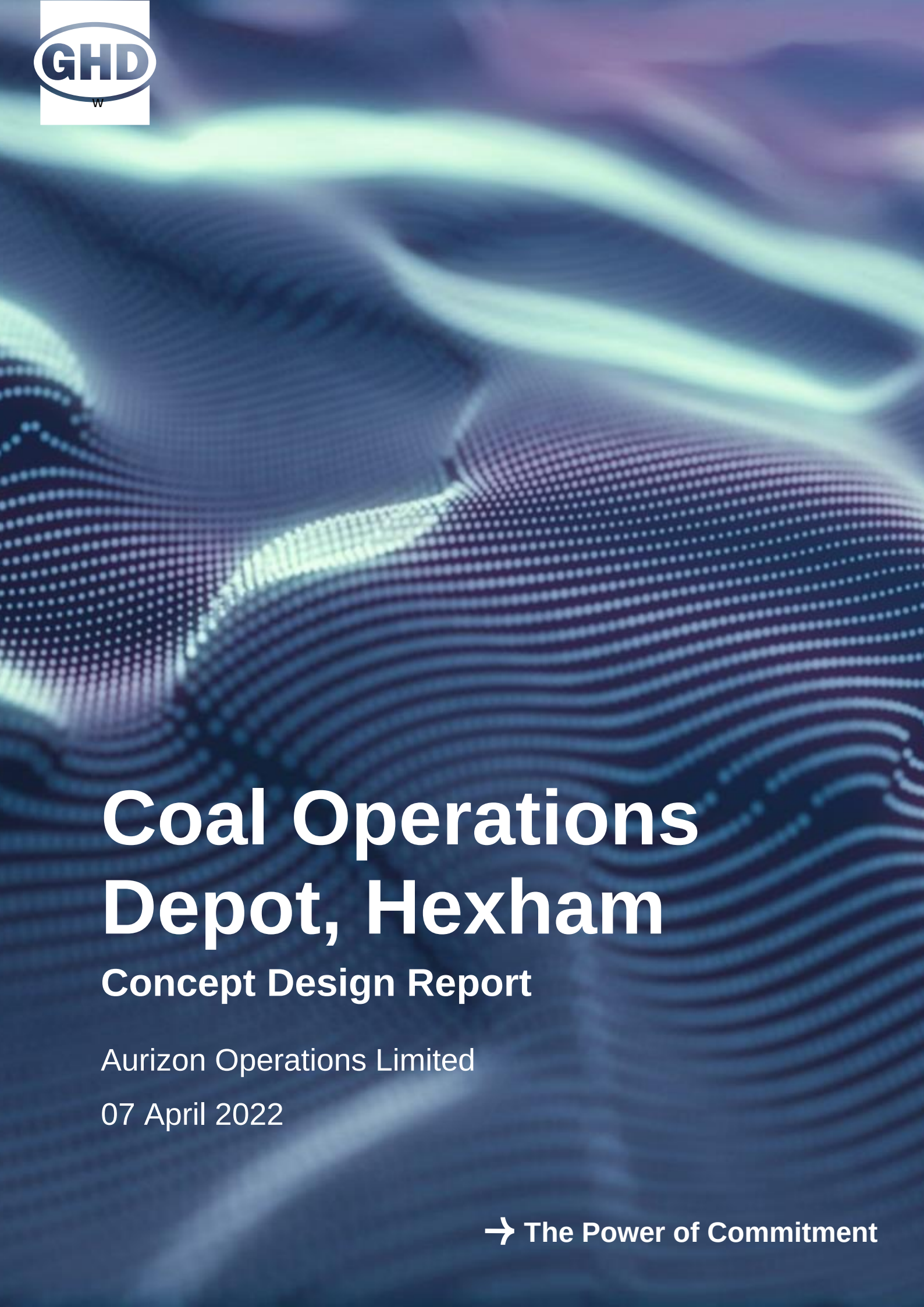

Coal Operations Depot, Hexham

Concept Design Report

Aurizon Operations Limited

07 April 2022

→ The Power of Commitment

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1. Introduction

Aurizon have engaged GHD to undertake the 30% concept design of the new Aurizon Operations Depot in Hexham. This new facility will comprise of an office building, a 500 m^2 warehouse, a vehicle wash bay and a carpark to cater for the 120 train crew members and 49 office staff. The new depot will be located next to Aurizon's existing Combined Maintenance Facility (CMF) in Hexham. Figure 1.1 below highlights the site identified by Aurizon as being the preferred location for the new operations depot.

Figure 1.1 Site locality

Aurizon aims to address and solve several matters by constructing a new operations depot in which they will relocate to, from their existing warehouse situated in Mayfield, NSW. These issues are regarding safety, productivity, site footprint and rolling stock storage problems. In addition to these concerns, Aurizon's organisational strategy provides an optimal footprint for the depot by means of reducing their asset/ lease portfolio and consolidating existing sites. This merge enhances the synergy, efficiency and collaboration between the Operations and Maintenance activities and increases the utilisation of the Hexham Train Support Facility (TSF).

1.1 Purpose of this report

The purpose of this report is to document the 30% Concept Design for the Hexham Operations Depot. The report will discuss the following design elements:

– Architectural
– Civil
– Structural
– Hydraulic
– Acoustic
– Mechanical
– Ecologically Sustainable Development (ESD)
– Electrical

Revision B of this report has been modified to suit the reduction in both the Office and Warehouse sizes as defined and instructed by Aurizon email dated 20/12/2021. There have been sections removed from the report, at the request of Aurizon's planning consultant. These sections include:

– Acoustic
– Hydraulics
– Mechanical
– Appendices

1.2 Scope and limitations

This report: has been prepared by GHD for Aurizon Operations Limited and may only be used and relied on by Aurizon Operations Limited for the purpose agreed between GHD and Aurizon Operations Limited as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Aurizon Operations Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

If the GHD document containing the disclaimer is to be included in another document, the entirety of GHD's report must be used (including the disclaimers contained herein), as opposed to reproductions or inclusions solely of sections of GHD's report.

GHD has prepared this report on the basis of information provided by Aurizon Operations Limited and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.3 Assumptions

The basis of the design pivots around the User Requirement Brief provided as part of the RFQ and further developed through a Return Brief.

2. General

2.1 Existing Mayfield operations

The existing Aurizon operations depot and warehouse facilities are located at 121 Woodstock St, Mayfield, NSW as shown in Figure 2.1 below. The warehouse is currently used to store parts on shelves and is accessed by a forklift. The office building is a structure previously built for other purposes. The current space includes the crew sign on space, multiple offices and meeting rooms, an operations work space, a support services works space, lunch rooms and kitchenettes and amenities.

Figure 2.1 Existing facility at Mayfield, NSW

2.2 User requirements and return brief

GHD was issued with the updated user requirements brief on 11 October 2021. This has been the guiding document utilised to develop the design incorporating room sizing and furniture requirements, as well as functionality and layout.

GHD attended a site visit of the existing facility on 13 October 2021. This facilitated the generation of a return brief, allowing GHD to capture specific details and any adjustments required to the user requirements. An additional site visit was undertaken with Peter Lenox on the 20 October 2021, to review the preliminary return brief and specific role relationships were discussed and clarified. GHD issued the return brief back to Aurizon for approval prior to incorporating into the design. This revised return brief now acts as the site specific governing instrument with the original user requirements closing out any potential gaps. The return brief is included with this report in Appendix A.

3. Site visit – existing facility

A site visit of the existing facility at Mayfield was undertaken on 13 October 2021. The objective of the site visit was to overlay the user requirements brief with the functioning building. During the visit we viewed the three separate buildings; warehouse, vehicle wash bay and office depot. This process allowed the design team to align their understanding and prepare a return brief which would inform the final building outcome.

During the site visit we gained operational insight into the following aspects:

– Room sizes
– Number of staff
– Retained, existing or new furniture
– Relationship/ connections between different functions
– Specific room requirements
– Service and maintenance requirements
– Support/ ancillary links

Once the preliminary return brief was drafted, we issued a draft copy to Peter Lenox and arranged another site visit on 20 October to ensure the document captured all the areas and relationships. This formed the return brief and now underpins the project's design outcome – attached in Appendix A.

4. Architecture

4.1 Site planning and design approach

The proposed Operations Depot will be located in Hexham – a heavy industrial precinct existing within a narrow corridor stretching along the Pacific Highway between the Main Northern railway line and the Hunter River.

The site is adjacent to the Newcastle – Maitland rail corridor and industrial precinct directly to the east, with greenfield/large open space to the west. An existing combined maintenance facility is located to the south east, with an existing storage building located to the south with an existing ring road and carpark.

The designated area for the proposed works is a greenfield site with the exception of 2 power poles and an Ausgrid easement. An unsealed access road to private property exists along the northern “boundary”. The site’s topography rises slightly towards the north west.

The planning of the site was driven by several pre-determined functional requirements, including:

– The warehouse was positioned along the western “boundary” with associated heavy vehicle (19 m Semi) loading area – accessed via existing ring road. Locating this building here strengthens the separation for heavy vehicles form pedestrian movements.
– Existing power poles, pole mounted substation and easement exclude the depot from being located along the eastern “boundary”. The required 70 carparks, 5 motorcycle parks and associated vehicle wash have been located along the eastern “boundary” adjacent the existing ring road, with an entry/exit to the north and an exit to the south to provide a cohesive traffic solution between the existing and new. This approach capitalises on unbuildable site area without the cost of relocating existing infrastructure. The carpark follows the angled line of the road with central pedestrian access to connect the depot to the existing combined maintenance facility and the rail corridor.
– The vehicle wash bay has been located at the southern end of the carpark, adjacent the heavy vehicle loading area and the car park exit.
– The location of the depot building is directly related to an efficient car parking layout on an existing easement, proximity to the existing combined maintenance facility for ease of pedestrian movement and the proposed warehouse.
– The BBQ area/open space is situated between the depot and the warehouse. This positioning creates a sense of refuge within the vast, open context of the site through the protection provided by the bulk of the warehouse and depot, whilst offering prospect and sightlines towards the northwest.

4.2 Layout

The layout of the building consists of two wings with a central area where communal facilities are located. This relates to the two different user groups that occupy the building – the crew/operations and the support staff.

The entry to the building is located centrally in line with the pedestrian access through the carpark. This entry consists of the “public”/main reception, and a separate but adjoining crew entry. This is an outdoor, covered entry containing storage and provision for an alcoholiser. This crew entry leads into the crew sign-on space containing a separate reception area, sign on stations, tv screens (for information) and a network map which also has a direct link to the operations office.

The wings of the building predominantly consist of an open plan office with associated board rooms, meeting rooms, private offices, print areas and lockers. Each user group also has a designated kitchen/lunch area which opens out onto the covered outdoor BBQ area.

4.3 Aesthetics

The façade design draws directly upon the industrial nature of site's context. The materiality and form of the existing combined maintenance facility and the proposed warehouse have been referenced in the depot design to provide cohesion across the site. This is demonstrated predominately within the metal clad, "shed" like design.

The design intent of the depot seeks to relate to the industrial context in which it sits, acknowledging and providing connection to the entire site whilst signifying an identity of its own.

The depot is a simple rectilinear form. The design consists of horizontal "bands" to break up the façade into thirds – fibre cement sheeting in the bottom band where robustness is required, vertical metal cladding in light grey (Shale Grey) occupies the middle band and vertical metal cladding in dark grey (Windspray) at the top. Glazing sits within the middle band, aligned with the spacing of the fibre cement sheets to create a strong vertical rhythm around the building. Colour selections have been made from Aurizon's design standards strengthening a consistent approach across all facilities.

A skillion roof extends across the building and over the BBQ area. A thin fascia along the western and eastern faces of the building are juxtaposed by pronounced eave overhangs to the north and south that deepen to a wider central structure. The fascia of the main roof will be a very dark grey (Monument).

An awning follows the same line of the main roof over the entry at a lower level in order to provide rain protection and signify this as the main access point to the building. The soffit lining to this awning will be painted orange (Resene High Five) contrast this access point to the grayscale palette of the rest of the building and to feature Aurizon's primary colour.

A key client design consideration requested the HVAC plant to be located on ground. These services have been integrated in a considered manner and designed into the overall form of the building. HVAC units at the northern and southern ends of the depot have been contained within the main building's form, being enclosed by the associated roof form with materiality and colour selections similarly have been carried through.

4.4 Accessibility compliance

The following table outlines how the design responds to relevant accessibility requirements as per AS 1428.1. It should be noted that only sections of AS 1428.1 relating to the 30% concept design have been referenced.

Table 4.1 AS 1428.1 compliance

AS 1428.1 Relevant Requirement	Design Response
Section 3: Continuous paths of travel	– All continuous paths of travel have been designed in compliance with section 3. – Adequate circulation space has been provided for a wheelchair turn as per section 3.5.
Section 7: Walkways/Ramps/Landings	– No ramps of landings in the design. – All walkways have been designed in accordance with section 7.2.
Section 10: Doorways/Doors/Circulation space at doorways	– All doorways, doors and circulation spaces at doorways have been designed in accordance with section 10.
Section 12: Sanitary facilities	– All amenities have been designed to comply with the standards outlined in Section 12.
Section 13: Sanitary compartment for people with ambulant disabilities	– All sanitary compartments for people with ambulant disabilities have been designed in accordance with section 13.

4.5 *Better Placed* design objectives

The following table outlines the design response to the seven design objectives identified by *Better Placed.*

Table 4.2 Better placed design objectives

Better Placed **Design Objective**	**Design Response**
Better fit – contextual, local and of its place	Addressed in Section 4.1.
Better performance – sustainable adaptable and durable	Sustainability addressed in Section 7. The design is adaptable through it's large, open plan spaces which enables flexibility for future uses. The building set out also allows for the possibility of expansion. Appropriate materials have been selected in order to ensure low maintenance. Life cycles of selected products have been considered in order to ensure the durability of the design.
Better for community – inclusive, connected and diverse	Not applicable, as the design is located within a secure compound and not accessible by the general public.
Better for people – safe, comfortable and liveable	Clear vehicular circulation has been integrated into the existing site complex. Pedestrian access between the rail corridor, the existing combined maintenance facility and the new depot/warehouse has been provided to ensure safe access for pedestrians. Whilst the buildings are separated (driven by functional requirements) there is a degree of safety provided through visual connection of each building. Orientation and distance from external windows has been a major consideration through the design process in order to provide all users equal access to natural daylight.
Better working – functional, efficient and fit for purpose	The design of the building is functional, efficient and fit for purpose as it directly responds to and satisfies the requirements of the client's needs, as captured in the return brief. Detail provided in Section 4.2.
Better value – creating and adding value	Whilst this is not a community facility, we have provided value through the provision of a communal BBQ space and outdoor area which joins together the two main user groups of the building. Construction methodology and material selection have been carefully considered through the design process in order to provide a "value for money" outcome.
Better look and feel – engaging, inviting and attractive	The overall form of the building draws the users in and signifies the main entry. The aesthetics of the building seek to respond to and reflect the surrounding industrial context, whilst referencing more traditionally residential materials and construction systems to create a more aesthetically pleasing experience for the user. Materials, finishes, proportions and details have been carefully considered within the design process in order to achieve an attractive outcome, as elaborated upon in Section 4.3.

5. Civil

5.1 Site layout

The site is located directly northwest of the existing Combined Maintenance facility, on the opposite side of the loop road. The site is gently sloping towards the adjacent roadway. The new facility proposes to have the carpark entry/exit located at the northeast corner of the site, to reduce vehicle interactions with the loop road and the potential for users to try to cut across the existing carpark area to gain entry.

The carpark is a two-way operated system, with a secondary exit to the south of the site which is shared with a heavy vehicle exit. Appropriate linemarking and signage shall be implemented in a later design stage to promote appropriate traffic functionality at this shared exit.

The vehicle wash bay is located to the southwest of the carpark, adjacent the heavy vehicle loading/unloading area.

An existing power line and power poles accommodating a pole mounted substation was highlighted as encumbering the site early on. The carpark has been designed around this constraint, retaining the pole mounted substation, negating the need for any relocation works. The Ausgrid easement is 15 m wide and crosses the new carpark.

The new operations depot office building is located adjacent to the carpark, to the west, with the new warehouse structure located west of the operations depot office building, adjoining the loading and unloading zone. Two additional carparks have been located adjacent the warehouse. A figure of the site layout can be seen below.

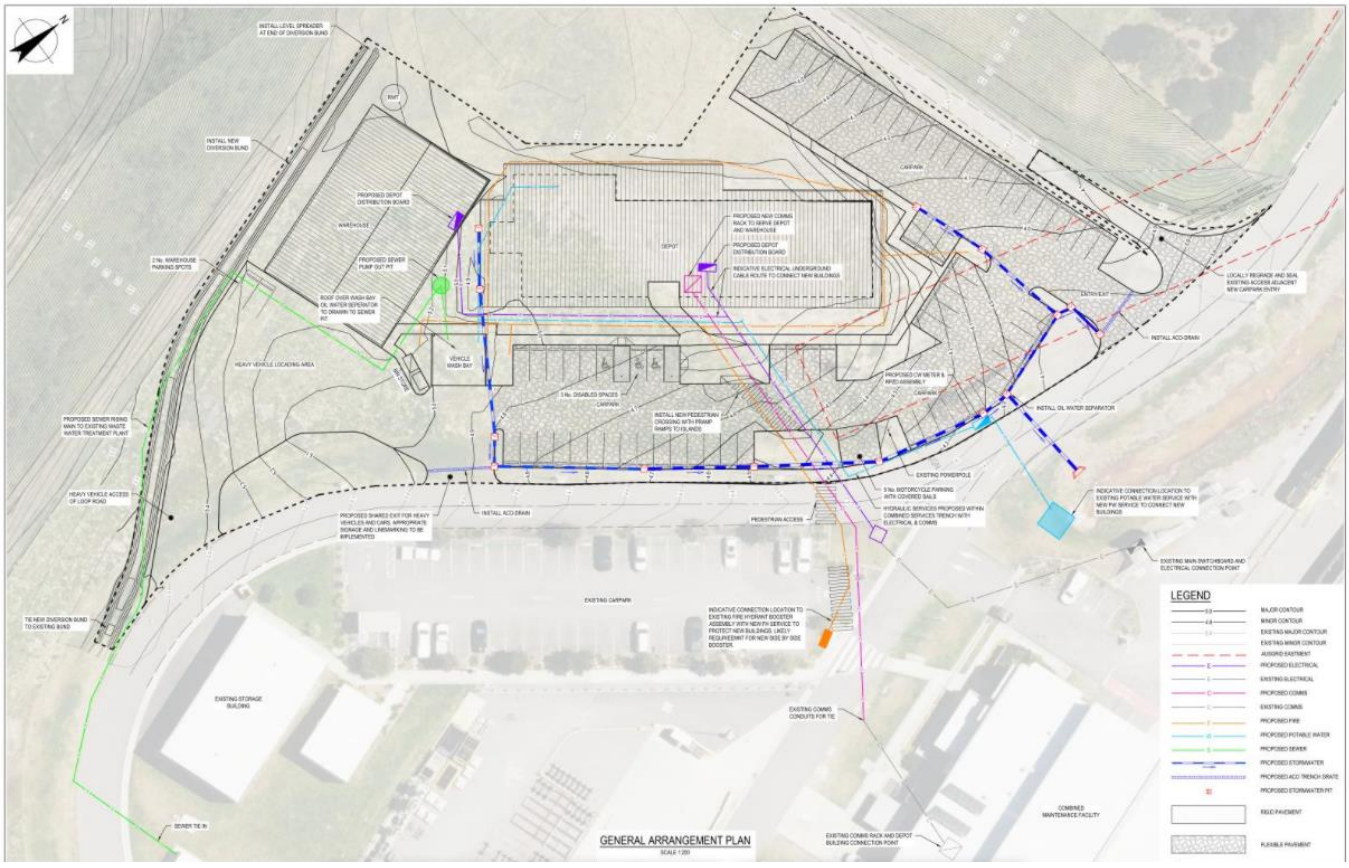

Figure 5.1 Site layout

5.2 Carpark

The carpark is to allow for 70 car spaces, with additional 5 motorcycle spaces. Specific requirements from the User Requirements were to increase the aisle width to 7.0 m side. A footpath is provided around the perimeter of the carpark, except for the northern interface, adjacent the existing unsealed access road. A pedestrian crossing has been provided through the carpark, tying in with the existing combined maintenance facility pedestrian crossing.

The carpark has the following features:

– Designed to the AS2890 Standard.
– Capacity of 70 vehicles, with a width of 2.5 m, 5.4 m long with 7.0 m aisles.
– Three Disabled spaces have been included.
– Five motorcycle parking spaces.
– Entry/ exit point for passenger cars is located at northern end of the carpark.
– Heavy vehicle entry at the southern end of the new depot.
– Shared exit for heavy vehicles and cars will require appropriate signage and line marking.
– Pedestrian access will be provided to join the new operations depot to the existing combined maintenance facility.
– The existing power poles have been incorporated into the carpark layout.
– Strip drains located at all exit points.
– An allowance of 19 m has been allocated for heavy vehicles to enter forward, exit forward and to stop within the loading/unloading area.
– The carpark consists of a northern two-way loop for light vehicles, and a southern two-way aisle dedicated for the heavy vehicles. Currently there is a shared exit on the south, however this may be removed if Aurizon would like to separate the operation of heavy and light vehicles.

5.3 Stormwater

The site stormwater design has been indicatively shown at this stage. Input is required from the concurrent hydraulic assessment for the overall Long Term Train Support Facility, which is determining if there is capacity in the existing detention basin and floating wetlands to accommodate this development. These key items will determine the following:

– If on-site detention is required prior to outletting to the existing channel.
– If any water treatment devices are required prior to outletting to the existing channel.

These two inputs will dictate the stormwater network design for the new operations depot.

In general, the strategy is to relocate the diversion bund to the west of the new warehouse structure. Any runoff from within the local site catchment will then be collected in the carpark via a pit and pipe network, and outlet to the adjacent channel across the existing roadway. All roofwater will be collected in rainwater tanks with overflow outletting into the new pit and pipe network.

5.4 Geotechnical

The geotechnical report, *12553874_REP-0_Hexham* TSF, has been completed by GHD and provided to the Operations Depot design team on 20 October 2021.

A review of this report highlighted the following design constraints for the civil design:

– Subsurface conditions in the area are comprised of a thin layer of recent (TSF construction) fill acting as topsoil overlying the older variable fill associated with the previous coal handling facility to the limit of investigation.
– Groundwater was encountered in all test pits in the area at between 1.2 m and 3.3 m depth.
– Assumed CBR 5%.
– Where required, the depth of excavation should be limited to 1.5 m to avoid groundwater collapse.
– Temporary batters up to 1 m deep above the water table or zones of groundwater seepage may be excavated at 1H:1V.

5.4.1 Pavement design

The pavement design has been completed as a part of the geotechnical investigations. This pavement will be verified at a later stage of design, as well as the design for the rigid pavement at the loading and unloading area. This rigid pavement will also be required to take forklift loading.

Table 5.1 Flexible pavement design thickness

Layer	Material and compaction requirements	Material thickness
Wearing course	Primer seal plus asphalt (25 AC or 40 AC without primer) or Primer seal plus two coat flush seal and plus bituminous microsurfacing in accordance with Austroads or suitable AUS-SPEC alternative	25 mm - 40 mm* No thickness assumed for spray seal in granular thickness calculation
Basecourse	Conforming to TfNSW QA3051 or AUS-SPEC alternative	100 mm
Sub-base	Conforming to TfNSW QA3051 or AUS-SPEC alternative	190 mm
	Total thickness	**290 mm**

* Note: Where 40 mm or thicker asphalt wearing course is provided, this thickness can be included in the total pavement thickness and an equivalent reduction in subbase thickness applied while ensuring a minimum subbase thickness of 150 mm is maintained.

More detail on the pavement design and other geotechnical considerations can be found in the geotechnical report which is included as Appendix B.

6. Structural

The built form of the depot will consist of a lightly loaded single storey office, shown below in Figure 6.1, amenities and driver shift sign-on building. The structure will be predominantly constructed of timber framing with concrete footings and ground slab. Structural steel beams and columns will be utilised to provide column free spaces where necessary and select walls will be used to brace the structure against lateral loading.

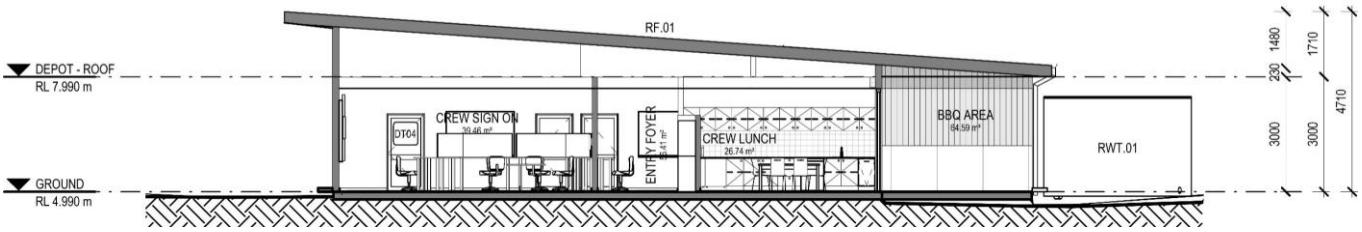

Figure 6.1 Indicative office structural section

The warehouse structure will be a portal frame building of structural steel and will be supported on a stiffened raft slab to suit the geotechnical constraints.

The wash bay and motorcycle shelter will be constructed of structural steel and will be supported on a stiffened raft slab.

6.1 Design parameters

Table 6.1 below summaries the proposed design criteria.

Table 6.1 Design parameters

Design Guide	Recommendations
AS1170.0 - Structural Design Actions Part 0: General Principles	– Importance Level - 2 (Normal Structure) – Design Working Life – 50 years – Annual Probability of Exceedance (Table F2) – Wind limit state= 1/500 – Earthquake limit state = 1/500 – Serviceability limit state = 1/25 – Load Combinations - in accordance with section 4 – Structural Robustness - in accordance with section 6 – Serviceability - The designer will adopt deflection limits using engineering judgement and the limits provided in table C1 (Appendix B) as a guide
AS1170.1 - Structural Design Actions Part 1: Permanent, imposed and other actions	– Permanent loads - in accordance with section 2 – Imposed loads – in accordance with section 2 – Roof Loads = (1.8/Area + 0.12)kPa but not less than 0.25 kPa or 1.4 kN plus any imposed point loads due to special fixtures such as large fans – Traffic loads will apply to pavement. Refer to civil design criteria for pavement traffic loads

Design Guide	Recommendations
AS1170.2 - Structural Design Actions Part 2: Wind Actions	– Region Area = A2 – Ultimate Regional Wind Speed = 46 m/s – Serviceability Regional Wind Speed = 37 m/s – Wind Direction Multiplier (Md) = 1.0 – Terrain Category = 1 (TC1) – Terrain/Height Multiplier Mz,cat = 1.08 – Shielding Multiplier (Ms) = 1.0 – Ultimate Site Wind Speed = 42.8 m/s – Serviceability Site Wind Speed = 35.2 m/s
AS1170.4 - Structural Design Actions Part 4: Earthquake actions in Australia	– Probability Factor (kp) = 1.3 – Hazard Factor (Z) = 0.11 – Sub-soil class – Class De or Ee (to be confirmed with Geotechnical investigations) – Earthquake design category: II
AS/NZS 2312.1 and 2– Guide to protection of structural steel against atmospheric corrosion by protective coatings	– All internal steelwork shall be hot dipped galvanised after fabrication. – All exposed steel to have an applied corrosion protection system to achieve a minimum durability of 25 years to first maintenance for the applicable atmospheric corrosivity category. No allowance is to be made for sectional loss in the design.
AS4100 – Steel Structures	– All structural steelwork shall be designed in accordance with AS4100.
AS1684.2-2021 – Timber Structures: Part 3 – Design criteria for timber-framed residential buildings	– All structural timber shall be designed in accordance with AS1684.2.
AS4055:2021 – Wind Loads for Housing	– Region Area = A2 – Terrain Category = 1 (TC1) – Topographic Class = T0 – Shielding Class = NS – Site Wind Classification = N2 – Ultimate Site Wind Speed = 40 m/s – Serviceability Site Wind Speed = 27 m/s
Geotechnical Conditions	– Shallow foundations such as strip or pad footings are considered appropriate for the lightly loaded single storey office, amenities and driver shift sign-on building and warehouse proposed for Area 1. A piled footing system is not considered suitable due to the significant depth to the founding unit (potentially greater than 25 m below ground surface). A stiffened raft slab for the warehouse could be designed based on elastic modulus values and taking into account the interaction between the slab and soil strata to evaluate system stiffness and hence the required slab thickness to limit contact stress and control structural actions in the slab.

7. Ecologically Sustainable Development (ESD)

This section of the report aims to provide guidance on sustainability initiatives for all disciplines under the theme of efficiency and sustainability.

7.1 Key targets and requirements

The mandatory sustainability targets are driven by the following:

1. Project Brief – Sustainability –Aurizon's commitment to deliver facilities to the best ecologically sustainable design standard.
2. National Construction Code 2019 – Section J Provisions.

Beyond the minimum performance standards GHD have sought to adopt best practice sustainability principles into the design where feasible. This focus being on energy efficiency, water efficiency indoor environment quality and material environmental impacts.

This project has also adopted net zero ready design principles to respond to Aurizon's broader business objective to be Carbon Neutral by 2050.

7.2 Site consideration/climate

The proposed development is located at Hexham in between the western side of the northern rail line. The building is situated in climate zone 5 (Warm Temperature). Designing buildings for warm temperate climates requires consideration of balancing both heating and cooling demand and where possible making use of shoulder seasons where outdoor conditions are generally favourable to provide occupant comfort. Passive solar design techniques such as building orientation and use of shading over windows exposed to sun will be required to manage building thermal loads.

NSW Adapt climate change projects that the mean temperatures will increase by 0.7 ºC and continue to rise by 2.1 ºC by 2070. The region is also expected to have an increase in the number of annual hot days, while the number of annual cold night will decrease. Future climate change impacts should be considered by designers in the next stage to ensure that building elements and systems are designed and selected to be resilient to future climate change.

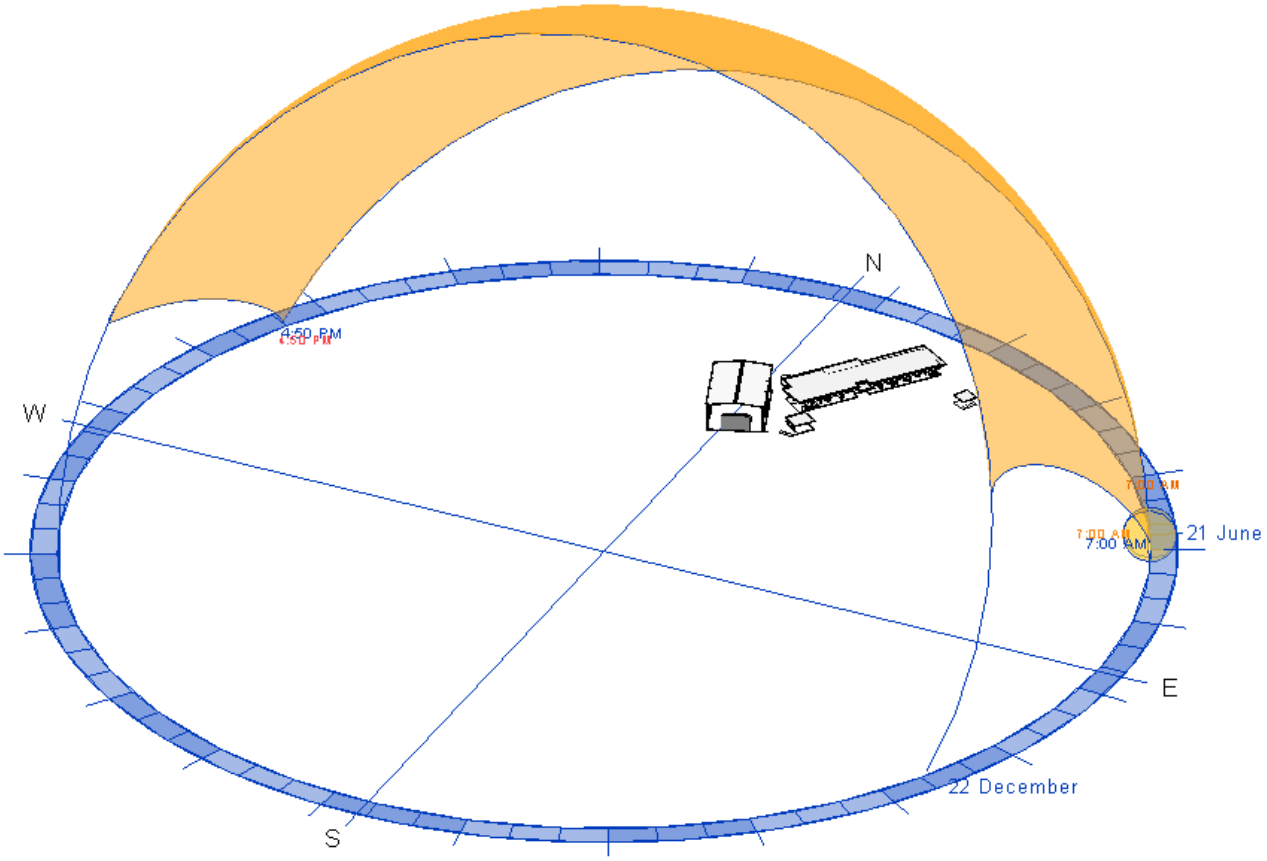

Figure 7.1 Sun path analysis diagram

The site location is exposed and not shaded by surrounding buildings or vegetation. Whilst this impact building thermal performance its does provide opportunity to introduce on site energy generation and is ideal location for solar PV adoption.

The site location also experiences moderate to high environmental noise due to the proximity of the Pacific Highway/ Maitland Road and the rail lines. As such, use of low energy comfort strategies such as natural or mixed model ventilation will not be practical for occupied spaces.

7.3 ESD initiatives summary

The following ESD initiatives are proposed for the project:

7.3.1 Passive design

The project has adopted a number of passive design principles to manage heat gains and losses. Due to other site constraints influencing the orientation, it was not possible to adopt an optimised massing and orientation. However, heat gains and losses will be managed through the following:

1. Limiting the extent of glazed elements. The project currently has a wall / window ratio of approximately 79% on all elevations.
2. Shading devices have been considered and implemented on the northern and western façade to prevent direct solar heat gains. The warehouse building will also provide shade to western elevation of the depot building.
3. Building envelope thermal performance has been determined. Increases over minimum Sec J performance should be considered to further reduce building energy use. Refer below Figure 7.2 and Table 7.1.
4. Warehouse spaces are using natural ventilation.

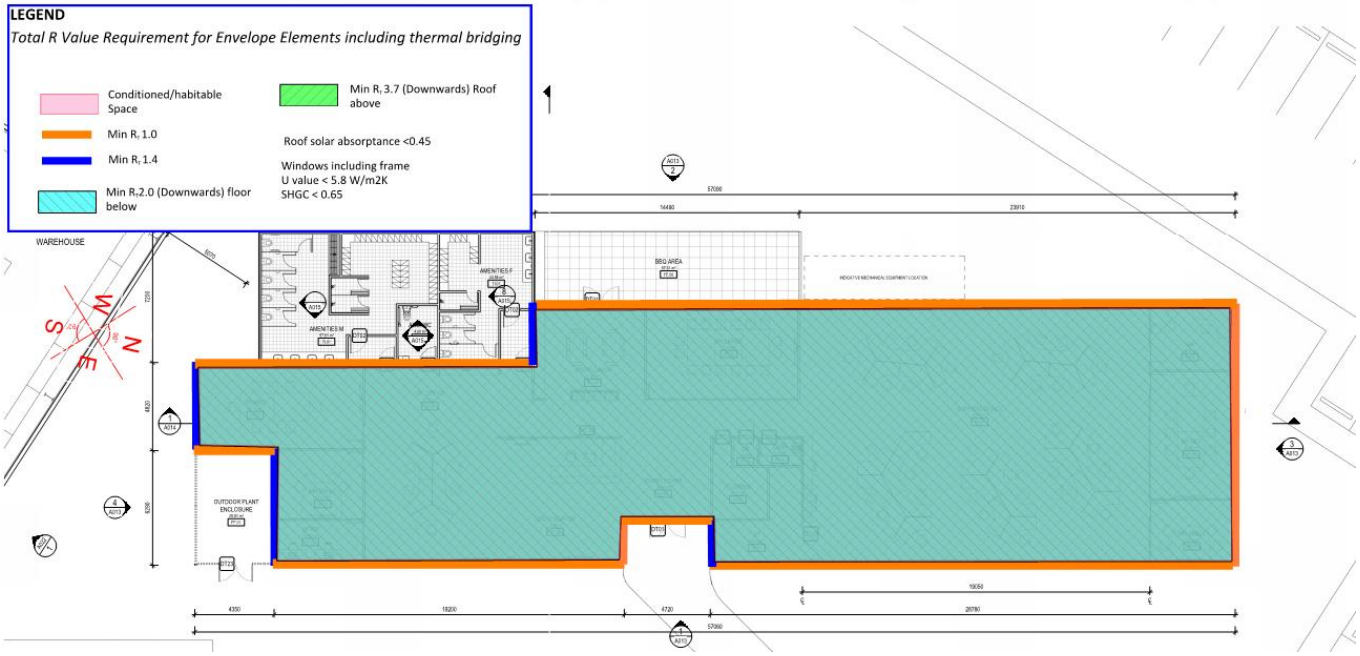

Figure 7.2 *Thermal performance mark up*

Table 7.1 *Building envelope thermal performance targets*

Type	NCC Section J1 DTS Requirements	Recommended Improvement
Walls	R1.0 (Western, Eastern and Northern Aspects) R1.4 (Southern Aspects)	R2.0 (All Aspects)
Glazing	SHGC 0.65, U-Value 5.80 W/m^2.K (single glazed)	SHGC 0.58, U-Value 3.0 W/m^2.K (double glazed)
Roof	R3.7	R4.1
Floor	R2.0	R2.2
Solar Absorptance	<0.45	<0.45

7.3.2 Active system efficiency

Lighting

The office and warehouse buildings are to utilise low power LED troffers fitted with control and sensors to limit operation in response to daylight and occupancy. The design aims to reduce the lighting power density by 10% prior to adjustment factor when compared to Table J6 of the NCC.

HVAC system

The current design intent for the building HVAC system is to utilise a VRF system with ducted fan coil units for majority of spaces and a packaged unit for the large open plan office area. To contribute to the building performance and sustainability approach the following is recommended for consideration:

– Target a 20% improvement over the NCC EER/COP requirement.
– Use CO_2 demand-controlled ventilation with internal C02 set point of 800 ppm instead of constant volume system.
– Air distribution to be tightly zoned to respond to building occupancy and external heat gains and losses.
– Low system pressure air distribution by oversizing ducts, using rounded bends, use turning vanes in large ductworks, use smooth gradual transitions and avoid abrupt entries/exits.

Hot water

The project will include a Domestic Electrified Hot Water Plant. Electrification of the hot water eliminate the need for gas and contributes to delivering the building as Net Zero Carbon ready. Current DHW options for consideration include:

– Heat pump
– Solar hot water

7.3.3 On site energy generation

As per the electrical section, the site can accommodate a 100 kW onsite PV system. Preliminary estimation indicates that system of this size can generate up to 137,440 kWh. Based on an assumed electricity cost of 0.15 cents/Kw.hr. This could lead to an annual electricity saving of approximately $20,000.

PV system and battery storage feasibility will be further explored in the next stage of the project. Introduction of PV will assist in reducing the buildings operational carbon emissions.

7.3.4 Carpark EV charging points

The design is incorporating up to six electric vehicle recharge points.

7.3.5 Water conservation

The design is incorporating the following water conservation features:

– Rainwater Harvesting with Class A filtration for toilet/urinal flushing and irrigation provisions. 2 x 20 kL rainwater tanks for Depot and Warehouse are proposed.
– Selection of efficient fixtures and fitting with the following minimum performance:
  - WELS Rating 5 Star – Taps, Urinals, Clothes Washing Machine, Dishwasher.
  - WELS Rating 4 Star –Toilets WELS Rating 3 Star – Showers.

7.3.6 Indoor quality

The following features are to be considered/adopted to improve occupant comfort:

– Indoor air quality to be maintained through:
  - Use of internal finishes with Low VOC content.
  - Use of internal wood products with low formaldehyde.
  - Use of demand-controlled ventilation and CO_2 set point of 800 ppm.
– Thermal comfort provided through combination of passive and active conditioning.
– Acoustic comfort provided through:
  - Maintaining internal noise levels to AS 2107 standard through controlling external noise intrusion and internal HVAC noise.
  - Controlling reverberation through selection of internal finishes.
  - Providing acoustic separation and speech privacy between occupied spaces (e.g. private offices, meeting rooms and open plan areas).
– Visual amenity is provided through specifying lights in occupied to:
  - Meet illumination level requirement in AS 1680.
  - Be Flicker-free lights with min. Colour Rendering Index (CRI) of 80.

7.3.7 Material selection

The following initiatives are to be considered to reduce impact of materials selection on:

- Concrete to include elements to reduce cement content and virgin materials through:
  - Targeting 30-40% use of cement replacement materials such as fly ash or ground blast furnace slag.
  - Using portion of recycled aggregates.
- The steel framing should have high recycled content and be sourced from a fabricator/supplier:
  - Accredited to the Environmental Sustainability Charter of the Australian Steel Institute (ASI).
- All external and internal finishes selected for increase durability to decrease maintenance requirements.
- Use of Low VOC paints, adhesives, sealants and flooring.
- Use of engineered timber products with no or low formaldehyde.
- Timbers to procured from sustainable forestry operations. Sources holding accreditation via Forest Stewardship Council (FSC) or Programme for the Endorsement of Forest Certification (PEFC).
- Avoid use of cables, pipes and flooring that contain PVC or select PVC products that meet the GBCA Best Practice PVC guidelines.
- Where practicable source all materials and finishes/products that have:
  - Recycled content.
  - Environmental Product Declarations.
  - Third Party Certification (e.g. GECA, etc.).

8. Electrical

8.1 Existing electrical installations

8.1.1 Mayfield operations buildings

The existing maintenance facility located in Mayfield consists of a two-storey office building and a warehouse storage facility. The office building has a typical electrical installation with distribution boards (DB's) serving small lighting and power as well as air conditioning and miscellaneous systems. The building is provided with a dedicated communications rooms with a connection to the NBN network. The existing warehouse has limited electrical load with one workstation as well as dedicated power for motorised roller doors and forklift charging.

8.1.2 CMF electrical

The existing combined maintenance facility is served by a 400 kVA Ausgrid pole top substation (Asset number HP63467). The site is connected via a private pole with consumer mains then reticulating underground to a main switchboard installed on a service platform to the West of the CMF building. Figure 8.1 Below shows the CMF main switchboard (MSB) located on the service platform. The main switchboard supplies the CMF main distribution board as well as smaller services to a signalling hut, service vehicle garage and a yard lighting distribution section. On review of the facilities energy bills, the main switchboard has a recorded peak demand of 120 kVA which was recorded in October 2020. The existing main switchboard has 3 spare 250 A circuit breaker spaces as well as a single 400 A circuit breaker space.

Figure 8.1 CMF main switchboard

8.1.3 CMF communications and security

The CMF communications network is serviced by an NBN fibre service with the main communications room located on the second floor of the office area. Figure 8.2 below shows the 4 racks within the existing communications room. There are spare ports within the fibre distribution panel to service the proposed building. The communications room also houses the security systems headend equipment that services the electronic access control system as well as the CCTV cameras located around the building and site.

Figure 8.2 CMF communications room

8.1.4 CMF fire detection and occupant warning systems

The CMF is serviced by a fire detection and alarm system for the 2 storey office area only. The Fire Detection, Control and Indicating Equipment (FDCIE) notes that the system is not connected to the fire brigade and provides local alarm only. Figure 8.3 shows the existing FIP installed within the CMF. Based on the size and classification of the building it is expected that the CMF office alarm system has been installed as an Aurizon preference and is not required to meet BCA fire detection and warning system requirements.

Figure 8.3 CMF FIP

8.2 Proposed Hexham facility

8.2.1 Electrical

It is proposed to connect the new operation building and warehouse into the existing CMF main switchboard. A distribution board will be provided within the operation office which will then supply a sub DB within the warehouse as well as a dedicated mechanical services switchboard (MSSB). The new office and warehouse are calculated to have a maximum demand of 140 kVA which when added to the existing maximum demand from the energy bills would have a total maximum demand of 260 kVA. An application for connection has been submitted to Ausgrid for the increased load and Ausgrid has approved the increase. Within the Application response Ausgrid have noted that the loads on the site must be limited to 375 A as to not exceed the 400 A rating of the low voltage fuses on the substation.

The office and warehouse building are to be provided with small lighting and power circuits as per the Aurizon design standards and user requirements. Lighting in the office shall consist of low power LED troffers and downlights and the warehouse shall utilise efficient low bay LED fittings with daylight control to limit operation time. The buildings shall be provided with emergency and exit lighting as per BCA requirements. Power and lighting layouts, electrical and lighting canulations shall be provided in the detailed design stage.

As discussed in section 7.1, a solar PV system is proposed for the site. Given the existing and proposed loads on site as well as the roof area available on the roof, a system up to 100 kW could be utilised on site with minimal export to the electrical grid. Final system sizing and location is to be agreed with Aurizon during the detailed design phase.

8.2.2 Communications and security

The new operation building shall be provided with a dedicated communications room as described by the requirements brief. The communication room shall be connected by optical fibre into the existing CMF communication room/network. A new rack shall provide patch panels and servers to serve the horizontal cabling to data outlets located throughout the building as required by the Aurizon design standards and user requirements. WIFI coverage shall be provided throughout the operations building as well as the warehouse to accommodate the moveable workstation.

Electronic access control and CCTV cameras shall be provided to the new buildings as per Aurizon requirements. A new expander panel shall be provided within the operations building communication room to service the new system with a connection to the security control panel in the CMF. Swipe Card access shall be provided on all external access doors, the IT room, the cleaners store and specific offices as defined by Aurizon. Final locations are to be confirmed by Aurizon during detailed design. As the new facility is over 90 m from the existing communications room, a new CCTV patch panel and network switch are to be provided within the new communications rack for connection of any new CCTV cameras required by Aurizon. The patch panel shall be connected by dedicated CCTV fibre link to the CCTV rack within the CMF.

8.2.3 Fire detection and occupant warning systems

Based on the classification of the buildings and the size, it is not expected that a fire detection systems or occupant warning systems will be required to be installed to suit BCA deemed to satisfy requirements. Noting the existing system installed within the office areas of the CMF building, it is expected that Aurizon will request a similar system to be installed within the new operations office. The system shall consist of smoke alarms installed within the office, connected into the CMF FDCIE with a new fire zone created for the operations building. This is to be confirmed by Aurizon during the detailed design phase.

Appendices

Appendix A

Return Brief

Design Report Appendices - All Documents (ghd.com)

Appendix B

Geotechnical Report

Design Report Appendices - All Documents (ghd.com)

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