



APPIN MINE GAS DRAINAGE MANAGEMENT PLAN

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DOCUMENT REVISION LOG

Persons authorising this Plan

Name	Title	Date
Chris Schultz	Superintendent Environment	3 December 2020

Document Revisions

Revision	Description of Changes	Date
1	New document	February 2014
2	Revised document	March 2014
3	Revised Document – address DoPI comments	May 2014
4	Revised Document – gas plant upgrades	November 2016
4.1	Revised Document – gas plant upgrades (incorporating DPE feedback)	December 2016
5.0	Updated format and content. Removal of references to historical gas drainage activities. Incorporated comments from consultation.	December 2020

Persons involved in the review of this Plan

Name	Title	Company	Exp (yrs)	Date
Chris Schultz	Superintendent Environment	South32 IMC	24	3/12/2020
Nicola Curtis	Principal Approvals	South32 IMC	7	17/11/2020
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1. INTRODUCTION

Appin Mine incorporates the underground mining operations, which extract coal from the Bulli Seam, and associated surface activities, including the West Cliff Coal Preparation Plant (WCCPP) and Coal Wash Emplacement Area (CWEA). Appin Mine is located approximately 25 kilometres (km) north-west of Wollongong in New South Wales (see Plan 1). Appin Mine is owned and operated by Endeavour Coal Pty Ltd, a subsidiary of Illawarra Coal Holdings Pty Ltd (ICHPL), which is a wholly owned subsidiary of South32 Limited. Appin Mine, Cordeaux Colliery and Dendrobium Mine (and associated facilities) collectively operate as South32 Illawarra Metallurgical Coal (IMC).

ICHPL received Project Approval 08_0150 (the Project Approval)¹ from the Planning Assessment Commission of NSW under delegation of the Minister for Planning and Infrastructure on 22 December 2011 for current and proposed mining of the Bulli Seam Operations (BSO) for the next 30 years, and production of up to 10.5 million tonnes per annum of run of mine coal. This approval incorporates underground mining, transport and coal wash emplacement activities undertaken 24 hours a day, seven days per week.

This Gas Drainage Management Plan (GDMP) has been prepared to detail the environmental management measures associated with future gas drainage for Appin Mine. This plan has been prepared to satisfy Condition 21 of Schedule 4 of the Project Approval for the Gas Drainage Management Plan.

1.1 Plan Objectives

The objectives of this GDMP are to:

- comply with Condition 21 of Schedule 4 of the Project Approval, with regards to vegetation clearing and rehabilitation, noise, air quality, biodiversity, heritage, groundwater, surface water and erosion and sediment control, as well as management and monitoring proposed in response to the proposed gas drainage infrastructure;
- improve mine safety during first working development and longwall extraction; and
- minimise Greenhouse Gas Emissions (GHGs).

1.2 Scope

The GDMP applies to gas drainage activities undertaken on the surface. The GDMP excludes underground gas drainage activities. The intent of the GDMP is to manage the safety and environmental risks associated with gas produced as part of the underground mining process.

In order to support the safe extraction of coal from the Bulli Seam in Appin Area 7 and Area 9, IMC will implement surface gas drainage works and operations where required. All coal mines with high coal seam gas concentrations are required to have procedures for controlling concentrations of methane gas. Surface gas drainage wells can extract methane

¹ As modified by MOD 1 (April 2015) and MOD 2 (October 2016)

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from within the coal seam prior to mining or from within the goaf during mining operations. The purpose of surface gas drainage is to provide a safe underground mining environment. Gas drainage maintains underground methane concentrations at safe concentrations.

The works associated with this GDMP are a continuation of the activities previously approved under Project Approvals 08_0256 and 07_0073.

Attachments will be included in the GDMP for specific gas drainage projects where required.

1.3 Environmental Management System

IMC has a comprehensive Environmental Management System (EMS) in place to minimise the impact of its operations on the local environment and community. The GDMP is a component of the EMS which is certified to ISO 14001.

1.4 Consultation

No consultation is required to be undertaken as part of the review of the GDMP. Comments from any relevant regulatory agencies will be incorporated into the GDMP as required and documented in Appendix 2.

2. ROLES AND RESPONSIBILITIES

Roles and responsibilities associated with environmental management at Appin Mine are defined in the Environmental Management Strategy. Table 1 outlines the roles and responsibilities associated with the implementation and periodic review of the GDMP.

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Table 1: Roles and Responsibilities

Role	Responsibilities
Manager Approvals	Implementing the GDMP.
Specialist Environment	Overseeing the operation and maintenance of site preparation, site water management and sediment and erosion control.
Specialist Gas and Ventilation	Overseeing the operation and maintenance of noise and air quality monitoring and mitigation. Overseeing drill site and pipeline rehabilitation. Preparing and disseminating reports and information.
Principal Community Specialist Community	Consulting with landowners, neighbours and members of the community regarding the activities outlined in this GDMP.
Manager Technical Services General Manager Appin Mine	Providing resources and systems as required to implement the GDMP.
Manager Health, Safety Risk and Training	Establishing a system to train personnel as required to fulfil their responsibilities under the GDMP.
All personnel	Undertake practices to manage and minimise potential environmental impacts according to the GDMP.

3. LEGISLATION AND PLANNING

3.1 Project Approval Conditions

Potential gas drainage management impacts associated with Appin Mine were evaluated during the preparation of the BSO Project Environmental Assessment (EA) 2009. The EA was assessed and the project was approved under the *Environmental Planning and Assessment Act 1979 (EP&A Act)* and associated Regulations.

All activities carried out at Appin Mine will be generally in accordance with the Project Approval and with the EA.

Appendix 1 outlines the gas drainage management requirements of the Project Approval and cross references where the requirements have been addressed within the GDMP.

3.2 Environment Protection Licence Requirements

Environment Protection Licence (EPL) 2504 applies to Appin Mine and associated activities. A copy of the licence can be accessed at the Environment Protection Authority (EPA) website: <http://www.epa.nsw.gov.au/prpoeoapp/>.

Gas drainage activities do not generally require an EPL because the proposed works do not meet any of the definitions within Schedule 1 of the *Protection of the Environment Operations Act 1997*.

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3.3 Relevant Legislation

Key regulatory and GDMP obligations applicable to Appin Mine are managed via an online obligations management database. The obligations are allocated to responsible personnel. This process is detailed in the Environmental Compliance/Conformance Assessment and Reporting Procedure.

Legislation applicable to gas drainage management includes but is not limited to:

- *Environmental Planning and Assessment Act 1979 (EP&A Act);*
- *Protection of the Environment Operations Act 1997;*
- *Biodiversity Conservation Act 2016;*
- *Soil Conservation Act 1938;*
- *Petroleum (Onshore) Act 1991;*
- *Petroleum (Onshore) Regulation 2007;*
- *Public Health Act 1991;*
- *National Parks and Wildlife Act 1974;*
- *Heritage Act 1977;*
- *Mining Act 1992;*
- *Water Act 1912; and*
- *Water Management Act 2000.*

3.4 Guidelines and Standards

This GDMP has been developed to be consistent with the principles of the following:

- ISO 14001:2015 Environmental Management Systems;
- South32 Sustainability Policy;
- South32 Environment Standard; and
- South32 Climate Change Strategy.

Other relevant guidelines for gas drainage management include:

- American Petroleum Institute Standards;
- Industrial Noise Policy (2000);
- Noise Policy for Industry (2017);
- Aquifer Interference Policy (2012);
- Soils and Construction, Volume 1, 4th edition July 2006, Landcom (the Blue Book);
- Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects (NSW Minerals Council 2010);
- NSW Heritage Office Skeletal Remains Guidelines (1998);
- EDG01 Borehole Sealing Requirements on Land;

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- EDG03 Guidelines to the Mining Rehabilitation and Environmental Management Process - MREP Guideline;
- NSW Code of Practice for Coal Seam Gas Well Integrity. Department of Trade and Investment, Regional Infrastructure and Services;
- Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth of Australia);
- Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth of Australia);
- Strategic framework for Mine Closure (ANZMEC).

3.4.1 **NSW Code of Practice for Coal Seam Gas Well Integrity (2012)**

The NSW Code of Practice for Coal Seam Gas Well Integrity (Code of Practice for CSG) provides a practical guide for undertaking Coal Seam Gas (CSG) exploration, extraction or production under the *Petroleum (Onshore) Act 1991* and the *Petroleum (Onshore) Regulation 2007* to ensure that well operations are safe, without risk to health and without detriment to the environment.

This Code of Practice will be applied to the extent that it is reasonably practicable to do so. The intent of this application is to provide protection for workers, landholders, and the environment.

3.4.2 **NSW Aquifer Interference Policy**

The Aquifer Interference Policy and *Water Management Act 2000* address water licensing and assessment for aquifer interference activities.

Aquifer interference includes “the penetration of an aquifer” which can occur during the gas drainage process. Under this policy, “mining activities” and “coal seam gas activities” are defined as high-risk activities.

Appin Mine was granted a Special Purpose (Mine Dewatering) Licence on 19 February 2013 in accordance with the *Water Act 1912*. On 2 May 2014, Appin Mine was granted Water Access Licence 36477 under the *Water Management Act 2000*. Groundwater extracted during pre-mining Mine Safety Gas Drainage (MSGD) activities will be in accordance with the requirements of this licence. No groundwater extraction would occur during the post-mining MSGD activities. All boreholes are cased and grouted to prevent interference with groundwater.

4. **GAS DRAINAGE INFRASTRUCTURE**

4.1 **Overview**

Gas drainage infrastructure consists of a series of boreholes drilled to a depth of approximately 500 m through which methane gas will be drained via a surface pipeline reticulation system connected to a gas extraction plant.

The BSO Project identified upgrades to the existing gas drainage plants located adjacent to the Energy Developments Limited (EDL) Power Stations to ensure ongoing efficiency in

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the extraction process and to minimise the environmental impact of hydrocarbon gases produced from mining operations. These upgrades include the installation and operation of flaring facilities to reduce venting to atmosphere. An image of the type of flaring units is provided in Plate 5 and Plate 6.

If borehole gas flows exceed the capacity of the extraction plant and associated existing management infrastructure, and/or during plant breakdown/maintenance periods, the excess gas is flared via onsite flaring units.

Where gas cannot be flared, or in an emergency, gas may be vented to the atmosphere. Depending on the quality and volume of gas extracted, it may be reticulated to other beneficial users.

Site-specific environmental assessments and descriptions of specific management arrangements for gas drainage management activities will be progressively attached to the GDMP where required. The generic management activities in the GDMP are implemented at all surface based gas drainage infrastructure sites and systems.

IMC's MSGD program utilises these two key phases where required:

- Pre-mine Drainage – MSGD is undertaken to reduce methane concentrations in the coal seam where development roadways are to be constructed to support longwall extraction. This occurs prior to extraction of the longwalls. The in-seam methods and surface to seam boreholes extract gas from the coal seam prior to the commencement of mining. The pre-mine drainage surface boreholes start vertically and are then steered to a near horizontal alignment within the coal seam to extract gas and water prior to the extraction of coal. Any water that is extracted during MSGD is stored temporarily within a tank or sump onsite, prior to being taken to the CWEA, an alternate appropriately licenced facility or, if not contaminated, irrigated to surrounding pastures (refer to Figure 1 for a schematic illustrating the pre-mine drainage well infrastructure; and Plate 1, Plate 2 and Plate 3 and for an image of typical vertical, MSGD and Medium Radius Drilling (MRD) borehole drilling infrastructure respectively).
- Post-mine Drainage – The methane is drained from the goaf areas during longwall extraction via surface boreholes. Two types of boreholes are utilised:
 - a) Vertical boreholes - drilling to either the goaf area above the Bulli Seam, or drilled into hydrocarbon gas bearing sandstone units that do not form part of the goaf, but will release gas via cracking induced by the longwall extraction.
 - b) MRD boreholes - comprising a borehole that starts vertically and is then steered to a near horizontal alignment for a known distance within sandstone strata above the coal seam. The MRD boreholes can have a number of branches to improve gas flow and maximise MSGD during-mining, which end approximately 5 m above the coal seam roof (refer to Figure 2 and Figure 3 for a schematic illustrating the MRD and Vertical borehole infrastructure respectively).

During the operational phase, all boreholes have gas flow metering and control systems in place at the wellhead. These systems are enclosed in green sleds to minimise visual amenity impacts. Plate 4 illustrates typical operational phase infrastructure during gas drainage.

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4.2 Standards for Borehole Development

4.2.1 Recording and Reporting Data

IMC records the well life cycle for each borehole. This includes the layouts, engineering designs, risk assessments and assumptions, specifications of equipment and well design, installation records, core descriptions (where relevant), drilling operations reports and completion reports.

Reporting is undertaken as per the relevant approvals or guidelines. This varies depending on the purpose of the activity and the primary approval agency. Generally, reporting is undertaken as follows:

- Government approvals (Resources Regulator, DPIE).
- Additionally, other government agencies may also require notifications under these approvals including the Biodiversity and Conservation Division (DPIE), EPA and/or WaterNSW.

4.2.2 Well and Drilling Program Design

IMC well designs meet the American Petroleum Institute (API) Standards, providing a safe and environmentally sound installation and operation. The design of each well is dependent on whether it is a:

- pre-mine drainage steered or vertical borehole;
- MSGD MRD borehole; or
- MSGD vertical well.

Drill montage schematic diagrams outline typical details of these boreholes, including the casing, grouting, and the drilling fluids for each section (refer to Figure 4, Figure 5 and Figure 6 for pre-mine drainage, MRD and vertical boreholes respectively).

Beyond the API Standards, IMC also incorporate guidance from the Code of Practice for CSG Well Integrity, DPIE and Resources Regulator project approval requirements; and IMC/South32 requirements.

Drilling fluids used for IMC projects are water based (i.e. not oil based), in line with the Code of Practice for CSG. The source of water is determined in the project scoping and is generally potable water, or potentially from a farm dam or licenced extraction point. IMC have a comprehensive assessment and internal approval process in place for any chemicals for drilling operations (refer to the Substance Management Procedure). Products are reviewed for their health, safety and environmental properties and the way in which they will be used. Biodegradable products are preferred.

Cuttings and liquids are either disposed of at a licenced facility, or where suitable, utilised at the CWEA.

4.2.3 Borehole Monitoring and Maintenance

MSGD boreholes are monitored and maintained on a regular basis during gas extraction. This involves on-site monitoring and continuous monitoring through Supervisory Control

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and Data Acquisition (SCADA) systems. Monitoring is in line with the requirements of the Code of Practice for CSG.

4.2.4 Well Abandonment/Rehabilitation

After gas drainage operations are no longer required, all boreholes are plugged in accordance with EDG 01, Exploration and API standards and the requirements of the Code of Practice for CSG.

Gas drainage facilities associated with each longwall are rehabilitated as mining progresses beyond the site and the volume of gas reporting to each well greatly reduces, or ceases. The GDMP requirements progressively become redundant once the longwalls have been completed. All wellhead infrastructure and pipelines are removed, boreholes sealed and sites rehabilitated to the appropriate standards and/or the requirements of the landholder.

5. COMMUNITY CONSULTATION AND LANDHOLDER AGREEMENTS

5.1 Consultation

Consultation with the community and affected landholders will be undertaken in accordance with the IMC Stakeholder Engagement Plan (SEP) and Section 5 of the Appin Mine Environmental Management Strategy.

The SEP details the strategies used by IMC with regard to social management and stakeholder engagement in the areas in which IMC operate. IMC acknowledges that commitment to a systematic approach is required to achieve sound social performance and best practice community relations. Such a system provides order and consistency so that stakeholder engagement is addressed through the allocation of appropriate resources, assignment of responsibilities and ongoing evaluation of practices, procedures and processes.

To ensure that these mechanisms are working effectively and that stakeholder engagement strategies are meeting both IMC and stakeholder requirements, evaluation methods are also employed. Such evaluation is informed primarily by community and stakeholder surveys, but also community enquiries / feedback / complaints, community consultative committees, information forums or other similar communications and engagement mechanisms.

The SEP is managed and under responsibility of the Principal Community and Specialist Community. The SEP provides the foundation for the strategies on communication and consultation required under the GDMP.

A project specific SEP may be developed dependent on the complexity of the project and identified impacts to the local community and landholders.

Specific environmental aspects requiring consultation are detailed in Section 7 where relevant.

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5.2 Landholder Agreements and Compensation

Where projects are isolated from existing operations, or close to residential receivers, IMC may be required to obtain agreements with landholders for access, or in relation to impacts from project noise, air quality or visual impacts.

The Specialist Community approaches relevant landholders, and in some cases, tenants (such as for noise impacts) to advise these stakeholders of the scope of the project. This includes the nature of the project, duration and operating hours, impacts, traffic and rehabilitation.

Landholder access agreements may be required to access properties not owned by IMC. These agreements are developed in consultation with the landholder and signed off by both parties.

Where residents are predicted to be affected by project noise in excess of the relevant noise criteria, IMC will seek to establish a noise agreement with affected residents. Consultation regarding noise agreements includes identification of any particularly sensitive times at the nearest receivers and determining the most suitable noise mitigation measures.

If it is predicted that residents will be impacted by poor air quality (that exceeds air quality criteria outlined in Condition 9 or 10 of Schedule 4 of the Project Approval), IMC will seek an agreement with the resident.

The management of visual impacts is discussed in Section 7. The necessary mitigation strategies will be implemented to minimise visual impacts as required. These potential impacts and strategies will be included in the discussions with the relevant residents.

This process for implementing mitigation measures will be undertaken in line with the relevant conditions of the Project Approval and the Landholder Compensation and Land Access Agreements Guideline.

6. ENVIRONMENTAL ASSESSMENT

Targeted noise and air quality assessments to assess compliance with applicable construction and operational noise and air quality criteria at the nearest sensitive receptors (e.g. private residences) will be undertaken as required.

Where compliance with applicable construction and operational noise and air quality criteria cannot be met at a sensitive receptor, IMC will attempt to reach a negotiated agreement with the interested party, commit to additional attenuation measures to ensure compliance with the relevant criteria, and/or relocate the proposed gas drainage site to comply with the relevant criteria (refer to Section 5.2).

Targeted visual impact assessment will also be undertaken where required, and management measures to minimise visual impacts at nearby affected sensitive receptors will be undertaken where necessary.

Public safety and traffic impacts associated with gas drainage sites will be assessed where applicable.

Surveys will be conducted of potential gas drainage sites for threatened flora species and endangered ecological communities (EECs) and site specific Aboriginal and non-Aboriginal heritage as required.

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Mitigation measures and management practices are outlined in Section 7.

7. ENVIRONMENTAL MANAGEMENT PRACTICES

The GDMP considers the following environmental aspects in order to determine adequate management and mitigation measures. Site management, mitigation and strategies ensure impacts on the surrounding environment and community are minimised.

7.1 Rehabilitation Strategies

7.1.1 Objectives

The objectives of progressive rehabilitation for gas drainage management activities are to:

- comply with all regulatory requirements in the Project Approval and other legislation with regards to rehabilitation management and monitoring;
- meet and uphold IMC environmental and other relevant strategies and policies;
- address temporary construction-phase impacts associated with drilling operations;
- rehabilitate all areas at the completion of operations, including plugging boreholes to avoid future groundwater interactions; and
- outline monitoring and performance evaluation measures.

7.1.2 Post-Construction Infrastructure and Landscape Rehabilitation Outcomes

Rehabilitation works undertaken at the completion of the construction phase include:

- stabilising access road verges and internal roads;
- use of top soil stockpiles to rehabilitate surrounding area;
- removal of drilling infrastructure;
- remediation of drilling sumps; and
- pad consolidation.

7.1.3 Post-Drainage Infrastructure and Landscape Rehabilitation Outcomes

Rehabilitation works undertaken at the completion of the gas drainage phase include:

- removing well head infrastructure and pipelines;
- plugging the borehole in accordance with EDG01 and the NSW Code of Practice for CSG;
- reshaping pads to the pre-project landform or as per landholder requirements; and
- topsoiling and establishment of a stable, self-supporting landform (generally this will be pasture re-establishment unless determined otherwise by landholder consultation).

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7.2 Air Quality Management Strategies

Gas drainage has the potential to impact air quality through diesel emissions from stationary and mobile plant, and dust generated during the construction phase. The following mitigation and management measures will be implemented where required to ensure dust emissions are controlled:

- watering of exposed areas to prevent dust;
- use of water sprays during drilling;
- replacement of topsoil and subsoil as soon as practicable and re-vegetating or stabilising disturbed areas where necessary to minimise wind-blown dust; and
- modification of dust generating activities during periods of high wind.

Gas will only be vented where it cannot be utilised or flared, or in emergencies.

7.3 Greenhouse Gas Management Strategies

IMC use in-seam drilling to drain methane within coal seams prior to mining. Gas from strata is drained by cross measure boreholes. The in-seam and cross measure drainage produces mostly methane gas. Methane is a GHG that has a Global Warming Potential (GWP) of 28.

Current best practice for the management of GHG emissions from underground coal mines involves the following:

- minimising GHG emissions to the atmosphere;
- maximising gas capture and utilisation for beneficial use; and
- flaring, which oxidises methane to carbon dioxide and water significantly reducing GWP.

IMC supplies gas captured from underground and surface gas drainage systems to EDL for power generation. This power generation reduces the emission of GHGs by several million tonnes of CO_{2-e} per annum. Where supply of this gas to a beneficial user (such as EDL) is not possible, then the methane is flared to minimise GHG emissions.

7.4 Water Management Strategies

Gas drainage works have the potential to impact surface and groundwater and therefore implementation of measures to mitigate or minimise these impacts are included as part of the projects.

IMC has a comprehensive understanding of the geology, stratigraphy, aquifers and aquicludes, groundwater flow and water quality in the BSO Project Area as described in Appendix B (Groundwater Assessment) of the BSO Project EA. This Groundwater Assessment describes the groundwater regime and assesses the predicted impacts associated with mining and other activities such as gas drainage. In addition, Geoterra (2011) undertook a comprehensive groundwater assessment for the surface gas drainage works undertaken at Appin Mine. Given the stratigraphy of the region, which includes three aquitards which control the vertical flow of groundwater, coupled with the strict borehole construction techniques employed, no significant impacts to aquifers are predicted to occur.

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Groundwater extracted in the area is predominately from the Hawkesbury Sandstone stratigraphic unit. Surface gas drainage boreholes in the Hawkesbury Sandstone are steel cased grouted through the entire depth of the Hawkesbury Sandstone, thereby preventing any interference with the flow or quality of the aquifer. No hydraulic fracturing or well stimulation is employed. IMC monitors the aquifers that may be influenced by mining at Appin Mine through an extensive array of multi-level piezometers.

IMC operates in accordance with Water Access Licences for the interception of groundwater for mining purposes.

IMC will implement the following water management strategies for gas drainage where required:

- Water used for drilling and extraction plant operations is from a Sydney Water Authorised user or sourced from on-site farm dams in accordance with landowner approval or other licenced extraction point.
- The walls of drilling sumps will be of an appropriate height to provide adequate freeboard (approximately 0.5 m) to prevent overflow during rainfall. The drilling sumps and pads have run-off diversion bunds in place to minimise runoff entering the sumps. If there is potential for sump overflow, offsite disposal will be used (if on-site irrigation is not possible). The sides and base of the sumps are compacted to minimise any interaction with shallow groundwater. When feasible to do so, above ground sumps or tanks will be used to support drilling activities.
- At the completion of drilling, water from drilling sumps will be transported to the CWEA or other appropriately licensed facility for treatment and reuse. If drilling water is uncontaminated it may be irrigated onto nearby pasture.
- All reasonable measures will be taken to prevent silt laden runoff from entering receiving waters.
- Vertical boreholes will be steel cased and grouted from the surface to the top of the Bulgo Sandstone (refer to Figure 4, Figure 5 and Figure 6) to prevent interception of groundwater.
- The MRD or steered pre-mine MSGD boreholes will be steel cased and grouted to the end of the radial or build section where the horizontal alignment and branching to the laterals of the borehole starts (~450 m depth) to prevent any interception of groundwater.
- Water used in the extraction plant cooling process will be reused at Appin Mine or irrigated onto nearby pasture well away from drainage lines and farm dams.

Gas drainage boreholes are cased to a depth below regionally significant groundwater aquifers and grouted to API Standards in order to prevent any interception or cross contamination of groundwater during gas drainage. No impacts to surface water, groundwater or surrounding vegetation have been observed during the gas drainage program since its inception. No evaporation ponds are utilised.

Saline water from pre-mine gas drainage works is captured in above ground tanks and transported to an appropriately licenced facility. No saline water is generated by the post-mine gas drainage works.

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7.5 Erosion and Sediment Management Strategies

Civil works have the potential to generate erosion and sediment laden runoff and therefore management measures are implemented to minimise these impacts.

Erosion and sedimentation control measures are implemented generally in accordance with the requirements of the “Blue Book” (Soils and Construction, Volume 1, 4th edition July 2006, Landcom). The following management strategies are used as required:

- Weekly inspections of site drainage and erosion/sediment controls will be undertaken and maintenance implemented as needed.
- Drainage channels will be identified and surface water effectively managed during construction and operation phases of work.
- Disturbed areas will be progressively revegetated and stabilised to minimise erosion and scour.
- The amount and velocity of any water flows over the construction site will be reduced through the use of rip rap and bunding.
- Sediment filters or fences will be installed downslope of disturbed areas.
- Clean water diversion drains will be installed.
- The length and duration of exposed excavations during pipe line laying will be minimised. Where trenches and soil stockpiles are exposed for more than one-week, silt fences will be deployed adjacent to the disturbed areas on the downslope side. Soil stockpiles will be placed on the uphill side of any excavated trench so that any sediment flows into the trench during runoff.
- Pasture adjacent to any disturbed areas will be maintained and runoff directed to flow through pasture prior to any flow to waterways.
- Drilling sumps will be maintained by irrigating sediment-laden water on a well-vegetated pasture away from drainage lines.

A site specific Soil and Water Management Plan may be developed where there is extensive disturbing works at the site as part of the Construction Environmental Management Plan (CEMP).

Drilling compounds are levelled to accommodate safe drilling operations. Cut/fill operations of generally less than 5,000 m³ are required. Crushed stone, gravel or coal wash is used to create working areas within the drill and extraction plant compounds or for access roads.

All sediment control structures will have sufficient capacity to trap sediment mobilised from cleared areas and sump overflows during normal rainfall events. Any overflow from sediment control structures is generally directed to grass paddocks where undertaken on agricultural land.

Pipelines are constructed to relevant extraction plants. Access is generally via formed roads or farm tracks already on site, and then follows the pipeline route for construction of the gas drainage boreholes, extraction plant compounds/flares and pipelines.

Pasture is re-established on disturbed areas such as buried pipelines, drilling compounds and access routes (where it is reasonable and practical to do so) after construction is

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complete to minimise potential for sediment runoff. Any cleared native vegetation is reinstated where it is reasonable and practical to do so.

At the end of gas extraction, the extraction plant compounds, well heads and pipelines are decommissioned, removed and rehabilitated. The boreholes are rehabilitated in accordance with Resource Regulator requirements. Any cut/fill areas are reshaped to the original land surface unless requested by the landowner. The extraction plant and drilling compounds as well as the pipelines are rehabilitated in accordance with the Rehabilitation Protocol and/or landholder requirements as soon as possible after the completion of site decommissioning.

7.6 Noise Management Strategies

Noise mitigation measures are tailored to address the noise generated at various stages of a project. Noise mitigation measures that may be implemented where required include but are not limited to:

- Orientation of equipment so that the noisiest side faces away from sensitive receivers.
- Erection of noise walls as close as possible to noisy equipment or drill rigs.
- Using noise source controls, such as residential class mufflers, to reduce noise from all plant and equipment including cranes, excavators and trucks.
- Using spotters, closed circuit television monitors, “smart” reversing alarms, or “quacker” type reversing alarms in place of traditional reversing alarms in sensitive areas.
- Selecting plant and equipment based on noise emission levels, including drill rigs.
- Optimising the schedule of truck deliveries to day time periods.
- Using alternative construction methods where possible to minimise noise levels.
- Offering alternative arrangements for temporarily affected residents, such as temporary relocation.

7.7 Flora and Fauna Management Strategies

The following actions will be implemented where possible to mitigate potential impacts to flora and fauna:

- The location of boreholes and sections of surface gas pipelines will be selected to avoid native trees and significant habitat features such as trees with hollows.
- Trees with hollows will be retained and protected, with no drilling within the critical root zone (extending to 2 m beyond the drip line) of the trees.
- Boreholes, pipelines and access tracks will be located within existing cleared areas.
- Erosion and sediment control measures will be installed.
- Machinery and vehicles will be washed down prior to accessing site where required to avoid the transmission of weed seed or disease into intact areas of native vegetation.

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- Borehole drilling compound locations will be rehabilitated with pasture (if undertaken on agricultural land) or local native species after the cessation of gas drainage to replace any cleared native vegetation.

7.8 Traffic Management Strategies

Traffic to and from the sites will be managed to ensure minimal impacts on local residents and to maintain road safety. The following mitigation strategies will be implemented as required:

- Erection of warning signs along access points to each property during the construction phase.
- Development of Journey Management Plans to highlight appropriate controls required for moving of the drill rigs from one borehole location to the next.
- Advising residents prior to the commencement of works and prior to any related disruptions to local traffic.

A Traffic Management Plan (TMP) will be prepared as required prior to the commencement of any construction works. The TMP guides the appropriate controls required for the day-to-day movements of employee's vehicles and associated construction traffic.

7.9 Waste Management Strategies

Small amounts of waste are likely to be generated as a result of gas drainage drilling. All wastes are removed from site for appropriate disposal. Spoil generated from borehole drilling is removed to the CWEA or used for onsite borehole rehabilitation.

A Waste Management Plan is prepared as part of the CEMP, for both the initial construction and the de-commissioning works. The Plan is developed in accordance with South32/IMC's Policies and standard operating procedures.

Wastes are removed offsite and recycled or disposed of at a suitable licenced waste management facility.

7.10 Cultural Heritage Management Strategies

To ensure projects do not have any significant impacts on Aboriginal cultural heritage, IMC implements the mitigation measures as detailed in the Appin Mine Heritage Management Plan.

In summary:

- Archaeological sites are avoided wherever possible. If on the same property and within 100 m of construction activities, archaeological sites are fenced prior to construction using protective barriers, and all site personnel are notified of the importance of avoiding archaeological sites.
- If the archaeological sites cannot be avoided, an Aboriginal Cultural Heritage Management Plan (ACHMP) will be developed and implemented to facilitate the management of these sites. The ACHMP will also apply to any additional heritage sites uncovered during the project.

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- The following contingency plan describes the actions that will be taken in instances where human remains or suspected human remains are discovered.
 - Discovery: If suspected human remains are discovered all activity in the vicinity of the human remains must stop to ensure minimal damage is caused to the remains. The remains must be left in place and protected from harm or damage.
 - Notification: Once suspected human remains have been found, the Coroners' Office and the NSW Police must be notified immediately. Following this, DPIE, Heritage NSW and Aboriginal stakeholders will be notified of the find, in consultation with the NSW Police, and the process as outlined in the Environmental Compliance/Conformance Assessment and Reporting Procedure will be followed.
 - Management: If the human remains are of Aboriginal ancestral origin an appropriate management strategy will be developed in consultation with Registered Aboriginal Parties and Heritage NSW. If the human remains are identified as historical relics, then an appropriate management strategy will be developed in accordance with the NSW Heritage Office Skeletal Remains Guidelines and Heritage NSW. If the exhumation of human remains is subsequently required, these works must be undertaken in accordance with *Public Health Act* exhumation guidelines and relevant heritage guidelines.
 - Recording: The find will be recorded in accordance with the requirements of the *National Parks and Wildlife Act*, *Heritage Act*, *Public Health Act* and Heritage NSW guidelines as appropriate. The ACHMP will be updated to include newly discovered Aboriginal ancestral remains.

The area of interest will be protected and work in the vicinity of the skeletal remains will cease. Work in the area that may impact the remains shall not recommence until at least verbal advice has been received from the NSW Police.

7.11 Visual Impact Management Strategies

Surface gas drainage during the operational phase generally has minimal visual impact primarily due to the locations being away from sensitive receivers, interim drill pad rehabilitation and the small size of infrastructure.

During drilling operations, noise barriers may be used to mitigate noise and visibility impacts. Noise barriers are generally higher than the noisy equipment during the 6 - 12 week drilling process. Well head control sleds and noise walls are generally painted green to minimise visual impacts.

IMC will consult with residents prior to the commencement of gas drainage construction activities. This consultation will address the potential visual aspects of the works during both the construction and operational phases. Any additional mitigation measures required will be planned and implemented in consultation with the relevant resident/s.

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7.12 Public Safety Management Strategies

Comprehensive safety management plans are prepared for members of the public and the workforce. Implementation of Journey Management Plans provides safe and efficient transport in association with the project. Traffic black spots are identified and avoided where possible. Where necessary, direct traffic control is implemented to safely enter/exit public roads from off-road areas. Where traffic control is needed, this will be undertaken by qualified traffic control contractors in accordance with relevant approvals from Roads and Maritime Services or the relevant Council.

Drilling sites are primarily located on private land. Only authorised personnel are permitted to enter the property. During borehole construction, the sites are temporarily fenced and safety management signs erected. Boreholes are constructed by appropriately licenced drilling contractors using fit for purpose equipment and techniques. Gas monitoring is undertaken during drilling. All persons entering the project site are inducted to the site or are accompanied by IMC or contractor personnel, and wear appropriate personal protective equipment.

During gas drainage, each borehole is managed by a wellhead management system that controls flow from the borehole. Flow from the borehole is continuously monitored so that any incident can be responded to immediately. This can include a remote shutdown of the well. Wellhead instrumentation is secured in a locked compound. Relevant safety signage is displayed at each wellhead.

NSW Fire and Rescue and the NSW Rural Fire Service will be briefed on the location and function of gas drainage activities.

8. COMPLAINTS AND NON-COMPLIANCE MANAGEMENT

8.1 Complaints and Dispute Resolution

IMC has a 24 hour, free community call line (1800 102 210) and email address (illawarracomunity@south32.net) which is displayed at IMC Projects and Mine Sites, and included in newsletters, letters and other correspondence. The call line is for all complaints and general enquiries regarding environmental or community issues associated with IMC's operations.

Community complaints and enquiries may also be received in person by any employee of IMC, with details to be immediately shared with the Community Team for investigation. All gas drainage related complaints received will be managed in accordance with the Handling Community Complaints, Enquiries and Disputes Procedure.

Upon receipt of a community complaint, preliminary investigations will commence as soon as practicable to determine the likely cause of the complaint. An initial response will be provided to the complainant within 24 hours of the complaint being made, with a follow up response being provided as soon as practicable once a more detailed investigation is complete.

A summary of all complaints received during the reporting year will be provided as part of the Annual Review. A log of complaints is also maintained on the IMC website at:

<https://www.south32.net/our-business/australia/illawarra-metallurgical-coal/documents>.

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8.2 Non-Compliance, Corrective Action and Preventative Action

Events, non-compliances, corrective actions and preventative actions are managed in accordance with the Reporting and Investigation Standard and Environmental Compliance/Conformance Assessment and Reporting Procedure. These procedures, which relate to all IMC operations, detail the processes to be utilised with respect to event and hazard reporting, investigation and corrective action identification. The key elements of the process include:

- identification of events, non-conformances and/or non-compliances;
- recording of the event, non-conformance and/or non-compliance in the event management system (G360);
- investigation/evaluation of the event, non-conformance and/or non-compliance to determine specific corrective and preventative actions;
- assigning corrective and preventative actions to responsible persons in G360; and
- review of corrective actions to ensure the status and effectiveness of the actions.

Non-compliances with the GDMP will be reported to all relevant agencies as detailed in Section 9.

9. REPORTING AND REVIEW

9.1 Reporting

IMC will report on the performance of the GDMP in the Annual Review.

The Annual Review is prepared in accordance with the requirement of Condition 4 of Schedule 6 of the Project Approval and is submitted to relevant agencies in September each year. Annual Reviews are made available to the general public via the South32 website.

The Annual Review will include:

- a summary of gas drainage activities undertaken;
- measures taken to mitigate impacts from gas drainage activities;
- a review of the performance of management/mitigation measures; and
- details of gas drainage site progressive rehabilitation.

9.2 Review of GDMP

In accordance with Condition 5 of Schedule 6 of the Project Approval, the GDMP will be reviewed, and if necessary revised, within three months, of:

- the submission of an Annual Review;
- the submission of an incident report;
- the submission of an Independent Environmental Audit (IEA) report; or

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- any modification to the conditions of the Project Approval (unless the conditions require otherwise).

Outcomes from each review will be documented in the Management Plan Review Log. The GDMP will only be revised where a material change to site operations or environmental management has occurred, or in accordance with the review period on the GDMP. Administrative or descriptive changes do not constitute a material change.

Where a review triggers a revision of the GDMP, the GDMP will be revised and submitted to the Secretary for approval.

9.3 Audits

9.3.1 *Independent Environmental Audit*

In accordance with Condition 9 of Schedule 6 of the Project Approval, an IEA shall be commissioned every three years, that will include a review of the GDMP. The report is required to be submitted to the Secretary within six weeks of completion of the audit, in accordance with Condition 10 of Schedule 6.

IEAs have been conducted in 2013, 2016/17 and 2019, with the next IEA to be conducted in 2022. Recommendations from the IEA will be incorporated into the GDMP where appropriate.

9.3.2 *ISO 14001*

As part of the ISO 14001 certification, IMC maintains an environmental auditing and governance program across all of its operational sites. The program, which includes the use of competent internal and accredited external auditors, is an integral part of maintaining certification under the ISO 14001 standard.

External surveillance audits are undertaken on an annual basis, with recertification audits undertaken every three years.

Internal Governance Reviews of the GDMP are nominally undertaken on a three-yearly basis.

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10. ACRONYMS

Term	Definition
ACHMP	Aboriginal Cultural Heritage Management Plan
BSO	Bulli Seam Operations
CSG	Coal Seam Gas
CEMP	Construction Environmental Management Plan
CWEA	Coal Wash Emplacement Area
DPIE	Department of Planning, Industry and Environment
EA	Environmental Assessment
EDL	Energy Developments Limited
EMS	Environmental Management System
EPA	Environment Protection Authority
<i>EP&A Act</i>	<i>Environmental Planning and Assessment Act</i>
EPL	Environment Protection Licence
G360	IMC event reporting system
GDMP	Gas Drainage Management Plan
GHG	Greenhouse Gas
GWP	Global Warming Potential
ICHPL	Illawarra Coal Holdings Pty Ltd
IEA	Independent Environmental Audit
IMC	Illawarra Metallurgical Coal
MRD	Medium Radius Drilling
MSGD	Mine Safety Gas Drainage
SEP	Stakeholder Engagement Plan
TMP	Traffic Management Plan
WCCPP	West Cliff Coal Preparation Plant

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- Department of Environment and Climate Change NSW (2008). Managing Urban Stormwater: Soils and Construction Manual.
- Geoterra (2011) Appin Mine Surface Gas Extraction – Groundwater Assessment
- IMC (2016) Landholder Compensation and Land Access Agreements (ICHGD0097)
- IMC (2018) Stakeholder Engagement Plan (ICHMP0016)
- IMC (2018) Handling Community Complaints, Enquiries and Disputes (ICHMP0112)
- IMC (2019) Substance Management Procedure (IMCP0054)
- IMC (2020) Substance Evaluation Form (IMCF0026)
- IMC (2020) Appin Mine Air Quality and Greenhouse Gas Management Plan (APNMP0112)
- IMC (2020) Appin Mine Noise Management Plan (APNMP0113)
- IMC (2020) Appin Mine Water Management Plan (IMCMP0235)
- IMC (2020) Appin Mine Traffic Management Plan (IMCMP0259)
- IMC (2020) Appin Mine Waste Management Plan (APNMP0110)
- IMC (2020) Appin Mine Heritage Management Plan (IMCMP15129)
- IMC (2020) Appin Mine Coal Wash Emplacement Area Management Plan (WCPMP0019)
- IMC (2020) Appin Mine Environmental Management Strategy (IMCMP0239)
- IMC (2020) Landholder Compensation and Land Access Agreements (ICHGD0097)
- IMC (2020) Environment Compliance/Conformance Assessment and Reporting (IMCP0186)
- IMC (2020) Reporting and Investigation Standard (IMCSTD0069)
- Niche (2013) Appin Area 7 Longwall 706-708 Surface Gas Drainage Works and Operations Terrestrial Flora and Fauna Assessment.
- Niche (2013) Appin Area 7 Longwall 706-708 Surface Gas Drainage Works and Operations Aboriginal and Non-Aboriginal Due Diligence Assessment.
- NSW Department of Primary Industries (2012) NSW Aquifer Interference Policy. Published by Department of Trade and Investment, Regional Infrastructure and Services.
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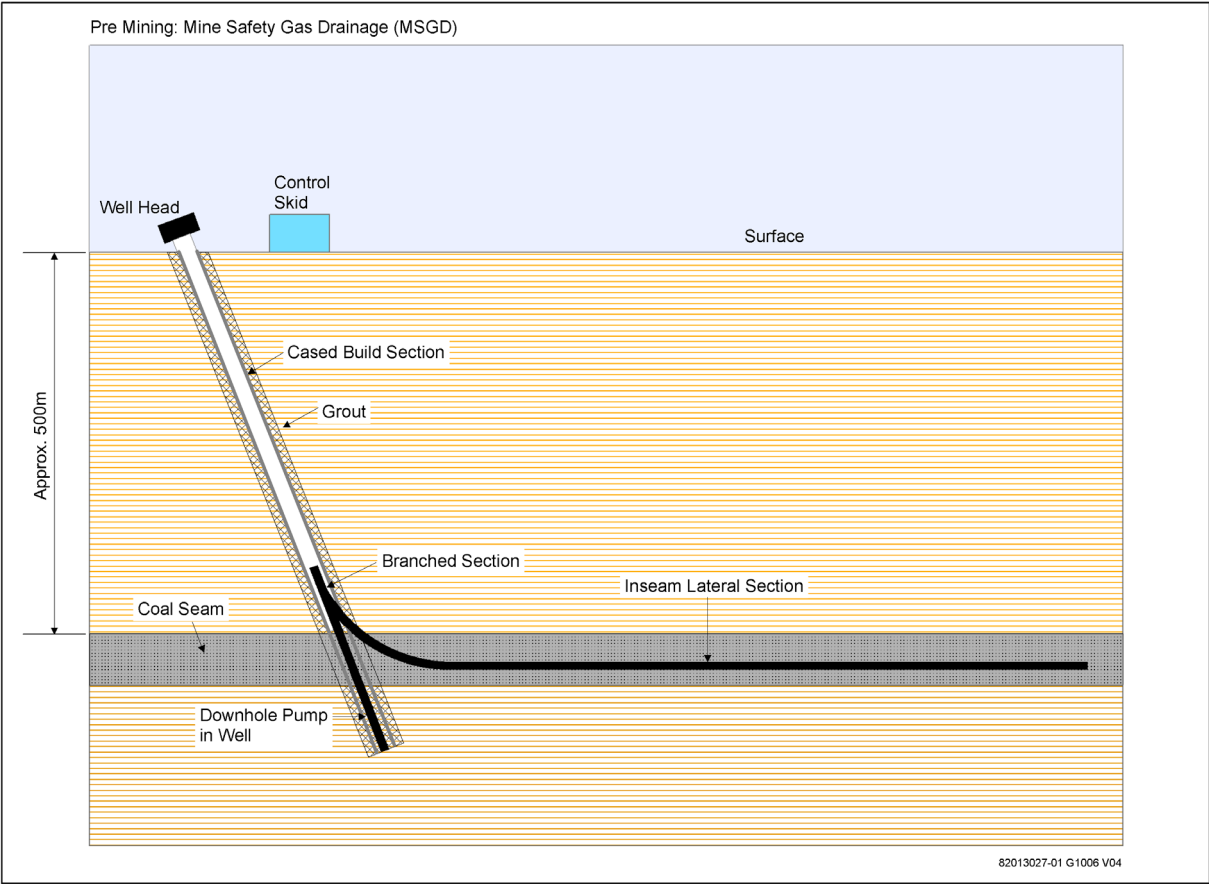
Plan 1: Appin Mine Locality Plan

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13. FIGURES

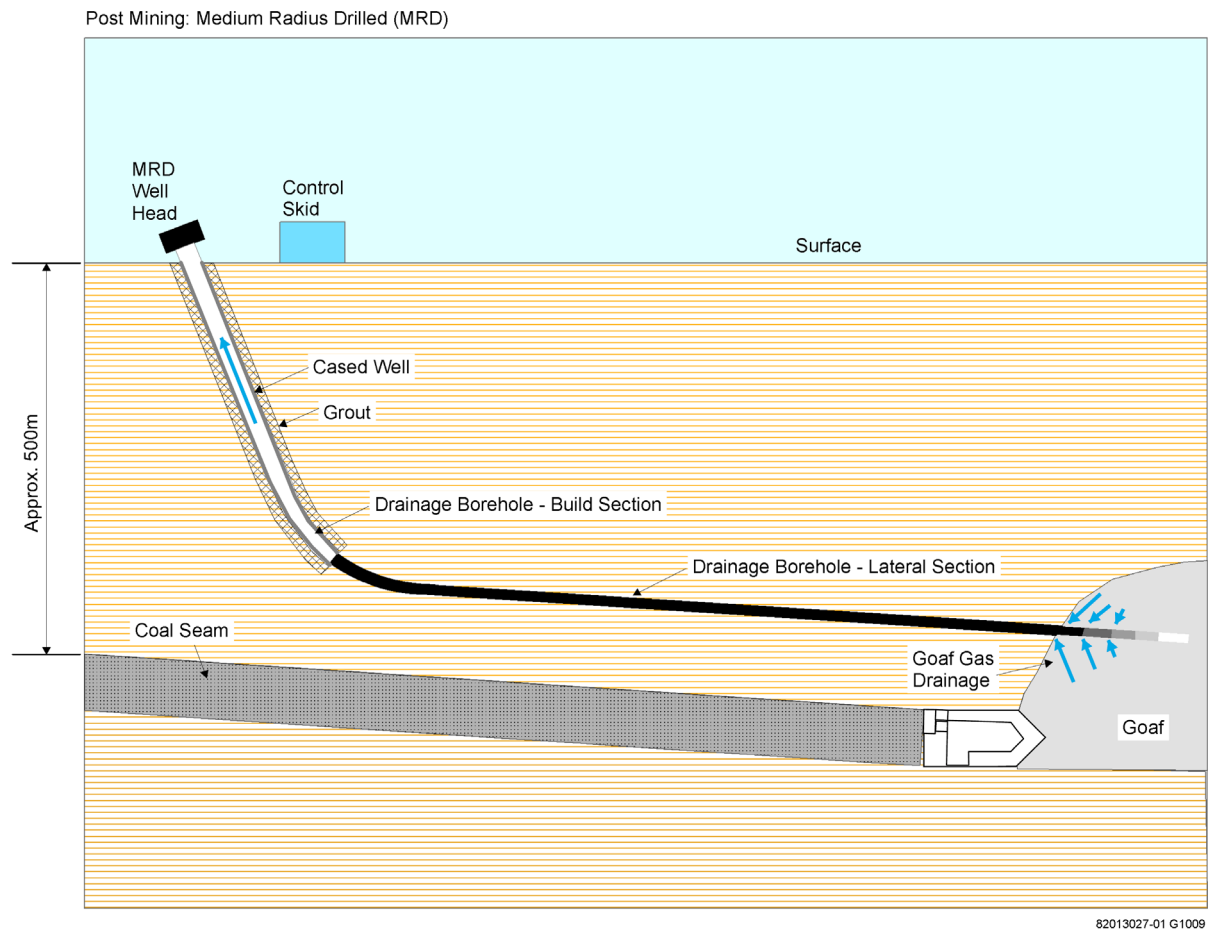
Figure 1: Pre-mine Drainage Borehole Schematic



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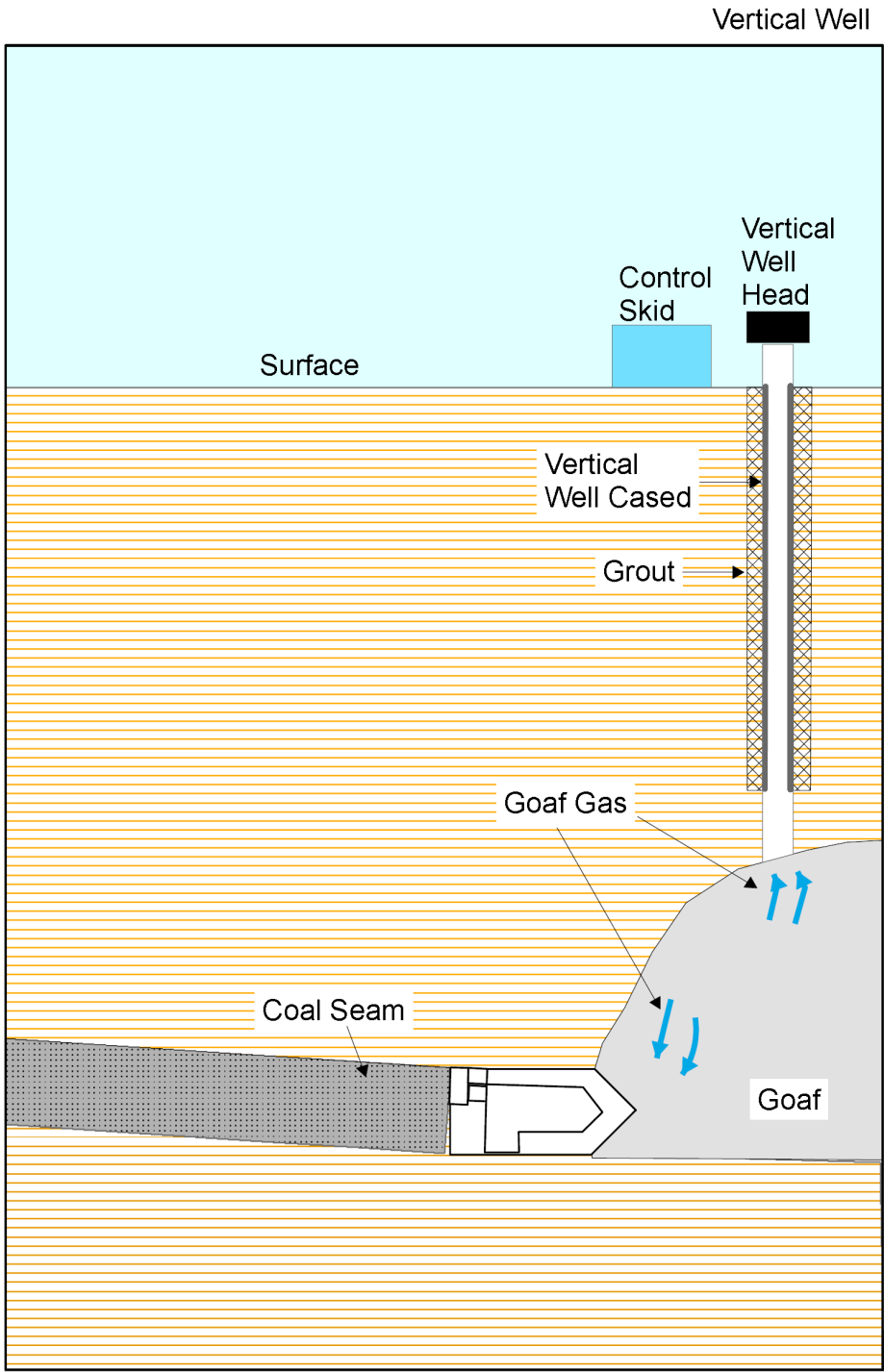
Figure 2: Post-mine Drainage – MRD Schematic



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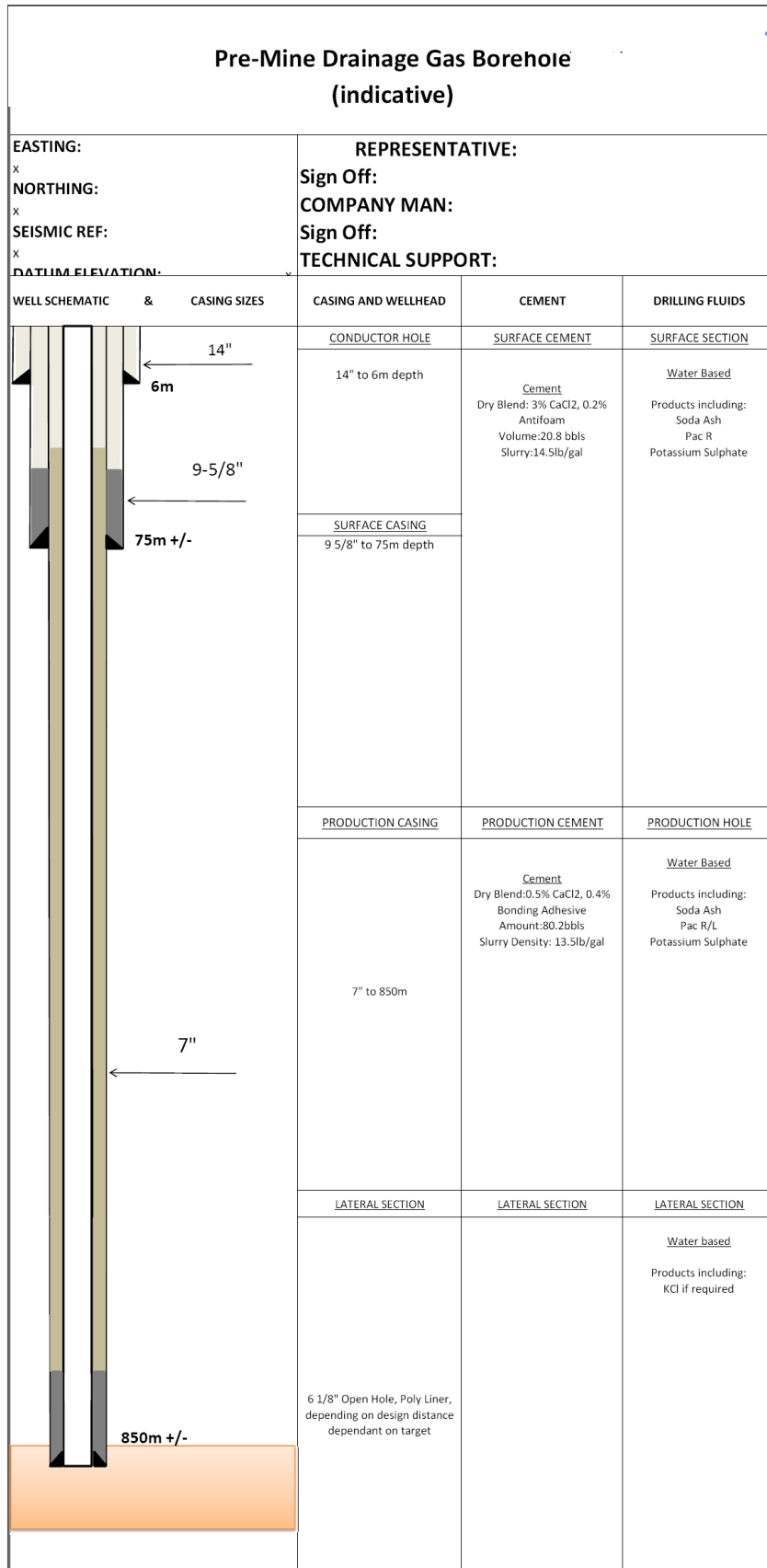
Figure 3: Post-mine Drainage – Vertical Wells Schematic



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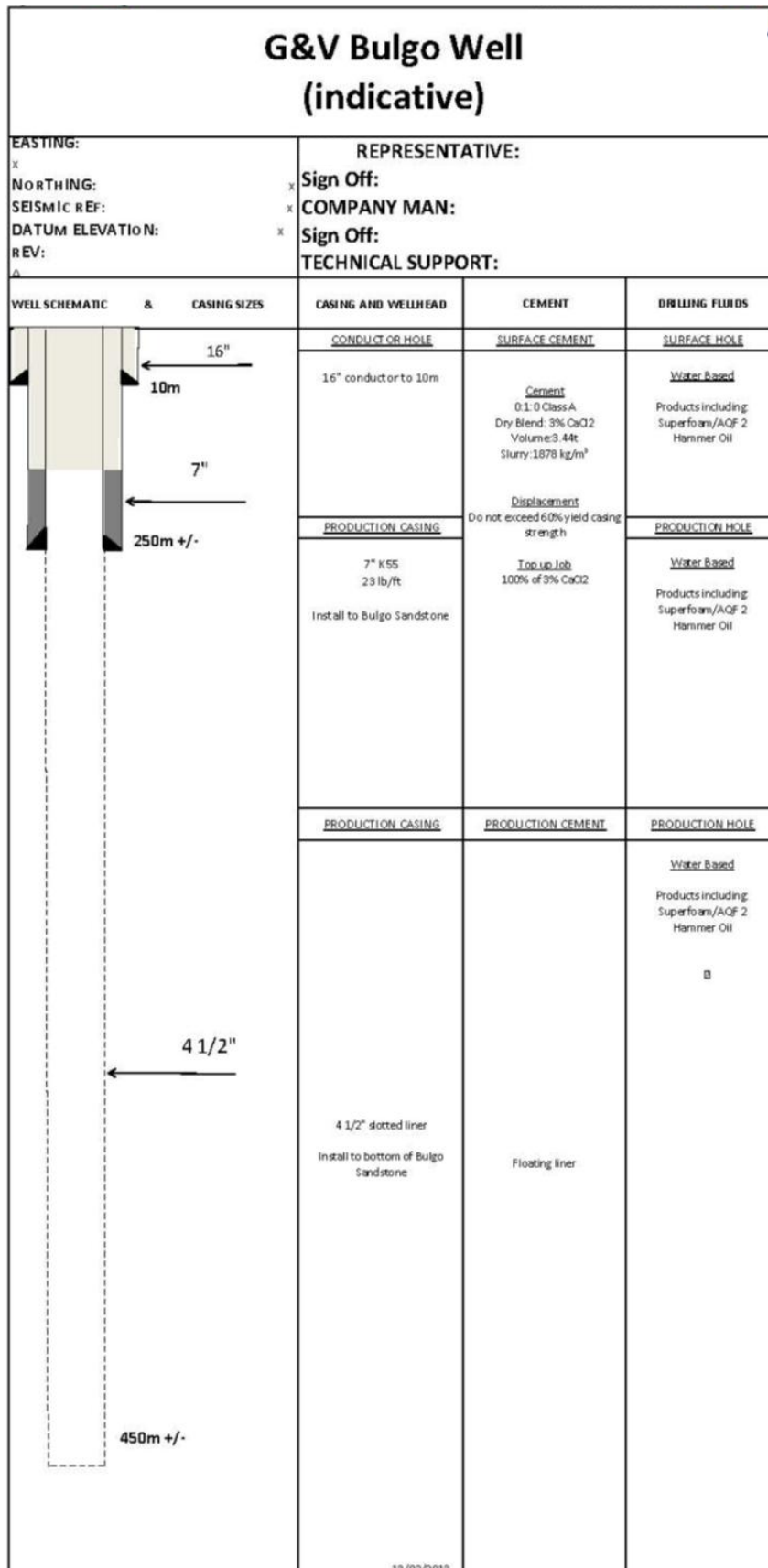
Figure 4: Drill Montage – Pre-mine Drainage Borehole



MRD Gas Well (indicative)				
EASTING: X NORTHING: X SEISMIC REF: X DATUM ELEVATION: X REV: A		REPRESENTATIVE: Sign Off: X COMPANY MAN: X Sign Off: X TECHNICAL SUPPORT:		
WELL SCHEMATIC & CASING SIZES	CASING AND WELLHEAD	CEMENT	DRILLING FLUIDS	
	<u>CONDUCTOR HOLE</u> 20" K55 94 lbm/ft	<u>SURFACE CEMENT</u> Cement 0:1:0 Class A Dry Blend: 3% CaO2 Volume: 3.44t Slurry: 1878 kg/m³ <u>Displacement</u> Do not exceed 60% yield casing strength	<u>SURFACE HOLE</u> <u>Water Based</u> Products including: Soda Ash Aus Gel Pac R/L	
	<u>SURFACE CASING</u> 13 - 3/8" K55 <u>Centralisers (how spring)</u> 10ft above the float shoe Centre of 2nd joint. Across the 3rd coupling.	<u>Top up Job</u> 100% of 3% CaO2	<u>SURFACE SECTION</u> <u>Water Based</u> Products including: Soda Ash Pac R Clay Doctor Pac L Xanbore	
	<u>PRODUCTION CASING</u> 9 - 5/8" K55 <u>Centralisers (how spring)</u> Across the 1st & 2nd couplings Across the 1st, 3rd & 5th coupling inside the surface casing shoe. Centralisers to be placed every 2nd joint over & dedicated sections.		<u>PRODUCTION CEMENT</u> Cement 0:1:0 Class A Dry Blend: 1.5% CaO2 Amount: 4.2t Slurry Density: 12.0ppg <u>Top Up</u> 100% excess of 1.5% CaO2 <u>Pressure Testing</u> 80% of internal yield of casing. Do not exceed 60% while pumping. DO NOT DRILL OUT UNTIL CEMENT REACHED 3500kPa or GREATER.	<u>PRODUCTION HOLE</u> <u>Water Based</u> Products including: Soda Ash Pac R Clay Doctor Pac L Xanbore Ausdet Xtra B
	<u>LATERAL SECTION</u>	<u>DO NOT DRILL OUT UNTIL CEMENT REACHED 3500kPa or GREATER.</u>	<u>OPEN HOLE</u> <u>Water based</u> Products including: Soda Ash Xanbore Clay Doctor AMC Pac L AUSDET Xtra XRTA Sweep	
	<u>B.S. "OPEN HOLE"</u>			



Figure 6: Drill Montage – Vertical Borehole



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14. PLATES

Plate 1: Vertical Borehole Drilling



Plate 2: MSGD Borehole Drilling



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Plate 3: MRD Borehole Drilling



Plate 4: Extraction Plant (Area 7 – now decommissioned)



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Plate 5: Horizontal Flares



Plate 6: Vertical Flares (as used at permanent facilities)



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Plate 7: Well Head Control Sleds





15. APPENDICES

Appendix 1: Project Approval Conditions: Gas Drainage Management

Condition	Requirement	Section
Condition 21 of Schedule 4	<p>The Proponent shall prepare and implement a Gas Drainage Management Plan in respect of construction and use of future gas drainage infrastructure (i.e. for any gas drainage not subject to approval at the date of this instrument) to the satisfaction of the Secretary. This plan must be submitted to the Secretary for approval prior to the construction of any future goaf gas drainage infrastructure and must include details of the proponent's commitments regarding:</p> <ul style="list-style-type: none"> (a) community consultation; (b) landholder agreements; (c) assessment of noise, air quality, traffic, biodiversity, heritage, public safety and other impacts in accordance with approved methods; (d) avoidance of significant impacts and minimisation of impacts generally; (e) flaring or use of drained hydrocarbon gases, wherever practicable; (f) achievement of applicable standards and goals; (g) mitigation and/or compensation for significant noise, air quality and visual impacts; and (h) rehabilitation of disturbed sites. 	<p>This document</p> <p>Section 5</p> <p>Section 6</p> <p>Section 7</p> <p>Section 4</p> <p>Section 6 and 7</p> <p>Section 7.1</p>

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Appendix 2: Agency Consultation

Agency Comments	IMC Response
Department of Planning, Industry and Environment	
<u>Response received 3 December 2020</u> You are requested to submit a revised document that addresses the following: <ul style="list-style-type: none">• Update Section 6 of the management plan to include assessment on public safety and traffic as conditioned in Schedule 4 Condition 21; and• Update Section 9.2 to clarify that the management plan will only be revised then submitted and approved by the Secretary in accordance with the requirements of the conditions of approval.	 Section 6 updated as requested Section 9.2 updated as requested

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Appendix 3: Management Plan Approval

To be included when received

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