Before the Independent Commissioner Hearing Panel

Under	the Resource Management Act 1991 (**RMA**)
In the matter of	an application by **Dunedin City Council** to develop a landfill at Smooth Hill, Dunedin. Applicant

Statement of evidence of Dr Tanya Jillaine Blakely

29 April 2022

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Qualifications and experience

1 My name is **Dr Tanya Jillaine Blakely**.

2 I am an Ecologist, Senior Principal and Technical Leader – Sciences with Boffa Miskell Limited. I have been employed as an Ecologist with Boffa Miskell since April 2012.

3 I hold a Bachelor of Science (First Class Honours) in Zoology (2002) and a Doctor of Philosophy in Ecology (2008) both from the University of Canterbury. I am a Certified Environmental Practitioner, Ecology Specialist, with the Environment Institute of Australia and New Zealand (**EIANZ**). I am also a full member of the New Zealand Freshwater Sciences Society and the EIANZ. I am currently (since 2018) the Chair of the New Zealand Fish Passage Advisory Group.

4 I have nearly 20 years' professional experience in ecological surveying, monitoring, applied scientific research and advising on ecological matters. I have published eleven peer-reviewed scientific papers, a technical guidebook on freshwater macroinvertebrates, and numerous technical ecological reports, ecological impact assessments and other publications on topics in my areas of expertise. I have prepared evidence on ecological matters for Council Hearings.

5 My core work area as an Ecologist at Boffa Miskell is in freshwater ecology. I am experienced in assessing ecological values and conducting ecological impact assessments, rehabilitation and restoration, and on-the-ground management of construction activities on freshwater fauna and habitats. I have worked on a number of major infrastructure projects and commercial and residential developments throughout New Zealand. I have worked on several major projects where freshwater restoration and loss of, or modification to, freshwater habitat were key challenges.

Project involvement

6 I have been involved in Dunedin City Council's proposed Smooth Hill landfill project since May 2019. I was engaged to undertake an ecological impact assessment, focused on freshwater ecology, for the proposed Smooth Hill project, including the landfill development and operation, and associated road upgrades.

7 I have visited the landfill designation and accessed Ōtokia Creek tributary between the designation site and McLaren Gully Road numerous times since 23 May 2019. This is described in Section 2.7.2 of the "Smooth Hill Landfill Ecological Impact Assessment", dated 28 May 2021 (the **EcIA**).

8 On 3 March 2022, I had another site walkover[1] where I visited the designation, the valley floor marsh wetland between the designation and McLaren Gully Road, a section of Ōtokia Creek downstream of Big Stone Road (within Wenita Forest Products' block), and the mouth of Ōtokia Creek at Brighton Beach.

9 I authored the freshwater sections of the previous version of the Ecological Impact Assessment, and the current EcIA, dated 28 May 2021, which was updated in response to the changes to landfill extent and that this current application is based on.

Code of contact

10 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence has been prepared in accordance with it and I agree to comply with it. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

Scope of evidence

11 I have been asked to prepare evidence in relation to the potential ecological effects of the proposed landfill project to freshwater ecology. My evidence:

(a) Sets out the methodology and limitations of the EcIA as it relates to freshwater ecology, in terms of habitats that support freshwater fauna

(b) Describes the existing freshwater ecology values of lotic (running water) habitat downstream of the designation

(c) Summarises the key findings of the EcIA relating to the potential effects of the Proposal on freshwater ecology

(d) Responds to the Otago Regional Council (ORC) Section 95 report and additional matters on ecology raised by ORC on 2 March 2022

(e) Responds to the ORC Section 42A report

(f) Responds to matters raised in submissions relevant to freshwater ecology.

12 I refer to the evidence of Mr Anthony Kirk in relation to the effects of the proposed Smooth Hill landfill on groundwater and surface water, and the evidence of Mr Allen Ingles for descriptions of the existing surface water

[1] Accompanied by wetland ecologist Dr Jaz Morris and surface water hydrologist Mr Allen Ingles.

and potential effects of the landfill proposal on the surface water. My evidence is relevant to freshwater ecology; I refer to the evidence of Dr Jaz Morris for matters on terrestrial vegetation, including wetlands, where this relates to my freshwater ecology assessment.

Executive summary

13 There are two watercourses shown on the topographical map, which have been confirmed ephemeral flow paths or gullies that would convey overland survey flows only during prolonged rainfall events. At the northern-most extent of the designation, where these gullies converge, a swamp wetland occurs. Downstream of this swamp wetland, defined channels that contain small areas of open surface water start to form and connect to the valley floor marsh wetland, which commences at about the designation boundary. This wetland system forms part of the headwaters of the Ōtokia Creek catchment that ultimately flows to the sea at Brighton Beach approximately 12.9 km downstream of the Smooth Hill designation.

14 The 1.3 km of the unnamed tributary of Ōtokia Creek (which is a linear-wetland intermittent-stream system) is the focus of my evidence on freshwater ecology.

15 This linear-wetland intermittent-stream system that occurs downstream of the proposed landfill has areas of open, defined channel that have surface water present at times, but that also dry during prolonged dry periods (e.g., over summer). These downstream habitats, which are seasonally variable in water level and surface water permanence, are unlikely to support freshwater fishes but do support a suite of macroinvertebrate taxa that are commonly found in soft-bottomed and slow-flowing / standing water freshwater systems.

16 However, two species of eels have been found within the constructed pond located approximately 300 m downstream of the designation. These freshwater fish are long-lived species, spending many decades in freshwater before returning to the sea to spawn and die. This pond provides perennial habitat for eels but is expected to be disconnected from Ōtokia Creek catchment during low-flow periods due to the intermittent nature of the linear-wetland intermittent-stream system that is the valley floor marsh wetland.

17 In my original assessment of effects on freshwater ecology[2], I considered the findings of GHD's surface water assessment[3], which concluded that any alteration to downstream surface flows is expected to result in only a slight change. My evidence, and evidence of other technical experts to which I refer, further concludes that while the construction of the landfill has the potential to decrease flows in the defined channels of the valley floor marsh wetland, with the proposed stormwater attenuation basin mitigation in place, alterations to the hydrology of this receiving environment are expected to be negligible and not discernibly different from the range of natural variation expected to occur already via afforestation, and variability due to seasonality and natural climatic variability.

18 There is expected to be no discernible change in the flow regime within the open channels within the valley floor marsh wetland. As such, I do not expect there to be any change to the freshwater habitat of the valley floor marsh wetland.

19 In response to the submissions and ORC's s42A report regarding uncertainty of ecological outcomes, I have proposed twice-yearly baseline monitoring to commence at least 36 months prior to construction of the landfill. This baseline ecological monitoring, alongside proposed baseline hydrological monitoring, will enable the development of an adaptive management approach, which will be detailed by the proposed Freshwater and Wetland Monitoring and Management Plan (**FWMMP**). This plan will ensure that, should there unexpectedly be any stream habitat loss, it is quantified and appropriately remedied or otherwise managed in accordance with the effects management hierarchy using this adaptive management approach. Updated draft conditions of consent are proposed to address this.

Methodology and limitations

20 I undertook the freshwater ecology assessment, which involved a desktop review of available existing information and field surveys of the habitat conditions and in-river macroinvertebrate and fish communities in the valley floor marsh wetland, a tributary of Ōtokia Creek tributary, between the designation and McLaren Gully Road.

21 This is detailed in Section 2.7 of the EcIA and is summarised below.

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[2] Section 5.4.1 of the Ecological Impact Assessment

[3] GHD (2021). Dunedin City Council Waste Futures Phase – Smooth Hill Landfill. Surface water assessment, Report prepared for Dunedin City Council. Draft version, May 2021.

22 On 7-8 October 2019 and 24-25 March 2020, I walked over the designation site to confirm if river centre lines shown on New Zealand Topographical Maps were present as watercourses on site.

23 On 10-11 June 2020, I walked the entire length of the downstream receiving environment between the designation and McLaren Gully Road. I investigated the freshwater ecology values at each of four sites along this extent and where lotic[4] habitats were distinguishable from the wider wetland habitat.

24 At each site, I assessed basic habitat conditions[5] and macroinvertebrate communities[6,7] following national protocols.

25 I also assessed the fish community at the four survey sites and a variety of other locations between the designation and McLaren Gully Road, wherever sufficient habitat was found.

26 Access to the downstream receiving environment, through the Wenita Forest Products Limited property, was granted on 6 May 2020. This access agreement allowed for the assessment of the potential ecological effects due to the widening of McLaren Gully and Big Stone Roads, and the potential ecological effects on the downstream receiving environment (the wetland / stream that forms part of the Ōtokia Creek catchment immediately downstream of the designation site).

27 The freshwater surveys of the downstream tributary of Ōtokia Creek was unable to occur until this land access agreement was in place.

28 As a result, the first surveys for freshwater fish and other fauna were conducted in winter months and outside of the period recommended by the national protocol[8,9].

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[4] Running waters like streams and rivers.

[5] Clapcott (2015). National rapid habitat assessment protocol developed for streams and rivers. Prepared for Northland Regional Council. Cawthron Report No. 2649.

[6] Stark et al. (2001). Protocols for sampling macroinvertebrates in wadeable streams. Prepared for the Ministry for the Environment.

[7] Stark and Maxted (2007). A biotic index for New Zealand's soft-bottomed streams. New Zealand Journal of Marine and Freshwater Research 41: 43-61.

[8] Joy et al. (2013). New Zealand freshwater fish sampling protocols. Part 1: wadeable rivers and streams. Massey University report.

[9] Surveying of freshwater fauna (particularly fish) should be undertaken between December and April, inclusive, as fish become less active (and, therefore, less susceptible to being caught) during cooler conditions.

29 To remedy this and in response to s92 requests for further information, I conducted additional surveys on 12 & 13 April 2021.

30 However, surveying[10] was limited to one location – a large, constructed pond approximately 300 m downstream of the designation. The remainder of the habitats found in June 2020 as potentially suitable for freshwater fish were dry.

31 I followed the ecological impact assessment guidelines of the Environment Institute of Australia and New Zealand (**EIANZ EcIA guideline**)[11], to determine the ecological value, magnitude of ecological effect, and level of effect on the freshwater ecology of the proposed landfill and associated activities. This is described in Section 2.9 of the EcIA.

32 In summary, the EIANZ EcIA guideline method enabled freshwater habitats and species within the zone of influence[12] to be assigned on a five-point scale as having a negligible to very high ecological value**[13]**. The magnitude of effect[14] of the proposed activity was then identified, again across a five-point scale from negligible to very high[15]. From this, the level of ecological effect can be determined, following a matrix approach[16] taking into account both ecological value and magnitude of effect. Level of effect on ecology ranges from very low to very high, or for positive effects equates to net gain.

33 In determining the ecological values, I used the information I collected during field surveys, supplemented by available existing information gathered during my desktop investigation.

34 The ecological values and potential effects of the landfill and associated activities on other aspects of ecology are discussed by Dr Jaz Morris (terrestrial vegetation and wetlands), Ms Karin Sievwright (avifauna), and Ms Samantha King (herpetofauna).

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[10] Using baited hīnaki / fyke nets.

[11] Roper-Lindsay et al. (2018). *Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems.* 2nd edition.

[12] Zone of influence: the areas / resources that may be affected by the biophysical changes caused by the proposed project and associated activities. From Roper-Lindsay et al. (2018).

[13] Following Tables 5, 6 and 7 of Roper-Lindsay et al. (2018).

[14] The degree to which a feature / area / resource will be changed or lost. From Roper-Lindsay et al. (2018).

[15] Following Table 8 of Roper-Lindsay et al. (2018).

[16] Following Table 10 of Roper-Lindsay et al. (2018).

Existing ecological environment

35 For clarity, I adopt the broad habitat types of most relevance to freshwater ecology as described by Dr Morris, including:

(a) Swamp wetland – situated at the northern downslope extent of the designation and below the proposed landfill bund footprint.

(b) Valley floor marsh wetland – the downstream receiving environment, connected to the swamp wetland.

36 Although there are two watercourses shown on the topographical map[17], I concur with Mr Ingles and consider these gullies would convey overland surface flows only during prolonged rain fall events. This is because there are no clearly defined beds and a general absence of natural stream bed substrates. Streamlines shown on topographic maps can extend further up the catchment than headwater areas might on the ground[18]; these streamlines often include ephemeral reaches. These ephemeral flow paths will not provide habitat for indigenous freshwater fish or macroinvertebrates. As there are no watercourses found within the designation, I did not assess freshwater ecological value within the designation.

37 At the northern-most extent of the designation, where these gullies converge, a swamp wetland occurs. Dr Morris discusses this in his evidence with respect to vegetation and wetlands. I observed isolated areas of standing water associated with the swamp wetland. I also observed areas of defined channel downstream of the swamp wetland that contained small areas of open surface water. This is where the swamp wetland meets and connects to the valley floor marsh wetland. Dr Morris describes the swamp wetland as having a high degree of water-level variability and soils are likely dry at times. Again, given these fluctuations in water-levels and surface water permanence, I consider it is unlikely that this habitat is of sufficient water depth or permanence to support indigenous freshwater fish populations within the designation. I did not consider the ecological value for freshwater and instead refer to Dr Morris' evidence for discussion on ecological values of this wetland.

38 At about the designation boundary, the valley floor marsh wetland commences, which forms part of the headwaters of the Ōtokia Creek

[17] Shown on Figure 6 of the EcIA.

[18] Wilding and Parkyn (2006). Small headwater streams of the Auckland Region Volume 1: Spatial extent. Auckland Regional Council Technical Publication TP313.

catchment and flows to the sea at Brighton Beach approximately 12.9 km downstream. The valley floor marsh wetland, also described in Dr Morris' evidence, includes a well-defined channel for parts of the approximately 1.3 km length between the designation boundary and the culvert at McLaren Gully Road. This 1.3 km of the unnamed tributary of Ōtokia Creek is the focus of my evidence on freshwater ecology.

39 When present, the channel within this linear wetland is approximately 200-300 mm wide but with a total wetted width (within wetland vegetation) ranging from 1 m to 2 m in most places. Where flow is diffuse, the defined channel is absent and the wetted width is up to 5-10 m wide. Within the areas of defined channel, water depth is variable, ranging from very shallow to c.100 mm, with scattered pools of c.500-700 mm depth. A large, deep and human-made pond is located approximately 300 m downstream of the swamp wetland.

40 I observed slow flowing or standing water present within the defined channel along the valley floor marsh wetland at times, but there were also times when I observed the channel to be dry or with only occasional isolated pools where water was impounded in locations such as upstream of the McLaren Gully Road culvert[19]. In April 2021, following a prolonged period of dry weather, the channel for much of its 1.3 km between the designation and McLaren Gully Road was entirely dry. In April 2021 and March 2022, two occasions when I visited the site after prolonged dry periods, the large, constructed pond located approximately 300 m downstream of the swamp wetland appeared to be approximately similar in extent and I could hear water releasing from this to the channel and wetland area downstream.

41 I consider this to be an intermittent watercourse within a linear wetland, from the swamp wetland to McLaren Gully Road. This is based on my observations that surface water is present for some but not all of the year.

42 I describe the freshwater habitat as a macrophyte-dominated linear-wetland system with intermittent flows; the vegetation values are described by Dr Morris (and in the EcIA). The substrates within the open channel were predominantly fine silts and sands, with some coarse substrates including gravels and cobbles. Thick black, anoxic sediment was present in places and iron deposits were present in areas close to McLaren Gully Road. I classified the in-stream habitat conditions as suboptimal for freshwater

[19] My site visit in April 2021 was after a prolonged and dry summer.

species. This was based on the rapid habitat assessment[20], which considers deposited sediment, invertebrate habitat diversity and abundance, fish cover diversity and abundance, hydraulic heterogeneity, bank erosion and bank vegetation, and riparian width and shade.

43 The macroinvertebrate community was dominated by 'soft-bottom' taxa that are more tolerant of slow-flowing waterways and can also be indicative of degraded conditions. The macroinvertebrate community was similar along the valley floor marsh wetland, with seed shrimps (Ostracoda) and other freshwater crustaceans (Cladocera and Copepoda), freshwater clams (Sphaeriidae) and the ubiquitous native mud snail *Potamopyrgus*. Aquatic worms, springtails and other freshwater snails were also common. I also found low numbers of damselfly nymphs, freshwater beetles and true fly larvae. These macroinvertebrates are often found in slow flowing waterways and are also common in wetlands. Because many macroinvertebrate taxa spend most of their lifecycle in freshwater, they can provide a long-term picture of the stream or ecosystem health. I classified the stream health as "poor" based on the macroinvertebrate community found and the MCI water quality categories[21].

44 Despite extensive effort surveying for fish along the channel in June 2020, I did not capture or observe any fish within the areas of open water of the valley floor marsh wetland. It is important to note that this survey was in the winter and outside of the recommended December to April timeframes[22]. Conducting fish surveys during cooler winter conditions risks not detecting fish when present due to fish inactivity. It is, therefore, possible that fish were present but not detected. However, the habitats that I considered could potentially support fish were dry, or near dry, in April 2021, except for the pond c.300 m downstream of the swamp wetland. Here, I captured one longfin eel and two shortfin eels.

45 Longfin eel has a conservation status of "at risk - declining" while shortfin eel is "not threatened"[23]. Both species of eel are migratory species and very long lived, living in freshwater habitats for many decades before migrating to sea for a single reproductive event. All three fish were approximately 500

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[20] Clapcott (2015). National rapid habitat assessment protocol development for streams and rivers. Prepared for Northland Regional Council. Cawthron Report No. 2649.

[21] Stark and Maxted (2007). A biotic index for New Zealand's soft-bottomed streams. New Zealand Journal of Marine and Freshwater Research 41: 43-61.

[22] Joy et al. (2013). New Zealand freshwater fish sampling protocols. Part 1: wadeable rivers and streams. Massey University report.

[23] Dunn et al. (2018). Conservation status of New Zealand freshwater fishes, 2017. New Zealand Threat Classification Series 24. Department of Conservation, Wellington.

mm in length; it is very hard to gauge age on size alone as growth rates can be variable depending on where they live. For example, an eel of 500 mm length could be 2 years old if growing in certain habitat conditions, or 30 years old if from a cold lake.

46 I consider that the eels captured in the pond downstream of the designation would have migrated up the tributary from Ōtokia Creek. Further, despite the limited presence of surface water in the defined channel in April 2021, the surrounding wetland soils were still relatively water-logged in places and could have provided refuge from drying conditions for juvenile eels, for short periods of time. I base this on experience in similar habitats around the South Island.

47 I assessed the freshwater ecology values of this linear wetland as of moderate ecological value, given modified habitat and water-quality conditions that supports a relatively depauperate and 'pollution-tolerant' macroinvertebrate community and at least two indigenous fish species including an at-risk species. The watercourse is within the valley floor marsh wetland and forms part of the Ōtokia Creek catchment.

Assessment of effects on freshwater ecology

48 The landfill project is described in the Assessment of Environmental Effects and the concept design that supports the consent application. The matters of most relevance to freshwater ecology are as follows:

(a) The progressive earthworks and construction activities to create the landfill will include construction of a low permeability lining system to contain and collect leachate. This leachate water will be collected and discharged off site.

(b) Perimeter drains and other stormwater management devices will be constructed to capture stormwater runoff separately to leachate contaminated water. This clean water will be directed to an attenuation basin before being treated and discharged to the swamp wetland and valley floor marsh wetland, and ultimately Ōtokia Creek.

(c) The effect of these landfill works is to alter the catchment water balance and, therefore, the hydrological inputs to the downstream receiving water environments (wetlands and the unnamed tributary of Ōtokia Creek).

49 In his evidence, Mr Kirk predicts that recharge to the deep groundwater system is likely to be reduced following placement of the landfill, however, he also considers that deep groundwater does not provide baseflow to the

downstream receiving environments. Further to this, Mr Kirk and Mr Ingles state that these receiving environments are rainfall driven.

50 Mr Kirk also predicts that net stormwater surface runoff for the swamp wetland (immediately downstream of the landfill) would be reduced by up to 20%, due to altered surface runoff patterns, direct leachate interception and increased evapotranspiration from the grassed landfill cap compared to existing ground cover. The effects of this on the swamp wetland and the valley floor marsh wetland are discussed in Dr Morris' evidence.

51 Of relevance to the freshwater ecology, there would be reduced discharge to Ōtokia Creek, however, with the proposed stormwater attenuation basin in place, alterations to the hydrology of the valley floor marsh wetland are expected to be negligible. Mr Kirk predicts that soakage to ground from the attenuation basin would provide a consistent source of recharge to the shallow groundwater system that provides baseflow to the linear-wetland intermittent-stream system that is the valley floor marsh wetland. Mr Ingles concurs with this assessment and notes that any reduction in surface runoff within the valley floor marsh wetland would be within the range of natural variation, and less than what would be expected to occur already via afforestation of the catchment. This linear-wetland intermittent-stream system (that is the valley floor marsh wetland) is the subject of my evidence, with respect to freshwater ecology values.

52 As far as freshwater ecology values are concerned, this linear wetland has areas of open, defined channel that have surface water present at times, but that also dry during prolonged dry periods (e.g., over summer). These downstream habitats do not appear to support freshwater fishes but do support a suite of macroinvertebrate taxa that are commonly found in soft-bottomed and slow-flowing / standing water freshwater systems. I found three small eels within the constructed pond c.300 m downstream of the designation; this pond provides large and perennial habitat for eels but is expected to be disconnected from Ōtokia Creek catchment during low flow periods due to the intermittent nature of the linear-wetland intermittent-stream system that is the valley floor marsh wetland.

53 In my original assessment of effects on freshwater ecology[24], I considered the findings of GHD's surface water assessment[25], which concluded that any alteration to downstream surface flows is expected to result in only a

[24] Section 5.4.1 of the Ecological Impact Assessment

[25] GHD (2021). Dunedin City Council Waste Futures Phase – Smooth Hill Landfill. Surface water assessment, Report prepared for Dunedin City Council. Draft version, May 2021.

slight change. This is corroborated by Mr Ingles' evidence. Mr Ingles states that while the construction of the landfill has the potential to decrease flows in the defined channels of the valley floor marsh wetland, he does not expect this predicted reduction in runoff due to the landfill construction to be significantly different from reduced runoff expected as a result of afforestation from the existing forestry activities within and downstream of the designation. Mr Ingles concludes that there would be no discernible change in the flow regime within the open channels within the valley floor marsh wetland. Based on this, I consider this very slight decrease in flows to be of a negligible magnitude of effect, which equates to a very low level of effect on the freshwater ecology of the valley floor marsh wetland.

54 Ecological connectivity between the constructed pond along the valley floor marsh wetland and to Ōtokia Creek is relevant for longfin and shortfin eels. Both are migratory species where juveniles return to freshwaters to feed and grow for many decades before adults move to the sea to spawn and die. Maintaining fish passage for both upstream migrating juveniles and downstream migrating adults is an important consideration. During their downstream migration as adults in autumn, eels actively seek out the dominant downstream flow pathways[26]. Juvenile (elver) eels are likely able to move through the vegetated wetted margins of the linear wetland, as well as along the defined channels when surface water is present. Eels are also able to navigate through small spaces amongst vegetation, and along wetted surfaces outside of water as they can respire through their skin if it remains damp. Given Mr Ingles' evidence states that there will be no discernible change in the flow regime within the open channels of the valley floor marsh wetland, I do not expect there to be any changes to fish passage opportunities.

55 I also considered the potential effects of the landfill construction and operation with respect to disturbance and mobilisation of soils into stormwater and into the downstream receiving environment of the valley floor marsh wetland. Suspended sediment can alter water quality and habitat conditions and have adverse effects on macroinvertebrate and fish communities. Mr Ingles and Mr Kirk discuss that the proposed change in land use from forestry to landfill is expected to result in a net reduction in total flux of all contaminants to groundwater. Their evidence also considers that there will be no significant downstream effects on surface water quality, as the leachate treatment system will keep leachate separate from surface water runoff to the downstream receiving environment. Based on this expert

[26] Jellyman and Unwin (2017). Diel and seasonal movements of silver eels, *Anguilla dieffenbachia*, emigrating from a lake subject to hydro-electric control. Journal of Fish Biology 91: 219-241.

evidence of Mr Ingles, I anticipate a negligible magnitude of effect (and possibly an overall positive effect given the largely unmanaged runoff and stormwater from the current pine plantation practices) to surface water quality due to the landfill activity. As discussed by Mr Ingles, a robust monitoring programme for sediment and contaminants, including leachate management, is proposed as conditions of this consent.

56 Lastly, I considered the road widening of McLaren Gully Road and Big Stone Road and potential effects on watercourses at crossing locations. The road upgrades may include upgrading or extending culverts at watercourse crossing locations. The installation of new structures, or the extension or upgrade to existing culverts, has the potential to impede the movement of fish along and between waterbodies. If new structures are built or existing structures are upgraded or modified, these would need to be in accordance with the design, monitoring and maintenance parameters set out by the National Environmental Standard for Freshwater (NES-F). This would ensure fish passage is maintained or improved.

Response to any issues in ORC peer review

57 Dr Mike Lake, Senior Freshwater Ecologist at Tonkin and Taylor (T+T) provided a technical review[27] of the EcIA to the ORC on 3 September 2021 to inform the Council's s95 report. Dr Lake's review queried the classification of the watercourse between the designation site and McLaren Gully Road, which was referred to as perennial within the EcIA. Dr Lake suggests that the c.1.3 km of watercourse between the designation and McLaren Gully Road is intermittent, rather than perennial.

58 Dr Lake further states that the EcIA does not identify the point at which the watercourse transitions from an ephemeral to an intermittent watercourse, and that this ephemeral-intermittent watercourse transition point is likely difficult to define. In paragraphs 39-42, I have described the valley floor marsh wetland as a linear-wetland intermittent-stream system. The watercourse within this linear wetland has intermittent flows, in that the channel entirely dries or has occasional isolated pool after prolonged periods of dry weather. This was apparent to me on site visits in April 2021 and February 2022, where parts of the defined channel were dry or near dry on these occasions.

[27] *Technical Review to Inform Notification Decision: Smooth Hill Landfill -Appendix 11 -Ecology Assessment*. Report prepared by Tonkin & Taylor Ltd. for Otago Regional Council. Dated 3 September 2021.

59 In the revised technical review[28] that accompanied the ORC's s42a report, Dr Lake notes that the point at which the unnamed tributary of Ōtokia Creek transitions from intermittent to perennial is likely downstream of McLaren Gully Road. Whilst I did not identify the location of this transition point in the EcIA, I agree with Dr Lake's statement that the perennial reaches are downstream of McLaren Gully Road and provide the following discussion on this matter. The c.1.3 km of watercourse that forms part of the valley floor marsh wetland downstream of the designation is intermittent, where I have observed surface water flow within the defined channel as either entirely absent or drying to form isolated pools after prolonged periods of dry weather (as observed in April 2021 and March 2022). In March 2022, I was granted permission to access the property downstream of McLaren Gully Road and I followed this tributary to its confluence with Ōtokia Creek, approximately 200 m downstream of the road culvert. Here, Ōtokia Creek also sits within a wider linear-wetland system, moving between areas with defined channel with intermittent flows, and areas of diffuse flow and wider wetland habitat. This wetland-intermittent-stream system continues for approximately 3 km downstream of McLaren Gully Road. Some areas with well-defined channels were dry in March 2022. I also viewed the upper reaches of Ōtokia Creek adjacent to McLaren Gully Road, upstream of where the unnamed tributary within the valley floor marsh wetland joins Ōtokia Creek; in March 2022, this section of Ōtokia Creek was dry and the bed nearly entirely covered by macrophytes (aquatic plants). I had also observed the bed to be dry on 6 October 2021 during a site walkover with ORC and Dr Lake. Lastly, I also accessed Ōtokia Creek north of Big Stone Road in March 2022, accompanied by Dr Morris and Mr Ingles[29]. Here, I would also describe this section of Ōtokia Creek as a linear-wetland intermittent-stream system, much the same in appearance as the valley floor marsh wetland downstream of the Smooth Hill designation.

60 I have based my conclusions on the following definitions, as stated in the EcIA[30]: an ephemeral stream is when concentrated flow occurs for short periods of time during and / or after rainfall but is other dry for most of the time; there are no defined banks. Intermittent streams are neither perennial or ephemeral; having intermittent flow and / or intermittent pools for the

[28] *Technical Review: Smooth Hill Landfill -Appendix 11 -Ecology Assessment*. Report prepared by Tonkin & Taylor Ltd. for Otago Regional Council. Dated 5 April 2022.

[29] At a point approximately southeast of spot height 183 m on Topo50 maps, around 3 km downstream of the designation site boundary.

[30] Storey, R. and Wadhwa, S. (2006). An assessment of the lengths of permanent, intermittent and ephemeral streams in the Auckland Region. Prepared by NIWA for Auckland Regional Council. Auckland Regional Council Technical Report 2009/028.

majority of the time and confined in a channel with defined banks. Perennial streams have continuous flow within a well-defined channel.

61 In summary, the designation has ephemeral flow paths but no watercourses within it. The intermittent watercourse that forms part of the valley floor marsh wetland commences downstream of the swamp wetland and continues to downstream of McLaren Gully Road where it joins Ōtokia Creek, which also has intermittent reaches and areas of linear-wetland habitat for some distance downstream.

62 Dr Lake agrees with the methods I used to assess the freshwater habitat conditions, the macroinvertebrate fauna and fish communities in this tributary of Ōtokia Creek. I set fyke nets in the constructed pond in April 2021. This was the only site that fyke nets could be set due to an absence of surface water in the defined channels between the designation and McLaren Gully Road. The pond was the only location that had suitable freshwater habitat to set traps within and, more importantly, the only freshwater habitat present that had the potential to support freshwater fish. Dr Lake comments on the placement of the leader of the fyke net, noting that a net set in this manner would be unlikely to capture fish species other than eels. The fyke nets were set in this manner due to challenging site conditions, including extremely deep water in and surrounding the constructed pond. As I described in the EcIA, these conditions were also factors that meant collection of appropriate environmental DNA (eDNA) samples was not possible. I consider these as very minor points of contention and, most importantly, Dr Lake agrees that eels are probably the only fish species likely to persist in the habitat available. Dr Lake also agrees with my assessment of moderate freshwater ecological value.

63 Dr Lake also agrees with my assessment, as discussed in paragraph 56, that effects of upgrades to McLaren Gully Road on fish passage will be managed through adherence to the NES-F. The NES-F requires the installation of new structures, or the extension or upgrade to existing culverts to accord either with the permitted activity design standards, or design, monitoring and maintenance requirements for separate resource consents.

64 In paragraph 53, I conclude that the proposed landfill is expected to have a very low (or less than minor) level of effect on the existing freshwater ecology values. This is based on the technical work completed by GHD and summarised in Mr Kirk's and Mr Ingles' evidence, where while the construction and operation of the landfill is not expected to cause any discernible change in the flow regime within the open channels of the valley floor marsh wetland. Mr Ingles' evidence further states that the swamp

wetland and constructed pond would somewhat buffer downstream water flows, retaining rainfall and prolonging the contribution of this rainfall to downstream recharge of the valley floor marsh wetland. Mr Ingles' evidence states that flows within the defined channels of the valley floor marsh wetland would not be expected to be significantly different from any reductions in that would likely occur as a result of afforestation from the existing forestry activities within and downstream of the designation, or as a result of natural climatic variability.

65 This is the basis of my conclusion of a very low (less than minor) level of effect on the moderate freshwater ecology values. The EIANZ EcIA guideline notes that the level of effect can be used as a guide to the extent and nature of ecological response (e.g., measures to avoid, remedy, or mitigate) required. Further, low and very low levels of effect should not normally be of concern, although normal design, construction and operational care should be exercised to minimise adverse effects[31]. Dr Lake raised concerns with the level of uncertainty as to how surface water flows may respond to the establishment of the landfill. As such, T+T's ecology experts are of the view that appropriate surface water hydrology monitoring should be established to ensure that the actual magnitude of effects is negligible or low. I believe this concern is in part raised as the AEE stated that there was a potential for reductions in groundwater flow that may result in surface water flows within the watercourse to transition from an ephemeral to perennial stream by up to 45 m further downstream from its current location. As discussed in paragraph 64, Mr Ingles' evidence has clarified that no discernible change in the flow regime within the open channels within the valley floor marsh wetland is anticipated. Further to this, T+T's recommendation is that monitoring of surface water hydrology should be established to ensure that the magnitude of effects is negligible or low. Updated draft consent conditions now refer to inclusion of detailed baseline hydrological monitoring of water flows and water quality, and of baseline freshwater ecology monitoring (including habitat conditions, and macroinvertebrate and fish communities). The updated draft conditions also require development and certification of a Receiving Waters Environment Monitoring Plan (**RWEMP**), which will detail the requirements of long-term monitoring of surface water sufficient to protect the receiving environment downstream of the landfill by ensuring the landfill does not have an adverse effect on water quality and quantity.

[31] Roper-Lindsay et al. (2018). *Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems.* 2nd edition.

66 Ecological monitoring during construction and operation of the landfill would be required if the hydrological monitoring identified any exceedances of trigger levels. These baseline and long-term ecological monitoring requirements have been included in updated draft conditions in response to ORC's s42a report (discussed in paragraphs 71-72 below). Dr Morris' evidence discusses this with respect to wetlands and the proposed baseline and long-term monitoring.

67 The final matter raised by Dr Lake with respect to freshwater ecology is regarding water quality. I assessed a negligible magnitude of effect, and possibly an overall positive effect, as presented in paragraph 55. This is based on the evidence of Mr Kirk and Mr Ingles, both who discuss the proposed change in land use from largely unmanaged runoff and stormwater from the current forestry activities, to separated leachate water and treated stormwater proposed by the landfill activity. As discussed by Mr Kirk and Mr Ingles, a robust monitoring programme for sediment and contaminants, including leachate management, is proposed as conditions of this consent. Mr Kirk discusses that the information from the proposed baseline monitoring will be used to develop water-quality trigger levels protective of the environment and also to determine long-term water-quality monitoring requirements. Automated water-quality monitoring is proposed to provide highly detailed understanding of the variability in water quality.

68 Dr Lake has recommended that freshwater ecological monitoring should be considered as part of the Landfill Management Plan. As above, updated draft consent conditions now refer to inclusion of detailed baseline and long-term hydrological monitoring of water flows and water quality, and baseline and long-term ecological monitoring. These baseline and long-term ecological monitoring requirements have been included in updated draft conditions in response to ORC's s42A report and are discussed in paragraphs 71-72 below.

Response to ORC Section 42A report

69 The ORC's s42A report concludes that there remains some uncertainty as to how surface water flows will respond to the establishment of a landfill and that a definitive conclusion regarding the magnitude of adverse effects cannot be made. In response to the ORC's peer review and s42A report, Mr Kirk and Mr Ingles have further investigated and clearly shown in their evidence that flows within the defined channels of the valley floor marsh wetland would not be expected to be significantly different from any reductions in that would likely occur as a result of afforestation from the existing forestry activities within and downstream of the designation. Mr Kirk's and Mr Ingles' evidence suggest that there is not expected to be any

discernible change in flows within the defined channels of the valley floor marsh wetland. As such, I do not expect there to be any change to the freshwater habitat of the valley floor marsh wetland.

70 However, to be more certain regarding the degree of hydrological alteration that may occur, detailed baseline hydrological monitoring is proposed (as reflected by the updated draft conditions) to commence at least 36 months prior to construction of the landfill. This baseline data will provide information to fully understand the relationship between rainfall and stream flows and separate this from variation due to the forestry activities within the catchment. This baseline hydrological monitoring will also inform the preparation of the RWEMP to be developed and certified prior to construction commencing.

71 Further to this, detailed baseline ecological monitoring is proposed, including twice-yearly (between December and April) assessments of habitat conditions and of the macroinvertebrate and fish communities, at three of the surface water / hydrological monitoring sites. Monitoring will closely follow national protocols for habitat, macroinvertebrate and fish assessments. The purpose of the baseline freshwater ecology monitoring is to determine the extent of existing freshwater habitat and the freshwater ecology values, including macroinvertebrate and fish communities, and how these may vary naturally seasonally and in response to the changes in the surrounding land use. This will supplement information I have already gathered as part of my EcIA and evidence. This baseline information will also serve as a comparison for any monitoring of ecological conditions during construction and operation of the landfill, which will be detailed in the FWMMP. This will allow an assessment of the impact of the construction and operation of the landfill on the downstream freshwater environment and indigenous species, to ensure residual or ongoing adverse effects are effectively remedied or otherwise managed.

72 The baseline hydrological and ecological monitoring information will then further inform the RWEMP and the FWMMP, which will each determine what ongoing / long-term monitoring is required during construction and operation. The establishment of this rigorous baseline and long-term monitoring will ensure that, should there unexpectedly be any stream habitat loss, it is quantified and appropriately remedied or otherwise managed in accordance with the effects management hierarchy.

[Response to matters raised in submissions]

Ecological values of Ōtokia Creek catchment

73 Numerous submitters have highlighted the ecological values, and particularly the fish diversity, within Ōtokia Creek. For example, Ōtokia Creek and Marsh Habitat Trust note a study carried out to investigate the fish community of the Ōtokia Creek catchment. The Trust conducted eDNA sampling above the head of Ōtokia Marsh, which confirmed indigenous fish species such as longfin and shortfin eel, giant kōkopu, banded kōkopu, redfin bully, and common bully are present in the catchment. Also, Fish and Game note that members of the public have sighted salmonids and longfin and shortfin eels in Ōtokia Creek near the mouth at Brighton. These findings are in line with my expectations for a catchment like Ōtokia Creek, and many of the species found by the Trust's sampling have been recorded by others as shown by records held in the New Zealand Freshwater Fish Database. My understanding from the description provided is that the Trust undertook this sampling upstream of the marsh at the mouth of Ōtokia Creek, which is expected to provide habitat for a variety of freshwater fish species. This eDNA sampling location includes approximately 70 km of upstream waterway, including McColl Creek, Ōtokia Creek and tributaries. As discussed in paragraphs 39-42, the watercourse within the valley floor marsh wetland is a linear-wetland intermittent-stream system and, except for the constructed pond, does not permanently contain sufficient water depth and freshwater habitat to support freshwater fishes.

74 A submitter noted that fish surveys of the downstream watercourse were conducted in winter, which is outside of the December to April timeframe recommended for fish surveys. However, as discussed in paragraph 62, I note that I returned in April 2021 and set baited fyke nets within the sole available freshwater habitat (the constructed pond) and confirmed the presence of two species of migratory freshwater fish: longfin eel and shortfin eel.

Adequacy of assessment

75 Some submitters have also raised concerns regarding a potential underestimation of ecological values and ecological effects. Ōtokia Creek and Marsh Habitat Trust was also critical of the EIANZ EcIA guideline method used when assessing the ecological values and level of effect on these values. The EIANZ EcIA guideline is a commonly used approach used throughout New Zealand and has been widely tested in Court. This best-practice method was first published in 2015 and was updated in 2018 where it more explicitly included freshwater ecology. As discussed in paragraphs 71 & 72, and in the evidence I present in paragraphs 36-47, I consider that my assessment of freshwater ecological values (between the designation and McLaren Gully Road) as moderate remains appropriate.

The ORC's freshwater ecology technical peer reviewer, Dr Lake, agrees with my assessment of moderate ecological value.

Monitoring requirements

76 The submission by the Director General of Conservation acknowledges that the conservation values are likely to be low but that there remains some risk and uncertainty, as noted in T+T's letter[27] to inform Council's s95 report. The Director General of Conservation also notes that, in their opinion, these risks and uncertainty are exacerbated by a reliance on management plans that are yet to be finalised; and that should consent be granted, appropriate conditions are required to ensure that the activity and effects are as outlined in the application. I agree with this comment but note that the freshwater habitat within the valley floor marsh wetland is limited largely to the defined channel with intermittent flows. I expect the freshwater ecological condition within the valley floor marsh wetland to respond to variation in water levels both seasonally and with climatic variation.

77 In response to the submissions and to ORC's s42A report, draft consent conditions have been updated to require twice yearly baseline monitoring to commence at least 36 months prior to construction of the landfill. This is described in paragraphs 69-72. This baseline hydrological monitoring prior to construction of the landfill would supplement baseline ecological monitoring and determine any ongoing / long-term ecological monitoring that may be required. Updated draft consent conditions now require this baseline monitoring and the development of a RWEMP (long-term hydrological monitoring) and FWMMP (long-term freshwater and wetland ecology monitoring). The FWMMP, to be prepared by a suitably qualified freshwater and wetland ecologist(s) and certified by the independent peer review panel, will ensure that, should there unexpectedly be any stream habitat loss, it is quantified and appropriately remedied or otherwise managed in accordance with the effects management hierarchy and through an adaptive management approach.

Conclusion

78 Mr Kirk and Mr Ingles state that without mitigation, construction of the proposed landfill would reduce surface water flow to the unnamed tributary of Ōtokia Creek, which sits within the valley floor marsh wetland downstream of the landfill and designation. However, with the proposed stormwater attenuation basin mitigation in place, alterations to the hydrology of this receiving environment are expected to be negligible and not discernibly different from the range of natural variation expected to occur already via afforestation, and variability due to seasonality and

natural climatic variability. This means there is expected to be no discernible change in the flow regime within the open channels within the valley floor marsh wetland.

79 As such, I do not expect there to be any change to the freshwater habitat of the valley floor marsh wetland.

80 However, the proposed baseline ecological monitoring, alongside proposed baseline hydrological monitoring, will enable the development of an adaptive management approach, which will be detailed by the proposed FWMMP. These will ensure that, should there unexpectedly be any stream habitat loss, it is quantified and appropriately remedied or otherwise managed in accordance with the effects management hierarchy using an adaptive management approach. Updated draft conditions of consent are proposed to address this.

Tanya Blakely

29 April 2022