Part B

Proposal-wide

18

18.0 Proposal-wide

As identified in Chapter 4 (Methodology) of this Environmental Impact Statement, this chapter provides an assessment of potential proposal-wide impacts during operation and construction and identifies mitigation measures to address these impacts.

Operational and construction impacts that would generally be applicable for the whole proposal have been considered on a proposal-wide basis in this chapter. These include property; air quality; sustainability, climate change and greenhouse gas; waste management and resource use; and hazard and risk. The proposal-wide elements of transport, social impacts, hydrology and water quality have also been addressed in this chapter, given that these elements would not be precinct-specific.

18.1 Overview

18.1.1 Operation

When operational, the proposal-wide benefits would be substantial. In particular, this proposal would provide significant improvements to the public transport network capacity and efficiency, including new public transport interchange facilities at and around stations. It would improve reliability across the rail network by relieving congestion on the T1 Western, T9 Northern, and T2 Inner West railway lines. It is also expected to provide wider road network benefits by encouraging greater use of public transport.

The operation of this proposal would also support new residential and employment zones along the Greater Parramatta to Sydney CBD corridor, including at Sydney Olympic Park and The Bays – providing improved transport for the additional 420,000 new residents and 300,000 new workers forecast to be located within the corridor over the next 20 years.

Operation of this proposal would also provide regional social benefits, such as reduced travel stress, improved accessibility to jobs, education and social facilities, and potential health and wellbeing outcomes associated with improved active transport.

Sustainability initiatives and targets would drive outcomes towards achieving a minimum rating of 75 under the Infrastructure Sustainability Council (ISC Design and As-Built rating Tool version 1.2) or 5 Star Green Star Design and As-built rating (or equivalent), as per the Concept condition of approval C-B7. Climate change risks would be assessed throughout design development and risk treatments would be progressively incorporated as appropriate.

When operational, the estimated greenhouse gas emissions would be around 157,800 tonnes of carbon dioxide equivalent per year. Sydney Metro would offset 100 per cent of greenhouse gas emissions associated with electricity consumption during operation. While difficult to quantify and assess, this proposal would also have the real potential to improve regional air quality and reduce regional greenhouse gas emissions by providing a low greenhouse gas alternative to private vehicle travel.

Potential impacts associated with property, hydrology and water quality, air quality, waste management and resource use, and hazard and risk, would comply with the relevant criteria and/or be minor to negligible.

18.1.2 Construction

During construction, proposal-wide impacts would generally be minor. Impacts would primarily relate to local amenity issues and would be addressed by proven management and mitigation measures.

Construction of this proposal would provide regional social benefits such as enhanced wellbeing from job opportunities and community investment. Potential temporary medium social impacts due to construction-related disruptions and potential amenity impacts would be manageable with the implementation of mitigation measures.

Greenhouse gas emissions are anticipated to be generated during the construction phase due to the need for energy consuming activities associated with plant, equipment and vehicle movements**.** The total estimated construction emissions from this proposal are 359,193 tonnes of carbon dioxide equivalent per year. Measures would be implemented to manage emissions, and Sydney Metro would offset 25 per cent of Scope 1 and Scope 2 construction emissions associated with this proposal.

During the construction of this proposal, the introduction of additional heavy vehicles on the road network has the potential to result in safety impacts on pedestrians, cyclists and other road users. Sydney Metro have extensive experience in managing construction related traffic safety issues in busy pedestrian areas on other similar projects. There is also potential for on-street parking impacts resulting from construction workers parking on surrounding streets. Specific mitigation measures to address this would be developed by the relevant construction contractor(s) in consultation with local councils during detailed construction planning.

Potential impacts associated with property, sustainability, climate change risk, air quality, waste management and resource use, hazard and risk, hydrology and water quality would comply with the relevant criteria and/or be minor to negligible with the implementation of standard management and mitigation measures.

Potential impacts would be managed through the implementation of the Sydney Metro management frameworks and standard mitigation measures including the Construction Environmental Management Framework (CEMF), Overarching Community Communications Strategy (OCCS) and Construction Traffic Management Framework (CTMF).

18.2 Property

The approach and methodology for the property assessment are provided in Chapter 4 (Methodology) of this Environmental Impact Statement. The legislative context for the assessment is provided in Appendix B (Legislative and policy context).

18.2.1 Baseline environment

Property impacts associated with work carried out under the previous Sydney Metro West planning applications, including the majority of the aboveground and substratum property acquisition, have been assessed as part of the *Sydney Metro West Environmental Impact Statement – Major civil construction work between Westmead to The Bays and Sydney CBD* (Sydney Metro, 2020a) and the *Sydney Metro West Environmental Impact Statement – Major civil construction between the Bays to Sydney CBD* (Sydney Metro, 2021a). Those assessments included a description of the existing environment and study area for each precinct, as well as identifying a proposed scope of property assessments for future stages. This proposal has used this same existing environment to provide a consistent approach. A review of recent information, in the form of maps and aerial photography, was carried out to confirm that the baseline environment is reflective of the current and future planned property conditions.

18.2.2 Operational impact assessment

Impacts to Crown land and Commonwealth land

There would be no impacts to Crown land or Commonwealth land as a result of additional land required for the operation of this proposal.

Aboveground and underground property acquisition, adjustments, and leasing

Aboveground property acquisition covered by the previous Sydney Metro West planning applications would generally encompass the majority of property acquisition required for this proposal. Where additional land is required, this is described in Section 18.2.3.

Where operational infrastructure interfaces with other NSW Government land or infrastructure (such as the existing rail corridors at Westmead and North Strathfield), Sydney Metro would enter into agreements with the relevant NSW Government department. This may involve acquisition, lease, licence or interface agreements.

At locations such as Westmead metro station, Sydney Olympic Park metro station and The Bays Station, Sydney Metro has entered into construction licences with NSW Government departments and would look to finalise the permanent acquisition based on as-built drawings. Further information on this is provided in Section 18.2.3.

It would be necessary to acquire land below the surface of the road and rail corridor for the construction of the underground concourse at Westmead metro station. This is referred to as substratum acquisition and is undertaken in accordance with the *Transport Administration Act 1988.*

Residual land

Some residual land has been identified for this proposal. This land would be required for most of the construction period (including work carried out under the previous Sydney Metro West planning application) and would be substantially altered during that time. Subject to detailed design and the requirements of this proposal, portions of this proposal's construction sites may not be required for operational infrastructure, landscaping and/or adjacent station developments (subject to separate approvals).

At this stage, potential residual land has only been identified around the Clyde stabling and maintenance facility and Rosehill services facility. This residual land is located to the north of Duck Creek in the area not required for the Rosehill services facility. In accordance with Concept condition of approval C-B2 (b), Sydney Metro is considering the future use of this residual land. This consideration includes the existing zoning of the land, the nature of the surrounding uses, the recreational needs of the local population, and the necessary work and remediation to make the land suitable for potential public use. Sydney Metro is also considering the potential use of this land to provide flood storage to meet the requirements of condition of approval D10 of SSI 10038. This consideration is subject to ongoing consultation with the City of Parramatta Council and the NSW Department of Planning and Environment.

18.2.3 Construction impact assessment

Impacts to Crown land and Commonwealth land

There would be no impacts to Crown land or Commonwealth land as a result of additional land required for the construction of this proposal.

Aboriginal land claim

Three lots adjacent to the Clyde stabling and maintenance facility and Rosehill services facility construction sites are subject to an undetermined Aboriginal land claim (Lots 3, 5 and 6 of DP1116474). These lots do not fall within the construction sites. As such, impacts to the area subject to claim are not anticipated and have not been assessed further.

Above ground and underground property acquisition, adjustments, and leasing

Above ground property acquisition covered by the previous Sydney Metro West planning applications would generally encompass the majority of property acquisition required for the construction of this proposal. There are some instances where additional land is required for the purposes of construction activities for this proposal. These indicative locations are discussed in more detail in Table 18-1.

The majority of this additional land involves the temporary use of NSW Government or local council-owned land, such as the existing rail corridors (at Westmead and North Strathfield) and road corridors at all sites to facilitate construction of transport interchange elements. In these instances, Sydney Metro would enter into agreements with the relevant NSW Government department or local council, such as licences, leases or a Memoranda of Understanding. In the instance of Sydney Olympic Park, Sydney Metro would undertake an exchange of land with the relevant landowner.

Where additional privately owned property may be required for this proposal, property acquisition would be managed in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* and the land acquisition reforms announced by the NSW Government, which can be viewed online at (www.propertyacquisition.nsw.gov.au).

It would be necessary to acquire land below the surface of the road and rail corridor for the construction of the underground concourse at Westmead metro station. This is referred to as substratum acquisition and is undertaken in accordance with the *Transport Administration Act 1988.*

Sydney Metro has appointed Personal Managers to offer residents and small businesses assistance and support throughout the acquisition process. Personal Managers are community engagement professionals specifically trained to assist residents and small business owners affected by property acquisition. They act as a primary point of contact between affected residents and Sydney Metro.

Table 18-1 Indicative additional property acquisition and land use/access requirements

Precinct	Additional property acquisition and land use/access requirements
Westmead	• temporary use of land within the existing rail corridor owned by the Transport Asset Holding Entity of NSW • temporary use of land within road corridors owned by local council or Transport for NSW • potential temporary use of land within the property north-west of the rail line and Hawkesbury Road • Sydney Metro would establish an agreement with relevant local councils for the land required for any upgrades to Alexandra Avenue, the aerial concourse and other potential supporting utilities and infrastructure • permanent acquisition of the land below the surface would be required for the underground concourse and other potential supporting utilities and infrastructure.

Precinct	Additional property acquisition and land use/access requirements
Parramatta	• temporary use of land within road corridors owned by local council or Transport for NSW.
Sydney Olympic Park	• temporary use of land within road corridors owned by local council or Transport for NSW • Sydney Metro is establishing an agreement with Sydney Olympic Park Authority for the land around the Figtree Drive/Olympic Boulevard intersection owned by Sydney Olympic Park Authority.
North Strathfield	• temporary use of land within the existing rail corridor owned by the Transport Asset Holding Entity of NSW • temporary use of land within road corridors owned by local council or Transport for NSW.
Burwood North	• temporary use of land within road corridors owned by local council or Transport for NSW.
Five Dock	• temporary use of land within road corridors owned by local council or Transport for NSW.
The Bays	• Sydney Metro is establishing an agreement with Place Management NSW for the land to the south of the White Bay Power Station for precinct works and the traction substation • temporary use of land owned by Place Management NSW to the north-east of the White Bay Power Station for precinct works • temporary use of land within road corridors owned by local council or Transport for NSW.
Pyrmont	• temporary use of land within road corridors owned by local council or Transport for NSW.
Hunter Street (Sydney CBD)	• temporary use of land within road corridors owned by local council or Transport for NSW.
Clyde and Rosehill	• no additional property acquisition anticipated for this proposal.

18.2.4 Management and mitigation measures

Environmental management for this proposal would be undertaken through the environmental management approach as detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. This includes operational mitigation measures (where relevant) and performance outcomes for the operation and construction of this proposal.

Property impacts during construction of this proposal would be managed in accordance with Sydney Metro's CEMF (Appendix F) and the OCCS (Appendix C). The CEMF includes management objectives and mitigation measures to minimise impacts as relevant to this proposal as a whole. The OCCS which would guide Sydney Metro's approach to stakeholder and community liaison, including engagement with communities, stakeholders and businesses.

18.3 Air quality

The approach and methodology for the air quality assessment are provided in Chapter 4 (Methodology) of this Environmental Impact Statement. The legislative context for the assessment is provided in Appendix B (Legislative and policy context).

18.3.1 Baseline environment

The baseline air quality environment has been identified through consideration of the existing ambient air quality in the region, along with the expected future ambient air quality conditions (including taking into account the work carried out under the previous Sydney Metro West planning applications).

Existing sources of air pollution in the corridor between Westmead metro station and Hunter Street Station (Sydney CBD) Station are dominated by road traffic emissions, which are included in the long-term monitoring data as presented below.

A search of the National Pollutant Inventory has also been carried out and indicates limited contribution by industry close to the proposed station locations, with the exception of Clyde stabling and maintenance facility and Rosehill services facility, which have several large industrial developments close by, including the Downer EDI Limited facility, the Viva Clyde Terminal facility and the James Hardie manufacturing facility. These facilities have the potential to contribute particulates into the atmosphere that may contribute to the background pollutant concentrations. As these facilities have been in operation for long periods of time, their contribution would also be included in the background monitoring data.

Ambient air quality data has been collected across the Sydney basin as part of a monitoring program undertaken by NSW Environment, Energy and Science. Pollutant concentrations measured by this program are affected by several factors including topography, and prevailing meteorological conditions (wind speed and direction in particular) along with local and regional scale pollutant sources (such as road traffic and industrial pollution). Given the variability of many of these factors across the Sydney basin, the ambient air quality can vary significantly at a local or regional level.

Several ambient air quality monitoring stations are operated by NSW Environment, Energy and Science close to this proposal and are considered relevant to this proposal. The stations of interest include Prospect, Parramatta North, Rozelle and Randwick. Pollutants measured at these locations include particulates (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO) and sulphur dioxide (SO_2). Air pollutant concentrations at these stations over the period from 2014 to 2020 are presented in Table 18-2 and Table 18-3. It should be noted that while the 2019 and 2020 pollutant concentrations have also been included, data from these time periods are considered to be skewed due to extreme events that occurred during those calendar years (black summer bushfires over 2019-20 and COVID-19 shutdowns in 2020). Further, no data was collected at Parramatta North between 2014 and 2017.

Data for the area surrounding this proposal showed that generally the monitoring stations located in the west showed higher concentration of particulates, with Prospect and Parramatta showing annual average $PM_{2.5}$ concentration generally higher than those to the east, at the Rozelle and Randwick stations.

Meteorological conditions affect the direction and rate of pollutant dispersion. Conditions within this proposal's construction sites can be described through data collected at several monitoring stations operated by the Bureau of Meteorology (BoM). Long-term monitoring records for this analysis were obtained from the BoM station situated at Sydney Olympic Park, which is central to the overall proposal.

A review of long-term climate data for Sydney Olympic Park showed that Sydney experiences warm wet summers with maximum temperatures around 28^{o}C. Winter conditions are cooler with generally dryer conditions between August and September.

Table 18-2 Pollutant concentrations at Prospect and Parramatta North (western portion of this proposal)

Pollutant	averaging time	Air impact assessment criteria[2]	Prospect							Parramatta North						
			2014	2015	2016	2017	2018	2019	2020	2014	2015	2016	2017	2018	2019	2020
PM_{10} ($\mu g/m^3$)	24-hour max	50	44	**69**	**110**	**61**	**113**	**183**	**246**	-	-	-	-	**107**	**195**	**189**
	95th percentile 24 hour[1]	-	30	30	34	32	37	61	40	-	-	-	-	39	58	38
	Annual average	25	18	18	19	19	22	**26**	20	-	-	-	-	22	25	19
$PM_{2.5}$ ($\mu g/m^3$)	24-hour max	25	-	**30**	**85**	**30**	**47**	**134**	**71**	-	-	-	-	**42**	**130**	**73**
	95th percentile 24 hour[1]	-	-	16	18	15	16	**34**	20	-	-	-	-	17	26	21
	Annual average	8	-	**8.2**	**8.7**	7.8	**8.4**	**11.8**	**8.6**	-	-	-	-	**9.2**	**10.4**	**8.2**
CO ($\mu g /m^3$)	Maximum 1 hour	30,000	2.4	2.2	1.8	1.8	1.5	6.3	2.4	-	-	-	-	1.5	6.6	3.2
NO_2 ($\mu g/m^3$)	1-hour maximum	246	88	100	100	113	96	92	81	-	-	-	-	120	132	70
	Annual average	62	19	20	18	18	17	16	14	-	-	-	-	20	19	14
SO_2 ($\mu g/m^3$)	1-hour maximum	570	50	71	55	60	66	55	47	-	-	-	-	55	79	52
	Annual average	60	2	1	2	2	2	2	1	-	-	-	-	2	2	1

[1] 95th percentile data used to demonstrate that most of the PM_{10} and $PM_{2.5}$ concentrations are below the 24-hour maximum criteria
[2] Criteria extracted from NSW EPA Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016)
Notes:

1. All gaseous data (CO, NO_2 and SO_2) expressed as a concentration at 25ºC
2. Only data presented where the station operated for a full calendar year
3. Bold data denote exceedance of NSW EPA criteria

Table 18-3 Pollutant concentrations at Rozelle and Randwick (eastern portion of this proposal)

Pollutant	Averaging time	Air impact assessment criteria[3]	Rozelle							Randwick						
			2014	2015	2016	2017	2018	2019	2020	2014	2015	2016	2017	2018	2019	2020
PM_{10} ($\mu g/m^3$)	24-hour max	50	44	**60**	**59**	**54**	**88**[2]	**143**	**113**	46	**77**	44	**56**	**96**	**128**	**137**
	95th percentile 24 hour[1]	-	30	29	30	31	31[2]	49	34	32	32	32	32	36	52	37
	Annual average	25	18	17	17	18	18[2]	23	18	18	19	18	19	21	24	19
$PM_{2.5}$ ($\mu g/m^3$)	24-hour max	25	-	**33**	**49**	**36**	19[2]	**102**	**87**	-	-	-	45	**32**	**95**	**115**
	95th percentile 24 hour[1]	-	-	14	14	13	14[2]	28	18	-	-	-	13	14	27	16
	Annual average	8	-	7.2	7.4	7.2	7.3[2]	**10.3**	7.6	-	-	-	-	7.6	**11.0**	7.6
CO (μg /m^3)	Maximum 1 hour	30,000	1.6	1.8	2.0	1.4	1.2[2]	6.0	3.8	-	-	-	-	-	-	-
NO_2 ($\mu g/m^3$)	1-hour maximum	246	103	113	94	115	107[2]	169	81	88	81	83	77	75	96	70
	Annual average	62	20	20	20	22	19[2]	18	15	11	16	15	13	12	12	9
SO_2 ($\mu g/m^3$)	1-hour maximum	570	-	73	52	63	79[2]	84	42	68	81	89	76	55	76	37
	Annual average	60	-	2	1	1	2[2]	2	1	2	2	2	3	3	2	2

[1] 95th percentile data used to demonstrate that most of the PM_{10} and $PM_{2.5}$ concentrations are below the 24-hour maximum criteria
[2] Low data capture for 2018. Annual average calculated based on 68 percent data capture.
[3] Criteria extracted from NSW EPA Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016)
Notes:

1. All gaseous data (CO, NO_2 and SO_2) expressed as a concentration at 25ºC
2. Only data presented where the station operated for a full calendar year
3. Bold data denote exceedance of NSW EPA criteria

18.3.2 Operational impact assessment

As this proposal would be powered by electricity, local emissions generated during operation are expected to be minimal and highly dispersed.

This proposal would include operation of twin tunnels between Westmead metro station and Hunter Street Station (Sydney CBD). Air would be drawn through the stations via a ventilation system that aims to reduce heat within the stations and tunnels and dilute the low levels of pollutants. In addition, air would be pushed through the tunnels via the piston effect of the trains moving through the tunnels. Minor quantities of particulate matter (PM_{10}) would be generated within the tunnel, mainly due to the wear of the train brake pads, vaporisation of metals due to sparking, and wear of steel due to friction between wheels and rail. These emissions would represent very low concentrations, and only a minor or negligible impact is anticipated within the tunnel and station network from these emissions. In addition, small quantities of carbon monoxide, volatile organic compounds and oxides of nitrogen would be contained within the ventilated air due to entrained air containing small quantities of air pollutants. It is anticipated that the emission of these compounds would result in a minor or negligible impact on the air quality around the stations or tunnel portals.

Air from the stations and tunnels would be vented from the tunnel entrances and through the ventilation outlets incorporated into the stations and at the services facility. As outlined above, the air being discharged from the tunnel ventilation would contain minor quantities of particulate matter (PM_{10}) and is expected to be dispersed quickly once outside the stations and tunnels and in the ambient environment, resulting in a negligible impact to air quality.

Overall potential air quality impacts would present a low level of risk, would occur infrequently and would be manageable with negligible impacts on local air quality.

This proposal is expected to benefit regional air quality by delivering an attractive alternative mode of public transport, which could result in a mode shift from road to rail (refer to Section 18.7). This has the potential to reduce air pollution emissions from road transport and associated congestion, when compared to the emissions that would otherwise occur if this proposal was not delivered.

18.3.3 Construction impact assessment

Construction activities associated with this proposal would largely involve the construction and fit-out of the station buildings along with minor demolition activities and works to complete the interface between the proposed stations and the existing Sydney Trains rail lines. For much of the construction works associated with this proposal it is not expected major demolition work or bulk earthworks would be required that would have a high potential to generate significant quantities of dust. However, some bulk earthworks are required at the Westmead metro station construction site (refer to Section 7.4 (Construction description) of this Environmental Impact Statement), Parramatta metro station construction site (refer to Section 8.4 (Construction description) of this Environmental Impact Statement) and some earthworks at Sydney Olympic Park metro station construction site (refer to Section 9.4 (Construction description) of this Environmental Impact Statement).

Potential dust impacts were assessed using a risk-based approach developed by the UK Institute of Air Quality Management (UK IAQM, 2014). The UK IAQM assessment approach evaluates the risk of dust impacts occurring during construction works and involves estimation of the magnitude (i.e. large, medium or small) of potential dust emissions associated with each of the relevant activities. For this proposal the relevant activities would include:

- minor demolition works
- minor earthworks at North Strathfield metro station, Five Dock Station and The Bays Station construction sites from works within the existing rail alignment, minor additional station excavation, or construction of trunk utilities, a traction substation and road works
- minor earthworks for trenching within road reserves for the construction of a power supply route between Rosehill services facility and Camellia substation
- more significant earthworks at Westmead metro station, Parramatta metro station and Sydney Olympic Park metro station construction sites associated with the underground concourse establishment, basement establishment, and site levelling, respectively
- construction of station and ancillary buildings and structures, including enabling and site establishment works required for each station and ancillary facility
- ‘track-out’ or transport related handling of construction materials on-site (with reference to the number of heavy vehicles per day and the extent of unsealed roads expected at the site).

The risk assessment includes the consideration of the sensitivity of the surrounding human and ecological environment, accounting for the proximity and density of human receivers within 350 metres of construction sites, and sensitive ecological receivers within 50 metres of construction sites.

The sensitivity of the surrounding receiver area is identified for the following:

- nuisance impacts (such as dust soiling), which is based on the number of sensitive receivers in close proximity to the site
- human health impacts, including eye irritation
- ecological impacts, where an ecological community or ecologically sensitive receiver could be affected through dust deposition from construction dust emissions.

Sensitive receiver description

A summary of the potential sensitivity to dust impacts with respect to the nature of nearby sensitive receivers across the project is provided in Table 18-4.

Table 18-4 Nature of nearby sensitive receivers

Location	Location of sensitive receivers	Expected sensitivity
Station construction		
Westmead metro station	Sensitive receivers within the study area around the Westmead metro station construction site include: • residential receivers situated to the north and east across Railway Parade, to the west across Hawkesbury Road and to the south across Bailey Street and Alexander Avenue • users of public parks (the closest being Cumberland Oval approximately 250 metres to north-west of the proposed metro station), as well as several educational facilities including Westmead Public School (approximately 100 metres from the site), and places of worship • there are no identified ecologically sensitive receivers close to Westmead metro station and as such, this has not been assessed further. Given the largely residential nature of the area surrounding Westmead metro station, there would be an expected high sensitivity to potential air quality impacts.	High
Parramatta metro station	Sensitive receivers within the study area around the Parramatta metro station construction site include: • high-density residential and commercial towers situated close to the station location in all directions • there are no identified ecologically sensitive receivers close to Parramatta metro station and as such, this has not been assessed further. Given the high-density commercial and residential nature of the area surrounding Parramatta metro station, there would be an expected high sensitivity to potential air quality impacts.	High
Sydney Olympic Park metro station	Sensitive receivers within the study area around the Sydney Olympic Park metro station construction site include: • high-density commercial towers situated close to the station location in all directions • there are no identified ecologically sensitive receivers close to Sydney Olympic Park metro station and as such, this has not been assessed further Given the commercial/industrial and residential nature of the area surrounding Sydney Olympic Park metro station, there would be an expected high sensitivity to potential air quality impacts.	High

Location	Location of sensitive receivers	Expected sensitivity
North Strathfield metro station	Sensitive receivers within the study area around the North Strathfield metro station construction sites include: • residential and commercial buildings located close to the east and west of the construction site • receptors of particular note close to the construction area include The McDonald College to the west (approximately 20 metres from the construction site) • there are no identified ecologically sensitive receivers close to North Strathfield metro station and as such, this has not been assessed further. Given the predominantly residential and sensitive nature of the area immediately surrounding North Strathfield metro station, there would be an expected high sensitivity to potential air quality impacts.	High
Burwood North Station	Sensitive receivers within the study area around the Burwood North Station construction sites include: • several low-density residential receivers to the north of the station building within 20 metres of the construction site, as well as many commercial receptors and a small number of high-density residential receptors across Burwood Road and Parramatta Road to the west and south respectively • special land use receptors close to the construction site with Concord Oval to east and St Luke's Anglican Church to the north of the construction site • there are no identified ecologically sensitive receivers close to Burwood North Station and as such, this has not been assessed further. Given the high-density residential and commercial nature of the area surrounding the Burwood North Station, there would be an expected high sensitivity to potential air quality impacts.	High
Five Dock Station	Sensitive receivers within the study area around the Five Dock Station construction sites include: • many low and high-density residential and commercial receivers surround the construction sites in all directions, with several of the receptors within 20 metres of the construction site • special land use receptors are also close to the construction site with GGC Life Church to the north-east and St Alban's Anglican church immediately to the north of the construction site. Five Dock Primary School is located approximately 90 metres to the west of the construction site • there are no identified ecologically sensitive receivers close to Five Dock Station and as such, this has not been assessed further. Given the mixed-density residential and commercial nature of the area surrounding Five Dock Station, there would be an expected high sensitivity to potential air quality impacts.	High
The Bays Station	Receivers within the study area around The Bays Station construction site include: • commercial buildings located close to the northern boundary of the Bays Station construction site. The closest residential receptors are located approximately 80 metres to the north and 140 metres to the west of construction site • ecologically sensitive receivers associated with White Bay are located immediately adjacent to the construction site. Given the predominantly commercial nature of the area immediately surrounding The Bays Station, there would be an expected high sensitivity to potential air quality impacts.	High

Location	Location of sensitive receivers	Expected sensitivity
Pyrmont Station	Sensitive receivers within the study area around the Pyrmont Station construction sites include: • many high-density residential and commercial dwellings in close proximity to the station construction area in all directions, with several of the receptors within 20 metres of the construction site • special land use receptors close to the construction site including hotels, The Star Sydney casino and a variety of outdoor restaurants and commercial establishments that are likely to be sensitive to dust emissions • there are no identified ecologically sensitive receivers close to Pyrmont Station and as such, this has not been assessed further. Given the high-density residential and commercial nature of the area surrounding Pyrmont Station, there would be an expected high sensitivity to potential air quality impacts.	High
Hunter Street Station (Sydney CBD)	Sensitive receivers within the study area around the Hunter Street Station (Sydney CBD) construction sites include: • the Hunter Street Station (Sydney CBD) area is characterised by high-density residential and commercial buildings in close proximity to the station construction area in all directions, with several receptors within 20 metres of the construction site • there are no identified ecologically sensitive receivers close to Hunter Street Station (Sydney CBD) and as such, this has not been assessed further. Given the high-density residential and commercial nature of the area surrounding Hunter Street Station (Sydney CBD), there would be an expected high sensitivity to potential air quality impacts.	High
Construction of ancillary infrastructure		
Clyde stabling and maintenance facility and Rosehill services facility	Sensitive receivers within the study area around the Clyde stabling and maintenance facility and Rosehill services facility construction sites include: • the Clyde area is largely characterised as commercial industrial with a small area of residential development to the west of the construction sites across James Ruse Drive (at a distance of over 150 metres from the construction site) • the Duck Creek and Duck River area to the east of the facility has been identified as a potential ecologically sensitive receiver • Rosehill Gardens racecourse is located to the north of the construction sites. Given Duck Creek's potential to contain important plant species, where its dust sensitivity is uncertain or unknown, the sensitivity of the area has been rated as medium sensitivity (from an ecological standpoint). Given the more dominant industrial nature of the area surrounding Clyde stabling and maintenance facility and Rosehill services facility, sensitivity to potential dust impacts would be expected to be medium.	Medium

The magnitude of the proposed construction activities (demolition, construction, earthworks and track-out) have been estimated for this proposal, pre-mitigation. The magnitudes are based on the construction activities as described in the project descriptions for each precinct, and the classification for small, medium and large construction activities as defined in the UK IAQM document Guidance on the assessment of dust from demolition and construction. A summary of these magnitudes is provided in Table 18-5.

Table 18-5 Construction activity magnitude

Station/precinct	Demolition	Earthworks	Construction	Track out
Westmead metro station construction site	Small	Medium	Medium	Large
Parramatta metro station construction site	None	Large	Large	Large
Sydney Olympic Park metro station construction site	None	Medium	Large	Large
North Strathfield metro station construction sites	None	Small	Small	Large
Burwood North Station construction sites	None	None	Large	Large
Five Dock Station construction sites	None	Small	Medium	Large
The Bays Station construction site	None	Small	Medium	Large
Pyrmont Station construction sites	None	None	Medium	Large
Hunter Street Station (Sydney CBD) construction sites	None	None	Medium	Large
Clyde stabling and maintenance facility construction site and Rosehill services facility construction site	None	Large	Large	Large

Predicted unmitigated and mitigated risks

The sensitivity of the receptors was combined with the magnitude of the construction activities occurring at each precinct construction site to predict the unmitigated and mitigated nuisance and human health risks. These are summarised in Table 18-6.

Potential ecological risks would be limited due to the locations being assessed, with the locations with potential ecological risk presented in Table 18-7.

With the implementation of appropriate mitigation measures (refer to Section 18.3.4), dust nuisance and human health risk and ecological risk would be negligible at all construction sites.

Table 18-6 Overall proposal risk summary – nuisance and human health risk

Location	Unmitigated risk				Mitigated risk			
	Demolition	Earthworks	Construction	Track out	Demolition	Earthworks	Construction	Track out
Station construction								
Westmead metro station	Medium	Medium	Medium	High	Negligible	Negligible	Negligible	Negligible
Parramatta metro station	No risk	High	High	High	No risk	Negligible	Negligible	Negligible
Sydney Olympic Park metro station	No risk	High	High	High	No risk	Negligible	Negligible	Negligible
North Strathfield metro station	No risk	Low	Low	High	No risk	Negligible	Negligible	Negligible
Burwood Station	No risk	No risk	High	High	No risk	No risk	Negligible	Negligible
Five Dock Station	No risk	Low	Medium	High	No risk	Negligible	Negligible	Negligible
The Bays Station	No risk	Low	Low	Medium	No risk	Negligible	Negligible	Negligible
Pyrmont Station	No risk	No risk	Medium	High	No risk	No risk	Negligible	Negligible
Hunter Street Station (Sydney CBD)	No risk	No risk	Medium	High	No risk	No risk	Negligible	Negligible
Construction of ancillary infrastructure								
Clyde stabling and maintenance facility and Rosehill services facility	No risk	Medium	Medium	Medium	No risk	Negligible	Negligible	Negligible

Table 18-7 Overall proposal risk summary – ecological risk

Location	Unmitigated risk				Mitigated risk			
	Demolition	Earthworks	Construction	Track out	Demolition	Earthworks	Construction	Track out
Clyde stabling and maintenance facility and Rosehill services facility	No risk	Medium	Medium	Medium	No risk	Negligible	Negligible	Negligible
The Bays Station	No risk	Low	Low	High	No risk	Negligible	Negligible	Negligible

Construction vehicles and equipment

The source of non-construction dust emissions during construction of this proposal would be due to the combustion of diesel fuel by heavy vehicles, mobile construction equipment and stationary equipment such as diesel generators. Emissions are expected to depend on the nature of the emissions source (i.e. size of the equipment, usage rates, duration of operation etc.). Pollutants emitted by construction vehicles include carbon monoxide, particulate matter, nitrogen dioxide, sulphur dioxide, volatile organic compounds and polycyclic aromatic hydrocarbons.

Given the typically transitory nature of construction site mobile equipment, vehicle numbers and the commonly applied mitigation measures expected to be incorporated into the operation of the equipment, adverse air quality impacts from the operation of construction equipment are not expected. On this basis, no further quantification of the potential impacts has been undertaken.

18.3.4 Management and mitigation measures

Environmental management for this proposal would be undertaken through the environmental management approach as detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. This includes operational mitigation measures (where relevant) and performance outcomes for the operation and construction of this proposal.

Air quality impacts during construction of this proposal would be managed in accordance with Sydney Metro's CEMF (Appendix F). The CEMF includes management objectives and mitigation measures to minimise impacts as relevant to this proposal as a whole.

18.4 Sustainability, climate change and greenhouse gas

The approach and methodology for the sustainability, climate change and greenhouse gas assessment are provided in Chapter 4 (Methodology) of this Environmental Impact Statement. The legislative context for the assessment is provided in Appendix B (Legislative and policy context).

18.4.1 Policy and strategy framework

Sydney Metro is committed to sustainability leadership to create a positive legacy for the customers and communities it serves, as outlined in its Environment and Sustainability Statement of Commitment (Sydney Metro, 2020e). This commitment is guided by the Transport for NSW Environment and Sustainability Policy (Transport for NSW, 2020d) and includes commitments to embed sustainability in all its activities, minimise environmental impacts such as greenhouse gas emissions, and deliver assets and services that are resilient to the effects of climate change. The Sydney Metro West Sustainability Plan represents the implementation of this commitment at the project level.

Sustainability

The Sydney Metro West Sustainability Plan outlines the sustainability principles, objectives and initiatives across all Sydney Metro West phases, including relevant performance targets and outcomes. Within the six sustainability principles, there are a series of initiatives and targets that have been identified to support the implementation of these sustainability principles. These principles are applicable to all phases of Sydney Metro West including planning, procurement, design, construction and operations to end-of life.

Targets and outcomes within this plan have been identified to support a range of complementary policies, plans and legislation (as highlighted in Chapter 2 (Planning and assessment process) of this Environmental Impact Statement), as well as other relevant legislation and policies, including alignment with the *Waste Avoidance and Resource Recovery Act (2001)*, *NSW Transport Administration Act (1988*), NSW Procurement Policy Framework (NSW Government, 2021c), and *NSW Modern Slavery Act (2019)*, among others. Table 18-8 highlights the specific targets that are applicable to this proposal.

Six sustainability principles have been developed as part of the Sydney Metro West Sustainability Plan and are applicable to this proposal – encompassing environmental, social and economic aspects. These principles are highlighted below in Figure 18-1.

Figure 18-1 Sustainability principles and objectives

The principles of Ecologically Sustainable Development also guide sustainability within NSW and for this proposal, as defined in the Environmental Planning and Assessment Regulation 2021. These principles are addressed in Chapter 20 (Synthesis) of this Environmental Impact Statement.

Climate change

The response by the NSW Government to climate change has largely been driven by the NSW Climate Change Policy Framework (NSW Government, 2016b), which aims to maximise the economic, social and environmental wellbeing of NSW in the context of a changing climate. The two key objectives of the framework are to achieve net-zero emissions by 2050 and to become better prepared and more resilient to climate change.

As highlighted in Table 18-9, baseline projections for the average climates of both Parramatta and Sydney (being the termini for this proposal), for the period from 1986 to 2005, have been provided to understand the current observed climate. This data includes relevant temperature and rainfall data (being among the most material challenges for the Greater Sydney region) for the purposes of establishing a basis to better understand future projections.

Agencies within NSW, including Transport for NSW, also align to a series of principles that guide adaptation planning in response to a changing climate across Australia through the National Climate Resilience and Adaptation Strategy (2021-2025), a number of which directly relate to transport infrastructure and services. These principles include:

- shared responsibility – responding to climate change requires all levels of government to address risks and adaptation
- climate change consideration into decision-making – ensuring current climate and future changes are factored into relevant decisions
- assisting the vulnerable – supporting and responding to the more vulnerable members of the population
- evidence-based – using the latest available science
- collaborative choices – leveraging experience, involving key stakeholders in decision-making
- revisit decisions and outcomes – reviewing actions and past experience on a regular basis and provide flexibility in future opportunities.

In addition, the Climate Risk Assessment Guidelines (Transport for NSW, 2021) outline an approach for Transport for NSW projects to consider climate change during the design and/or modification of infrastructure. This Guideline forms the basis for how the design of Sydney Metro West would respond to the effects of climate change.

Greenhouse gas

Management of greenhouse gases in NSW is generally governed by the NSW Climate Change Policy Framework (NSW Government, 2016b), which aims to achieve net-zero emissions by 2050; and at present, the Net Zero Plan Stage 1: 2020-2030 (NSW Department of Planning, Industry and Environment, 2020c), which outlines the steps needed to deliver a 50 per cent reduction in emissions over 2005 levels by 2030. The Net Zero Plan highlights opportunities to meet this commitment including:

- capitalising on the demand for low-emissions products and services
- leveraging cost-competitive low-emissions technologies
- encouraging early adoption and innovation in traditional methods and processes.

As highlighted in the Net Zero Plan, emissions are projected to stabilise by 2030, regardless of further action occurring; however, the opportunities highlighted above will be needed to achieve both the required reduction in emissions by 2030 as well as broader net-zero aspirations by 2050. For the 2020, calendar year, transport emissions contributed 17.6 per cent of the total annual emissions across Australia (DISER, 2021). The total emissions in Australia being an estimated 499 Mt CO2e (Australian Government Department of Industry, Science, Energy and Resources, 2021a), while total emissions in 2019 for NSW were an estimated 136.58 Mt CO2e (Australian Government Department of Industry, Science, Energy and Resources, 2021b). These estimates are consistent with the proportion of emissions based on the Net Zero Plan Stage 1: 2020-2030 (28 Mt CO2e or 20.4 per cent of total emissions in NSW coming from transport) (NSW Department of Planning, Industry and Environment, 2020c).

18.4.2 Operational impact assessment

Sustainability

For this proposal, sustainability means the delivery of rail infrastructure, stations, precincts and operations that meets the needs of current and future generations, while optimising environmental and social outcomes, cost effectiveness and the quality of public transport services.

How this proposal will address specific ecological and sustainability initiatives and targets as identified in the Sydney Metro West Sustainability Plan are highlighted below in Table 18-8. A number of specific actions to respond to the targets can be found within Chapter 20 (Synthesis) of this Environmental Impact Statement.

Table 18-8 Sydney Metro West sustainability principles, initiatives and targets

Principle	Initiative	Targets	Planning	Design	Construction	Operations	End of life
Demonstrate leadership	Transparency and assurance	Obtain an Infrastructure Sustainability rating for relevant infrastructure of 'Leading' (75 points) for design and as built in operation		●	●	●	
		Obtain a minimum 5-Star Green Star ratings for relevant buildings and precincts		●	●	●	
Tackle climate change	Infrastructure and operations will be resilient to the impacts of climate change	Identify and mitigate all extreme and high climate change risks for this proposal	●	●	●	●	
	Reduce energy use and carbon emissions	Implement passive design features such as maximising natural ventilation and natural daylight	●	●	●		

Principle	Initiative	Targets	Planning	Design	Construction	Operations	End of life
	Establish energy efficiency and renewable energy/offset targets	Offset at least 25% of the greenhouse gas emissions associated with consumption of fuel and electricity (Scope 1 and 2) during construction.			●		
		Offset 100 per cent of the greenhouse gas emissions associated with operational consumption of electricity.	●			●	
		Assess the feasibility of carbon neutral certification for the project	●				
		Maximise opportunities for sourcing at least 10 per cent of the low voltage electricity required at above ground stations and stabling facility from on-site renewable energy sources.	●			●	
		Investigate opportunities for at least 15 percent improvement on the minimum performance requirements stipulated in the National Construction Code (NCC) for stations and relevant buildings.	●	●	●		●
Manage resources efficiently	Minimise potable water use and maximise opportunities for reuse of non-potable water sources	Reuse at least 80 per cent of train wash water at the stabling yard		●	●	●	
		Harvest and reuse rainwater at permanent and temporary facilities where feasible	●	●	●	●	
	Minimise waste through project lifecycle	Recycle or beneficially reuse at least 95 per cent construction and demolition waste	●		●		
	Reduce embodied carbon and increase use of recycled materials	Minimise the embodied impacts of concrete through the adoption of proposal-wide supplementary cementitious materials use target and set targets for the use of alternate binder systems on non-structural elements		●	●		
	Manage spoil effectively	Beneficially reuse 100 per cent of reusable spoil, in accordance with the Spoil Management Hierarchy	●	●	●		
	Practice environmentally responsible sourcing	Maximise the use of timber products from either re-used timber, post-consumer recycled timber, Forest Stewardship Council or Programme for the Endorsement of Forest Certification certified sources	●	●	●		

Principle	Initiative	Targets	Planning	Design	Construction	Operations	End of life
Drive Supply Chain Best Practice	Practice environmentally responsible sourcing	Maximise the use of timber products from either re-used timber, post-consumer recycled timber, Forest Stewardship Council or Programme for the Endorsement of Forest Certification certified sources			●		
Respect the environment	Provide and promote green infrastructure	Enhance biodiversity and reduce urban heat island through maximising green infrastructure	●	●	●	●	
		Integrate water sensitive urban design solutions to manage and treat stormwater	●	●	●	●	

These initiatives and targets, as well as those adopted as standard practice (as provided in the Sydney Metro West Sustainability Plan), will drive outcomes towards achieving a minimum rating of 75 under the Infrastructure Sustainability Council (ISC) Rating Tool v1.2 or 5-Star Green Star rating (or equivalent level of performance using a demonstrated equivalent rating tool), in accordance with Concept condition of approval C-B7.

Climate change risk and adaptation

Climate change projections

Given the expected design life of the infrastructure varying across proposal elements and the available climate data, the time periods selected for climate risk assessment were 2030 (an average of the period from 2020 to 2039), 2070 (an average the period from 2060 to 2079), and 2090 (an average of the period from 2080 to 2100). This accounts for shorter design elements, such as signalling and cabling, with longer design elements, such as pavements, rail and structures, as well as providing for a design that can withstand the impacts from climate change through to 2100.

Data and projections presented in Table 18-9 are based on the Representative Concentration Pathway (RCP) 8.5 and regional climate models for the Sydney region (regionalised to a local level based on the Intergovernmental Panel on Climate Change Fifth Assessment Report (2014)). They have been separated where possible to reflect local condition variations between Parramatta and Sydney. In general, climate change projections note:

- an increasing trend in average, maximum and minimum temperatures into the future, with a tripling of the number of days above 35°C – highlighting risks to human health and safety
- a reduction in mean annual rainfall across, with an increase in the extreme rainfall intensity – highlighting less frequent, but more intense rainfall events
- an increase in sea level rise in the order of 0.10-0.19 metres by 2030 and around 0.45-0.88 metres by 2090
- an increase in atmospheric CO_2 concentrations – highlighting potential increases to carbonation of concrete structures.

The projected increases in temperature and decreases in annual rainfall are also likely to increase time spent in drought and bushfire weather for the region (those days where the Forest Fire Danger Index > 50 or designated ‘severe’). While the baseline environment comprises existing urban settings, that are not mapped as bushfire prone areas, recent bushfire events have demonstrated the widespread impacts from smoke and power outages due to damage to electricity infrastructure from bushfires in areas surrounding Greater Sydney.

Table 18-9 Summary of regional climate change projections

	Baseline climate (1986 2005)	2030	2070	2090
Temperature				
Sydney CBD				
Average maximum temperature (°C)	22.5	23.3	25.2 – 26.1	26.4 – 27.3
Average temperature (°C)	18.5	19.2	21.3 – 22.0	22.2 – 23.3
Average minimum temperature (°C)	14.5	15.1	17.4 – 18.0	18.0 – 19.2
Days over 35°C	3.7	5.4	8.4 - 10.8	11.1 - 15.3
Parramatta CBD				
Average maximum temperature (°C)	23.4	24.1	26.0 – 26.9	27.2 – 28.2
Average temperature (°C)	17.7	18.4	20.5 – 21.2	21.4 – 22.5
Average minimum temperature (°C)	12.1	12.7	15.0 – 15.6	15.6 – 16.9
Days over 35°C	11.2	15.7	23.3 - 29.8	30.1 - 40.0
Rainfall				
Sydney CBD				
Mean annual rainfall (mm)	1,215	1,221	1116 - 1181	796 - 854
2.5% Annual Exceedance Probability daily rainfall event (mm)	328	344	379 – 392	397 - 413
Parramatta CBD				
Mean annual rainfall (mm)	977	988	896 - 874	666 - 691
2.5% Annual Exceedance Probability daily rainfall event (mm)	293	308	339 – 350	355 - 369
Extreme rainfall (Greater Sydney)				
Extreme rainfall intensity (climate change factor) (%)	-	+5.60%	+15.80%	+21.30%
Wind speed (Greater Sydney)				
Average wind speed (%)	-	-0.50%	N/A	-1.10%
Relative humidity (Greater Sydney)				
Average relative humidity (%)	-	-0.60%	N/A	-1.50%
Atmospheric CO_2 concentration (global)				
Atmospheric CO_2 concentration (parts per million)	369 (in 2000)	449	541	935
Sea level rise (Greater Sydney)				
Sea level rise (m)	-	0.10-0.19	-	0.45-0.88

Climate change risk assessment results

Sydney Metro has undertaken a climate change risk assessment process which identified the following potential risks after the implementation of climate change adaptation measures (residual risks):

- three medium (tolerable) risks. These risks also received an inherent risk rating of medium, and while post-treatment ratings typically saw a reduction in the consequence rating, the overall rating remained as medium (tolerable)
- twenty-five low (acceptable) risks – noting that risk treatment options for these risks were not specifically identified, however risks will be reviewed between proposal phases for relevance and accuracy
- no extreme (unacceptable) or high (undesirable) risks were identified.

Climate change risks will be assessed throughout design development and risk treatments will be progressively incorporated as appropriate. For the four medium climate change risks identified, their consequences and proposed risk treatments are assessed in further detail in Table 18-10. These are considered to present the most material risks to the operational performance of the Sydney Metro West in terms of service disruption, passenger and income reduction, increased maintenance costs, and concerns for passenger and staff safety.

The material risks reflect the susceptibility of the Western Sydney region to extreme heat and extreme rainfall and flooding events. While the increase in severe fire weather days was not identified as a medium or high risk, potential bushfire risks and relevant mitigation measures are discussed in Section 18.6.

Table 18-10 Key climate change risks identified

Potential risk	Consequence/impact	Pre treatment risk rating	Risk treatment	Post treatment risk rating
Increased frequency and intensity of extreme heat and heatwave events lead to tunnel ventilation systems becoming unable to maintain temperatures below design criteria.	• failure of critical electrical equipment within tunnels leading to operational service disruptions and maintenance costs for repair • could also lead to increased temperatures within rolling stock leading to customer discomfort • potential for heat stress to maintenance staff in tunnels.	Medium	• sensitivity analysis undertaken to understand implications of RCP8.5 through 2100 for projected mean and extreme temperatures and to make allowance for future timed adaption. For example, enabling replacement of larger heating, ventilation, and air conditioning (HVAC) systems at end of design life to maintain present day ambient conditions in the future • review temperature requirements of critical equipment and assumptions of rolling stock HVAC system against predicted maximum tunnel temperatures.	Medium
Increased frequency and intensity of extreme heat and heatwave events lead to tunnel ventilation systems becoming unable to maintain temperatures below design criteria and increases in ambient temperature exposure for external assets.	Increased temperatures leading to track twisting, resulting in reduced rail operation, speed restrictions and delays.	Medium	• increase frequency of inspection and maintenance regimes, particularly following period of extreme heat or prolonged high temperatures • review track design to consider future temperatures across the track's design life.	Medium
	Greater expansion of metals in earthing and bonding systems leading to breakages and loss of electrical continuity that could cause electrocution of staff and/or greater rates of electrolysis corrosion.	Medium	• where projected temperatures lie outside of earthing and bonding system design allowances, review potential for alternative materials or strategies.	Medium
Increase in extreme heat impacting staff and passengers' health and wellbeing at stations, stabling facility and maintenance facility	• extreme heat exposure leading to risk of heat exhaustion and associated health and wellbeing impacts for staff and customers • potential reputational impact for failing to appropriately allow for extreme temperatures • potential inability to fill maintenance staff roles during heat wave events leading to operational impacts.	Medium	• access to water at stations for customers • implementation of an extreme weather management process for responding to customers in distress • develop extreme weather operations plan to respond to the health risks of working in heat wave conditions, including incentives or adjusted work hours to reduce the likelihood of being unable to fulfill roles.	Medium

Greenhouse gas

This proposal would support efforts to shift the mode of transit users from road to rail service. Based on projected demand and uptake of new passenger rail service, this proposal may result in a net reduction in greenhouse gas emissions as a result of this shift (understanding that carbon emissions of public transport are lower per person than private vehicles).

Greenhouse gas emissions are categorised into 'scopes' based on their source, including direct and indirect emissions, as defined by the Greenhouse Gas Protocol (WRI and WBCSD, 2004):

- Scope 1: direct emissions owned or controlled by a project. For example, Scope 1 emissions include the burning of carbon-based fuels in on-site/construction equipment
- Scope 2: indirect emissions from the upstream generation of electricity. For example, Scope 2 emissions include those associated with electricity purchased from the grid
- Scope 3: other indirect emissions that are indirectly influenced by a project but are generated within the wider economy. For example, Scope 3 emissions include those generated during the extraction, production and transport of purchased materials.

Greenhouse gas emissions resulting from operation of this proposal (largely Scope 2) would generally be associated with the consumption of electricity from:

- signalling, communications and electrical systems (including traction substations)
- station facilities such as lighting, heating, ventilation and air conditioning, as well as lifts and/or escalators
- operational and maintenance control centre.

Scope 2 emissions, including electricity usage at station facilities and operation of the metro rail service, would be the largest contributor to operational greenhouse gas emissions, and as such have been estimated for this proposal.

Table 18-11 provides the annual total tCO_2e of greenhouse gas emissions for Scope 2 during operation of this proposal. Refer to Appendix D (Detailed assessment methodologies) for a description as to how these calculations have been determined.

Table 18-11 Estimated operation greenhouse gas emissions

Scope	Emissions source	Greenhouse gas emissions (tCO_2e)
Scope 2	Annual Electrical Consumption 199,735 (MWh)	157,791
Total		**157,791**

Note: tCO_2e = tonnes of carbon dioxide equivalent

The annual tonnes of carbon dioxide equivalent of Scope 2 greenhouse gas emissions from the operation of this proposal were found to be 157,791 tCO_2e.

18.4.3 Construction impact assessment

Sustainability

Sustainability impacts during construction are anticipated to relate to the relevant other environmental impacts. This includes impacts such as:

- increased generation of waste materials or spoil, and use of potable water and energy, as well as inability to appropriately recycle materials
- disruption to surrounding areas and receptors due to air pollution, noise and vibration, increased vehicular traffic and light spill
- potential exceedance of pollution, groundwater or surface water discharge limits, resulting in notices or violations
- the use of materials and resources for construction
- social impact and disruption to local community during construction.

Based on the application of mitigation and management measures provided throughout this Environmental Impact Statement, sustainability impacts resulting from construction are anticipated to be minor.

Climate change risk and adaptation

Climate change risks during construction would primarily be associated with the occurrence of severe weather events, such as the increased frequency and severity of rainfall events placing increased pressure on erosion and sediment control measures, and/or resulting in the flooding of the tunnels and/or construction sites. These risks are anticipated to be adequately managed with standard management measures, such as increasing the capacity of erosion and sediment controls, and minimising construction impacts on the capacity of existing stormwater drainage systems (for example through the reuse of treated water to meet construction water demand requirements where possible).

Greenhouse gas

A majority of the greenhouse gas emissions are anticipated to be generated during the construction phase due to the need for energy consuming activities associated with plant, equipment and vehicle movements. Specifically, these emissions would be generated from:

- fuel combustion in construction plant, equipment and vehicles on-site (Scope 1 emissions)
- emissions from vegetation clearance or construction waste (Scope 1 emissions)
- electricity used on-site for temporary facilities, project offices, etc. (Scope 2 emissions)
- embodied emissions through the use of construction materials including cement and steel (Scope 3 emissions)
- fuel combustion of offsite vehicles for deliveries and offsite waste removal (Scope 3 emissions).

Table 18-12 provides the total tCO_2e of greenhouse gas emissions by emissions sources broken down into Scope 1, 2 and 3 during construction of this proposal. Refer to Appendix D (Detailed assessment methodologies) for a description as to how these calculations have been determined.

Table 18-12 Estimated construction greenhouse gas emissions

Scope	Emissions source	Greenhouse gas emissions (tCO_2e)
Scope 1	On-site diesel fuel consumption (light vehicles)	4,395
	On-site diesel fuel consumption (mobile plant equipment)	37,546
	Vegetation and street tree removal	367
	Scope 1 Total	**42,308**
Scope 2	Electrical consumption	9,752
	Scope 2 Total	**9,752**
Scope 3	Off-site diesel fuel consumption (light vehicles)	3,053
	Off-site diesel fuel consumption (heavy vehicles)	12,805
	Embodied energy in concrete	238,907
	Embodied energy in steel	52,368
	Scope 3 Total	**307,133**
Total		**359,193**

Note: tCO_2e = tonnes of carbon dioxide equivalent

The total estimated construction emissions from the project are 359,193 tCO2e of greenhouse gas emissions. Most of the emissions from construction would be indirect emissions, with Scope 2 and Scope 3 emissions making up approximately 88 per cent of this proposal's contribution. The remaining 12 per cent Scope 1 or direct emissions would be 42,308 tCO2e.

18.4.4 Management and mitigation measures

Environmental management for this proposal would be undertaken through the environmental management approach as detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. This includes operational mitigation measures (where relevant) and performance outcomes for the operation and construction of this proposal.

Sustainability

This proposal would be constructed in accordance with the Sydney Metro West Sustainability Plan (refer to Section 18.4.1). Contractors for Sydney Metro West would be required to develop an environmental and sustainability management system that would be linked to the Sydney Metro sustainability system. The relationship between key documents within Sydney Metro's and the Contractor's environment and sustainability management systems is shown in Figure 18-2. Notably:

- the Contractor's Construction Environment Management Plan and sub plans would capture the construction environmental management requirements from the Minister's conditions of approval as relevant and the *Sydney Metro West Sustainability Plan*
- the Contractor's Sustainability Management Plan would capture governance and design requirements, social sustainability initiatives required by the *Sydney Metro West Sustainability Plan* and contract requirements. This plan would vary in scope across different delivery packages
- progress against sustainability objectives and targets would be tracked through regular sustainability reporting over the delivery period.

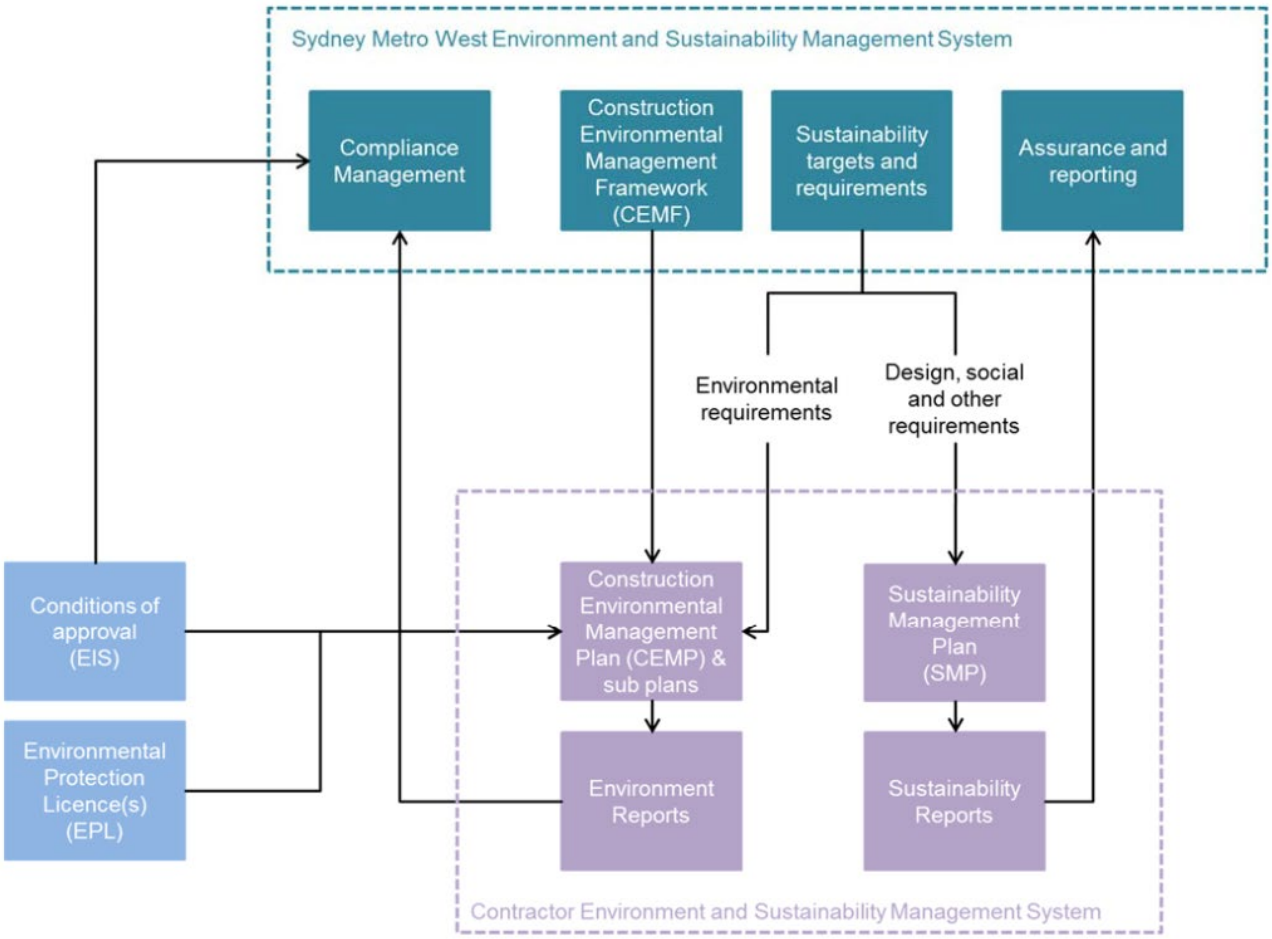

Figure 18-2 Sydney Metro West Environment and Sustainability Management System

Climate change risk and adaptation

This proposal has been designed, in accordance with Concept condition of approval C-B11, to withstand known impacts associated with climate change to the year 2100.

Sydney Metro is investigating a range of climate change adaptation measures in addition to those considered to be business as usual. The types of proposed measures to improve resilience to climate change include:

- sensitivity analysis undertaken to understand implications of RCP 8.5 through 2100 for projected mean and extreme temperatures and to make allowance for future timed adaption (for example enabling replacement of larger HVAC systems at end of design life)
- consider best practice energy efficiency in HVAC system design with improvements on minimum standards (i.e. National Construction Code (NCC) 2019 Section J)
- develop extreme weather operations plan to respond to the health risks of working in heat wave conditions including incentives or adjusted work hours to reduce the likelihood of being unable to fulfill roles.

It is anticipated that the identified adaptation actions would be reviewed and refined at each delivery phase to determine applicability and whether the action needs to be modified. Future publication of updated climate projections (such as local downscaling of climate models published within the Intergovernmental Panel on Climate Change's Sixth Assessment Report (2021)) also represent an opportunity to review controls to ensure adequate management of resulting future scenarios.

Greenhouse gas emissions

Management of greenhouse gas emissions would largely be carried out through:

- a reduction of materials usage and embodied carbon where relevant during design development and construction
- appropriate construction scheduling to minimise emissions resulting from fuel used in plant, equipment and vehicles
- utilising electrically driven mobile and stationary plant equipment in favour of diesel-powered equipment where feasible during construction
- maximise opportunities for on-site renewable generation to supply low voltage loads in operation where relevant during design development
- commitment to offset remaining emissions including:
  - Offset 25 per cent of Scope 1 and Scope 2 construction emissions
  - Offset 100 per cent of Scope 2 emissions from operation
- commitment to identifying a pathway to achieve net-zero emissions for operation in line with the NSW Government's commitment to net-zero by 2050.

Environmental management for this proposal would be undertaken through the environmental management approach as detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. This includes operational mitigation measures (where relevant) and performance outcomes for the operation and construction of this proposal. Sustainability, climate change and greenhouse gas during construction of this proposal would be managed in accordance with Sydney Metro's CEMF (Appendix F). The CEMF includes management objectives and mitigation measures to minimise impacts as relevant to this proposal as a whole.

18.5 Waste management and resource use

The approach and methodology for the waste management and resource use assessment are provided in Chapter 4 (Methodology) of this Environmental Impact Statement. The legislative context for the assessment is provided in Appendix B (Legislative and policy context).

18.5.1 Baseline environment

The baseline environment is not considered relevant in the context of waste generation and resource use.

18.5.2 Operational impact assessment

The design development for this proposal has aimed to avoid or minimise impacts associated with waste management and resource use during operation. Potential impacts would be avoided by designing and operating this proposal so that wastes are managed according to the waste hierarchy and implementing the management and mitigation measures provided in Section 18.5.4.

Waste generation

The main types of activities anticipated to potentially generate waste during operation of this proposal are outlined in Table 18-13.

Table 18-13 Indicative types of waste generated during operation of this proposal

Activity	Waste streams that may be produced	Likely classification of waste stream
General litter in station bins and wastes associated with cleaning activities associated with trains, stations and other infrastructure	General non-recyclable and putrescible waste (such as food waste from station rubbish bins)	General solid waste (putrescible)
	Recyclable wastes such as plastics and aluminium cans, office waste including paper and plastics	General solid waste (non-putrescible)
Infrastructure maintenance	Cable and conduit off-cuts from maintenance of track electrical infrastructure	General solid waste (non-putrescible)
	Solvents, paints, acetylene, adhesives, cleaning fluids, greases, acids and alkali materials, and spent spill-kit absorbent materials used to clean up accidental spills during maintenance	Hazardous waste and/or special waste
Groundwater and stormwater ingress into tunnel and stations	Sediment-laden and/or potentially contaminated wastewater	Liquid waste
Use of station customer facilities (such as toilets)	Sewage and grey water	Liquid waste

As discussed in Chapter 5 (Proposal description – operation) of this Environmental Impact Statement, the capture and treatment of groundwater and stormwater ingress into the tunnels and stations would occur at the water treatment plant at the Clyde stabling and maintenance facility. Treatment of groundwater and stormwater may generally involve the removal of dissolved iron and manganese prior to disposal to adjacent catchments.

The other wastes potentially generated during the operation of this proposal (as listed in Table 18-13) would be considerably lower than those generated during construction and would be typical of similar infrastructure projects. Confirmation of the volumes of these wastes is subject to further design development.

Waste management

Potential waste management impacts that could occur during operation of this proposal include:

- waste from stations and maintenance activities being directed to landfill due to the inadequate collection, classification and disposal of waste, which would increase the demand for landfill capacity within the Sydney region
- waste (such as litter) from station buildings being blown into the surrounding environment if adequate bins are not provided or emptied regularly
- contamination of soil, surface and/or groundwater if wastewater from tunnels and stations (toilets and station cleaning activities) is managed inadequately

- an increase in vermin from the incorrect storage, handling and disposal of putrescible waste at stations
- excessive amounts of maintenance materials being ordered, resulting in a large amount of leftover, unused resources.

Potential waste management impacts are considered manageable through standard mitigation measures (refer to Section 18.5.4) and the waste hierarchy outlined in the *Waste Avoidance and Resource Recovery Act 2001*. Relevant initiatives in the Sydney Metro West Sustainability Plan would also be implemented to minimise and manage potential waste impacts (refer to Section 18.4).

Resource use

The resource requirements for the operation of Sydney Metro West are likely to be typical for an infrastructure project of this scale and similar to other operational rail lines including the Metro North West Line. It is unlikely that the operational resource requirements would result in any resource becoming scarce or in short supply. The resources that would be required during operation include:

- electricity
- water
- materials for ongoing maintenance activities.

Electricity use during operation is outlined in Section 18.4. Opportunities to minimise resource consumption and maximise resource efficiency would be implemented during design development. Relevant initiatives in the Sydney Metro West Sustainability Plan would be implemented to manage demand on resources (refer to Section 18.4).

18.5.3 Construction impact assessment

The development of this proposal has aimed to avoid or minimise impacts associated with waste management and resource use during construction. Potential impacts would be avoided by constructing this proposal so that wastes are managed according to the waste hierarchy and implementing the management and mitigation measures provided in Section 18.5.4.

Waste generation

The quantity of waste associated with construction of this proposal (totalling about 225,000 cubic metres) would be comparable to similar infrastructure projects and would be adequately managed with standard waste management measures. The main construction activities anticipated to generate waste are outlined in Table 18-14, along with the likely waste materials produced.

Table 18-14 Indicative types of waste generated during construction of this proposal

Activity	Waste stream	Examples of waste	Likely waste classification
Demolition of structures as part of rail interchange work	General demolition wastes	• concrete • bricks • tiles, timber (treated and untreated) • metals • plasterboard • electrical and plumbing fittings • furnishings (such as doors and windows)	• general solid waste (non-putrescible)
	Hazardous waste	• heavy metals	• hazardous waste
	Special waste	• asbestos	• special waste
Dust suppression, wash down of plant and equipment, and staff amenities at construction compounds (such as toilets)	Wastewater	• sediment-laden and/or potentially contaminated wastewater • sewage and grey water, inflows to untanked station excavations constructed under previous Sydney Metro West planning applications	• liquid waste

Activity	Waste stream	Examples of waste	Likely waste classification
General construction activities and resource use	General construction wastes	• concrete waste • timber formwork • scrap metal • steel • concrete • plasterboards • cable • packaging materials • groundwater inflows	• general solid waste (non-putrescible)
Maintenance of construction plant, vehicles and equipment	Mechanical wastes	• adhesives • lubricants • waste fuels • oils • engine coolant • batteries • hoses • tyres	• hazardous waste and/or special waste • liquid waste
Activities at offices and crib rooms	General wastes	• putrescibles • paper • cardboard • plastics • glass • printer cartridges	• general solid waste (non-putrescible) • general solid waste (putrescible)
Clearing and grubbing of vegetation, landscaped and/or turfed areas (where required)	Vegetation wastes	• trees • shrubs • ground cover • soil	• general solid waste (non-putrescible)
Excavation and general earthworks (where required)	Spoil	• virgin excavated natural material (uncontaminated soil and crushed rock) • acid sulfate soils • soils and materials containing asbestos, heavy metals, hydrocarbons, pesticides and/or other industrial residues	• general solid waste (non-putrescible) • general solid waste (putrescible) • special waste • restricted solid waste • hazardous waste

Waste management

Potential waste management issues during construction would be temporary and would include:

- waste being directed to landfill due to its inadequate collection, handling, classification and disposal, which would deplete available landfill capacity within the Sydney region
- contamination of soil, surface and/or groundwater from the inappropriate storage, transport and disposal of liquid and solid wastes
- an increase in vermin from the incorrect storage, handling and disposal of putrescible waste from construction sites
- incorrect classification and/or disposal of waste, including the incorrect storage, handling and disposal of contaminated spoil, and other hazardous materials (for example, asbestos from demolition)
- excessive amounts of materials being ordered, resulting in a large amount of leftover, unused resources
- lack of identification of feasible options for recycling or reuse of resources.

Existing metropolitan waste management facilities would have capacity to receive the anticipated waste streams generated. General construction and demolition waste and wastes from site offices would be collected for off-site recycling wherever practicable. Wastes that contain hazardous, special or otherwise contaminated materials would be treated and disposed of off-site at a licensed facility in accordance with the relevant guidelines.

Waste facilities in Sydney currently licensed to accept general solid waste and vegetation waste include (but are not limited to):

- Clyde Transfer Terminal
- Eastern Creek Resource Recovery Park
- Kemps Creek Advanced Resource Recovery Park
- Lucas Heights Resource Recovery Park.

A number of waste facilities in Sydney are currently licensed to accept special and/or hazardous waste, including:

- Chullora Resource Recovery Facility
- Elizabeth Drive Landfill, Kemps Creek
- Eastern Creek Resource Recovery Park
- Genesis Xero Waste – Landfill and Recycling
- Horsley Park Waste Management Facility
- Jacks Gully Waste and Recycling Centre
- Kimbriki Recycling and Waste Disposal Centre
- Lucas Heights Resource Recovery Park
- Wetherill Park Resource Recovery Facility.

Recyclables, such as containers (plastics, glass, cans, etc.), paper and cardboard, would be collected by an authorised contractor for off-site recycling. There are a number of materials recovery facilities in Sydney. The recycling facility would be determined by the contractor engaged to collect the material. Management strategies that would be developed to address specific construction wastes are discussed further below.

Potential waste management issues would be manageable through standard mitigation measures. These measures would be developed in accordance with the Sydney Metro CEMF, which requires the Principal Contractor to develop a waste management plan and comply with the Sydney Metro West Sustainability Plan, and would address the following:

- classification of waste in accordance with the current guidelines
- handling of waste, including measures to facilitate segregation of waste into stockpiles of concrete, steel, timber, paper and cardboard, and vegetation to make it easier to recycle components and prevent cross contamination
- management of waste
- waste minimisation and reuse
- lawful disposal or recycling locations for each type of waste using a hierarchy that prioritises higher value end use
- contingencies for the above, including managing unexpected waste volumes.

Construction wastes

The management of construction wastes for this proposal is outlined in Table 18-15.

Table 18-15 Management of construction wastes

Waste type	Proposed management
Spoil	The majority of spoil removal would have primarily occurred as part of work carried out under the previous Sydney Metro West planning applications. Spoil removal for this proposal would generally be limited to: • minor earthworks at North Strathfield metro station, Five Dock Station and The Bays Station construction sites from works within the existing rail corridor; minor additional station excavation; or construction of trunk utilities, a traction substation and road works; respectively • removal of about 30,000 cubic metres of spoil to construct the underground concourse at the Westmead metro station construction site • removal of about 145,000 cubic metres of spoil for the excavation of basement structures for future over station and adjacent station development at the Parramatta metro station construction site • removal of about 32,000 cubic metres of spoil associated with site levelling at the Sydney Olympic Park metro station construction site. Spoil would be reused according to the hierarchy of options established by the previous Sydney Metro West planning application (refer to Chapter 8 of *Sydney Metro West Environmental Impact Statement – Major civil construction work between Westmead to the Bays and Sydney CBD* (Sydney Metro, 2020a)). The hierarchy includes the following re-use options: • within the construction sites • environmental projects • other development projects (including other Sydney Metro projects) • land restoration • landfill management. Sydney Metro would target beneficial reuse of 100 per cent of the usable spoil generated during construction. The geology of the spoil material, as well as its consistency and quality, would determine the reuse options. Spoil that cannot be reused would be classified in accordance with NSW Waste Classification Guidelines.
Demolition wastes	The vast majority of building demolition would have primarily occurred as part of work carried out under the previous Sydney Metro West planning applications. Demolition and/or clearing activities would be generally limited to areas of additional footprint for this proposal at the Westmead metro station, Sydney Olympic Park metro station, North Strathfield metro station and The Bays Station construction sites. As such, the quantity of demolition materials produced during construction of this proposal is anticipated to be minor. Where demolition is required, demolition waste would be managed as follows: • waste would be managed through the waste hierarchy established under the *Waste Avoidance and Recovery Act 2001* • waste would be segregated and stockpiled on-site, with materials such as bricks and tiles, timber, plastic and metals separated where practicable • waste would be classified in accordance with the *Waste Classification Guidelines* (EPA, 2014) and sent to a waste management facility with recycling capabilities, where appropriate, or directed to a facility that is lawfully permitted to accept that type of waste.
Hazardous materials	There is the potential for materials to be present within demolished structures that meet the hazardous waste criteria within the Waste Classification Guidelines (EPA, 2014). The presence of potentially hazardous wastes would be identified through a hazardous material survey that would be completed for those buildings and structures suspected of containing hazardous materials prior to their demolition – refer to Section 18.6. If materials that meet the hazardous waste criteria are encountered, they would be handled and managed in accordance with relevant legislation, codes of practice and Australian standards.

Waste type	Proposed management
Special wastes	There may be potential for asbestos containing materials to be present within demolished buildings/structures. Under the Waste Classification Guidelines (EPA, 2014), asbestos is defined as a 'special waste'. Potential disturbance, movement and disposal of asbestos containing materials would be carried out in accordance with the Work Health and Safety Regulation 2011 (NSW) and applicable guidelines. The management of contaminated spoil which may be classified as special wastes, is discussed below.
Contaminated spoil	The potential for substantial volumes of contaminated spoil to be generated during construction of this proposal is generally expected to be low. Notwithstanding, there may be potential to encounter contaminated soil during construction. This potential risk and relevant mitigation measures are discussed in Technical Paper 7 (Contamination) and Chapter 20 (Synthesis) of this Environmental Impact Statement, respectively. Sampling and testing of soils in areas of potential contamination concern would be conducted to characterise the soils and determine the appropriate waste classification (which may include hazardous wastes or special wastes). Characterisation would be carried out in accordance with guidelines made or approved under the Contaminated Land Management Act 1997. Waste classification would be carried out in accordance with the Waste Classification Guidelines (EPA, 2014).
Acid sulfate soils	There is potential to encounter acid sulfate soils during ground disturbance at Sydney Olympic Park metro station construction site. This potential risk and relevant mitigation measures are discussed in Technical Paper 7 (Contamination) and Chapter 20 (Synthesis) of this Environmental Impact Statement, respectively. Acid sulfate soils would be managed in accordance with the NSW Waste Classification Guidelines Part 4: Acid Sulfate Soils (EPA, 2014).
Wastewater	Construction of this proposal would result in wastewater being generated from water used in construction work and earthworks, groundwater ingress, rainfall runoff and machinery washdown runoff. About 8200 megalitres of wastewater would be produced per year during construction of this proposal. Details on the treatment of construction wastewater are provided in Section 18.9 and Technical Paper 8 (Hydrology, flooding and water quality). Wastewater would generally be managed as follows: • temporary construction wastewater treatment plants would treat water to meet the requirements of relevant guidelines • the reuse of treated water would be used to meet construction water demand requirements where possible. Where surplus treated water required discharge from the sites, it would likely be discharged to the local stormwater system.

Resource use

While construction would increase demand on local and regional resources, it is unlikely that it would result in any resource becoming scarce or in short supply. The main resources used during construction would and indicative quantities required are provided in Table 18-16.

Table 18-16 Indicative quantities of resources for construction of this proposal

Material	Indicative quantity required
Electricity	660 megawatt hours
Diesel	130,000 kilolitres
Concrete	945,000 tonnes
Rail steel	6,000 tonnes
Other steel (reinforcing, galvanised and structural)	45,000 tonnes
Water	390,000 kilolitres

Further details of the quantities of construction materials and water anticipated to be used during construction of this proposal are included in Section 6.5.7 (Construction materials and resources) of this Environmental Impact Statement. Electricity use during construction is outlined in Section 18.4. Relevant initiatives in the Sydney Metro West Sustainability Plan would be implemented to manage demand on resources (refer to Section 18.4).

18.5.4 Management and mitigation measures

Environmental management for this proposal would be undertaken through the environmental management approach as detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. This includes operational mitigation measures (where relevant) and performance outcomes for the operation and construction of this proposal.

Waste management and resource use during construction of this proposal would be managed in accordance with Sydney Metro's CEMF (Appendix F). The CEMF management objectives and mitigation measures to minimise impacts as relevant to this proposal as a whole.

18.6 Hazard and risk

The approach and methodology for the hazard and risk assessment are provided in Chapter 4 (Methodology) of this Environmental Impact Statement. The legislative context for the assessment is provided in Appendix B (Legislative and policy context).

18.6.1 Baseline environment

Chapter 25 of *Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD* (Sydney Metro, 2020a) describes the potentially hazardous activities that pose a risk to the environment and/or human health if not properly managed. Key elements identified that are relevant to the assessment of potential hazards and risks for this proposal include:

- existing utilities within the construction sites
- classified and regulated major hazard facilities within the vicinity of this proposal
- potentially contaminated sites and hazardous waste in buildings and structures within or adjacent to the construction sites.

This proposal traverses through highly urbanised areas with a diverse range of receivers and land uses, including suburban and residential areas, commercial precincts including Parramatta and Sydney CBDs, urban renewal precincts, and industrial and urban services areas.

A search of bushfire prone land mapping developed and published by the relevant local councils found this proposal is not within bushfire prone land. As such, bushfire risk is considered to be negligible and has not been considered further in this chapter.

18.6.2 Operational impact assessment

A key metro characteristic is to provide a system that is inherently safe for customers on trains, at stations, and at the interface with the public domain. The safety of passengers and the general public has been, and would continue to be, a key consideration during the design process.

Potential hazards and associated risks during operation would be low and manageable using standard measures. The potential types of hazards and risks that may be encountered during operation would include:

- the on-site storage, use and transport of chemicals, fuels and materials
- potential for hazards to customer and public safety, and security
- emergency situations such as derailment, fire or deliberate sabotage
- potential exposure to electric and magnetic fields.

The on-site storage, use, and transport of chemicals, fuels and materials

The operational water treatment plant for Sydney Metro West would be located within the Clyde stabling and maintenance facility and would require the storage, use and transport of several chemicals for the treatment tanks, including sodium hydroxide, poly-aluminium chloride and polymer. Environmental contamination or human health risks could arise in the event of a spill during transport or storage of hazardous substances during operation.

The volumes of dangerous goods stored on-site would be low. Potential environmental hazards and risks associated with the on-site storage, use and transport of chemicals, fuels and materials would be managed through standard mitigation measures to be developed as part of the operational environmental management system. These measures would include the storage and management of all hazardous substances in accordance with the Work Health and Safety Act 2011 and the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005), so that they do not cause a significant off-site risk.

Customer and public safety and security

During operation of Sydney Metro West, there would be potential public safety risks, including train strike due to trespass, and safety or crime incidents at stations. Unauthorised access to the rail corridor has the potential to result in serious injury or fatality.

In general, potential public safety impacts would be avoided by managing operations in accordance with relevant legislative and policy requirements.

A key Sydney Metro characteristic is to provide a system that is inherently safe for customers on trains, at stations, and at the interface with the public domain. As described in Chapter 5 (Proposal description – operation) of this Environmental Impact Statement, the safety of passengers and the general public has been, and will continue to be, a key consideration during the design process.

This proposal would incorporate measures to eliminate security and public safety risks as much as practicable, including implementation of the principles from Crime Prevention Through Environmental Design. The following key metro features would contribute to the safety and security of customers for this proposal:

- customer service assistants at every station and moving through the network during the day and night
- ensuring customers can see all the way along the train and move easily between carriages, including wide, open walkways between carriages
- level access between the platform and train, and reduced gaps between the platform and the train
- providing platform screen doors at stations, creating a physical barrier that keeps people and objects separated from the edge of the platform and operating tracks, improving customer safety and allowing trains to get in and out of stations faster
- measures to prevent public access to the rail corridor where it sits at surface, including security fencing along both sides of the rail corridor and a trackside intruder detection system.

Other station safety features include closed-circuit television, emergency help points and passenger information signage.

Emergency situations – derailment, fire or deliberate sabotage

Emergency situations during operation such as train derailment, tunnel or station fire or deliberate sabotage (such as arson or terrorism) may result in the risk of injury or fatality, and/or risks to property or infrastructure. A tunnel or station fire may result in injury and/or smoke inhalation for customers and would result in emergency evacuation and/or a halt in services.

While the risk of an emergency situation is very low, Sydney Metro emergency response procedures would be implemented as required.

Station sites would include fire stairs to allow for customer evacuation and emergency services access. Tunnels would provide space for fire and life safety systems. The Clyde stabling and maintenance facility would include fire control systems, including the provision of fire hydrants, hoses and other firefighting equipment within the facility.

A tunnel ventilation system would be provided to allow for a range of ventilation requirements, including station ventilation and ventilation for fire and life safety and operational scenarios (such as heat build-up in the event of a tunnel fire). Section 5.5 (Operational ancillary infrastructure) of this Environmental Impact Statement provides further details on the ventilation systems for this proposal.

Separate mechanical ventilation systems would be provided at each underground station for heat removal and to provide fresh air. Full-height platform screen doors at stations would assist in controlling underground station temperatures by physically separating the tunnel and station environments.

Potential exposure to electric and magnetic fields

The design and operation of the proposal's power supply would be carried out in accordance with standard industry guidelines and codes of practice, such that conductive and semi-conductive materials would effectively shield electrical fields. With regard to magnetic fields, the separation distance would be maximised between substations and public areas to minimise the potential to alter electromagnetic field strength within the surrounding area.

Sydney Metro West would be designed to comply with the limits of exposure set out in the International Commission for Non-Ionising Radiation Protection Guidelines for Limiting Exposure to Time Varying Electric and Magnetic Fields (1HZ – 100 kHZ) (ICNIRP, 2010). This would minimise the risk associated with electric and magnetic field exposure. Electric and magnetic fields are therefore not expected to pose a significant risk to public safety.

18.6.3 Construction impact assessment

Construction planning for this proposal involved consultation with the respective proponents of other infrastructure projects to avoid construction conflicts where possible and minimise cumulative construction impacts. This consultation would be ongoing through to the design development and construction phases of this proposal.

Potential hazards during construction would be temporary and would be associated with:

- the on-site storage, use, and transport of chemicals, fuels and materials
- the on-site handling and transport of contaminated soil and hazardous waste
- impacts to utilities
- potential interaction with a major hazard facility.

Other work, health and safety hazards are not specifically considered in this Environmental Impact Statement. These issues would be addressed by the relevant construction contractor in accordance with relevant guidelines and legislative requirements.

On-site storage, use, and transport of chemicals, fuels and materials

Potentially dangerous goods and hazardous substances are anticipated to be temporarily used, stored and transported during construction of this proposal. The potentially hazardous materials include petrol, diesel, lubricating and hydraulic oils and greases, industrial grade oxygen, acetylene, cement, premix concrete, concrete curing compounds, concrete retardant, shotcrete accelerator, epoxy glue, coagulants, acids, bases, disinfectant, antiscalant, membrane preservative, de-bonding agents, contaminated waste and paints. The method of storage would vary depending on the materials but would include drums of various sizes, small and intermediate bulk containers, cylinders in racks, bags/pallets and bunded areas where appropriate.

Environmental contamination or human health risks could arise in the event of a spill during transport or storage of hazardous substances during construction.

Typically, low volumes of potentially hazardous materials would be stored on site for this proposal. The volume required to be stored on site would largely depend on the anticipated rates of consumption, with deliveries of dangerous goods coordinated to match consumption rates.

The construction sites for this proposal will be established as part of work carried out under the previous Sydney Metro West planning applications. The construction site layouts would ensure that storage of hazardous materials would be at a suitable distance from sensitive receivers, in accordance with the thresholds established under the Hazardous and Offensive Development Application Guidelines – Applying SEPP 33 (2011) (SEPP 33 Guideline). If minimum buffers cannot continue to be maintained during construction of this proposal, either due to space constraints, the close proximity of sensitive receivers, or a requirement to store volumes of hazardous materials in excess of storage thresholds, a risk management strategy would be developed on a case-by-case basis.

Environmental hazards associated with the on-site storage, use and transport of chemicals, fuels and materials would be managed through standard mitigation measures to be developed as part of the construction environmental management documentation for this proposal. These measures would include the storage and management of all dangerous goods and hazardous substances in accordance with the *NSW Work Health and Safety Act 2011*, the NSW Work Health and Safety Regulation 2017, the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005) and SEPP 33 Guideline, so that they do not cause a significant off-site risk.

Dangerous goods would be transported to and from construction sites using the routes identified in Part B (Environmental Assessment) of this Environmental Impact Statement. Transport of dangerous goods would be in accordance with the *Dangerous Goods (Road and Rail Transport) Act 2008* and Dangerous Goods (Road and Rail Transport) Regulation 2014, and extended routes would avoid areas (such as road tunnels) prohibited by NSW Road Rule 300-2 (carriage of dangerous goods in prohibited areas).

On-site handling and transport of contaminated soil and hazardous waste

Existing soil contamination within the construction sites for this proposal would be predominantly remediated as part of work carried out under the previous Sydney Metro West planning applications and residual contamination is likely to be minor and isolated.

Areas of contamination may be encountered during construction where ground disturbance of areas of additional footprint is required for this proposal at Westmead metro station, North Strathfield metro station and The Bays Station construction sites, and during excavation for basement structures at Parramatta metro station. The areas of additional footprint and where excavation is required for basement structures at Parramatta have been assessed as low to moderate contamination risk in Technical Paper 7 (Contamination). Hazardous materials (such as asbestos) may also be encountered when undertaking earthworks or demolition associated with rail integration work at Westmead metro station and North Strathfield metro station.

Exposure to these contaminants could cause potential health and safety impacts on the community through inhalation, incidental ingestion, direct contact, and or/impacts on the environment due to contamination of land and/or groundwater.

Environmental, health and safety impacts associated with potential exposure to contaminated and hazardous materials would be minimised through the measures identified in Technical Paper 7 (Contamination) and Chapter 20 (Synthesis) of this Environmental Impact Statement. These include a further review of data where potential contamination risk is moderate, high or very high, and management of risk through a Soil and Water Management Plan or remediation, if required.

Wastewater generated during construction of this proposal (such as water used during construction, including for earthworks, groundwater ingress, rainfall runoff or machinery washdown runoff) would be captured, treated and discharged from temporary construction water treatment plants. The water treatment plants would be designed so that wastewater is treated to a level that is compliant with the trigger levels from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) default guidelines for 95 per cent species protection and 99 per cent species protection for toxicants that bioaccumulate unless other discharge criteria are agreed with relevant authorities. Further detail is provided in Section 18.9.

Contaminated waste (such as structures containing asbestos) would be removed and disposed of in accordance with the relevant legislation, codes of practice and Australian Standards (including the Work Health and Safety and Regulation).

Further information on contamination and associated mitigation measures is provided in the contamination sections provided in Part B (Environmental Assessment) of this Environmental Impact Statement.

Impacts to utilities

Utilities identification, relocation, protection and/or removal would be completed as part of work carried out under the previous Sydney Metro West planning applications. Additional utilities work may be required, for example at sites where minor additional land is required for this proposal at Westmead metro station, North Strathfield metro station and The Bays Station construction sites. Potential risks associated with impacts to utilities in these locations would be minimised by carrying out utility investigations (such as Dial Before You Dig searches and non-destructive digging) and consulting with relevant utility providers. It may also be necessary to carry out the following prior to construction commencing:

- provide physical protection for the utility, where the utility is not directly affected but may be indirectly affected by vibration or accidental impact
- modify construction methods to avoid impacting a nearby utility, such as by using smaller plant and equipment, hand excavation and compaction tools, such as hand digging tools, a vibration plate or pedestrian rollers
- divert the utility around the construction sites.

Consultation with utility providers would continue during construction to mitigate the risk of unplanned and unexpected disturbance of utilities.

Further information relating to proposed utility work at Westmead metro station, North Strathfield metro station and The Bays Station construction sites is outlined in Chapter 7, Chapter 10 and Chapter 13 of this Environmental Impact Statement, respectively.

Potential interaction with major hazard facilities

A major hazard event could occur if construction work for this proposal results in an uncontrolled interaction with a major hazard facility.

The construction of this proposal is not expected to interact with any major hazard facilities. The closest major hazard facility is Viva Energy's Clyde Terminal (classified and regulated as a major hazard facility under the NSW *Work Health and Safety Act 2011* and NSW Work Health and Safety Regulation 2017), which is located about 350 metres to the north-east of the Clyde stabling and maintenance facility construction site.

Other construction health and safety risks

Other construction activities that could result in temporary potential impacts on the health and safety of the community and workers if not properly managed include:

- the operation of vehicles and construction equipment on-site
- the transportation of equipment and material to and from the site
- health impacts from noise and air pollution during construction
- reduced safety for road users and pedestrians during construction
- construction failures or incidents resulting in flooding, inundation, or excavation collapse
- cumulative construction impacts or increased construction-related risks resulting from concurrent construction of other projects, including the work carried out under the previous Sydney Metro West planning applications.

In addition, there is the potential for risks to pedestrians and to public safety resulting from unauthorised access to construction work areas. NSW workplace safety laws require construction sites to have adequate site security, including appropriate fencing.

All construction work would be isolated from the general public. The construction contractor would ensure that construction sites are secure at all times and take all possible actions to prevent entry by unauthorised persons.

Health and safety risks during construction would be managed by the implementation of standard workplace health and safety requirements. A work health and safety management plan and safe work method statements would be developed in accordance with regulatory requirements.

18.6.4 Management and mitigation measures

Environmental management for this proposal would be undertaken through the environmental management approach as detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. This includes operational mitigation measures (where relevant) and performance outcomes for the operation and construction of this proposal.

Hazard and risk during construction of this proposal would be managed in accordance with Sydney Metro's CEMF (Appendix F). The CEMF includes management objectives and mitigation measures to minimise impacts as relevant to this proposal as a whole.

18.7 Transport

Further details of the operational and construction transport assessment, including the approach and methodology, is provided in Technical Paper 1 (Operational transport) and Technical Paper 2 (Construction transport).

Potential impacts (including benefits) at a regional level or where impacts are common across precincts are assessed in this chapter. This includes strategic transport benefits during operation, and potential impacts in relation to road user safety, construction worker parking, emergency vehicles and road condition during construction. A discussion of potential precinct specific transport impacts (including benefits) is provided in Chapter 7 to Chapter 17 of this Environmental Impact Statement.

18.7.1 Baseline environment

The surrounding active transport network, public transport network, road network and traffic volumes on key access roads for each precinct is described in the Transport sections of Chapter 7 to Chapter 17 of this Environmental Impact Statement. The regional transport network relevant to this proposal is outlined in the following section.

Regional active transport network

The regional active transport network in the vicinity of this proposal consists of footpaths, shared paths, signalised road crossings and cycle networks. Key recreational cycle and pedestrian facilities are located:

- in Parramatta Park
- in Sydney Olympic Park
- along Parramatta River
- along the foreshores of Iron Cove (known as the Bay Run), Rozelle Bay, Blackwattle Bay and Jones Bay.

Key off-road cycle corridors include:

- Rouse Hill to Parramatta via the North-West Transitway
- Liverpool to Parramatta, running parallel to the rail line
- Parramatta to Sydney Olympic Park, running parallel to the M4 Western Motorway
- Drummoyne to Sydney CBD via Victoria Road and Anzac Bridge.

Regional public transport network

Key aspects of the regional public transport network of relevance to this proposal include the following:

- existing rail services operated by Sydney Trains and NSW TrainLink. Major interchanges between rail lines are located at Parramatta, Lidcombe, Strathfield, Redfern, Central, Town Hall and Wynyard
- Sydney Metro City & Southwest (currently under construction), located within the vicinity of the proposed Hunter Street Station (Sydney CBD)
- light rail services, including:
  - L1 Dulwich Hill Line, which operates between Dulwich Hill and Central via Lilyfield and Pyrmont. Light rail stops in Pyrmont are located in the vicinity of the proposed Pyrmont Station
  - L2 Randwick Line and L3 Kingsford Line, which operate from the Sydney CBD to Randwick and Kingsford respectively. A number of stops are in the vicinity of this proposal within the Sydney CBD
  - Parramatta Light Rail Stage 1 (currently under construction). Once complete, there will be light rail stops in the vicinity of the proposed Westmead metro station and Parramatta metro station
  - Parramatta Light Rail Stage 2, in planning and if approved, would connect Parramatta Light Rail Stage 1 and Parramatta CBD to Ermington, Melrose Park, Wentworth Point and Sydney Olympic Park, where it would connect to the Sydney Olympic Park metro station
- major bus corridors, including:
  - North-West Transitway
  - Liverpool to Parramatta Transitway
  - Windsor Road
  - Parramatta Road
  - Victoria Road
- ferry services that operate along the Parramatta River, including the F3 Parramatta River Line between Parramatta, and Circular Quay via Sydney Olympic Park and Balmain. Ferry stops located in the vicinity of this proposal include Parramatta and Sydney Olympic Park, as well as The Bays, which is served by a Captain Cook ferry that operates on cruise ship days from the city (King Street Wharf, Barangaroo).

Regional road network

Motorways and principal arterial roads within the vicinity of this proposal include:

- M4 Western Motorway, which is the major east-west high-capacity and high-speed corridor linking the Blue Mountains and Western Sydney with Sydney CBD
- A4/A44 corridor consisting of Great Western Highway, Parramatta Road, City West Link and Anzac Bridge, which is an alternative east-west corridor linking Western Sydney with Sydney CBD
- A40 corridor consisting of Old Windsor Road, parts of James Ruse Drive and Victoria Road, which links Parramatta with the Hills District and Sydney CBD
- A6 corridor, including Silverwater Road, which is a major north-south corridor linking Heathcote and Carlingford via Bankstown and Silverwater
- A3 corridor, including Homebush Bay Drive, which is a major north-south corridor linking Blakehurst and Mona Vale via Hurstville, Ryde, Macquarie Park and Pymble
- WestConnex M4-M5 Link Tunnels and Rozelle Interchange (currently under construction), which will link the WestConnex M4, the WestConnex M8, and the future Western Harbour Tunnel, along with connections to other major arterial roads such as City West Link and Victoria Road.

18.7.2 Operational impact assessment

The design of this proposal would aim to avoid or reduce impacts associated with operational transport. It would improve road traffic conditions by providing a convenient and efficient travel alternative to the use of private vehicles.

Strategic transport benefits of the Concept were established in Chapter 2 (Strategic need and justification) of the *Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD* (Sydney Metro, 2020a). These strategic transport benefits and impacts of the operation of this proposal would include:

- increased transport network capacity – Sydney Metro West would more than double rail capacity from Parramatta to the Sydney CBD and would be able to move more than 40,000 people an hour in each direction, complementing the existing suburban and intercity services
- reduced train crowding – by providing additional rail services, Sydney Metro West would assist in reducing train crowding parts of the T1 Western Line, T9 Northern Line and the T2 Inner West and Leppington Line due to direct interchange with Sydney Metro West. This would help improve the reliability of Sydney Trains services and improve customer comfort. This also means more efficient Sydney Trains services in the west, outer west and regional areas like the Blue Mountains due to resulting improved capacity on the T1 Western Line
- reduced station crowding at existing Sydney Trains stations – the introduction of new rail services and infrastructure, including new stations in the Parramatta and Sydney CBDs, would reduce congestion and help alleviate platform and station crowding at existing Sydney Trains stations, including existing Parramatta, Strathfield, Burwood, Central, Town Hall and Wynyard Stations. Reduced platform and station crowding would shorten the time spent by customers in heavily crowded platform conditions and improve network performance by reducing station dwell times (and therefore improve travel times)
- increased accessibility to key centres – Sydney Metro West would substantially improve the public transport network accessibility to key economic centres across the Greater Parramatta to Sydney CBD corridor such as Westmead, Parramatta, Sydney Olympic Park and the Sydney CBD. This proposal would also increase accessibility to the future key centre at The Bays, which is not currently serviced by rail
- increased public transport network reach and use – Sydney Metro West would increase the reach (the catchments from which customers access the public transport network) and use of Sydney's public transport network by:
    - providing new stations at localities not serviced by the existing Sydney Trains suburban rail network, including Burwood North, Five Dock, The Bays and Pyrmont
    - increasing the number of customers who are able to access the Parramatta and Sydney CBDs by rail

  - providing a more direct connection to Sydney Olympic Park. Customers on the T7 Olympic Park Line are currently required to transfer at Lidcombe to travel to or from the Parramatta or Sydney CBDs
  - providing additional interchange capability at Westmead, North Strathfield and in the Sydney CBD
  - providing the opportunity for bus network optimisation, which would increase the frequency and directness of feeder services to new metro stations
  - integrating with the future Parramatta Light Rail Stage 1 and Parramatta Light Rail Stage 2 (if approved). Light rail would complement Sydney Metro West by serving local demand across Greater Parramatta and improving the quality of feeder services
  - providing new rail interchange at North Strathfield, which would enable T9 Northern Line customers to more directly access locations to the east or west
- travel time savings – Sydney Metro West would create a significant opportunity to improve travel times by providing more direct routes between areas with existing rail services, access to rail services in areas that currently do not have train stations, and reduced crowding on trains and at some stations
- improved network resilience – an additional, high-capacity public transport link in the corridor between Greater Parramatta and Sydney CBD, separated from the suburban rail network, would provide an alternative route for customers during these planned and unplanned events. Sydney Metro West would also enable additional connectivity with interchange opportunities to the wider rail and public transport network. This would reduce the impact on customers during major incidents and increase the resilience of the network
- bus network benefits – the additional mass transit accessibility and amenity would provide the opportunity to optimise the bus network. This could include additional 'feeder services' (services that generally connect customers to rail stations) to Sydney Metro West stations and re-deployment of existing parallel bus services that would duplicate parts of the Sydney Metro West alignment
- improved conditions for road users – by encouraging people to use the metro network, Sydney Metro West would provide the opportunity for mode shift from car to public transport. This could result in road-user travel time savings by reducing the numbers of vehicles on the road network. Analysis undertaken by Sydney Metro shows that total network-wide car trips could be reduced by about 83,000 weekday trips by 2036. The potential reduction in private vehicle car use could create benefits including car-use travel time savings and improved reliability for remaining car users who do not shift modes; and a reduction in environmental impacts to communities such as air pollution, greenhouse gas, noise and water pollution.

Travel time savings

The *Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD* (Sydney Metro, 2020a) identifies that travel time savings would be confirmed once the location of the Sydney CBD Station is determined. The decision to include a metro station at Pyrmont has also influenced the potential travel time savings delivered by this proposal. Table 18-17 provides updated forecast public transport travel time savings based on a comparison of existing travel times without Sydney Metro West and future travel times with Sydney Metro West from operational modelling undertaken by Sydney Metro.

The largest travel-time savings would be experienced in areas where:

- new stations are provided in areas currently not serviced by the existing suburban rail network, such as Burwood North, Five Dock, The Bays and Pyrmont
- more direct routes are provided, such as trips from Parramatta to the Sydney CBD and to and from Sydney Olympic Park
- customers could more efficiently transfer between services at new stations, including at Westmead and North Strathfield.

Sydney Metro West would also improve connections between key employment centres, enabling journeys between centres, such as Parramatta to Chatswood and Sydney Olympic Park to North Sydney, to take less time.

Table 18-17 Travel time savings between key locations

Locations	Without/with Sydney Metro West	Approximate travel time	Approximate travel time savings
Parramatta to Sydney CBD	Without Sydney Metro West	31 minutes	11 minutes
	With Sydney Metro West	20 minutes	
Sydney Olympic Park to Parramatta	Without Sydney Metro West	25 minutes	20 minutes
	With Sydney Metro West	5 minutes	
Sydney Olympic Park to Sydney CBD	Without Sydney Metro West	42 minutes	27 minutes
	With Sydney Metro West	15 minutes	
Burwood North to Parramatta	Without Sydney Metro West	29 minutes	19 minutes
	With Sydney Metro West	10 minutes	
Five Dock to Sydney CBD	Without Sydney Metro West	47 minutes	39 minutes
	With Sydney Metro West	8 minutes	
The Bays to Sydney CBD	Without Sydney Metro West	21 minutes	16.5 minutes
	With Sydney Metro West	4.5 minutes	
Pyrmont to Sydney CBD	Without Sydney Metro West	15 minutes	12.5 minutes
	With Sydney Metro West	2.5 minutes	
Blacktown to Sydney Olympic Park	Without Sydney Metro West	38 minutes	18 minutes
	With Sydney Metro West	20 minutes	
Parramatta to Rhodes	Without Sydney Metro West	27 minutes	5 minutes
	With Sydney Metro West	22 minutes	
Parramatta to Epping	Without Sydney Metro West	35 minutes	7 minutes
	With Sydney Metro West	28 minutes	
Parramatta to Macquarie Park	Without Sydney Metro West	46 minutes	7 minutes
	With Sydney Metro West	39 minutes	

18.7.3 Construction impact assessment

Pedestrian, cyclist and road user safety

During the construction of this proposal, the introduction of additional heavy vehicles on the road network has the potential to result in safety impacts on pedestrians, cyclists and other road users, especially where there is an increased likelihood of interaction with pedestrians and cyclists.

Key locations where pedestrian and cyclist safety issues may potentially arise include:

- construction site access and egress points where construction vehicles would interface with pedestrians using surrounding footpaths. This would be particularly relevant at the Westmead metro station, Parramatta metro station, Sydney Olympic Park metro station, North Strathfield metro station, Five Dock Station, Pyrmont Station, and Hunter Street Station (Sydney CBD) construction sites, where there are existing high volumes of pedestrians
- construction sites where access and egress points, or construction vehicle routes, would interface with marked cycle routes. This would occur at the Parramatta metro station, Sydney Olympic Park metro station, North Strathfield metro station, Burwood North Station, Five Dock Station and Pyrmont Station construction sites
- locations where footpath widths are reduced around construction sites.

Sydney Metro have extensive experience in managing construction related traffic safety issues in busy pedestrian areas on other similar projects (e.g. Sydney Metro City & Southwest, and Sydney Metro Northwest).

Access and egress arrangements at construction sites have been developed with consideration for pedestrian, cyclist and motorist safety. For example, the need for construction vehicles to perform a right turn to or from an arterial road to access a construction site has been avoided where possible.

Appropriate controls would be established where vehicles are required to cross footpaths to access construction sites. This may include manual supervision, physical barriers or temporary traffic signals as required. Road safety audits would be carried out as part of construction traffic management planning for each construction site.

In addition, the Sydney Metro CTMF outlines the requirements in relation to construction phase road safety audits and the management of risks to vulnerable road users (such as pedestrians and cyclists). These would be undertaken in accordance with the Sydney Metro Principal Contractor Health and Safety Standard to minimise the road safety risk to pedestrians, cyclists and motorcyclists on route to, and near, construction sites. This includes measures such as:

- assessing the suitability of construction haulage routes through sensitive land use areas with respect to road safety
- deployment of speed awareness signs in conjunction with variable message signs near construction sites to provide alerts to drivers
- providing community education and awareness about sharing the road safely with heavy vehicles
- specific construction driver training to understand route constraints, safety and environmental considerations such as sharing the road safely with other road users, and limiting the use of compression braking
- requiring technology and equipment to eliminate heavy vehicle blind spots, monitor vehicle location and driver behaviour, and improve vehicle safety standards.

Construction worker parking

The approach to the management of construction worker parking during construction of this proposal is outlined in the CTMF provided as Appendix G.

There is potential that construction workers may park in local streets around the sites which could reduce local parking availability, particularly in locations where existing parking restrictions allow for all-day parking.

Some construction worker parking would be provided at the Clyde stabling and maintenance facility and Rosehill services facility construction site and The Bays Station construction site, although it would not meet the expected full demand based on indicative workforce numbers, Shuttle bus services to transfer construction workers to and from major transport interchange(s) would be considered. The final arrangements for this service would be confirmed during detailed construction planning for this proposal and may be coordinated with other concurrent transport projects in consultation with Transport for NSW.

Parking for construction workers would not be provided at all sites due to the constrained nature of the construction sites. However, each construction site would typically provide parking spaces intended to be used by trade vehicles or other light vehicles that are required to travel between construction sites. The majority of construction sites are located in close proximity to public transport services and construction workers would be encouraged to use these services or existing commercial car parking facilities.

Emergency vehicles

The introduction of construction traffic is anticipated to result in minor impacts on intersection performance at most construction sites. As such, there is not anticipated to be any substantial change to emergency vehicle access. Construction sites would be arranged so that emergency vehicle access to nearby buildings and the surrounding area is maintained, or alternative arrangements are in place as determined in consultation with relevant emergency services. Construction sites may also be made available for emergency vehicle passage if required. Ongoing consultation would be carried out with emergency services providers in relation to changed traffic conditions.

Due to the close proximity of the Westmead metro station construction site to the Westmead health precinct, specific discussion of potential impacts to emergency vehicle access for that precinct is provided in Section 7.5.3 (Construction impact assessment) of this Environmental Impact Statement.

Road condition

During construction of this proposal, the increase in construction traffic, in particular heavy vehicles, on the road network has the potential to impact the condition of roads along construction haul routes. A pre-construction condition survey would be carried out to document the existing condition of all local roads along construction haul routes between the construction site and the arterial road network. Upon completion of construction, a post-construction condition survey would be carried out to determine whether construction activities and/or construction vehicles have caused sections of road to deteriorate.

A report would be prepared by the construction contractor in consultation with Transport for NSW and relevant councils, detailing the findings of the pre-construction and post-construction condition surveys and any remediation work required. Damage attributed to construction work would be rectified (or compensated) by the construction contractor, in line with any relevant Transport for NSW and council requirements.

18.7.4 Management and mitigation measures

Environmental management for this proposal would be undertaken through the environmental management approach as detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. This includes operational mitigation measures (where relevant) and performance outcomes for the operation and construction of this proposal.

The approach to transport and traffic management during the construction phase, including the process for the development of all construction traffic management plans is outlined in the CTMF provided in Appendix G.

The CTMF provides the overall strategy and approach for construction traffic management for Sydney Metro West, and an outline of the traffic management requirements, mitigation measures and processes that would be common to each of the proposed construction sites. It establishes the traffic management processes and acceptable criteria to be considered and followed in managing roads and footpaths adjacent to construction sites.

18.8 Social impacts

Further details on the social impact assessment, including the approach and methodology, are provided in Technical Paper 9 (Social impacts). A discussion of potential precinct specific and proposal corridor social impacts (both benefits and disbenefits) are provided in Chapter 7 to Chapter 17 of this Environmental Impact Statement.

18.8.1 Baseline environment

The characteristics of the communities within the social locality is described as the social baseline. The social baseline has been analysed by considering the human, social, economic, physical, and natural capital present at a proposal-wide level.

Statistical analysis of the social baseline has been carried out by considering the primary geographical areas of interest as defined by the Australian Bureau of Statistics (ABS). These areas of interest have been termed as:

- **the proximal area**: Statistical Area level 1 (SA1s) have been chosen as the closest approximation of each of the localities along the corridor
- **suburb**: Statistical Area level 2 (SA2s) have been chosen to prepare community profiles for this proposal's corridor
- **region**: the Greater Sydney area has been chosen to assist with the assessment of the broader social impacts. It has also been used for comparative purposes.

The study area, known as the social locality, for this proposal is illustrated in Figure 18-3.

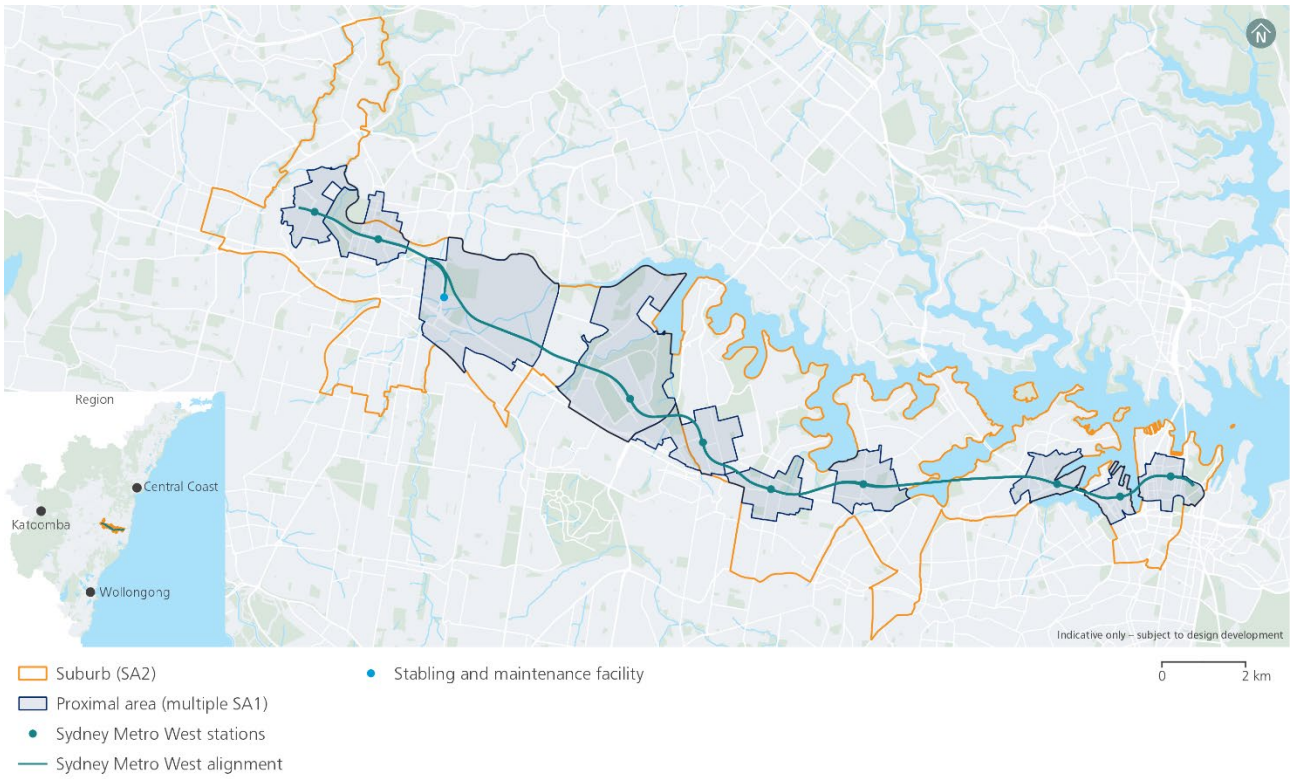

Figure 18-3 Social locality for this proposal

A discussion of each type of community capital as it relates to the proposal-wide social baseline is discussed below. A similar comparison at a precinct level can be found in the respective precinct section. The social baseline provided in Chapter 5 of Technical Paper 9 (Social impacts) also identifies and defines vulnerable communities that have the potential to be impacted by this proposal.

Table 18-18 Community capitals summary – proposal-wide

Capital	Summary
Human	**Region** In 2016, Greater Sydney had a resident population of 4,823,991 residents, making it the largest urban area in Australia. The population growth of Greater Sydney is expected to be negatively impacted by COVID-19, with approximately 340,000 fewer residents by 2031 compared to pre-COVID projections. While the rate of growth is expected to decrease, Greater Sydney will still experience a net increase in residents. The impact to Greater Sydney's future population growth is primarily caused by disruption to net overseas migration. Compared to NSW, Greater Sydney had a relatively younger population in 2016, with a median age of 36 compared to 38. Greater Sydney's lower median age can be attributed to the high proportion of residents aged 20-44 years of age and low proportion of residents aged 65 years and older, when compared to NSW. Greater Sydney had higher rates of education attainment in 2016, when compared to NSW, with higher rates of residents with tertiary qualifications and high completion rates for year 12 of high school. **Suburb** In 2016 the corridor had a total of 318,343 residents. When compared to the Greater Sydney region, the corridor had a higher proportion of residents aged 20-34 (33.4 per cent and 23.1 per cent respectively) and a lower proportion of residents 65 years or older (10.8 per cent and 14.0 per cent respectively). Collectively this suggests that the corridor had a slightly young age profile than Greater Sydney.

Capital	Summary
	A notably higher proportion of residents were studying at a tertiary institution in 2016 across the corridor compared to Greater Sydney (35.2 per cent and 24.2 per cent respectively). The proportion of residents with a year 9 or below level of education was higher in Greater Sydney compared to the corridor in 2016 (7.1 per cent and 5.7 per cent respectively).
Social	**Region** When compared to NSW, Greater Sydney was slightly more culturally diverse with 38.1 per cent of residents born overseas compared to 35.0 per cent. However, when compared to suburb context, Greater Sydney was notably less culturally diverse. Across Greater Sydney, 1.4 per cent of residents identified as Aboriginal and/or Torres Strait Islander in 2016. When compared to the NSW rate of 2.9 per cent, this was notably lower than the rest of the State. However, the Greater Sydney rate was higher than all proximal areas along the proposal corridor. Across Greater Sydney residents are relatively established, with more than half (53.2 per cent) living in the same address for five years or more in 2016. This was notably higher than most proximal areas along this proposal's corridor. **Suburb** Compared to Greater Sydney, the corridor was more culturally diverse in 2016 with a higher proportion of residents born overseas (38.1 per cent and 55.3 per cent respectively). Households are more linguistically diverse across the corridor compared to Greater Sydney, with a lower proportion of households only speaking English (45.0 per cent and 62.5 per cent respectively). The corridor also had a higher proportion of residents who use to live overseas a year ago and five years ago, reflecting a high proportion of recent overseas arrivals. Compared to Greater Sydney, the corridor had more diverse households, represented by a higher proportion of lone person households (23.6 per cent and 21.7 per cent respectively) and group households (8.8 per cent and 4.6 per cent respectively).
Economic	**Region** In 2016, there was a higher proportion of high-income households compared to low-income households across Greater Sydney. Approximately one in three households were high income households while one in six were low-income households. This suggests residents of Greater Sydney are generally economical affluent. Housing costs across Greater Sydney in 2016 were relatively high, with 38.5 per cent of households in the highest mortgage repayment quartile and 49.8 per cent of renting households in the highest rent payment quartiles. When compared to the suburb context, Greater Sydney had relatively lower workforce participation in 2016, with 65.6 per cent of residents engaged in the workforce. **Suburb** In 2016, the corridor had a lower proportion of residents engaged in home ownership and a notably higher proportion of residents renting when compared to Greater Sydney (48.8 per cent and 35.1 per cent respectively). While the corridor and Greater Sydney have similar proportions of high-income households (33.8 per cent and 31.8 per cent respectively), there are notable differences in housing costs, with the proposal corridor having higher costs of living. This is reflected by 42.3 per cent of households in the highest mortgage repayment quartile, compared to 38.5 per cent across Greater Sydney, and 62.4 per cent of renters in the highest rent payment quartile, compared to 31.8 per cent across Greater Sydney.

Capital	Summary
	A slightly larger proportion of residents participate in the workforce in the corridor compared to Greater Sydney (68.2 per cent and 65.6 per cent respectively).
Physical	**Region** In 2016, housing diversity across Greater Sydney was skewed towards low-density dwellings, with 57.2 per cent of homes separate dwellings while 28.2 per cent were high-density apartments. Only 14.0 per cent were medium-density, semi-detached dwellings, overall reflecting relatively low housing choice across the region. The majority of households owned at least one car (72.5 per cent) in 2016. Private cars accounted for 53.9 per cent of residents' commute to work in 2016, reflecting high private vehicle dependency. **Suburb** In 2016, the corridor had a notably higher proportion of high-density dwellings compared to Greater Sydney (60.8 per cent and 28.2 per cent respectively). Car ownership was lower across the corridor compared to Greater Sydney, with a higher proportion of households not owning a car (20.0 per cent and 11.4 per cent respectively), and a higher proportion of households with only one car (46.2 per cent and 38.5 per cent respectively). Residents across the corridor have lower rates of car utilisation for their commute to Greater Sydney (39.4 per cent and 53.9 per cent respectively).
Natural	**Region and suburb** Despite the dense population of Greater Sydney, natural capital is abundant. The area is rich in watercourses including the Parramatta River, White Bay, Blackwattle Bay, Darling Harbour, and many small creeks and tributaries. There are a number of natural heritage sites, including the UNESCO World Heritage listed Parramatta Park, the natural heritage Bicentennial Park that is part of the Sydney Olympic Park and features an important wetland ecosystem and parklands, and The Royal Botanic Garden in the Sydney CBD, a heritage-listed 30-hectare (74-acre) botanical garden.

18.8.2 Operational impact assessment

Social impacts would be experienced at different geographies or spatial extents. A large proportion of operational social impacts associated with this proposal would be felt at a regional and suburb level. This section focuses on the operational impacts at the regional and a suburb level, while a proximal based analysis for each precinct is provided in the relevant precinct.

An assessment of the potential social impacts, both positive (benefits) and negative (disbenefits), of operating this proposal at a proposal-wide level is outlined in Table 18-19.

The potential impacts presented in Table 18-19 are unmitigated and would be appropriately managed through the implementation of the OCCS and the mitigation measures and performance outcomes presented separately in Chapter 20 (Synthesis) of this Environmental Impact Statement. Sydney Metro would also develop a Community Benefit Plan to guide the development of community benefit initiatives (by Principal Contractors).

A residual impact rating after the above mitigation measures have been applied is also presented in the table.

The assessment indicates that the longer term and ongoing regional social impacts of this proposal would be largely beneficial – particularly with respect to health and wellbeing, way of life, and accessibility.

Table 18-19 Summary of operational social impacts – proposal-wide

Pre mitigation impact	Level of statistical analysis	Social impact category	Impact type	Mitigated residual impact rating
Potential to reduce travel-related stress for people who switch modes in peak hours by reducing the time spent in congested conditions (de-crowding and destressing). Potential to reduce travel-related stress for people during unplanned and planned events on the network.	Region	Health and wellbeing Way of life Accessibility	Positive	Very high
Improved accessibility to jobs, educational facilities services, and social facilities leading to improved social cohesion, community resilience and reduce social health related issues for a number of stakeholders, including vulnerable communities.	Region	Way of life Accessibility Livelihoods Community	Positive	High
Improved intergenerational equity as a result of sustainable development, including for vulnerable and marginalised communities.	Region	Surroundings	Positive	Very high
Increase in economic activity, businesses and employment opportunities for Greater Sydney, particularly around each of the stations resulting from both Sydney West Metro and other major projects.	Region	Livelihoods	Positive	High
Improvements to local air quality due to less motor vehicle trips, improving physical health	Suburb	Health and wellbeing	Positive	Medium
Improved accessibility and connectivity for cyclists and pedestrians. Increased walking and cycling trips could increase the proportion of the population achieving sufficient physical activity level to maintain health.	Suburb	Accessibility Health and wellbeing	Positive	Medium
Potential decline in how people experience their surroundings due to presence of new stations and ancillary facilities, and the perception of increased potential for antisocial behaviour.	Suburb	Way of life Surroundings Health and Wellbeing	Negative	Low

Overall, the assessment found that at the regional level (Greater Sydney), improved access to public transport options is highly likely to provide benefits for community cohesion and improve equity, particularly for groups that currently experience transport or mobility difficulties, such as older people, youth, people with a disability, non-drivers or people without access to a private vehicle. Travel facilitates social interactions and economic transactions across Sydney, bringing community members closer by reducing the travel time between destinations. Where mobility is constrained, people generally avoid making trips that have unacceptable travel times. Sydney Metro West would improve access between Greater Parramatta and the Sydney CBD corridor, thereby decreasing travel times and facilitating greater community interaction.

Overall, the assessment found that at the suburb level, the operation of Sydney Metro West would see planned changes to land use, improved accessibility, and the facilitation of new homes and jobs, with the number of people who live, work in and visit the Greater Parramatta to Sydney CBD corridor expected to grow. Sydney Metro West would promote more sustainable travel behaviours and enhanced liveability for those within the corridor through opportunities for incidental exercise, with customers able to walk and cycle, better access to jobs and services, and improved social cohesion.

By encouraging people to use the metro network, Sydney Metro West would provide the opportunity for mode shift from car to public transport. This could result in road user travel time savings by reducing the numbers of vehicles on the road network. As outlined in Chapter 2 of the *Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD* (Sydney Metro, 2020a), analysis undertaken by Sydney Metro shows that total network-wide car trips would be reduced by about 83,000 weekday trips by 2036 and about 110,000 weekday trips by 2056. The potential reduction in private vehicle car use could create benefits in the form of reduction in environmental impacts to communities, such as air pollution, greenhouse gas, noise and water pollution.

This proposal would also facilitate active transport through the provision of upgrades to public areas and streetscapes including tree planting and landscaping, the integration of the station with future developments and enhanced pedestrian environments with active transport links. Technical Paper 6 (Landscape and visual amenity) identifies aspects such as bicycle parking, high-quality pavements and lighting, which would make it easier to access the station for people walking and cycling.

18.8.3 Construction impact assessment

Construction activities would predominantly affect communities at a proximal level; however, some construction impacts have been identified at a regional and a suburb level. An assessment of the potential social impacts, both positive (benefits) and negative (disbenefits), of constructing this proposal at a proposal-wide level is outlined in Table 18-20. Delineation between impacts at region-based and suburb-based statistical analysis levels have also been provided.

These potential impacts are unmitigated and would be appropriately managed through the implementation of mitigation measures outlined in Section 18.8.4 and through the performance outcomes detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. Sydney Metro would also develop a Community Benefit Plan to guide the development of community benefit initiatives (by Principal Contractors).

A residual impact rating has been assigned to each unmitigated impact to quantify the impacts after these mitigation measures have been applied.

Table 18-20 Summary of construction social impacts – proposal-wide

Pre mitigation impact	Level of statistical analysis	Social impact category	Impact type	Residual impact rating
Enhanced wellbeing from job opportunities and community investment related to Sydney Metro West contributing to the generation of an estimated 10,000 direct and 70,000 indirect jobs in total across all stages and station localities of Sydney Metro West, including vulnerable communities.	Region	Livelihoods	Positive	Very high
Continued temporary changes to the way of life for people living, working, or accessing services near the construction site, including impact on daily routines due to pedestrian and traffic detours.	Region	Accessibility Way of life	Negative	Medium
Continued temporary change to the way of life for people living, working, or accessing services near construction sites due to a greater construction interface with customers on the existing Sydney Trains platform, or changes to transport including temporary changes to bus stops, parking, footpaths and pedestrian crossings, temporary removal of parking spaces and additional road work.	Suburb	Accessibility Way of life	Negative	Medium
Time delay-related stress as a result of road work, increased construction traffic and impacts to the road network.	Suburb	Health and wellbeing	Negative	Low
Continued impact to people's livelihoods due to ongoing construction impacts on businesses.	Suburb	Livelihoods	Negative	Medium

The assessment indicates that the social impacts of constructing this proposal would effectively represent a continuation of the impacts identified by the previous Sydney Metro West planning applications, though generally at a lower level of intensity and extent. Key negative impacts would be related to health and wellbeing, accessibility, and way of life, and would be temporary in nature. These impacts would be managed to an acceptable level through proven mitigation measures as identified in Chapter 20 (Synthesis) of this Environmental Impact Statement.

18.8.4 Management and mitigation measures

Environmental management for this proposal would be undertaken through the environmental management approach as detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. This includes operational mitigation measures (where relevant) and performance outcomes for the operation and construction of this proposal.

During construction of this proposal, social impacts would be managed in accordance with Sydney Metro's CEMF (Appendix F). The CEMF includes social impact management objectives and mitigation measures to minimise impacts as relevant to this proposal as a whole.

The OCCS (Appendix C) also specifies that a Community Communication Strategy would be prepared and implemented during construction which would define the location specific measures to be implemented to minimise impacts on people during construction.

Design refinements that have occurred to avoid or minimise social impacts, and to respond to stakeholder feedback are provided in Technical Paper 9 (Social impacts). Monitoring commitments during the operation and construction of this proposal, including adaptive management measures, are provided in Technical Paper 9 (Social impacts).

18.9 Hydrology and water quality

Further details of the hydrology and water quality assessment, including the approach and methodology, are provided in Technical Paper 8 (Hydrology, flooding and water quality).

18.9.1 Baseline environment

A review of available data in the *Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD* (Sydney Metro, 2020a) indicates the nearby waterways along the proposal corridor are generally in poor condition and are representative of heavily urbanised systems.

Table 18-21 outlines the following existing environment information (where relevant and available) for the waterways relevant to this proposal:

- environmental values in accordance with the water quality and river flow objectives
- water quality characteristics of waterways relevant to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000) indicators
- surface water features, including stream order in accordance with the Framework for Biodiversity Assessment – Appendix 2 (Office of Environment and Heritage, 2014)
- condition level
- overall sensitive receiving environment rating.

Section 6.5.6 (Construction water management) of this Environmental Impact Statement identifies the approach for water management during construction, including the indicative discharge locations and volumes for treated construction water.

Table 18-21 Existing environmental values, water quality and surface water features of receiving waterways

Watercourse and/or receiving waters	Environmental values	Water quality characteristics	Surface water features	Condition	Sensitive receiving environment rating
Domain Creek	• aquatic ecosystems • visual amenity	• low dissolved oxygen levels • elevated nutrient concentrations	• modified channel, with no SEPP Coastal Wetlands within 0.5 kilometres • first order waterway	Highly disturbed	Low
Duck River	• aquatic ecosystems • visual amenity • secondary contact recreation	• low dissolved oxygen levels • elevated nutrient concentrations • high turbidity	• type 1 Key Fish Habitat • SEPP Coastal Wetlands within 0.5 km • third-order estuarine waterway • concrete-lined in upper reaches	Moderately disturbed	High
Duck Creek	N/A	• elevated nutrient concentrations • elevated concentrations of faecal coliforms	• type 1 Key Fish Habitat • second-order waterway • unlined	Moderately disturbed	High
A'Becketts Creek	N/A	• elevated nutrient concentrations • elevated concentrations of faecal coliforms	• type 1 Key Fish Habitat • first-order waterway • concrete-lined channels along long sections	Highly disturbed	Moderate
Haslams Creek	• aquatic ecosystems • visual amenity • secondary contact recreation	• elevated nutrient concentrations • elevated concentrations of faecal coliforms	• type 1 Key Fish Habitat • SEPP Coastal Wetlands within 0.5 km • third-order waterway	Moderately disturbed	High
Bicentennial Park Wetlands	N/A	N/A	• rehabilitated wetland/Nature Reserve • SEPP Coastal Wetlands within 0.5 kilometres	Moderately disturbed	High

Watercourse and/or receiving waters	Environmental values	Water quality characteristics	Surface water features	Condition	Sensitive receiving environment rating
Saleyards Creek	• visual amenity • secondary contact recreation	• low dissolved oxygen levels • elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity	• type 1 Key Fish Habitat • SEPP Coastal Wetlands within 0.5 kilometres • first-order waterway • concrete-lined channel	Highly disturbed	Moderate
Powells Creek/Mason Park Wetland	• aquatic ecosystems • visual amenity	• low dissolved oxygen levels • elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity	• highly modified channel with limited aquatic habitat • SEPP Coastal wetlands within 0.5 kilometres • first-order waterway • permanently flowing • estuarine with tidal limit 0.1 kilometres upstream of Allen Street Bridge, Homebush	Moderately disturbed	Moderate
St Lukes Park Canal	• aquatic ecosystems • visual amenity	• low dissolved oxygen levels • elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity	• type 1 Key Fish Habitat • SEPP Coastal Wetlands within 500 metres • first–order waterway • estuarine • predominantly concrete-lined • no in-stream aquatic habitat • mapped seagrasses within 500 metres of the point of discharge of this canal into Parramatta River	Highly disturbed	Moderate
Barnwell Park Canal	• aquatic ecosystems • visual amenity	• low dissolved oxygen levels • elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity	• highly modified channel with limited aquatic habitat • SEPP Coastal Wetlands greater than 0.5 kilometres downstream • first order waterway • concrete lined channel • no in-stream aquatic habitat	Highly disturbed	Moderate

Watercourse and/or receiving waters	Environmental values	Water quality characteristics	Surface water features	Condition	Sensitive receiving environment rating
Dobroyd Canal/Iron Cove Creek	• aquatic ecosystems • visual amenity	• low dissolved oxygen levels • elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity	• highly modified channel with limited aquatic habitat • first-order waterway • concrete-lined channel • mapped seagrasses within 500 metres of the point of discharge of this canal into Iron Cove	Moderately disturbed	High
White Bay	• aquatic ecosystems • visual amenity • primary contact recreation • secondary contact recreation	• elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity	• concrete-lined, enclosed embayment • SEPP Coastal Wetlands within 0.5 kilometres • fourth order waterway	Highly disturbed	Low
Blackwattle Bay	• aquatic ecosystems • visual amenity	• elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity	• potential habitat for threatened aquatic species and protected aquatic vegetation • type 1 Key Fish Habitat • fourth-order waterway • permanently flowing	Moderately disturbed	High
Cockle Bay/Pyrmont Bay	• aquatic ecosystems • visual amenity	• elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity	• potential habitat for threatened aquatic species and protected aquatic vegetation • type 1 Key Fish Habitat • fourth-order waterway • permanently flowing	Moderately disturbed	High

Watercourse and/or receiving waters	Environmental values	Water quality characteristics	Surface water features	Condition	Sensitive receiving environment rating
Darling Harbour	• aquatic ecosystems • visual amenity • secondary contact recreation	• elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity	• potential habitat for threatened aquatic species and protected aquatic vegetation • type 1 Key Fish Habitat • fourth-order waterway • permanently flowing	Moderately disturbed	High
Circular Quay	• aquatic ecosystems • visual amenity • primary contact recreation • secondary contact recreation • aquatic foods (cooked)	• elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity	• potential habitat for threatened aquatic species and protected aquatic vegetation • type 1 Key Fish Habitat • fourth-order waterway • permanently flowing	Moderately disturbed	High
Parramatta River	• aquatic ecosystems • visual amenity • primary contact recreation • secondary contact recreation • aquatic foods (cooked)	• elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity	• numerous SEPP Coastal Wetlands • potential habitat for threatened aquatic species and protected aquatic vegetation • type 1 Key Fish Habitat • fourth-order waterway • permanently flowing	Moderately disturbed	High
Sydney Harbour	• aquatic ecosystems • visual amenity • primary contact recreation • secondary contact recreation • aquatic foods (cooked)	• elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity	• numerous SEPP Coastal Wetlands • potential habitat for threatened aquatic species and protected aquatic vegetation • type 1 Key Fish Habitat • fourth-order waterway • permanently flowing	Moderately disturbed	High

18.9.2 Operational impact assessment

Hydrology

Modified discharge volumes, durations and velocities

At all sites except for the Clyde stabling and maintenance facility and Rosehill services facility, flood and stormwater discharges would enter the minor and major urban drainage system, rather than directly entering nearby watercourses. Stations would include the onsite detention of stormwater, except at Pyrmont Station and Hunter Street Station (Sydney CBD) eastern site where it is not required based on the relevant policy documents. Ultimately these stormwater discharges would enter Sydney Harbour or Parramatta River and therefore the degree of impact on natural processes, such as modified discharge volumes, durations and velocities, is likely to be negligible as these watercourses have extensive contributing catchment areas.

The Clyde stabling and maintenance facility and Rosehill services facility are located near Duck Creek which is tidal (Manly Hydraulics Laboratory, 2006). Stormwater and wastewater discharges would enter the creek at several locations along the extent of the site. One of these outlets would be from the operational water treatment plant and is anticipated to discharge between 0.5 and one megalitre per day of treated wastewater. As Duck Creek is considered perennial (water flow throughout the year) and due to the tidal behaviour, it is likely to always have flow when wastewater is being discharged.

The other outlets at Clyde and Rosehill would be stormwater discharge points constructed as part of the work carried out under the previous Sydney Metro West planning application. Trunk drainage including associated discharge structures would be designed to comply with relevant standards and to meet requirements of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018). The hydrological regime of the internal drainage of the Clyde stabling and maintenance facility is not expected to alter substantially from that considered during the previous Sydney Metro West planning application. Furthermore, the contributing catchment associated with this proposal is small in the context of the overall catchment for this creek. Consequently, impacts on these natural processes such as modified discharge volumes, durations and velocities due to this proposal are likely to be low. Collectively, these measures would also minimise changes to natural hydrological attributes.

Potential erosion and siltation impacts

At all sites except for the Clyde stabling and maintenance facility and Rosehill services facility, flood and stormwater would drain to the minor and major urban drainage systems rather than directly entering nearby watercourses. At the Clyde stabling and maintenance facility and Rosehill services facility, stormwater flows would drain to Duck Creek via the trunk drainage, water quality ponds and discharge outlets that would have been constructed under the previous Sydney Metro West planning application. Water quality management and mitigation measures identified for this proposal would limit velocities and sediment loads such that it would be unlikely that this proposal would result in instability of riverbanks or watercourses.

Potential impacts on natural hydrological attributes

The catchments of the stations and ancillary facilities are highly urbanised and developed with widespread impervious surfaces. This proposal would not substantially increase the amount of impervious area. Additionally, the total catchment of the watercourses is large compared with the portion associated with this proposal. The management and mitigation measures outlined in Section 18.9.4 make provision for augmentation of the existing stormwater system where required. It is therefore expected that, once onsite storage detention facilities are also implemented, the impact on conveyance capacity of existing stormwater systems where discharges are proposed would be minimised.

Impacts on water availability and flows

No surface water resources would be taken or interfered with by this proposal.

Water quality

Surface water quality

The operation of this proposal has the potential to further degrade and impact the water quality of receiving waterways through the discharge of polluted water flows or airborne contaminants (e.g. particulate matter) if appropriate mitigation measures are not implemented. Potential surface water contaminants of concern during operation include:

- suspended and dissolved compounds in rainwater flows from impervious areas
- gross pollutants, such as litter from stations and ancillary facilities
- chemical pollutants from trains and vehicles around the station precincts and ancillary facilities.

The most likely source of pollutants would be the increased pollutant loads and runoff volumes from newly impervious surfaces, such as roofs and paved areas. Maintenance activities also have the potential to generate chemical pollutants, particularly at ancillary facilities, such as the Clyde stabling and maintenance facility. Implementation of the mitigation measures outlined in Section 18.9.4 would mitigate and manage potential water quality impacts during operation.

Water balance

Non-potable sources (e.g. treated wastewater and harvested rainwater) would be used to meet operational water demand requirements where feasible and reasonable. The deficit for the non-potable demand and any potable demand would be sought from the Sydney Water supply network.

Sydney Metro would further investigate options in detailed design to minimise potable water use and maximise wastewater reuse during operation.

The indicative annual water balance for the operation of this proposal based on average groundwater inflows, and the estimated treated discharge quantities during operation are shown in Table 18-22.

Table 18-22 Operational annual water balance

Activity	Type	Approximate amount (megalitres per year)	Total (megalitres per year)
Supply			
Approximate rainfall available for non-potable use	Non-potable	17.5	89.2
Groundwater inflows at untanked stations and structures to meet non-potable demand	Non-potable	0	
Sydney Water (mains supply) to meet any deficit in non-potable water supply for stabling and maintenance facility and service facility	Potable	6.6	
Sydney Water (mains supply) to meet any deficit in non-potable water supply for stations	Potable	65.1	
Demand			
Operations and maintenance activities associated with the stabling and maintenance facility and service facility	Potable	9.9	70
	Non-potable Potable	2.5	
Operations and maintenance activities at stations	Potable	46.2	
	Non-potable	11.5	
Total discharge			
	Non-potable		19.2

Water quality treatment

Wastewater and groundwater ingress into the stations, tunnels and other underground facilities would be collected and pumped to the Clyde stabling and maintenance facility. An operational water treatment plant at the Clyde stabling and maintenance facility would treat this water prior to discharge, to mitigate the potential water quality impacts to receiving waterways.

The discharge from the water treatment plant would achieve the trigger levels for 95 per cent and 99 per cent species protection for toxicants that bioaccumulate for aquatic ecosystems, in accordance with ANZECC & ARMCANZ (2000) and ANZG (2018) guidelines. The discharge water quality level would be determined in consultation with the NSW Environment Protection Authority during detailed design, taking into consideration the current water quality of the receiving watercourse.

The wastewater treatment plant would be configured so that treated water is compliant with the NSW Water Quality and River Flow Objectives (NSW Department of Environment, Climate Change and Water, 2006) and ANZECC & ARMCANZ (2000) and ANZG (2018) guideline values (refer to Table 6-3 of Technical Paper 8 (Hydrology, flooding and water quality)), which would either maintain or improve the water quality of waterways and the marine environment. Operational monitoring would be carried out to show compliance with the discharge criteria. Potential impacts on the water quality of the catchment would therefore be negligible.

Water sensitive urban design features such as gross pollutant traps, grassed swales and bioretention trenches would be provided at stations and ancillary facilities to treat stormwater runoff to required levels prior to discharge into the environment via the local stormwater system.

During operation of this proposal, there also remains the potential for soil erosion in recently disturbed areas. This risk would be higher where soft landscaping is proposed, including open areas at station entrances and plazas, adjacent to disturbed areas, and in areas where topsoil is settling, and vegetation is establishing. The majority of stations would undergo landscaping in and around the station precincts, which present the greatest risk of sediment loads entering waterways through the stormwater system. Soil stabilisation work may be required at these stations following construction and during severe storms, to prevent further erosion, topsoil loss or soil mitigation. Measures to manage erosion would be included in the Operational Environmental Management Plan or System.

Impacts on NSW water quality objectives

During the operation phase of this proposal, the Water Quality and River Flow Objectives (NSW Department of Environment, Climate Change and Water, 2006) and the ANZG (2018) and ANZECC & ARMCANZ (2000) trigger values, as outlined in Section 3.2 of Technical Paper 8 (Hydrology, flooding and water quality) would be used as a guideline so discharged water either maintains or improves the water quality of surface waterways and the marine environment. Based on this, and other water quality mitigation measures, this proposal would continue to meet the relevant NSW water quality objectives (where they are currently being met) or would assist in working towards their achievement (where they are not currently being met). Further consideration of the potential impact of this proposal against each of the relevant NSW water quality objectives is provided in Technical Paper 8 (Hydrology, flooding and water quality).

18.9.3 Construction impact assessment

Hydrology

Modified discharge volumes, durations and velocities

At all construction sites except for the Clyde stabling and maintenance facility and Rosehill services facility construction sites, flood and stormwater discharges would enter the minor and major urban drainage system rather than directly entering nearby watercourses. Ultimately, these stormwater discharges would enter Sydney Harbour or the Parramatta River and therefore the degree of impact that these discharges may have on natural processes, such as modified discharge volumes, durations and velocities, is likely to be low as these watercourses have considerable contributing catchment areas.

The Clyde stabling and maintenance facility and Rosehill services facility are located near Duck Creek which is tidal in this location. As part of the previous Sydney Metro West planning application, stormwater and wastewater discharge points would be introduced and would enter the creek at several locations along the extent of the site. One of these outlets would be from the temporary water treatment plant. The hydrological regime of the water treatment plant discharge at the Clyde stabling and maintenance facility is not expected to alter substantially from that considered under the previous Sydney Metro West planning application. Wastewater would be treated and reused where practicable.

The other outlets at Clyde and Rosehill would be stormwater discharge points which along with the trunk drainage and stormwater discharge ponds would have been constructed as part of the work carried out under the previous Sydney Metro West planning application. The stormwater discharge ponds during construction would meet the requirements of the Blue Book (Landcom, 2004).

The hydrological regime of the internal drainage of the Clyde stabling and maintenance facility construction site is not expected to alter substantially from that considered during the previous Sydney Metro West planning application. Furthermore, the contributing catchment associated with this proposal is small in the context of the overall catchment for this creek. Consequently, impacts on these natural processes such as modified discharge volumes, durations and velocities due to this proposal are likely to be low.

Mitigation measures identified in Chapter 20 (Synthesis) of this Environmental Impact Statement would manage potential increases in flow velocity that may occur where construction of this proposal could alter flow patterns and divert or concentrate flows.

Potential erosion and siltation impacts

At all construction sites except for the Clyde stabling and maintenance facility and Rosehill services facility, flood and stormwater would drain to minor and major urban drainage systems rather than directly entering nearby watercourses. During construction, these flows would also be managed in accordance with the CEMF (Appendix F) to address erosion and sediment control.

The rehabilitation of Duck Creek would be carried out in a staged approach to minimise potential erosion and bank instability. Native vegetation would be retained with removal of vegetation limited to weed species. This is further detailed in Section 17.3.3 (Riparian rehabilitation). Collectively, these measures would be expected to limit velocities and sediment loads such that it would be unlikely that this proposal would result in instability of riverbanks or watercourses.

Potential impacts on natural hydrological attributes

The catchments of the stations and ancillary facilities are highly urbanised and developed with widespread impervious surfaces. The amount of impervious area would not be substantially increased by this proposal and changes to natural hydrological attributes and conveyance capacity of existing stormwater systems would be limited. Wastewater would be treated prior to discharge and would be reused where practicable.

Potential impacts on water availability and flows

No surface water resources would be taken or interfered with by this proposal.

Water quality

Surface water quality

Construction of this proposal has the potential to temporarily impact the water quality of the waterways due to the release of pollutants. If not managed appropriately, the following pollutants could be released directly, or conveyed by stormwater or wind, to nearby waterways:

- sediment from soil excavation, movement, storage and stormwater runoff through disturbed sites
- chemicals, fuels and hydrocarbons from use, refuelling and maintenance of equipment and construction machinery
- concrete slurry and wastewater from mobile concrete batching plants
- contaminants related to previous land uses or mobilised acid sulfate soils
- gross pollutants, such as paper and plastic packaging from material use and general construction staff litter.

An assessment of potential temporary water quality impacts for key construction activities is provided in Table 18-23. The likelihood and magnitude of potential impacts would vary depending on the stage of construction, the area of disturbance, and the presence of high rainfall or wind weather events. Construction activities would be carried out in a highly modified and urban environment and would generally not be located within or near waterways (with the exception of the Clyde stabling and maintenance facility construction site and Rosehill service facility construction site located adjacent to Duck Creek and A'Beckett's Creeks, and The Bays Station construction site located adjacent to White Bay).

Soil and water mitigation measures would be implemented in line with best practice as outlined in the Blue Book (Landcom, 2004). These mitigation measures are commonly applied for major construction projects and are discussed in further detail in the CEMF (Appendix F).

Table 18-23 Potential construction impacts on water quality

Construction work	Potential impact
General construction work	Although demolition would be minor during this proposal, demolition required at the Westmead metro station has the potential to disturb and/or spread sources of pollutants, and generate soils and waste materials, which could be conveyed into adjacent or nearby waterways. This could result in elevated levels of pollution or increased turbidity.

Construction work	Potential impact
Earthworks and stockpiling	Excavation is required for this proposal at the Parramatta metro station construction site for the basements, and at the Westmead metro station construction site for a subsurface pedestrian connection. Minor earthworks are also required at the Westmead metro station, Sydney Olympic Park metro station, North Strathfield metro station, Five Dock Station construction sites and for the power supply route between Rosehill services facility and the Camellia substation. Earthworks and soil stockpiling could result in exposure of soils, temporary soil erosion, and off-site movement of eroded sediments into receiving waterways by wind and/or stormwater. If sediments enter waterways, they could directly and indirectly potentially impact on the aquatic environment by increasing turbidity, reducing dissolved oxygen levels, and increasing the concentration of nutrients and heavy metals.
Accidental spills	Accidental spills or leaks of hydrocarbons could occur from the use, maintenance or re-fuelling of construction plant and equipment at construction sites, or from vehicle/truck incidents travelling to and from construction sites. Contaminants could potentially be transported downstream to receiving waters via drainage infrastructure.
Disturbances of acid sulfate soils or contaminated land/groundwater	Potential disturbance of contaminated soils, groundwater or acid sulfate soils during construction, demolition or earthworks could result in the mobilisation of contamination or acid sulfate soils by stormwater runoff and subsequent transportation to downstream waterways, potentially increasing contaminant concentrations in the receiving environment.
Concreting activities	Concreting activities could result in the discharge of concrete dust, concrete slurries, or washout water to downstream waterways. This could potentially increase the pH of downstream waterways, which can be harmful to aquatic life. Concrete solids contained in the discharge also have the potential to cause increased turbidity.

Water balance

Non-potable sources (e.g. treated wastewater and harvested rainwater) would be used to meet construction water demand requirements where possible. The deficit for the non-potable demand and any potable demand would be sought from the Sydney Water supply network. The use of non-potable water over potable water would depend on the location and nature of the water use activity, as well as the quantity and quality of available water at the time. Water availability would vary as construction progresses, as well as seasonally.

Sydney Metro would further investigate options to minimise potable water use and maximise wastewater reuse during detailed design. This may include opportunities to:

- maximise storage capacity of treated wastewater on site. This could provide additional opportunities for the reuse of water both on site and off-site
- carry out treatment of wastewater to enable additional end uses (such as wash down, toilet flushing etc). This would further reduce reliance on potable water supply
- provide wastewater to others for reuse (e.g. to local councils for parkland and sporting field irrigation, or to nearby golf courses for irrigation). This would reduce reliance on potable water for these uses.

The indicative water balance for the construction of this proposal, based on average groundwater inflows and the estimated treated discharge quantities, are shown in Table 18-24. Non-potable water uses would include dust suppression, plant wash-down and rock bolting. Some demand activities are consumptive, such as water used in offices that would be discharged to the sewerage network. There would also be minor losses in the system due to evaporation. The remainder would be treated and either re-used or discharged at the proposed discharge locations listed in Section 6.5.6 (Construction water management) of this Environmental Impact Statement.

Table 18-24 Construction water balance

Activity	Type	Approximate amount (megalitres per year)	Total (megalitres per year)
Supply			
Recycled groundwater available for stabling and maintenance facility and service facility re-use for non-potable use	Non-potable	1,261.4	8,216.9
Recycled groundwater available for station re-use for non-potable use	Non-potable	6,937.9	
Sydney Water (mains supply) for site offices and to meet any deficit in non-potable water supply for stabling and maintenance facility and service facility	Potable	2.9	
Sydney Water (mains supply) for site offices and to meet any deficit in non-potable water supply for stations	Potable	14.7	
Demand			
Construction activities associated with the stabling and maintenance facility and service facility	Non-potable	14.7	96.7
	Potable	2.9	
Construction activities associated with station construction	Non-potable	66.0	
	Potable	13.1	
Losses via consumption			
Consumed by construction activities (e.g. dust suppression, plant wash-down)	Non-potable	80	80
Total discharge			
	Non-potable		8,039

Water treatment plant discharge

The following sources of wastewater would be generated during construction of this proposal:

- water used during construction including for earthworks
- groundwater ingress
- rainfall runoff
- machinery washdown runoff.

To manage the potential impact of untreated wastewater, temporary construction water treatment plants would capture, treat and discharge wastewater. The water treatment plants would be designed so that wastewater is treated to a level that is compliant with the trigger levels from the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines, the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) and the draft (ANZG, 2020) default guidelines for 95 per cent species protection and 99 per cent species protection for toxicants that bioaccumulate, unless other discharge criteria are agreed with relevant authorities.

An overview of the water treatment plant locations, indicative discharge volume and the receiving waterways is provided in Section 6.5.6 (Construction water management) of this Environmental Impact Statement.

Wastewater from construction activities would be treated, and standard erosion and sediment control measures would be implemented for all surface work areas to minimise pollutant loading to the downstream waterways during construction. These measures would be designed to meet the standards outlined in the Blue Book (Landcom, 2004) and NSW Department of Environment, Climate Change and Water (2006). Temporary sediment basins would also be designed to the 80th percentile 5-day rainfall event as a minimum in accordance with Managing Urban Stormwater: Soils and Construction and Managing Urban Stormwater, Volume 2D: Main Road Construction (NSW Department of Environment and Climate Change, 2008a).

With the implementation of these management measures, pollutant loading to the receiving waterways would be low, with the possibility of improvements to existing water quality where it does not meet the applicable NSW Water Quality Objectives (NSW Department of Environment, Climate Change and Water, 2006) (refer to Section 6.1.3 of Technical Paper 8 (Hydrology, flooding and water quality).

Impacts on NSW water quality objectives

During the construction of this proposal, the ANZG (2018) and ANZECC & ARMCANZ (2000) trigger values would be used as a guideline so discharged water either maintains or improves the water quality of surface waterways and the marine environment. Based on this, and other water quality mitigation measures, this proposal would continue to meet the relevant NSW water quality objectives (where they are currently being met), or would assist in working towards their achievement (where are not currently being met). Further consideration of the potential impact of this proposal against each of the relevant NSW water quality objectives is provided in Technical Paper 8 (Hydrology, flooding and water quality).

18.9.4 Management and mitigation measures

Environmental management for this proposal would be undertaken through the environmental management approach as detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. This includes operational mitigation measures (where relevant) and performance outcomes for the operation and construction of this proposal.

During construction of this proposal, hydrology and water quality would be managed in accordance with Sydney Metro's CEMF (Appendix F). The CEMF includes hydrology and water quality management objectives and mitigation measures to minimise impacts as relevant to this proposal as a whole.