2.5.3 Riparian freshwater habitats and potential groundwater dependent ecosystems

The original topographic survey undertaken for the project by SurDevel Surveyors on 28 October 2013 indicates that surface flow from the north western development site plus stormwater from the developed lands to the north-west are collected into a constructed stormwater pond which then drains north under the existing dirt access road and into the riparian coastal woodland and saltmarsh habitat. This drainage pathway also collectes natural drainage from the west and from the south-eastern portion of the north-south ridge that runs parallel to the lake foreshore.

The groundwater survey undertaken by Douglas & Partners for the original Concept Approval EAR (EAR Appendix F) noted that groundwater was encountered at depths as shallow as 0.4 m below ground surface during the investigation and that these groundwaters were constrained by clay layers below the water table. They suggested that it may be possible that there is some tidal influence in the groundwater levels in the low-lying area of the site and that groundwater levels may therefore fluctuate depending on the water level in Lake Macquarie, particularly during periods of elevated water levels, such as observed in June 2007 when the water level in Lake Macquarie rose by about 1 m above average levels.

Given the shallow nature of the watertable, a survey was undertaken of the development site to check for seepages that may indicate surface expressed groundwater dependent ecosystems (GDEs). Three surveys were conducted, one on 8 May 2014 during an extended dry period and two on 2 and 15 September 2014 during and following an extended wet period. Photographs of the freshwater habitats associated with the existing stormwater pond overflow and of the drainage sites around the site are shown in Annexure E to this report and water quality results from the freshwater pool below the access road are shown in Table 8 below. This table also indicates lake water quality on the day (which would be indicative of saltwater intrusion if this were to occur) and provided the ranges of bore groundwater quality as summarised in the Douglas & Partners (2007) geotechnical report for the original EAR.

Table 8 Trinity Point Water Quality Data 2nd September 2014

Site	Time	Depth	Temp	Cond	Cond	Sal	DO	DO	pH	ORP	Turb
		M	°C	ms/cm	µS/cm	ppt	%sat	mg/l	Units	mv	ntu
Freshwater	16:38	0.1	16.53	0.3	263	0.15	65.9	6.4	7.21	404	14.9
Inshore Lake	15:16	0.1	16.56	49.6	4457	32.41	84.7	6.8	8.10	444	9.5
Douglas & Partners Study for EAR - groundwater bore water quality											
				0.6 to 6.8			31 to 95		4.1 to 7.7		>1277

Results of the various surveys are summarised as follows:

- There were no indications of any groundwater seepages or bogs observed on the site walkover on 8 May 2014 (during the dry spell) and no seepages were found along the riparian foreshore.
- Inspections of the upper northern development site drainage that flows via a grassy swale to the site stormwater pond on 2 September 2014 (during the extended wet period) indicated some surface rainwater pooling in the swale but there was no indication of aquatic or water tolerant plants or biota and it is concluded that the drainage is ephemeral surface drainage only.
- The drainage channel flows through kikuyu pasture for the majority of the length downstream from the end of Celestial Drive prior to draining into the stormwater pond.
- The overflow discharge from the stormwater pond is a shallow grassy swale (<10cm within swale upstream of road pool) and deeper within the access roadside pool (maximum depth 40cm but generally <20cm).
- There were three macrophytes observed within the roadside pool; cumbungi (*Typha sp*), river clubrush (*Scheonoplectus validus*) and knotweed (*Persicaria sp*), and there was filamentous green algae noted to be smothering some of the inundated edge areas of the pool.
- Downstream from the road pool the drainage continued as a surface grassy swale toward the *Casuarina* coastal woodland. There were no indications of any aquatic or water tolerant plants in the swale indicating that the discharge is ephemeral.
- This drainage also collects stormwaters from swales entering from the east and west, both of which contained 5-10cm of water on 2 September 2014.
- The presence of macrophytes and filamentous green algae suggests that the knotweed and cumbungi pool is semi-permanent; whereas the soaked channel areas and all swales adjoining the upper and lower ends of the pool are ephemeral and would most likely only contain aquatic habitats for short periods after rainfall.
- The semi-permanent nature of the roadl pool is highlighted by the diversity of the aquatic fauna found in the pool that included acarina (mites), aeshnidae (dragonflies), ostracoda (seed shrimp), copepoda, cladocera (water fleas), chironominae (bloodworms), ceratopogonidae (biting midges), scirtidae (marsh beetles), hydrobiidae (snails), dytiscidae (water beetles), culicidae (mosquitoes), oligochaeta (worms), hydroptilidae (caddis-flies) and tapoles.

It is concluded that there are no expressed GDEs at the site and that the access road pool is sustained by collected stormwater with little or no influence from groundwater (i.e, no base-flow). This conclusion is also supported by the water quality results in table 8 that indicate the pool waters to be rainwater runoff.