# 6.10 Groundwater quality and hydrology

The groundwater quality and hydrology supplementary technical memorandum is provided in **Appendix J**, and a summary is provided below. This section should be read in conjunction with Section 7.10 of the EIS and the groundwater quality and hydrology assessment report provided in Appendix N of the EIS.

The groundwater quality and hydrology supplementary technical memorandum in **Appendix J** includes a number of clarifications in relation to the assessment methodology, potential construction impacts and management measures, which provide further context behind the groundwater assessment prepared for the EIS and amended project. This is discussed in the relevant sections below.

## 6.10.1 Assessment methodology

The assessment focused on changes to potential groundwater impacts associated with changes to the construction and operational footprints, and vertical alignment from the project presented in the EIS. The assessment methodology involved:

- Desktop assessment groundwater level data was supplemented using WaterNSW's (2020) online bore database to evaluate if the spatial coverage of groundwater level data in the EIS could be improved
- Impact assessment assessment of dewatering impacts was carried out to estimate potential groundwater inflows and reductions to groundwater levels if excavations extend below the water table and are drained.

The study area presented in Section 7.10.2 of the EIS comprised a two kilometre buffer around the EIS construction footprint. This area is therefore considered sufficient to capture the amended construction footprint and has not been updated for this assessment. The study area is shown in **Figure 6-55**.

As the study area was unchanged from that described in the EIS, no site inspections or field investigations were determined to be required for the assessment. See Section 2.6.2 of **Appendix J** for further detail on the assessment methodology.

### 6.10.1.1 Clarifications

The memorandum in **Appendix J** includes a number of clarifications on the assessment methodology, which provide further context behind the groundwater assessment prepared for the EIS, including:

 Groundwater level range – project monitoring bores. The memorandum in Appendix J addresses concern raised by DPIE Water regarding accuracy of groundwater levels given the short-period over which monitoring occurred. Groundwater monitoring was carried out at most monitoring bores between February 2018 and August 2018. The assessment was also informed by a cumulative rainfall deviation (CRD) plot which included rainfall data from the Badgerys Creek station between January 1996 and February 2019. Based on the CRD trends and timing of the project's groundwater monitoring period, groundwater levels measured during the monitoring period are anticipated to be higher than long-term averages. Appendix N of the EIS presented the entire range of available data from project monitoring bores, and from this, for drawdown and groundwater inflow assessment purposes, conservatively adopted the maximum monitored groundwater level.







----- Waterways

The amended project construction footprint

Motorway

— Main roads



Figure 6-55 Groundwater study area for the amended project

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- Groundwater level range non-project monitoring bores. The memorandum in Appendix J addresses concern raised by DPIE Water regarding the accuracy of groundwater levels given the omission of maximum wet weather groundwater levels. The BOM's (2018) online Australian Groundwater Explorer did not contain water level records for bores in the study area, as defined in the EIS. Subsequent to the EIS, the online WaterNSW (2020) bore database was reviewed as part of the supplementary groundwater assessment of the amended project to assess water level records for bores inside the study area. There is only one location that monitors the shallow groundwater systems applicable to the project. The data from the multiple bores in this location cannot be used to infer maximum wet weather groundwater levels, as the data periods are either too short or the data is interpreted to be erroneous.
- 'Aquifers' and impacts. The memorandum in Appendix J addresses the requests from DPIE Water for more detail regarding interaction with aquifers and more information regarding interaction with Hawkesbury Sandstone and seepage faces. Project data, surrounding data and the subsequently developed conceptual hydrogeological model indicate aquifers are not present in the near surface profile which the project is associated with. Groundwater systems near the land surface are conceptualised as low yielding and saline. Potentially relatively higher yielding aquifers, if present, would be substantially deeper than the project, with relatively higher yields and lower salinity likely best obtained from Hawkesbury Sandstone groundwater systems. Hawkesbury Sandstone is anticipated to commence at levels which are at least about 75 metres deeper than the minimum project design surface level in the study area.
- Modelling. The memorandum in **Appendix J** addresses the request from DPIE Water for more hydrological information at the Western Cut. For the EIS, site specific modelling on the drawdown associated with one area of road cutting which may intersect the water table was completed. The only anticipated potential drawdown for the project as described in the EIS was an area referred to as the 'western cut'. Additional road cuttings associated with the amended project which may intersect the water table have been identified and are discussed in Section 5 of **Appendix J**.

## 6.10.2 Existing environment

Section 7.10.3 of the EIS provides a detailed description of the existing environment within which the project is located, including groundwater conditions. The existing environment has not changed since the preparation of the EIS and is still applicable to the amended project.

## 6.10.3 Assessment of potential impacts

### 6.10.3.1 Clarifications

The memorandum in **Appendix J** includes a number of clarifications in response to issues raised by DPIE Water on the assessment of potential construction impacts, which provide further context behind the groundwater assessment prepared for the EIS, including:

Consolidation. The memorandum in Appendix J addresses concern regarding the potential impact of compaction (consolidation) on aquifers and GDEs. Borehole Standard Penetration Test (SPT) data indicates alluvial material is generally sufficiently stiff/dense to circumvent groundwater level impacts due to consolidation. However, it is noted that relatively softer material was observed at Kemps Creek. Bridges are proposed at the major creeks, including Kemps Creek. Consolidation of alluvial material will not occur underneath bridges as such areas will not be filled. Potential increases in groundwater levels due to surcharge loading, if any, are expected to be minimal and limited to areas in the vicinity of fill placement.

- Dewatering. The memorandum in Appendix J addresses concern regarding the potential impacts of dewatering on GDEs. Dewatering is only anticipated at the 'western cut', plus two additional road cuttings associated with the proposed design changes (see Section 6.10.3.2).
- Potential impacts to GDEs. The memorandum in **Appendix J** addresses concern regarding the potential impact of compaction on GDEs and the request for further information regarding drawdown. Potential groundwater level impacts to the GDEs due to compaction are considered unlikely. Potential increases in groundwater levels due to surcharge loading, if any, are expected to be very small, and limited to areas in the vicinity of fill placement. Drawdown from the 'western cut' is highly unlikely to impact GDEs as the nearest mapped potential GDE to the 'western cut' is about 240 metres away from the cut, which is outside the calculated extent of groundwater level reduction of about 60 metres.

### 6.10.3.2 Construction impacts

The EIS identified one location where the project may interest the water table, the western cut, located about 1500 metres east of The Northern Road. The amended project would result in two additional areas of cut that may potentially intersect the water table. Both areas are in the vicinity of the Western Sydney International Airport interchange and are a result of the proposed lowering of this intersection. These are the Airport interchange northern cut and the Airport interchange southern cut.

The location of these additional areas of cut is shown in **Figure 6-56** and described in further detail in the sections below.

#### Groundwater inflows

Groundwater impacts associated with the western cut documented in the EIS would not change as a result of the amended project.

The amended project would result in two additional areas of cut that may potentially intersect the water table, these are:

- Airport interchange northern cut
  - The minimum amended project finished design level is about 57 metres AHD, which is lower than the EIS design level at this location by about nine metres AHD
  - The amended project design level is about four metres lower than the maximum monitored groundwater level at BH117 (60.79 metres AHD), which is located about 100 metres west of the cut's western extent
  - A water table penetration depth of four metres was adopted for assessment as a result of the above
  - A conservative area of 60,000 square metres was used for groundwater inflow estimation purposes as it represents the entire cutting area
- Airport interchange southern cut
  - Minimum amended project finished design level is about 60 metres AHD, which is lower than EIS design level at this location by about two metres AHD
  - Perched local groundwater system near groundwater monitoring bore BH119 (about 400 metres south of the cut) based on monitoring data
  - A water table penetration depth of four metres was adopted for assessment as a result of nearby monitoring (BH120)
  - A conservative area of 30,000 square metres was used for groundwater inflow estimation purposes as it represents the entire cutting area.





Main roads

- Project groundwater monitoring bores
  - Groundwater assessment study area
  - The amended project construction footprint
- Indicative location of western cut
- Indicative airport interchange northern cut
- Indicative airport interchange southern cut



Figure 6-56 Three areas of cut associated with the amended project

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For the airport interchange northern cut, the estimated groundwater inflow rate (conservative estimate) is anticipated to be in the range of 0.8 to 8.4 kilolitres per day. However, based on project specific hydraulic conductivity testing values, the probable groundwater inflow rate is anticipated to be more likely in the range of 0.8 to 1.6 kilolitres per day. Most or all the groundwater inflow is anticipated to be evaporated, even for the scenario with the highest inflow rate.

For the airport interchange southern cut, the estimated groundwater inflow rate (conservative estimate) is anticipated to be in the range of 0.6 to 6.5 kilolitres per day. However based on project specific hydraulic conductivity testing values, the probable groundwater inflow rate is anticipated to be in the range of 0.6 to 1.2 kilolitres per day. Similarly with the northern cut, most or all the groundwater inflow is anticipated to be evaporated, even for the scenario with the highest inflow rate.

Overall, the entire range of groundwater inflow rates are considered low.

#### Groundwater levels

The maximum predicted change in groundwater level change due to road cuttings intersecting the water table is about four metres at both the airport interchange northern and southern cuts, with a maximum areal drawdown extent of about 220 metres.

The magnitude of potential drawdown associated with the two additional project cuts that may intersect the water table is sufficiently small such that:

- Regional groundwater drawdown will not occur
- Regional groundwater flows directions will not change
- Changes to groundwater system levels, if any, are anticipated to be highly localised to the project footprint and limited to the near surface groundwater systems.

The estimated changes to groundwater levels due to potential drawdown meet the minimal impact considerations outlined in the NSW Aquifer Interference Policy (DPI NOW, 2012) for GDEs and existing bores. Potential impacts to groundwater for the amended project are predicted to be minor and localised.

#### Groundwater dependent ecosystems

There are no mapped GDEs or existing licensed bores within the area of the maximum drawdown areal extent for either of the two additional areas of cut.

The nearest mapped GDE to the Airport interchange northern cut is Badgerys Creek riparian zone. This is approximately 620 metres east of the cut. The nearest mapped GDE to the airport interchange southern cut is Badgerys Creek riparian zone, which is approximately 690 metres east of the cut.

Given that the estimated maximum drawdown areal extent for the airport interchange northern cut or airport interchange southern cut does not encroach upon areas of mapped GDEs, the estimated changes to groundwater levels due to potential drawdown meet the minimal impact considerations outlined in the NSW Aquifer Interference Policy (DPI NOW, 2012) for GDEs. This is consistent with the project as described in the EIS.

#### Groundwater bores

There are no existing licensed bores within the area of the maximum drawdown areal extent for either of the two additional areas of cut for the amended project, with the nearest bore about 450 metres away.

As discussed above, the estimated changes to groundwater levels due to potential drawdown meet the minimal impact considerations outlined in the NSW Aquifer Interference Policy (DPI NOW, 2012) for existing bores.

#### Groundwater take and licensing

As discussed in Section 2.2.1 of EIS, the project is exempt from the need for water use approval, a water supply work approval and a WAL.

For the purpose of assigning a volume for groundwater accounting, groundwater take from the western cut and airport interchange northern and southern cuts is summarised in **Table 6-56** for the amended project. **Table 6-56** presents the maximum estimated groundwater inflow for each groundwater inflow area. Therefore, the inflow volumes are considered conservative.

The annual estimate groundwater inflow from all three cuts as a result of the amended project is 7.87 megalitres per year. A water balance for both groundwater and surface water is provided in **Section 6.9.3**.

Road cutting area	Maximum estimated groundwater inflow rate (kL/day)	Maximum estimated groundwater inflow rate (ML/yr)		
Western cut	6.75	2.46		
Airport interchange northern cut	8.36	3.05		
Airport interchange southern cut	6.45	2.36		
Maximum total inflow volume = 7.87 ML/yr				

Table 6-56 Estimated groundwater take for amended project

#### Groundwater contamination and discharge

In the EIS, discharging potential groundwater inflows from the western cut was assessed as unlikely to impact sensitive receiving environments. This is consistent with the amended project.

There is currently no groundwater water quality data for the areas of the airport interchange northern cut and airport interchange southern cut. Potential discharge of groundwater inflows from these cuts, however, is not anticipated to result in adverse impacts to the receiving environments because the estimated inflow rates are very low (about 0.01 litres per second from each cut). All inflow rate scenarios would likely mostly or fully evaporate prior to being discharged.

Section 7.10.4 of the EIS identified the following potential groundwater contamination related risks during construction:

- Accidental spills or leakages of hazardous materials may result in groundwater contamination
- If groundwater is contaminated, construction workers coming into contact with this groundwater may be subjected to a human health risk
- Construction works may mobilise contaminants towards sensitive receiving environments.

The above risks are applicable to the airport interchange northern and southern cuts and are also assessed as low risk due to the very low inflow rates and likely evaporation of inflows prior to being discharged. Groundwater monitoring would further reduce risks to human health and the environment.

### 6.10.3.3 Operational impacts

Impacts to groundwater during the operational phase of the amended project are assessed to be generally consistent with those described in the EIS. This is because both the amended project and the EIS project are assessed as unlikely to cause changes to regional groundwater levels and flow directions, with regional drawdown not anticipated. Changes to groundwater systems, if any, are anticipated to be highly localised to the project footprint and limited to the near surface groundwater systems.

## 6.10.4 Cumulative impact

The cumulative groundwater quality and hydrology impacts associated with the amended project would be likely to remain unchanged from the assessment carried out as per Section 7.10.5 of the EIS, due to:

- All areas of identified road cuttings which may extend below the water table (ie western cut and airport interchange northern and southern cuts) are not expected to regionally impact groundwater flows and levels. Drawdown heights at these cuts and the expected areal drawdown extents are minimal and localised.
- Groundwater quality impacts of the project are expected to be minimal and highly localised.
- Given the project is unlikely to result in substantial impacts to groundwater alone, it is therefore also not anticipated to result in cumulative impacts in conjunction with surrounding projects.

## 6.10.5 Environmental management measures

Groundwater impacts associated with the amended project are generally consistent with impacts described in the EIS and would therefore be managed through the implementation of the proposed management measures described in Section 7.10.6 of the EIS. Two additional environmental management measures to manage the groundwater quality and hydrology impacts are proposed, however, along with slight amendments to two existing management measures to address the new cuttings. These are outlined in **Table 6-57**. Additional text is shown in **bold**.

The memorandum in **Appendix J** also includes a clarification on future sites for replacement bores, where construction will remove existing sites noted in the EIS. The groundwater monitoring program shown in Section 7.2 of Appendix N of the EIS indicates that bores BH104, BH107 and BH112 would require replacement during the construction period. The groundwater monitoring program (GW01) for the amended project would now include the two additional areas of cut at the airport interchange as well as the western cut for the construction phase and operational phase. The groundwater indicators to be monitored for the amended project will be as per Section 7.10.6 of the EIS. Groundwater monitoring locations for the baseline, construction and operational phases of the amended project are clarified in **Table 6-58**.

Table 6-57 Revised environmental management measures (groundwater quality and hydrology) (bold text shows change from EIS)

Impact	Reference	Environmental management measures	Responsibility	Timing
Impacts on groundwater quality and flows	GW01	Groundwater monitoring will be carried out as part of the construction water quality monitoring program for the project. The groundwater monitoring will be based on the water quality monitoring methodology, water quality indicators and the monitoring locations shown in Appendix N of the EIS and Table 7-1 in the groundwater supplementary technical memorandum (Appendix J of amendment report). Baseline groundwater monitoring will be carried out at least monthly for at least six months before construction. Monitoring will also be carried out at least monthly during construction and will continue for at least six months of operation to verify that there are no groundwater impacts, and that management measures are adequate.	TfNSW/ Contractor	Prior to construction, and during construction
Alteration of groundwater flows and levels	GW02	Potential impacts on groundwater flows will be reconsidered as the detailed design for the project progresses, particularly in relation to the project's vertical alignment and extent of road cuttings. The aim of this will be to ensure that the groundwater controls proposed for the design as set out in this document would remain effective in mitigating groundwater impacts. In the instance that, during detailed design it cannot be demonstrated that the groundwater controls would be effective in mitigating potential impacts, or if observed groundwater inflow rates into the western cut or airport interchange northern and southern cuts are higher than estimated, additional measures will be implemented to minimise potential impacts to groundwater to minimise potential impacts on groundwater flows due to road cuttings or other sub-surface components of the project.	Contractor	Detailed design
Alteration of groundwater flows and levels	GW03	Installation of supplementary groundwater monitoring bores in the area of both airport interchange cuts would be carried out following project approval, at detailed design stage, to better understand groundwater depths and levels (and groundwater quality) in these areas.	Contractor	Detailed design

Impact	Reference	Environmental management measures	Responsibility	Timing
Alteration of groundwater flows and levels	GW04	Groundwater will be monitored at the airport interchange northern and southern cuts and the western cut during the construction phase and operational phase as outlined in Table 7-1 in the groundwater supplementary technical memorandum (Appendix J of amendment report). The groundwater indicators to be monitored will be as per Section 7.2.5 of Appendix N of the EIS. Groundwater inflows to the airport interchange northern and southern cuts and the western cut are to be observed by the groundwater monitoring contractor during the construction and operational phases at monthly intervals. As part of observing the airport interchange northern and southern cuts and the western cut groundwater inflows, the groundwater monitoring contractor is to estimate the groundwater inflow rates and note the areas where groundwater inflow is occurring. During construction, if groundwater inflows are observed from the airport interchange northern and southern cuts and the western cut, the groundwater inflows are observed from the airport interchange northern and southern cuts and the western cut, the groundwater quality from the cut is to be sampled. Operational phase groundwater quality sampling, including the quality sampling of the airport interchange northern and southern cuts and the western cut inflows, is to occur at a monthly interval for at least 6 months.	Contractor	Construction and operation

Table 6-58 Groundwater monitoring locations for the baseline, construction and operational phases of the amended project

Monitoring type	Monitoring locations			
	Baseline phase	Construction phase	Operational phase	
Groundwater quality monitoring	EIS dataset locations (BH104, BH112, BH145, BH202, BH207, BH209, BH217, BH223, BH301, BH302), plus supplementary post- EIS and amendment report monitoring at BH104, BH107, BH112 and BH145	BH104, BH107, BH112 and BH145. However, at some point during construction, bores BH104, BH107, BH112 will be decommissioned and replaced with newly drilled and constructed bores. Once replaced, groundwater quality monitoring is to be undertaken at the replacement bores, plus continue at BH145. Western cut, plus airport interchange northern cut and airport interchange southern cut	BH145, plus the bores that replace BH104, BH107, BH112. Western cut, plus airport interchange northern cut and airport interchange southern cut	
Groundwater level monitoring	All project bores (except BH301 and BH302, which were installed to monitor gas)	All project bores (except BH301 and BH302, which were installed to monitor gas) until the bores get progressively decommissioned during construction. All bores except BH145 will be decommissioned. Bores BH104, BH107, BH112 will replaced with newly drilled and constructed bores. Once replaced, groundwater level monitoring is to be undertaken at the replacement bores, plus continue BH145	BH145, plus the bores that replace BH104, BH107, BH112.	
Groundwater inflows (observation of inflow rates and areas of inflow)	Not applicable	Western Cut, plus airport interchange northern cut and airport interchange southern cut	Western Cut, plus airport interchange northern cut and airport interchange southern cut	