34. Surface water and groundwater

34.1. Introduction

This chapter provides an analysis of the surface water and groundwater resources affected by the indicative long term development of the proposed airport. It draws on technical assessments of hydrology and geomorphology (Appendix L1), surface water quality (Appendix L2) and groundwater (Appendix L3) in Volume 4. The assessment contained in this chapter builds on the assessment of impacts associated with the Stage 1 development (refer Chapter 18).

34.2. Methodology

A range of quantitative and qualitative assessment approaches were adopted to consider the impact of the proposed airport on surface and groundwater resources at the airport site.

Predictive models were used to consider the impact of the change in landform characteristics on runoff volumes and the subsequent impacts on stream flow, flooding, groundwater recharge and water quality. Potential impacts on the environmental values and beneficial uses of surface and groundwater resources were identified, and options for future management practices were considered as part of the assessment.

Full assessment methodologies are described in the respective technical papers presented in Appendix L. A summary of the regulatory and policy settings relevant to the management of water resources at the airport site is presented in Chapter 18.

The hydrologic, hydraulic and water quality models used in the assessment include representations of the drainage system incorporated into the concept design of the indicative long term development. This drainage system would comprise a series of channels and basins to direct and contain flows prior to discharge (refer Figure 34-1).

The drainage system would be largely constructed during the Stage 1 development and would be expanded to cater for the long term development. Notably, the capacity of the basins would be increased and an additional basin would be established in the south-west of the site.

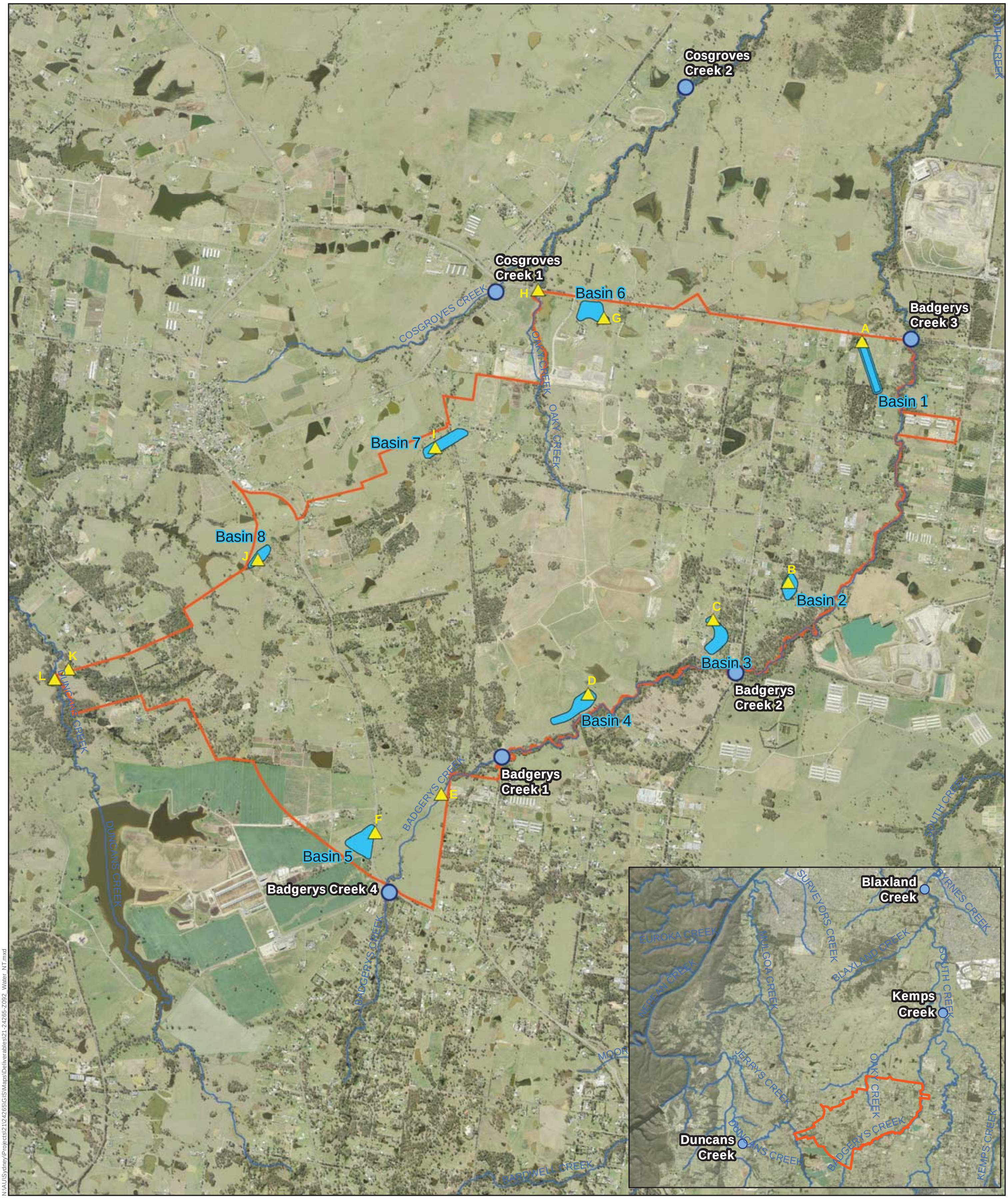
The basins would be situated at key locations where surface water flows off the airport site, and would be designed to release water at controlled velocities. The basins would also have the effect of improving the quality of the surface water prior to release to receiving waters.

The results of the models were analysed to identify impacts on waterways, people and property and thereby assess the effectiveness of the drainage system. The drainage system has been designed to contain flows up to the 100 year average recurrence interval (ARI) event.

The capacities of the basins to store surface water flows are presented in Table 34–1.

Table 34–1 – Indicative detention basin attenuation volumes

Basin	Volume (kilolitres)	Discharge
Basin 1	80,000	Badgerys Creek
Basin 2	27,000	Badgerys Creek
Basin 3	53,000	Badgerys Creek
Basin 4	82,000	Badgerys Creek
Basin 5	65,000	Badgerys Creek
Basin 6	75,000	Oaky Creek
Basin 7	82,000	Oaky Creek (via tributary)
Basin 8	41,000	Duncans Creek (via tributary)



LEGEND

- Airport site
- Watercourses
- Detention ponds
- Hydrology assessment reporting locations
- Water quality sampling sites
- Watercourses

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

0 0.25 0.5 1 Kilometres

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Figure 34-1 - Surface water drainage system and sample sites

34.3. Existing environment

The airport site lies in the north-east of the Hawkesbury-Nepean catchment and contains 64 kilometres of watercourses. The main watercourses at the airport site are Badgerys Creek, Cosgroves Creek and Duncans Creek. Other tributaries include Oaky Creek and a number of unnamed drainage lines and depressions. Clearing, agriculture and the construction of in-stream dams have affected the physical stability of the creeks and drainage channels, with bank erosion evident on the major watercourses despite their having well vegetated riparian zones.

Existing surface water flows at the airport site during one and 100 year ARI storms were simulated in hydrologic and hydraulic models. In the one year ARI event, flooding is mostly confined to main watercourse channels and dams, while considerable out-of-bank flooding is expected in a 100 year ARI event.

Water quality modelling simulations at locations in and around the airport site indicate that water quality is relatively degraded, with high nutrient levels that are attributable to existing land uses at the airport site and broader catchment. These results are consistent with surface water quality sampling at the airport site and prior data (PPK 1997; SMEC 2014).

Groundwater at the airport site is generally of poor quality, with limited beneficial use or environmental value. The aquifers at the airport site include:

- shallow alluvium of the main watercourses at the airport site;
- weathered clays overlying the Bringelly Shale (intermittent);
- an aquifer within the Bringelly Shale; and
- an aquifer within the Hawkesbury Sandstone.

The varying respective depths of the each aquifer and their limited hydraulic conductivity mean there is low potential for connectivity between groundwater systems or surface water interaction.

Groundwater bores in the vicinity of the airport site are understood to target the Hawkesbury Sandstone aquifer. This aquifer is significantly deeper than the other aquifers at the airport site.

A more detailed description of the existing environment of the airport site and surrounding area with regard to surface water and groundwater is presented Chapter 18.

The implementation of the Stage 1 development would transform the northern portion of the airport site from a rolling grassy and vegetated landscape to an essentially built environment. These changes would alter the catchment areas within the airport site and the permeability of the ground surface, which in turn would alter the duration, volume and velocity of surface water flows. The baseline environmental conditions for the long term development would therefore be representative of already modified environmental conditions.

34.4. Assessment of impacts during operation

34.4.1. Watercourses and flooding

The long term development would modify the topography and permeability of catchment areas within the airport site. These changes would affect site run-off and receiving water flow patterns and increase the potential for flooding. The long term development would also involve the removal of watercourses. The total length of watercourses that would be removed is approximately 20 kilometres, the majority being minor drainage lines and valley fills with less defined channels. It is anticipated that Badgerys Creek would be preserved along the south-eastern boundary of the airport site.

The concept design of the long term development includes expanding the drainage system to control the flow of surface water (refer Table 34–1). The assessment considers the effectiveness of this system in avoiding potential impacts on waterways, people and property.

A summary of changes to catchment areas as a result of the long term development is provided in Table 34–2. The long term changes to catchment areas and impervious surfaces are based on comparison with existing conditions, and incorporate the persistent effects of the Stage 1 development and the progressive implementation of the long term development.

Table 34–2 – Catchment area comparison

Location	Catchment area (existing)	Catchment area (long term)	Impervious area (existing)	Impervious area (long term)
Badgerys Creek at Elizabeth Drive	2052 ha	2394 ha ↑	12%	↑30%
Oaky Creek at Elizabeth Drive	361 ha	289 ha ↓	10%	↑53%
Cosgroves Creek at Elizabeth Drive	536 ha	600 ha ↑	14%	↑29%
Badgerys Creek at South Creek	2799 ha	2831 ha ↑	12%	↑27%
Cosgroves Creek at South Creek	2163 ha	2142 ha ↓	14%	↑24%
Duncans Creek at Nepean River	2379 ha	2360 ha ↓	14%	↑17%

The long term development would result in substantial increases in impervious areas and modification to sub-catchment flows within the airport site. An increase in catchment area or impervious surfaces would typically increase runoff volumes and the timing of peak flows at the airport site.

The proposed drainage system has been designed to mitigate the increased runoff associated with the altered catchment conditions at the airport site. As a result, modelling of stream flows indicates that duration, volume and velocity of surface water flows in watercourses would generally be similar or reduced when compared to existing flow conditions.

Hydrology and flooding in and around the airport site during the one year ARI and 100 year ARI storms was simulated using hydrologic and hydraulic models. Peak flow rates for a range of reporting locations are summarised in Table 34–3, and demonstrate the basins are generally effective in restricting the peak flows to the equivalent of, or less than, existing flows. Flood extents and depths for a one year ARI and 100 year ARI storm event show minimal change from the existing catchment characteristics. No changes to flood levels are expected to occur at dwellings or other infrastructure surrounding the airport site.

Increased stream depths of up to 100 mm may occur at Cosgroves Creek, and up to 250 mm in limited reaches of its tributary, Oaky Creek. These changes have the potential to affect the physical stability of watercourses through bed or bank erosion, particularly at Oaky Creek.

Localised changes in flow duration, volume and velocity would be expected at locations where basins release surface water. These basin outlets would be designed to avoid the associated potential impacts of localised scour and erosion.

Table 34–3 – Peaks flows at the airport site with long term development

Location	Basin	1 year ARI peak flows (m^3/s)			100 year ARI peak flows (m3/s)		
		Existing	Basin inflow	Outflow	Existing	Basin inflow	Outflow
Location A	Basin 1	8.4	10.8	8.0	33.5	72.8	29.9
Location B	Basin 2	1.9	2.3	1.7	8.2	15.6	5.1
Location C	Basin 3	3.2	5.0	2.6	12.9	33.2	8.8
Location D	Basin 4	2.3	8.8	5.3	9.1	58.1	17.3
Location E/F	Basin 5	6.5[a]	3.5	2.6[b]	26.3[a]	23.1	7.6[b] 3.9
Location G/H	Basin 6	8.9[d]	8.4[c]	6.8[c] 8.4[d]	37.6[d]	56[c]	24.6[c] 30.7[d]
Location I	Basin 7	4.1	6.9	4.2	16.5	46.2	12.4
Location J	Basin 8	3.3	3.7	2.2	10.9	24.9	7.3
Location K	–	2.1	–	2.0	9.6	–	13.3
Location L	–	4.6	–	4.2	19.8	–	18.0

[a] Location E

[b] Location F

[c] Location G

[d] Location H

34.4.2. Surface water quality

Existing surface water quality was modelled at upstream, downstream and major outflow locations in and around the airport site. The model results show that actual pollutant concentrations would decrease at most downstream locations (see Table 34–4). The reduction in pollutant concentrations is a function of their dilution in surface water flows leaving the airport site. The volume of surface water flows leaving the airport site would increase in proportion to changes in catchment areas and increases in impervious surfaces at the airport site. Despite the long term development leading to general improvements in pollutant concentrations locally and regionally, the improvements would not be sufficient to meet ANZECC guidelines.

Notwithstanding the general decrease in pollutant concentrations, the indicative long term development would result in increased loads of phosphorous and nitrogen. The increase in pollutant loads would also be a function of the increased surface water flows leaving the airport site. Increases in phosphorous and nitrogen loads would be most pronounced at basin outlets where surface water flows leave the airport site. Relative increases in loads, as a proportion of existing conditions, would decrease progressively downstream of the airport site as surface water flows are received from the wider catchment. Though loads would be volumetrically higher, actual pollutant concentrations would be generally improved compared with existing water quality conditions.

The operation of the proposed airport would involve the use of a range of fuels and chemicals. These substances may be released to the environment in the event of a mishap during refuelling, maintenance or general storage and handling.

Releases would be avoided with the implementation of Australian Standards for the storage and handling of hazardous materials. In the unlikely event of a significant leak or spill of contaminants, remediation would be implemented as soon as practicable.

Table 34–4 – Surface water quality at the airport site

	Existing (mg/L)			Long term development (mg/L)		
Location	**Suspended solids**	**Phosphorous**	**Nitrogen**	**Suspended solids**	**Phosphorous**	**Nitrogen**
ANZECC criteria	**40**	**0.05**	**0.5**	**40**	**0.05**	**0.5**
Basin 1	22.1	0.14	1.54	↓12.4	↓0.11	↓0.90
Basin 2	22.1	0.09	1.25	↓14.7	↑0.11	↓0.96
Basin 3	21.9	0.09	1.26	↓10.5	↑0.11	↓0.84
Basin 4	20.7	0.38	2.91	↓8.24	↓0.12	↓0.78
Basin 5	23.0	0.17	1.72	↓13.2	↓0.11	↓0.94
Basin 6	22.5	0.15	1.60	↓7.43	↓0.12	↓0.77
Basin 7	22.3	0.14	1.46	↓10.9	↓0.12	↓0.83
Basin 8	23.2	0.13	1.51	↓12.8	↓0.11	↓0.92
Badgerys Creek 1	21.5	0.14	1.47	↓14.4	↓0.11	↓1.02

	Existing (mg/L)			Long term development (mg/L)		
Location	Suspended solids	Phosphorous	Nitrogen	Suspended solids	Phosphorous	Nitrogen
Badgerys Creek 2	21.8	0.15	1.54	↓11.4	↓0.12	↓0.93
Badgerys Creek 3	21.9	0.14	1.53	↓12.0	↓0.12	↓0.94
Cosgroves Creek 1	22.7	0.14	1.54	↓11.0	↓0.12	↓0.91
Duncans Creek	10.3	0.06	0.70	↑13.6	↑0.11	↑0.98
Kemps Creek	20.9	0.13	1.34	↓13.2	↓0.12	↓0.98
Blaxland Creek	20.8	0.12	1.31	↓13.4	0.12	↓0.97

34.4.3. Reclaimed water irrigation

An estimated 14.4 ML of domestic wastewater per day would be generated during operation of the long term development. The wastewater may be treated and recycled through irrigation at the airport site, or transferred to an offsite sewage treatment system.

Specific treatment and irrigation methods would be determined during detailed design. Wastewater treatment at the airport site would be expected to utilise membrane biological reactor technology, which produces high quality reclaimed water suitable for beneficial reuses including irrigation.

The key risks to surface water and groundwater associated with the irrigation of reclaimed water would be runoff to surface water, or infiltration to groundwater. These risks would be limited in the first instance because the reclaimed water would be relatively high quality. Runoff would be avoided because the irrigation scheme would be optimised to prevent excessive irrigation.

34.4.4. Groundwater

The long term development would have the potential to affect groundwater conditions through changes to groundwater recharge, groundwater drawdown and impacts on groundwater quality.

Groundwater drawdown would be anticipated as a result of airport site re-profiling and dewatering of excavations beneath the water table. The re-profiling would result in a lowering of groundwater levels in areas that currently have higher topographical elevation, and is anticipated to result in a slight reduction in groundwater flow rates. The re-profiling would not result in dewatering of the groundwater system below the level of the surrounding creeks, and there would be no potential for drying up of the creeks from this activity.

The peripheries of the re-profiled area and establishment of basement levels in terminal buildings would result in exposed cuttings that would seep and require dewatering and management. Seepage volumes would be relatively small as a result of the inherent low hydraulic conductivities in the local geology.

Overall there is anticipated to be minimal change to local groundwater recharge or drawdown associated with the long term development of the site. The minor modification to groundwater conditions is not anticipated to result in impacts on any sensitive ecological receptors or beneficial uses of the groundwater system.

Groundwater seepage into building basements would need to be managed by pumping any seepage to stormwater management facilities or other suitable treatment systems. Chemicals of concern in groundwater seepage include total dissolved solids, metals, total nitrogen, phosphorus and sulphate. Significant groundwater inflows to underground infrastructure would not be expected and would be controlled, if necessary, through the use of lining or other engineering controls.

The operation of the proposed airport would involve the use of a range of fuels and chemicals. These substances may be released to the environment in the event of a mishap during refuelling, maintenance or general storage and handling.

Releases would be avoided with the implementation of Australian Standards for the storage and handling of hazardous materials. In the unlikely event of a significant leak or spill of contaminants, remediation would be implemented as soon as practicable.

Groundwater bores in the vicinity of the airport site are understood to target the Hawkesbury Sandstone aquifer. Direct impacts on this aquifer are not predicted as a result of the construction of the proposed airport. As such, there are no impacts during the long term development predicted to groundwater bore users.

34.5. Considerations for future development stages

Measures to manage potential impacts on surface water and groundwater would be similar to those implemented for the Stage 1 development, being adjusted or expanded as necessary according to the detailed assessment which would be undertaken for the long term development. Some of the key proposed measures include:

- investigation and refinement of the surface water drainage system, including outlet structures, during detailed design to improve flood and water quality performance as far as practicable;
- implementation of erosion controls in line with industry practice at the time of construction;
- design and operation of waste water treatment and reclaimed water reuse scheme in accordance with relevant guidelines at the time of operation, or transport of waste water off site and treatment within the Sydney Water system;
- regular inspection and maintenance of the surface water drainage system to ensure all components are functioning as designed;
- implementation of standards for storage and handling of fuels or chemicals with the potential to contaminate surface water or groundwater; and
- baseline and ongoing monitoring of surface water and groundwater.

Water quality matters associated with the proposed airport would also be regulated under the Airports (Environment Protection) Regulations or equivalent legislation in place at the time.

34.6. Summary of findings

The long term development would transform the southern portion of the airport site from a rolling grassy and vegetated landscape to an essentially built environment. These changes would alter the catchment areas within the airport site and the permeability of the ground surface, which in turn would alter the duration, volume and velocity of surface water flow. The long term development would generally represent a continuation of the impacts identified for the Stage 1 development.

Hydrologic and hydraulic modelling of the airport site during operation indicates that there is a degree of variation in how the drainage system would respond to different storm events. The drainage system would generally be effective at mitigating watercourse and flooding impacts; however, refinement of the drainage system would occur during the detailed design.

Minor alterations to local groundwater recharge and drawdown are anticipated to occur at the airport site, along with the need for minor dewatering as a result of the establishment of building basements. Changes to groundwater conditions at the airport site are anticipated to be minor and are not expected to impact any sensitive ecological receptors or beneficial uses of the groundwater system.