q1 flood event and would be in place for the entire construction period (BWA 2009). The coffer dam would comprise of H-piles embedded into the underlying rock with horizontal whalers providing support for vertical sheet-piles (BWA 2009). Excavation of soil materials using conventional earthmoving equipment and underlying bedrock using rock-breakers (hydraulic hammers) would then be possible.

Continuous sump pumping from the groundwater would also be required to create dry working conditions for concrete construction. It is also expected that the excavation of soil materials would extend below the water table, in which case this would required the excavation walls to be either battered or mechanically supported to avoid collapse.

Access to the LLPS would be provided off the existing Angle Crossing Road. A construction site compound (approximately 760 m²) and a pipe lay down area (approximately 2,300 m²) would be made available during construction (Figure 2.3).

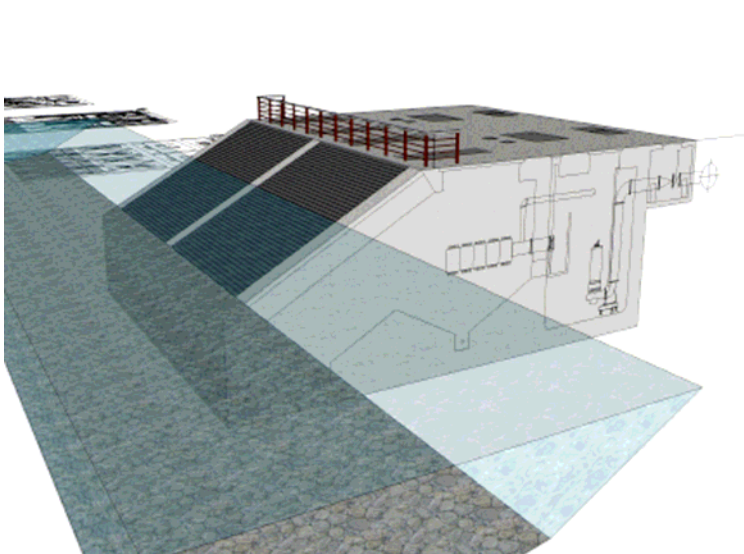


Figure 2.1 Example of proposed intake structure



Figure 2.2 Visual representation of intake structure of Angle Crossing

Angle Crossing high-lift pump station

The HLPS would be located adjacent to Angle Crossing Road, approximately 290 m east of Angle Crossing causeway. The structure would be an architecturally designed and would include a pump hall and an electrical services/amenities building. A visual representation of the HLPS is shown in Figure 2.4.

The proposed location would likely require cut-to-fill earthworks to prepare the foundation pad. A change in the grading of the road at the frontage of the HLPS would be needed to raise and flatten the section at the truck bay entrance to allow easier vehicle access. Approximately 3,000 m³ of soil would be disturbed and excavated for this structure to be constructed.

A site office and crib facilities (approximately 5,500 m²) and a pump station, pipe lay down and storage facility (approximately 4,200 m²) would be established during construction (Figure 2.3).

Figure 2.3 Site Compounds within the ACT.

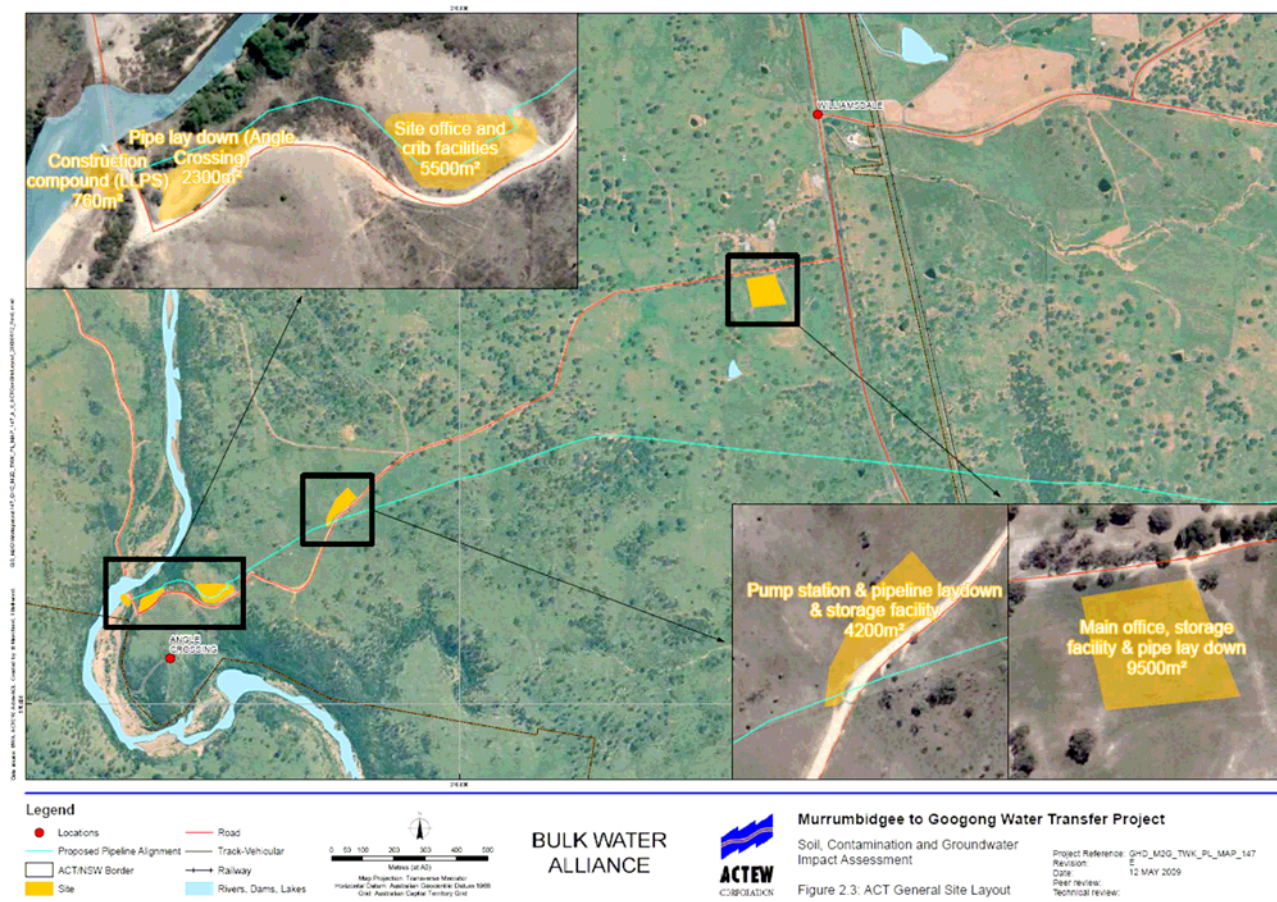


Figure 2.4 Visual representation of the HLPS structure near Angle Crossing



2.1.2 Pipeline (ACT and NSW)

The 1 m diameter buried pipeline would contain above ground isolation valves, air valves and scour valves. The scour valves would be designed to drain waters and sediment from low-elevation sections of the pipeline during maintenance activities.

Minor road realignment along Williamsdale Road is anticipated to be carried out after the pipeline has been installed.

Approximately 55,250 m³ of soil would be excavated to install the pipeline long the entire length of the alignment. Within the ACT, a pump station, pipe lay down and storage facility (approximately 4,200 m²) as well as a main office, storage facility and pipe lay down area (approximately 9,500 m²) would be made available during construction (Figure 2.3). Within NSW, three site compound areas would be established during construction (Figure 2.5):

- Pipe lay down (Williamsdale Road) – approximately 1,300 m²;
- Spoil and pipe storage (Williamsdale Road) – approximately 1,300 m²; and
- Pipe lay down and material storage (Williamsdale Road) – approximately 5,800 m².

Pipe trench excavation

It is understood that the pipeline would be laid in a shallow continuous trench, with an average depth of cover to the top of the pipe of approximately 800 mm, and an average depth to pipe invert of approximately 2000 mm. It is expected that the excavation of soils could be undertaken using conventional earthmoving equipment and / or trench excavating equipment. Top soil would be stockpiled to one side of the trench. Seeding of the stockpiles and the installation of silt barriers would be used to minimise the loss of topsoil during construction.

The typical volume of excavated material would be approximately 5 m³ per linear metre of pipeline with approximately 2.3 m³ of excess material per metre length. Most of this excavated material would be suitable for backfilling, however approximately 29,835 m³ of spoil would remain. The quantity of spoil would increase if the material is not suitable for backfilling the excavation, which could occur if trenching were to be undertaken in weathered rock.

It is expected that trenching through the railway line on the ACT / NSW border would occur. This would be facilitated by temporarily removing a small portion of the railway line and reinstating this portion once the pipeline has been laid.

Pipeline Directional Drilling

It is understood that directional drilling may be undertaken beneath the Monaro Highway. Directional drilling would require the excavation of a 'launch pit', at the start of the directionally drilled section, of a suitable size to contain the drill equipment, casing and pipe lengths, and sump pumping equipment. Similarly, a 'receiving pit' would be excavated at the end of the directionally drilled section on the opposite side of the Monaro Highway. It is envisaged that pit walls would be battered back to approximately 2H:1V slope.

The quantity of spoil generated during direction drilling would be minimal compared to that which would be generated during trenching. However, some spoil is expected to be generated following the backfilling of the launch and receiving pits.

2.1.3 Burra Creek Outlet Facility (Commonwealth land)

The actual discharge point is located approximately 100 m downstream of the Burra Road Bridge and is also located downstream of the gauging weir on Burra Creek. The installation of the outlet facility would require excavation into the creek bank up to approximately 3.5 m depth (upslope) and approximately 10 m in length, in a direction parallel to the creek alignment. Approximately 220 m² of soil would be excavated for this structure to be constructed.

The discharge structure would take the form of a weir box arrangement (Figure 2.6). The proposed design of the outlet facility comprises a cast in situ concrete outfall structure, which would be located within Burra Creek just east of Burra Road. The pipeline would terminate at this structure. Access to this structure would be provided by a bitumen sealed road, which would also provide access to the temporary Burra Creek Compound.

The incoming pipe would be centred on a 2 m high end wall. Water would flow into the weir box from the pipe and would well up to flow over a 10 m long weir located on the sidewall closest to the creek. Once discharged over the weir, the water would run down the creek bank to meet the creek water level prevailing at the time. It is proposed to install a rock fill mattress across the creek bed to prevent scour and erosion in the vicinity of the outfall weir.

The excavation at this location is likely to encounter bedrock. The excavation works to accommodate the outlet structure would be carried out using standard earthmoving equipment (i.e. an excavator fitted with a hydraulic rock-breaker) positioned on the river bank slope. Continuous sump-pumping of groundwater water seeping into the excavation may be required during temporary works.

A discharge structure lay down area (approximately 2,600 m²) would be made available during construction (Figure 2.5).

Figure 2.5 Site compounds within NSW and Commonwealth jurisdictions

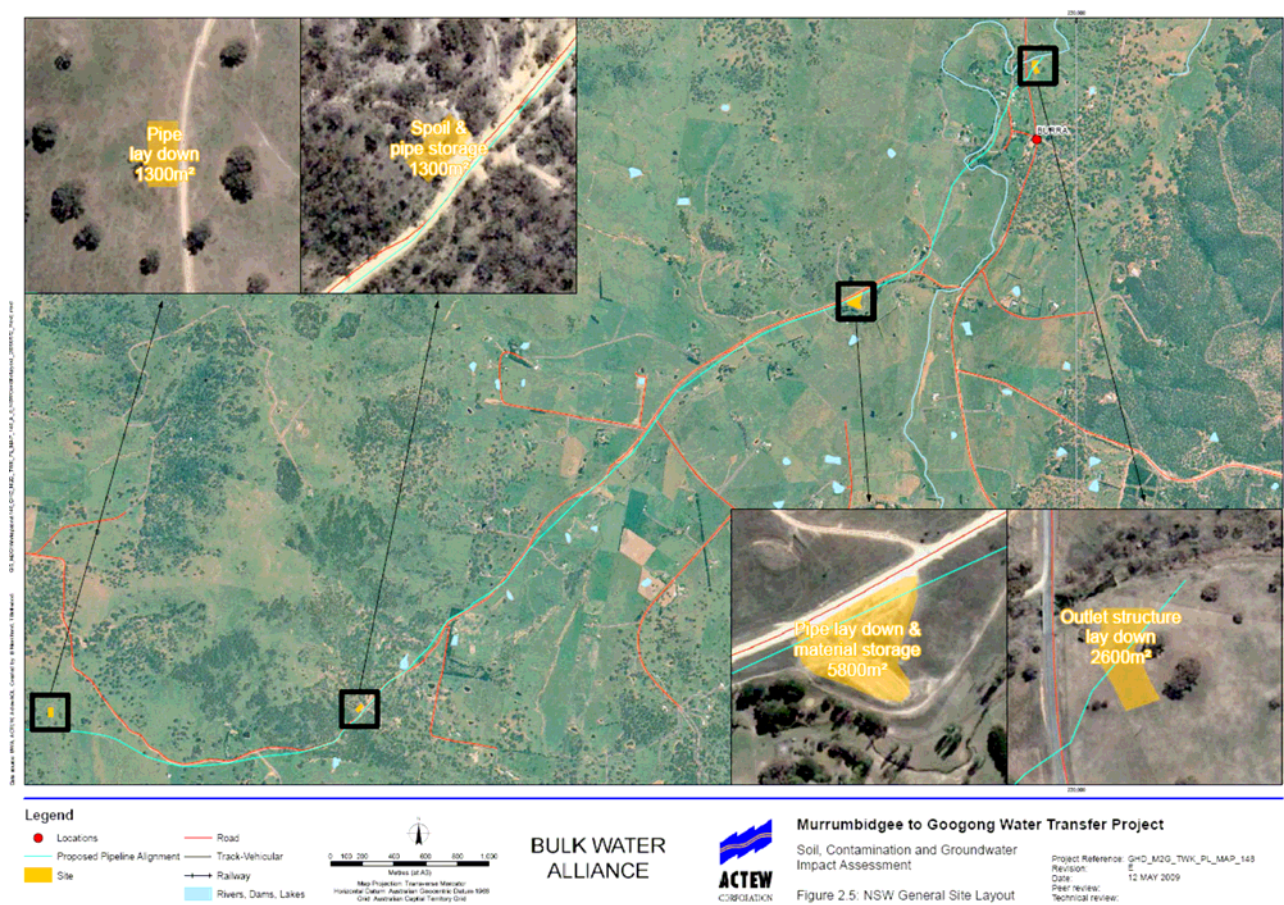




Figure 2.6 Visual representation of discharge structure

2.2 Expected operation activities

2.2.1 Angle Crossing Intake Structure / LLPS and HLPS

Minor maintenance of the intake facility / LLPS and HLPS would need to be conducted on a regular basis. Minor quantities of oils, fuels and chemicals, needed for the operation of the structures would require storage on-site.

2.2.2 Pipeline (ACT and NSW)

Once the pipeline is installed and the trench backfilled, the disturbed areas along the route and land access points would be stabilised, rehabilitated and revegetated. Future maintenance activities would likely result in soil excavations that would be needed to access the pipeline. Similar rehabilitation practices would be implemented following maintenance activities.

The pipeline would have associated air valves and scour valves, installed on crests and sags along the pipeline, which would be permanent above ground structures. Releases of water from these valves, during maintenance activities for example, and the valves themselves would have a minor impact on the topographic character at these localities.

2.2.3 Burra Creek Outlet Facility

Future maintenance activities would likely result in soil excavations that would be needed to access the parts of the outlet facility, and rehabilitation practices would follow.

3 Legislative requirements

The legislative instruments outlined below are applicable to the consideration of the potential impact on soil, contamination and groundwater resulting from the construction and operation of the Murrumbidgee to Googong pipeline.

3.1 ACT legislation

Environment Protection Act 1997

The Environment Protection Act 1997 (EP Act) provides the regulatory framework to protect the environment from pollution and its effects. The Act establishes the Environment Protection Authority (EPA) as the statutory decision maker for environmental regulation and policy. The EPA administers legislation covering air and water quality, waste, contaminated land, noise control and hazardous chemicals.

Under the EP Act there is a general environmental duty to take steps that are practicable and reasonable to prevent or minimise environmental harm or environmental nuisance. Causing pollution of water, significant erosion or loss of soil, contaminating soil and groundwater could be considered to cause environmental harm or environmental nuisance.

Under the EP Act, an Environmental Authorisation is needed to undertake certain activities (Class A activities). Environmental Protection Agreement or an Environmental Authorisation is needed to undertake other activities (Class B activities). The construction of the pipeline is not considered to be a Class A or Class B activities. However, the EPA may still require an Environmental Protection Agreement to be entered into for undertaking activities that are not Class A or Class B activities.

Water Resources Act 2007

The Water Resources Act 2007 (WR Act) controls the access and use of water and groundwater in the ACT.

The WR Act prescribes which activities must be licensed for water use. This includes the construction of a dam 2 ML or larger; the construction or alteration of a bore; the taking water from a water body or bore; and construction or alteration of structures that affect flows in a waterway.

The construction of the intake facility is anticipated to require a licence under the WR Act.

Nature Conservation Act 1980

The Nature Conservation Act 1980 (NC Act) protects, manages and conserves species and communities within the Territory. Through the conservator of Flora and Fauna, conservation officers and flora and fauna committee that have been established under the Act, the following issues are managed:

- Nature Conservation Strategy
- Declaration of special protection statues to the members of a species of migratory animal;
- Protection of fish or invertebrates;
- Exemption of animals;
- Protection of native plants;
- Protection of native animals;
- Prohibition of organisms;
- Conservation of a species or ecological community or the ecological significance of a threatening process;
- Action plans in relation to each species, ecological community or process;
- Reserved areas;
- Management Agreements; and
- Licences.

Under this Act, a licence is required to be obtained before works can be carried out in waterways located within the ACT Territory.

3.2 NSW legislation and policies

Protection of the Environment Operations Act 1997

The Protection of the Environment Operations Act 1997 (POEO Act) is the key pollution control legislation in force in NSW. Amongst other things, it regulates pollution offences, including offences relating to:

- The wilful or negligent disposal of waste in a manner that harms or is likely to harm the environment;
- The wilful or negligent causing of a substance to leak, spill or otherwise escape in a manner that harms or is likely to harm the environment; and
- The pollution of waters through deliberate actions or actions that cause or permit pollution of waters. Under the Act, 'water pollution' includes introducing litter, wash water, soil, debris, detergent, paint, cement slurry, building materials etc. into waters or placing such material where it is likely to be washed or blown into waters or the stormwater system or percolate into groundwater.

The proposal has the potential to cause pollution of waters. Mitigation measures would need to be implemented to prevent any pollution of waters.

Water Act 1912

The Water Act 1912 facilitates development and use of water, by controlling the extraction of water, the use of water, the construction of works, such as dams and weirs, and the carrying out of activities in or near sources in NSW.

Approval for licence(s) under Part 5 of the Water Act 1912 issued by the Department of Water and Energy (DWE) should be sought if it is anticipated that excavations for the Proposal would intercept the groundwater.

NSW State Rivers and Estuaries Policy

The NSW State Rivers and Estuaries Policy was prepared in 1993 as the overarching policy for the sustainable management of NSW's rivers, estuaries and wetlands. Although the proposal does not involve disturbance of rivers and estuaries in NSW, it does involve disturbance of the Murrumbidgee River (ACT) and Burra Creek (Commonwealth land), and as such the general intent of this policy has been considered. The three major objectives of this policy are as follows:

The objectives of the policy are to manage rivers and estuaries in a ways which:

- Slow, halt or reverse the overall rate of degradation in the systems;
- Ensure the long term sustainability of their essential biophysical functions, and
- Maintain the beneficial use of the natural resources provided by the rivers and estuaries.

These objectives are to be achieved by adopting the six principals for sustainable management listed below.

- Encourage non-degrading uses of rivers and estuaries;
- Non-sustainable resource uses which are not essential should be progressively phased out;
- Environmentally degrading processes and practices should be replaced with more efficient and less degrading alternatives;
- Environmentally degraded areas should be rehabilitated and their biophysical functions restored;
- Remnant areas of significant environmental values should be accorded special protection
- An ethos for the sustainable management of river and estuarine resources should be encouraged in all agencies and individuals, who own, manage or use these resources.

The proposed development is consistent with the above principles in relation to the potential impacts on soils, land contamination and groundwater. This report details the potential impacts to soils and groundwater resulting from disturbance to the Murrumbidgee River and Burra Creek, and suggests mitigation measures to minimise and prevent any degradation to the existing values of those systems.

NSW Sand and Gravel Extraction Policy for Non Tidal Rivers

The NSW Sand and Gravel Extraction Policy for Non Tidal Rivers is a component of the NSW State Rivers and Estuaries Policy (see above). Although the proposal does not involve extensive extraction of sand and

gravel from rivers in NSW, it does involve excavation of materials from river banks in the ACT (Murrumbidgee River) and on Commonwealth land (Burra Creek), and as such the general intent of this policy has been considered. The three major objectives of this policy are as follows:

- To ensure that extraction of sand and gravel from a State's non tidal rivers is undertaken on a sustainable use basis;
- To manage such extraction in a way which minimizes and detrimental effects on the riverine environment thereby protecting other river uses and values; and
- To ensure that the extraction policy is consistent with the aims of the other Government policies and initiatives.

The proposal is considered to be generally consistent with the policy in relation to the potential impacts to soils and groundwater. Mitigation measures detailed in this report are provided to minimise potential impacts on river bank stability (erosion) and groundwater quality.

NSW State Groundwater Policy

The sustainable management of the State's groundwater resources is framed by an overarching policy document (NSW State Groundwater Policy Framework Document) and three component policies relating to groundwater quality (NSW Groundwater Quality Protection Policy), groundwater quantity (NSW Groundwater Quantity Management Policy) and groundwater dependant ecosystems (NSW Groundwater Dependant Ecosystem Policy).

The NSW State Groundwater Policy adopts eight principles for the sustainable management of groundwater resources in NSW. These principles, which are listed below, are reflected in the other component policies:

- An ethos for the ecologically sustainable management of groundwater resources should be encouraged in all agencies, communities and individuals who own, manage or use these resources, and its practical application facilitated;
- Non-sustainable resource uses should be phased out;
- Significant environmental and/or social values dependent on groundwater should be accorded special protection;
- Environmentally degrading processes and practices should be replaced with more efficient and ecologically sustainable alternatives;
- Where possible, environmentally degraded areas should be rehabilitated and their ecosystem support functions restored;
- Where appropriate, the management of surface and groundwater resources should be integrated;
- Groundwater management should be adaptive, to account for both increasing understanding of resource dynamics and changing community attitudes and needs; and
- Groundwater management should be integrated with the wider environmental and resource management framework, and also with other policies dealing with human activities and land use, such as urban development, agriculture, industry, mining, energy, transport and tourism.

The proposed development is also consistent with the above framework document principles governing the management of groundwater quality, quantity management and groundwater dependant ecosystems. As described in this report, the environmental impacts of the proposal on soils and groundwater have been assessed and mitigation measures have been suggested that minimise impacts on soils and groundwater and provide for the rehabilitation of areas likely to be temporarily degraded.

NSW Groundwater Quality Protection Policy

The NSW Groundwater Quality Protection Policy is a component of the NSW Groundwater Policy as discussed above and focuses on the protection of groundwater against pollution. The objectives of this policy are to:

- Slow and halt, or reverse any degradation in groundwater resources;

- Direct potentially polluting activities to the most appropriate local geological setting so as to minimise the risk to groundwater;
- Establish a methodology for reviewing new developments (industrial/mining/urban and rural) with respect to their potential impact on water resources that will provide protection to the resource commensurate with both the threat that the development poses and the value of the resource; and
- Establish triggers for the use of more advanced groundwater protection tools such as groundwater vulnerability maps, or groundwater protection zones.

The objectives of the policy are achieved by the application of nine groundwater management principals relating to the protection of groundwater quality. The principals are:

- All groundwater systems should be managed such that their most sensitive identified beneficial use (or environmental value) is maintained;
- Town water supplies should be afforded special protection against contamination;
- Groundwater pollution should be prevented so that future remediation is not required;
- For new developments, the scale and scope of work required to demonstrate adequate groundwater protection shall be commensurate with the risk the development poses to a groundwater system and the value of the groundwater resource;
- A groundwater user shall bear the responsibility for environmental damage or degradation caused by using groundwaters that are incompatible with soil, vegetation or receiving waters;
- Groundwater dependent ecosystems will be afforded protection;
- Groundwater quality protection should be integrated with the management of groundwater quantity;
- The cumulative impacts of developments on groundwater quality should be recognised by all those who manage, use, or impact on the resource;
- Where possible and practical, environmentally degraded areas should be rehabilitated and their ecosystem support functions restored.

The proposed development is consistent with the NSW Groundwater Quality Protection Policy and as described in this report it will not cause a significant long term impacts to the quality of groundwater in the area of the proposal. As described in this report, due to the nature of the proposal, there is likely to be some impact on shallow groundwater. However the impacts would likely be short term. Furthermore, mitigation measures have been suggested to protect groundwater from the risks of pollution.

NSW Groundwater Quantity Management Policy

The NSW Groundwater Quantity Management Policy is a component of the NSW Groundwater Policy as discussed above and focuses on using groundwater in a sustainable manner. The objectives for managing groundwater quantity in NSW are:

- To achieve the efficient, equitable and sustainable use of the state's groundwater;
- To prevent, halt, or reverse degradation of the State's groundwaters, and their dependent ecosystems;
- To provide opportunities for development which generate the most cultural, social and economic benefits to the community, region, State and nation, within the context of environmental sustainability; and
- To involve the community in the management of groundwater resources.

The policy is implemented by applying thirteen groundwater management principles predominantly dealing with entitlements, licensing extraction, managing actions that recharge aquifers and minimising impacts to groundwater dependant ecosystems.

The proposal is consistent with this policy. As described in this report the proposal does not involve ongoing extraction of groundwater and therefore will have no impact on the sustainable yields of the aquifers located along the proposed pipeline route. The potential to recharge localized aquifers in the Burra Creek from water discharges is considered to be minimal and unlikely to cause impacts to the quality of groundwater. Impacts

from salinity associated with the potential for rising groundwater levels in the Burra Creek area not anticipated.

NSW Groundwater Dependant Ecosystem Policy

The NSW Groundwater Dependant Ecosystem Policy provides a framework maintaining the ecological processes and biodiversity of dependant ecosystems in NSW. There are five principles which guide management actions under the Policy. The principles relate to the following:

- Protecting groundwater dependant ecosystems;
- Limiting extraction of groundwater to sustainable aquifer yields;
- Ensuring the availability of groundwater for dependant ecosystems;
- Applying a precautionary approach to protecting groundwater dependant ecosystems; and
- Ensuring land uses are consistent with minimising impacts to groundwater dependant ecosystems.

The proposal is also considered to be consistent with this policy. As discussed in this report, groundwater impacts would be minimal as the proposal does not involve permanent or long term extraction of groundwater. Groundwater recharge to shallow aquifers beneath Burra Creek may occur but is unlikely to have significant impacts to groundwater dependent ecosystems as the rise in groundwater levels is likely to be minor.

3.3 Commonwealth

Environmental Protection and Biodiversity Conservation Act 1999

The Googong Foreshores is located on Commonwealth land with management responsibility transferred to the Australian Capital Territory Executive by the Commonwealth.

The Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) is directly applicable to the Googong Foreshores area, since the area is Commonwealth land. With relevance to the proposed development, approvals by the Commonwealth Minister of Environment may be required under the EPBC Act for:

- Actions likely to have a significant impact on matters of National Environmental Significance (NES) including impacts on nationally listed threatened species and ecological communities;
- Actions taken on Commonwealth land that are likely to have a significant impact on the environment; and
- Actions that are likely to have a significant impact on the environment of Commonwealth land, even if the action is taken outside Commonwealth land.

Consideration needs to be given to whether the proposed development is a control development under the EPBC Act.

4 Existing environment

4.1 Topography

4.1.1 Topographic Maps

A review of the Williamsdale 1:25,000 topographic map (LPI 2002) and Figure A1 (Appendix A) identified various features and their correlating elevation in the local topography. The proposed pipeline route traverses steep rocky gorges within the Murrumbidgee River corridor and gentle undulating slopes towards Williamsdale. A series of ridges and gullies exist along a length of approximately 4.5 km to the town of Williamsdale. Lobb Hill and Cunningham Hill are located to the far north and south of the proposed pipeline route, outside of the immediate study area.

The proposed pipeline route proceeds past Williamsdale to traverse lower slopes associated with Gibraltar Hill, Gibraltar Ranges and Warri Hill within NSW. Gently undulating hills and flats continue east of the Gibraltar Ranges and low-lying valley areas are associated with the tributaries of Burra Creek in the Burra town area. The depth of channel in Burra Creek is estimated to be approximately 2.5 to 3 m deep. At the outlet facility location in Burra Creek the gradient is approximately one to two percent.

The elevation of the study area ranges from 600 m at Angle Crossing to over 1,100 m at Gibraltar Hill. The proposed pipeline corridor would pass through the Gibraltar Ranges at an elevation of about 860 m, south of Gibraltar Hill.

4.1.2 Aerial Photography

A review of the 1:25,000 scale aerial photograph stereo-pairs of the proposed pipeline route has been undertaken to identify features in the landscape (BWA 2008). The observations made are summarised below.

Rock Outcrops

The occurrence of larger rock outcrops (greater than 20 m in plan length) was observed on the aerial photographs. Excavatability of materials is difficult to confirm simply based on the occurrence of rock outcrops. The exposed rock may in some cases be rock masses and boulders detached from the parent bedrock mass as a result of preferential weathering, and may require less excavation effort than if the bedrock mass was intact.

Small rock outcrops within the proposed alignment that were observed during site visits were not visible on the photographs. The occurrence of large outcrops was more frequently observed over the portion of the project route located to the west of the convergence between the pipeline and Williamsdale Road (NSW).

Watercourses

There are no major water courses along the proposed pipeline route other than the Murrumbidgee River and Burra Creek. However, several minor ephemeral streams would be crossed by the proposed pipeline route.

While the occurrence of streams, creeks and rivers are readily observed on aerial photos, stereoscopic interpretation indicates that many of these features have formed through the process of 'gully erosion', whereby soils are locally eroded to form a channel comprising steep-sided walls. This often signifies the presence of highly erodible soils. Gully-eroded watercourses were observed on the aerial photographs across the entire proposed pipeline route, with a more frequent occurrence along the eastern portion south of Williamsdale Road (Burra Creek and its tributaries).

4.2 Geology

The proposed pipeline appears to lie within the Cowra-Yass Synclinal Zone, bounded to the west by the Murrumbidgee Fault and to the east by the Foxlow Beds (Henderson 1987 and Richardson & West 1977). The proposed pipeline route appears to traverse a number of geological units, which are briefly described in Table 4.1 and shown in Figure A2 (Appendix A).

Within the Googong Foreshore Reserve at the Burra Creek end, there is evidence of limestone formations (such as London Bridge Archway a natural arch of limestone which straddles Burra Creek about 1,500 m from Googong foreshore).

4.3 Soil Landscapes

The Michelago 1:100,000 Soil Landscape Series sheet identifies three soil landscapes in the vicinity of the proposed pipeline route (DCLM 1994 and Jenkins 1993). The soil landscapes are the Burra, Campbell and Williamsdale. These are shown in Figure A3 (Appendix A) and are summarised in Table 4.2.

All the above soil landscapes are characterised by moderate erodibility at the surface, and highly to moderately erodibility below the topsoil. This supports the observation of potentially highly erodible soils from aerial photography as outline in Section 4.1.2.

The pipeline route is located within the Murrumbidgee Valley, which has a generally north-south trending valley, extending westward to the Murrumbidgee River and eastward to a gradual transition to the Tinderry Ranges (BWA 2008). The Murrumbidgee Valley comprises a series of alternating ridges and narrow basins, which dominate its morphology and is the main sediment source within this landscape (Jenkins 1993).

Dryland salinity issues are known to occur in the Burra area.

Due to the inland nature of the site, acid sulphate soils are not expected along the proposed pipeline route.

Table 4.1 Summary of expected geology along the proposed pipeline route (Henderson 1987 and Richardson & West 1977)

Jurisdiction	Geological unit	Approximate length of route ¹	Description	Excavatability of less weathered materials ²
NSW	Cainozoic Sediments (Cza)	3.75 km length of pipeline route	High-level gravels, sand silt and talus breccia, alluvium and colluvium.	Excavatability unknown. (Cainozoic age sediments may be cemented and have significant rock strength).
ACT	Colinton Volcanics (Bransby Shear Zone) (Sb)	Intake Site and 0.2 km length of pipeline route.	Sheared dacite and tuff, commonly sericitised; lenses of slaty shale.	Moderate excavation difficulty, may require rock-breakers (hydraulic hammers). (High to very high strength, distinctly bedded and jointed rock mass).
ACT and NSW	Colinton Volcanics (Sc)	2.75 km	Rhyolitic crystal tuff and dark grey, purple & white Rhyolite, minor coarse sandstone.	Moderate excavation difficulty, likely to require rock-breakers. (Very high strength jointed rock mass with distinct bedding / cleavage trending north-south).
NSW and Commonwealth	Colinton Volcanics (Williamsdale Dacite Member)	Outlet Facility and 4.15 km	Dacitic crystal tuff	Likely requires rock-breakers to excavate. Locations where "massive" rock occurs may require blasting to excavate.
ACT	Deakin Volcanics (Sd)	1.75 km	Green grey to purple Rhyolite to dacite.	Moderate excavation difficulty, likely to require rock-breakers. (Very high strength jointed rock mass with distinct bedding / cleavage trending north-south).
NSW	Intrusions (Sp)	0.55 km	Pale grey Rhyolite	Possible hard excavation. Blasting may be required.

Notes:

1. Based on preliminary and approximate route alignment as shown in Figure 1.1.
2. Note that excavatability of a rock mass is dependent on the degree of weathering, rock material strength and spacing and orientation of defects.

Table 4.2 Summary of Soil landscapes located along the proposed pipeline route (DCLM 1994)

Jurisdiction	Soil landscape	Approximate length of route¹	Soil profile thickness (m)	Acidity	Erodibility
ACT and NSW	Campbell (ca)	Intake site and 1 km of pipeline	Less than 0.3 m on crests. Up to 1.2 m along drainage lines.	Variable pH 5.5 – 8.5	Moderate erodibility at surface. Highly to moderately erodible below the topsoil. Sheet erosion and gully erosion along drainage lines is common.
ACT, NSW and Commonwealth	Burra (ba)	Outlet site and 6.9 km of pipeline	0.2 – 0.6 m on crests and upper slopes. Up to 1.0 m on drainage lines / lower slopes.	pH 6.0 – 7.0	Moderate erodibility at surface. Highly to moderately erodible below the topsoil. Minor sheet erosion is common.
NSW	Williamsdale (wi)	5.25 km of pipeline	Unknown. Expected to be relatively deep.	Variable pH 5.5 – 9.5	Moderate erodibility at surface. Highly erodible below the topsoil. Variable, low to very high wind erosion potential. Minor gully erosion is common. Partly stabilised, severe gully erosion has occurred on Burra Creek and Deep Creek tributaries.
ACT	Murrumbidgee Gorge (go)	Not mapped, but may occur locally at Angle Crossing site.	Non-persistent, up to 0.5 m. Occurs in depressions and crevices and some steep slopes.	pH 6.0	Moderate erodibility

Notes:

1. Based on preliminary and approximate route alignment as shown in Figure 1.1.

4.4 Groundwater

Groundwater typically exists in aquifers comprising subsurface permeable materials such as sandy or gravelly lenses or in fractured rock formations. Aquifers can be unconfined, confined and semi-confined. An unconfined aquifer is an aquifer that does not have an overlying impermeable layer, allowing the groundwater level to rise and fall as recharge waters enter and leave the aquifer. Semi-confined and confined aquifers are aquifers that have overlying confining (impermeable) layers. Groundwater typically occurs under pressure in confined and semi-confined aquifers as the overlying confining layer restricts the groundwater levels from rising when recharge water enters the aquifer. Groundwater levels measured in boreholes that intercept confined and semi confined aquifers can therefore be significantly higher than the upper depth of the aquifer.

Given the nature of the topography and geology, most groundwater flow in this area will occur through fractures in the host rocks. In the lower parts of the terrain, flow will also occur through permeable zones of the weathered rock and colluvial cover.

Information on bores located in the vicinity of the pipeline route were obtained from the NSW Department of Water and Energy's (formerly the Department of Natural Resources) database of registered groundwater bores located throughout New South Wales (DWE 2004). This data may have originated from boreholes of varying location and depth, from which measurements such as water level have been made at different times for each bore (generally at the time of drilling), and under different circumstances with little or no quality assurance. For these reasons, the data can be used as a guide only. A review of information held in this database revealed there are between 30 to 50 registered groundwater bores located in the vicinity of the proposed pipeline route.

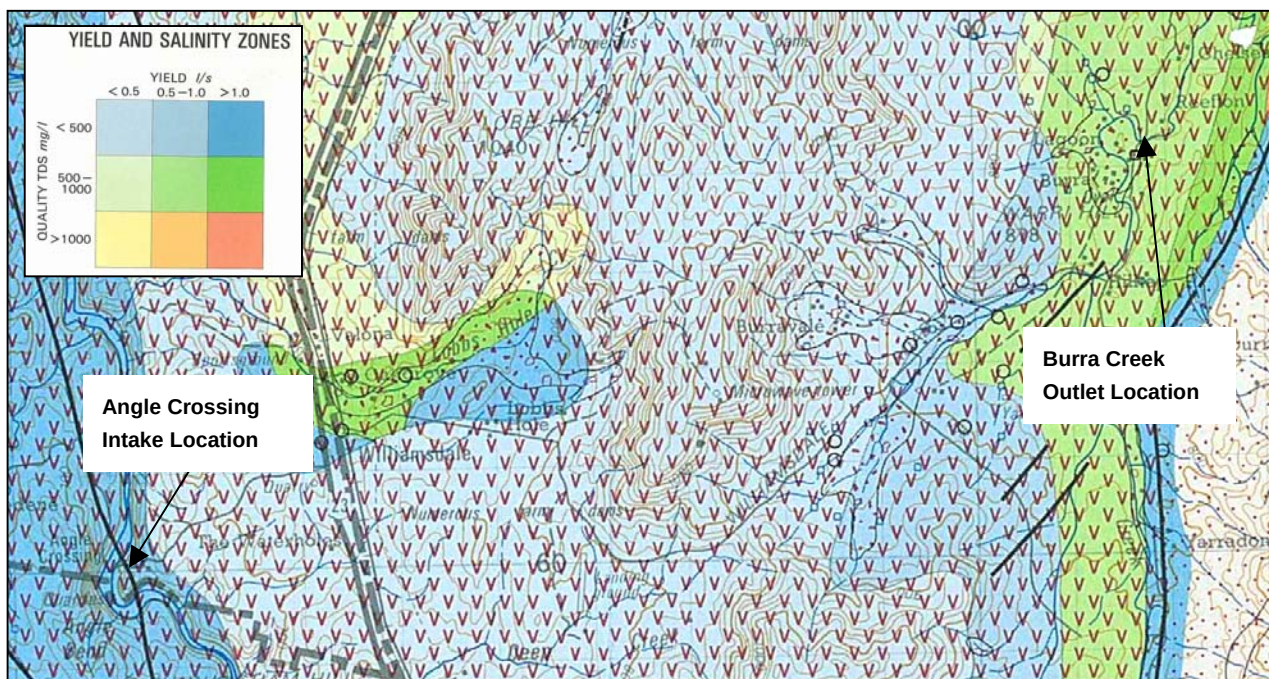
A summary of online groundwater bore data within 500 metres from the proposed pipeline route is presented in Table 4.3. Locations of the listed groundwater bores are shown in Figure A4 (Appendix A). The predominant use of groundwater is recorded as domestic stock watering.

Reported groundwater levels (or 'static water levels' – SWL) varied from 1.2 m below ground level (bgl) to 24 m bgl (Table 4.3). This variability in depth is typical for the topographical environment, with the SWL occurring beneath topographically elevated areas, and the shallower SWL occurring beneath lower elevated ground such as valley floors. Although some groundwater bores that are located within 20 to 550 m from the proposed pipeline route have SWL within the proposed excavation depth (1.8 to 3.0 m below ground surface, while greater depth is required in a number of separate areas including crossings, seasonal areas of inundation, areas parallel to road reserves and in industrial / residential areas), the depth of these groundwater bores (typically > 20 m depth) suggests that the groundwater bearing aquifer/s is at a depth that is well below the likely maximum trench excavation depth (Figure A4, Appendix A). The data also shows groundwater bores in proximity to Burra Creek and the outlet structure (within the Burra soil landscape) have recorded SWL of approximately 3 m bgl (Table 4.3). It is expected that SWL at the intake structure and outlet facility would be shallow (<1 m depth below ground level) due to their location close to Murrumbidgee River and Burra Creek respectively (Figure A4, Appendix A).

Based on the topography of the area, groundwater in the area to the south and west of Gibraltar Rise would likely flow toward the Murrumbidgee River (south west direction), while groundwater in the area east of Gibraltar Rise would likely flow toward Burra Creek (easterly direction).

Burra Creek is likely to be fed in part by a karst aquifer. Limestone can act to transfer subterranean water, and there is a possibility that the flow of Burra Creek is supported by these groundwaters. Previous studies (Gippel and Nayar 2005) suggested the hardness of the baseflow indicates that the base flow in Burra Creek is spring fed (sourced within limestone bedrock) and also suggests that the creek is gaining with respect to groundwater (i.e. groundwater flows into the creek).

Salinity of the groundwater recorded in fractured and unconsolidated rocks indicate that Total Dissolved Solids (TDS) are low (<500 mg/L) along most of the entire pipeline route (Figure 4.1). TDS increases at the Burra Creek end of the pipeline to 500-1000 mg/L (Figure 4.1). No other physical or chemical groundwater data are available for the groundwater in the local area.



			YIELDS AND WATER QUALITY IN FRACTURED AND UNCONSOLIDATED ROCKS
			Generally high yields are related to stress release features adjacent to faults, folds and intrusive bodies
CAINOZOIC		Alluvium, colluvium. Layered gravel, sand, silt, clay	Unconsolidated. High permeability layers rare and of limited areal extent, except in the Dairy Flat-Pialligo-Majura Valley area. Generally poor storage except where leakage occurs from underlying fractured rock aquifers. Variable quality
EARLY DEVONIAN		Rhyolite, ignimbrite, sandstone, siltstone	
		Granite, granodiorite, adamellite, leucogranite, quartz-porphyr, tonalite	No data available within mapped area
LATE SILURIAN		Dacitic, rhyodacitic tuffs, agglomerate, volcanoclastic sediments, shale, arenite, sandstone	Fractured, massive. High yielding areas limited to inhomogeneities such as dykes, faults and xenolithic bodies, and to widely spaced sheeting joints. Good quality
		Dacitic, rhyodacitic, ignimbrite, bedded tuffs, minor shale, sandstone, limestone, ashstone	No data available within mapped area
late MIDDLE SILURIAN		Andesitic, dacitic, rhyodacitic ignimbrite, minor ashstone, shale, sandstone, limestone, disseminated sulphides	Fractured. Higher yielding zones are associated with the upper and lower portions of the individual ash-flow tuffs, and interbedded sediments. Variable quality
		Mudstone, siltstone, minor sandstone, limestone, dacite, rhyodacite, ashstone, sometimes pyritic	Fractured. Higher yielding zones are associated with the upper and lower portions of the individual ash-flow tuffs, and interbedded sediments. Quality tends to be poor
late EARLY SILURIAN ORDOVICIAN		Quartz arenite, siltstone, shale, sandstone, greywacke, minor black shale, quartzite, chert, granitoids	Fractured. High yielding zones are associated with minor limestone beds, major fold closures, and major geologic contacts. Quality tends to be variable to poor
			Fractured. High yielding zones are associated with the lower parts of high relief areas

Figure 4.1 Yield and salinity in fractured and unconsolidated rocks (Evans, 1987).

Table 4.3 Summary of groundwater data (DWE 2004)

Bore reference	Jurisdiction	Approx distance / bearing from pipeline route	Authorised purpose / intended purpose	Soil Landscape	Geology	Approx ground level (m AHD) 1	Drill depth (m)	Groundwater	
								Depth (m)	RL (m AHD)
GW403177	NSW	1250m / SE	Unknown	Campbell	Bransby Zone	730	132	101	629
GW056734	NSW	2000m / S	Unknown	Burra	Bransby Zone	710	75	-	-
GW056733	NSW	1900m / S	Unknown	Campbell / Burra	Bransby Zone	710	23.5	9	701
GW064202	NSW	1800m / S	Unknown	Campbell / Burra	Bransby Zone	710	18.2	5.4	704.6
GW403127	NSW	400m / N	Domestic Stock / Domestic Stock	Burra	Colinton Volcanics	770	72	-	-
GW404059	NSW	600m / S	Domestic Stock / Domestic Stock	Williamsdale	Cainozoic Sediments	790	48	11	779
GW400727	NSW	550m / S	Domestic Stock / Domestic Stock	Williamsdale	Williamsdale Dacite Member / Cainozoic	810	20	-	-
GW042943	NSW	100m / SE	Domestic Stock / Irrigation	Williamsdale	Williamsdale Dacite Member / Cainozoic	835	45.7	13.1	822
GW068135	NSW	20m / SE	Farming Stock / Farming Stock	Williamsdale	Cainozoic Sediments	825	15	-	-
GW042580	NSW	100m / NW	Unknown	Burra	Cainozoic	827	27.4	-	-

Bore reference	Jurisdiction	Approx distance / bearing from pipeline route	Authorised purpose / intended purpose	Soil Landscape	Geology	Approx ground level (m AHD) 1	Drill depth (m)	Groundwater	
								Depth (m)	RL (m AHD)
GW402615	NSW	400m / NW	Unknown	Campbell / Burra	Williamsdale Dacite Member	840	67	24	816
GW064280	NSW	500m / NW	Unknown	Williamsdale	Williamsdale Dacite Member / Cainozoic	815	21.5	1.2	814
GW037491	NSW	70m / SE	Domestic Stock / General Use	Williamsdale	Williamsdale Dacite Member / Cainozoic	797	22.9	3	794
GW048423	NSW	300m / NW	Domestic Stock / Domestic Stock	Williamsdale	Williamsdale Dacite Member / Cainozoic	800	45.7	3	797
GW404383	NSW	450m / NW	Unknown	Williamsdale / Burra	Williamsdale Dacite Member / Cainozoic	798	66	20	778
GW053812	NSW	50m / SE	Domestic Stock / Irrigation	Williamsdale	Cainozoic sediments	775	18	-	-
GW402488	NSW	350m / SE	Unknown	Burra	Williamsdale Dacite Member	787	17	17	770
GW403737	NSW	100m / NW	Domestic Stock / Domestic Stock	Williamsdale / Burra	Williamsdale Dacite Member	775	42	10	765
GW044695	NSW	100m / SE	Domestic Stock / General Use	Williamsdale	Cainozoic sediments	770	22.9	6.1 or 4.0	764 or 766
GW051578	NSW	100m / NW	Domestic Stock / Domestic Stock	Burra	Williamsdale Dacite Member / Cainozoic	775	47.5	9.7	765

Bore reference	Jurisdiction	Approx distance / bearing from pipeline route	Authorised purpose / intended purpose	Soil Landscape	Geology	Approx ground level (m AHD) 1	Drill depth (m)	Groundwater	
								Depth (m)	RL (m AHD)
GW403176	NSW	700m / SE	Unknown	Burra	Williamsdale Dacite Member	776	60	-	-
GW068103	NSW	50m / NW	Unknown / Domestic Stock	Burra	Williamsdale Dacite Member / Cainozoic	770	41.2	-	-
GW067982	NSW	200m / NW	Unknown / Domestic Stock	Burra	Williamsdale Dacite Member	780	97.5	-	-
GW402412	NSW	550m / SE	Domestic Stock / Domestic Stock	Burra	Cainozoic sediments	775	53	3	772
GW056747	NSW	450m / SE	Domestic Farming Stock / Irrigation	Burra	Williamsdale Dacite Member	760	38.1	3.3	757
GW403539	NSW	500m / W	Unknown	Burra	Williamsdale Dacite Member	765	66	3.05	762
GW047269	NSW	20m / W	Unknown	Burra	Williamsdale Dacite Member / Cainozoic	772	4.3	2.7	269
GW042662	NSW	650m / N	Unknown	Burra	Williamsdale Dacite Member	750	51.8	3	747
GW403670	NSW	950m / N	Unknown	Burra	Williamsdale Dacite Member	740	60	15	725

Notes:

Approximate ground levels from 1:25,000 scale topographic map (10m elevation contours).

Driller's logs have not been subjected to technical review. These should be used as a guide only in the absence of geotechnical data.

4.5 Contaminated land

The existing environment with respect to the presence of contaminated land within the vicinity of the proposed pipeline route was investigated. The investigation involved a review of historical aerial photographs, a walkover survey and a search of various database of known location of contaminated land. No physical investigations, involving soil or groundwater sampling and analysis were undertaken. The outcomes of the investigation are provided below, for which 'areas of potential concern' refers to areas where there is some indication that potentially contaminating activities have or may have taken place in the past.

4.5.1 Review of historical aerial photographs

A review of the 1951, 1961, 1976, 1992 and 2004 historical aerial photographs was undertaken for evidence of past land uses that may have cause soil contamination along the pipeline route. Copies of the aerial photographs are provided in Appendix B. The findings of the review of the aerial photographs are discussed below.

ACT

The outcomes of the review of historical aerial photographs of Angle Crossing and the area along the pipeline route in the ACT are provided in Table 4.4. No areas of potential concern were observed on the aerial photographs reviewed.

Table 4.4 Aerial Photograph Observations – ACT (Appendix B).

Date	Aerial photograph	Details observed
1951	Michelago Run 2 25,500 ft ASL Black and white	A road leads up to Angle Crossing, indicating it was used as a crossing point at this time. The road is seen to wind its way from Angle Crossing to the Monaro Highway, which is a dirt road. The main land use of the area along the proposed pipeline appears to be stock grazing. No evidence of disturbance along pipeline route.
1961	Michelago Run 2 18,800 ft ASL Black and white	Similar to 1951 photo. A residence is now present on Block 1471. No evidence of disturbance along pipeline route.
1976	Michelago Run 2 8,534m ASL Black and white	Similar to 1961 photo. Road running through Angle Crossing is clearer, and looks to have been improved or widened. No evidence of disturbance along pipeline route.
1992	Michelago Run 2 4,907m ASL Colour	Similar to 1976 photo. No evidence of disturbance along pipeline route.
2004	Michelago Run 3 Colour	Similar to 1992 photo. No evidence of disturbance along pipeline route.

NSW

The outcomes of the review of historical aerial photographs of the pipeline route in the NSW are provided in Table 4.5. No areas of potential concern were observed on the aerial photographs reviewed.

Table 4.5 Aerial Photograph observations – NSW (Appendix B)

Date	Portion of pipeline route in NSW	Aerial Photograph	Details Observed
1951	West	Photo showing west portion of pipeline route in NSW not available	-

Date	Portion of pipeline route in NSW	Aerial Photograph	Details Observed
	East	Michelago Run 2 25,500 ft ASL Black and white	Very little development along Williamsdale Road section. The main land use of the area along the proposed pipeline appears to be stock grazing. Small amount of houses around Burra. No evidence of major land disturbance or land clearing.
1961	West	Michelago Run 2 18,800 ft ASL Black and white	Williamsdale Road present in photo. No evidence of major disturbance or land clearing along Williamsdale Road or within the affected rural leases. No change in the main land use of the area (stock grazing) is evident.
	East	Photo showing Burra Township area not available	-
1976	West	Michelago Run 2 8,534m ASL Black and white	Similar to 1961 photo. More houses present along Williamsdale Road. No evidence of major disturbance or land clearing along Williamsdale Road or within the affected rural leases. No change in the main land use of the area (stock grazing) is evident.
	East	Michelago Run 1 8,534m ASL Black and white	Several houses now present along Williamsdale Road. Several houses now present around Burra. No evidence of major disturbance or large scale land clearing. No change in the main land use of the area (stock grazing) is evident.
1992	West	Michelago Run 3 4,907m ASL Colour	Similar to 1976 photo. No evidence of major disturbance or land clearing along Williamsdale Road or within the affected rural leases. No change in the main land use of the area (stock grazing) is evident.
	East	Michelago Run 3 4,907m ASL Colour	Similar to 1976 photo. No evidence of major disturbance or land clearing along Williamsdale Road or around Burra. No change in the main land use of the area (stock grazing) is evident.

Date	Portion of pipeline route in NSW	Aerial Photograph	Details Observed
2004	West	Michelago Run 3 Colour	Similar to 1992 photo. No evidence of major disturbance or land clearing along Williamsdale Road or within the affected rural leases. No change in the main land use of the area (stock arazing) is evident.
	East	Michelago Run 3 Colour	Similar to 1992 photo. No evidence of major disturbance or land clearing along Williamsdale Road or around Burra. No change in the main land use of the area (stock grazing) is evident.

Commonwealth

The outcomes of the review of historical aerial photographs of the pipeline route in the NSW are provided in Table 4.6. No areas of potential concern were observed on the aerial photographs reviewed.

Table 4.6 Aerial Photograph Observations – Commonwealth (Appendix B)

Date	Aerial Photograph	Details Observed
1951	Michelago Run 2 25,500 feet ASL Black and white	No evidence of major disturbance or large scale land clearing. Trees lining Burra Creek at discharge point. The area appears not to have been cleared and therefore the land use could be for water catchment purposes.
1961	Photo not available	-
1976	Michelago Run 1 8,534m ASL Black and white	Similar to 1951 photo. No evidence of major disturbance or large scale land clearing. Trees lining Burra Creek at discharge point.
1992	Michelago Run 3 4,907m ASL Colour	Similar to 1976 photo. No evidence of major disturbance or large scale land clearing. Trees lining Burra Creek at discharge point.
2004	Michelago Run 3 Colour	Similar to 1992 photo. No evidence of major disturbance or large scale land clearing. Trees lining Burra Creek at discharge point.

4.5.2 Walkover survey

A walkover survey of the pipeline route was conducted on 2 December 2008 with an additional follow-up survey undertaken on 26 February 2009. The purpose of the walkover surveys was to identify 'areas of potential concern' typically being areas containing oily or discoloured soil, disturbed or uneven ground, visual evidence of past activities that could cause contamination of soils, or disturbed or dead vegetation. The results of the walkover survey are outlined below.

ACT

Access to Block 1654, 1653 and 36 Tuggeranong was provided to undertake the walkover survey. Areas of potential concern observed during the walkover survey in the ACT portion of the pipeline are marked on

Figure C1 (Appendix C) and included an area containing abandoned old farm equipment and materials located towards the eastern boundary of Block 1653. The proposed pipeline alignment is located approximately 250 m from this area of potential concern. This abandoned equipment appeared to have been present for a number of years.

There is the potential that leaks of oil or fuel from the abandoned equipment may have occurred, although no oily or discoloured soil was observed at this location.

No other areas of potential concern were identified during the walkover survey on Blocks 1654, 1653 and 36 Tuggeranong.

NSW

The walkover survey of the NSW portion of the pipeline route was undertaken on the following allotments:

- Lots 141, 191 and 222, DP754889;
- Lot 3, DP1097402;
- Lot 28, DP754913;
- Road reserve adjacent to Williamsdale Road
- Lot 7004, DP96235;
- Lot 1, DP821774;
- Lots 7003 and 7005, DP96235;
- Lot 3, DP1097402; and
- Lot 28, DP754913.

Access was not permitted to the following allotments:

- Lots 201, 152 and 170, DP754889;
- Lot 1, DP843907;
- Lot 2, DP854164.

Observations of these areas were undertaken from the road where possible.

An area of potential concern identified during the walkover survey was a small pile of tyres, small tins and barrels on Block 91/754889 adjacent to Williamsdale Road. The condition of the tins and barrels and the potential risk from contaminants is unknown as access to the site was not permitted at the time of the walkover survey.

Areas of potential concern observed during the walkover survey in the NSW portion of the pipeline route are marked on Figures C2 and C3 (Appendix C).

Pesticide contamination typically occurs on railway line ballast and adjacent areas as a result of past weed spraying maintenance activities. Therefore there is the potential for pesticide impacted soil to be encountered during the excavations beneath the railway line.

Commonwealth

The proposed pipeline route ends in a small section of Commonwealth lease Lot 7 DP592796. The total length of the pipeline through this lease is only approximately 100 metres. No areas of potential concern in regards to contamination were observed during the walkover survey.

4.5.3 Contaminated land database searches

ACT

A search of the Register of Contaminated Sites was undertaken by the ACT Environment Protection Agency (EPA) for the three ACT leases on which the pipeline is proposal to be located. The EPA confirmed in writing that all three blocks are not recorded on the Register of Contaminated Sites under Section 21(A) of the Environment Protection Act 1997.

Copies of the searches are provided in Appendix D.

NSW

A search of the NSW Department of Environment and Climate Change (DECC) website (DECC 2008) did not list any contaminated sites within the pipeline route. The search was undertaken for the Local Government Area (LGA) of Palerang Shire Council for contaminated land notices associated with lots through which the pipeline would be constructed.

Copies of the search results are provided in Appendix D.

Commonwealth

There are no registers or databases of contaminated land on Commonwealth sites.

4.5.4 Overview of potential areas of concern

ACT

The ACT section of the pipeline runs from Angle Crossing to the ACT border near the Monaro Highway.

An area containing abandoned old farm equipment and materials, located towards the eastern boundary of Block 1653, was the only area of concern within the ACT section identified in the walkover survey. This equipment and material is located approximately 250 m to the alignment of the proposed pipeline. Although this equipment appears to have been placed at this location for some time, no signs of contaminated soils were observed.

A review of historical aerial photos and the search of the ACT Register of Contaminated Sites did not reveal other areas of potential concern within the ACT portion of the pipeline.

NSW

The NSW section of the pipeline covers over ten kilometres. The majority of the proposed pipeline runs along Williamsdale Road but also crosses agricultural land currently used for stock grazing. Towards Burra Township, the pipeline route leaves the Williamsdale Road and crosses a number of rural allotments. Due to access restrictions, parts of this route were not included in the walkover survey.

The walkover survey identified a small pile of tins and barrels adjacent to Williamsdale Road. The impacted area is not extensive and therefore is unlikely to cause a significant impact to the proposed pipeline route.

A review of aerial photos of the pipeline route in NSW did not reveal any past activities that could have the potential to cause contamination of land.

Commonwealth

The final section of the proposed pipeline is located within a section of Commonwealth lease. The review of historical aerial photos of this area, and the results of the site walkover survey conducted did not reveal any potential areas of concern in Commonwealth land.

5 Assessment of potential impacts

5.1 General

The assessment of potential impacts of the proposed development to topography, geology, soils, groundwater and soil contamination has been divided into impacts that could potentially occur during the construction phase and operational phase of the proposed development.

Potential construction phase impacts to topography, geology, soils, groundwater and soil contamination, are those that could occur during the construction of the proposed pipeline and associated intake and outlet facilities. Section 2.2 provides an overview of the expected construction activities.

Potential operational phase impacts to topography, geology, soils, groundwater and soil contamination are also described. The potential operational phase impacts are likely to be less significant than the potential construction phase impacts as they have been considered in the design of the proposed development.

Mitigation measures to minimise the potential construction and operational phase impacts are described in Section 6.

5.2 ACT

5.2.1 Intake structure / LLPS and HLPS

Potential construction impacts

Topography

The construction of the proposed development would cause an impact to the local topography, particularly in the locations of the intake structure / LLPS and the HLPS. The expected impacts would likely be moderate, however the overall impact would be minimal as earthworks would be limited to that which is necessary and rehabilitation surrounding the constructed infrastructure would be undertaken.

Short-term modifications to the topography are expected due to various site facilities and material storage areas being located along the pipeline (refer to Section 2.1). However, these impacts are expected to be short-term for the duration of construction only. These sites would also be appropriately rehabilitated after use.

Geology and soils

The construction of the intake structure / LLPS and HLPS would involve excavation of soils within the Murrumbidgee River's riparian zone at Angle Crossing and adjacent to the riparian zone at the location of the HLPS. It is expected that some ground cover (grasses) would be removed as a result of construction activities, site preparation works and site compound construction. Soils may also be disturbed as a result of construction vehicle traffic movements around the site and to and from the site from Angle Crossing Road.

Excavated soils would be temporarily stockpiled and reused for rehabilitation once the intake facilities are constructed. Stockpiling of soils potentially exposes the soils to increased risks of wind and water erosion.

The Campbell soil landscape is considered to be susceptible to erosion as it is characterised as being of moderate erodibility at surface and highly to moderately erodible below the topsoil. Therefore there is a potential for soil erosion and sedimentation of river water to occur as a result of ground excavations and disturbance in this area. It is noted that sheet erosion and gully erosion along drainage lines is also common in this soil landscape.

Implementation of the recommended mitigation measures targeting the causes of soil erosion would be implemented. These measures would be set out in a Construction Environmental Management Plan (CEMP) which would be approved by the ACT EPA. Mitigation measures are described in Section 6.

Groundwater

There is potential for groundwater to be impacted as a result of the construction of the intake structure and LLPS. As portions of these structures are most likely to be installed below the existing groundwater level (which is expected to be at the level of the water in the Murrumbidgee River at this location) the groundwater table would likely need to be temporarily drawn down to allow the structures to be constructed. Lowering of

the groundwater table would be undertaken through sump pumping. A coffer dam would be installed to direct water around the intake structure location during its construction. It is anticipated that the extracted groundwater would not require treatment in order to be released into the Murrumbidgee River.

Despite the potential for the groundwater to be impacted, the scale (or significance) of the potential impacts are considered to be minor for the following reasons:

- Groundwater draw down would only occur in localised locations where the intake structure / LLPS is to be constructed;
- Significant volumes of groundwater would not be extracted as extraction of the groundwater would occur on a temporary basis (during the construction only);
- The groundwater levels are expected to normalise quickly after pumping ceases;
- The construction activities proposed do not present a contamination risks (e.g. from fuel and chemical spills) to the groundwater; and
- Groundwater would not be used for on-site construction purposes.

Contaminated land

No areas of potential concern with respect to land contamination were identified during the walkover survey or the review of the aerial photographs and the search of the Register of Contaminated Sites. Therefore it is considered unlikely that the construction of the intake facility / LLPS and HLPS would encounter any significant land contamination and that the potential to disburse contaminated soils would be minimal.

There is a potential however for construction activities to cause minor contamination of soils, resulting from oil and / or fuel leaks from operating construction equipment. Impacts could also occur during operating equipment refuelling and minor maintenance activities.

Fuels and chemicals would be stored on site in appropriate storage containers that meet the requirements of the Australian Standards. This may include diesel, unleaded petrol, oxygen, acetylene gas, solvents, paints, epoxy, weed killer, curing compounds, form oils, hydraulic oils and motor oils.

However, the recommended mitigation measures described in Section 6 would minimise the potential for significant impact to soils to occur should a leak be experienced during the construction of the proposed development.

Potential operational impacts

As permanent structures are proposed to be built, there would be an impact to the topography in the area of the intake structure and the pump stations. Once the intake structure / LLPS and HLPS are constructed, the areas, including the site compounds, all disturbed ground (including disturbed soils and river bank areas) would be stabilised and revegetated.

There is also likely to be minor quantities of oils, fuels and chemicals, needed for the operation of the pump station, requiring storage within the high level pump station building. Accidental spills or leaks could result in impacts to soils, surface water and groundwater. However, the consequence of such an event occurring is considered to be minor as all fuels, chemical and oils would be stored in appropriately bunded areas in accordance with Australian Standards. Maintenance of the intake facility / LLPS and HLPS would be conducted in accordance with ACTEW's management system which requires that maintenance personnel conduct their work in a way that prevents such incidents occurring.

Future maintenance activities are unlikely to require soil excavation.

Therefore, it is considered unlikely that significant impacts would occur to topography, geology and soils, groundwater and soil contamination from the operation of the intake structure / LLPS and the HLPS.

5.2.2 Pipeline

Potential construction impacts

Topography

The construction of the pipeline within ACT administered land would have a moderate impact, however the impact is not expected to cause significant impacts to the topography along the pipeline route. A pipeline

trench would be excavated and once the pipe has been backfilled, the area would be rehabilitated, including site compounds.

Short-term modifications to the topography are expected due to various site facilities and material storage areas being located along the pipeline (refer to Section 2.1). However, these impacts are expected to be short-term for the duration of construction only. These sites would also be appropriately rehabilitated after use.

Geology and soils

The construction of the pipeline would involve rock breaking or ripping, significant soil excavations, stockpiling of soils, and significant vehicle traffic along the pipeline route and land accesses point. Excavating and stockpiling of soils potentially exposes the soils to increased risks of wind and water erosion.

Excavated soils would likely be temporarily stockpiled and reused for backfilling and landscaping of the pipeline trench. Where appropriate, excess spoil could be reused in areas nearby that are impacted by erosion.

The predominant soil landscape along the pipeline route in the ACT is the Williamsdale Landscape which is considered to be susceptible to erosion as it has the following properties:

- Moderate erodibility at the surface and highly erodible below the topsoil;
- Variable (low to very high) wind erosion potential; and
- Minor gully erosion is common. Partly stabilised, severe gully erosion has occurred on Burra Creek and Deep Creek tributaries.

Therefore there is potential for soil erosion and sedimentation of surface water and gully erosion to occur as a result of ground excavations and disturbance in this area. However, if the recommended mitigation measures described in Section 6 are implemented, then the potential impacts would be minimised.

Groundwater

The construction of the pipeline is not likely to impact the availability or quality of groundwater for existing and future users as there would not be any significant groundwater extraction during construction. It is also unlikely that groundwater contamination from construction activities would occur due to the unlikelihood of the construction works coming in contact with the groundwater system, as discussed below.

No information was obtained indicating that boreholes exist near the pipeline route in the ACT. The nearest bore is bore GW403127 located in NSW along the pipeline route, approximately 300 m from the ACT / NSW border. The data obtained from this bore showed that groundwater would likely occur at a depth not less than 49 m below ground level. Based on this, it is unlikely that pipeline trench excavations (typically at an average of 1.8 to 3 m depth below ground level, with extra depth required in a number of special areas including crossings, seasonal areas of inundation, areas parallel to road reserves and in industrial / residential areas) would impact groundwater along the route. The hilly topography in this portion of the pipeline also supports the expectation that the groundwater level is likely to be well below the excavation depth of the pipeline trench.

At the Monaro Highway, directional drilling beneath the highway is proposed. Directional drilling would require the excavation of a 'launch pit' of a suitable size to contain the drill equipment, casing and pipe lengths, excavated spoil removal, sump pumping equipment and personnel. Similarly, a 'receiving pit' would be excavated at the end of the directionally drilled section. It is expected that the launch and receiving pits would be excavated to a maximum depth the 3 m to 5 m below ground level. Again, it is unlikely that groundwater at this location would be at a depth within 5 m of the ground surface. Therefore it is unlikely that directional drilling would cause impacts to the groundwater.

Contaminated land

A review of historical aerial photos, a site walkover survey and a search of the Register of Contaminated Sites did not indicate any areas of potential concern with respect to land contamination along the route of the pipeline in the ACT. Therefore it is considered unlikely that the construction of the pipeline would encounter contaminated soils and the potential to disburse contamination soils is minimal.

If during construction works potentially contaminated material is encountered, work around the area would cease and a qualified environmental consultant with experience in contaminated land management would be engaged to investigate the potential risks posed. Soil sampling and laboratory analyses would be undertaken to delineate the extent of contamination if deemed necessary.

There is a potential however for construction activities to cause minor contamination of soils, resulting from oil and / or fuel leaks from operating construction equipment. Impacts could also occur during operating equipment refuelling and minor maintenance activities.

Fuels and chemicals would be stored on site in appropriate storage containers that meet the requirements of the Australian Standards. This may include diesel, unleaded petrol, oxygen, acetylene gas, solvents, paints, epoxy, weed killer, curing compounds, form oils, hydraulic oils and motor oils.

Potential Operational impacts

The pipeline would have associated air valves and scour valves, installed on crests and sags along the pipeline, which would be permanent above ground structures. Releases of water from these valves, during maintenance activities for example, and the valves themselves would have a minor impact on the topographic character at these localities.

Once the pipeline is installed and the trench is backfilled, the disturbed areas along the route and land access points would be stabilised, rehabilitated and revegetated. Future maintenance activities are unlikely to require soil excavation.

There is not likely to be any on-going impacts to the groundwater along the ACT portion of the pipeline route as the groundwater is expected to be a significant depth below the base of the pipeline trench excavation. Routine pipeline maintenance would also require the pipeline to be purged, resulting in minor quantities of pipeline water potentially incoming in contact with the groundwater. However, because the quality of the water that would be pump through the pipeline would be high, it is unlikely that maintenance activities would significantly impact the quality of the groundwater.

It is unlikely that significant impacts to topography, geology and soils, groundwater, and soil contamination would occur as a result of the operation of the proposed development.

5.3 NSW

Potential pipeline construction impacts

Topography

The construction of the pipeline within NSW administered land would have a moderate impact, however the impact is not expected to cause significant impacts to the topography along the pipeline route. A pipeline trench would be excavated and the pipe would be placed within the trench. The trench would then be backfilled, and therefore the impact would be short-term.

The pipeline would have associated air valves and scour valves, installed on crests and sags along the pipeline, which would be permanent above ground structures. Releases of water from these valves, during maintenance activities for example, and the valves themselves would have a low impact on the topographic character at these localities.

Short-term modifications to the topography are expected due to various site facilities and material storage areas being located along the pipeline (refer to Section 2.1). These sites would also be appropriately rehabilitated after construction.

Geology and soils

The construction of the pipeline would involve rock breaking or ripping, significant soil excavations, stockpiling of soils, and significant vehicle traffic along the pipeline route and land access point. Excavated soils would likely be temporarily stockpiled and reused for backfilling and landscaping of the pipeline trench. Where possible and appropriate, excess spoil would be reused on the allotments in areas impacted by erosion. Excavating and stockpiling of soils potentially exposes the soils to increased risks of wind and water erosion.

There are predominantly three soil landscapes along the pipeline route in the NSW namely the Williamsdale, Burra and Campbell Landscapes. All soil landscapes are considered to be susceptible to water and wind

erosion. Gully erosion is a common feature in all these landscapes. Therefore there is a significant potential for soil erosion and sedimentation of surface water and gully erosion to occur as a result of ground excavations and disturbance in this area. However, if the recommended mitigation measures (see Section 6) are implemented, then the potential impacts would be minimised.

Groundwater

Based on the groundwater bore information obtained (see Table and Appendix A), shallow recorded groundwater levels (<3 m depth below ground level) were recorded in bores near the proposed pipeline route (in a location approximately 4 km south west along Williamsdale Road from Burra township). However, shallow groundwater levels measured in groundwater bores do not necessarily indicate the presence of an aquifer at that depth. The bores in which shallow groundwater levels were recorded were drilled to a depth of typically 20 m or more below ground level. Therefore it is likely that these bores intercept a confined or semi-confined aquifer at a depth of between 15 to 20 m below ground level. Based on this, it is unlikely that the pipeline trenching (typically at an average of 1.8 to 3 m depth below ground level, with extra depth required in a number of special areas including crossings, seasonal areas of inundation, areas parallel to road reserves and in industrial / residential areas) would intercept this groundwater aquifer, and inundation is unlikely.

Near the township of Burra however, bore GW047269 exists near the proposed pipeline route. This bore is recorded as being 4.3 m deep and the groundwater level is recorded at 2.7 m depth below ground level. This bore might be intercepting a shallow perched aquifer close to Burra Creek. Significant aquifers are likely to be at greater depths as discussed above. If the pipeline trench were to be excavated to a depth greater than the general 1.8 to 3 m in the portion of the pipeline located close to bore GW047269, then there is the potential to impact the shallow groundwater quality in this area. As no groundwater extraction is proposed during the construction of the pipeline, potential impacts to the current availability of groundwater are not expected.

If the pipeline trench excavation were to extend to an underlying aquifer, then there would be a risk of exposing the groundwater to contaminants. However, the proposed construction activities and the absence of a source of soil contamination indicates that there is unlikely to be significant risks to groundwater quality. Groundwater flow into the pipeline trench could become turbid as a result of the excavation of materials. This seeped groundwater would flow to the lowest point within the trench and would infiltrate back into the aquifer as the groundwater level rises and falls over time. The turbidity in the seeped groundwater is expected to be removed during infiltration back into the aquifer.

Pipeline construction is therefore not likely to significantly impact the availability or quality of groundwater for existing and future users.

Contaminated land

The review of the historical aerial photographs did not identify any areas of potential concern along the pipeline route in NSW. Furthermore, a search of the NSW EPA database found no contaminated land notices had been issued in the pipeline section of the Palerang LGA.

However, during a walkover survey along the pipeline route a number of areas of potential concern with respect to land contamination were identified. These were the two stockyards and a loading yard located adjacent to Williamsdale Road, some tins and small barrels located along Williamsdale Road, yards located on the corner of Williamsdale Road and McDiarmid Road and the railway line located on the ACT / NSW border.

Although unlikely, the yards located on Williamsdale Road could be a source of soil contamination, which may have resulted from past activities such as treating farm animals with agriculture chemicals. However, it is unlikely that the yards will be directly impacted by the proposed works, therefore any contaminated soil that may exist (which is unlikely) would not be disturbed by the proposed pipeline.

Possible land contamination associated with the railway on the ACT/NSW border could also exist. Maintenance of railway lines often included spray of weeds with pesticides and herbicides. Such activities have the potential to cause localised soil contamination. The construction of the pipeline through the railway line embankment would involve removal of a portion of the railway track to allow open trenching. Once the pipeline is installed, the track would be reinstated to the satisfaction of the rail authority.

Excavated soil from trenching beneath the railway track would be stockpiled separately. Once the track is reinstated, any excess spoil needing off site disposal would be sampled and analysed to determine its waste classification in accordance with the NSW Waste Classification Guidelines (DECC, 2008). Transport and disposal of the excess spoil would also be undertaken in accordance with these guidelines.

Although the likelihood to encounter existing potentially contaminated material during construction is minimal, there is a potential for construction activities to cause contamination of soils. Impacts could occur if leaks of oils and/or fuels occurred from operating construction plant. Similarly impact could also occur during refuelling.

Fuels and chemicals would be stored on site in appropriate storage containers that meet the requirements of the Australian Standards. This may include diesel, unleaded petrol, oxygen, acetylene gas, solvents, paints, epoxy, weed killer, curing compounds, form oils, hydraulic oils and motor oils.

However, if the recommended mitigation measures detailed in Section 6 are implemented, then the potential impact would be minimised.

Potential pipeline operational impacts

The pipeline would have associated air valves and scour valves, installed on crests and sags along the pipeline, which would be permanent above ground structures. Releases of water from these valves, during maintenance activities for example, and the valves themselves would have a minor impact on the topographic character at these localities.

Once the pipeline is installed and the trench is backfilled, the disturbed areas along the route and land access points would be stabilised, rehabilitated and revegetated. Future maintenance activities are unlikely to require soil excavation.

There is not likely to be any on-going impacts to the groundwater along the NSW portion of the pipeline route as the groundwater is expected to be a significant depth below the base of the pipeline trench excavation. Routine pipeline maintenance would also require the pipeline to be purged, resulting in minor quantities of pipeline water potentially incoming in contact with the groundwater. However, because the quality of the water that would be pump through the pipeline would be high, it is unlikely that maintenance activities resulting in the release and possible infiltration of pipe water to the groundwater would significantly impact the quality of the groundwater.

It is unlikely that significant impacts to topography, geology and soils, groundwater, and soil contamination would occur as a result of the operation of the operation of the pipeline.

5.4 Commonwealth

Potential outlet facility construction impacts

Topography

There is moderate potential for impacts to the topography within the land under Commonwealth jurisdiction. Some topographic alteration would be required to accommodate the outlet structure at Burra Creek, however, the associated impacts would be localised. Downstream erosion and degradation of the topography, particularly Burra Creek bank and bed would be prevented as a rock fill mattress would be installed across the creek bed to prevent scouring and erosion in the vicinity of the outfall weir. This is discussed further in the geomorphic assessment.

Short-term changes to the topography are expected due to various temporary site facilities and material storage areas located along the pipeline (refer to Section 2.1). These sites would also be appropriately rehabilitated after use.

Soils and geology

There is a potential for impacts to soils and rock outcrops to occur during the construction of the outlet facility. Erosion, sedimentation and water quality impacts could occur due to disturbance on ground in works areas, site access areas and the stockpiling of excavated materials.

The predominant soil landscape at the outlet facility in Burra Creek is the Williamsdale Soil Landscape which is considered to be susceptible to erosion as it has the following properties:

- Moderate erodibility at the surface and highly erodible below the topsoil;
- Variable, low to very high wind erosion potential; and
- Minor gully erosion is common. Partly stabilised, severe gully erosion has occurred on Burra Creek and Deep Creek tributaries.

The regional geology of this area is Cainozoic Sediments which includes alluvium and colluvium, gravels and sandy silts. It is likely that alluviums and colluviums occur at the site of Burra Creek outlet facility. These geological formations are also particularly susceptible to erosion.

Therefore there is a significant potential for soil erosion and sedimentation of surface water to occur as a result of ground excavations and disturbance in this area. However, if the recommended mitigation measures are implemented, then the potential impacts would be within acceptable standards.

Groundwater

Near the township of Burra however bore GW047269 exists near the proposed pipeline route in NSW. This bore is the closest to the outlet facility site. Information on recorded for bore GW047269 shows it has a total depth of 4.3 m and depth to groundwater of 2.7 m depth below ground level. This bore might be intercepting a shallow perched aquifer close to Burra Creek.

This indicates that recorded groundwater level is likely to exist at shallow depths close to Burra Creek and the outlet facility location. As portions of the outlet structure may be installed below the existing groundwater level it is expected that the groundwater level would need to be temporarily lowered to allow the structures to be constructed. Lowering of the groundwater table would be undertaken through sump pumping.

It is anticipated that the extracted groundwater would be too turbid to release directly into Burra Creek. As such, a sedimentation pond or modified steel skips would be used to assist in the processes of sediment settlement and any other water quality modifications. Regular water quality testing would also occur downstream of the construction works to ensure any significant impacts to the water quality in Burra Creek and Googong Dam are quickly identified and managed.

Seepage loss out of the creek bed is expected not to exceed 0.2 to 0.3 ML/day/km (Gippel and Nayar, 2005). This estimate is based on the relatively small size of Burra Creek, and seepage loss is unlikely as Burra Creek appears to be gaining from the groundwater system (Gippel and Jayar, 2005).

Despite the potential for the groundwater to be impacted, the scale (or significance) of the potential impacts are considered to be minor for the following reasons:

- Groundwater drawdown would only occur in localised locations where the outlet is to be constructed;
- Significant volumes of groundwater would not be extracted as extraction of the groundwater would occur on a temporary basis (during the construction phase only);
- The groundwater levels are expected to normalise quickly after pumping ceases;
- The construction activities proposed do not present a contamination risk to the groundwater; and
- Groundwater would not be used for on-site construction purposes.

Contaminated land

The review of historical aerial photos and the site walkover survey did not indicate any major areas of potential concern with respect to land contamination at the outlet facility location. The pipeline route comes close a number of existing yard areas along the alignment. The potential for the soils in these areas to be contaminated is unknown however it is unlikely that these areas will be impacted by the proposed works. Therefore it is considered unlikely that the construction of the pipeline would encounter contaminated soils and the potential to disburse contaminated soils is minimal.

If during construction works potentially contaminated material is encountered, work around the area would cease and a qualified environmental consultant with experience in contaminated land management would be engaged to investigate the potential risks posed. Soil sampling and laboratory analyses would be undertaken to delineate the extent of contamination if deemed necessary.

There is a potential however for construction activities to cause minor contamination of soils, resulting from oil and / or fuel leaks from operating construction equipment. Impacts could also occur during operating equipment refuelling and minor maintenance activities.

Although the likelihood to encounter existing potentially contaminated material during construction is minimal, there is a potential for construction activities to cause contamination of soils. Impacts could occur if leaks of oils and/or fuels occurred from operating construction plant. Similarly impact could also occur during refuelling and minor maintenance activities. However, if the recommended mitigation measures described in Section 6 are implemented, then the potential impact would be minimised.

Fuels and chemicals would be stored on site in appropriate storage containers that meet the requirements of the Australian Standards. This may include diesel, unleaded petrol, oxygen, acetylene gas, solvents, paints, epoxy, weed killer, curing compounds, form oils, hydraulic oils and motor oils.

Potential outlet facility operational impacts

General

There is unlikely to be any significant impacts to topography, geology, soils and contaminated land from the operation of the outlet facility. The transferred water would be discharged onto a rock mattress, which will be constructed on the banks and bed of Burra Creek at the discharge point. This rock mattress will prevent erosion and bank instability at this location.

Future maintenance activities are unlikely to require soil excavation or other activities that would impact soils at this location.

Groundwater

The outlet structure would be situated where the groundwater table is expected to be relatively shallow and, as such, groundwater flows and levels may be impacted by the discharged water and increased flow in the creek. It has been estimated that a discharge flow of 100 ML/day (considered to be a full flow scenario where all pumps are operating) would raise the stream level in Burra Creek by 300 mm to 500 mm. Depending on the time and location, the increased level and flow may either increase the natural recharge from the creek to the groundwater, or reduce the natural discharge from groundwater to the creek. However, it is considered the long term impacts to the groundwater flows and subsequent groundwater levels in the vicinity of Burra Creek, and subsequent impacts upon the local and downstream environments, would not be significant for the following reasons:

- the potential groundwater level rise, of less than 500 mm, is minor in comparison with the surrounding topography, and any groundwater level rise would likely occur adjacent to the creek, and would decrease to existing levels within a short distance from the creek (i.e the rise in groundwater levels immediately adjacent to the creek would likely be resemble a 'mound' and would reflect a level no greater than the level of water in the creek. Groundwater levels a short distance from the creek are expected to be unaffected by rises in creek water levels during water transfer discharges);
- the 'recharge/discharge' area of the creek bed is minor in comparison with scale of the surrounding landscape and its associated recharge, through flow and discharge potential, and
- When the transfer of water ceases and the creek reverts back to pre transfer flow conditions, it is expected that the water added to the groundwater immediately adjacent to the creek, would flow back into the creek, resulting in groundwater levels stabilising to pre water transfer discharge levels.

Given the above points, groundwater levels in the vicinity of Burra Creek downstream from the outlet facility are not expected to change significantly or to the detriment of the local and downstream environments. The risk of increased salinity in the area around Burra, and its potential to impact existing infrastructure such as roads and buildings, is therefore low.

The overall impact to groundwater during operation of the project is likely to be minimal.

6 Proposed mitigation measures

6.1 Proposed mitigation measures for potential construction impacts

Appropriate measures can be adopted to minimise or eliminate potential impacts associated with the geological and soil conditions at the sites of the intake structure / LLPS and HLPS, the pipeline route, and at the outlet facility.

Sediment and Erosion Control Plan

A site Sediment and Erosion Management Plan should be prepared (and incorporated into a Construction Environmental Management Plan). The Sediment and Erosion Control Plan should be developed in accordance with the requirements of the 'Blue Book' (Managing Stormwater: Urban Soils and Construction, NSW Department of Housing) and the following selected ACT guidelines:

- Construction and Land Development in the ACT;
- Preventing Pollution from Concreting Operations—Information Sheet
- Prevent Pollution from Commercial Developments—Information Sheet
- Discharge from Sediment Control Ponds—Information Sheet

The Sediment and Erosion Management Plan would have the following structure:

- Site characteristics – including existing contours, the area of natural temperate grassland, limitations of the site's soil type and climatic data including rainfall;
- Clearing and disturbance of the site – nature and extent of proposed ground disturbance, final contours and location of any temporary soil stockpiles and visual screening mounds;
- Existing and proposed drainage patterns – including existing surface water drainage paths and proposed drainage design;
- Erosion control practices – including the location and design of structural erosion control measures and the monitoring and maintenance of these control structures. Erosion protection measures should be implemented to minimise the potential for erosion of soils from the proposed development. Provided these measures are adequately implemented and maintained it is unlikely that any significant erosion should occur following excavation of soils and disturbance of ground areas. Controls should be implemented before any construction commences and inspected regularly particularly after a rainfall event;
- Sediment control practices - including the location and design of structural sediment control measures and the monitoring and maintenance of these control structures. Controls should be implemented before any construction commences and inspected regularly particularly after a rainfall event; and
- Rehabilitation program – including the revegetation of landscaped areas and visual mounds.

Sediment Control Practices

- The location of site compounds should consist of existing cleared areas and, where possible, on the right of way in order to minimise disturbance;
- All cut and fill batters should be protected from run-off and stabilise immediately following construction;
- A site specific erosion and sediment control plan will be prepared for the area in and around Burra Creek;
- Permanent drainage structures should be installed with sediment traps at completion of initial earthworks;
- Where possible 'clean' surface water should be directed away from disturbed areas to stable or stabilised discharge points;
- Upstream diversion drains and downstream sediment traps should be used to carry run-off away from disturbed areas;
- Where creation of sediment laden runoff cannot be prevented or where extracted groundwater cannot be discharged to existing surface waters, temporary sediment control ponds should be constructed to

intercept sediment laden run-off and to trap and retain sediment. General arrangements for sediment control ponds are shown in Figure 6.1;

- Surface water runoff to the Murrumbidgee River should be managed by the site specific sediment control plan;
- Engineered structures such as rock fill mattresses should be constructed to ensure minimal erosion and scouring of the creek bed and embankments should occur; and
- Sediment traps should be placed in drainage lines to prevent sediment transport via surface water flows. A typical sediment trap arrangement is provided in Figure 6.2.

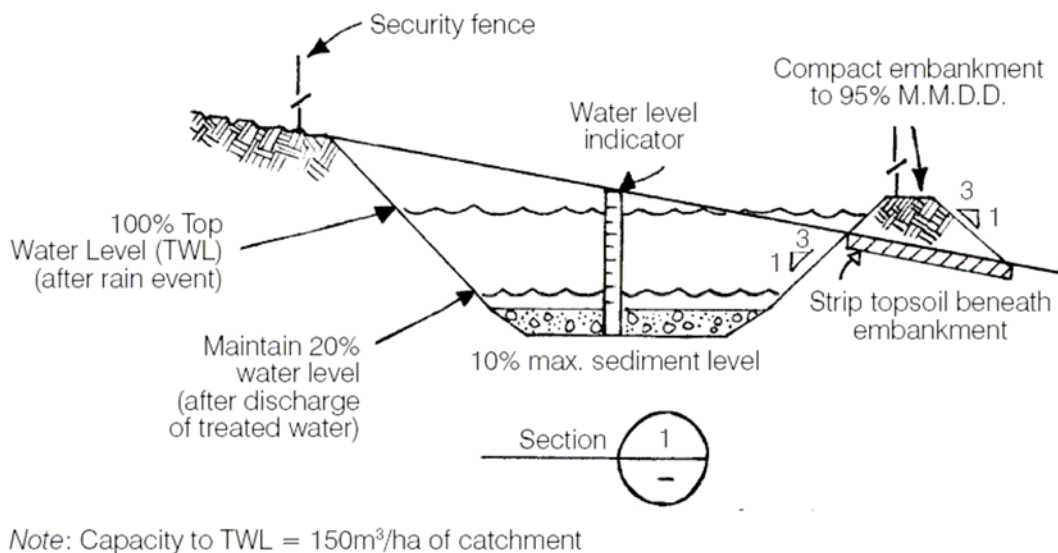


Figure 6.1 General arrangement for sediment control ponds (ACT EPA 2007)

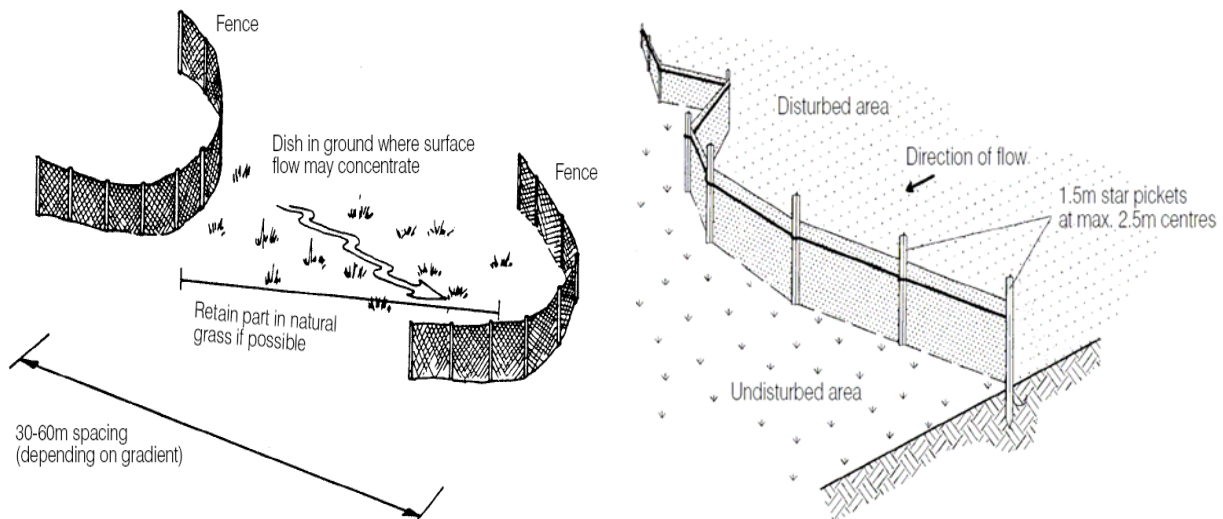


Figure 6.2 Typical arrangements for installation of sediment traps (ACT EPA 2007)

Soils and Spoil Management

All spoil management actions should be undertaken in accordance with the resource management hierarchy principles. This could include the following management actions:

- Construction excavation activities should be limited to the original construction design to minimise the influence to geology and soils;

- The extent of exposed and unprotected areas should be limited by preserving existing groundcover;
- Construction practices should aim to eliminate the generation of excess topsoil (i.e. all topsoil should be used to rehabilitate the near surface ground following backfilling of the pipeline trench);
- Topsoil should be held in storage (preferably piled to one side of the trench) for the minimum possible time before being re-used directly on-site, preferably being replaced in its original location;
- Top soil should be seeded for the duration of storage, and silt barriers used whilst seeding is establishing;
- Where possible, topsoil should be recovered through the reuse of materials for remediation purposes. This should involve being spread evenly over the backfill material to reflect the final backfill contours;
- General spoil should be removed from the site and adequately covered during transportation to avoid wastage;
- Spoil should be stored stock-piled material with the appropriate covering and, if required, additional wind protection;
- Topsoil and spoil should be stockpiled separately to eliminate contamination through mixing;
- Topsoil stockpiles should be kept below 2 m in height;
- Stockpiles should not be placed in high water flow areas and should be protected by sediment control barriers or diversion drains;
- Where possible, spoil should be recovered through the reuse of materials for remediation purposes. Reinstatement should occur prior to hydrostatic testing of the installed pipeline, where practical;
- Following backfilling of the pipeline trench all disturbed areas should be seeded and / or protected with straw mulch to promote stabilisation through revegetation, as soon as possible;
- Excess spoil materials should be utilised at other locations along the pipeline for remediation purposes, or utilised by landowners or council; and
- Disposal of spoil material, where inappropriate for reuse as an example, should be undertaken as a last resort.

Stabilised Access Point and Site Traffic

- All site area access points that should be subject to heavy construction traffic movements should be stabilised before construction work commences (includes any point where construction traffic would be entering or leaving an unpaved area). A stabilised access point should consist of a stabilised pad of aggregate underlain with geotextile fabric. A general arrangement for a stabilised access point is shown in Figure 6.3;
- The number of access points should be limited to one entry/exit point where possible;
- All access roads should be controlled on the site and vehicles and plant should be kept to well defined haul roads to minimise ground disturbance and compaction;
- Where there is more significant and heavier traffic, the use of a grid or vehicle wash bay should be considered to remove excess soil and dust before leaving the site. The grid or vehicle wash bay should be lifted and cleared out periodically. Grids and vehicle wash bays should be followed by stabilised material to ensure that vehicles do not carry mud onto public roads and areas; and
- Oil or fuel leakages from vehicles and equipment through regular maintenance should be eliminated. Spill kits should be available for the refuelling of vehicles.

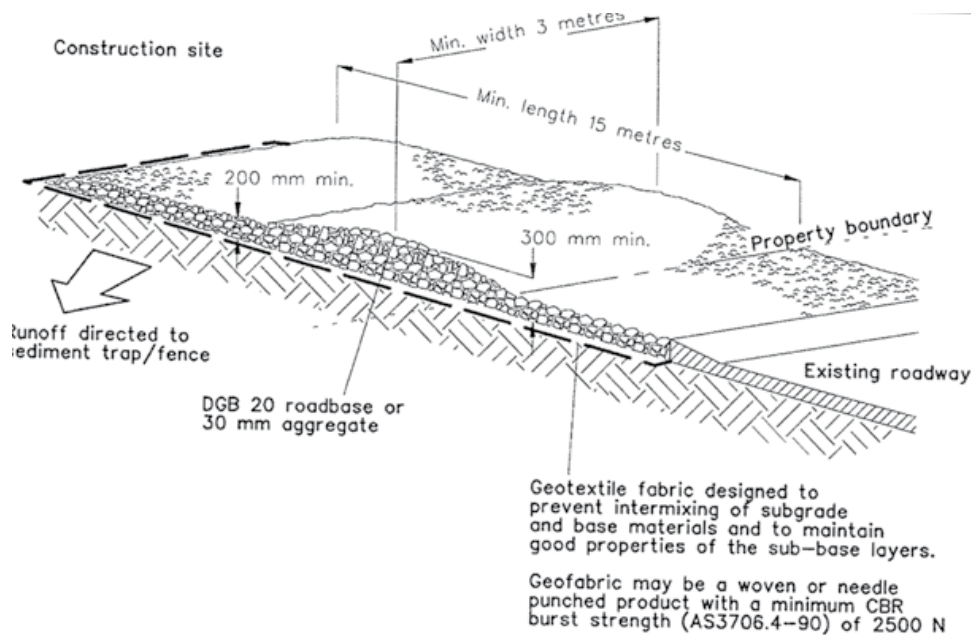


Figure 6.3 Typical arrangements for a stabilised access point (ACT EPA 2007)

Contamination Management

- The assessment of significant and the reporting of significant contaminated areas on site should be assessed according to the document *Contaminated Sites - Guidance for significant Risk and Harm and Duty to Report*, EPA 1999;
- Maintain pollution control measures during construction and until full stabilisation;
- Be aware of the location of the yards and where possible, limit soil disturbance in the area;
- Management of the railway line should involve the reinstatement of the line post-construction to the satisfaction of the rail authority. Leach tested on spoil from the ACT / NSW boundary Railway site should be undertaken before disposing/re-using to determine the degree of contamination;
- Fuels, oils and chemicals stored throughout the construction site should be kept to a minimum. All storage of fuels, oils and chemicals should be in appropriate storage containers as specified in relevant Australian Standards;
- Regular downstream water quality testing in the Murrumbidgee River and Burra Creek should be undertaken to ensure that no contamination of released groundwater has occurred;
- Leach tested should be undertaken on spoil from the ACT / NSW boundary Railway before disposing/re-using;
- If during construction works potentially contaminated material is encountered (particularly at the ACT / NSW boundary Railway), work around the area should cease and a qualified environmental consultant with experience in contaminated land should be engage to investigate the potential risks posed; and
- Soil sampling and laboratory analyses should be undertaken to delineate the extent of contamination if deemed necessary.

Groundwater Management

- Regular groundwater quality testing should occur in relation to water extracted at the intake structure construction site to ensure that the quality of drawn groundwater is suitable for discharge into the Murrumbidgee River. In the case that the drawn groundwater requires treatment prior to its release, a temporary treatment storage in the form of modified steel skips should be used to assist in the processes of sediment settlement and any other water quality modifications;

- Regular water quality testing should also occur downstream of the intake structure construction works to ensure any significant impacts to the water quality in the Murrumbidgee River are quickly identified and managed; and
- If groundwater requires treatment prior to being released at downstream locations of Murrumbidgee River and Burra Cree, a temporary treatment storage in the form of modified steel skips should be used to aid in water settlement, sediment precipitation and any necessary changes to water quality.

6.2 Proposed mitigation measures for potential operational impacts

The following mitigation measures are suggested to minimise the potential impacts during the operation of all structures:

- The quantities of fuels, oils and chemicals stored in the LLPS (within the intake structure) and the HLPS should be kept to a minimum. All storage of fuels, oils and chemicals should be in appropriate storage containers as specified in relevant Australian Standards;
- Where possible and practicable, maintenance activities involving the handling of fuels, oils or lubricants should be undertaken in bunded areas; and
- The intake structure and HLPS should be periodically inspected to ensure rehabilitation and stabilisation works have been effective in the longer term;

7 References

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- LPI, 2002. Williamsdale 1:25,000 Topographic & Orthophoto Map, 8726-4N, 2nd Edition, Land and Property Information (NSW);
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- Richardson, 1976. Geology of the Michelago 1:100,000 Sheet 8726 (explanatory report), Geological Survey of NSW, Department of Mineral Resources and Development.

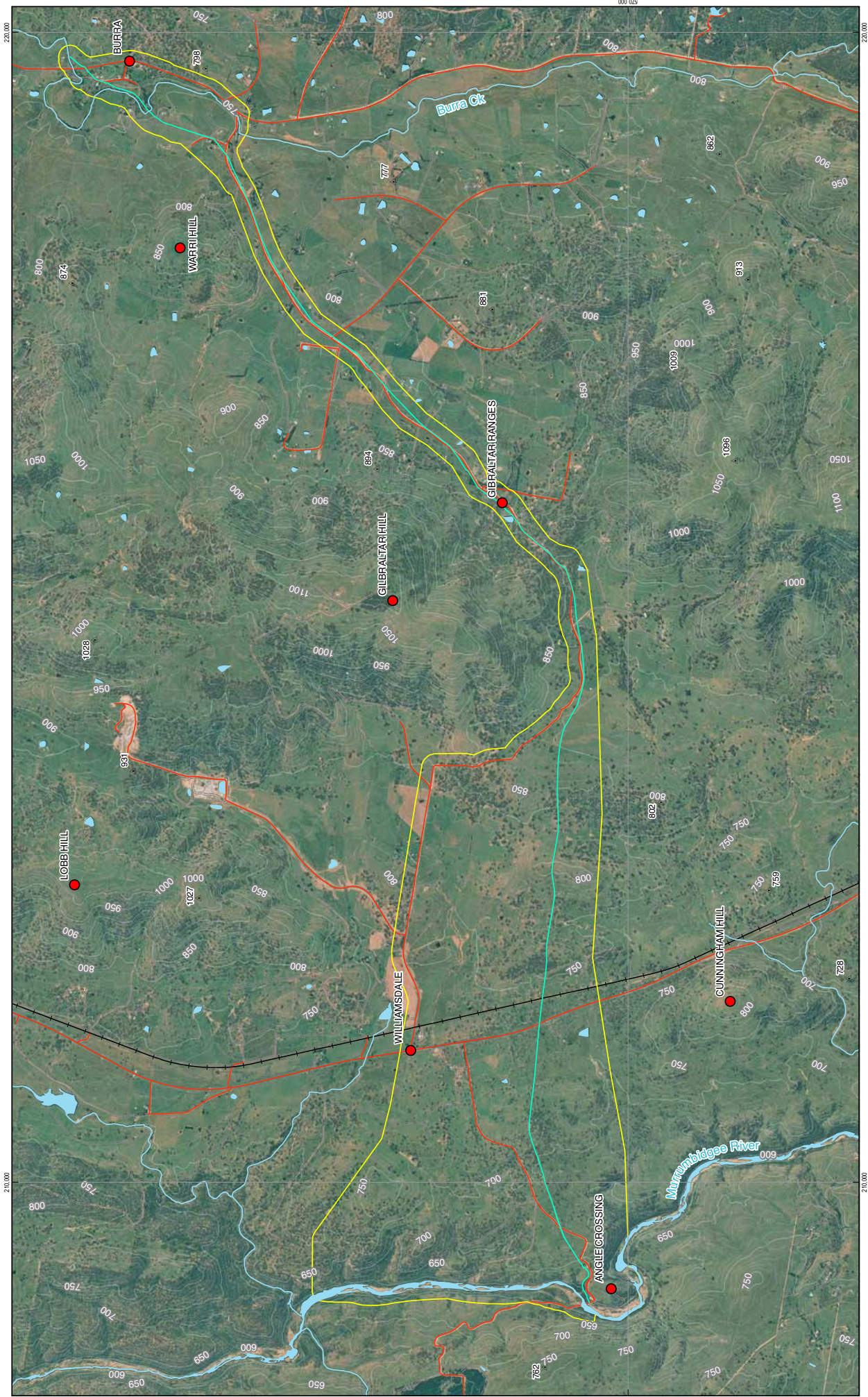
Appendix A Maps and plans

Topographical map (Figure A1)

Geological map (Figure A2)

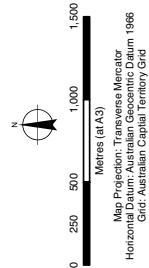
Soil Landscape map (Figure A3)

Groundwater bore location plan (Figure A4)



Legend

- Spot Heights
- Locations
- Proposed Pipeline Alignment
- Study Area
- Road
- Track-Vehicular
- Railway
- Rivers, Dams, Lakes



BULK WATER ALLIANCE

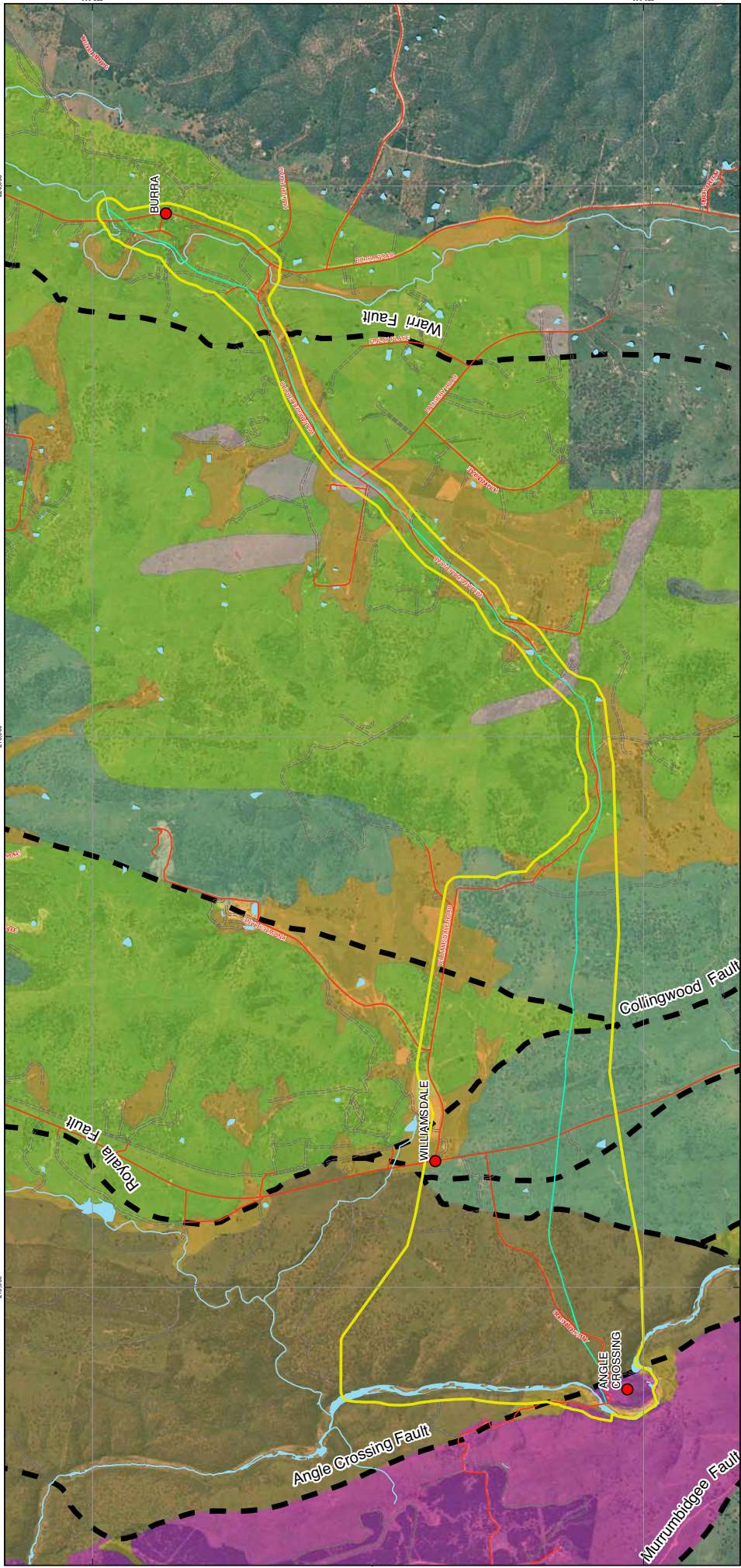


Murrumbidgee to Googong Water Transfer Project

Soil, Contamination and Groundwater
Impact Assessment

Project Reference: GHD_M2G_GEN_GN_MAP_103
Revision: E
Date: 08 MAY 2009
Peer review:
Technical review:

Figure A1: Topography



Geological Units

- Cainozoic Sediments
- Bransby Shear Zone
- Colinton Volcanics
- Colinton Volcanics (Williamsdale Dacite Member)
- Deakin Volcanics
- Rothlyn Formation
- Intrusions

Legend

- Locations
- Proposed Pipeline Alignment
- Road
- Track-Vehicular
- Rivers, Dams, Lakes
- Faults
- Study Area

BULK WATER ALLIANCE

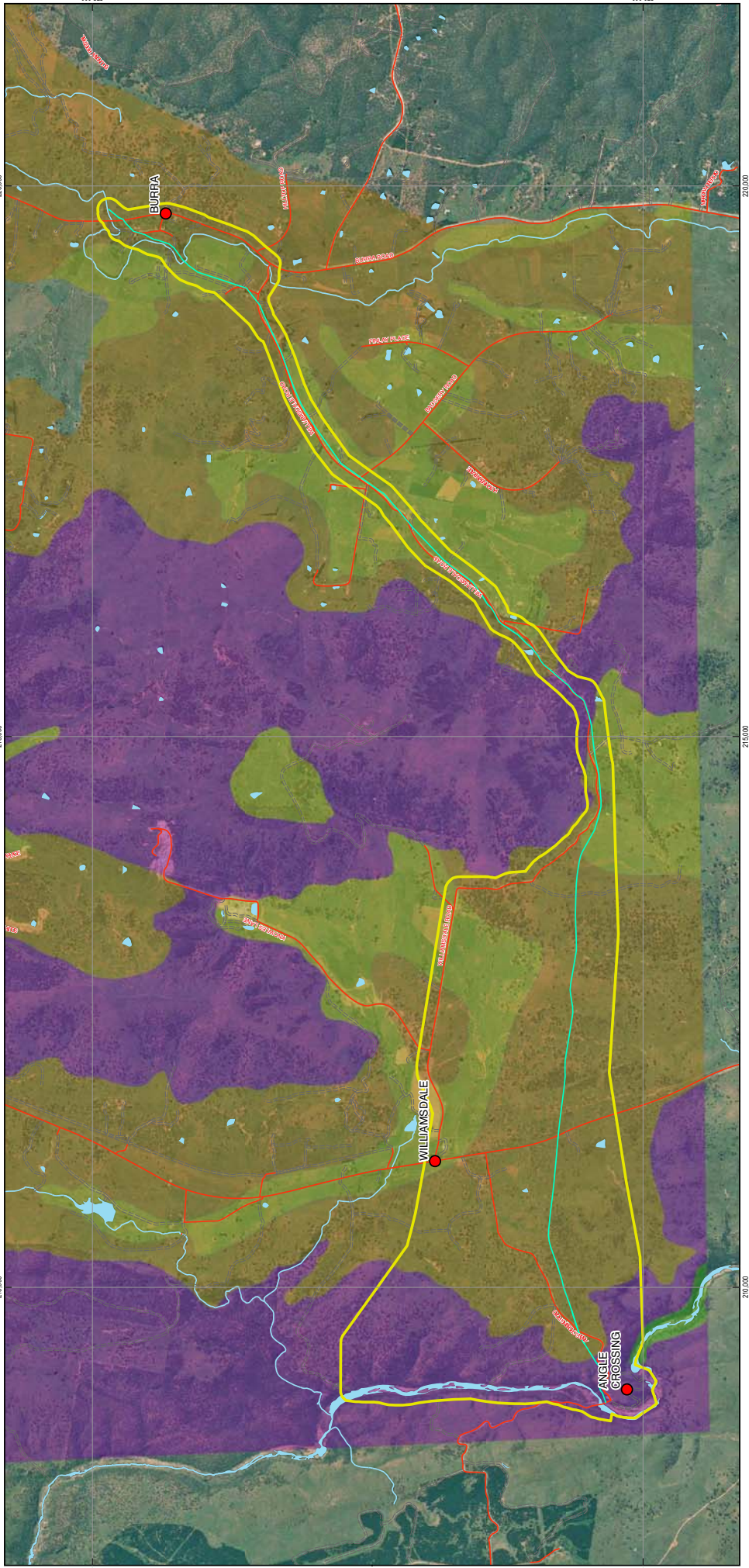


Murrumbidgee to Goong Water Transfer Project

Soil, Contamination and Groundwater
Impact Assessment

Figure A2: Regional Geology

Project Reference: GHD_M2G_PIP_GE_MAP_002
Revision: C
Date: 08 MAY 2009
Peer review:
Technical review:

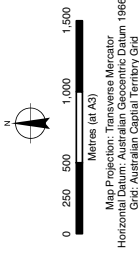


Soil Landscapes

- Burra
- Campbell
- Murrumbidgee Gorge
- Williamsdale

Legend

- Locations
- Proposed Pipeline Alignment
- Road
- Track-Vehicular
- Rivers, Dams, Lakes
- Study Area



BULK WATER ALLIANCE



Murrumbidgee to Goongong Water Transfer Project

Soil, Contamination and Groundwater
Impact Assessment

Figure A3: Soil Landscapes

Project Reference: GHD_M2G_PIP_GE_MAP_003
Revision: C
Date: 09 MAY 2009
Peer review:
Technical review:

Appendix B Historical aerial photographs

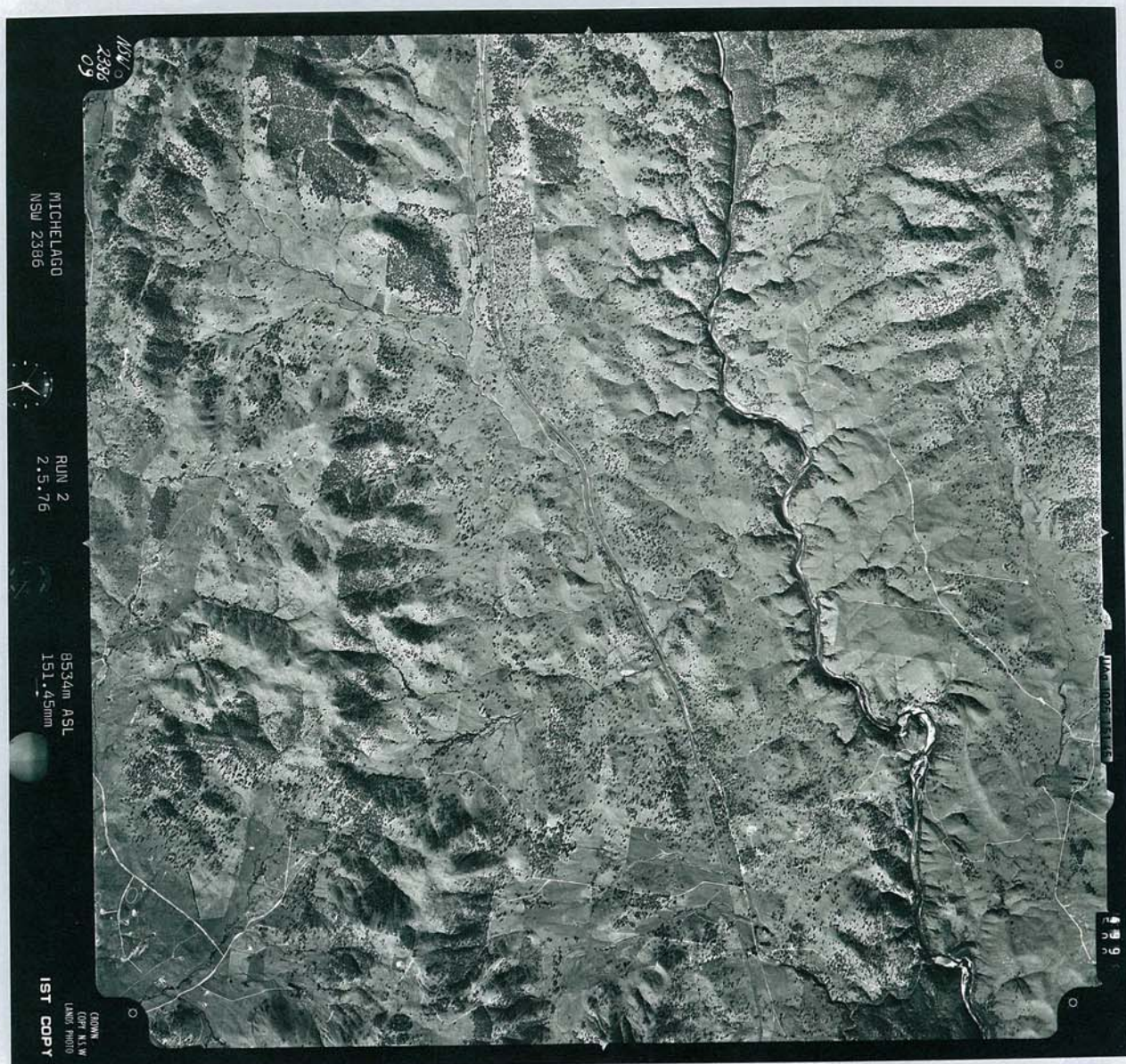
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SVY1235 MICHECHIO (KUN) (8-84) HUG 30 '57 / 53-25" 25300'

30/08/51







1851
2386
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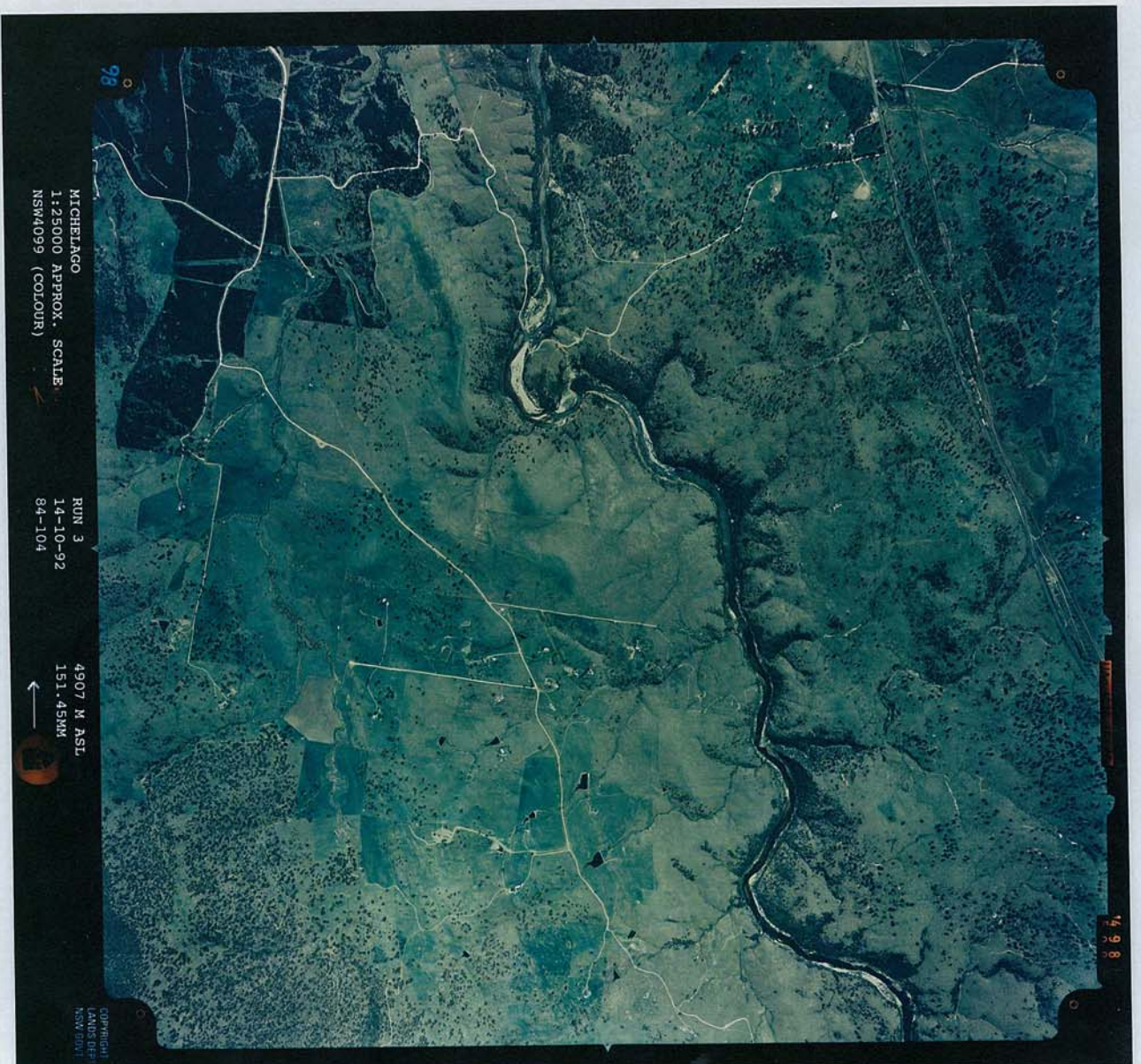
MITCHELAGO
NSW 2386

RUN 2
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8534m ASL
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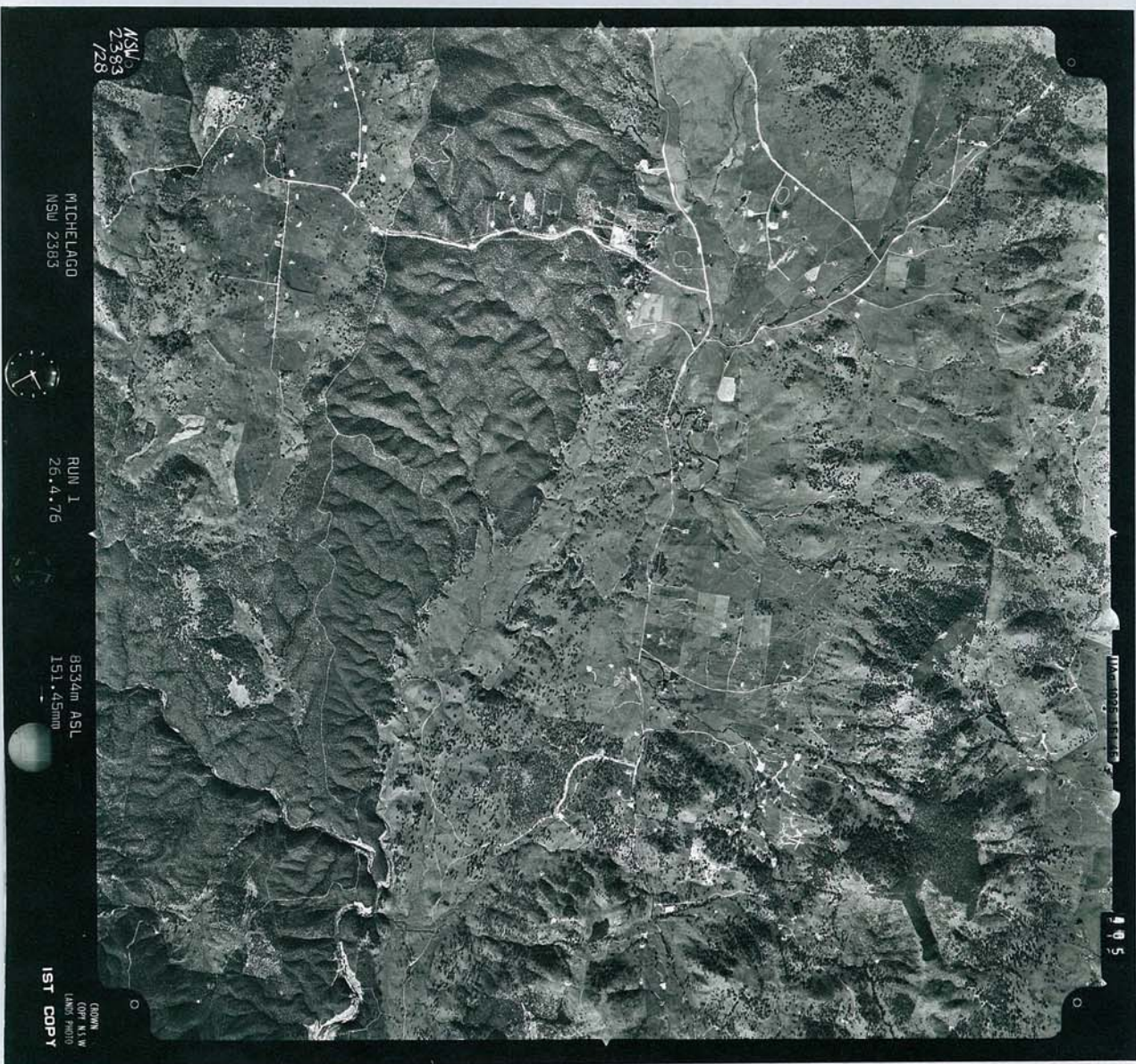
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MAGNETIC
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5078

SVY 1435 MICHELLE RIVER - 24170630' 51.154.45" 25320'

30/08/51





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MICHELAGO
NSU 2383



RUN 1
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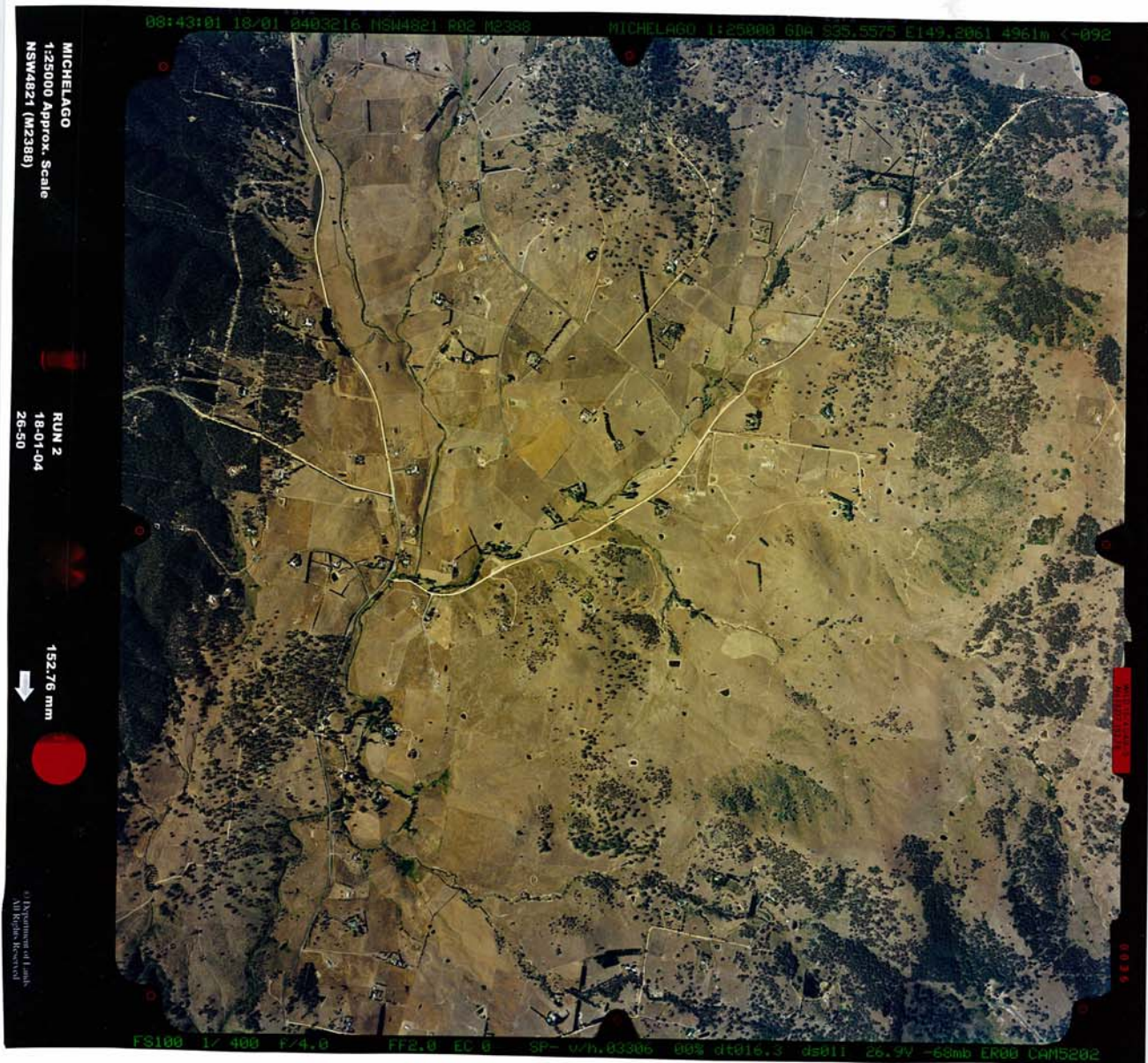


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NSM4099 (COLOUR)

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NSW 6899





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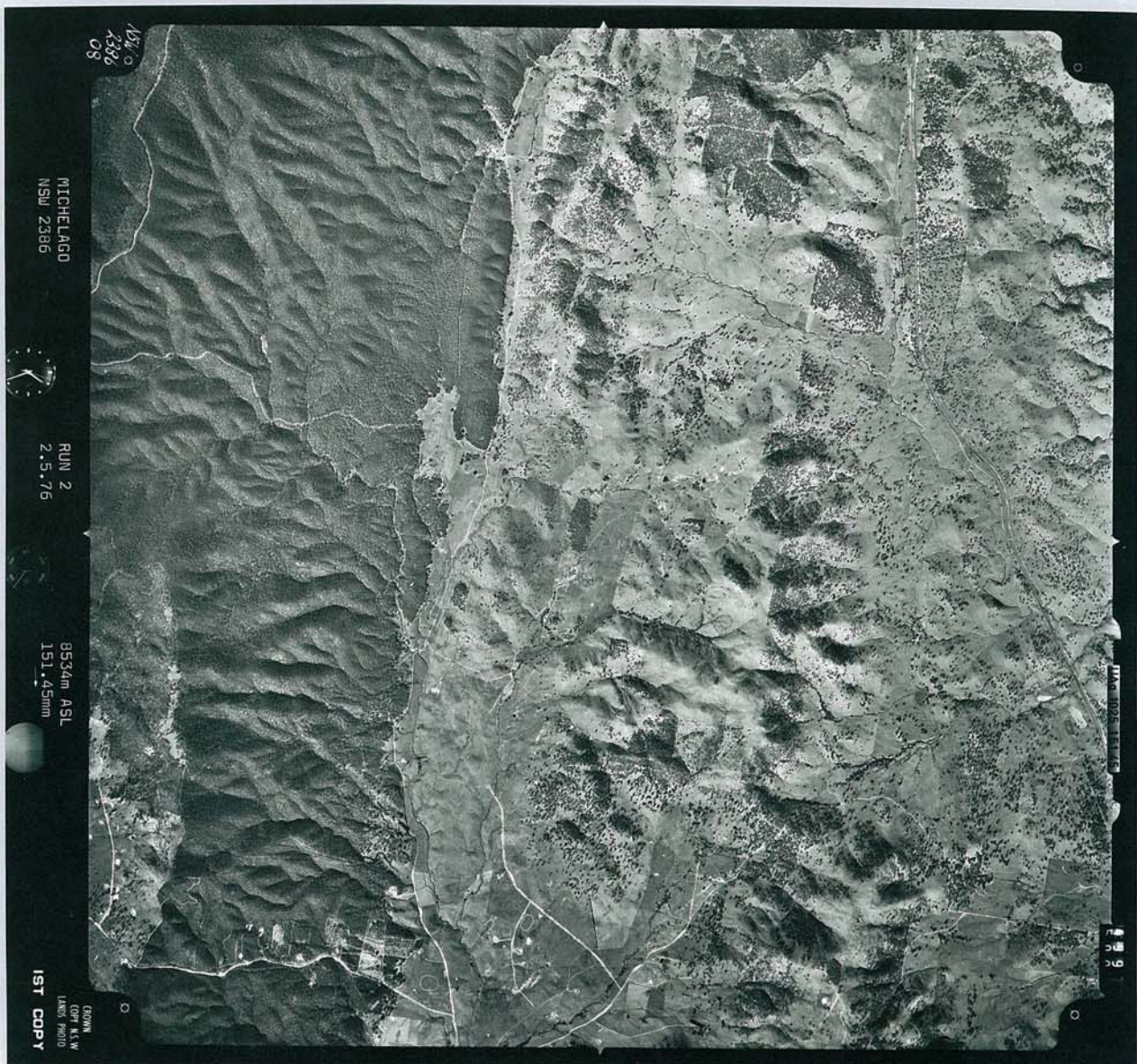
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LANDSPHOTO

LOG - E

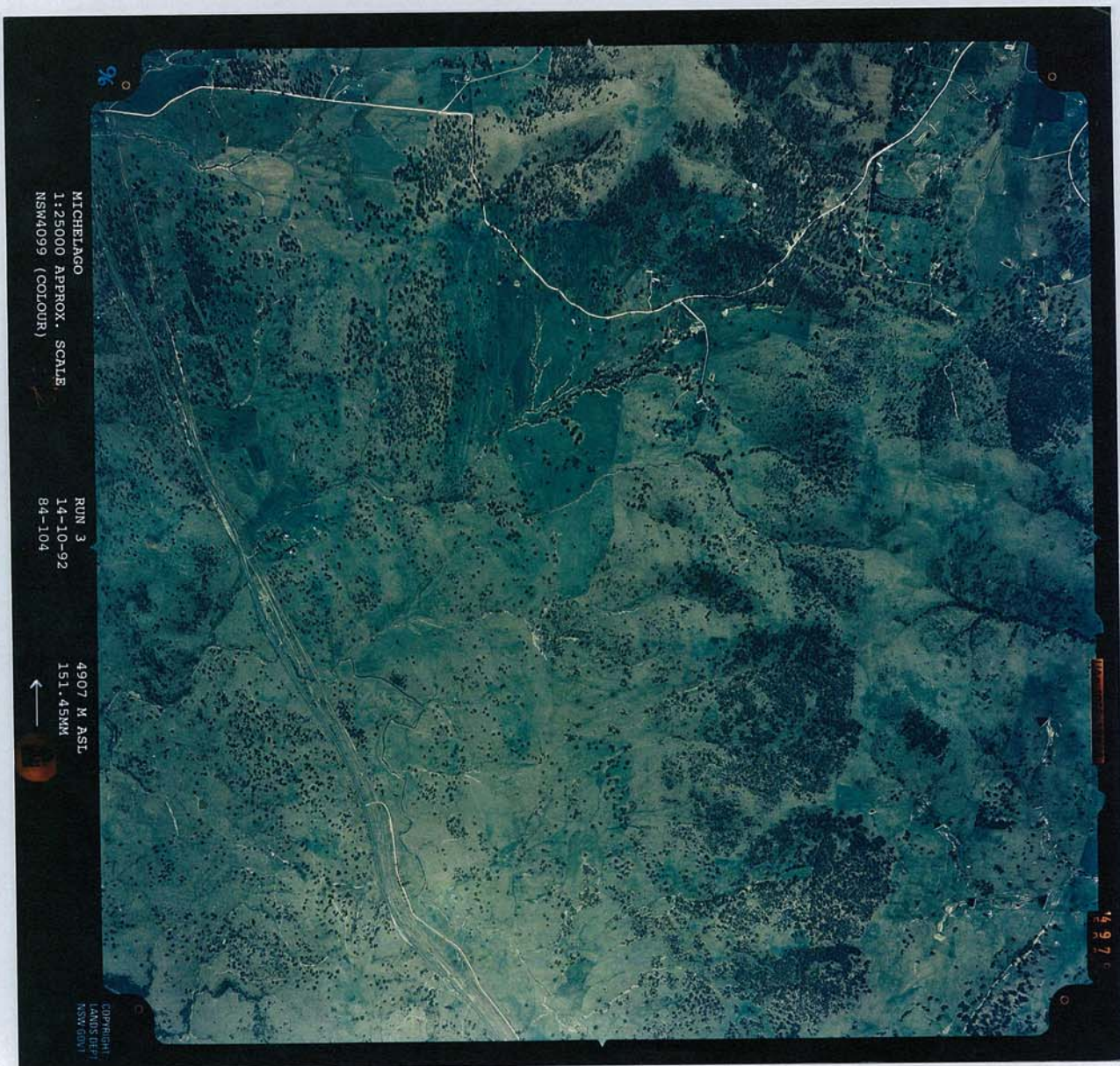


MICHELAGO
NSW 2386

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LAND PHOTO



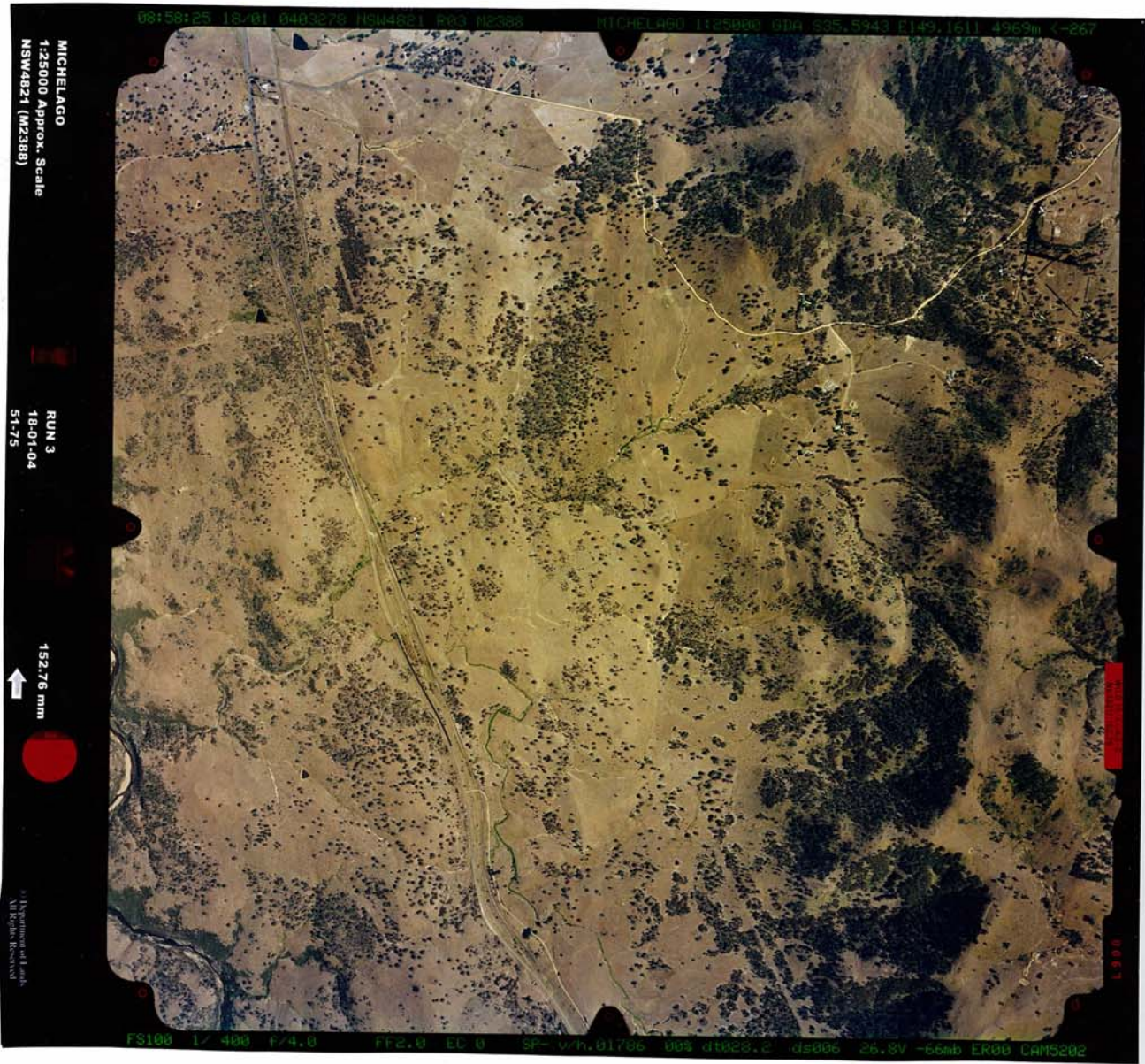
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84-104

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NSM 5008

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08:58:25 18/01 0403278 NSW4821 R03 N2388 MICHEL 960 1125000 004 335.5943 E149.1611 4969m -267

MICHELAGO
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NSW4821 (M2388)

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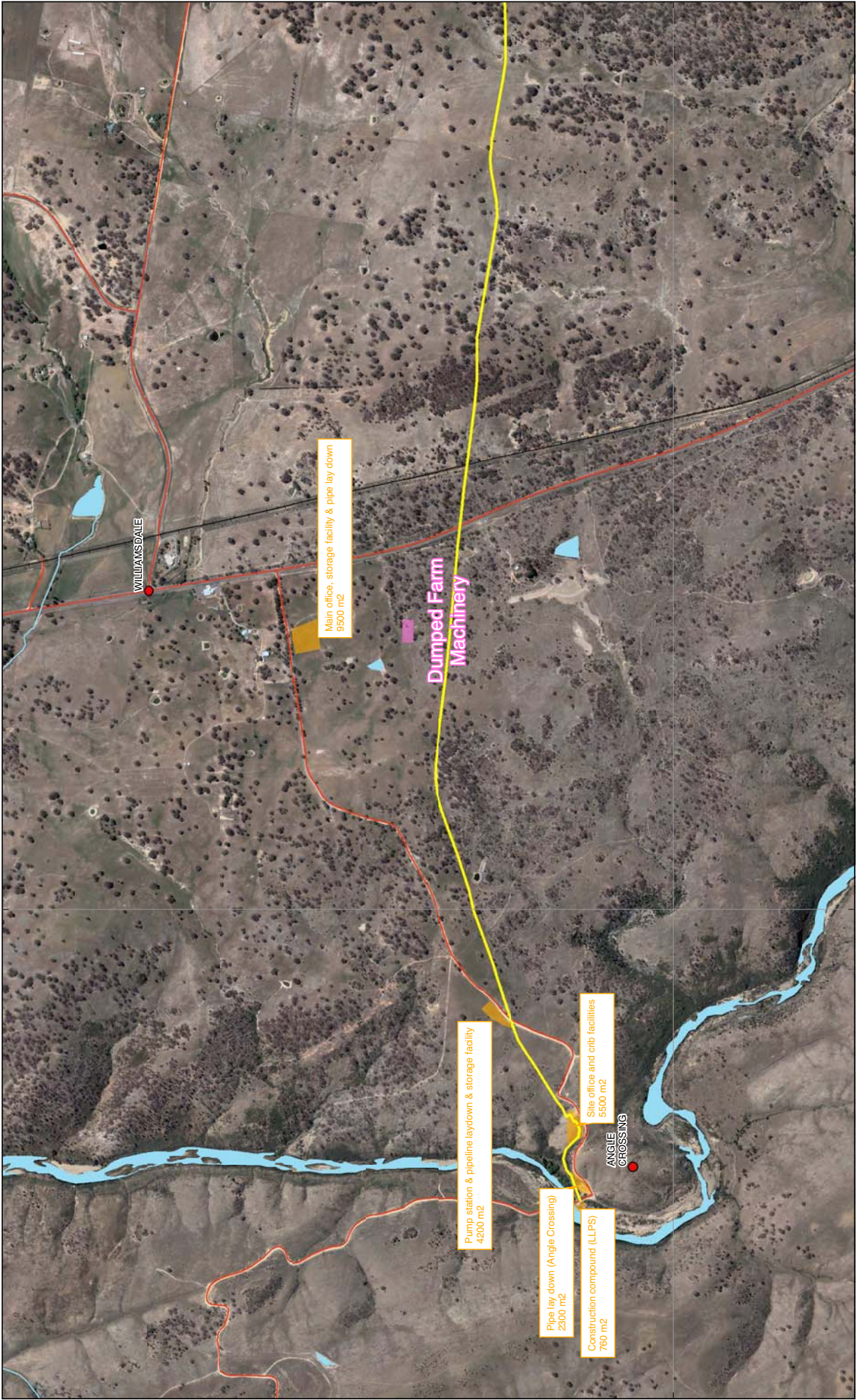
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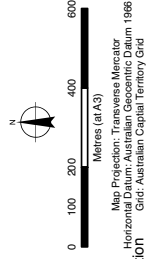
Appendix C Areas of potential concern

Figures C1 to C3



Legend

- Locations
- Proposed Pipeline Alignment
- Road
- Track-Vehicular
- Railway
- Rivers, Dams, Lakes
- Site Compounds
- Possible Soil Contamination



BULK WATER ALLIANCE



Murrumbidgee to Googong Water Transfer Project

Soil, Contamination and Groundwater
Impact Assessment

Figure C1: Areas of Potential Concern

Project Reference: GHD_M2G_GEN_GN_MAP_087_C1
Revision: E
Date: 08 MAY 2009
Peer review:
Technical review:



Legend

- Locations
- Proposed Pipeline Alignment
- Railway
- Rivers, Dams, Lakes
- Road
- Track-Vehicular
- Site Compounds
- Possible Soil Contamination

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Soil, Contamination and Groundwater Impact Assessment

Figure C3: Areas of Potential Concern

Project Reference: GHD_M2G_GEN_MAP_087_C3

Revision: D

Date: 02 MAR 2009

Peer review:

Technical review:

Appendix D Contaminated land database searches

ACT Register of Contaminated Site

NSW Database of contaminated land notices



File Ref: 99/9286

Mr Stephen Lawler
GHD Pty Ltd
PO Box 36
Belconnen ACT 2616

RE: CONTAMINATED LAND SEARCH

Dear Mr Lawler

Thank you for your search form request of 13/11/2008 enquiring about:

Block 36 - Tuggeranong

Records held by the Environment Protection Unit (EPU) for the above block(s) indicate the following:

The block is not recorded on the Register of contaminated sites under section 21(A) of the Environment Protection Act 1997.

At present the EPU has no information on contamination of the above block(s). However, this does not absolutely rule out the possibility of contamination and should not be interpreted as a warranty that there is no contamination.

I appreciate that this does not absolutely rule out the existence of contamination of the soils. If you or your clients wish to be completely sure, you, or they, should arrange to conduct independent tests.

Yours sincerely

A handwritten signature in black ink that reads 'Mark Heckenberg'.

Mark Heckenberg
Project Officer,
Environment Protection Unit

19/11/2008



File Ref: 99/9286

Mr Stephen Lawler
GHD Pty Ltd
PO Box 36
Belconnen ACT 2616

RE: CONTAMINATED LAND SEARCH

Dear Mr Lawler

Thank you for your search form request of 13/11/2008 enquiring about:

Block 1654 - Tuggeranong

Records held by the Environment Protection Unit (EPU) for the above block(s) indicate the following:

The block is not recorded on the Register of contaminated sites under section 21(A) of the Environment Protection Act 1997.

At present the EPU has no information on contamination of the above block(s). However, this does not absolutely rule out the possibility of contamination and should not be interpreted as a warranty that there is no contamination.

I appreciate that this does not absolutely rule out the existence of contamination of the soils. If you or your clients wish to be completely sure, you, or they, should arrange to conduct independent tests.

Yours sincerely

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Mark Heckenberg
Project Officer,
Environment Protection Unit

19/11/2008



File Ref: 99/9286

Mr Stephen Lawler
GHD Pty Ltd
PO Box 36
Belconnen ACT 2616

RE: CONTAMINATED LAND SEARCH

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Block 1653 - Tuggeranong

Records held by the Environment Protection Unit (EPU) for the above block(s) indicate the following:

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At present the EPU has no information on contamination of the above block(s). However, this does not absolutely rule out the possibility of contamination and should not be interpreted as a warranty that there is no contamination.

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Yours sincerely

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Mark Heckenberg
Project Officer,
Environment Protection Unit

19/11/2008

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Search results

Your search for: LGA: Palerang Council
Notice Type: Declaration of Investigation Area

[SearchAgain](#)[RefineSearch](#)

did not find any records in our database.

If a site does not appear on the record it may still be affected by contamination. For example:

- Contamination may be present but the site has not been regulated by the EPA under the Contaminated Land Management Act 1997 or the Environmentally Hazardous Chemicals Act 1985.
- The EPA may be regulating contamination at the site through a licence or notice under the Protection of the Environment Operations Act 1997 (POEO Act).
- Contamination at the site may be being managed under the planning process.

Search TIP

To search for a specific site, search by LGA (local government area) and carefully review all sites listed.

... [more search tips](#)

More information about particular sites may be available from:

- The POEO public register
- The appropriate planning authority: for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act.

See What's in the record and What's not in the record.



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Search results

Your search for: LGA: Palerang Council
Notice Type: Investigation Order

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Search results

Your search for: LGA: Palerang Council

Notice Type:
Note of
Existence of
Voluntary
Investigation
Proposal

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Search results

Your search for: LGA: Palerang Council

Notice Type:
Declaration of
Remediation
Site

[SearchAgain](#)[RefineSearch](#)

did not find any records in our database.

If a site does not appear on the record it may still be affected by contamination. For example:

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- The EPA may be regulating contamination at the site through a licence or notice under the Protection of the Environment Operations Act 1997 (POEO Act).
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... [more search tips](#)

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- The appropriate planning authority: for example, on a planning certificate issued by the local council under [section 149 of the Environmental Planning and Assessment Act](#).

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Search results

Your search for: LGA: Palerang Council
Notice Type: Remediation Order

[SearchAgain](#)[RefineSearch](#)

Suburb	Address	Site Name	Notices related to this site
Bungendore	Corner King and Butmaroo Streets	Timber Treatment Plant	1 former
Larbert	Mayfield Road	Waste Oil Storage	1 current

Page 1 of 1

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Site and notice details

Your search for: LGA: Palerang Council
Notice Type: Remediation Order
2 notices on 2 sites were matched.

[Return to list of search results](#)[SearchAgain](#)[RefineSearch](#)**Area No: 990**

The information below was correct at the time the notices were issued.

Site: Timber Treatment Plant**Address:** Corner King and Butmaroo Streets, Bungendore, 2621**LGA:** Palerang Council**Occupier:** Marscent Pty Ltd**Owner:** Marscent Pty Ltd

Lot 1/8 DP 976608	Lot 10/8 DP 976608	Lot 11/8 DP 976608	Lot 12/8 DP 976608	Lot 2/8 DP 976608
Lot 3/8 DP 976608	Lot 4/8 DP 976608	Lot 5/8 DP 976608	Lot 6/8 DP 976608	Lot 7/8 DP 976608
Lot 8/8 DP 976608	Lot 9/8 DP 976608			

Notices relating to this site (0 current and 1 former)

(Map) where available, maps show the part of the site affected by the notice

*notice matched search criteria

Notice recipient	Notice type & number	Status	Date
Name Withheld	Remediation Order* <u>406</u>	Not in force	Issued 14 Jun 1995 Invalid 12 Jul 2006



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Site and notice details

Your search for: LGA: Palerang Council
Notice Type: Remediation Order
2 notices on 2 sites were matched.

[Return to list of search results](#)[SearchAgain](#)[RefineSearch](#)**Area No: 3122**

The information below was correct at the time the notices were issued.

Site: Waste Oil Storage**Address:** Mayfield Road, Larbert, 2622**LGA:** Palerang Council**Occupier:** Name Withheld

Lot 136 DP 754892

Lot 149 DP 754892

Notices relating to this site (1 current and 0 former)

(Map) where available, maps show the part of the site affected by the notice

*notice matched search criteria

Notice recipient	Notice type & number	Status	Date
Name Withheld	Remediation Order* 422	Current	Issued 16 Apr 1996



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Search results

Your search for: LGA: Palerang Council

Notice Type:
Note of
Existence of
Voluntary
Remediation
Proposal

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Search results

Your search for: LGA: Palerang Council

Notice Type:
Notice for
Maintaining
Remediation

[SearchAgain](#)[RefineSearch](#)

did not find any records in our database.

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Search results

Your search for: LGA: Palerang Council

Notice Type:
Notice to End
Declaration /
Declaration
and Order

[SearchAgain](#)[RefineSearch](#)

did not find any records in our database.

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... [more search tips](#)

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- The appropriate planning authority: for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act.

See [What's in the record](#) and [What's not in the record](#).



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Soils, Contamination and Groundwater Assessment Addendum

Murrumbidgee River to Googong Water Transfer Project

December 2009

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Abbreviations

ACT	Australian Capital Territory
AHD	Australian Height Datum
ASL	Above sea level
Ba	Burra Soil Landscape Unit
CCO	Chemical Control Orders
Cza	Cainozoic Sediments Geological Unit
DCLM	Department of Conservation and Land Management
DECC	Department of Environment and Climate Change
DP	Part of a lot and DP number (development)
DWE	Department of Water and Energy
EHC Act	<i>Environmentally Hazardous Chemicals Act 1985</i>
ft	Feet
HLPS	High Lift Pump Station
LLPS	Low Lift Pump Station
LPI	Land and Property Information
m	Metres
mg/L	Milligrams per litre
OCP	Organochlorine Pesticides
TDS	Total dissolved solids
VENM	Virgin Natural Excavated Material

1 Introduction

1.1 Background

ACTEW Corporation Limited (ACTEW) proposes to transfer water from the Murrumbidgee River through an underground pipeline to Burra Creek in NSW which flows into Googong Reservoir. This proposed project is known as the Murrumbidgee to Googong Water Transfer.

In order to obtain community feedback and satisfy statutory approval requirements a series of community meetings and a period of public exhibition of the Environmental Assessment (NSW) and Draft Environmental Impact Statement (ACT) (referred to as the EA/Draft EIS) were undertaken. In response to community feedback received before and during the public exhibition period ACTEW has modified the location at which the pipeline would discharge into Burra Creek.

This report addresses the impacts associated with the proposed upstream outlet location into Burra Creek.

1.2 Upstream outlet overview

The project involves construction and operation of infrastructure required to transfer approximately 100 ML/day of water a distance of approximately 12 km from the Murrumbidgee River to Burra Creek which flows into Googong Reservoir. The infrastructure required to transfer the water includes an intake/low lift pump station; a high lift pump station; an underground pipeline; an outlet structure and a power supply.

The original outlet location outlined in the EA/Draft EIS proposed that the pipeline would discharge just downstream of an existing flow measuring station near Burra Road, approximately 10 km south of Googong Reservoir. The original outlet structure was located east of Burra Road within land known as the Googong Foreshores, which is Commonwealth owned land within NSW.

The modified outlet location is 3.2 km upstream from that previously proposed in the EA/Draft EIS. The new outlet location is located in the vicinity of the low level crossing on Williamsdale Road near the junction of Burra and Williamsdale Roads.

The transferred water would discharge through a concrete structure located on the banks of Burra Creek. The outlet structure has been modified to suit this alternative Burra Creek location where the channel is only approximately 1 m deep. It would be a concrete topped structure stretching approximately 12 m along the creek bank with a 250 mm grated opening.

A mini-hydro power generation facility would be located close to the Burra Creek discharge location, but above flood level. The mini-hydro power generation facility would largely be housed underground and would recover almost 20% of the total electricity used for the pumping of the water.

The upstream outlet proposed by the community submissions would reduce a number of adverse environmental and social impacts of the original project including:

- Project footprint reduced as follows:
 - Pipe length reduced by one km;
 - One less pipeline creek crossing;
 - Five landholders no longer affected by easement requirements;
 - An estimated 10 landholders no longer indirectly impacted by construction works;
 - An estimated five air valves, four scour valves and associated potential impacts reduced;
 - Four less road crossings;
 - Less disruption to flora and fauna (habitats within this area are mostly highly disturbed but includes a small area of box-gum grassy woodland close to the original proposed outlet site);
 - Outlet location not on Commonwealth land;

- Greenhouse gas emissions would be reduced by at least 3% during construction.

Additional targeted consultations are also underway with major stakeholders and those landholders located near the new outlet location or abutting the additional length of creek that would be affected by increased flows.

1.3 Purpose and scope of the report

The purpose of this study is to discuss:

- The existing condition of Burra Creek at the upstream outlet point;
- Potential impacts associated with the outlet; and
- Mitigation recommendations.

1.4 Structure of the report

This report will address the impact of the upstream structure.

This report should be read in conjunction with the Soil, Contamination and Groundwater Specialist Report (hereafter referred to as the 'main report').

2 Existing environment

2.1 Topography

From a review of the Williamsdale 1:25,000 topographic map, the proposed outlet location and associated structures are situated on gentle undulating slopes that are typical towards Williamsdale (LPI 2002). Elevation at the proposed outlet location and associated structures ranges from 750–800 metres above sea level (Appendix A, Figure A1 of the main document).

2.2 Geology

The proposed outlet location and associated structures lie within the Cowra-Yass Synclinal Zone, with geology made up of Cainozoic Sediments (Cza) (Appendix A, Figure A2 of the main report). This geologic unit consists of high-level gravels, sand silt and talus breccia, alluvium and colluvium. Due to the potential for cementation, the unit may have significant rock strength (Henderson 1987; Richardson & West 1977).

Based on site observations, geology at the proposed outlet structure indicated the presence of locally eroded and detached or partially detached rock masses (BWA, 2009). Engineering issues may also arise due to the presence of talus and other transported sediments.

According to the Geotechnical Investigation Report (BWA, 2009), the Colinton Volcanics group is common within the immediate area and generally comprise rhyolitic to rhyodacitic crystal and lithic tuff, minor siltstone, sandstone, and limestone.

2.2.1 Additional Geological Information

The following sections are in response to a request for more information from ACT PLA regarding information on geological properties that may have an influence on ground stability, OH&S and rehabilitation programs.

Temporary Stability and OHS

The current ACT and NSW WorkCover codes of practice for construction works/excavations requires that excavations in soils deeper than 1.5 m must be stabilised by benching, battering, or mechanical support. However, the occurrence of particular subsurface conditions such as groundwater seepage, unstable soil masses (e.g. colluvium) or unfavourable rock mass defect orientations and faulting may require excavation support or stabilisation to be put in place at a shallower depth. Further, limitations to the work site layout, such as restricted loading and storage adjacent to excavations may be warranted locally (BWA 2009).

It is recommended that an experienced geotechnical engineer assess the excavation conditions as construction progresses. Potential ground stability issues are outlined in Table 1.

Rehabilitation Capacity

The success of rehabilitation on the ground surface and re-vegetation at the site post-construction will be dependant on the methods adopted. The success of any rehabilitation program would also depend on the consideration of local soils and geology, as well as other considerations, such as surface runoff concentration, erodibility of imported topsoil / fill.

Table 1 Summary of expected geology along the proposed pipeline route (Henderson 1987; and Richardson and West 1977)

Approximate length of route ¹	Geological unit	Description	Excavatability of less weathered materials ²	Ground stability and potential engineering issues
Discharge and 3.90 km of pipeline route	Cainozoic Sediments (Cza)	High-level gravels, sand silt and talus breccia, alluvium and colluvium.	Excavatability unknown. (Cainozoic age sediments may be cemented and have significant rock	Talus and other transported sediments may vary in engineering behaviour.

Approximate length of route ¹	Geological unit	Description	Excavatability of less weathered materials ²	Ground stability and potential engineering issues
			strength).	Potential erosion issues.
Intake site and 0.2 km length of pipeline route.	Colinton Volcanics (Bransby Shear Zone) (Sb)	Sheared dacite and tuff, commonly sericitised; lenses of slaty shale.	Moderate excavation difficulty, may require rock-breakers (hydraulic hammers). (High to very high strength, distinctly bedded and jointed rock mass).	Potential stability issues with cut batter engineering.
2.75 km	Colinton Volcanics (Sc)	Rhyolitic crystal tuff and dark grey, purple and white Rhyolite, minor coarse sandstone.	Moderate excavation difficulty, likely to require rock-breakers. (Very high strength jointed rock mass with distinct bedding / cleavage trending north-south).	Stability issues with temporary excavation faces with north-south trend.
3 km of pipeline route	Colinton Volcanics (Williamsdale Dacite Member)	Dacitic crystal tuff	Likely requires rock-breakers to excavate. Locations where 'massive' rock occurs may require blasting to excavate.	Stability issues with temporary excavations trending at or near 030N.
1.75 km of pipeline route	Deakin Volcanics (Sd)	Green grey to purple Rhyolite to dacite.	Moderate excavation difficulty, likely to require rock-breakers. (Very high strength jointed rock mass with distinct bedding / cleavage trending north-south).	Stability issues with temporary excavation faces with north-south trend.
0.55 km of pipeline route	Intrusions (Sp)	Pale grey Rhyolite	Possible hard excavation. Blasting may be required.	Unknown condition of intrusive material.

Notes: 1. Based on preliminary and approximate route alignment.

2. Note that excavatability of a rock mass is dependent on the degree of weathering, rock material strength and spacing and orientation of defects.

2.3 Soil Landscapes

The Michelago 1:100,000 Soil Landscape Series sheet identified that the Burra (Ba) soil landscape underlies the proposed outlet location and associated structures (DCLM 1994 and Jenkins 1993) (Appendix A, Figure A3 of the main report). This soil landscape is typically 0.2–0.6 metres thick on crests and upper slopes, and up to 1 metre thick on drainage lines/upper slopes (DCLM 1994). The pH of the soil landscape is typically 6–7 (DCLM 1994).

The Burra soil landscape demonstrates moderate erodibility at the surface, and high to moderate erodibility below the topsoil (DCLM 1994). Minor sheet erosion is common within this soil landscape (DCLM 1994).

Dispersive soils could be encountered, particularly around waterways (BWA 2009).

2.3.1 Additional Soil Information

The following section is in response to a request for more information from ACT PLA regarding information on geological properties that may have an influence on the quality of waste water leaving any area disturbed by the project. A discussion on soil stability adequately answers this question.

Potential Soil Stability Issues

Dispersion is a characteristic where soil, generally clays, will break down into individual particles when exposed to water. Erosion is generally a breakdown of the soil structure caused by exposure to water or wind. The severity of erosion is often a function of the velocity of the flow that the soil is exposed to. Typically, dispersive soils are, in turn, highly erodible (BWA 2009).

Limited laboratory testing to determine dispersive potential (i.e. Emerson Class Number) of the encountered soil and weathered rock materials across the M2G route indicates that different subsurface materials along the route range in dispersive potential from low to high. Materials of high dispersive potential (Emerson Class Number of 1) were generally encountered near watercourses (BWA 2009).

Disturbance of dispersive soils during excavation may impact upon the quality of waste water and surface water which comes in contact with the construction site.

2.4 Groundwater

Data from groundwater bores located in the vicinity of the pipeline route were obtained from the NSW Department of Water and Energy's (formerly the Department of Natural Resources) database of registered groundwater bores located throughout New South Wales (DWE 2004). This data may have originated from boreholes of varying location and depth, from which measurements such as water level have been made at different times for each bore (generally at the time of drilling), and under different circumstances with little or no quality assurance. For these reasons, the data can be used as a guide only.

As indicated in the main report, groundwater is likely to flow east of Gibraltar Rise toward Burra Creek due to the topographic nature of the area. Only two registered groundwater bores were located within 250 metres of the proposed outlet location and associated structures (Refer to Appendix A, Figure A4 of the main document). These were GW402412 and GW56747, both located south-east of the proposed outlet location and associated structures. These groundwater bores are used for domestic stock and irrigation purposes. Groundwater depths have been recorded as very shallow (3-3.3 metres, or 772-757 m AHD).

Salinity of the groundwater recorded in fractured and unconsolidated rocks indicated that Total Dissolved Solids (TDS) are moderate (approximately 500 mg/L) at the proposed outlet location and associated structures (Refer Figure 4.1 of the main report). No other physical or chemical groundwater data are available for the groundwater in the local area.

2.5 Contaminated land

2.5.1 Review of historical aerial photographs

The outcomes of the review of historical aerial photographs for the area comprising the proposed outlet location and associated structures are provided in Table 2. No areas of potential concern were observed during the review.

Table 2 Aerial Photograph observations – NSW (Refer to Appendix B of the main report)

Date	Aerial Photograph	Details Observed
1951	Michelago Run 2 25,500 ft ASL Black and white	Very little development along Williamsdale Road. Vegetation had been heavily cleared and the main land use of the area along the proposed pipeline appeared to be stock grazing. Some unidentified structures were present on the corner of Williamsdale and Macdiarmid Roads. There was no evidence of major land disturbance other than heavy clearing of vegetation.
1961	Photo showing Burra Township area	Not available.
1976	Michelago Run 1 8,534 m ASL Black and white	Several dams have been constructed on properties along Williamsdale Road. Improved pasture was noted in several paddocks along the amended pipeline section however, no residential dwelling or other structures are noted nearby. No evidence of land major disturbance other than occasional tilling / ploughing in several paddocks. Area apparently still used primarily for grazing purposes.
1992	Michelago Run 2 4,907 m ASL Colour	Several residential dwellings and other structures have been constructed on allotments in the vicinity of the amended pipeline alignment. Several new dams also noted. No other significant changes noted
2004	Michelago Run 3 Colour	Some of the residential dwellings appeared to have expanded. No other significant changes noted The main land use still appeared to be grazing of livestock.

2.5.2 Walkover survey

A walkover survey of the newly proposed outlet structure, mini hydro and associated re-aligned pipeline was undertaken on the following allotments:

- Lot 7, DP246137; and
- Road reserve adjacent to Williamsdale Road

In addition, the following properties adjacent to the outlet structure, mini hydro and amended pipeline alignment were observed from the road reserve, where possible:

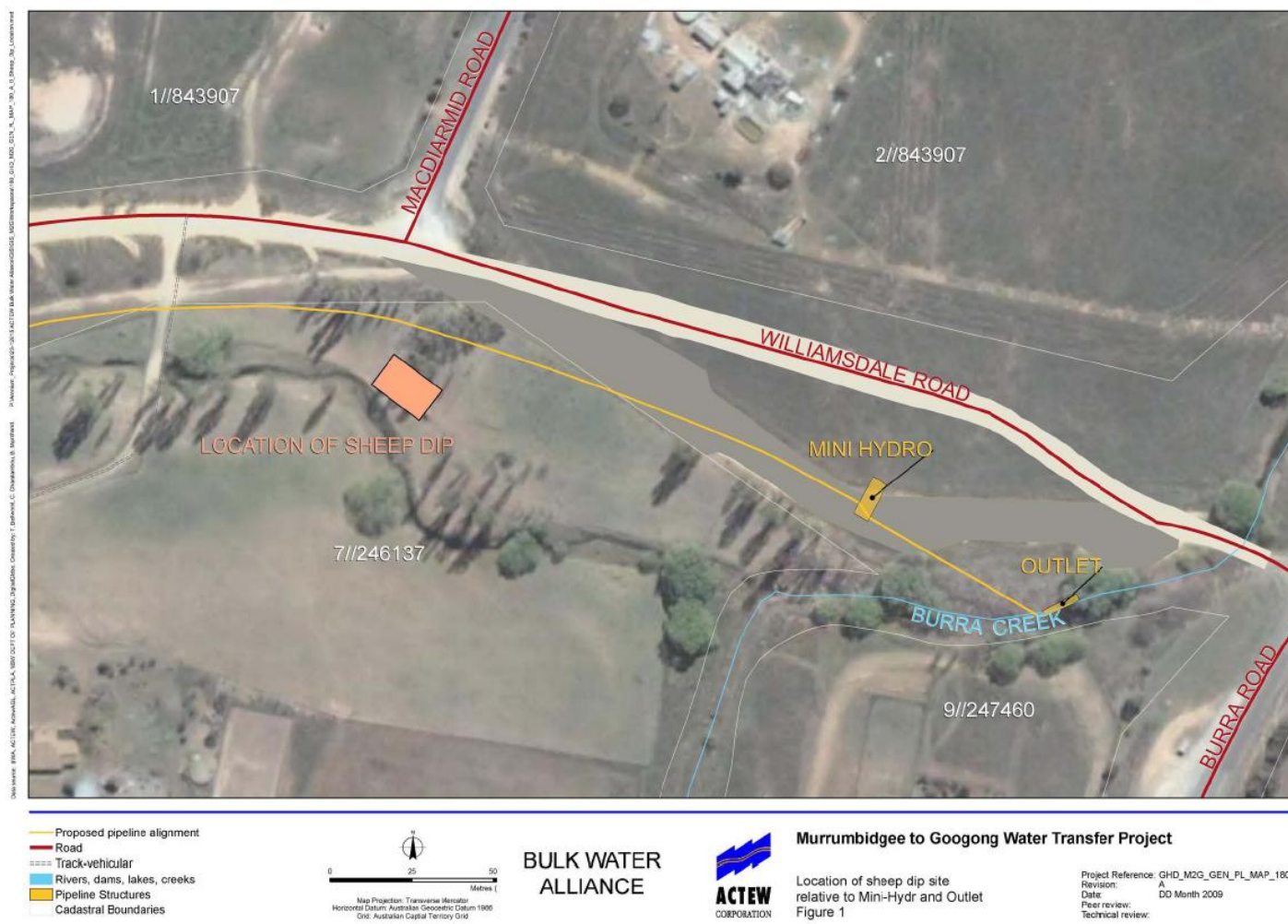
- Lots 1 and 2, DP 843907; and
- Lots 8 and 9, DP 247460

The allotments were typically rural properties with minor residential dwellings and associated agricultural structures, such as sheds and water tanks / troughs. The road reserve was generally in a state of good

repair, and no obvious physical signs of gross widespread contamination concerns were noted. A fill bank was noted adjacent to the road near the location of the proposed mini hydro plant; however the local topography suggested that the fill material was sourced from an adjoining cut to make way for the road.

An unused concrete-lined sheep dip was present in the northern portion of Lot 7 of DP 246137 (Figure 1). The location of the sheep dip was approximately 20 metres south of the proposed alignment of the pipeline. The state of repair of the sheep dip indicated that it had not been used for some time. Grass and other vegetation around the sheep dip appeared healthy and did not show any signs of undue stress. A 44 gallon drum was noted at the entrance to Lot 7 of DP 246137. Closer inspection of the drum identified that it was used by the owners of the property to store household garbage.

A small stockpile (approximately 1-2 metres cubed) of bitumen and road base material was noted near the proposed location of the outlet structure. While this is not considered to be of significant concern with respect to contamination, it will have to be handled in accordance with the *Waste Classification Guidelines – Part 1: Classifying Waste*, NSW DECC 2008, if it is disturbed and requires off-site disposal as part of the pipeline and outlet structure construction works.



2.5.3 Contaminated land database searches

A search of the NSW Department of Environment and Climate Change (DECC) website (DECC 2008) did not list any contaminated sites at the proposed outlet location and associated structures. The search was undertaken for the Local Government Area (LGA) of Palerang Shire Council for contaminated land notices associated with lots within the LGA. The search reported two sites in the LGA for which remediation orders

had been issued, however neither were located close enough to the investigation area to pose a threat of cross contamination. Search results are located in Appendix D of the main report.

2.5.4 Overview of potential areas of concern

Little to no evidence of gross widespread contamination concerns were identified for the areas adjacent to the proposed outlet location and associated structures. However, an apparently disused concrete sheep dip was identified approximately 20 metres to the south of the proposed pipeline alignment in the northern portion of Lot 7 of DP 246137.

Sheep dips are typically associated with potential arsenic and/or pesticide contamination concerns with respect to both soil and groundwater. Therefore, construction works in the vicinity of the dip may need to be undertaken under the guidance of a specific site and/or environmental management plan. Some form of intrusive soil and groundwater investigations may also be needed to be undertaken prior to construction of the pipeline, to better assess the potential contamination concerns associated with the presence of the sheep dip.

3 Assessment of potential impacts

3.1 Potential Construction Impacts

3.1.1 New outlet location

Topography

Excavation activities are likely to cause some topographic alterations at the outlet structure at Burra Creek. These activities could promote bed and bank erosion within Burra Creek, however it is proposed that a rock fill mattress would be installed to minimise this impact. Therefore, the likely impacts to topography are likely to be **negligible**.

Appropriate mitigation measures to minimise the impacts to topography are discussed in Section 6.1 of the main report.

Geology and Soils

Geology and soils are likely to be disturbed by excavation and ground disturbance at works areas, site access areas and through the stockpiling of excavated materials during construction at the new outlet location. These activities could result in soil erosion, particularly in respect to moderate erodibility of the local topsoil and high to moderate erodibility of the local subsoil. However, as the construction activities are likely to be localised, the potential impacts to geology and soils are **low**.

Appropriate mitigation measures to minimise the impacts to geology and soils are discussed in Section 6.1 of the main report.

Groundwater

As discussed in the main report, it is anticipated that the groundwater level would need to be temporarily lowered through sump pumping in order to allow construction at the new outlet location. However, the potential impact to groundwater during the construction of the new outlet is expected to be **low**, due to the following considerations:

- Groundwater drawdown would only occur in localised locations where the outlet is to be constructed;
- Significant volumes of groundwater would not be extracted as extraction of the groundwater would occur on a temporary basis (during the construction phase only);
- The groundwater levels are expected to normalise quickly after pumping ceases;
- The construction activities proposed do not present a contamination risk to the groundwater;
- Extracted groundwater would be stored in a sedimentation pond or modified steel skips before release into Burra Creek; and
- Regular water quality testing would occur downstream of the construction works to identify and manage any significant water quality impacts in Burra Creek.

Appropriate mitigation measures to minimise the impacts to groundwater are discussed in Section 6.1 of the main report.

Contaminated Land

A review of historical aerial photos, a site walkover survey and a search of the Register of Contaminated Sites did not indicate any areas of potential concern with respect to land contamination at the new outlet location. Therefore it is considered unlikely that the construction of the outlet would encounter contaminated soils and the potential to disburse contamination soils is **negligible**.

Appropriate mitigation measures to minimise the impacts to contaminated land are discussed in Section 6.1 of the main report.

3.1.2 New pipeline alignment

Topography

Construction of the pipeline would involve rock breaking or ripping, significant soil excavations, stockpiling of soils, and significant vehicle traffic along the pipeline route and land access points. These activities would disrupt the local topography, however impacts are likely to be short-term as backfilling and site rehabilitation would follow. Also, as the distance of this pipeline route is relatively short (approximately 200 metres), the impacts to the local landform is likely to be **low**.

Appropriate mitigation measures to minimise the impacts to topography are discussed in Section 6.1 of the main report.

Geology and Soils

The construction of the pipeline would involve rock breaking or ripping, significant soil excavations, stockpiling of soils, and significant vehicle traffic along the pipeline route and land access points. These impacts are likely to expose soils, particularly during excavation and stockpiling activities, and increase the risk of wind and water erosion. Acceleration of these processes may be supported by moderate erodibility of the local topsoil and high to moderate erodibility of the local subsoil. However, as the distance of this section of pipeline is relatively short (approximately 200 metres), geology and soil impacts are likely to be **low-moderate**.

Appropriate mitigation measures to minimise the impacts to geology and soils are discussed in Section 6.1 of the main report.

Groundwater

From local groundwater bore data, the depth to groundwater is expected to be 3-3.3 metres from the surface (guide data only). Based on a typical pipeline trench depth of 1.8 to 3 m depth below ground level, it is therefore possible that the local groundwater could be impacted during construction. These activities could impact the quality of groundwater for existing and future uses through direct contact, and the likely impact is **moderate**.

Appropriate mitigation measures to minimise the impacts to groundwater are discussed in Section 6.1 of the main report.

Contaminated Land

Construction activities in the vicinity of the sheep dip, as identified during a site walkover survey, may come in contact with or potentially disturb contaminated soils. However, due to the desktop nature of this study, the extent (if any) of contamination from sheep dip operations is unknown and could only be determined through intrusive soil and groundwater sampling.

Therefore, as the proposed pipeline alignment is located within 20 metres from the sheep dip, and the construction footprint is **likely** to come in contact with the potentially contaminated site. This disturbance could facilitate the spread of potential arsenic and/or pesticides through contamination of soil and groundwater.

Appropriate mitigation measures to minimise the impacts to contaminated land are discussed in Section 4 of this addendum.

3.1.3 Mini hydro power facility

Topography

The construction of this facility would require some earthworks for the preparation of the site facility. These activities would disrupt the local topography, however impacts are likely to be short-term and confined to the immediate facility site. Therefore, the likely impacts to topography at this location are **negligible**.

Appropriate mitigation measures to minimise the impacts to topography are discussed in Section 6.1 of the main report.

Geology and Soils

The construction of the facility would require earthworks, disturbance of topsoil and would involve soil stockpiling activities. These activities are likely to promote wind and water erosion, particularly in relation to stockpiling activities. Acceleration of these processes may be supported by moderate erodibility of the local topsoil and high to moderate erodibility of the local subsoil. However, as the proposed construction would be confined to the immediate facility site, potential geology and soil impacts are likely to be **low**.

Appropriate mitigation measures to minimise the impacts to geology and soils are discussed in Section 6.1 of the main report.

Groundwater

From local groundwater bore data, the depth to groundwater is expected to be 3-3.3 metres from the surface (guide data only). However, it is unlikely that the excavation and ground clearance activities required for the construction of the mini hydro power facility would come in contact with the groundwater system. Therefore, the likely impact to the groundwater at this location is **negligible**.

Appropriate mitigation measures to minimise the impacts to groundwater are discussed in Section 6.1 of the main report.

Contaminated Land

A review of historical aerial photos, a site walkover survey and a search of the Register of Contaminated Sites did not indicate any areas of potential concern with respect to land contamination along the route of the pipeline in the ACT. Therefore it is considered unlikely that the construction of the pipeline would encounter contaminated soils and the potential to disburse contamination soils is **negligible**.

Appropriate mitigation measures to minimise the impact to contaminated land from the construction at the mini hydro power facility are discussed in Section 6.1 of the main report.

3.2 Potential Operation Impacts

3.2.1 New outlet location

There is unlikely to be any significant impacts to topography, geology, soils and contaminated land from the operation of the outlet facility. The transferred water would be discharged onto a rock mattress, which will be constructed on the banks and bed of Burra Creek at the discharge point. This rock mattress will prevent erosion and bank instability at this location.

Future maintenance activities are unlikely to require soil excavation or other activities that would impact soils at this location.

Impacts to groundwater during operation are not expected to significantly change or be to the detriment of the local and downstream environments (either groundwater or surface water). Reasons supporting this statement are discussed further in Section 5.4 of the main report.

3.2.2 New pipeline alignment

Environmental impacts likely to occur during the operation of the new pipeline alignment could include the following:

- Minimal soil impact during the release of water from scour values for maintenance purposes;
- Minimal impact to the topographic character due to the permanent location of scour values above ground; and
- Minimal groundwater impacts during pipeline maintenance purging, which may result in minor quantities of pipeline water coming in contact with the groundwater. Due to the high quality of the pipeline water, these impacts are unlikely to significantly impact the quality of the groundwater.

Future maintenance activities are unlikely to require soil excavation or other activities that would impact soils at this location.

The above potential impacts are considered **negligible** and it is unlikely that significant impacts to topography, geology and soils, groundwater, and soil contamination would occur as a result of the operation of the operation of the pipeline.

3.2.3 Mini hydro power facility

Potential operation impacts from the operation of the facility are likely to include the following:

- Minimal impact to the local topography due to the placement of a permanent structure in the landscape;
- Unlikely soil impacts during future maintenance activities as soil excavation is unlikely to be required; and
- Potential soil contamination from accidental spills or leaks of minor quantities of oils, fuels or chemicals which would be required during the operation of the facility.

The overall impact to the environment during operation of the mini hydro power facility is likely to be **negligible**. Appropriate mitigation measures to minimise the impacts to the environment at the mini hydro power facility are discussed in Section 6.2 of the main report.

4 Proposed Mitigation Measures

4.1 Proposed mitigation measures for potential construction impacts

As discussed in Section 3.1 of this report, the majority of potential construction impacts to topography, geology and soils, groundwater and contaminated land are similar to potential impacts discussed in the main report. Therefore, for most potential construction impacts, references have been made to Section 6.1 of the main report for the discussion of appropriate mitigation measures.

Due to the potential to disturb potentially contaminated land during the construction of the new pipeline alignment, the following mitigation measures have been proposed:

- Construction works in the vicinity of the sheep dip should be undertaken under the guidance of a specific site and/or environmental management plan. Due to the desktop nature of this study, the extent (if any) of contamination from sheep dip operations is unknown and could only be determined through intrusive soil and groundwater sampling;
- The presence of the sheep dip places restrictions on any soil excavated in the vicinity being classified as Virgin Natural Excavated Material (VENM) under the provisions of the *Waste Classification Guidelines, 2008*. Due to the sheep dip the presence of Arsenic and Organochlorine Pesticides (OCP) contamination can not be ignored and soil sampling must be undertaken prior to any material in the vicinity being classified as VENM (if it is residual soil and not fill) for disposal purposes off-site; and
- If following any assessment of soils in the vicinity of the sheep dip it is found that soils are heavily impacted with OCPs, any soil excavated would need to be handled and disposed of in accordance with Chemical Control Orders (CCOs) issued under the *Environmentally Hazardous Chemicals Act (EHC Act) 1985*.

4.2 Proposed mitigation measures for potential operation impacts

As discussed in Section 3.2 of this report, the majority of potential operation impacts to topography, geology and soils, groundwater and contaminated land are similar to potential impacts discussed in the main report. Therefore, reference has been made to Section 6.2 of the main report for the discussion of appropriate mitigation measures for potential operation impacts.

5 References

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