APPENDICES

# G

**OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS**

# Description of the Project

OVEN MOUNTAIN PUMPED HYDRO STORAGE

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# 1 Description of the Project

## 1.1 Introduction

This document provides the description of the Project, including details of how it will be built over the estimated four to five-year construction period and how it will be operated over its 100+ year life. The proposed phases of the Project comprise construction (including pre-construction activities) and operation, which are further broken down into different activities and described in Section 1.3.2.

The structure of this document is as follows:

- Section 1.2 – provides an overview of the Project, including a summary of the principles of the Project, guiding design principles used to develop the Project, and a summary of key Project elements including site infrastructure, and sequencing of the works.
- Section 1.3 – details the construction stages of the Project including pre-construction activities, a detailed overview of construction areas, construction activities, permanent infrastructure, temporary infrastructure, as well as traffic, transport, workforce requirements, and sequencing of the works.
- Section 1.4 – details the operational stage of the Project, including details surrounding the Project commissioning, maintenance, and progressive rehabilitation.

The description of the Project is based on feasibility designs prepared by the Project's engineering and design consultants including SMEC, Beca and Local Government Engineering Services, with additional detailed design to be undertaken prior to construction. These designs are expected to be further refined as the Project develops.

The details outlined within this description form the basis for the environmental impact assessment undertaken.

The SEARs that are relevant to this description of the Project are as follows:

> … the EIS must include:
>
> …
>
> - a full description of the project accompanied by suitable maps and plans, including the:
>   - disturbance area;
>   - physical layout of the project over time, including sections of key components;
>   - key uses and activities to be carried out on site; and
>   - likely timing of the project including any stages, the key phases within each stage (site preparation, construction, commissioning, operation, decommissioning and rehabilitation) and the sequencing of these stages and phases.

A summary of this document is provided in Chapter 3 of the EIS.

It should be noted that all units of measurements within this document are approximate only and based on a feasibility design. These measurements may change during the detailed design.

## 1.2 Overview of the Project

### 1.2.1 Principles of the Project

The Project involves the construction and operation of a pumped hydro energy storage scheme which includes building two 'off river' water containment structures to create an upper and a lower reservoir (referred to as 'the upper dam and reservoir' and 'the lower dam and reservoir'), on an ephemeral tributary of the Macleay River (known as Fingerboard Crossing Creek). An underground power station complex, with pump-turbine/ motor-generator units and associated infrastructure, will be connected to the reservoirs by underground tunnelling. The power station complex will effectively have three operating modes: energy generating mode, pumping mode, and synchronous condenser (syncon) mode.

During the **energy generating** mode, water stored within the upper dam and reservoir is released and allowed to flow through the underground tunnels, generating electricity as it passes through the underground power station complex into to the lower dam and reservoir. The downhill flowing water spins the turbines within the power station causing the generator shaft to turn and thereby produce electricity by converting the water's potential energy (stored energy) into electrical energy that is then sent to the electricity grid.

During the **pumping** mode, electricity sourced from the grid is used to turn the generator shafts in reverse to the energy generating mode and act as a pump to draw water from the lower reservoir through the underground power station complex and tunnels back to the upper reservoir.

In the **synchronous condenser** mode, no water is required. Using excess electricity from the grid, the turbines spin freely. This operating mode is designed to improve stability and maintain voltages in the grid.

Figure 1.1 provides an illustration of the principles and workings behind the proposed pumped hydro system.

The Project will also require a new two-lane unsealed access road and a minimum of one new single lane low-level bridge crossing of the Macleay River, which will connect the Project area to Kempsey-Armidale Road and enable access for construction and eventual operation and maintenance of the Project. As previously discussed, a temporary bridge may be utilised prior to the construction of the permanent bridge. Crossings of ephemeral creeks along the access roads will require either minor bridge crossings or culverts. Additional shorter access roads will be required for the construction and maintenance of the transmission line to TransGrid Line 965.

Power will be transmitted and received to the Project by way of the establishment of new transmission lines and associated infrastructure which will connect to TransGrid Line 965. The existing section of TransGrid Line 965 from the Project to Armidale will need to be upgraded to accommodate the Project, however, this upgrade does not form part of this application.

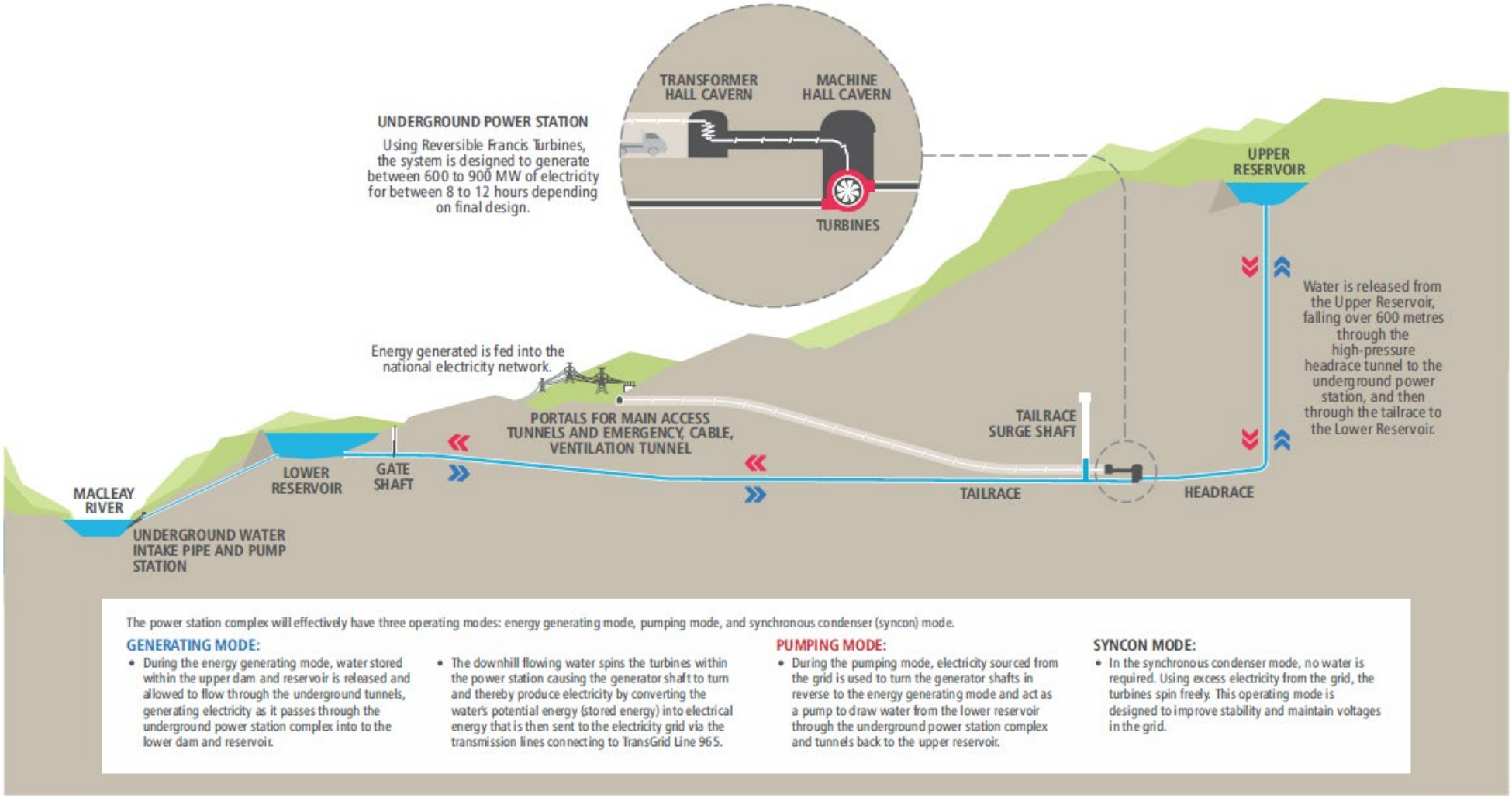



**Figure 1.1 Illustration of the workings behind the Project**

### 1.2.2 Guiding design principles and approach

Given the complexities of the Project, an iterative and risk-based design and assessment process was adopted in identifying and assessing potential environmental impacts (the design integration and assessment (DIAA) process, as shown in Figure 1.2). This process was undertaken to develop the design and construction methods with the guiding principles of avoiding and minimising environmental impacts where possible and engaging with key stakeholders throughout the process. This EIS has been prepared with consideration of impacts commensurate with the levels of risk identified through the DIAA process.

The challenges for the design team included the need to develop solutions that balance the need for ensuring a safe working environment for the construction of the Project, including the safe movement of plant, equipment, materials and personnel across the sites, with the need to preserve and protect the values of the area and the environmental constraints of the location. Throughout the design process, the objective was to identify and avoid sensitive locations, to minimise the construction envelope and maintain as much of the existing natural environment as is reasonable and feasible. As previously stated, this EIS is based on feasibility designs provided by engineering and design consultants providing information sufficient to define a Project footprint, activities and resources required for the Project's planning purposes. Future design efforts will refine the feasibility design to a detail level suitable for construction commencement. While Project components are generally fixed, some refinements to the physical layout or design of certain components of the Project may be required following further investigation and design. Consistent with the DIAA process, the objective for the detailed design process is to optimise the design to meet construction requirements while continuing to minimise environmental impacts.

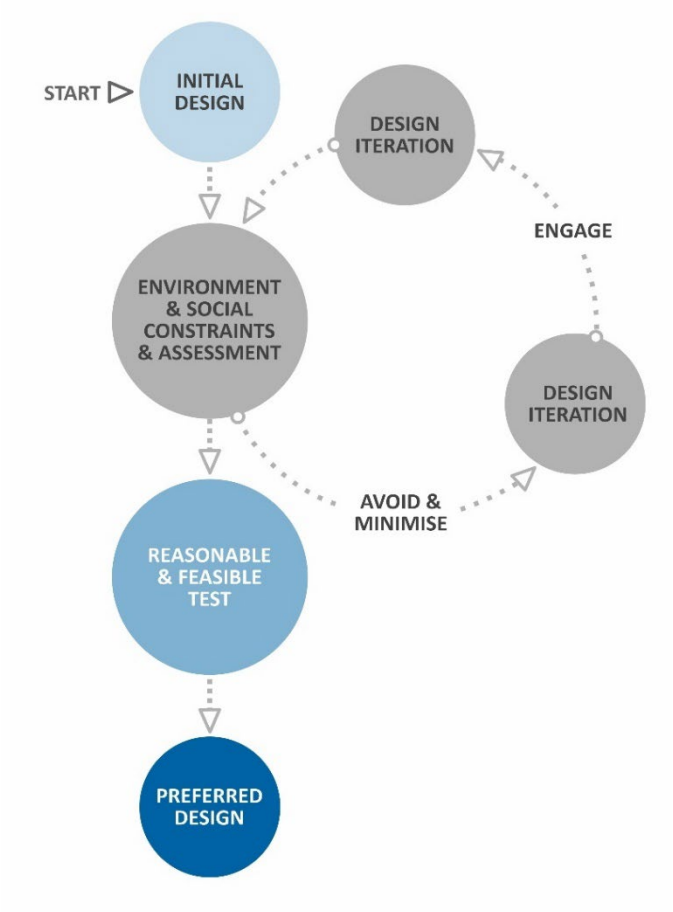



**Figure 1.2 Design integration and assessment process**

### 1.2.3 Key Project design elements

The Project will result in the creation of permanent infrastructure, both above and below the ground, which is required to operate the Project. The design of the infrastructure elements has considered the existing environment with careful consideration of its values, as well as maintaining public access during construction and operation to valued areas such as the National Trail along the Macleay River and Georges Junction campground.

Broadly, the Project has been categorised into three key components, which are further broken down in Table 1.1:

- pumped hydro-electric and generation works (PHGW) – including:
  - new upper and lower water storage dams and reservoirs
  - a new underground pumped hydro-electric power station and transformer hall
  - water tunnels, access tunnels, portals and adits
  - tailrace surge tank
  - intake and outlet structures
  - associated gates, shafts and screens
- transmission connection works – including:
  - new electricity transmission lines to connect the PHGW to the existing electricity transmission network (Line 965)
  - new electricity transmission infrastructure
  - a new substation
- ancillary development – including but not limited to:
  - access roads
  - on-site quarries, spoil emplacement areas and related infrastructure
  - utilities and communications infrastructure
  - construction pads containing assets such as workshops, concrete batching plants (CBPs), and offices
  - laydown and storage areas
  - construction accommodation
  - pumping infrastructure
  - operational facilities such as offices, and camps for staff
  - construction and operational power supply.

## Table 1.1 Key Project elements

| Project element | Description |
|---|---|
| **PHGW** | |
| Underground power station complex | An underground pumped hydro-electric power station located below the upstream end of the pumped hydro system to optimise the hydraulic arrangement of the Project. The power station complex consists of:<br>• two main caverns, comprising:<br>– the machine hall<br>– the transformer hall<br>• interconnecting tunnels, the transformer hall tunnel and isolated phase busbar (IPB) tunnels. |
| Dams and reservoirs | Two concrete faced rockfill dams (CFRD) and reservoirs, referred to as the upper dam and reservoir and lower dam and reservoir, with the following specifications: |
| | Upper dam and reservoir:<br>• CFRD approximately 70 m high and 780 m long<br>• reservoir covering a total area of approximately 20 hectares (ha) and an inundation extent of approximately 16.7 ha<br>• reservoir height of approximately 881 m Australian Height Datum (AHD) at full supply level (FSL) and approximately 830 m AHD at minimum operating level (MOL)<br>• total reservoir storage capacity of around 5.1 gigalitres (GL) at FSL. |
| | Lower dam and reservoir:<br>• CFRD approximately 70 m high and 280 m long<br>• reservoir covering a total area of approximately 24.7 ha and an inundation extent of approximately 21.6 ha<br>• reservoir height of 250 m AHD at FSL, 215 m at MOL and 205 m AHD at lowest operating level (LOL)<br>• total reservoir storage capacity of around 6.5 GL at FSL. |
| Water intake structures | Two intake structures, one at each reservoir, including:<br>• a morning glory, vertical-type intake structure situated at the upper dam and reservoir<br>• a lateral intake structure, with head gates and stoplog slots, and an intake channel, at the lower dam and reservoir. |
| Spillway | Two concrete lined spillway chutes, one for each of the upper and lower dams and reservoirs. Both spillway crests will comprise of ungated ogee-shaped overflow weirs on the upstream ends of the spillway chutes. |
| Macleay River pump facility | A pump facility on the edge of the Macleay River, which will include an access road, duty and standby pumps for the initial fill and for ongoing reservoir top-ups as required. |
| Tunnels | Three main tunnels comprising of:<br>• two main access tunnels (MAT1 and MAT2)<br>• the emergency, cable, ventilation tunnel (ECVT).<br>The MAT1 and MAT2 will provide loop access to the power station complex from the MAT portal.<br>The ECVT will provide services access and egress between the switchyard portal and the transformer hall. The ECVT portal will contain the station switchyard, control rooms, ventilation and firefighting equipment, with blast walls separating important equipment. |

## Table 1.1 Key Project elements

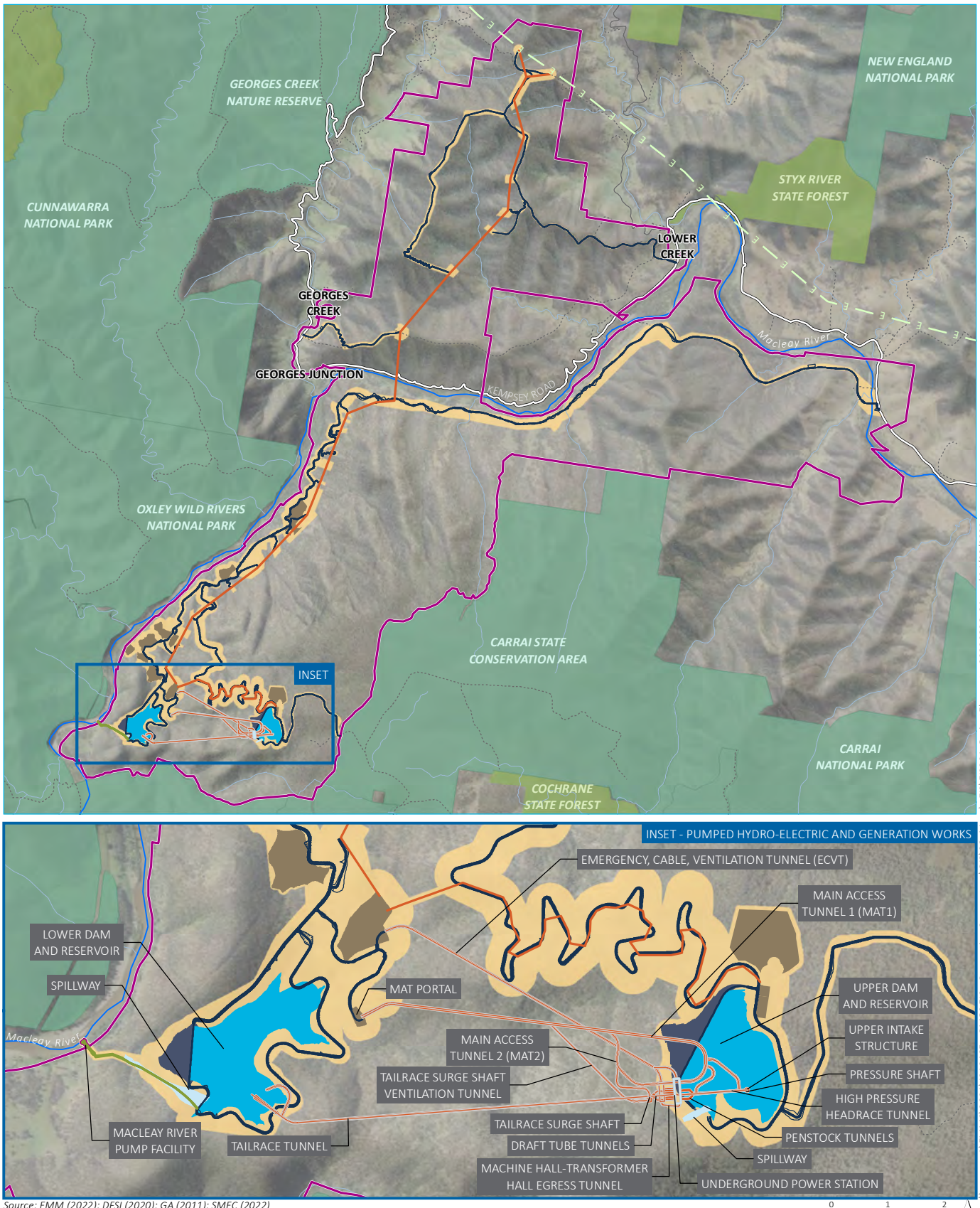
| Project element | Description |
|---|---|
| Power waterway | The power waterway will consist of:<br>• an approximately 660 m deep, 5.1 m diameter vertical pressure shaft<br>• an approximately 250 m long concrete and steel lined high-pressure headrace tunnel<br>• three or more approximately 80 m long penstock tunnels<br>• three or more approximately 120 m long draft tube tunnels<br>• an approximately 1,825 m long concrete lined tailrace tunnel. |
| **Transmission connection works** | |
| Connection works | The connection works will consist of:<br>• an approximately 15 km long transmission alignment comprising, at a maximum, double circuit single tower 330 kV overhead infrastructure and single circuit single tower 132 kV overhead infrastructure connecting to TransGrid Line 965<br>• up to 25 transmission tower sites (approximately 50 m x 50 m) containing the 132 kV and 330 kV infrastructure<br>• a transmission easement width of a maximum of approximately 105 m.<br>Note: The upgrade of existing Line 965 will be the subject of a separate application. |
| Sub-station | Construction of a substation and associated connection infrastructure of up to 330 kV rating. |
| Switchyard | • A high voltage connection linking the connection transmission lines to the cables exiting the underground power station complex. The outdoor air insulated switchyard will likely include:<br>– switchgear and control room<br>– cable potheads<br>– disconnector/earth switches<br>– capacitive voltage transformer (VT)<br>– lightning protection<br>– security fencing, lighting and surveillance<br>– surge arrestor. |
| **Ancillary development (construction and operation)** | |
| Access roads, access tracks and bridge | A variety of road works to improve existing access, and construction of new permanent roads to enable construction access, temporary establishment and use of construction sites, and general access to the Project area including transmission line infrastructure. |
| | The proposed main access will be via the construction of a new unsealed two-lane access road located to the east of the site (the Eastern Access Road (EAR)). The main access road will interface with the existing Kempsey-Armidale Road and will require the construction of at least one new single- or two-lane low-level bridge crossing over the Macleay River. A temporary bridge may be utilised prior to the construction of the permanent bridge. |

## Table 1.1 Key Project elements

| Project element | Description |
|---|---|
| | There will be approximately 40 km of permanent roads connecting the dams, surface works, portals, transmission assets and spoil sites. Some of these roads are existing roads, however approximately 25 km will be newly constructed roads. The key road components include:<br>• Main Access Road (approximately 4.7 km)<br>• EAR (up to approximately 11.4 km)<br>• Lower Dam Access Road (approximately 3.6 km)<br>• Upper Dam Access Road (approximately 7.1 km)<br>• access to portals and underground works<br>• Upper Dam Emergency Egress Road (approximately 2.2 km).<br>Access to the transmission infrastructure north of the Macleay River will be via two roads accessed from the Kempsey-Armidale Road. These two roads include the:<br>• Northern Transmission Access Road (approximately 15 km)<br>• Transmission Tower 8 Access Road (approximately 2.3 km).<br>To support access along the transmission line easement south of the Macleay River and to each of the tower sites, a network of interconnecting access and maintenance tracks will be constructed, to a large extent utilising existing access tracks. |
| Surface works pads and facilities | There are four main construction pads in addition to surface portals which will be used temporarily during construction for different services (accommodation camp, construction site offices, workshop area, and laydown storage). |
| | Construction works will require the establishment of the following ancillary support infrastructure and areas:<br>• main accommodation camp, which will temporarily accommodate the majority of workers as required throughout the construction period<br>• temporary or fly camps that may be required in addition to the main accommodation camp being constructed<br>• two works areas including Works Area 1 and Works Area 2, which will contain ancillary facilities such as CBPs, mechanical and electrical workshops, a laboratory and various water treatment and wash areas<br>• spoil emplacement areas<br>• staging areas<br>• stockpiling areas<br>• temporary site offices to be used during construction. |
| Communications | Communication infrastructure such as fibre optic cables are required for the operation of the Project and will be located:<br>• on an overhead line linking the upper and lower dams and reservoirs (in conjunction with the electrical line)<br>• buried in road corridors.<br>The communication network will also include a communications tower near the upper dam and reservoir. |
| Utilities during construction | • Construction water will be supplied to water storage systems either via groundwater bores, or via pumping of water from the Macleay River to support camp operations, the CBP, dust suppressions and other activities across the site.<br>• Construction power will be supplied primarily by use of portable diesel generators and supported where possible by leveraging off existing electricity distribution infrastructure running through the generation site. |
| Utilities for operation | Alignment and length of utilities (electricity, water, etc.) will be combined into a single corridor (total length of about 5.4 km). |

## Table 1.1 Key Project elements

| Project element | Description |
|---|---|
| Water diversion and water treatment facilities | • Site drainage will include a combination of cross drainage culverts, drainage pits and pipe, open channels/open drains (vegetated, rock-lined or concrete), levees/bunds, and detention basins.<br>• Various water treatment plants will be used for construction drainage and water treatment facilities – for the main accommodation camp, temporary or fly camps, CBP, tunnel, etc.<br>• Specific discharge locations are planned for stormwater and surface water runoff and will be determined during detailed design or construction planning. |
| Laydown/stockpile areas | Temporary laydown/stockpile areas will be utilised across the Project area, with a total allocated stockpile area of around 114,000 $m^2$. |
| Spoil emplacement areas | To accommodate spoil generated through excavation of the underground caverns and tunnels, three permanent spoil placement locations have been identified with a capacity to store around 2.9 million cubic metres ($Mm^3$) of material. Dead storage space within the reservoirs will also be used for spoil placement, with a capacity to store approximately 300,000–400,000 $m^3$. One construction laydown area within the construction envelope has been identified as providing further surplus storage capacity (around 300,000$m^3$) however assessment and approval of this area would be sought separately, if the storage is required. |
| Ancillary operational facilities | Primary operation of the Project can be undertaken remotely and will require minimal onsite operational staff, other than for maintenance activities. Operational facilities include maintenance housing, work area, car parking, workshop and storage, control room and switchgear, water treatment plant, office area, heating, ventilation and air conditioning (HVAC), backup generators and Macleay River pump facility. |
| **Other** | |
| Construction | • Construction duration of around four to five years.<br>• Construction workforce of over 600 workers at construction peak. |
| Rehabilitation | Rehabilitation of areas disturbed during pre-construction and construction will be undertaken progressively where practical during all stages and phases of the Project. Progressive rehabilitation will occur over about 60 ha including spoil emplacement areas and areas used for construction ancillary facilities no longer needed during operation.<br>At the end of the Project's life, 192 ha in total will be rehabilitated to native ecosystem (including native vegetation and rock landscape). Approximately 138 ha will be retained permanently for the water storages and access roads, subject to agreement with relevant landowners/land managers. |
| Operation | • The Project will provide up to 900 MW of electricity generating capacity and up to twelve hours of energy storage at full generating capacity.<br>• Maintenance and operational activities will include power station operations, infrastructure inspections, maintenance to assets, vegetation management, auditing and compliance and other activities.<br>• It is expected that the operation of the new power station will require around 30–50 full-time workers, as well as additional contractors for regular and ad hoc maintenance and repairs. |
| Hours of operation | • Construction of the Project will be 24/7 and 365 days per year.<br>• Operation of the Project will be 24/7 and 365 days per year. |
| Project timeline | The Project will involve the construction and operational stages, and numerous phases which are outlined in Section 1.3. |
| CIV | Estimated to be a base cost of approximately $1.8 billion (refer to Appendix BB). |

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*Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)*

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KEY

- Project area
- Construction envelope
- Surface works

Project operational elements

- Power station
- Pump station
- Tunnels, portals, intakes, shafts
- Transmission overhead lines
- Permanent road
- Dam wall
- Reservoir
- Spillway

Existing environment

- Macleay River
- Watercourse/drainage line
- Major road
- Minor road
- Vehicular track
- Existing transmission line
- NPWS reserve
- State forest

## Overview of key project elements

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.3

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### 1.2.4 Project area terminology

Approval for the Project is being sought based on a feasibility design is common for projects of this size and scale. To accommodate minor changes and amendments to the design as it progresses, a 'Project area', 'construction envelope', 'disturbance footprint' and 'operational footprint' approach is being adopted for the Project. This approach is aimed at ensuring environmental impacts are assessed as accurately as possible, whilst accounting for the current level of design and the likelihood of design refinements occurring as the Project progresses towards construction.

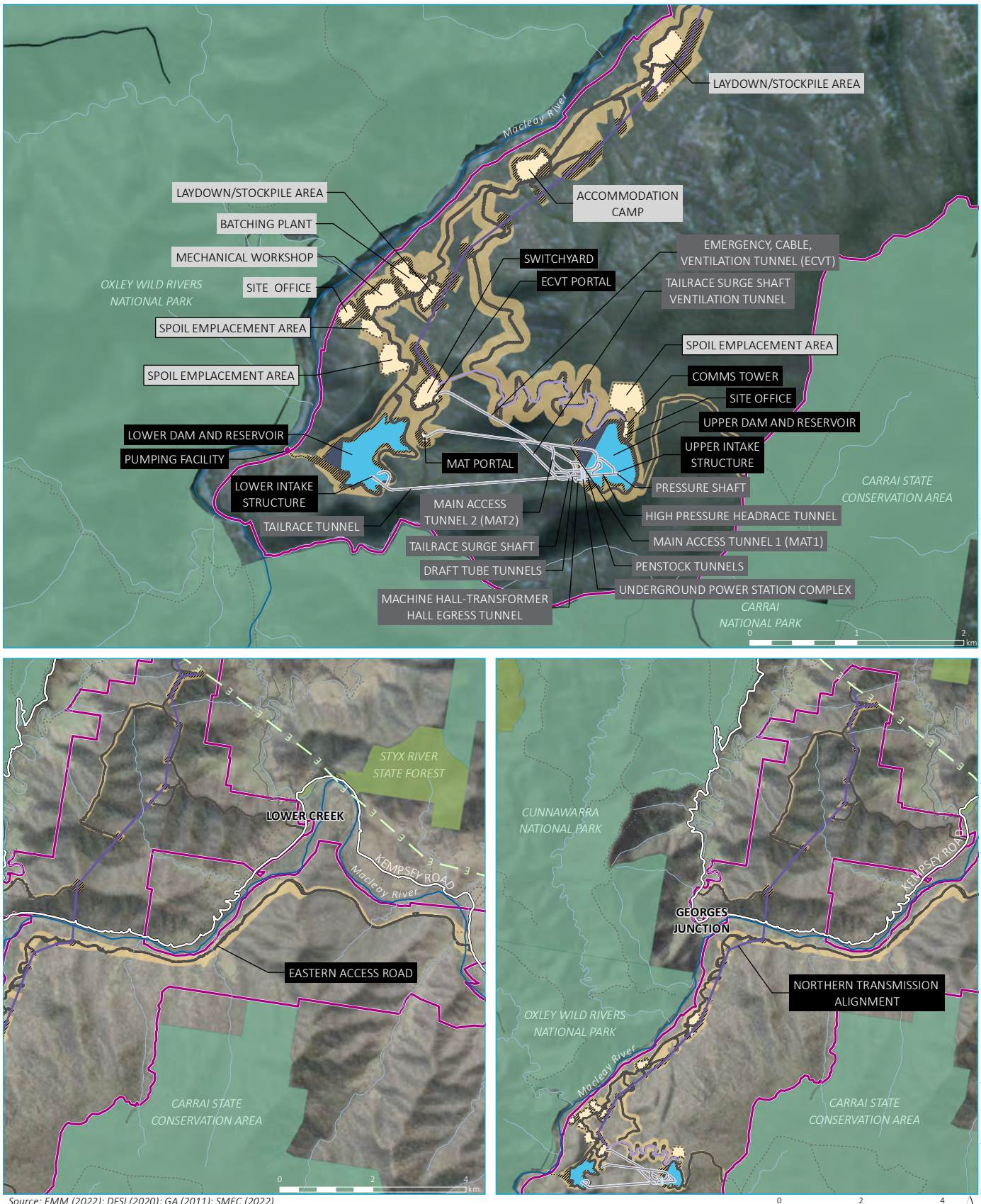
The ***Project area*** is the broader area within which the Project will be built and operated, and the extent within which direct impacts from the Project are anticipated. Importantly the Project area does not represent a footprint for the construction works, but rather indicates an area that was investigated during environmental assessments. The Project area has been further divided into different areas to facilitate the assessment of direct impacts from the Project.

The ***construction envelope*** represents the maximum extent of where disturbance may occur during the construction of the Project. In order to derive the construction envelope, buffers have been applied to key Project elements and infrastructure. The buffers used to derive the final construction envelope area reflect the confidence around the current siting of the asset or infrastructure, and the likelihood that some amendments may be required prior to commencing the construction works as a result of the detailed design. The construction envelope for the Project covers an area of around 780 ha.

Located entirely within the bounds of the construction envelope sits the ***disturbance footprint***, a smaller area that has been derived directly from the current level of design. The disturbance footprint represents the physical disturbance that can be expected as part of the construction works. As the design is refined, the final siting of the disturbance footprint can move within the construction envelope, subject to the recommended environmental management measures, and provided it does not exceed any limits as defined by the construction envelope. It is proposed that most of the disturbance footprint will be rehabilitated and land formed at the completion of the Project. However, other parts will be retained after construction which are necessary for the ongoing operation and maintenance of the new power station (operational footprint). The disturbance footprint for the Project covers an area of around 330 ha.

Progressively, and at the end of construction, temporary components that are required to support the construction of the Project will be rehabilitated and returned to a state representing its previous use. The exceptions to this are the areas required for permanent operation of the Project, which would be retained (referred to as the ***operational footprint***). The operational footprint of the Project covers an area of around 270 ha. Approximately 60 ha would be progressively rehabilitated during and following completion of construction.

The Project area, construction envelope and disturbance footprint are shown in Figure 1.4. An overview of the operational footprint at the completion of the Project is shown in Figure 1.5.




*Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)*

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## KEY

- Project area
- Disturbance footprint
- Construction envelope
- Surface works

Project operational elements

- Underground power station complex
- Power and communications lines
- Transmission overhead lines
- Tunnels, portals, intakes, shafts
- Permanent road
- Reservoir
- Dam wall

Existing environment

- Macleay River
- Watercourse/drainage line
- Kempsey-Armidale Road
- Vehicular track
- Existing transmission line
- NPWS reserve

Label format

- SURFACE PERMANENT INFRASTRUCTURE
- UNDERGROUND PERMANENT INFRASTRUCTURE
- TEMPORARY INFRASTRUCTURE
- PERMANENT SPOIL EMPLACEMENT

# Project areas overview

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.4

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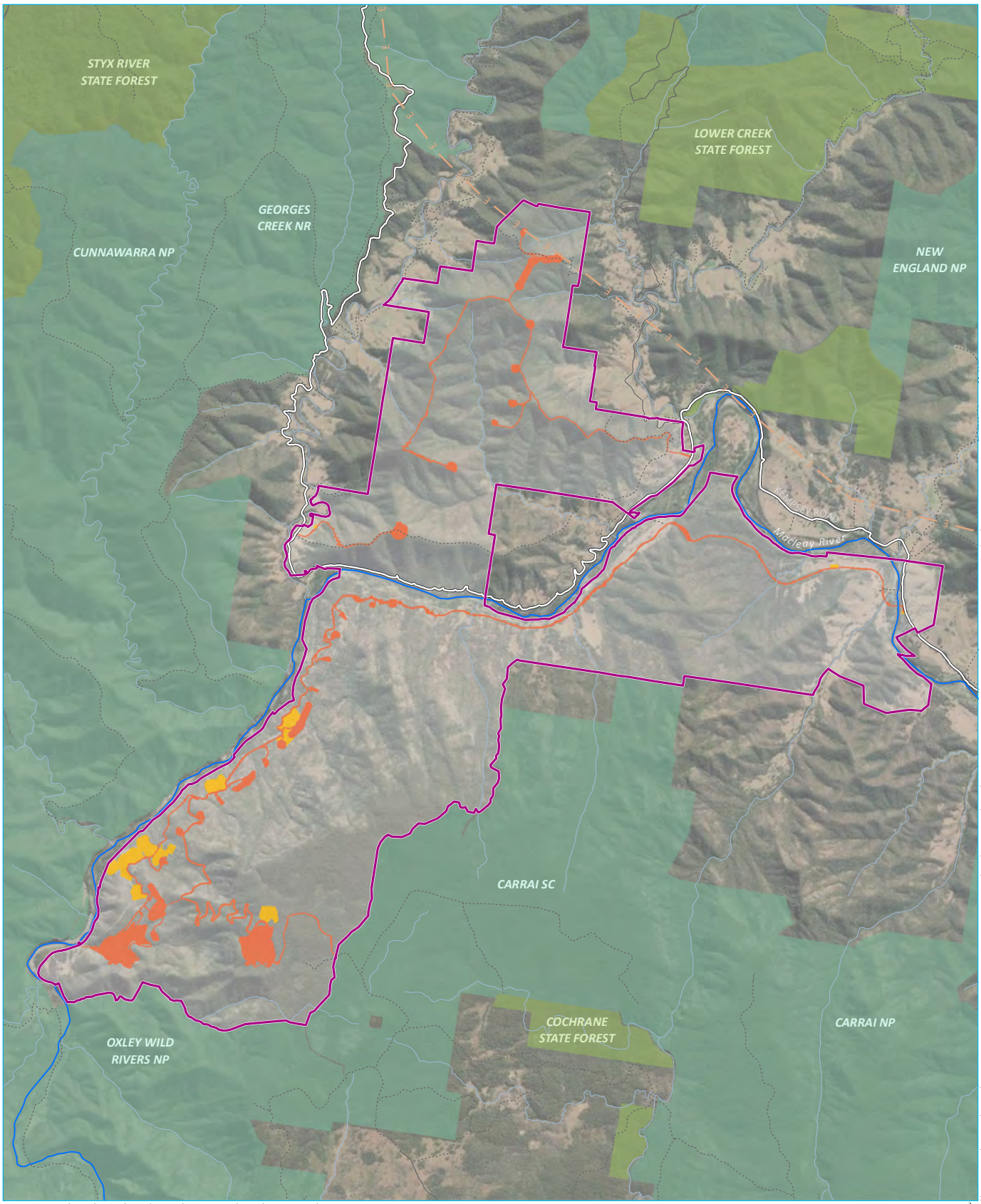


Source: EMM (2022); ABS (2021); DFSI (2020, 2021); GA (2011, 2020)

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KEY

- Project area
- Operational footprint
- Progressive rehabilitation

Existing environment

- Macleay River
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Existing transmission line
- NPWS reserve
- State forest

Overview of Operational footprint

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.5

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## 1.3 Construction

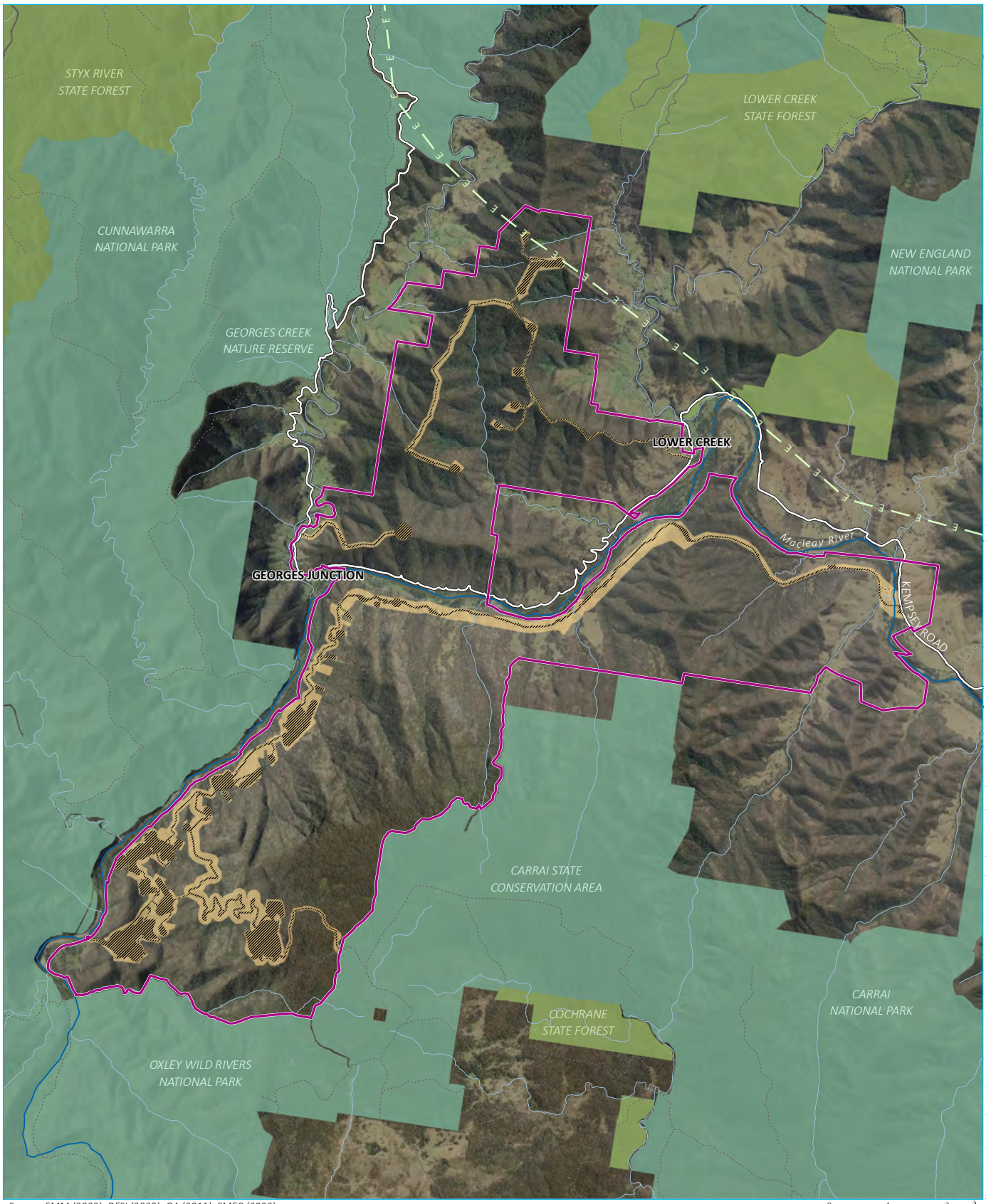
The development of the Project will require significant construction related activities to be undertaken and key supporting infrastructure to be established. This section outlines the key infrastructure based on feasibility level designs that form the construction phase of the Project.

### 1.3.1 Construction areas

To assist in detailing the key infrastructure associated with the Project, the footprint has been divided into five 'construction areas' (Figure 1.6). The construction areas are predominantly centred around the generation components in the south of the Project area, with only transmission lines and access roads occupying the north of the Project area. The degree of construction related activities that are to be undertaken within each construction area varies, dependant on the infrastructure within each. The five construction areas used to describe the Project are:

- upper dam and reservoir
- lower dam and reservoir
- underground works
- access roads
- transmission infrastructure (northern and southern areas).

Details of these construction areas are provided below.




Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

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KEY

- Project area
- Disturbance footprint
- Construction envelope

Existing environment

- Macleay River
- Watercourse/drainage line
- Kempsey-Armidale Road
- Minor road
- Vehicular track
- Existing transmission line
- NPWS reserve
- State forest

Overview of Project construction areas

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.6

EMM creating opportunities

### i Upper dam and reservoir

Situated approximately 2.5 km east of the Macleay River on the south-east end of the Project area, this area contains the upper reservoir itself, the upper intake structure, emergency egress road, and the spoil emplacement areas to the north of the reservoir. The upper dam and reservoir area is displayed in Figure 1.7 with detail on Project elements, purpose, and description provided in Table 1.2.

**Table 1.2 Upper dam and reservoir construction area – Project elements, purpose, and description**

| Element | Purpose | Method summary – during construction | Final land use | Long-term use |
|---|---|---|---|---|
| Upper dam and reservoir | The upper dam and reservoir forms the headwater of the new power station, storing water to be used for the hydro-electric power generation. The upper dam and reservoir will include the construction of a 70 m high, 780 m long CFRD, a concrete lined spillway chute, a temporary concrete encased diversion conduit, and morning glory style intake. | Rockfill for the dam wall will be taken from a quarry situated within the reservoir inundation area to the east of the dam wall. Approximately 536,000 $m^3$ of spoil is expected to be generated during the reservoir excavation in addition to the 534,000 $m^3$ of aggregates to be used in the construction of the dam. | Permanent infrastructure | The structures associated with the upper reservoir will remain in place and continue to be utilised throughout the duration of the Project's life. |
| Upper intake structure | Water is drawn in through the upper intake structure from the reservoir into the tunnels during generation mode and to replenish water into the reservoir during pumping mode. The structure will utilise trash racks designed to prevent the ingress of logs and other foreign materials into the waterway headrace tunnel. | The intake will be upward facing and constructed from reinforced concrete. The intake will have a gate structure to facilitate maintenance and emergency situations, as well as metal trash racks. | Permanent infrastructure | The structure will remain in place and continue to be utilised throughout the duration of the Project's life. |
| Site office | A site office located adjacent to the reservoir will be constructed for administrative purposes during the construction and operation phases. | The office will be constructed to minimise environmental impacts. | Permanent infrastructure | The office will remain in place and continue to be utilised throughout the duration of the Project's life. |
| Communications tower | A secondary redundant communication path is required to complement the fibre optic path (via transmission line). This allows for back-up communication with the national electricity market (NEM) participants including the Australian Energy Market Operator (AEMO), and TransGrid. Further, the tower will enhance radiocommunications within the site. | The tower will be sized to allow clear line of sight towards Armidale or similar.<br>The tower will likely be a free-standing lattice tower and be supplemented with a fenced communications control building (and associated access) including power supply, back-up power (batteries and/or generation), electronic controls. | Permanent infrastructure | The tower will remain in place and continue to be utilised throughout the duration of the Project's life. During its life span it would provide mobile coverage to all users (including the public) in the vicinity of the tower. |

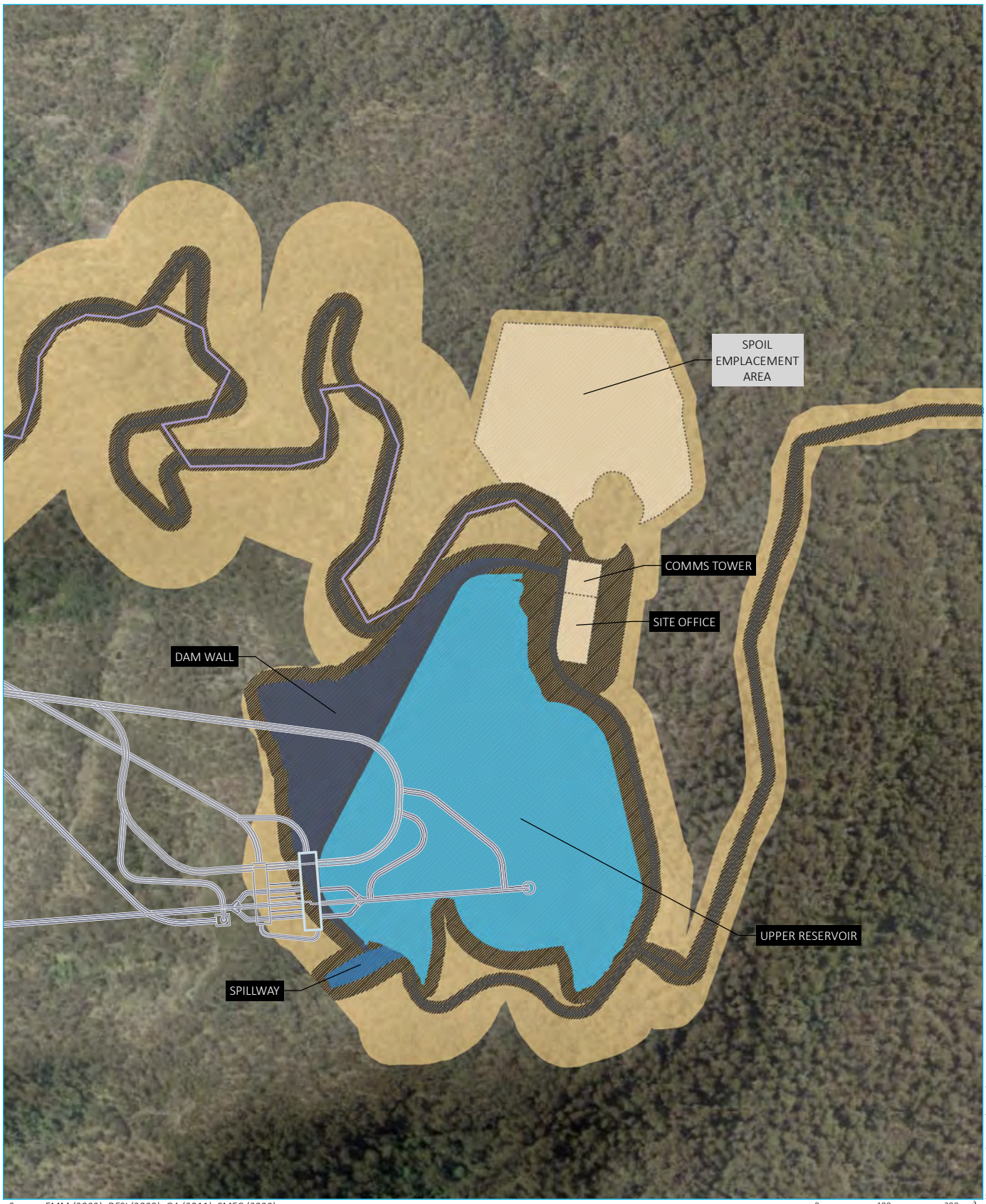
**Table 1.2 Upper dam and reservoir construction area – Project elements, purpose, and description**

| Element | Purpose | Method summary – during construction | Final land use | Long-term use |
|---|---|---|---|---|
| Spoil emplacement area | Spoil will be generated from excavation and surface works throughout the construction phase. One spoil emplacement area will be situated near the upper reservoir. The site has been selected as it is close to construction areas and likely to have a minimal impact on major water courses. | Vegetation clearing will commence across the spoil emplacement site along with minor earthworks. Spoil will be placed to minimise erosion. | New rehabilitated landform | The spoil emplacement area will be land formed to integrate into the existing topography, and progressively rehabilitated. |

### ii Lower dam and reservoir

The lower dam and reservoir construction area will be the most heavily developed construction area. It is located nearer to the eastern bank of the Macleay River, with all permanent components set to be constructed outside of the 10,000 year flood level. Key components of the construction area include the lower reservoir, spoil emplacement areas, and accommodation for workers, as well as various workshops and service areas to support the construction effort. The lower dam and reservoir area is displayed in Figure 1.8 with detail on Project elements, purpose, and description provided in Table 1.3.

The design provides for the location of the main accommodation camp. However, its location may change as part of the detailed design phase to an alternate location within the construction envelope.




*Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)*

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KEY

- Project area
- Disturbance footprint
- Construction envelope

Project operational elements

- Underground power station complex
- Tunnels, portals, intakes, shafts
- Permanent road
- Power and communications lines
- Surface works
- Upper dam spillway
- Reservoir
- Dam wall

Existing environment

- Vehicular track

Label format

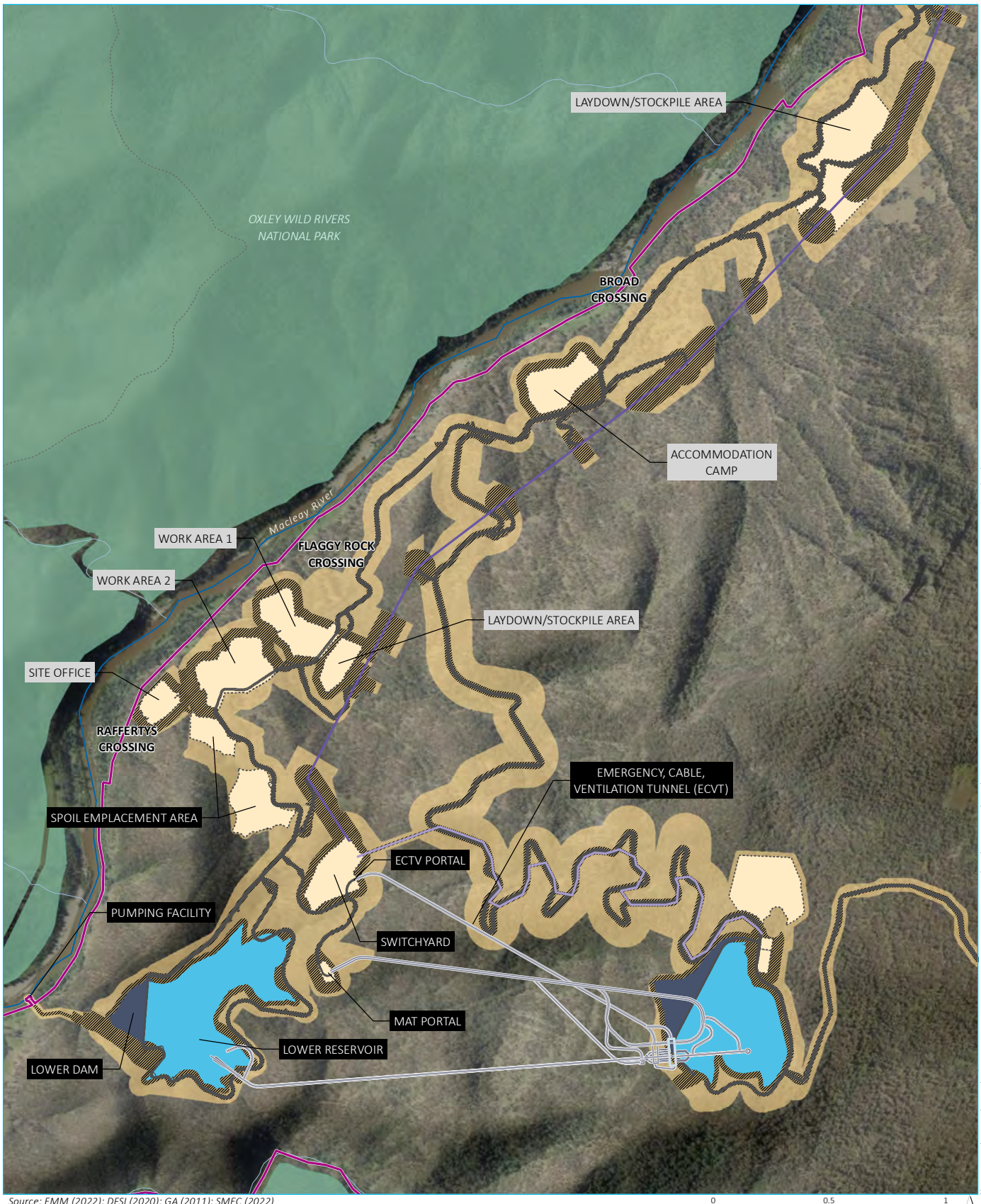
SURFACE PERMANENT INFRASTRUCTURE

TEMPORARY INFRASTRUCTURE

# Upper dam and reservoir construction area

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.7

EMM creating opportunities




Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

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KEY

- Project area
- Disturbance footprint
- Construction envelope

Project operational elements

- Underground power station complex
- Tunnels, portals, intakes, shafts
- Permanent road
- Power and communications lines
- Transmission overhead lines
- Surface works
- Reservoir
- Dam wall

Existing environment

- Macleay River
- Watercourse/drainage line
- Kempsey-Armidale Road
- Vehicular track
- Existing transmission line
- NPWS reserve

Label format

SURFACE PERMANENT INFRASTRUCTURE

TEMPORARY INFRASTRUCTURE

# The lower dam and reservoir construction area

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Assessment
OMPS Pty Ltd
Figure 1.8

EMM creating opportunities

**Table 1.3 Lower dam and reservoir construction area – Project elements, purpose, and description**

| Element | Purpose | Method summary – during construction | Final land use | Long-term use |
|---|---|---|---|---|
| Works area 1 | Works Area 1 will be used as a hub for civil activities. It will consist of an 18,000 $m^2$ upper area used for aggregate storage and a 36,000 $m^2$ lower area which will include a CBP, laboratory, concrete wash, and stormwater sediment pond. | Vegetation clearing and conventional earthworks will be the primary action required during construction. | Rehabilitated consistent with previous use. | Works Area 1 will be rehabilitated following the construction phase. Integrated revegetation will be used to minimise environmental effects. |
| Works area 2 | Works Area 2 is a 36,500 $m^2$ area that will contain the electrical and mechanical services area. It will include electrical and mechanical workshops, laydown areas, a warehouse, storage and maintenance workshops. | Vegetation clearing and conventional earthworks will be the primary action required during construction. | Rehabilitated consistent with previous use. | Works Area 2 will be rehabilitated following the construction phase. Integrated revegetation will be used to minimise environmental effects. |
| Laydown/stockpile areas | There will be two areas used for stockpiling and material laydown, covering a total area of 114,000 $m^2$. One area is located along the main access road (between transmission towers 14–16), and one area is located in proximity to the batching plant. The larger of the two areas has also been flagged as a potential area for future development, to provide further flexibility as the detailed design progresses. | Vegetation clearing and conventional earthworks will be the primary action required during construction. | Rehabilitated consistent with previous use. | The laydown/stockpile areas will be rehabilitated following the construction phase. |
| ECVT portal | The ECVT portal will house the switchyard for the power station and will provide secondary access and egress during the operational period of the Project. Infrastructure at the ECVT portal will include a building containing switchgear and control room, and ECVT ventilation fans to provide fresh air to the underground power station complex and tunnels. | Vegetation clearing and conventional earthworks will be the primary action required during construction. | Permanent infrastructure. | The ECVT portal and the infrastructure associated to this area will continue to be used throughout the life of the Project. |
| MAT portal | The MAT portal will provide primary access to the underground power station complex via MAT1. A small service building will be constructed near the MAT portal for first aid and administrative purposes. | The MAT portal will have a footprint of approximately 3,000 $m^2$. 30,000 bank cubic metres ($bm^3$) of spoil are expected to be generated during the excavation of the MAT1 and portal. | Permanent infrastructure. | The MAT portal and the infrastructure associated to this area will continue to be used throughout the life of the Project. |

**Table 1.3 Lower dam and reservoir construction area – Project elements, purpose, and description**

| Element | Purpose | Method summary – during construction | Final land use | Long-term use |
|---|---|---|---|---|
| Spoil emplacement areas | Spoil will be generated from excavation and surface works throughout the construction phase. Spoil emplacement areas are located to the north of the Lower Reservoir. These areas have been selected as it is close to underground construction adits and likely to have a minimal impact on major water courses. | Vegetation clearing will commence across the spoil emplacement area and minor earthworks will completed. Spoil will be placed and compacted in layers of similar composition to minimise erosion. | New rehabilitated landform | The spoil emplacement will be land formed to integrate into the existing topography, and progressively rehabilitated. |
| Site offices | Temporary offices will be constructed for administrative purposes during the construction phase. | The offices will be constructed across three level pads to minimise environmental impacts. The total area of the pads will be approximately 13,000 $m^2$. | Rehabilitated consistent with previous use. | The site office areas will be rehabilitated following the construction phase. Integrated revegetation will be used to minimise environmental effects. |
| Lower dam and reservoir | The lower dam and reservoir will contain tailwater for the underground power station. The lower reservoir will include the construction of a 70 m high, 280 m long CFRD a concrete lined spillway chute, and a concrete lined diversion tunnel. | Rockfill for the dam wall will be taken from a quarry situated within the reservoir inundation area to the east of the dam wall. Approximately 466,000 $m^3$ of aggregates for the dam are expected to be extracted from the quarry, alongside approximately 664,000 $m^3$ of spoil.<br>The reservoir will be filled from the Macleay River. It is expected that this filling will take around 6–9 months, dependent on the hydrology at the time filling occurs. | Permanent infrastructure | The structures associated with the lower reservoir will remain in place and continue to be used throughout the duration of the Project's life. |
| Lower intake structure | The lower intake structure will draw water from the reservoir into the tailrace tunnel during pumping mode and to release water into the lower reservoir during generation mode. As with the upper intake structure, the lower intake structure will employ trash racks to prevent foreign objects being introduced to the waterways. | The lower intake structure will be laterally oriented and founded in rock. A lower intake gate shaft with head gates and stoplog slots will also be constructed to allow for inspection and maintenance of the lower gate seals. | Permanent infrastructure | The structure will remain in place and continue to be used throughout the duration of the Project's life. |

**Table 1.3 Lower dam and reservoir construction area – Project elements, purpose, and description**

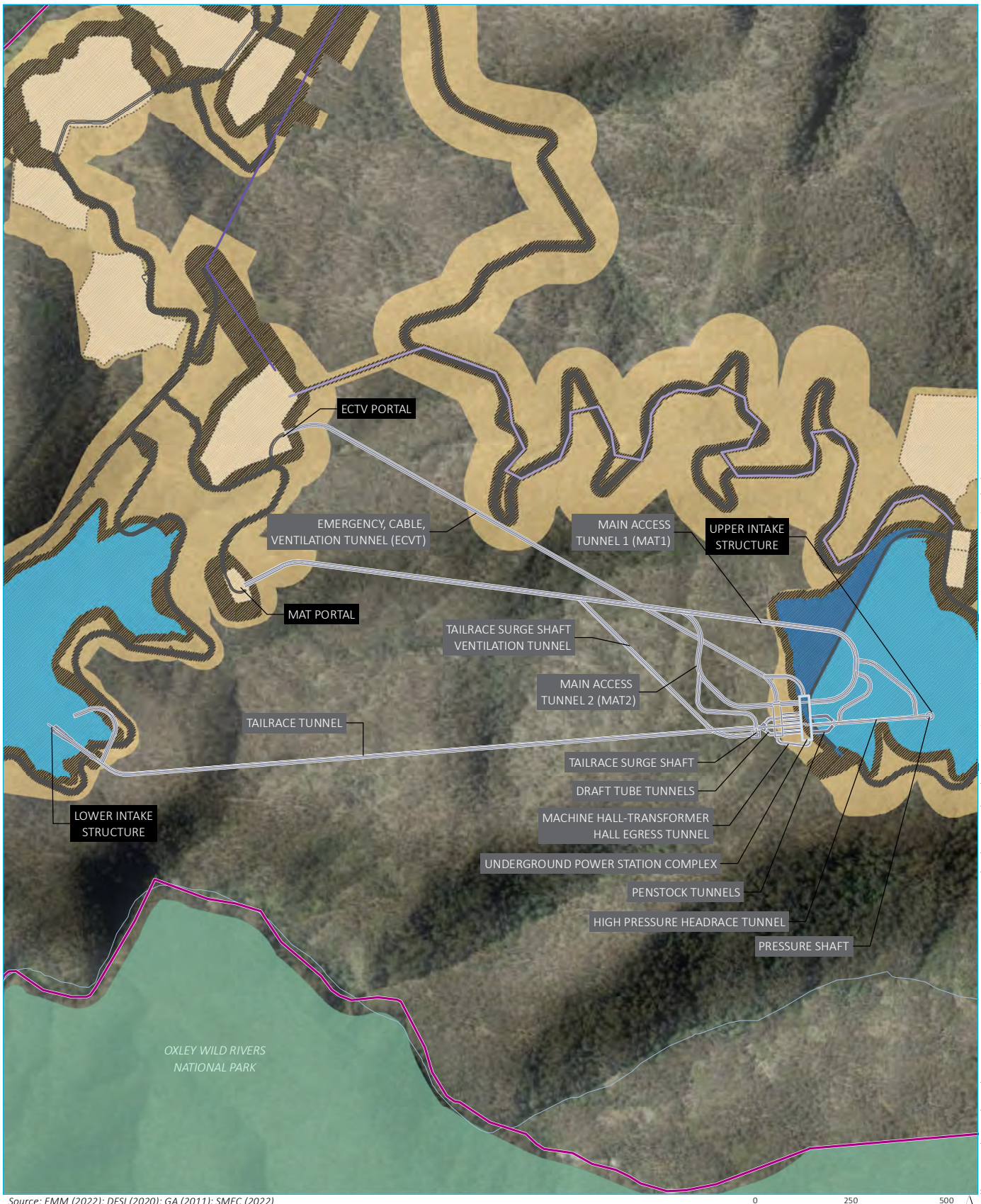
| Element | Purpose | Method summary – during construction | Final land use | Long-term use |
|---|---|---|---|---|
| Main accommodation camp | The main accommodation camp will provide temporary worker accommodation for the majority of the onsite workforce (around 600 people). This will be required throughout the construction period. A variety of facilities will be constructed to support them. | The camp area will have an area of 35,000 $m^2$. Vegetation clearing and conventional earthworks will be the primary action required during construction.<br>As stated previously, the location of the main accommodation camp may change as part of the detailed design phase to an alternate location within the construction envelope. | Rehabilitated consistent with previous use. | The accommodation camp pad will be rehabilitated following the construction phase. |
| Macleay River pump facility | The pumping facility will be used for the initial filling of the lower reservoir, and for subsequent top ups as required periodically throughout operations. | Duty and backup (standby) pumps will be installed in a below ground pump well or small shed on the east side of the Macleay River. An access road, river intake and power supply will also be implemented. | Permanent infrastructure | The lower reservoir will require periodic top ups. As such, the pump facility will continue to be used sporadically throughout the Project's life. |

### iii Underground works construction area

The underground works construction area encompasses all the subterranean elements of the Project. The waterway tunnels linking the upper and lower reservoirs, the power station complex, and the tunnels used to access them are key components of this construction area.

Tunnelling will be undertaken using either road headers or drill and blast methodologies, or a combination of the two. In general, tunnel excavation is expected to progress at a rate of approximately 6 m/day. This rate may vary and is largely dependent on the geology of the rock being excavated, hydrogeological conditions, and the method of excavation (e.g. drill and blast vs road headers).

As a result of the underground excavations, large volumes of suitable spoil are expected to be generated. Where suitable, spoil will be re-used as a construction material (e.g. aggregate for the construction of concrete structures) and for use within the reservoir dam wall. For spoil that does not meet the required specifications, and for any excess volumes, these will be transported to the designated spoil emplacement areas. The underground works area is displayed in Figure 1.9 with detail on Project elements, purpose, and description provided in Table 1.4.




*Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)*

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KEY

- Project area
- Disturbance footprint
- Construction envelope

Project operational elements

- Underground power station complex
- Tunnels, portals, intakes, shafts
- Permanent road
- Power and communications lines
- Transmission overhead lines
- Surface works
- Reservoir
- Dam wall

Existing environment

- Watercourse/drainage line
- Kempsey-Armidale Road
- NPWS reserve

Label format

SURFACE PERMANENT INFRASTRUCTURE

UNDERGROUND PERMANENT INFRASTRUCTURE

# Underground works construction area

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.9

EMM creating opportunities

**Table 1.4 Underground works construction area – Project elements, purpose, and description**

| Element | Purpose | Method summary – during construction | Final land use | Long-term use |
|---|---|---|---|---|
| MAT1 | The MAT1 will provide the primary access to the underground power station complex. The MAT1 will be approximately 1,862 m in length, with a D-shaped profile and diameter of around 8 m. During construction, the MAT1 will be the key route used for transporting spoil from the cavern and other tunnels during excavation. | A combination of drill and blast and road headers may be used during the excavation of the MAT1. | N/A (underground) | The tunnel will be retained permanently to enable access to the underground power station complex. This will be necessary for on-going operational and maintenance purposes. |
| MAT2 | The MAT2 bifurcates off from MAT1 to provide direct access to the transformer hall. This tunnel will be approximately 408 m long and will have the same cross-sectional dimensions as the MAT. | A combination of drill and blast and road headers may be used during the excavation of the MAT2. | N/A (underground) | The tunnel will be continually used for maintenance and operational purposes, particularly related to transformer hall maintenance. |
| Machine hall and -transformer hall egress tunnel | This tunnel is approximately 106 m long tunnel that connects the southern side of the power station cavern to the southern side of the transformer hall. It will have a D-shaped cross section with a diameter of 4 m. | A combination of drill and blast and road headers may be used during the excavation of the machine hall-transformer hall egress tunnel. | N/A (underground) | The tunnel will be continually used for maintenance and operational purposes. |
| ECVT | The ECVT will connect the switchyard portal and the northern end of the power station cavern. It will allow ventilation of the caverns, the laying of cables between the switchgear building and the transformer hall, and an additional exit route. Its profile will be D-shaped with a diameter of 7 m. | A combination of drill and blast and road headers may be used during the excavation of the ECVT tunnel. | N/A (underground) | The tunnel will be continually used for maintenance and operational purposes. |
| Underground power station complex | The power station complex houses the main mechanical and electrical equipment of the power station, including the turbines and generators.<br>The power station complex consists of a machine hall that houses the generator units and a transformer hall. | The power station complex will be excavated using a combination of drill and blast and road headers with the current design having a total excavated volume of around 154,000 $m^3$. This volume may change with detailed design refinement.<br>Excavated material will be transported to the surface via the MAT and tailrace tunnels. | N/A (underground) | Accessible via the MAT, the power station complex will remain in use for the duration of the operation of the Project. |

### Table 1.4 Underground works construction area – Project elements, purpose, and description

| Element | Purpose | Method summary – during construction | Final land use | Long-term use |
|---|---|---|---|---|
| Tailrace surge shaft ventilation tunnel | This tunnel will provide permanent access and services to the top of the downstream tailrace surge shaft. It will be approximately 600 m long and will have a D-shaped cross section with a diameter of around 6 m. | Drill and blast or road headers may be used during the excavation of the tailrace surge shaft ventilation tunnel. | N/A (underground) | The tunnel will be used continually for maintenance and operational purposes. |
| Pressure shaft | The pressure shaft vertically connects the upper reservoir to the high pressure headrace tunnel. The current design has a pressure shaft internal diameter of around 5.1 m to limit the maximum flow into the generation units. | The pressure shaft tunnel will be constructed using raise-bore construction methodology in order to accommodate its vertical orientation. | N/A (underground) | The pressure shaft will support operation of the power station throughout the Project's life. |
| High pressure headrace tunnel | The high-pressure headrace tunnel connects the base of the pressure shaft to the penstock tunnels. This tunnel will be lined with concrete and steel as required. | A combination of drill and blast and road headers may be used during the excavation of the high-pressure tunnel. | N/A (underground) | The high-pressure tunnel will support operation of the power station throughout the Project's life. |
| Penstock tunnels | The penstock tunnels split the flow for each of the machine units in the power station. The current design has penstocks being steel-lined and with diameters of between 2.2 m and 2.7 m. The design of these penstocks may change with design refinement. | A combination of drill and blast and road headers may be used during the excavation of the penstock tunnels.<br>Access to excavate the penstock tunnels will be via the headrace construction adit. | N/A (underground) | The penstock tunnels will support operation of the power station throughout the Project's life. |
| Draft tube tunnels | The draft tube tunnels are used to convey water from each of the machines during generation mode and allow convergence into the single tailrace tunnel. They also act to divide the flow into streams to supply each machine during pumping mode.<br>The current design has draft tube tunnels steel lined, with a diameter of around 3.3 m and a length of approximately 95 m. The design of the draft tube tunnels may change with design refinement. | Access for excavation to the draft tube tunnels will be via the tailrace tunnel. The final 10 to 20 m will be excavated from the power station cavern.<br>A combination of drill and blast and road headers may be used during the excavation of the draft tube tunnels. | N/A (underground) | The draft tube tunnels will support operation of the power station throughout the Project's life. |
| Tailrace surge shaft | The tailrace surge shaft is a vertical shaft located on the lower reservoir side of the underground power station complex. The tailrace surge shaft improves the hydraulic system stability of the tailrace tunnel. | The tailrace surge shaft will be constructed using raise-bore construction methodology in order to accommodate its vertical orientation. | N/A (underground) | The tailrace surge shaft will support operation of the power station throughout the Project's life. |

**Table 1.4 Underground works construction area – Project elements, purpose, and description**

| Element | Purpose | Method summary – during construction | Final land use | Long-term use |
|---|---|---|---|---|
| Tailrace tunnel | The tailrace tunnel conveys water between the draft tube tunnels to the lower reservoir during generation and pumping modes. The current design has a diameter of around 5.1 m.<br>In addition to its use as a watercourse during the Project's operational phase, it will be used to transport spoil during the excavation process. | It will be constructed early in the construction programme via the lower intake portal. A combination of drill and blast and road headers may be used during the excavation of the tailrace tunnel. | N/A (underground) | The tailrace tunnel will support operation of the power station throughout the Project's life. |
| Various adits | Five adits will be excavated and will provide access to the pressure shaft, the penstocks, the tailrace surge shaft, the machine hall, and the tailrace during construction. The current design has adits between 159 m and 268 m in length. | A combination of drill and blast and road headers may be used during the excavation of the various adit tunnels | N/A (underground) | The machine hall adit will continue to be used to route the power station ventilation ducts. All other adits will be closed with concrete plugs at the tunnel end. |

### iv Access roads construction area

Access roads will be constructed throughout the Project area to enable safe transportation of workers, visitors, materials, equipment and deliveries across the Project construction areas. The Project area will primarily be accessed via the EAR and Main Access Road. The EAR will run approximately parallel to the Macleay River, connecting the Kempsey-Armidale Road in the eastern part of the Project area. A component of this road will be bridges across the Macleay River and Carrolls Creek near its confluence with the Macleay River. Once at Georges Junction, the EAR connects to the Main Access Road which then provides access to the main construction and generation areas of the Project. A number of short transmission spur roads run off the Main Access Road to provide access to the transmission tower sites within the southern transmission construction area.

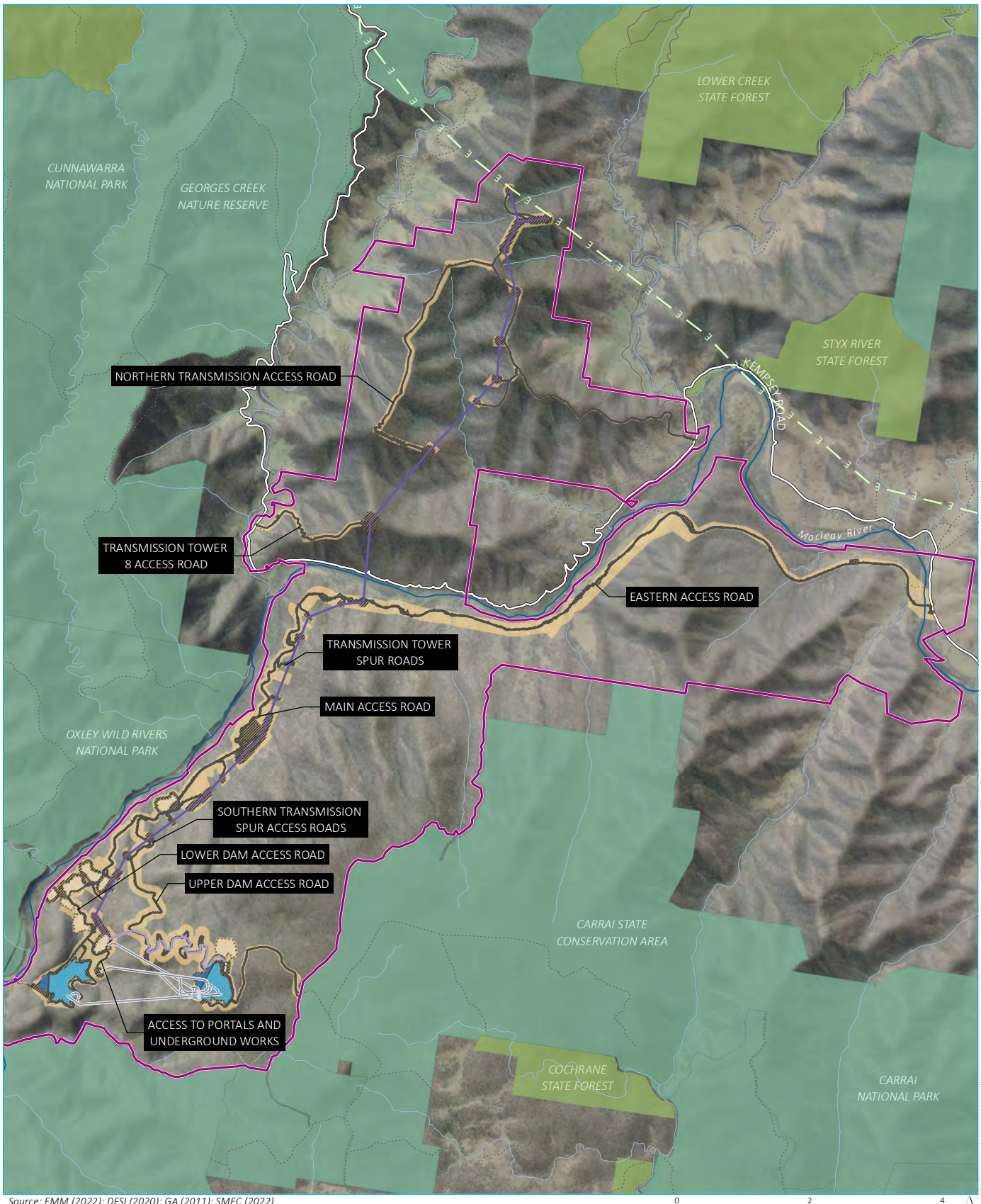
Two other access roads originating from the Kempsey Armidale Road will be constructed, the Northern Transmission Access Road and Transmission Tower Site 8 Access Road, both of which will build upon existing trails north of the Macleay River to facilitate the construction and maintenance of transmission line towers in the northern transmission construction area.

An emergency egress road will be established from the upper dam and reservoir to link with existing fire trails in the Carrai State Conservation Area. This trail will utilise an existing access track and would be used for emergency egress in the case of a bushfire or flooding or the like. The road could also be used by NPWS and RFS fire crews to access the Project area for bushfire purposes.

The location of all planned roads is shown in Figure 1.11.

In general, the roads will be unsealed or gravel, have widths of around 8.0 m, allow for two-way movements and varying speed limits of up to 50 km/h. Table 1.5 provides an overview of the access roads that are proposed across the Project area.

Temporary or fly camps may be required for the construction workforce prior to the construction and operation of the main accommodation camps. The location and size of these camps, which are likely to be close to the access road construction area, will be documented during the detailed design phase.

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*Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)*

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## KEY

- Project area
- Disturbance footprint
- Construction envelope
- Surface works

Project operational elements

- Underground power station complex
- Tunnels, portals, intakes, shafts
- Power and communications lines
- Transmission overhead lines
- Permanent road
- Reservoir
- Dam wall

Existing environment

- Macleay River
- Watercourse/drainage line
- Kempsey-Armidale Road
- Minor road
- Vehicular track
- Existing transmission line
- NPWS reserve
- State forest

Label format

SURFACE PERMANENT INFRASTRUCTURE

# Access roads construction area

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.10

EMM creating opportunities

**Table 1.5 Roads construction area – Project elements, purpose, and description**

| Element | Purpose | Method summary – during construction | Rehabilitated to previous use | Long-term use |
|---|---|---|---|---|
| EAR | Provides primary access to generation related construction areas of the Project from the existing Kempsey Armidale Road. | The EAR will be a two-lane, unsealed road with a length of approximately 12 km.<br>A new low-level bridge of up to two lanes over the Macleay River and Carrolls Creek forms part of the EAR.<br>A temporary bridge may be utilised prior to the construction of the permanent bridge. | Permanent infrastructure | The EAR will be used and maintained on an ongoing basis throughout the life of the Project. |
| Main Access Road | The Main Access Road links the EAR to lower generation site. The Main Access Road originates near George's Junction and continues south before connecting with the Upper and Lower Dam Access roads. It will include spurs to allow access to nearby transmission line towers. | The Main Access Road will be around 4.7 km long, with a nominal pavement depth of 400 mm. It will consist of two lanes. | Permanent infrastructure | The Main Access Road will be used and maintained on an ongoing basis throughout the life of the Project. |
| Lower Dam Access Road | The Lower Dam Access Road travels south-west through the lower dam and reservoir construction area. At its endpoint it meets the lower reservoir access track, which continues to the lower intake, spillway, river pumping facility and left abutment. | The Lower Dam Access Road will be around 3.6 km long, with a nominal pavement depth of 400 mm. It will consist of two lanes. | Permanent infrastructure | The Lower Dam Access Road will be used and maintained on an ongoing basis throughout the life of the Project. |
| Upper Dam Access Road | Branching off from the Main Access Road, the Upper Dam Access Road will connect to the upper dam and reservoir. It will support all construction activities in the upper reservoir construction area, including spoil haulage. The road will include spurs to allow access to nearby transmission and communication line towers and various other construction areas. | The Upper Dam Access Road will be around 7.1 km long, with a nominal pavement depth of 400 mm. It will consist of two lanes. | Permanent infrastructure | The Upper Dam Access Road will be used and maintained on an ongoing basis throughout the life of the Project. |

**Table 1.5 Roads construction area – Project elements, purpose, and description**

| Element | Purpose | Method summary – during construction | Rehabilitated to previous use | Long-term use |
|---|---|---|---|---|
| Northern Transmission Access Road | The Northern Transmission Access Road provides access to the northern section of the transmission connection works. The road will connect to the Kempsey-Armidale Road via a new intersection near Lower Creek and provide access to tower sites 1, 26 and 2 through to 7. | The Northern Transmission Access Road will be around 15 km long and will be unsealed roads. A large portion of this road will be established by widening and upgrades to existing fire trails. | Permanent infrastructure | The Northern Transmission Access Road will be used and maintained on an ongoing basis throughout the life of the Project. |
| Transmission Tower Site 8 Access Road | The Transmission Tower Site 8 Access Road provides access to the northern section of the transmission connection works. The road will connect to the Kempsey Armidale Road via a new intersection north of George's Junction and provide access to tower site 8. | The Transmission Tower Site 8 Access Road will be around 2.3 km long and will be unsealed. | Permanent infrastructure | The Transmission Tower Site 8 Access Road will be used and maintained on an ongoing basis throughout the life of the Project. |
| MAT Portal Road | The MAT Portal Road will split from the Lower Dam Access Road before passing by the switchyard, ECVT portal, and the MAT portal. It will provide permanent access, and support construction of the underground works around the underground power station complex. | The MAT Portal Road will be around 1 km long, and will have a nominal pavement depth of 400 mm. It will consist of two lanes. | Permanent infrastructure | The MAT Portal Road will be use and maintained on an ongoing basis throughout the life of the Project. |
| Access tracks upgrades | Existing trails will be used to gain access to parts of the Project area, particularly around the transmission connection works on the northern side of the Macleay River. Upgrades to these may be necessary to ensure they are sufficiently safe. | Widening, resurfacing and improving drainage are the primary actions that will be undertaken. | Temporary infrastructure | Access tracks will be maintained on an ongoing basis. Any tracks that are not required as part of the Project's operations will be rehabilitated. |
| Emergency egress road | To provide emergency egress to the Carrai area fire trails should the lower part of the Project area be restricted. | Two lane unsealed road from upper reservoir to Project area boundary where it adjoins existing road. | Permanent infrastructure | The egress road will remain in place and continue to be utilised throughout the duration of the Project's life. |

**Table 1.5 Roads construction area – Project elements, purpose, and description**

| Element | Purpose | Method summary – during construction | Rehabilitated to previous use | Long-term use |
|---|---|---|---|---|
| Additional access tracks | Extensions to existing trails may be necessary in some places including:<br>• construction of new sections, particularly around spur access to the southern transmission connection works<br>• additional trails to provide access to specific construction areas<br>• the provision of safe egress from the Project area (for example, from the upper reservoir site to existing fire trails within adjacent national parks). | The extension and construction of access tracks will require vegetation clearing, surface grading and resurfacing. | Permanent infrastructure | Access tracks will be maintained on an ongoing basis. |

### v Transmission infrastructure construction area

The underground power station complex will be connected to the electricity grid by high-voltage transmission lines connecting the power station complex to TransGrid Line 965, located towards the northern end of the Project area. The transmission lines will consist of up to a double-circuit 330 kV line and a single circuit 132 kV line within the same transmission corridor. The transmission infrastructure will comprise of the lines, towers, as well as a substation.

The transmission easement will run north from the switchyard near the ECVT portal, approximately parallel to the Main Access Road, before crossing the Macleay River east of Georges Junction and continuing north to TransGrid Line 965. Up to 25 transmission tower sites will accommodate the dual 132 kV and 330 kV infrastructure and will be positioned near roads wherever possible to minimise impacts associated with their construction and maintenance. Tower site 1A will accommodate only 330 kV infrastructure while tower site 1B will only accommodate 132 kV infrastructure.

A series of distribution poles will be installed between the upper and lower dams and reservoirs to allow electricity and communications lines to be provided to facilities located at the upper dam and reservoir. The voltage carried will be low, and as such the poles will have a small profile that will allow them to predominantly remain within the disturbance footprint associated with the Upper Dam Access Road.

The transmission infrastructure area is represented in Figure 1.11 and Figure 1.12 (north and south of the Macleay River respectively) with detail on Project elements, purpose, and description provided in Table 1.6. Figure 1.13 provides an example of the infrastructure to be located at the transmission tower sites.


Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

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## KEY

- Project area
- Disturbance footprint
- Construction envelope
- Surface works

Project operational elements

- Power pole
- Transmission site
- Northern transmission overhead line
- Southern transmission overheadline
- Power and communications lines
- Underground power station complex
- Tunnels, portals, intakes, shafts
- Permanent road
- Reservoir
- Dam wall

Existing environment

- Macleay River
- Watercourse/drainage line
- Kempsey-Armidale Road
- Vehicular track
- NPWS reserve

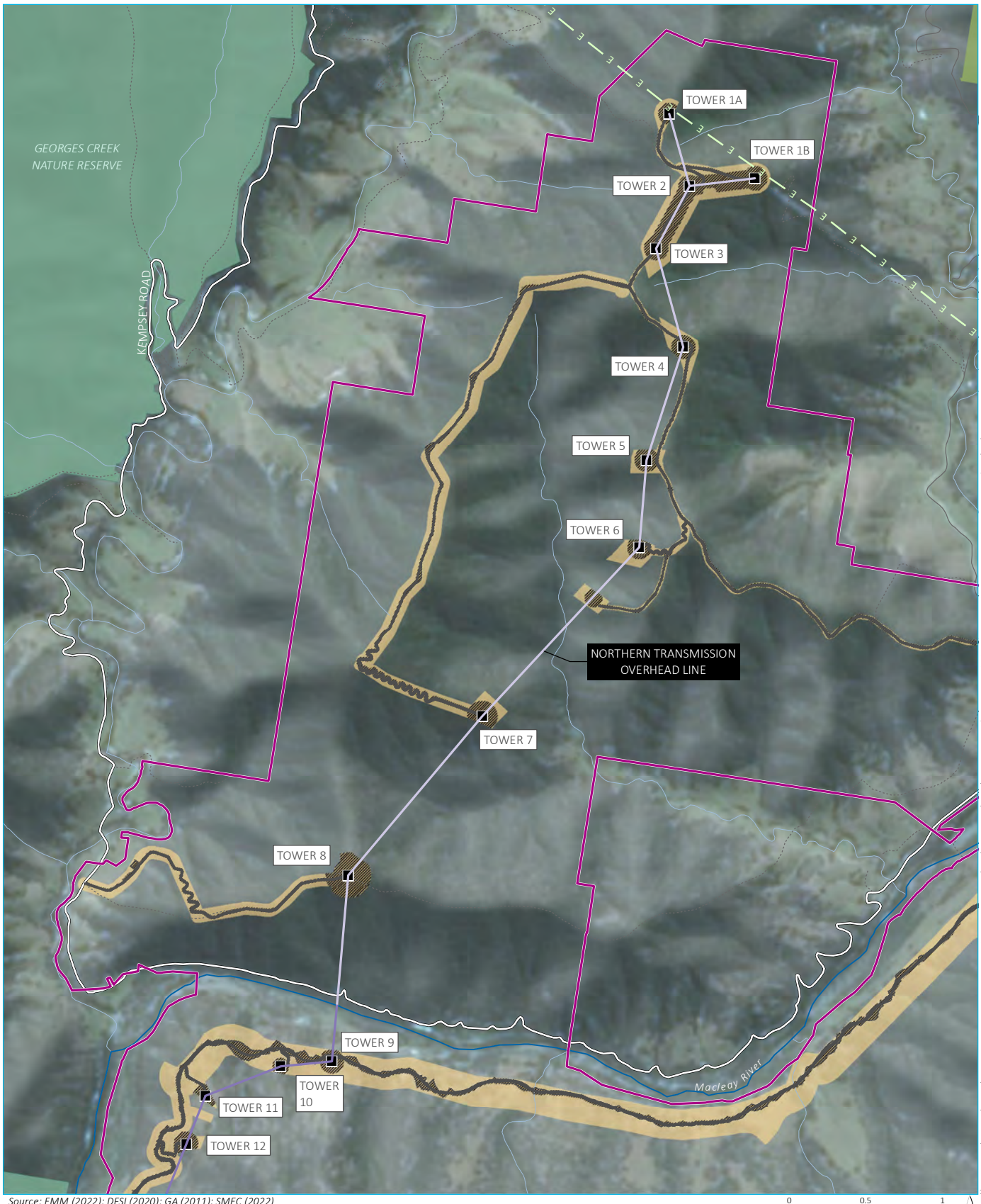
Label format

SURFACE PERMANENT INFRASTRUCTURE

Southern transmission construction area

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.11

EMM creating opportunities




*Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)*

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KEY

- Project area
- Disturbance footprint
- Construction envelope

Project operational elements

- Transmission site
- Northern transmission overhead line
- Southern transmission overhead line
- Permanent road

Existing environment

- Macleay River
- Watercourse/drainage line
- Kempsey-Armidale Road
- Minor road
- Vehicular track
- Existing transmission line
- NPWS reserve
- State forest

Label format

SURFACE PERMANENT INFRASTRUCTURE

# Northern transmission construction area

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.12

EMM creating opportunities

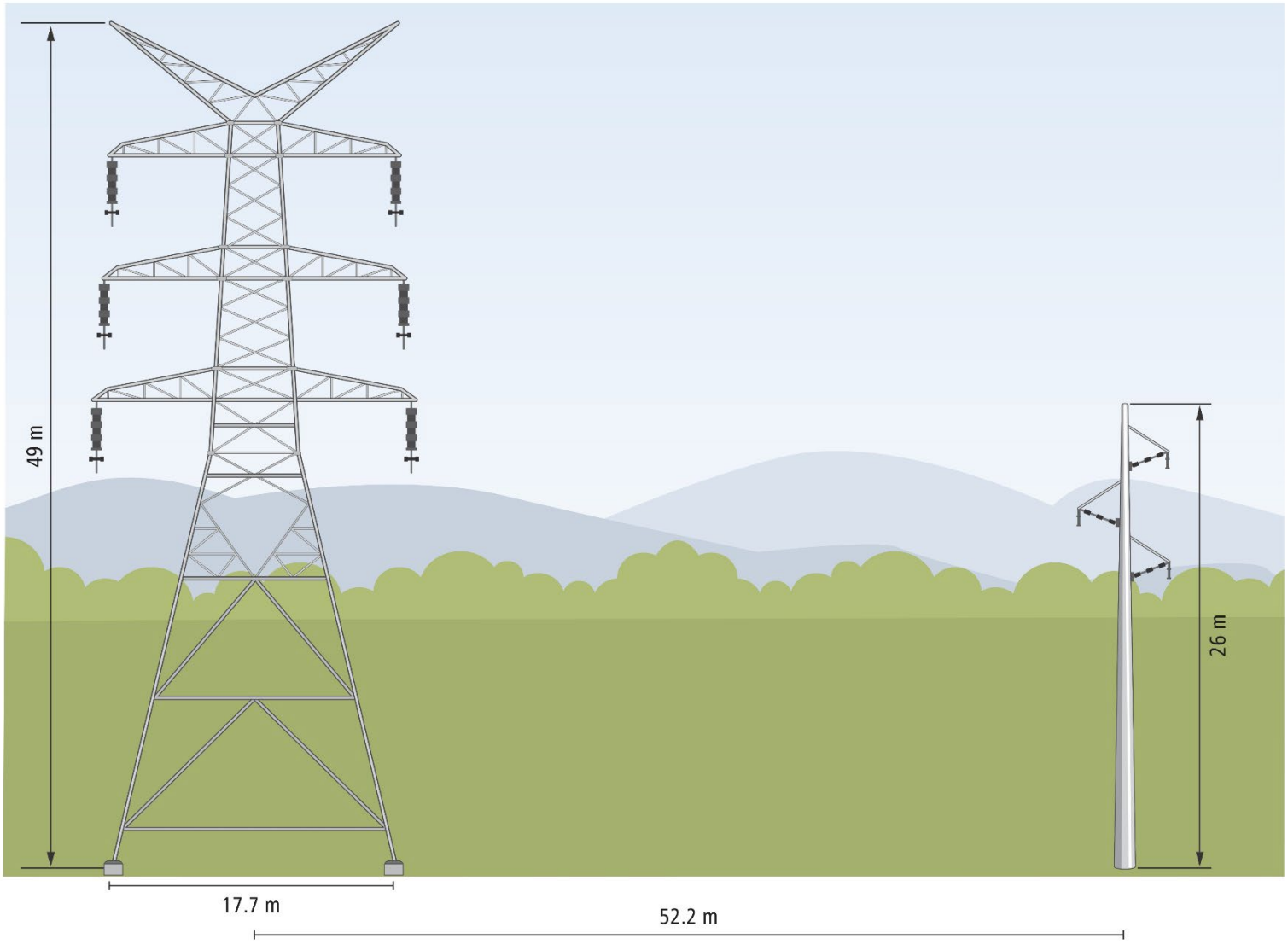



**Figure 1.13 Illustration of transmission infrastructure**

**Table 1.6 Transmission infrastructure construction area – Project elements, purpose, and description**

| Element | Purpose | Method summary – during construction | Rehabilitated to previous use | Long-term use |
|---|---|---|---|---|
| Transmission easement | The transmission easement relates to the portion of disturbance footprint that is required to support the construction and operation of the transmission towers and overhead lines. The proposed width of the transmission easement is a maximum of 105 m. | Vegetation clearing and trimming will only be undertaken at certain locations across the length of the easement as required. The transmission easement has been sited to reduce vegetation clearing to the smallest area necessary to establish the transmission easement. | Permanent infrastructure | The transmission easement is integral to the operation of the Project and will be used throughout the Project's life. Vegetation maintenance in the corridor will be regularly undertaken. |
| Transmission towers and overhead lines | Transmission towers and overhead lines will connect the power station to the existing power network. It will consist of up to a double-circuit 330 kV line, and a single circuit 132 kV line located side-by-side within the transmission easement.<br>The 330 kV transmission towers will likely be steel lattice towers. The 132 kV transmission towers will likely be steel or concrete monopoles. Both are subject to detailed design. | The transmission towers for the 132 and 330 kV lines will be constructed within the 25 transmission tower sites situated along the length of the transmission corridor. | Permanent infrastructure | The transmission towers and overhead lines are integral to the operation of the Project and will be used throughout the Project's life. |
| Substation | The substation supports the connection to the existing power network at TransGrid Line 965. The substation will have a capacity of up to 330 kV and will also include ancillary connection infrastructure as required. | Vegetation will be cleared, and a foundation to support the new substation will be established. | Permanent infrastructure | The substation is an integral part of the operation of the Project and will be used throughout the Project's life. |
| TransGrid Line 965 and 132 kV connection point | The 132 kV transmission line splits from a dual line configuration at tower 2 and connects to TransGrid Line 965 at tower 1B. | Vegetation will be cleared, and a foundation to support. This connection will be terminated but kept in situ for back-up purposes once TransGrid Line 965 is upgraded to support the 330 kV connection. | Permanent infrastructure | The transmission towers and overhead lines are integral to the operation of the Project and will be used throughout the Project's life. |
| TransGrid Line 965 and 330 kV connection point | The Project 330 kV transmission splits from a dual line configuration at tower 2 and connects to TransGrid Line 965 at tower 1A. | This connection will not be undertaken until TransGrid Line 965 is upgraded to support the 330 kV connection. | Permanent infrastructure | The transmission towers and overhead lines are integral to the operation of the Project and will be used throughout the Project's life. |

### 1.3.2 Construction phases and activities

The construction of the Project has numerous overlapping phases and stages during the approximate 4–5 year construction period. The planned Project phases and stages are shown in Figure 1.14 and outlined in Table 1.7. Detailed design will be undertaken prior to construction commencing. These phases and stages are indicative only and would be subject to change as the detailed design and construction planning progresses.

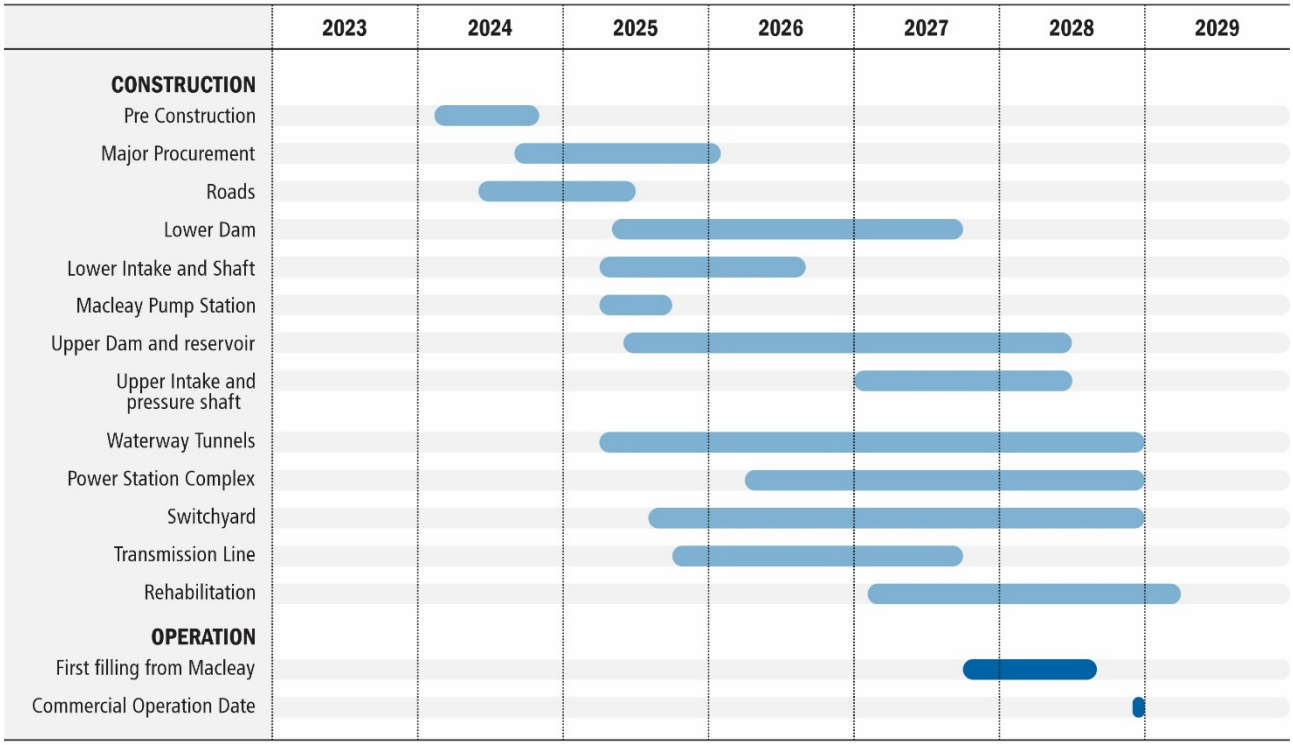



**Figure 1.14 Project timing and sequencing**

**Table 1.7 Overview of Project phases, stages, and sequencing**

| Project phase | Project stage | Sub-stage | Typical activities | Indicative timeline |
|---|---|---|---|---|
| Construction | Pre-construction | Investigation and surveying | Prior to the commencement of any construction works, the disturbance footprint will be assessed, surveyed and defined.<br>Ongoing environmental investigations will include archaeological, heritage and ecological surveys of the area, as required.<br>Soil sampling and geotechnical investigations as required within the disturbance footprint. | 2023–2024 |
| | | Design | This is an approximate two-year phase that involves the detailed design of civil, mechanical and electrical design components. The design phase forms the basis of the Project and detail will increase with each iteration. | 2024–2025 |
| | | Management plans and secondary approvals | Includes developing and obtaining:<br>• environmental management plans as required<br>• secondary consents and permits (e.g. road openings, traffic permits, etc.)<br>• HSE permits and documentation (e.g. emergency response plans, drug and alcohol policies etc.)<br>• construction related permits (e.g. dial-before-you dig, building approvals for key components if required etc.). | 2024–2025 |
| | | Installation of environmental mitigation measures | Prior to the commencement of construction works, a number of mitigation measures will be installed, including:<br>• erection of site fencing, where required, to delineate the construction boundary and provide security and safety<br>• installation of sediment and erosion control measures, and in particular surrounding stockpile and soil emplacement areas.<br>This phase will also involve the establishment of feasible environmental management and monitoring measures as identified throughout the EIS process. | 2024–2025 |
| | | Clearing works | Vegetation will be cleared only within the disturbance footprint. | 2024–2026 |

**Table 1.7 Overview of Project phases, stages, and sequencing**

| Project phase | Project stage | Sub-stage | Typical activities | Indicative timeline |
|---|---|---|---|---|
| Construction | Early works | Site preparation | Once vegetation has been cleared, and appropriate mitigation measures have been installed, site preparation activities will take place. Activities will include, but not be limited to, the following:<br>• clearing and grubbing works<br>• earthworks and levelling<br>• upgrade of existing and establishment of new access roads including the EAR and Main Access Road<br>• installation of water and wastewater facilities<br>• establishment of temporary works areas, stockpile and soil emplacement areas<br>• construction of other ancillary facilities required to commence construction, including power supply, temporary or fly camps, main accommodation camp, first aid and medical building, helipad area, bushfire refuge, and garbage areas<br>• establishment of tunnel portals and exploratory tunnels<br>• mobilisation to site<br>• establishment and filling of construction water stores. | 2024–2025 |
| | Staged construction | | Once access roads to the Project have been constructed multiple construction fronts will occur concurrently across the various construction areas throughout the Project area.<br>Construction activities at each construction area will vary depending on the infrastructure and asset being constructed at each location.<br>Extraction of water to fill reservoirs. | 2024–2028 |
| | Testing | | Testing of operating and protection systems will take place towards the end of the construction period. Once everything has been identified to be in full working order, the new power station will complete its final commissioning. | 2028–2029 |
| Operation | Commissioning | | Completion of final commission is planned to occur towards the end of 2028. | 2028 |
| | Operation and maintenance | | Operation and maintenance will be ongoing for the life of the power station. | 2028 and ongoing |
| | Progressive rehabilitation | | Temporary areas of the disturbance footprint, which are not required for operation, will be progressively rehabilitated throughout the construction and operation stages of the Project. | 2027–2029 |

Various activities and methodologies will be utilised to enable the construction of the Project. Due to the nature of the Project, construction activities will occur as both surface works and below ground excavation works. The above ground surface works primarily involves conventional earth works associated with the establishment of the various pieces of Project infrastructure, including access roads, dams, and tunnel portals. The underground construction works primarily involves the tunnelling and excavation works for power station caverns, access tunnels and power waterways.

It should be noted that these phases are not sequential and that the detailed construction phasing will be confirmed in the staging report to be prepared during Project delivery.

Some of the key construction related activities are described in further detail below.

### i Pre-construction activities

During the initial phase of Project implementation and prior to commencing the detailed construction site activities, a range of activities will be undertaken by the Project team as described in the table above. It includes an early works program for undertaking additional investigations and surveys where required, completion of detailed design, preparation of environmental management plans, obtaining secondary approvals, installation of environmental mitigation measures and controls and clearing works.

### ii Site establishment

The site establishment activities may vary slightly between construction areas, however, will generally consist of the following activities:

- construction of site access roads
- detailed site survey and demarcation
- clearing and grubbing of vegetation
- establishment of erosion and sediment (ERSED) controls
- site intrusive and non-intrusive testing
- establishment of site utilities including power, water, communications and waste facilities
- establishment of site offices and compounds
- the establishment of any temporary access as required.

These pre-construction and site establishment activities will support the construction activities and methodologies that will be required to construct the key elements of the Project.

### iii Vegetation clearing and trimming

To enable construction works to commence, clearing of vegetation will be required within the Project's disturbance footprint. From a vegetation clearance perspective, particular sections of the footprint will be cleared to allow for the construction of permanent assets to be built, whilst other areas of the disturbance footprint will be cleared to house temporary components of the Project. The areas that are temporary and only required to support the construction phase of the Project will be progressively rehabilitated when they are no longer required.

As part of the transmission connection works, vegetation clearing and trimming will be required along some sections of the alignment of the transmission lines and clearing around each tower location. Vegetation will be trimmed in a manner that allows for sag in the transmission lines, whilst also providing a buffer as required to prevent future ignition of fires or other safety considerations. Vegetation clearance is generally lower where line is strung between ridges.

Once operational, vegetation will require regular trimming and maintenance around all permanent infrastructure to ensure that safe operating distances are maintained during the operation of the Project.

### iv Earthworks

Conventional earthworks and earth moving activities will be required for the construction of new access roads, bridges, the establishment of site pads, installation of plant and equipment and the installation of utilities across the site. Equipment utilised for earthwork activities will include excavators, bobcats, bulldozers, backhoes, articulated dump trucks, rollers and graders. Additional equipment including fuel trucks and water tankers may also be used to facilitate the plant operations across the site.

As a general overarching principle, design of pads and roads will aim to optimise the cut and fill balance of all earthworks Project wide. This will optimise re-use opportunities and reduce the need to dispose of excess material. If suitable material cannot be sourced across the construction envelope, materials may need to be imported to site for use within the construction of the roads and dam structures.

### v Tunnelling

To construct the required underground components, tunnels will need to be excavated. It is proposed that the bulk of the underground excavation will be completed via full-face excavations utilising a drill and blast methodology, supported by tunnel wheel jumbo drillers. Road headers may also be used to support excavation of the underground components while raised bore excavation methodology is proposed to be used for drilling of vertical tunnels and shafts.

Underground infrastructure including power waterways, access tunnels, power station and transformer caverns and tunnel adits will be excavated using a combination of tunnelling methods. The tunnels will be augmented with tunnel support, consisting of shotcrete, steel fibre reinforced concrete, rock bolts and full-bond rock bolts with cement mortar where required. Components of the headrace and penstock tunnels are likely to be lined with steel.

The pressure shaft will be constructed using a different tunnelling methodology due to its vertical orientation. It will be constructed using a raise bore technique, which will require access to both the top and bottom of the shaft to facilitate the disposal of the excavated spoil.

### vi Cavern excavating

Subject to detailed design, the excavation of the caverns will likely differ slightly from the methodology used for tunnelling. The proposed construction sequence will involve:

- top heading, long drive
- side drives
- crown support
- crane beam construction and anchoring
- bulk excavation to bottom of cavern including side wall support as required through a central slot excavation followed by edge strip excavation.

Mucking shafts will be employed to allow spoil removal to be undertaken independently of excavation and blasting activities. Conjoining tunnels will be met with excavation from the cavern side to ensure that no damage is done to the cavern.

#### vii Quarrying

Quarrying activities will be undertaken upstream within the footprints of the upper and lower reservoirs. Quarried material will be used to provide rockfill for the dams, road base and concrete aggregate, if deemed suitable, while also increasing the capacity of the reservoirs. The quarrying practices will consist of the removal of vegetation and the excavation of unsuitable material, followed by the excavation of competent bedrock through drill and blast using a benching methodology.

#### viii Dam construction

The general dam construction process is expected to consist of eight distinct steps, these being:

- mobilisation and stripping of the site
- the construction of diversion works
- the excavation of the creek bed for dam foundations and abutments following the completion of the coffer dams
- consolidation and curtain grouting, the placement of concrete plinth and cut-off walls
- the excavation, crushing and placement of rockfill for the dam body
- the installation of the concrete face to interface with the concrete plinth
- the construction of stilling basin, crest, and spillway walls and installation of outlet infrastructure to the river diversion works
- the initial filling of reservoirs.

Upstream and downstream cofferdams will be constructed abutting the diversion conduit to floodproof the dam construction sites. Once the dams are completed the diversion conduit upstream bulkhead will be closed which will result in reservoir impoundment.

The rate of dam construction will be dependent upon the rate of rockfill placement, with total completion expected to take approximately three years, including reservoir excavation.

### 1.3.3 Permanent infrastructure

This section describes in further detail the permanent infrastructure that will remain post construction to operate the Project. The permanent infrastructure has been designed and situated to minimise or mitigate impacts.

The following key Project elements are proposed to be constructed as permanent infrastructure.

### i Macleay River pumping facility

The Macleay River pump facility will be used for the initial filling of the lower reservoir, as well as supplying water for use supporting the construction activities of the Project. Water extraction and pumping will be managed through a Specific Purpose Access Licence (SPAL) issued under the NSW *Water Management Act 2000* (WM Act). Over a period of months, up to 6.5 GL of water from the Macleay River will be extracted during high flow periods to the nearby lower reservoir using pumps. The Surface Water assessment (Appendix M) has assessed there will be minimal impacts on the Macleay River ecosystem and downstream water users as water will only be pumped when the Macleay River's stream value is above the 50$^{th}$ percentile which means that the river flow cannot drop below 597 ML/day as a result of pumping. A maximum extraction rate of 86.4 ML/day can be extracted with the full amount extracted only when the river's flow is above 683.4 ML/day. The time that the initial fill will take will be highly dependent upon hydrological conditions in Macleay River at the time and is expected to take from 6 to 9 months in a typical year.

Once the initial filling of the lower reservoir is complete, the pumping station and its access road will remain as permanent infrastructure so that it can be utilised for periodical top-up of the reservoir. While on average, surface water inflows will compensate for seepage and evaporation water loss, there may be infrequent occasions where a top-up is required to be sourced from the Macleay River. This will occur on a similar high flow basis as the initial fill and will be limited to 1.0 $m^3/s$.

The majority of the pumping infrastructure will be underground with only the top of the structure likely visible from the surface including an access road for maintenance. To minimise potential impacts associated with extracting water from the Macleay River, fish screening is to be installed on pump infrastructure in general accordance with:

- *The practical guide to modern fish-protection screening in Australia* (Boys et al. 2021)
- *Design specifications for fish protection screens in Australia* (Boys 2021).

As several factors require consideration when designing an effective fish-protection screen, OMPS will continue to consult with DPE Water and DPI Fisheries over the fish screen design moving forward and into detailed design to mitigate the potential risks associated with pump operation.

### ii ECVT portal

The ECVT portal serves a variety of purposes, including acting as a connector between the high voltage transmission lines and the cables from the power station complex. It will consist of a cluster of infrastructure that will, subject to detailed design, include the following buildings and equipment:

- building/office, including switchgear and a control room
- cable potheads
- disconnector/earth switches
- capacitive voltage transformer
- surge arrestors
- ECVT ventilation fans to provide air circulation for the tunnels and power complex
- a car park
- backup diesel generators and diesel tanks

- security fences
- a water bore
- permanent water tanks holding raw water and potable water
- firefighting apparatus.

Along with the MAT portal, the ECVT portal is one of only two access points to the subterranean component of the Project. For this reason, it will be a crucial access zone during the construction and ongoing operational phases of the Project.

#### iii MAT portal

The MAT1 portal will serve as the primary point of access for the underground component of the Project. The portal will consist of an entry into the main access tunnel accompanied by a raw water storage tank and a small service building that will provide administrative services and have first aid supplies on hand.

#### iv Pumped hydro-electric and generation works

The PHGW comprises of the energy storage and power components of the Project. The PHGW will incorporate two water reservoirs at different elevations (an upper and lower dam reservoir) that will generate power as water moves from the upper dam and reservoir to the lower dam and reservoir passing through a turbine, and consume power as water is pumped back into the upper reservoir. The following provides further detail around the components involved in this process. It should be noted that the dimensions stated in this section are based on the feasibility design. Final dimensions and configurations of all Project infrastructure will be optimised and confirmed throughout the detailed design phase of the Project, and therefore amendments will likely be required.

#### a Dams and reservoirs

##### Lower dam and reservoir

The lower dam and reservoir will be established approximately 350 m east of the Macleay River. Figure 1.15 shows the proposed layout of the dam and reservoir. The following are its main components:

- A CFRD on the eastern side.
- Shown below in Figure 1.15, this is the largest component of the lower reservoir. It will be approximately 70 m high and approximately 280 m long. Rockfill for the dam will be partially attained from the quarry to be constructed to the east of the dam within the lower reservoir area. The crest of the dam will be 6 m wide and sit at an elevation of 255 m AHD.
- A concrete lined spillway chute through the left abutment. The spillway will have a capacity of 150 $m^3/s$. It will be 10 m wide at the crest, narrowing down to 5 m in the lower chute. A dissipator structure will be designed to dissipate the energy of the flow before it is discharged back to the creek.
- A concrete lined diversion tunnel beneath the left abutment. The tunnel will have a diameter of 3 m and will contain the long-term outlet facilities for an emergency drawdown of the reservoir.
- A quarry located to the east of the dam within the lower reservoir area. In addition to providing rockfill for the dam wall, the quarry itself will ultimately form the outlet for the tailrace tunnel.

The primary operational function of the lower dam and reservoir is to act as a storage vessel for water. It will collect pumped water from the Macleay River during the initial filling of the reservoir and will hold water to be pumped to the upper reservoir for electricity generation purposes. The Project is a closed-loop system, so minimal additional water will be required once the initial filling of the lower reservoir has occurred.

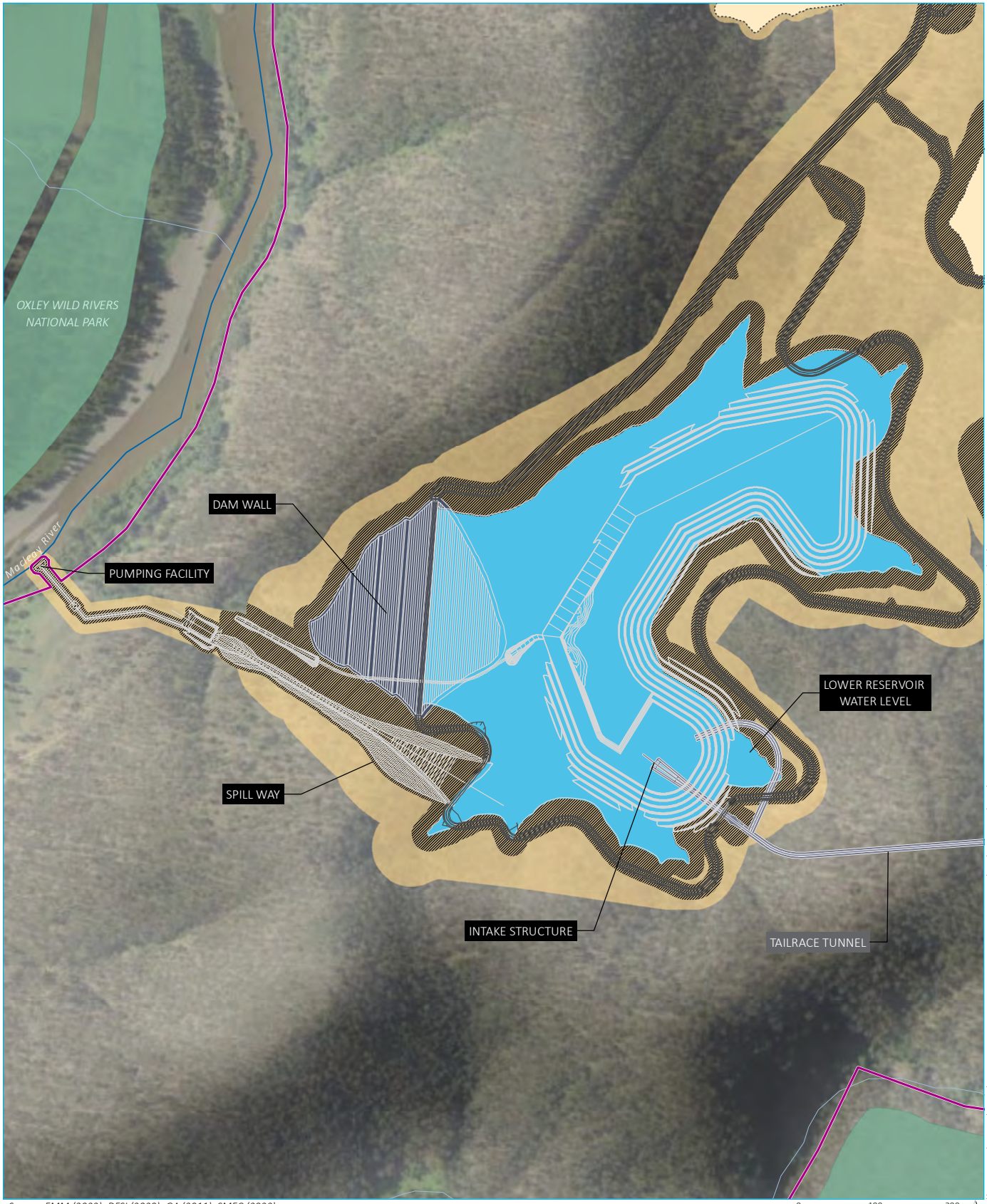
### b Upper dam and reservoir

The site for the upper dam and reservoir was selected due to its favourable geological attributes, vertical elevation and its proximity to the lower dam and reservoir. It will be established to the east of the lower dam and reservoir, approximately 2.7 km from the Macleay River and will sit approximately 650 m higher than the lower reservoir. As shown in Figure 1.16 the main components of the upper dam and reservoir will be:

- an approximately 70 m high and approximately 780 m long CFRD, with crest elevation of 885 m AHD
- a concrete lined spillway chute with a capacity of 75 $m^3/s$, which will discharge into a gully at the southern tip of the dam wall
- a concrete encased diversion conduit, which will be permanently plugged following the construction of the embankment
- a quarry to the east of the dam and within the upper reservoir area which will provide rockfill for the construction of the dam wall and will house the intake structure of the waterway.

Much like the lower dam and reservoir, the upper dam and reservoir's main purpose is to act as a means for water storage. Water is to be held in the upper reservoir after it has been pumped up into it and will be released back into the lower reservoir, converting its potential energy into electricity at the power station complex in the process.

Service buildings and access roads will be present at both the upper and lower reservoir sites for the purpose of monitoring the reservoirs and the associated machinery.




*Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)*

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## KEY

- Project area
- Disturbance footprint
- Construction envelope

Project operational elements

- Dam and reservoir design
- Tunnels, portals, intakes, shafts
- Transmission overhead line
- Permanent road
- Surface works
- Reservoir
- Dam wall

Existing environment

- Macleay River
- Watercourse/drainage line
- Kempsey-Armidale Road
- Existing transmission line
- NPWS reserve

Label format

SURFACE PERMANENT INFRASTRUCTURE

UNDERGROUND PERMANENT INFRASTRUCTURE

# Lower dam and reservoir

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Assessment
OMPS Pty Ltd
Figure 1.15

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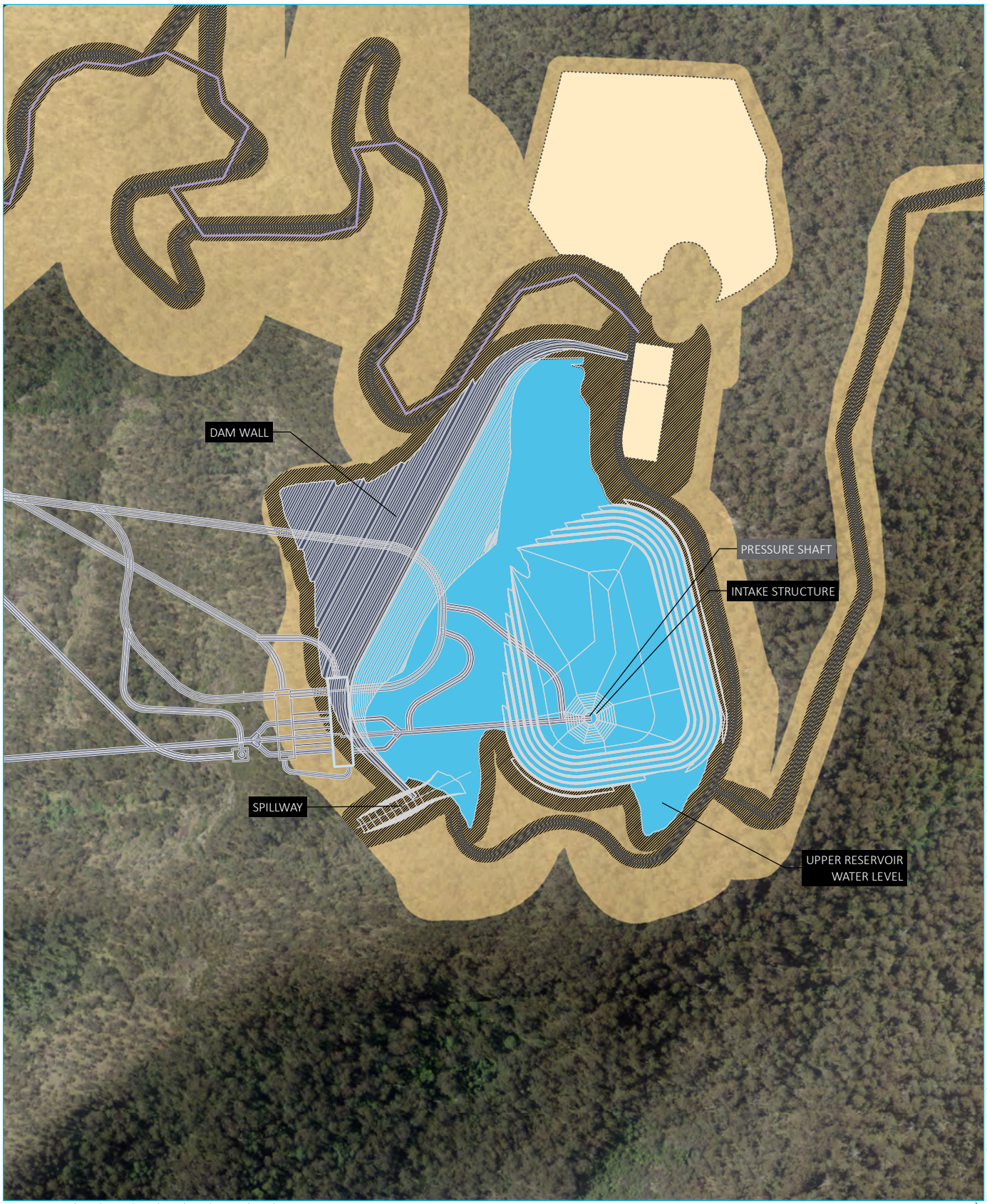


*Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)*

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KEY

- Disturbance footprint
- Construction envelope

Project operational elements

- Underground power station complex
- Dam and reservoir design
- Power and communications lines
- Tunnels, portals, intakes, shafts
- Permanent road
- Surface works
- Reservoir
- Dam wall
- Kempsey-Armidale Road
- Existing transmission line

Label format

SURFACE PERMANENT INFRASTRUCTURE

UNDERGROUND PERMANENT INFRASTRUCTURE

## Upper dam and reservoir

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.16

EMM creating opportunities

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### c Upper intake structure

The upper intake structure will consist of a vertically oriented, octagonal, submerged, reinforced concrete structure embedded within an excavated pit in the upper reservoir. The design of the upper intake structure is typical of a “morning glory” type arrangement. The proposed feasibility design of the structure is displayed in Figure 1.17.

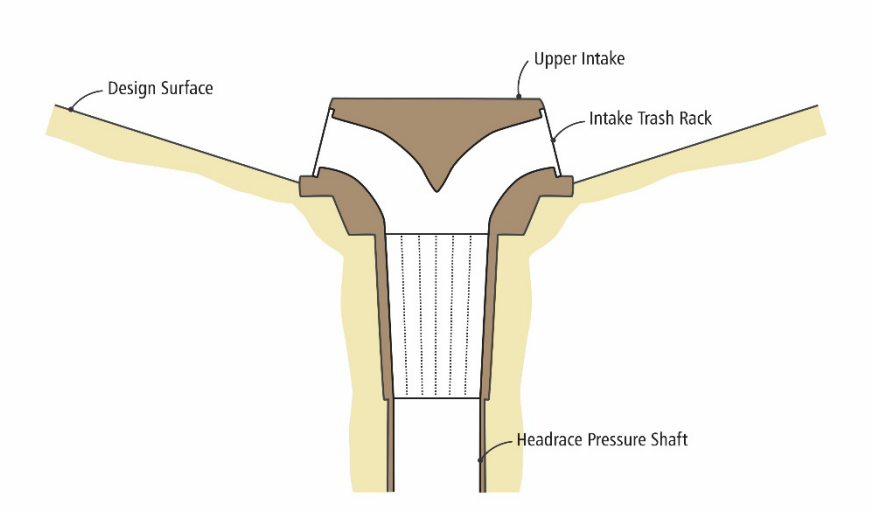



**Figure 1.17 The upper intake structure**

This design has been selected with the goals of minimising headloss, avoiding the formation of vortices, ensuring that water velocity through trashracks is suitable, and ensuring compatibility with the components of the other connected structures. The anticipated average gross velocity of water across the trash racks is expected to be approximately 1 m/s when operating without blockages. The flow will accelerate to an average of around 5 m/s in the headrace shaft with a diameter of approximately 5.1 m.

No headgates will be required for the upper Intake structure, as the upper reservoir can be drained as required for maintenance procedures. Blockage of the trashracks is expected to be of minimal concern due to the frequent reversal of water flow through the structure.

### d Lower intake structure

The orientation of the lower intake will differ to the upper intake structure although the performance objectives are the same. The concrete structure will be embedded into competent rock on the edge of the reservoir, with a sediment trap downstream of the trashrack screen. The style of intake is referred to as a lateral intake, and it features trashracks to avoid debris entrainment, a sediment trap, a flow diffuser to gradually reduce flow velocities approaching the trashrack panels, and a lower gate and gate shaft.

The lower gate shaft will house equipment used for the hydraulic isolation of the lower reservoir, which will consist of a double protection system utilising a gate and stoplogs. As shown in Figure 1.18, the lower gate shaft will connect to the tailrace tunnel at its lower end and reach the surface at an elevation of approximately 256 m, 6 m higher than the lower reservoir full supply level at maximum capacity. This will allow the gate and stoplogs to be operated from the surface, using a permanent hoist and mobile crane respectively.

Similar to the upper intake structure, blockage due to the accumulation of debris in the trashracks is not anticipated to be problematic due to the frequent reversal of flow direction, however the intake structure will be able to continue operating in the event of a partial blockage. The flow rate through the lower intake structure is intended to be less than 2 m/s at maximum flow.

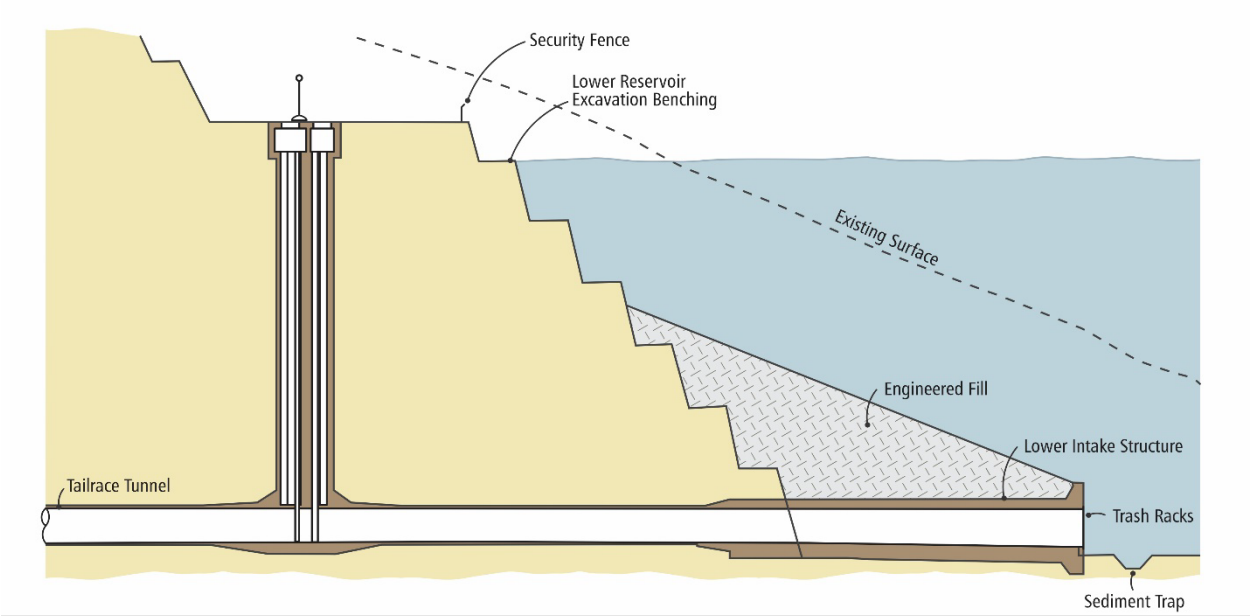



**Figure 1.18 The laterally oriented lower intake structure**

### e Underground power station complex

Central to the operation of the Project is the multi-level underground power station complex. The station has been optimised to be located as far upstream as possible to reduce effects from water hammer. Additional geotechnical investigations may be required to determine its exact location. The cavern complex will house the power station and will be accessible via the MAT1 and ECVT. The key electrical and mechanical components of the Project will be housed in the power station complex, including the turbines, transformers, and generators. Drainage equipment will also be housed here, as the surrounding tunnels will self-drain into the power station.

The power station complex will comprise a machine hall, a transformer hall, and isolated phase busbars (IPBs) between them. The machine hall will sit upstream of the IPBs and the transformer hall and will nominally house three Francis fixed speed pump-turbines. Each turbine unit will have a generating capacity of up to approximately 300 MW. It should be noted that the final configuration and number of pump-turbines will be optimised during the detailed design phase. The power station will be constructed from mass and reinforced concrete and will also contain associated plant facilities required for operating the power station such as the control room and underground amenities. The pump-turbines will operate together to provide a combined nominal power export capacity of up to 900 MW. Overhead cranes for the construction of equipment will be installed in the cavern and will continue along the upstream wall of the MAT and the downstream wall of the transformer hall.

The machine hall is currently designed to comprise seven distinct bays along its 115 m length. These will be:

- A 13 m wide unloading bay, where vehicles will be able to park and utilise the overhead crane for equipment unloading.
- A 22 m wide assembly bay, which will be necessary as the turbines and generators will be transported in parts. The lower levels of the assembly bay will include mechanical and electrical equipment, the switchboard room, air compressors, water chillers, drainage, and the dewatering pit.
- 25 m wide and 20 m long machine bays, which will house the pump-turbine and motor-generator machines and their auxiliary control systems.

- 2 service bays, each spanning seven floors. Service bay 1 will be 8 m wide and will contain the sewage water tank room, emergency dewatering pump panel room, store, cleaners' room, and employee facilities (toilets, change rooms, kitchen and mess rooms). Service bay 2 will be 12 m wide and will contain the control room and offices, communication room, sensitive spare parts store, auxiliary services room and water tanks, ventilation fans, and lift panel on the upper level.

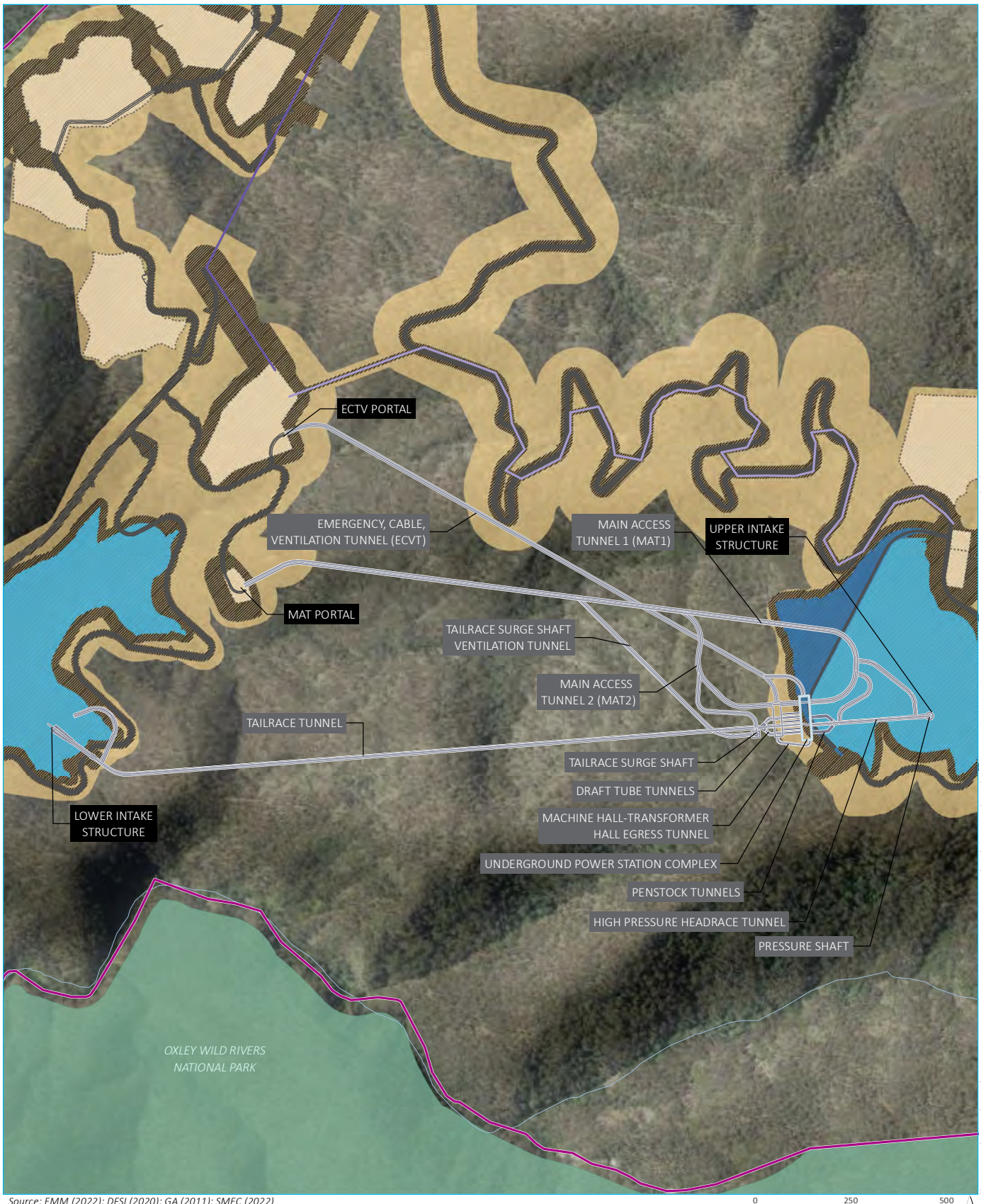
The machine hall will also be divided into levels, accessible via a spiral staircase. Based on the current design, these levels, and their nominal heights (in elevation (EL)), are as follows:

- The drainage gallery floor, approximately 121 m. This floor is an access way to the draft tubes, and also provides access to the station drainage, emergency dewatering pump and dewatering pit, which is located below this floor.
- The main inlet valve floor, approximately 127 m. the main inlet valves and their ancillaries are located on this floor, and it provides access to the draft tube cone and the underside of the turbine runner.
- The mechanical services floor, approximately 128 m. Only marginally elevated above the main inlet valve floor, this floor will house water-cooling systems, water/oil treatment equipment, and a variety of machinery for operating the turbines and the flap gates.
- The turbine floor, approximately 132 m. This is where most of the turbine control equipment will be situated, as well as a mechanical workshop.
- The generator floor, approximately 140 m. The main electrical systems, including the generators and their auxiliary systems will be situated on this level.
- The operating floor, approximately 146 m. This floor is the entrance level for the power station, and will contain the platform for the assembly and maintenance of the pump-turbines and motor-generator. The control room, communications room, cleaner rooms, and sewage water tank will also be situated on this level.
- The amenities floor, approximately 150 m. This floor will include the offices, toilets, kitchens, mess rooms, maintenance offices and sensitive parts store.
- The crane maintenance service floor, approximately 154 m. This floor is where crane maintenance will be undertaken, and it also has the auxiliary tunnel connection to the transformer hall.

During generation mode, water will enter the machine hall from the penstock tunnels via the main inlet valve, pass through the pump-turbines and exit through the downstream draft tube tunnels. The draft tube tunnels will pass beneath the IPBs and the transformer hall. Included within the draft tube will be a flap gate for each of the draft tube tunnels, which will allow each unit to be isolated from the downstream waterway.

Downstream from the machine hall, the transformer hall will house the transformers. The transformers will step up generator voltage to the grid voltage of 330 kV. This will allow the power to be evacuated from underground without electrical losses. The generators and main transformers will be connected via the IPBs, located in the IPB galleries. The IPB galleries will also contain an array of electrical equipment needed between for operation. The ECVT will provide access for the high voltage cables to the above ground switchyard located proximate to the ECVT portal.

The final configuration and number of pump-turbines and generating units will be optimised during the detailed design phase of the Project. These will be dependent on the final generation capacity output of the power station.




*Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)*

0 250 500 m

GDA 1994 MGA Zone 56

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## KEY

- Project area
- Disturbance footprint
- Construction envelope

Project operational elements

- Underground power station complex
- Tunnels, portals, intakes, shafts
- Permanent road
- Power and communications lines
- Transmission overhead lines
- Surface works
- Reservoir
- Dam wall

Existing environment

- Watercourse/drainage line
- Kempsey-Armidale Road
- NPWS reserve

Label format

SURFACE PERMANENT INFRASTRUCTURE

UNDERGROUND PERMANENT INFRASTRUCTURE

# Underground power station complex

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.19

EMM creating opportunities

### v Tunnels

There will be two types of tunnels excavated for the Project, these being access tunnels (MAT and ECVT) and power waterway tunnels. Various adits will be excavated as a part of the construction process, and these will be sealed with concrete plugs prior to the commencement of operations. The power waterway tunnels will transport water between the reservoirs and the power station complex, while the access tunnels provide a route for people and machinery between the surface and the power station complex. The key tunnels are listed below. The design of the tunnels may be refined during the detailed design phase.

#### a MAT1

The MAT1 is an access tunnel that will provide direct access to the power station complex. This tunnel will be the primary access route to the underground component of the Project for most workers and machinery throughout both the construction and operating phases.

The portal for the MAT1 is downstream of the power station complex, and the MAT1 itself has a similar orientation to the tailrace tunnel until it passes the power station complex, whereupon it hooks around to connect to the northern side of the machine hall. It will have a D-shaped profile, be approximately 8 m in diameter and have a total nominal length of 1,862 m. The MAT1 will connect to all the adits and other access tunnels, with the exception of the ECVT and the auxiliary tunnel connection.

The MAT1 connects to the following smaller tunnels:

- the penstock construction adit (191 m long with a 6 m diameter), which will connect to the western side of the headrace tunnel, near the penstocks
- the pressure shaft construction adit (235 m long, 6 m diameter), which will connect to the eastern end of the headrace tunnel, near its junction with the pressure shaft
- the tailrace surge shaft ventilation tunnel (600 m long, 4 m diameter), which provides access to the top of the tailrace surge shaft.

#### b MAT2

An offshoot of the MAT1, the MAT 2 has a steeper gradient and provides direct access to the transformer cavern. It has the same profile as the MAT1 and is approximately 408 m long. This tunnel will also constitute a key access route to the power station complex throughout the life of the Project. It will be connected to the tailrace surge shaft construction adit, which will have a length of 268 m, a diameter of 6 m, and will connect to the eastern end of the tailrace tunnel.

#### c ECVT

The ECVT is the only access tunnel, other than the MAT1, that leads to the surface. It will run directly between the ECVT portal and the transformer cavern. The purpose of the ECVT is to provide a path for electrical cables between the transformers and the switchyard, to allow additional ventilation of the tunnels and power station complex, and to provide a secondary exit route for underground workers in the event of an emergency. The ECVT switchyard will be located at the ECVT portal and will house the necessary structures to support these objectives.

The machine hall construction adit will be connected to the ECVT, a 133 m long tunnel near the end of the ECVT that leads to the machine hall. Unlike other adits, this tunnel will remain open throughout the operation of the Project in order to allow for better ventilation.

### d Machine hall-transformer egress tunnel

This is an approximately 106 m long tunnel with a diameter of 4 m that connects the upper levels of the machine hall and the transformer hall. It is designed predominantly for the movement of people between the underground caverns.

### e Pressure shaft

The pressure shaft is the power waterway tunnel that connects the upper reservoir to the high-pressure headrace tunnel at approximately the elevation of the lower reservoir. It is designed with a vertical orientation to minimise head losses by ensuring that, during generation mode, the length of pipe that the water must pass through before reaching the power station is minimised.

Due to its vertical orientation, the pressure shaft will be excavated using raise-bore technology. It will have a diameter of approximately 5.1 m throughout its length.

### f High pressure headrace tunnel

The high-pressure headrace tunnel will sit between the pressure shaft and the penstocks. It will have a horizontal orientation and be generally lined with steel to resist the high static and dynamic pressures experienced during operation. The diameter of the tunnel will decrease from 5.1 m at its western end to 4.7 m at its eastern end.

### g Penstocks

The penstocks are steel pipes associated with each pump-turbine, welded and back-grouted into penstock tunnels. During generation mode, they will divide the flow of water from the single high-pressure headrace tunnel and feed it into the power station cavern. Isolation from the upstream water way is provided via each unit's main inlet valve. Each of the steel penstock have diameters that decrease from around 2.7 m to 2.2 m.

It will be necessary for the penstock tunnels to be partially excavated via the penstock construction adit, and partially excavated via the power station complex.

### h Draft tube tunnels

The draft tube tunnels mirror the penstock tunnels on the western side of the machine hall. There will be distinct draft tube tunnels which, during generation mode, will recombine the water flow from each pump-turbine into a single channel as it enters the tailrace pipe. During pump mode this process will be reversed. The length of the draft tube tunnels will be approximately 95 m each.

### i Tailrace tunnel

The tailrace tunnel will have a small gradient and a diameter of 5.1 m and will connect the draft tube tunnels to the lower reservoir. It will be lined with reinforced concrete and will be excavated from the lower reservoir end. A 240 m long tailrace construction adit with a diameter of 6 m will be excavated to enable simultaneous construction of the lower intake and tailrace. The tailrace construction adit will meet the tailrace tunnel on the eastern side of the tailrace gate shaft.

## vi Transmission connection works

The Project will connect to the electricity grid via TransGrid Line 965. This will serve as a two-way link that will allow electricity to be exported to the grid while the Project is in generation mode, while also allowing the Project to draw electricity while it is in pumping mode.

The transmission lines between the switchyard and TransGrid Line 965 will consist of two transmission lines, a 132 kV single circuit overhead line, and a 330 kV double circuit overhead line. Both lines will sit alongside each other within the same transmission corridor, minimising overall impacts. The connecting transmission line will follow the route travelling north from the switchyard at the ECVT portal, crossing over the Macleay River east of Georges Junction before connecting with TransGrid Line 965. The transmission connection works will also incorporate a substation rated up to 330 kV, aligning the voltages of the lines to enable connection to the power network.

The 330 kV transmission line towers will be lattice steel towers. They will be constructed on approximately 25 m x 25 m bases and extend to around 50 m in height. The 132 kV line will be supported using a standard steel or concrete pole configuration, with a height of around 26 m for each pole. The 132 kV and 330 kV transmission infrastructure will be installed within the 25 tower sites located between the switchyard and TransGrid Line 965. The sites for the towers have been selected to minimise impacts associated with their construction and maintenance. The tower sites south of the Macleay River will be accessible via spur roads along the EAR and Main Access Road, with the remaining tower sites accessed via the Northern and Transmission Tower Site 8 Access Roads and associated access tracks. Their positioning along with the extent of the associated easement is shown in Figure 1.11 and Figure 1.12.

Where required, vegetation will be cleared and trimmed along the route of the transmission line including around and within each tower site. The transmission line route will remain in place throughout the life of the Project.

In addition to the high-voltage transmission lines linking the switchyard and TransGrid Line 965, there will be low voltage power and communications lines extending between the switchyard and the upper dam and reservoir. This line will operate at a lower voltage as it will only carry power for operational purposes relating to the operation of machinery and communications. The power line route is shown in Figure 1.11.

### vii Access roads

The proposed access roads make up a large portion of the Project's permanent infrastructure. The bulk of the roads constructed during the Project's construction phase will continue to be maintained and used for purposes supporting the on-going operation and maintenance of the Project's infrastructure. The Project's road network will include the following key components:

- the Main Access Road (4.7 km), which has a north-north-east orientation and extends from the north of the Project area before branching adjacent to the accommodation camp
- the EAR (up to 11.4 km), which will connect the generation portion of the Project area to the Kempsey-Armidale Road, and include a bridge across the Macleay River and Carrolls Creek to the east of the Project area
- the Lower Dam Access Road (3.6 km), which extends from the accommodation camp to the lower reservoir and river pumping facility after passing the workshops and site offices
- the Upper Dam Access Road (7.1 km), which extends from the accommodation camp to the upper reservoir
- portal and underground works access road, this road branches off from the Lower Dam Access Road to provide a path to the ECVT and MAT portals
- the Northern Transmission Access Road, which will allow the eight northernmost transmission tower sites and related infrastructure components to be accessed
- the Transmission Tower Site 8 Access Road, which will extend east from Kempsey-Armidale Road near Georges Junction to provide access to the first transmission tower north of the Macleay River

- transmission spur roads along the EAR and Main Access Road providing access to the tower sites south of the Macleay River
- an emergency egress road from the upper dam and reservoir joining the existing fire trail network in the adjoining Carrai State Conservation Area.

In addition to the key roads mentioned above, there will also be a need to establish short temporary roads that will be used to access the various construction areas and temporary pads. These roads will be used throughout the construction period and will be rehabilitated once they are no longer required.

Roads have been located to minimise the potential impact of flood damage and designed to meet the Australian Road Research Board's specifications of Class 4B minor roads. In general, roads will be 8 m wide two lane roads, formed and gravelled, with a speed limit of 50 km/h. The roads will also have a 1.5 m wide, 300 mm deep open cut drain and will generally conform to the following Austroads and RMS guidelines:

- have a general grade of up to 10%, with an absolute maximum grade of 15%, excluding steeper sections on the Northern Transmission Access Road
- have a minimum radius of 50 m, and 100 m for roads required for OSOM vehicles and transformer transport
- braking bays, if required, every 2 km.

The construction of the roads in accordance with these plans will make them suitable for use by the large vehicles required for the construction of the Project's infrastructure.

Various existing access tracks will also be upgraded where necessary to support construction. Tracks such as the Macleay River fire trail, Cochrane fire trail, George's Junction campground track, Peach Tree Creek trail and various forestry trails may need to be used to gain access to the Project area prior to the construction of the permanent access roads and for other purposes including design investigations, early works and mobilisation. Once the permanent access roads have been established for construction and the site is mobilised these tracks will only be used for emergency egress and will not be used for construction activities. Road maintenance works, including improving drainage, placing of geofabric and gravel to improve trafficability, and removing boggy sections of road are the main activities that will be undertaken on these access roads.

Additional ancillary access tracks will also be constructed to lengthen existing tracks and provide access to certain areas. When required, this will entail the trimming or clearing of vegetation, surface grading and the placement of geofabric and gravel.

Ancillary access tracks will include:

- a 2.7 km long lower reservoir access track, leading from the lower dam and reservoir access road directly to the left abutment, spillway, river pumping facility and lower intake
- a 2.2 km long emergency egress track connecting to the Peach Tree Creek Trail
- a 1.8 km long upper reservoir access track to allow construction teams to access the left abutment and pressure shaft.

All maintenance or upgrade works that are required outside of the Project area will be completed in liaison with the relevant party, in particular NPWS.

### viii Spoil emplacement areas

The actions involved in the construction of large amounts of infrastructure are expected to generate large quantities of excess spoil. The most significant actions in terms of excavation are listed below:

- tunnel excavation
- cavern excavation
- dam foundation excavation
- surface works
- reservoir excavation.

A large portion of this material will be reused for other purposes such as concrete aggregate, fill for embankments and pads, road-base and rockfill for the construction of the reservoir dam walls. Material which is not suitable for this purpose will be disposed at spoil emplacement areas. The spoil emplacement areas have been selected with the goal of avoiding impacts on waterways and construction activities while being located in close proximity to the spoil source to minimise transportation time.

The spoil emplacement areas will be cleared of vegetation prior to the placing of spoil, rockfill will be placed to form stable embankments and the spoil will be spread in layers of like material, and drainage channels will be implemented to ensure that proper drainage can occur. Dust suppression measures and silt traps will also be used to minimise the environmental impact of fine particles. Spoil emplacement areas will be land formed, and then rehabilitated at the end of the Project.

There is currently a balance between excavated materials, construction materials (roads, pads, concrete aggregate, dam walls), and spoil. The net spoil balance, as per the below graph, will be placed into 3 dedicated spoil areas and a construction laydown area. This includes an allowance for a drought reserve to be incorporated into the Lower Reservoir providing increased scheme energy resilience.  Also included is an allowance for the additional underground works associated with a 900 MW scheme. Detail design will further refine and optimise the excavated material and spoil balance and requirement for spoil emplacement, and maximise onsite use of excavated materials, where suitable. Several opportunities have been identified that would assist to achieve this.

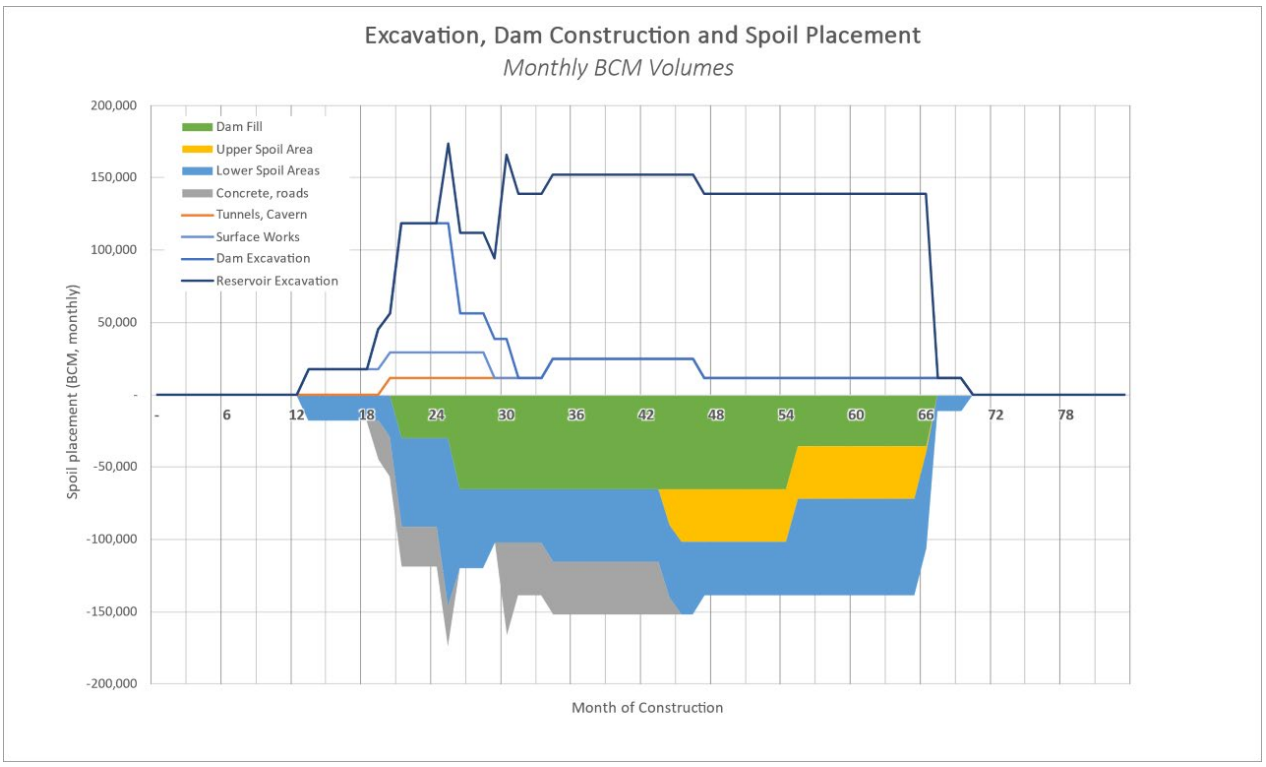


**Figure 1.20 Monthly excavation volumes and placement**

Excavated material generated within the Upper Reservoir area will be prioritised for construction materials or disposed as spoil in close proximity to the excavation source. This will limit movement from the Upper Reservoir to the Lower Reservoir or other areas within the construction footprint.

To minimise impacts and provide cost-effective solutions, the excess spoil material will be disposed as close to its original source as possible to avoid incremental costs for additional haulage and/or double handling of the material. The spoil areas which have been designed to permanently store the excess spoil material are shown in Figure 1.21 to Figure 1.26.

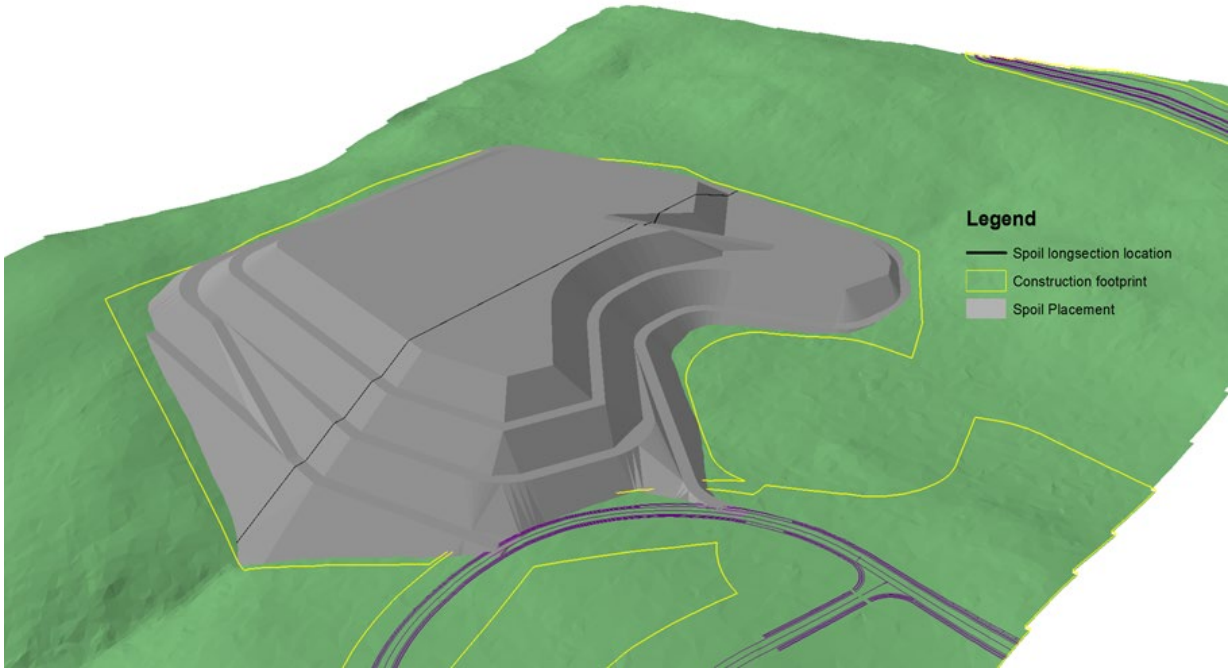


**Figure 1.21** **Aerial view of upper spoil emplacement area**

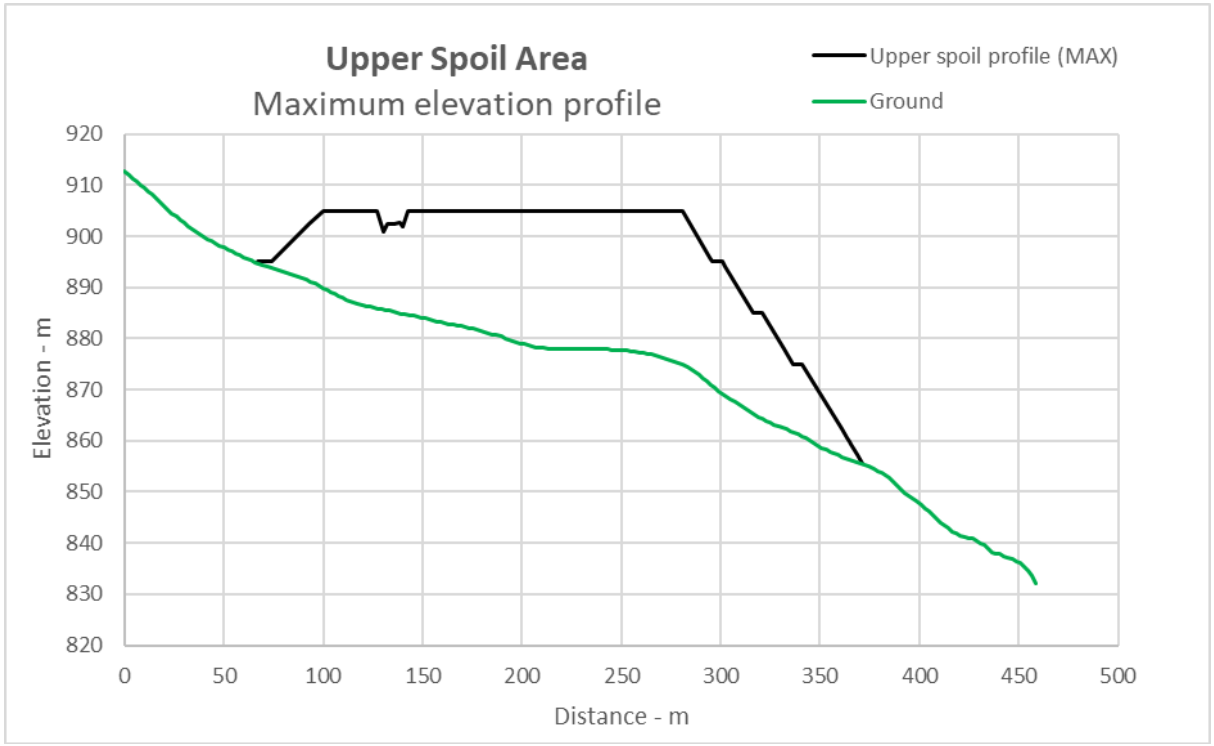


**Figure 1.22** **Upper spoil emplacement long section**

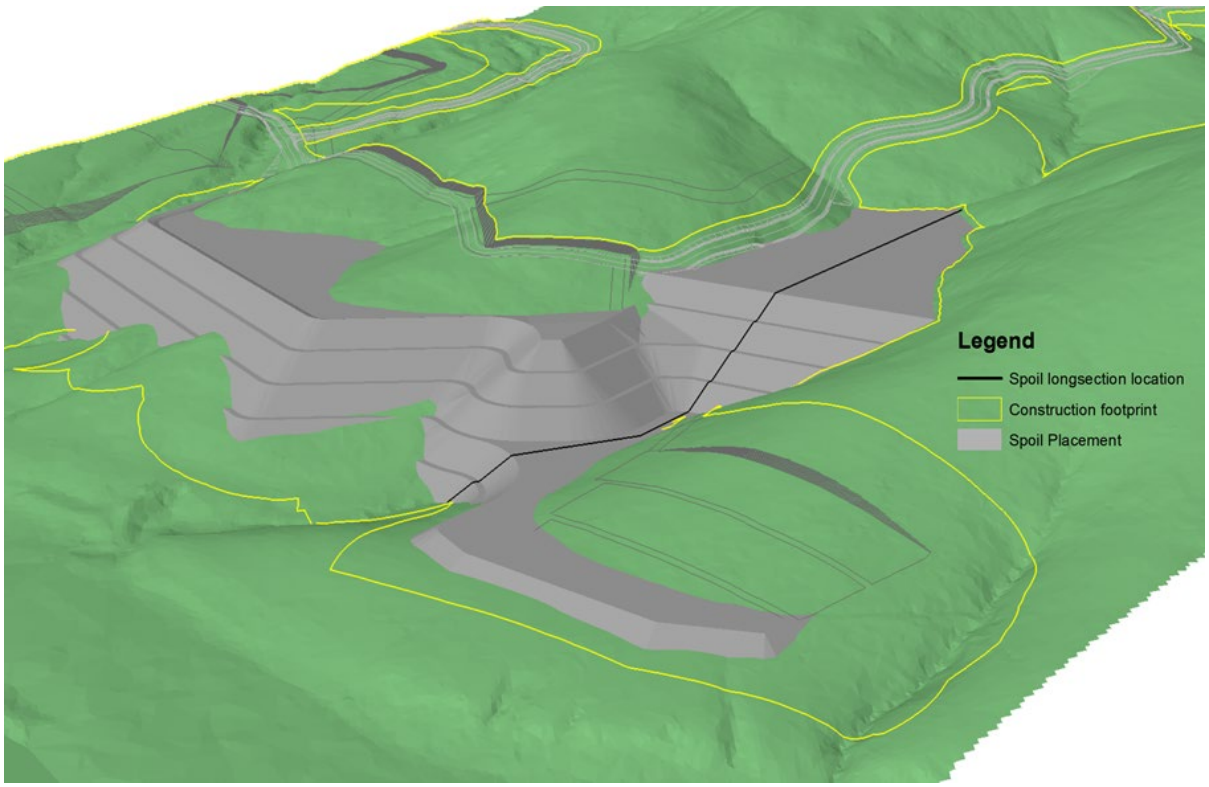


**Figure 1.23** Aerial view of lower spoil area A (grey: rockfill, orange: unsuitable)

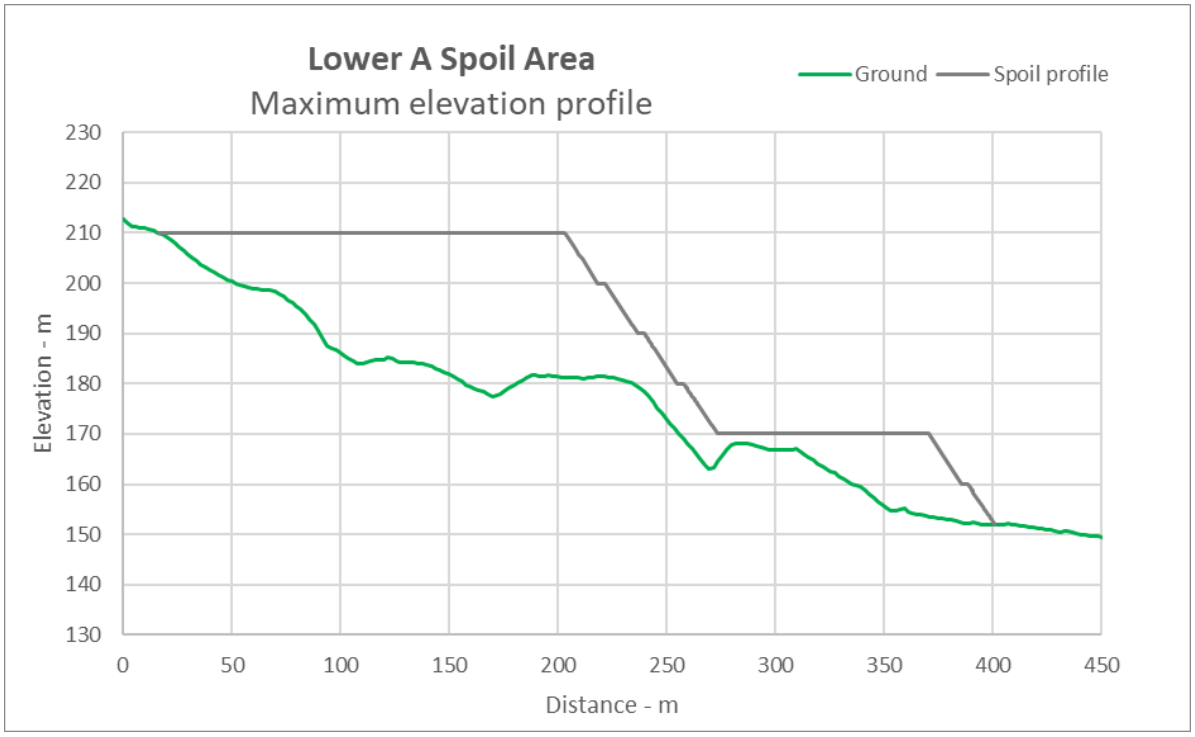


**Figure 1.24** Long section of lower spoil area A

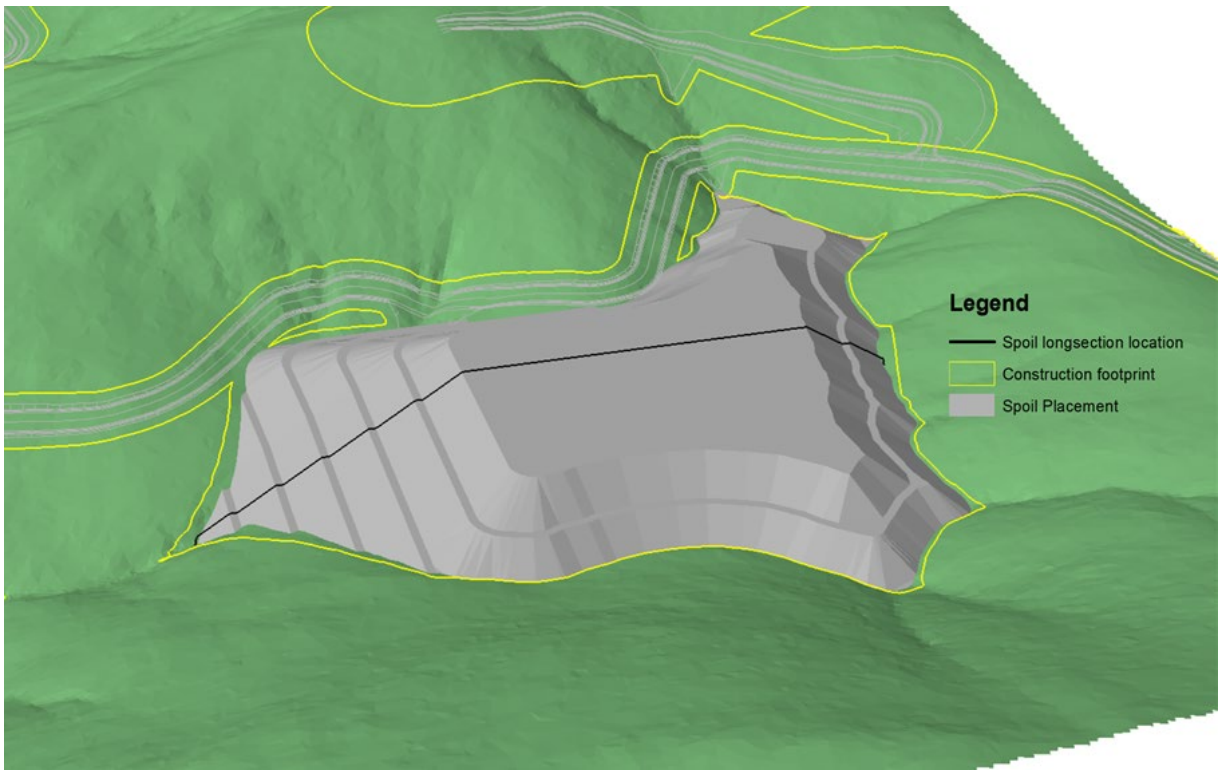


**Figure 1.25** Aerial view of lower spoil area B (grey: rockfill, orange: unsuitable)

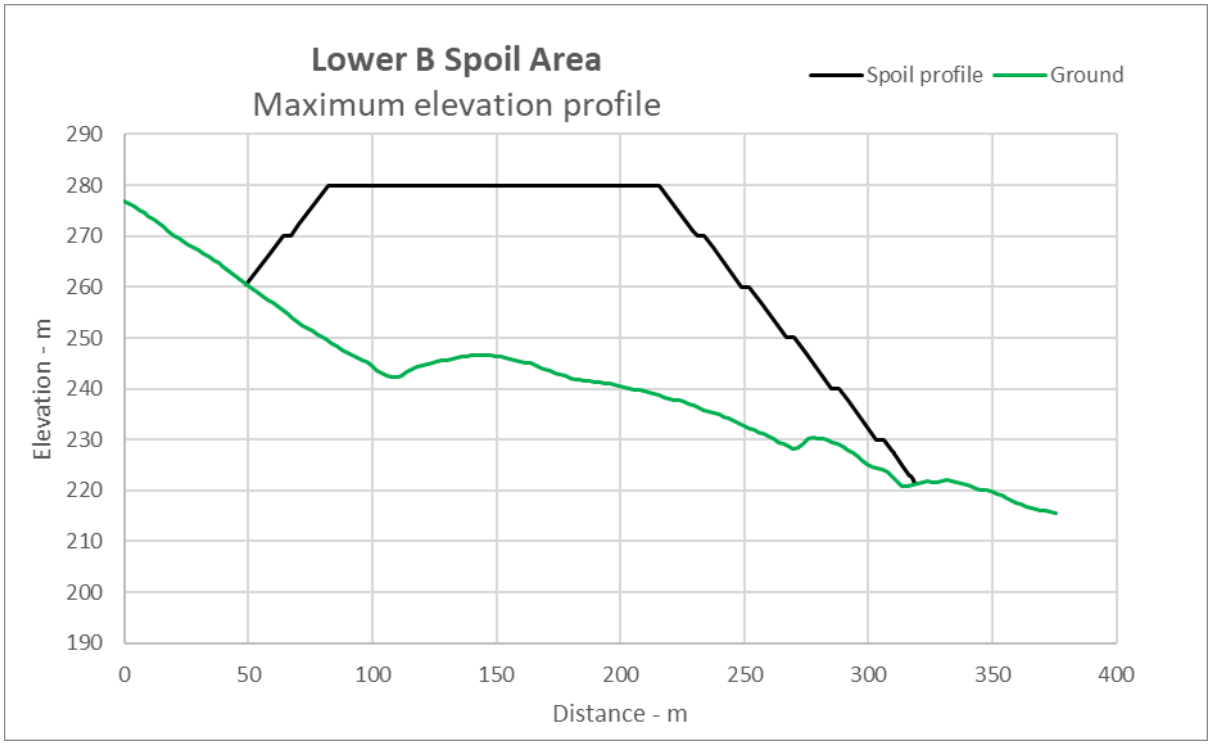


**Figure 1.26** Long section of lower spoil area B

### 1.3.4 Temporary construction elements

The construction phase of the Project will be extensive and is expected to take approximately four to five years. Over the course of this time a significant amount of infrastructure will be constructed to facilitate the efficient construction of the permanent infrastructure required for the ongoing operation of the Project. This temporary infrastructure will be predominantly situated on the western side of the Project area along the Lower Dam Access Road and is set back from the Macleay River. The sites for this temporary infrastructure have been selected to minimise the risk of damage from flooding, and all the sites will be rehabilitated once they are no longer required. Figure 1.8 shows the layout of the majority of the temporary infrastructure sites.

The assets and infrastructure associated with the temporary construction elements will be decommissioned or relocated when no longer required, and the area across which they were established will be progressively rehabilitated. A detailed rehabilitation management plan will be established to ensure effective rehabilitation will be achieved. The total rehabilitation area is expected to be around 60 ha.

Construction of the Project is not expected to significantly impact the ongoing recreational use of the Macleay River, Georges Junction Camp Ground and the National Trail.

The temporary use and layout of each work area will be confirmed during detailed design and construction planning.

#### i Works Area 1

Located adjacent to the Lower Dam Access Road, Works Area 1 will be a construction area divided into two pads that will be utilised as the main CBP area. The upper pad will have an area of around 18,000 $m^2$ and will likely be devoted for the storage of aggregate, while the lower pad will have an area of approximately 36,000 $m^2$ that will likely be used for the CBP, water bore and a laboratory. The pads will be connected by a road link and have been designed to minimise the magnitude of earthworks required for their construction.

#### ii Works Area 2

Situated to the south of Works Area 1, Works Area 2 is the area that will likely be used for electrical workshops, mechanical workshops, maintenance workshops, laydown areas, warehouse, and storage facilities. It will be situated on the same elevation as Works Area 1 to minimise the risk of flood damage. The total area of the pad will be approximately 36,500 $m^2$.

Both Works Areas 1 and 2 will be surrounded by security fences and will have sedimentation basins to allow run off water to be treated before being released into the Macleay River.

#### iii Accommodation camp

At the peak of construction, the number of workers present in the Project area is expected to reach over 600, the majority of whom will be accommodated onsite within the main accommodation camp. The accommodation camp area that will hold the facilities for these contractors is located at the junction between the Lower Dam Access Road and the Upper Dam Access Road. The accommodation camp will be situated on two adjacent platforms, with a combined total area of approximately 35,000 $m^2$. The primary form of accommodation in the camp will consist of 12.0 m long and 2.4 m wide containerised accommodation units which can be positioned in a double deck arrangement if necessary.

A range of additional facilities are also planned, including:

- contractor's staff and labour accommodation
- employer's staff accommodation

- private staff and bus parking
- kitchens, food preparation and storage
- dining area
- shop and social facilities
- laundries, washrooms, and locker rooms
- gymnasium and recreation facilities
- first aid unit
- camp offices
- fire water and raw water tanks
- raw water and fire water pump station (camp use only)
- water and wastewater treatment
- generator building
- rubbish area
- security and emergency assembly points.

Water is likely to be sourced from the Macleay River (under a water licence and allocation regulated under the WM Act).

Food and laundry units will be shared, and waste will be collected in holding tanks before being transported to nearby processing plants.

The current design provides for the location of the main accommodation camp. However, its location may change as part of the detailed design phase to an alternate location within the construction envelope.

#### iv Temporary or fly camps

Temporary or fly camps may be required for the construction workforce in addition to the construction and operation of the main accommodation camps. The location and size of these camps will be documented during the detailed design phase.

#### v Construction phase offices

An area designated for offices will be situated on three pads with a combined area of approximately 13,000 $m^2$. The site is located to the west of the Lower Dam Access Road, south-west of Works Area 2. Temporary offices at other locations may also be established.

#### vi Staging areas

Staging areas will be at the northernmost area of temporary infrastructure. Consisting of a large, flat, cleared area, they will allow vehicles of all sizes a place to be located while not working within the construction zones to the south. This area will be also used for material laydown, material storage and other needs if required.

#### vii Stockpiling areas

Stockpiling areas will be present in the lower reservoir construction area to provide flexible spaces for site deliveries, aggregate storage, and the preparation and staging of vehicles of all sizes. Much like the staging area, the stockpiling areas will consist of large areas of level, cleared land.

#### viii Progressive rehabilitation

Rehabilitation will be carried out in several phases through the construction period to achieve the desired outcome for affected landowners and receptors. Activities during (or prior to) construction to enhance rehabilitation will be performed, such as salvaging habitat resources and native seed collection. Other progressive rehabilitation techniques will be carried out including temporary stabilisation of batters and construction of appropriate erosion and sediment control devices.

### 1.3.5 Traffic and transport requirements

The construction of the Project will be subject to traffic management measures to ensure safe access to the Project, the ongoing functionality of surrounding roads, and the safety of members of the public, motorists and construction workers.

#### i Traffic generating activities

A variety of activities will be undertaken throughout the construction phase of the Project that will generate considerable traffic on the Project's road network. Such activities will include:

- deliveries of materials and equipment
- the transportation of excavation and construction equipment
- transportation, including busing, of personnel between sites and their accommodation
- servicing of accommodation camps (temporary or fly camps and main accommodation camps), such as waste collection and food delivery
- transportation of spoil from tunnelling and surface works, as necessary.

A wide range of vehicles will be used for these activities and others, such as light vehicles, buses, helicopters, concrete agitators, excavators, and semi-trailers, in addition to a variety of specialised vehicles such as a tunnel wheel jumbo. The Project's road network has been designed to accommodate these vehicles.

#### ii Transport routes

Traffic entering and exiting the Project area south of the Macleay River will predominantly do so via the EAR. Traffic entering and exiting the Project area north of the Macleay River will do so via the Northern and Transmission Tower Site 8 Access Road off the Kempsey-Armidale Road. This is a result of Kempsey-Armidale Road being the only viable transportation route to the Project area. Kempsey-Armidale Road connects to Armidale in the north-west and Kempsey in the south-east. Deliveries and vehicle movements are expected to occur in both directions; however, the preferred delivery route, particularly for OSOM, is via the Kempsey side of the Project area.

It is proposed that the largest components or loads (for example, transformers) will delivered to the Project via the Kempsey side of the Project.

Once vehicles are inside the Project area, each of the roads laid out in Section 1.3.1iv will be used as key transport routes throughout the Project's construction phase.

### iii Site movement of personnel and shifts

The majority of personnel will be transported throughout the Project area by bus and light vehicle so as to minimise parking requirements and the number of vehicles present on the Project's road network. This will improve the efficiency of transport within the Project area while also improving safety outcomes. Bus pickup and drop off points will be marked, and sufficient buses will be present to account for the extent of the workforce. Superintendents, engineers, and other employees requiring flexibility of transport for their roles will have access to light vehicles in accordance with their needs.

Shifts will be arranged to accommodate 24/7 construction throughout the construction period.

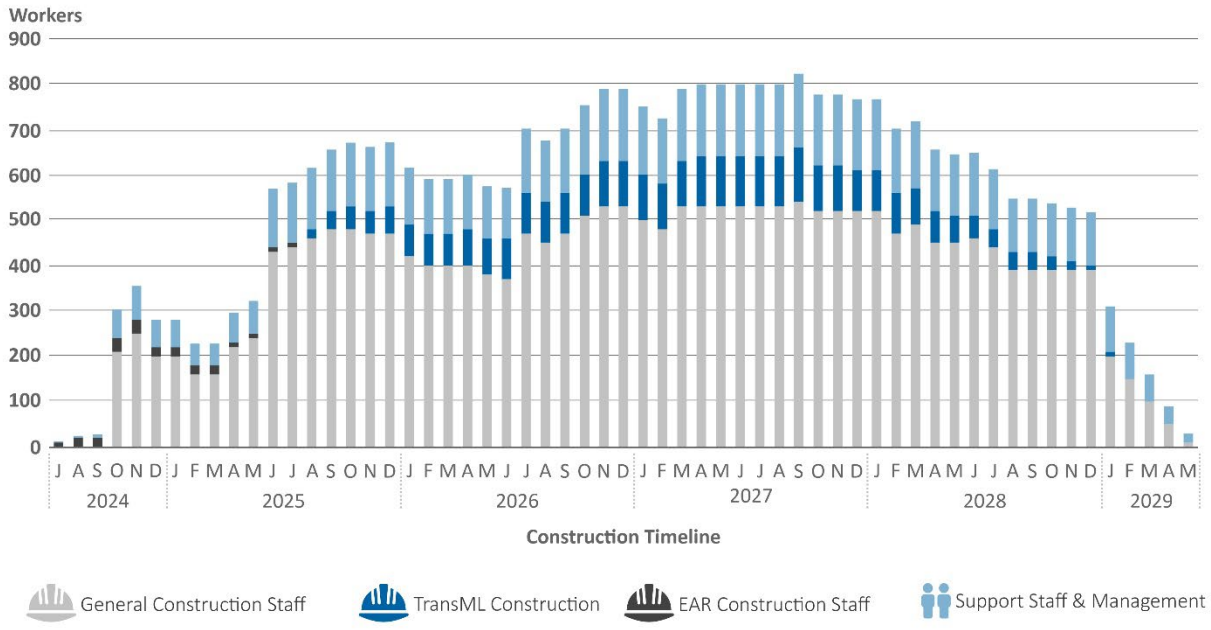


**Figure 1.27 Number of workers throughout the construction period**

### iv Transportation of personnel to and from the Project area

To reduce traffic movements on the public roads, most workers will be transported via bus to the construction site and to the on-site accommodation. Locations for pick up and drop off have yet to be determined. These will be determined during the detailed design phase, and in consultation with local councils. It is likely that FIFO workers would fly into one of the towns close to the Project area, like Armidale, Coffs Harbour or Port Macquarie.

## 1.3.6 Off-Project area (external) road improvement works

To support the construction of the Project, some off-Project road improvement works will be required at various identified locations. Detailed assessments will be undertaken during the detailed design phase. These works include upgrades to sections of the Kempsey-Armidale Road as follows:

- approximately 600 m section extending from Pee Dee Creek to Pee Dee Road
- approximately 3,300 m section extending from Pee Dee Road to Five Day Creek
- approximately 1,000 m section at cutting between Five Day Creek Road and Schoolhouse Gully

- approximately 700 m section at cutting west of Blackbird Flat Creek
- approximately 700 m section at cutting 3 km west of Lagoon Creek Bridge
- approximately 700 m section at cutting 5 km west of Lagoon Creek Bridge.

These road improvement works do not form part of this EIS and will be separately undertaken by the local councils on behalf of the Project. The identified sections of external road improvements have been developed to a concept design level to demonstrate the works are considered feasible and implementable for the Project (see Appendix for Q further detail) however are not assessed further. Further engagement will be undertaken with local councils and Transport for NSW during the detailed design phase to optimise the scope and delivery of these external road works. The upgrade works would be subject to separate approvals under the EP&A Act and would be obtained by Armidale Regional Council and Kempsey Shire Council as applicants.

## 1.4 Operation of the Project

### 1.4.1 Overview

This section provides an overview of how the Project will be commissioned, operated and maintained post-construction and throughout its operational life. It also provides details of the proposed progressive rehabilitation works, which will commence towards the end of construction and continue through to commissioning and once the Project is fully operational.

### 1.4.2 Operational details

The Project will become operational once all Project infrastructure has been constructed, installed, tested and connected to the electricity transmission network.

Prior to commissioning, an electro-mechanical contractor selected for the Project will design, manufacture and test all plant and equipment, including turbines, generators, switchgear, transformers, station cranes, valves, and gates. Once these components have been tested and commissioned, the pumped hydro system can become operational.

At the time of commissioning, the lower reservoir will need to be filled to the full supply level (250 m AHD).

Once the Project has been commissioned, and the transmission lines connected, electricity can start being generated, consumed and transmitted to the NEM via TransGrid Line 965.

Further detail and principles behind the operation of the Project are described in Section 1.2 (i.e. both the generating and pumping modes used to produce and store electricity via the closed loop pumped hydro system).

#### i Project life

It is anticipated that the Project will become fully operational by the end of 2028–29. The Project will have a full operating life span of 100+ years. Turbines are designed to continuously operate with regular routine maintenance checks.

#### ii Power output

The Project will provide up to 900 MW of electricity generating capacity and, depending on the ultimate capacity of the plant, up to twelve hours of energy storage at full generating capacity. There are recognised significant benefits to the existing transmission network, to the NEM and to the New England REZ with a power rating of up to 900 MW. These include the facilitation of 1,600 MW of renewable energy capacity within the New England REZ, lower REZ infrastructure costs, and greater network resilience. Further details on this are provided in Appendix F.

### iii Operation, management and maintenance of the Project

The operation, management and maintenance of the Project will be consistent with other water storage and power generation facilities across NSW. This includes all necessary activities such as operating, monitoring, surveillance and maintenance. Specific management and maintenance measures are covered under each environmental matter assessed as part of this EIS.

### iv Control

Control of the Project can be conducted remotely. However, on-site staff will also be able to operate the Project from the office area which will be located at the onsite control building at the ECVT portal. This control building will be utilised during commissioning, testing, operation and maintenance over the life of the Project.

Other facilities such as the Macleay River pump facility, water treatment plant, HVAC and generators, will operate automatically, however periodic routine maintenance and inspection will take place by on-site crew.

An office area will be provided as part of the control room building, to be used by staff when requiring on-site work.

### v Management and maintenance

Throughout the operational life of the Project, there will be an ongoing need to perform regular maintenance and repairs to the operational infrastructure.

Operational maintenance activities required for the Project will include:

- maintenance of plant and equipment and systems within the power station complex, intake structures, gates and control building
- maintenance of access roads and tracks (e.g. vegetation management and pavement works/repairs)
- maintenance of electricity and communications infrastructure (cables, switchyard, cable tunnel)
- maintenance of transmission lines and sub-substation as required (e.g. line and pole inspections and vegetation management of easement corridor)
- maintenance of fences, fence lines and firebreaks.

Less frequent maintenance is expected to involve:

- dewatering of the headrace and tailrace tunnel (as required)
- electro-mechanical works, approximately every 20 years
- hydro-mechanical works, approximately every 20 years
- control systems and instrumentation, approximately every 15 years
- pumping station, approximately every 20 years
- dam, approximately every 30 years.

It is likely that the operation and maintenance of the new section of the overhead powerlines connecting to TransGrid Line 965 will be the responsibility of an external provider. This would include ongoing management of vegetation to reduce the risk of power outages and potential bushfires as well as the maintenance of access tracks required to perform maintenance operations. All operational activities would be undertaken in accordance with the external provider's operational procedures.

#### vi Permanent access for operation and maintenance

Permanent access to the Project area is discussed in Section 1.3.3.

### 1.4.3 Infrastructure servicing

The operation of the Project will require ongoing servicing including power, communications, sewage, waste and water. These requirements will be met by retaining select utility infrastructure established during construction outlined in Section 1.3.3. A summary of infrastructure services required during operation is provided below:

- Ongoing electrical supply is required for the provision of ongoing power for MAT1, MAT2 and ECTV tunnel services, such as lighting, ventilation, pumps and the surge shaft, as well as the control building, and raw water pumping infrastructure. Permanent electrical supply will be sourced from the pumped hydro system itself, and any excess required will be sourced from the newly constructed transmission connection work.

- Ongoing communication supply will be required between the power station and access tunnels (MAT1, MAT 2 and ECVT), control building and switchyard and intake structures. Communication will be provided via cables installed during construction. The wireless communication tower installed at the upper reservoir will also provide communication across the Project area and externally during the operational phase of the Project.

- Raw water supply will be required for firefighting at the power station complex, access tunnels and portals, and treatment to a potable standard. Raw water will be sourced via internal offtake pipelines that will be established during construction. Water will be sourced from the reservoirs for ongoing operational water supply.

- Potable water supply will be required at the office building and temporary construction housing for staff facilities. Water treatment plant will be used to treat raw water and supply potable water for use on site.

### 1.4.4 Rehabilitation

Rehabilitation will, as far as practicable, be undertaken progressively during all phases of the Project and consideration of rehabilitation risks and planning will apply from construction, operations and decommissioning through to final landform design, reinstatement, and revegetation.

Following the construction works, revegetation works will be completed within areas that are no longer required for construction, and that will not form part of the operational footprint. A detailed rehabilitation plan will be prepared for areas to be revegetated and rehabilitated. The total rehabilitation area is expected to be around 70 ha on completion of Project construction.

Indicative rehabilitation activities are provided in Table 1.8 below.

**Table 1.8 Rehabilitation**

| Development feature | Rehabilitation |
|---|---|
| Road works | All areas disturbed by road works will be stabilised using erosion and sediment control techniques and revegetation. |
| Construction portals | Portal area to be sealed from entry using suitable fill material, shaped, stabilised and rehabilitated. |
| Construction compounds and supporting infrastructure | Infrastructure removed (as agreed with relevant landowners or land managers) and rehabilitated to an agreed state consistent with the nominated final land use. |
| Tunnel entries | Construction or works area is to be limited and revegetated. The tunnel entry batters will be stabilised and rehabilitated. |
| Temporary stockpiles and pad | Stockpile material re-used in rehabilitation (if suitable), and surface pads land formed and rehabilitated. |
| Permanent landforms | Spoil emplacement areas will be stabilised and rehabilitated to native vegetation and rock landscape. |

### 1.4.5 Decommissioning

The decommissioning of a pumped hydro system is not usually done until the system has served its useful life and in accordance with a dedicated decommissioning plan. Pumped hydro systems usually function for a very long time and are maintained for decades with the repowering of pumped hydro systems a common practice extending their useful life.

In the event that the Project needs to be decommissioned, all decommissioning activities will be set out in a detailed and dedicated decommissioning plan.

Some elements of a pumped hydro system are more likely to require decommissioning and replacement over the life of the Project, either directly or post-construction. An impact assessment would need to be undertaken if a significant Project element were to require decommissioning.

## 1.5 Interactions with nearby areas

Public access to the construction envelope and operational footprint will be respectively restricted during the construction and operation phases of the Project in order to allow the Project to proceed in an efficient and safe manner.

Impacts beyond the boundaries of the Project area are expected to be minimal. Since the Project will operate as an off-river closed-loop system its impacts on nearby waterways will be insignificant, even whilst the lower reservoir is being filled. A safety exclusion zone surrounding the Macleay River pumping station and intake will be implemented if required to ensure the safety of river users.

### 1.5.1 National Trail

A section of the National Trail (part of the 'Ebor to Barrington Tops' section) passes through the western side of the Project area, running adjacent to the Macleay River. Access to this section of the National Trail will be retained throughout the construction and operational phases of the Project. A dedicated management plan will be developed in consultation with relevant stakeholders to ensure access to the trail is retained in a safe manner.

### 1.5.2 Travelling stock reserves

Access and continued use of the TSRs in and around the Project area are expected to be retained in some capacity. A dedicated management plan will be developed in consultation with relevant stakeholders to ensure the appropriate safe access and use of the TSR is retained.