A review of the shorebird values and management actions in Hawke's Bay Regional Council's Ecological Management and Enhancement Plans

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Cover Image: Adult female banded dotterel (*Charadrius bicinctus*) with young chick.
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Executive Summary

The Tutaekuri, Ngaruroro and Tukituki Rivers provide breeding habitat for internationally, nationally and regionally significant populations of indigenous shorebirds including banded dotterels, black-fronted dotterels and South Island pied oystercatchers. Hawke's Bay Regional Council (HBRC) has a statutory responsibility for flood and erosion mitigation in Hawke's Bay, and this includes carrying out a range of activities on the riverbeds of these three rivers which have the potential to adversely impact these shorebird populations. To address this risk, HBRC has developed an Ecological Management and Enhancement Plan (EMEP) for each river, identifying key ecological values and outlining a set of rules and guidelines to be applied to flood mitigation activities, to avoid or minimise the adverse impacts of these activities.

In recent years, a significant amount of new work has been done both to update our knowledge of the shorebird values of Hawke's Bay rivers, and to test and improve current methods being used to avoid or minimise potential adverse impacts of flood mitigation and gravel extraction activities on riverbed-breeding shorebirds. To ensure that HBRC's Environmental Management and Enhancement Plans continue to be fit-for-purpose and remain at the forefront of best practice in New Zealand, HBRC have commissioned this review of the shorebird sections of these EMEPs with the aim of striking a pragmatic balance between managing potential adverse impacts on shorebirds caused by flood mitigation and gravel extraction activities, and recognising that these activities make an important contributions to the social and economic wellbeing of Hawke's Bay ratepayers.

This review provides a set of updated summaries of the bird values of the Tutaekuri, Ngaruroro and Tukituki Rivers, based on a comprehensive survey of riverbed-nesting shorebirds carried out by HBRC in November 2019. This review also provides a set of recommended changes and additions to shorebird management activities included in HBRC's Environmental Management and Enhancement Plans, including changes to recommended exclusion periods and nest set-back distances, a standard methodology and reporting template for pre-works shorebird surveys, and an improved system for marking the locations of shorebird nests.

It is recommended that this review be updated in mid-2022 following the completion of the current 3-year series of riverine shorebird surveys being carried out by HBRC, and that this review be repeated every six years from 2022 onwards. By doing this, HBRC's management of the potential adverse impacts of flood mitigation and gravel extraction on riverbed-nesting shorebirds in Hawke's Bay will remain at the forefront of best practice in New Zealand.

Keywords: Banded dotterel, black-fronted dotterel, flood mitigation, gravel extraction, Ngaruroro River, pied stilt, South Island pied oystercatcher, Tukituki River, Tutaekuri River

1. Background

The Tutaekuri, Ngaruroro and Tukituki Rivers provide habitat for a high diversity of indigenous bird species, including internationally, nationally and regionally significant populations of indigenous shorebirds such as banded dotterels (*Charadrius bicinctus*), black-fronted dotterels (*Elseyornis melanops*) and South Island pied oystercatchers (*Haematopus finschi*) (Parrish, 1988; Stephenson, 2010; Stephenson, 2011; McArthur et al, 2020). During a shorebird survey carried out in November 2019, a total of 2308 banded dotterels was counted on these three rivers, representing 12% of the global population of this species. The results of this survey also demonstrated that the Tukituki, Ngaruroro and Tutaekuri Rivers respectively support the second, third, and twelfth largest single-river banded dotterel populations in New Zealand. During the same survey, a total of 1168 black-fronted dotterels was recorded on these three rivers, representing 45% of the national population of this species (McArthur et al, 2020).

Hawke's Bay Regional Council (HBRC) has statutory responsibilities for flood and erosion mitigation in the Hawke's Bay region under Section 30 of the Resource Management Act (1991) and Sections 10 and 126 of the Soil Conservation and Rivers Control Act (1941). To meet these responsibilities, HBRC carries out a range of river drainage and flood control activities on the Tutaekuri, Ngaruroro and Tukituki Rivers, some of which have the potential to adversely impact the ecological values of these rivers. To avoid or minimise these potential adverse impacts, HBRC has prepared an Ecological Management and Enhancement Plan (EMEP) for each of these three rivers, the purpose of which is to identify existing ecological, recreational and drainage values, and to specify the management standards to be applied to river drainage and flood control activities to be carried out (Forbes & Whitesell, 2015; Forbes 2017a; 2017b).

Included in each of these EMEPs are some of the most ambitious management actions designed to avoid or minimise adverse impacts on riverbed-nesting shorebirds that have been implemented by any regional council in New Zealand (McArthur et al, 2018). These management actions include avoiding undertaking some flood mitigation activities during the core shorebird breeding season, carrying out pre-works surveys to locate shorebird nests and chicks prior to flood mitigation or gravel extraction activities, and imposing large set-back distances around nests and chicks to minimise the risk of disturbance (Forbes & Whitesell, 2015; Forbes, 2017a; Forbes, 2017b). These measures appear to be succeeding in ensuring that HBRC's flood mitigation activities are having a net neutral or net positive impact on these riverine shorebird populations. For instance, a recent analysis of shorebird trends on the Tutaekuri, Ngaruroro and Tukituki Rivers has shown that numbers of all five shorebird species that breed on these rivers have been either stable or increasing since 1962 (McArthur et al, 2020). Furthermore, it has also been demonstrated that beach raking carried out prior to the shorebird breeding season can lead to higher local densities of breeding banded dotterels, due to a reduction in riverbed vegetation cover (McArthur, 2020).

These EMEPs are now several years old, and since then a significant amount of new work has been done both to update our knowledge of the shorebird values of Hawke's Bay rivers, and to test and improve existing methods being used to avoid or minimise potential adverse impacts of flood mitigation and gravel extraction activities on riverbed-breeding shorebirds. To ensure that these EMEPs continue to be fit-for-purpose and remain at the forefront of best practice, HBRC has commissioned this review of the shorebird sections of the EMEPs. A key principal underpinning this review is to strike a balance between avoiding and minimising any adverse impacts on shorebirds caused by flood mitigation and gravel extraction activities, and recognising that these

activities make important contributions to the social and economic wellbeing of Hawke's Bay ratepayers.

This review is divided into two parts. Section two of this report provides updated descriptions of the indigenous bird values of the Tutaekuri, Ngaruroro and Tukituki Rivers, with a particular emphasis on riverbed-nesting shorebirds. These descriptions are intended to update those descriptions included in the existing EMEPs and are informed by the results of the November 2019 bird survey carried out by HBRC. A key feature of this survey was to subdivide these rivers into a total of 318 relatively short survey sections and to record separate shorebird counts for each section. This created the opportunity to compile the most detailed shorebird distribution maps ever produced for these rivers, and to quantify the effects of beach raking and riverbed vegetation cover on shorebird densities for the very first time (McArthur et al, 2020; McArthur 2020). Section three of this report provides a series of recommended changes to the management actions included in the EMEPs which are designed to avoid or minimise adverse flood mitigation impacts on riverbed-nesting shorebirds. This part of the review draws on information from three key sources:

- Consultation with three HBRC staff involved in managing beach-raking, gravel extraction and shorebird survey activities on the Tutaekuri, Ngaruroro and Tukituki Rivers, namely: Keiko Hashiba, Graham Edmondson and Luke Davis.

- The results of a comprehensive review commissioned by Environment Canterbury, quantifying the impacts of commercial gravel extraction on riverbed-nesting shorebirds on Canterbury Rivers, and an evaluation of the efficacy of various methods to avoid or minimise adverse impacts (McArthur et al, 2018).

- The results of two field trials carried out by Greater Wellington Regional Council, quantifying the Flight Initiation Distances of nesting banded dotterels in response to disturbance by people and machinery (Sim, 1997; McVeagh & John, 2020).

This review concludes with a summary of recommended changes to specific sections of the existing EMEPs together with recommendations for further work to ensure that Hawke's Bay Regional Council remains at the forefront of best-practice management of flood mitigation impacts on riverbed-nesting shorebirds in New Zealand.

2. An update of the shorebird values of the Tutaekuri, Ngaruroro and Tukituki Rivers

2.1 Tutaekuri River

A total of 88 bird species has been recorded on the Tutaekuri River, including 68 indigenous species, of which 31 are ranked as either Nationally Threatened or At Risk, and 23 are ranked as Regionally Threatened or At Risk under the New Zealand Threat Classification System (Appendix 1; Robertson et al, 2017; HBRC unpublished data).

Many of these species occupy the riparian vegetation and both freshwater and estuarine wetlands associated with the river. The estuarine wetlands at the Tutaekuri/Ngaruroro River mouth at Waitangi support a particularly high diversity of bird species, including highly threatened resident or migrant birds such Australasian bittern (*Botaurus poiciloptilus*), white heron (*Ardea modesta*) and black-fronted tern (*Chlidonias albostriatus*) (Stephenson, 2011).

The unvegetated gravels of the Tutaekuri River support breeding populations of five Nationally Threatened or At Risk shorebird species, namely banded dotterels, black-fronted dotterels, pied stilts (*Himantopus himantopus*), South Island pied oystercatchers and black-billed gulls (*Larus bulleri*) (Parrish, 1988; Stephenson, 2011; McArthur et al, 2020). All these species nest on unvegetated riverbed gravels during the spring and summer months, and the majority of these species are largely confined to these habitats during the breeding season. For these reasons, these species are particularly susceptible to disturbance caused by flood mitigation activities such as beach raking and gravel extraction, whenever they are carried out during spring and summer.

A total of 280 banded dotterels was counted on the Tutaekuri during a population census carried out in November 2019, demonstrating that the Tutaekuri River currently supports the 12th largest single-river breeding population of banded dotterels in New Zealand (O'Donnell & Monks, *in press;* McArthur et al, 2020). This survey also demonstrated that the combined banded dotterel population on the Tutaekuri, Ngaruroro and Tukituki River represents 12% of the global population of this species (McArthur et al, 2020). Banded dotterels occupy the bed of the Tutaekuri River at a mean density of 1.0 birds/ha, with densities ranging from 0 – 2.3 birds/ha. Above average banded dotterel densities occur between XS17 and XS49, whereas banded dotterels are either absent, or occur at lower densities downstream of XS17, and upstream of XS49 (Figure 2.1.1).

A total of 139 black-fronted dotterels was counted on the Tutaekuri River in November 2019, and the combined black-fronted dotterel population on the Tutaekuri, Ngaruroro and Tukituki Rivers represents 45% of the national population off this species (McArthur et al, 2020). Black-fronted dotterels occupy the bed of the Tutaekuri River at a mean density of 0.5 birds/ha, with densities ranging from 0 – 1.5 birds/ha. Black-fronted dotterels were relatively widespread on the Tutaekuri River, with above average densities occurring between XS03 and XS31, and between XS41 and XS54 (Figure 2.1.2). Whereas banded dotterels show a clear preference for large expanses of unvegetated riverbed gravels, black-fronted dotterels appear to have more specialised habitat preferences. Black-fronted dotterels tend to occupy relatively small areas of muddy habitats adjacent to small backwaters, minor braids and ephemeral pools, and typically nest on raised gravel ridges within 50m of these habitats. Given these more specialised habitat

requirements, it is crucial that flood mitigation and gravel extraction activities are carried out in a manner that maintains the quantity and distribution of these “muddy” habitats on the bed of the Tutaekuri River.

A total of 209 pied stilts was counted on the Tutaekuri River in November 2019, and the combined pied stilt population on the Tutaekuri, Ngaruroro and Tukituki Rivers represents 3.5% of the national population of this species (McArthur et al, 2020). Pied stilts occupy the bed of the Tutaekuri River at a mean density of 0.8 birds/ha, with densities ranging from 0 – 3.2 birds/ha. Above average pied stilt densities occur between XS15 and XS46, whereas pied stilts are either absent, or occur at lower densities downstream of XS15, and upstream of XS46 (Figure 2.1.3).

No South Island pied oystercatchers or black-billed gulls were recorded on the Tutaekuri River during the November 2019 survey, however both species have been recorded on this river previously. Two pairs of South Island pied oystercatchers were encountered on the Tutaekuri River by Brent Stephenson in October 2010, one of which had a nest containing two eggs. This was the first time that South Island pied oystercatchers had been recorded breeding on this river (Stephenson, 2011), although they have been breeding on the nearby Ngaruroro River since at least 1980 (McArthur et al, 2020). Black-billed gulls were recorded during each of the Tutaekuri River shorebird surveys carried out between 1962 and 1986, and regularly nest at Tutaekuri/Ngaruroro River mouth at Waitangi. During the November 2019 survey, a mixed nesting colony of black-billed gulls and white-fronted terns was present on the estuary’s shingle barrier beach. There are no known records of black-billed gulls breeding on the bed of the Tutaekuri River, upstream of the Tutaekuri/Ngaruroro River mouth.

Appendix Two of this report provides a spatially explicit shorebird risk assessment matrix for flood mitigation and gravel extraction activities on the Tutaekuri River. This matrix provides an indication of the risk of disturbing nests or chicks of each shorebird species present on each section of the Tutaekuri River during the breeding season, based on shorebird densities mapped during the November 2019 survey. This matrix can be used as a decision-making tool to plan the timing and extent of flood mitigation and gravel extraction activities in unvegetated gravel habitats, and to determine whether or not a pre-works shorebird survey is required.

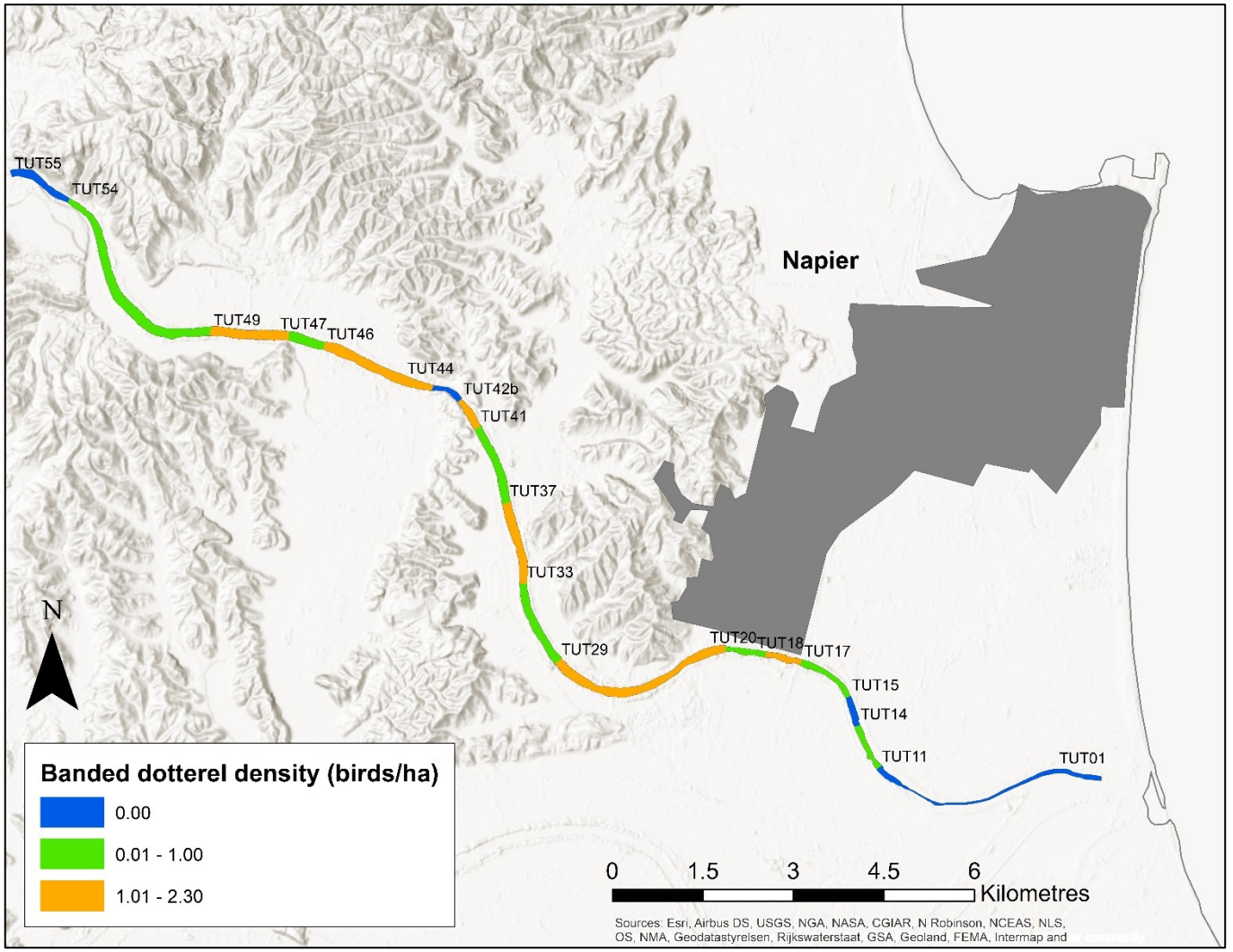

Figure 2.1.1: Banded dotterel densities on the Tutaekuri River in November 2019. Orange sections represent above average banded dotterel densities, green sections represent below average densities and blue sections represent river reaches where banded dotterels were absent.

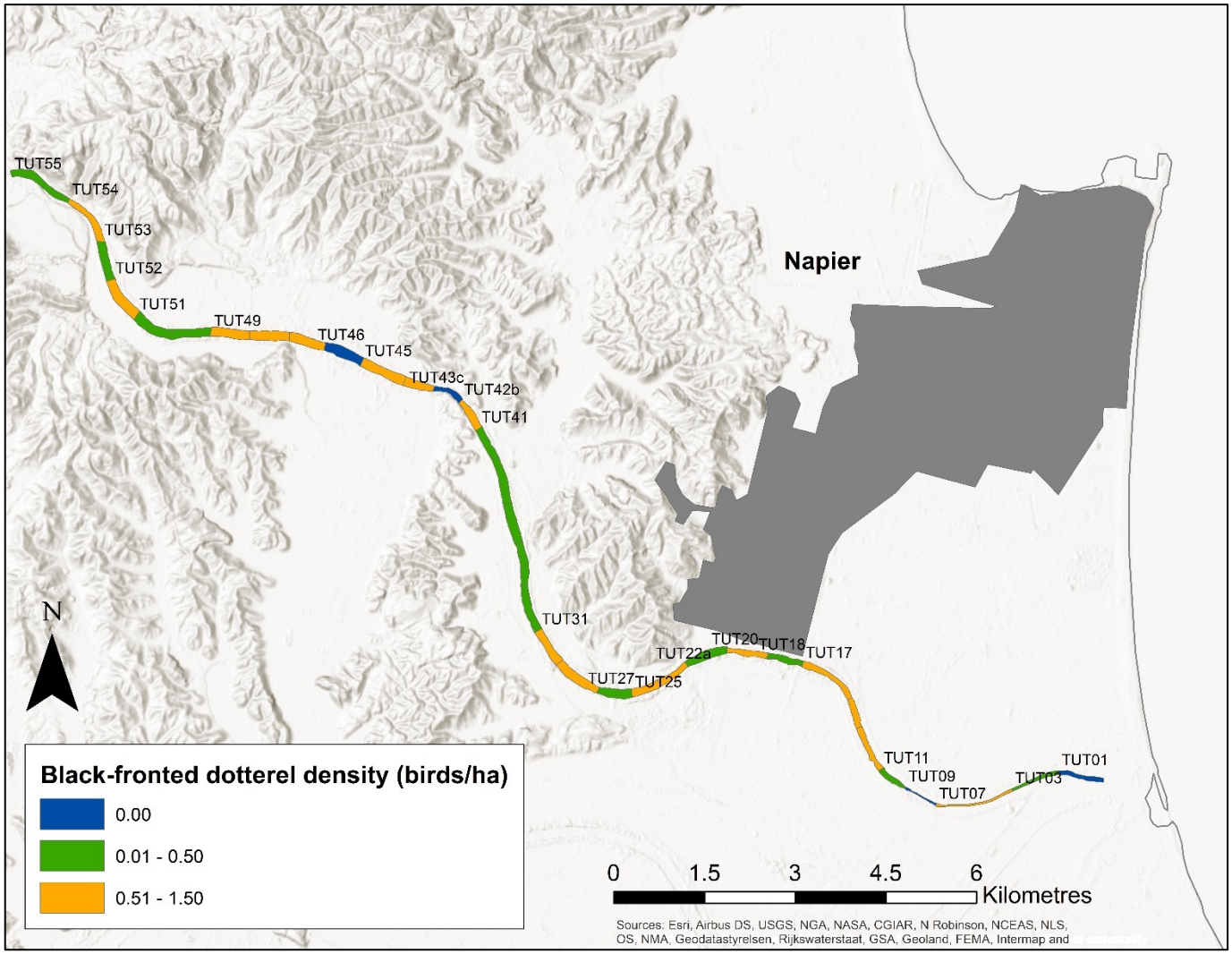

Figure 2.1.2: Black-fronted dotterel densities on the Tutaekuri River in November 2019. Orange sections represent above average black-fronted dotterel densities, green sections represent below average densities and blue sections represent river reaches where black-fronted dotterels were absent.

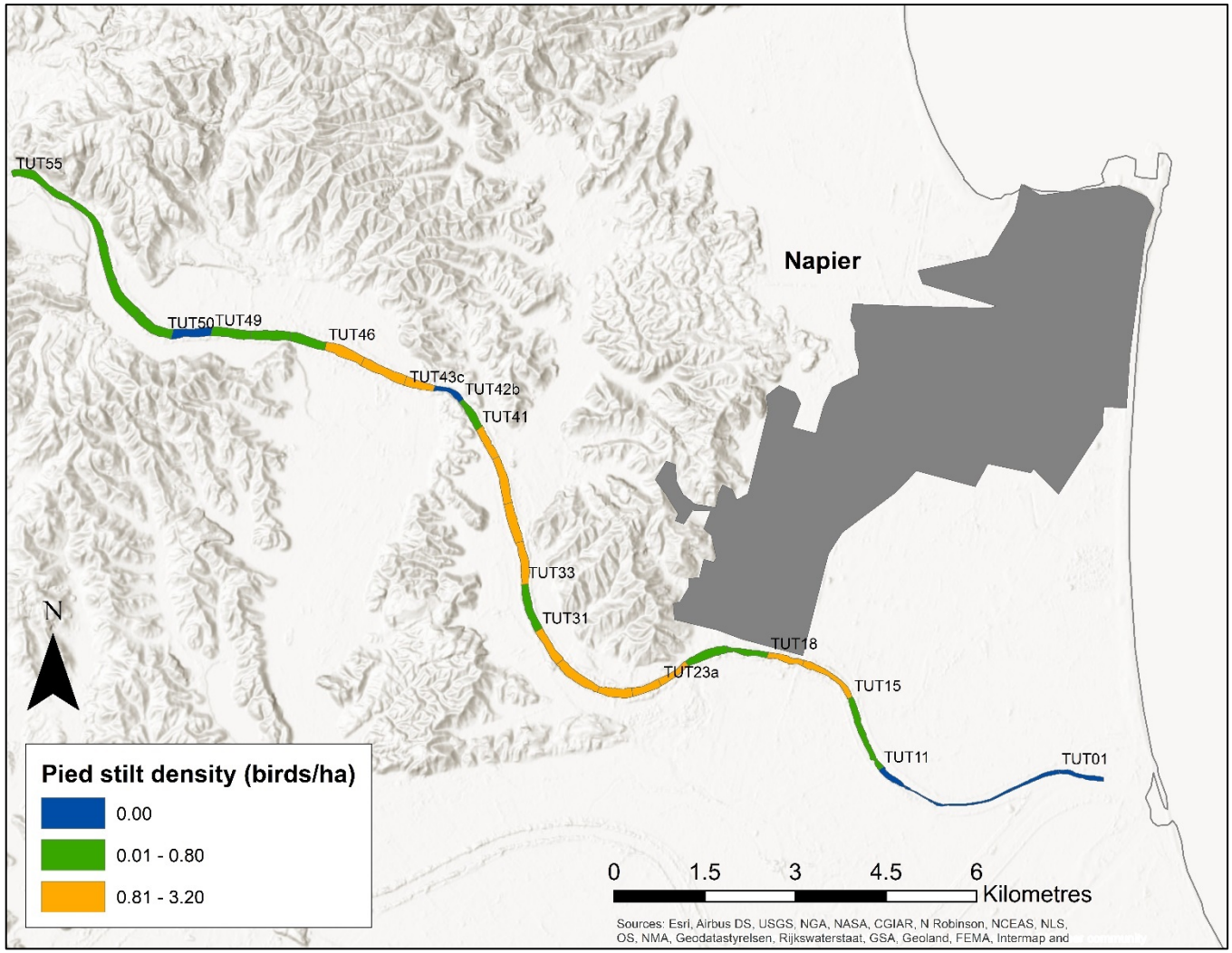

Figure 2.1.3: Pied stilt densities on the Tutaekuri River in November 2019. Orange sections represent above average pied stilt densities, green sections represent below average densities and blue sections represent river reaches where pied stilts were absent.

2.2 Ngaruroro River

A total of 85 bird species has been recorded on the Ngaruroro River, including 63 indigenous species, of which 27 are ranked as either Nationally Threatened or At Risk and 20 are ranked as Regionally Threatened or At Risk under the New Zealand Threat Classification System (Appendix 3; Robertson et al, 2017; HBRC unpublished data).

Many of these species occupy the riparian vegetation and both freshwater and estuarine wetlands associated with the river. The estuarine wetlands at the Tutaekuri/Ngaruroro River mouth at Waitangi support a particularly high diversity of bird species, including highly threatened resident or migrant birds such as Australasian bittern, white heron and black-fronted tern (Stephenson, 2011).

The unvegetated gravels of the Ngaruroro River support breeding populations of five Nationally Threatened or At Risk shorebird species, namely banded dotterels, black-fronted dotterels, pied stilts, South Island pied oystercatchers and black-billed gulls (Parrish, 1988; Stephenson, 2011; McArthur et al, 2020). All these species nest on unvegetated riverbed gravels during the spring and summer months, and the majority of these species are largely confined to these habitats during the breeding season. For these reasons, these species are particularly susceptible to disturbance caused by flood mitigation activities such as beach-raking and gravel extraction, whenever they are carried out during spring and summer.

A total of 916 banded dotterels were counted on the Ngaruroro River during a population census carried out in November 2019, demonstrating that the Ngaruroro River supports the 3rd largest single-river banded dotterel population in New Zealand (O'Donnell & Monks, *in press;* McArthur et al, 2020). This survey also demonstrated that the combined banded dotterel population on the Tutaekuri, Ngaruroro and Tukituki River represents 12% of the global population of this species (McArthur et al, 2020). Banded dotterels occupy the bed of the Ngaruroro River at a mean density of 0.6 birds/ha, with densities ranging from 0 – 2.0 birds/ha. Banded dotterels are relatively evenly distributed along the entire length of the Ngaruroro River, but are scarce or absent in reaches with narrower active channel widths, including downstream of XS11, and between XS59 and XS64 (Figure 2.2.1).

A total of 272 black-fronted dotterels was counted on the Ngaruroro River in November 2019, which is the largest number ever recorded on this river. The combined number of black-fronted dotterels counted on the Tutaekuri, Ngaruroro and Tukituki Rivers in November 2019 represents 45% of the national population of this species (McArthur et al, 2020). Black-fronted dotterels occupy the bed of the Ngaruroro River at a mean density of 0.3 birds/ha, with densities ranging from 0 – 2.4 birds/ha. Black-fronted dotterels are relatively widespread on the Ngaruroro River, with above average densities occurring between XS03 and XS38a (Figure 2.2.2). Whereas banded dotterels show a clear preference for large expanses of unvegetated riverbed gravels, black-fronted dotterels appear to have more specialised habitat preferences. Black-fronted dotterels tend to occupy relatively small areas of muddy habitats adjacent to small backwaters, minor braids and ephemeral pools, and typically nest on raised gravel ridges within 50m of these habitats. Given these more specialised habitat requirements, it is crucial that flood mitigation and gravel extraction activities are carried out in a manner that maintains the quantity and distribution of these "muddy" habitats on the bed of the Ngaruroro River.

A total of 312 pied stilts was counted on the Ngaruroro River in November 2019, and the combined pied stilt population on the Tutaekuri, Ngaruroro and Tukituki Rivers represents 3.5% of the national population of this species (McArthur et al, 2020). Pied stilts occupy the bed of the Ngaruroro River at a mean density of 0.3 birds/ha, with densities ranging from 0 – 3.7 birds/ha. Pied stilts are relatively widely distributed on the Ngaruroro River, with above average densities occurring downstream of XS49 and between XS60 and XS61 (Figure 2.2.3).

A total of 25 South Island pied oystercatchers were counted on the Ngaruroro River in November 2019, representing the second-highest number ever recorded on this river. Together with an additional six birds recorded on the Tukituki River, these birds represent the only SI pied oystercatchers known to be breeding in the North Island at the present time (McArthur et al, 2020). SI pied oystercatchers were present on the Ngaruroro River between XS51 and the Cableway and were absent from the river downstream of XS51 (Figure 2.2.4).

The vast majority of black-billed gulls counted on the Ngaruroro River in November 2019 were at the Tutaekuri/Ngaruroro River mouth at Waitangi and were associated with a mixed breeding colony of black-billed gulls and white-fronted terns. No other breeding colonies were located on the Ngaruroro River during the 2019/2020 breeding season. A flock of 100 black-billed gulls had been observed on the mid-Ngaruroro River in early September 2019 but did not subsequently attempt to nest at this site (McArthur et al, 2020).

Appendix Four of this report provides a spatially explicit shorebird risk assessment matrix for flood mitigation and gravel extraction activities on the Ngaruroro River. This matrix provides an indication of the risk of disturbing nests or chicks of each shorebird species present on each section of the Ngaruroro River during the breeding season, based on shorebird densities mapped during the November 2019 survey. This matrix can be used as a decision-making tool to plan the timing and extent of flood mitigation and gravel extraction activities in unvegetated gravel habitats, and to determine whether or not a pre-works shorebird survey is required.

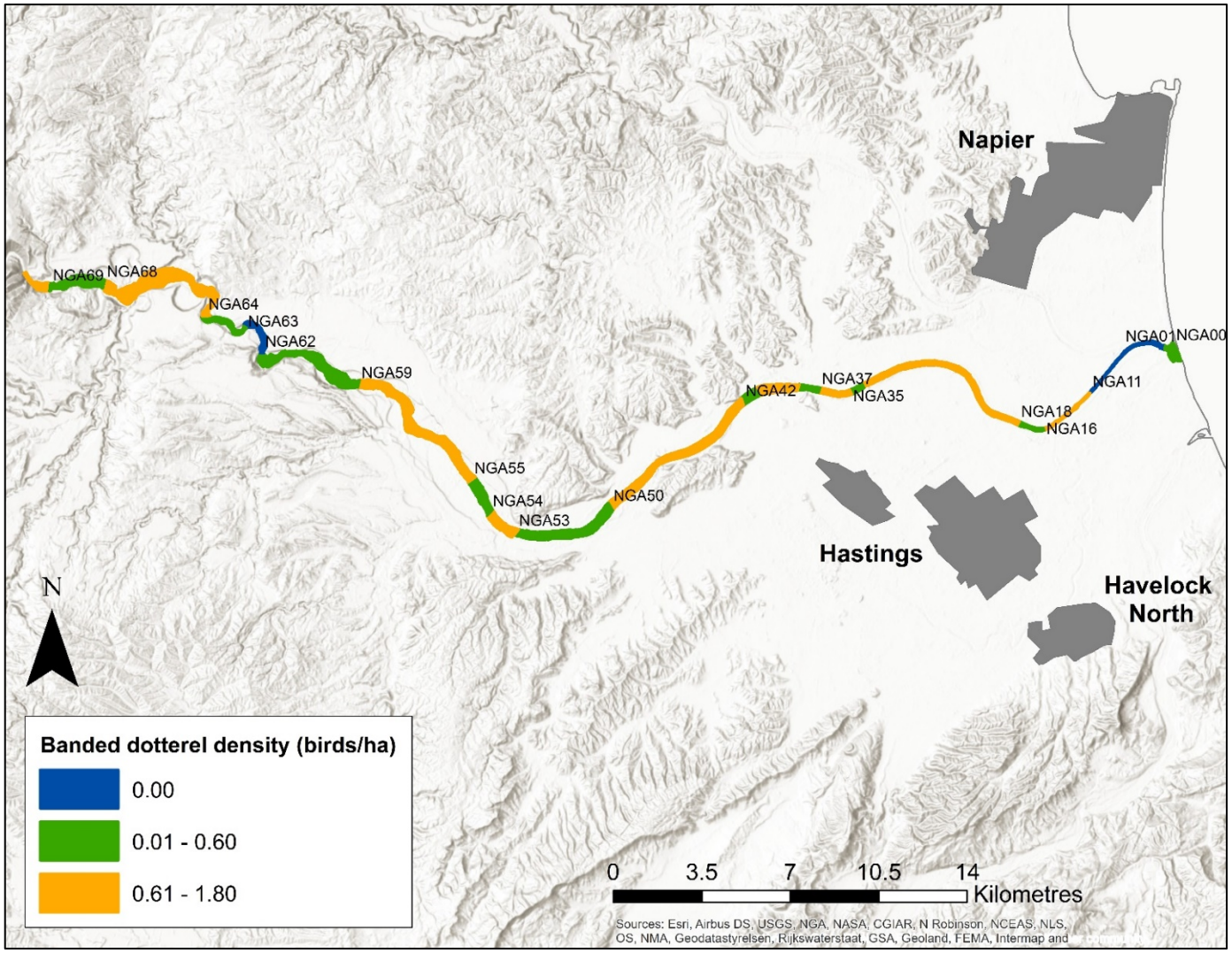

Figure 2.2.1: Banded dotterel densities on the Ngaruroro River in November 2019. Orange sections represent above average banded dotterel densities, green sections represent below average densities and blue sections represent river reaches where banded dotterels were absent.

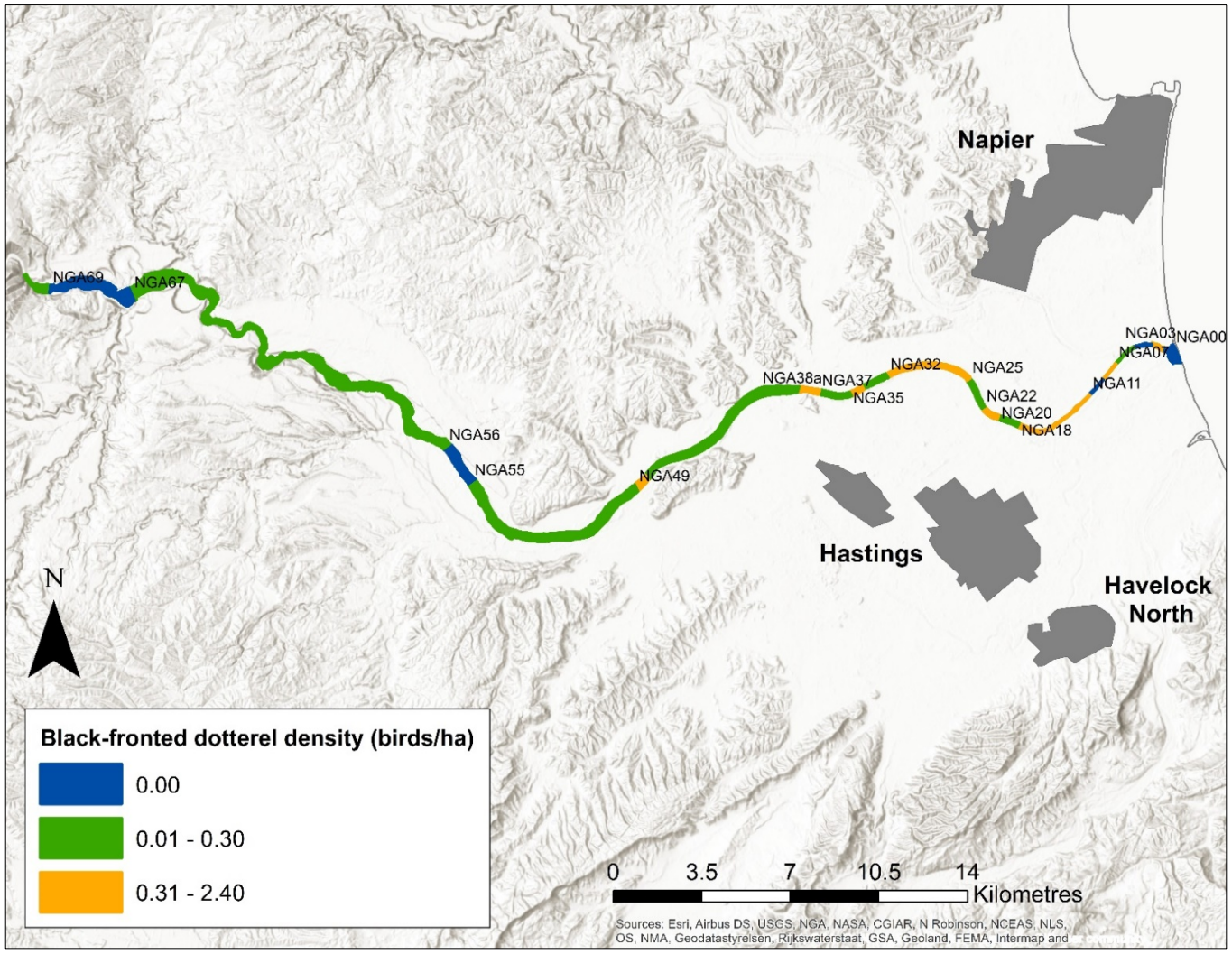

Figure 2.2.2: Black-fronted dotterel densities on the Ngaruroro River in November 2019. Orange sections represent above average black-fronted dotterel densities, green sections represent below average densities and blue sections represent river reaches where black-fronted dotterels were absent.

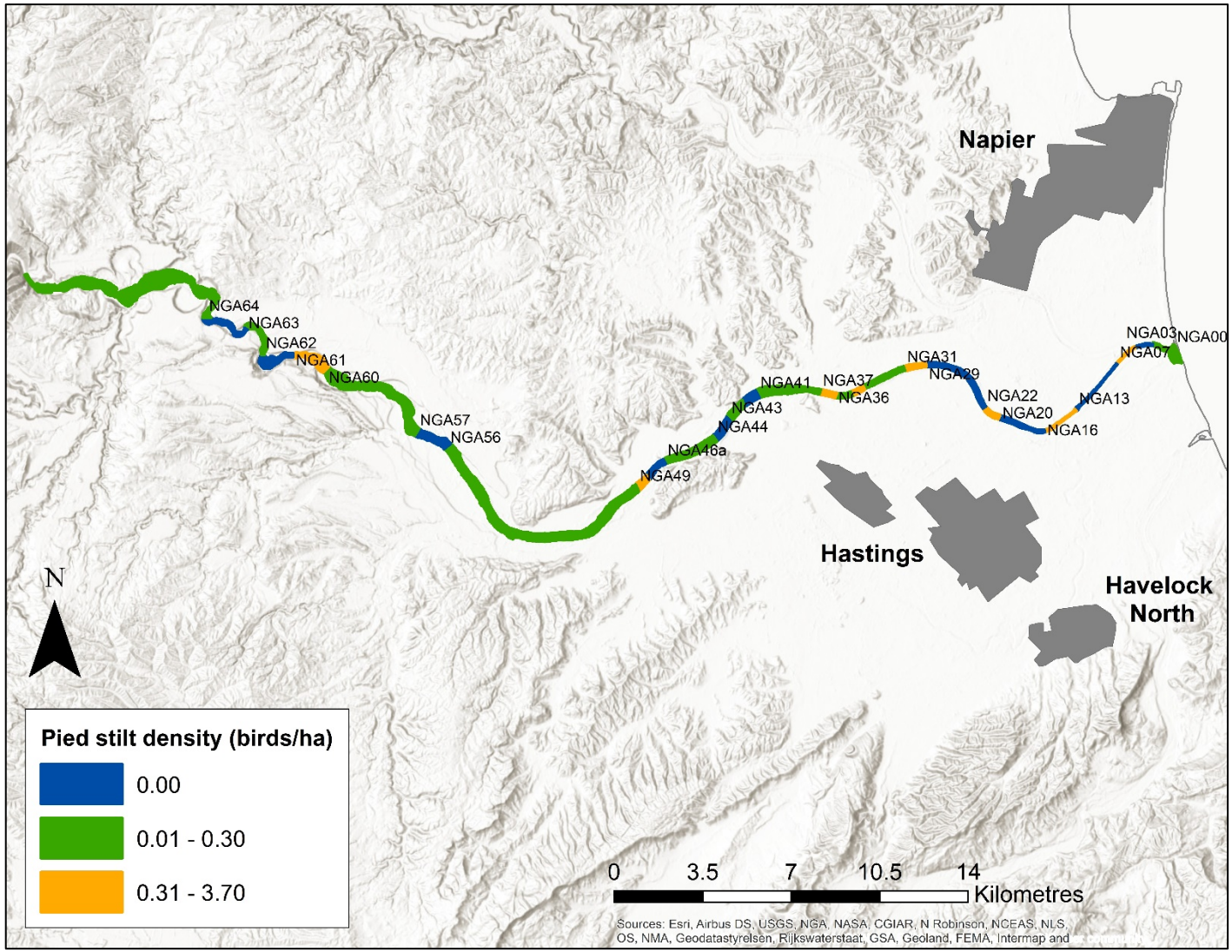

Figure 2.2.3: Pied stilt densities on the Ngaruroro River in November 2019. Orange sections represent above average pied stilt densities, green sections represent below average densities and blue sections represent river reaches where banded pied stilts were absent.

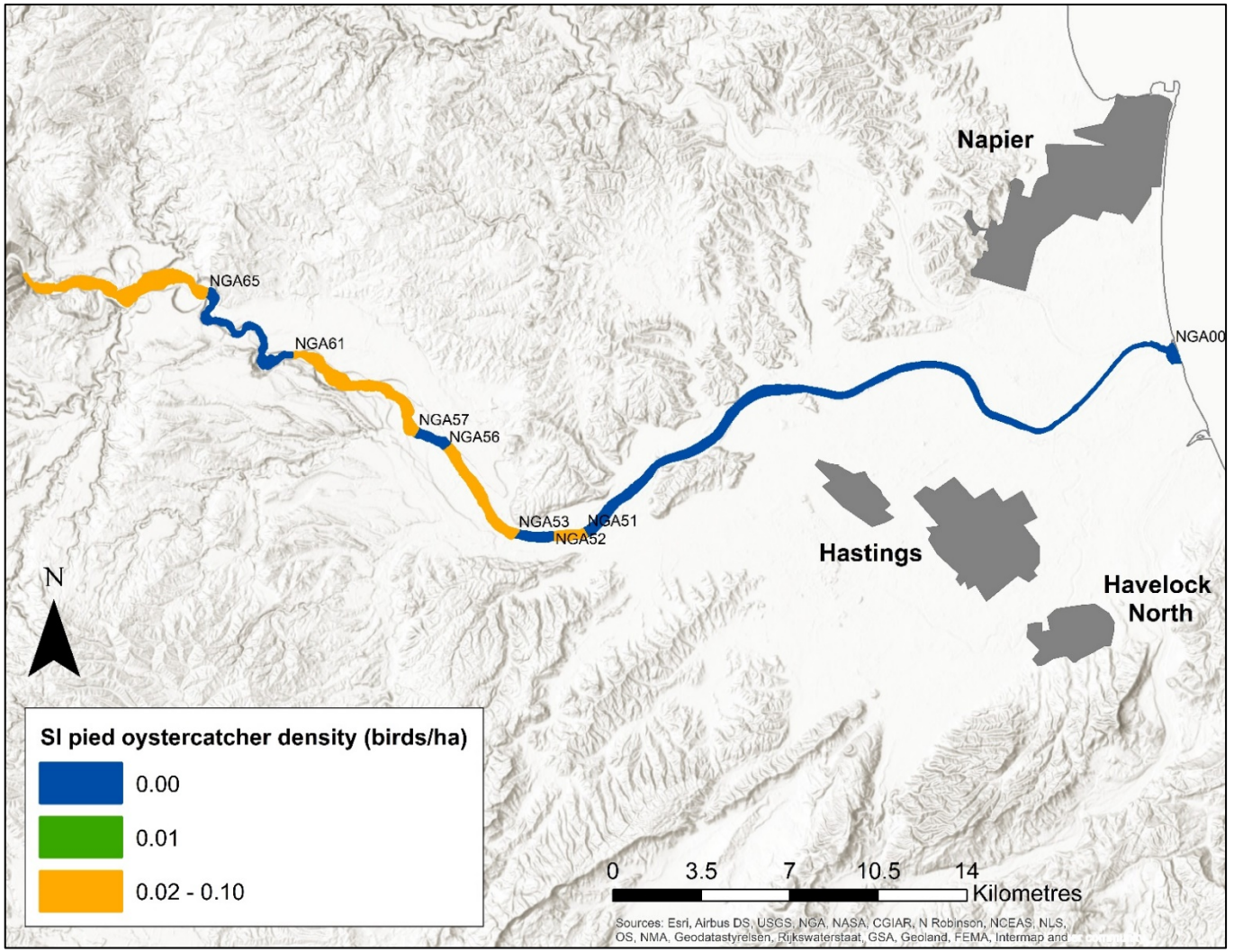

Figure 2.2.4: SI pied oystercatcher densities on the Ngaruroro River in November 2019. Orange sections represent above average SI pied oystercatcher densities, green sections represent below average densities and blue sections represent river reaches where SI pied oystercatchers were absent.

2.3 Tukituki River and its tributaries

A total of 62 bird species has been recorded on the Tukituki River and its tributaries, including 39 indigenous species, of which 16 are ranked as either Nationally Threatened or At Risk and 14 are ranked as Regionally Threatened or At Risk under the New Zealand Threat Classification System (Appendix 5; Robertson et al, 2017; HBRC unpublished data).

Many of these species occupy the riparian vegetation and both freshwater and estuarine wetlands associated with the river. The Tukituki estuary supports a particularly high diversity of bird species, including highly threatened resident or migrant birds such Australasian bittern, white heron and New Zealand dotterel (*Charadrius obscurus*) (Stephenson, 2011).

The unvegetated gravels of the Tukituki River and its tributaries support breeding populations of five Nationally Threatened or At Risk shorebird species, namely banded dotterels, black-fronted dotterels, pied stilts, South Island pied oystercatchers and black-billed gulls (Parrish, 1988; Stephenson, 2011; McArthur et al, 2020). All these species nest on unvegetated riverbed gravels during the spring and summer months, and the majority of these species are largely confined to these habitats during the breeding season. For these reasons, these species are particularly susceptible to disturbance caused by flood mitigation activities such as beach-raking and gravel extraction, whenever they are carried out during spring and summer.

A total of 1112 banded dotterels was counted on the Tukituki River and its tributaries during a population census carried out in November 2019, demonstrating that the Tukituki River supports the 2nd largest single-river banded dotterel population in New Zealand (O'Donnell & Monks, *in press;* McArthur et al, 2020). This survey also demonstrated that the combined banded dotterel population on the Tutaekuri, Ngaruroro and Tukituki River represents 12% of the global population of this species (McArthur et al, 2020). Banded dotterels occupy the bed of the Tukituki River at a mean density of 0.3 birds/ha, with densities ranging from 0 – 2.0 birds/ha. Banded dotterels are largely absent from the Mangaonuki, Makaretu and Tukipo Rivers, and from the Waipawa river upstream of XS56 and the upper Tukituki River, upstream of XS48. Above average densities of banded dotterels occur along the Waipawa River downstream of XS56, and along the majority of the Tukituki River downstream of (TTU) XS48 (Figure 2.3.1).

A total of 758 black-fronted dotterels was counted on the Tukituki River and its tributaries in November 2019, and the combined black-fronted dotterel population on the Tutaekuri, Ngaruroro and Tukituki Rivers represents 45% of the national population of this species (McArthur et al, 2020). Black-fronted dotterels occupy the bed of the Tukituki River at a mean density of 0.4 birds/ha, with densities ranging from 0 – 1.7 birds/ha. Black-fronted dotterels are relatively widespread on the Tukituki River and its tributaries, with above average densities occurring on the Mangaonuku, lower Tukipo and Makaretu Rivers, and on the upper Tukituki River (Figure 2.3.2). Whereas banded dotterels show a clear preference for large expanses of unvegetated riverbed gravels, black-fronted dotterels appear to have more specialised habitat preferences. Black-fronted dotterels tend to occupy relatively small areas of muddy habitats adjacent to small backwaters, minor braids and ephemeral pools, and typically nest on raised gravel ridges within 50m of these habitats. Given these more specialised habitat requirements, it is crucial that flood mitigation and gravel extraction activities are carried out in a manner that maintains the quantity and distribution of these "muddy" habitats on the bed of the Tukituki River and its tributaries.

A total of 520 pied stilts was counted on the Tukituki River and its tributaries in November 2019, and the combined pied stilt population on the Tutaekuri, Ngaruroro and Tukituki Rivers represents 3.5% of the national population of this species (McArthur et al, 2020). Pied stilts occupy the bed of the Tukituki River at a mean density of 0.2 birds/ha, with densities ranging from 0 – 2.4 birds/ha. Pied stilts are widely distributed on the Tukituki River downstream of (TTU) XS04, with particularly high densities occurring downstream of (TTL) XS24. Pied stilts are absent from large reaches of the Mangaonuku, Waipawa, Tukipo and Makaretu Rivers (Figure 2.3.3).

Six South Island pied oystercatchers were counted on the Tukituki River and its tributaries in November 2019, which is the first time that this species has been recorded in this catchment (McArthur et al, 2020). SI pied oystercatchers were recorded on the Waipawa River between XS51 and XS52, and on the mid Tukituki River between XS41 and XS46 (Figure 2.3.4). Together with an additional 25 birds recorded on the Ngaruroro River, these represent the only SI pied oystercatchers known to be breeding in the North Island at the present time (McArthur et al, 2020).

Only seven black-billed gulls were recorded on the Tukituki River and its tributaries during the November 2019 survey, although counts of up to 258 birds have been recorded during earlier surveys. Black-billed gulls have previously bred on the Tukituki riverbed, in the vicinity of Kahuranaki Road (McArthur et al, 2020).

Appendix Six of this report provides a spatially explicit shorebird risk assessment matrix for flood mitigation and gravel extraction activities on the Tukituki River and its tributaries. This matrix provides an indication of the risk of disturbing nests or chicks of each shorebird species present on each section of the Tukituki River and its tributaries during the breeding season, based on shorebird densities mapped during the November 2019 survey. This matrix can be used as a decision-making tool to plan the timing and extent of flood mitigation and gravel extraction activities in unvegetated gravel habitats, and to determine whether or not a pre-works shorebird survey is required.

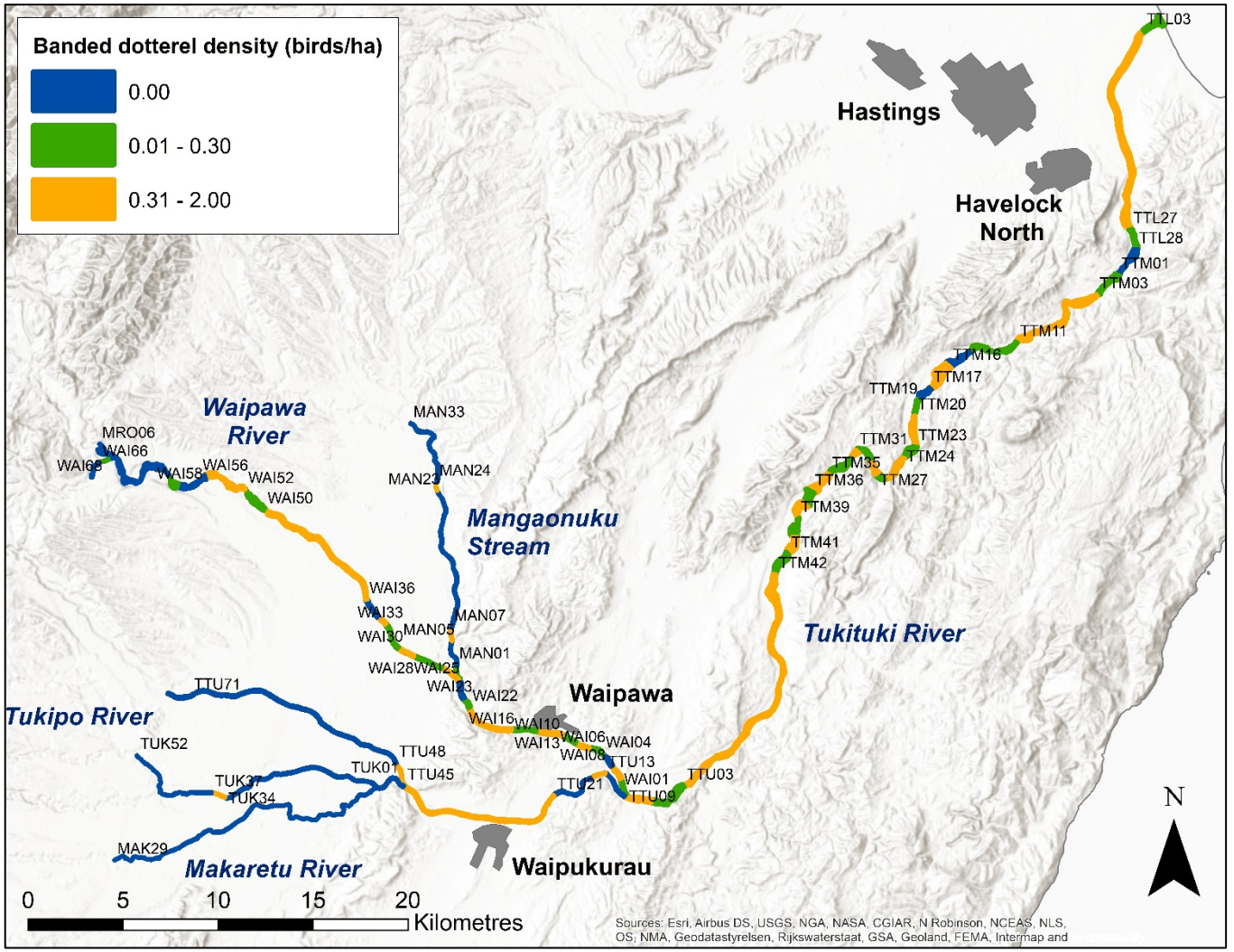

Figure 2.3.1: Banded dotterel densities on the Tukituki River and its tributaries in November 2019. Orange sections represent above average banded dotterel densities, green sections represent below average densities and blue sections represent river reaches where banded dotterels were absent.

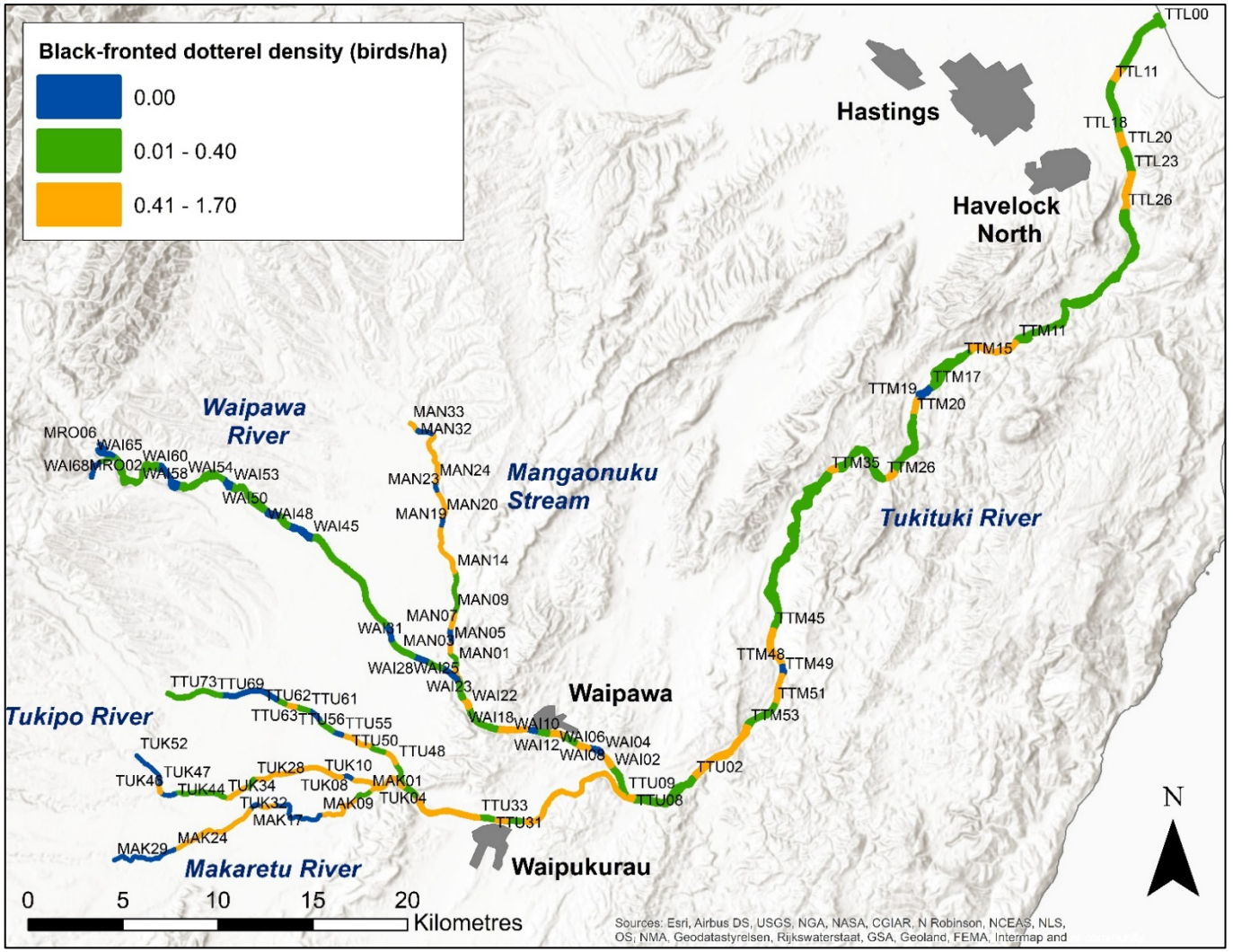

Figure 2.3.2: Black-fronted dotterel densities on the Tukituki River and its tributaries in November 2019. Orange sections represent above average black-fronted dotterel densities, green sections represent below average densities and blue sections represent river reaches where black-fronted dotterels were absent.

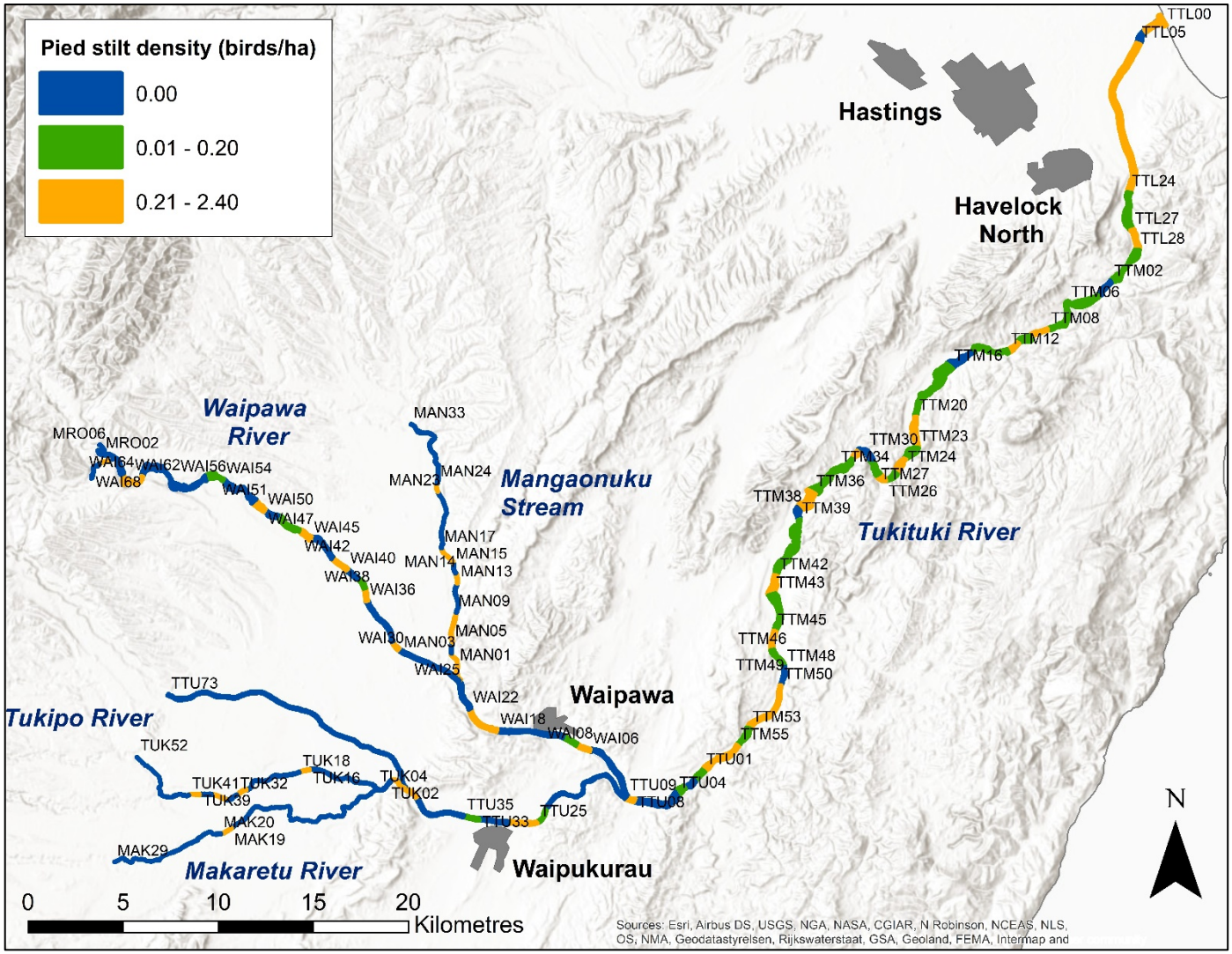

Figure 2.3.3: Pied stilt densities on the Tukituki River and its tributaries in November 2019. Orange sections represent above average pied stilt densities, green sections represent below average densities and blue sections represent river reaches where banded pied stilts were absent.

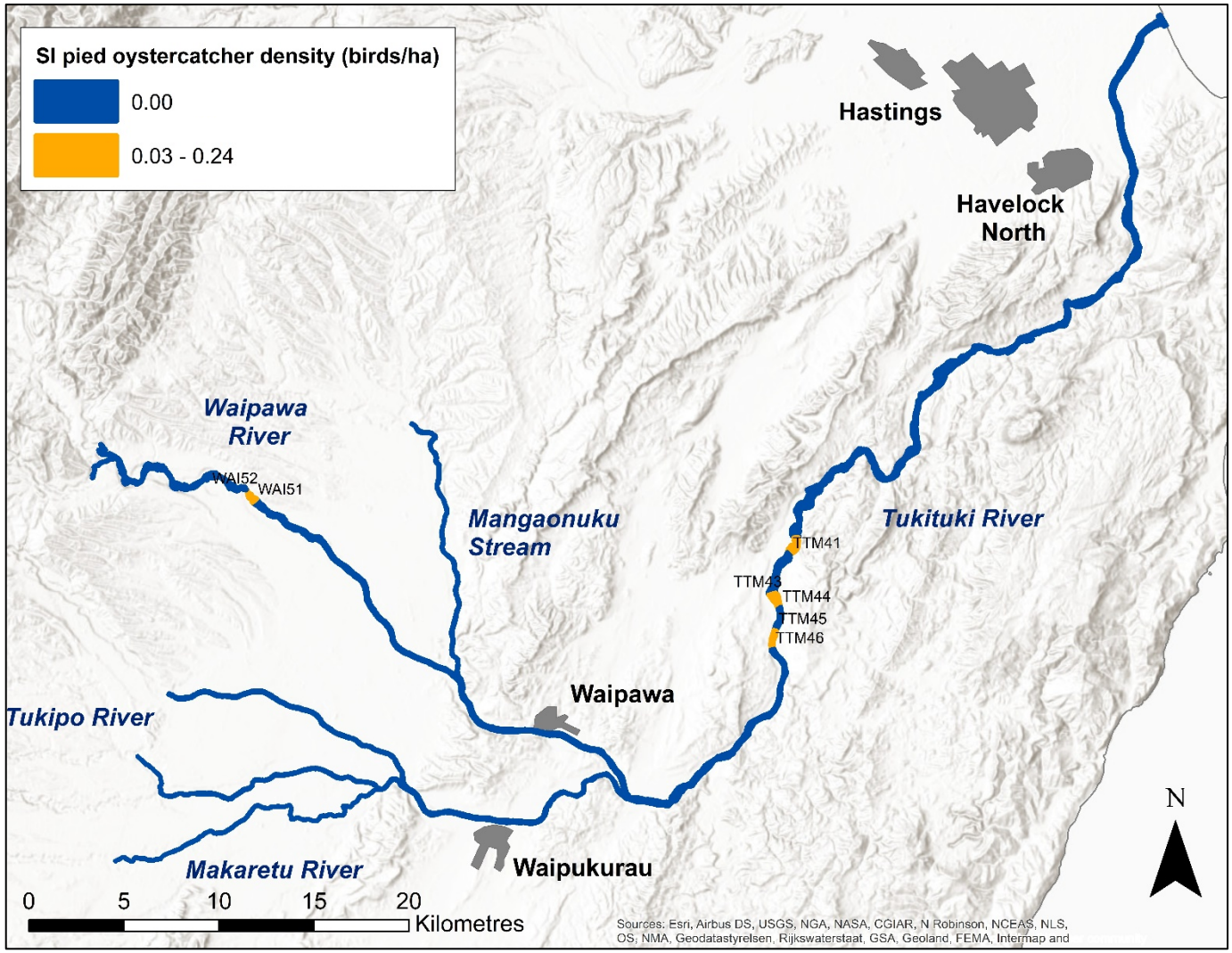

Figure 2.3.4: SI pied oystercatcher densities on the Tukituki River and its tributaries in November 2019. Orange sections represent above average SI pied oystercatcher densities and blue sections represent river reaches where SI pied oystercatchers were absent.

3. Recommended changes to shorebird management actions in Hawke's Bay river Ecological Management and Enhancement Plans

The Ecological Management and Enhancement Plans for the Tutaekuri, Ngaruroro and Tukituki Rivers recognise the potential for some flood mitigation and gravel extraction activities to have an adverse impact on riverbed-nesting shorebirds. Beach raking, gravel extraction and herbicide application are three activities that occur on Hawke's Bay riverbeds, and a key objective of the EMEPs is to:

> *Protect those specialist bird communities which are reliant on the gravel riverbed habitat from scheme operations on the active river channel; particularly during their critical nesting season when their reproductive success can be adversely affected.*

By doing so, HBRC will be working towards an ecological management vision that these rivers will:

> *provide habitat as part of functioning wildlife corridors, between inland Hawke's Bay and the sea, and serve as an important biodiversity refuge, where common and threatened native plants and animals thrive.*

Each EMEP outlines a series of management actions designed to achieve these objectives with respect to riverbed-nesting shorebirds (Forbes & Whitesell, 2015; Forbes 2017a; Forbes 2017b). This section of the review provides a set of recommended updates and additions to the management actions included in the existing EMEPs. Each of the recommended additions or changes listed below is accompanied by a summary of evidence justifying each recommendation.

3.1 Exclusion periods

Recommendation

It is recommended that each EMEP be updated to allow beach raking, edge retreat and channel diversion activities to be carried out anywhere on the Tutaekuri, Ngaruroro and Tukituki Rivers at any time between March and August inclusive, without the need for a pre-works survey. It is also recommended that these activities do not occur on these rivers between September and January inclusive, unless a particular river reach has a risk assessment ranking of "Low" for all shorebird species listed (See Appendices 2, 4 and 6). Any of these activities carried out on the Tutaekuri, Ngaruroro or Tukituki Rivers during the month of February must be preceded by a pre-works shorebird survey carried out no more than 10 days prior to the commencement of work, unless that particular river reach has a risk assessment of "Low" for all shorebird species listed (see Appendices 2, 4 and 6) (Figure 3.1.1).

It is recommended that herbicide application be allowed to be carried out anywhere on the Tutaekuri, Ngaruroro and Tukituki Rivers at any time between March and August inclusive, without the need for a pre-works survey. Between September and February inclusive, herbicide application at sites <1ha in area may occur without the need for a pre-works survey, but herbicide application at sites >1ha must be preceded by a pre-works survey carried out no more

than 10 days prior to the commencement of work, unless that particular river reach has a risk assessment of "Low" for all shorebird species listed (see Appendices 2, 4 and 6) (Figure 3.1.1).

Gravel extraction may occur at any time of the year on Tutaekuri, Ngaruroro or Tukituki Rivers, but between September and February inclusive any gravel extraction activities must be preceded by a pre-works shorebird survey carried out no more than 10 days prior to the commencement of gravel extraction, unless that particular river reach has a risk assessment of "Low" for all shorebirds species listed (see Appendices 2, 4 and 6) (Figure 3.1.1).

Activity	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Beach raking, edge retreat and channel diversion												
Herbicide application, <1ha area												
Herbicide application, >1ha area												
Gravel extraction												

Shorebird breeding season
Activity not permitted
Activity permitted, pre-works survey required
Activity permitted, no pre-works survey required

Figure 3.1.1: Calendar showing months of the year during which beach-raking and gravel extraction activities can be carried out on the Tutaekuri, Ngaruroro and Tukituki Rivers

Justification

The adoption of these new exclusion period rules will provide protection for a larger proportion of the shorebirds breeding on the Tutaekuri, Ngaruroro River while at the same time simplifying existing rules in the EMEPs and reducing the challenges associated with carrying out pre-works surveys during the month of August.

Each of the existing EMEPs identifies one or more sections of river possessing high shorebird values (termed "Management Zones"), and applies management zone-specific exclusion periods to beach raking, herbicide application, edge retreat, channel diversion and gravel extraction activities occurring within these areas (Forbes & Whitesell, 2015; Forbes 2017a; Forbes 2017b). While providing good protection to shorebirds breeding within these zones, this approach has two shortcomings. Firstly, these zones have been delineated using datasets that are a number of years old, so don't take into account changes in shorebird distribution and habitat use that have occurred in the interim. For example, no black-billed gulls or SI pied oystercatchers have been recorded breeding in the 49ha Ngaruroro River black-billed gull/SI pied oystercatcher Management Zone for several years (HBRC, unpublished data; Keiko Hashiba, personal

communication). Secondly, the existing management zones provide protection to only a limited proportion of the internationally and nationally-significant shorebird populations inhabiting these rivers, creating the risk that any adverse effects of flood mitigation activities they are exposed to outside of these zones may not be avoided or minimised.

To solve these two issues, this review provides a set of exclusion periods to be applied to all reaches of the Tutaekuri, Ngaruroro and Tukituki Rivers, for the five flood mitigation activities most likely to have an adverse impact on riverbed-nesting shorebirds (Figure 3.1.1). This review also uses the spatially explicit shorebird distribution dataset collected during HBRC's November 2019 shorebird survey to create a shorebird risk assessment matrix for 318 individual river reaches on these three rivers (Appendices 2, 4 and 6). River reaches that support higher than average densities of any one of the five species of riverbed-nesting shorebirds present are given a risk assessment of "High", and river reaches that support lower than average densities of any of these shorebird species are given a risk assessment of "Medium". River reaches on which none of the five species of riverbed-nesting shorebirds were recorded during the November 2019 survey are given a risk assessment of "Low". The exclusion periods summarised in Figure 3.1.1 above must be implemented when undertaking flood mitigation activities on any river reaches given a risk assessment of "High" or "Medium" for any one of the five shorebird species present on these rivers. However, flood mitigation activities may proceed year-round without the need for a pre-works shorebird survey, on any river reach given a risk assessment of "Low" for all of the five shorebird species present.

This simplified set of exclusion period rules also removes the August 'shoulder period' during which beach raking, herbicide application, edge retreat, channel diversion and gravel extraction activities previously needed to be preceded by a pre-works survey. The rationale for removing this requirement from the rules is that the available evidence suggests that the risk of shorebirds nesting during the month of August is very low. Several pre-works surveys have been conducted by HBRC staff and contractors during the month of August, and in each case, no evidence of shorebird breeding was found (Keiko Hashiba, personal communication; Adam Forbes, personal communication). This evidence is consistent with shorebird nest monitoring data collected from riverine and coastal sites in the Wairarapa and Wellington since 2011, which demonstrates that species such as banded dotterel, black-fronted dotterel and pied stilt tend to begin nesting from the first or second week of September, or later (GWRC, unpublished data). Removing this requirement to carry out pre-works surveys during August also solves a problem identified by Keiko Hashiba and Graham Edmondton, namely that it is often difficult to complete these August surveys in a safe and timely manner due to high river flows.

The degree of risk that these flood mitigation activities pose to riverbed-nesting shorebirds is directly linked to the spatial scale over which these activities occur. Activities such as beach-raking tend to disturb larger areas of nesting habitat than activities such as herbicide application or gravel extraction, and therefore pose a greater risk to nesting shorebirds. Potential risks also need to be balanced against the potential benefits that these activities provide to riverbed-nesting shorebirds. Beach raking, gravel extraction and herbicide application all assist with the suppression of woody and herbaceous vegetation on riverbeds, improving both habitat quantity and quality for nesting shorebirds. The recommended exclusion period rules summarised in Figure 3.1.1 are designed to take these two factors into account. Greater constraints are placed on those activities that disturb larger areas of shorebird nesting habitat than those activities that disturb smaller areas, and these constraints have been kept to the absolute minimum required to

mitigate the risk of adverse impacts to shorebirds, to enable these activities to be carried out during the shorebird breeding season, when required.

3.2 Pre-works shorebird survey field methods and reporting

Recommendation

It is recommended that Hawke's Bay Regional Council creates a standard pre-works shorebird survey methodology and a standard report template and maintains an electronic archive of all pre-works survey reports carried out either by HBRC staff and contractors, or by commercial gravel extractors and their contractors. All gravel extraction resource consents and gravel authorisations should include a condition requiring pre-works surveys to be carried out using this standard methodology and reporting template, together with a requirement that all pre-works survey reports be submitted to HBRC's electronic archive prior to gravel extraction activities commencing.

It is recommended that the standard pre-works survey methodology includes the following elements:

- That the surveyor walks slowly and systematically through any open gravel habitats within the proposed work area, and an additional 100 m buffer zone surrounding the proposed area, surveying for nests, nesting colonies or chicks of any bird species listed as 'Nationally Threatened' or 'At Risk' under the New Zealand Threat Classification System (Robertson et al, 2017). The surveyor should aim to grid search all unvegetated gravel beaches and islands on a 50 x 50 m grid, or zig-zag pattern, to ensure any incubating birds present are likely to be flushed from their nests and therefore detected.

- If adults are flushed from nests, or are showing other signs of breeding activity (e.g. defensive or alarmed behaviour, broken wing displays etc), then the surveyor should back away until the bird resumes normal behaviour, then observe the bird as it returns to its nest, or check for the presence of chicks.

- For any nesting or breeding birds detected, the location of any nests or chicks found should be recorded to an accuracy of 5-10 m using a handheld GPS device, and any nests found should be marked with a waratah or wooden stake situated 2 metres immediately downstream of the nest (see section 3.3 below). Any coordinates should be recorded using the NZGD2000 New Zealand Transverse Mercator projection.

- The surveyor should clearly delimit the area of habitat surveyed, either by marking the area on an aerial photo, or by delimiting the area using a handheld GPS, by recording either a sequence of waypoints or a track describing the boundary of the survey area.

- The surveyor should record the start and finish times of their survey, so that the total amount of time spent surveying the proposed gravel extraction site and surrounding buffer can be calculated.

- Once the survey has been completed, the surveyor should prepare a pre-works survey report using the template supplied in Appendix 7 of this report. This pre-works survey report should focus on documenting the name and qualifications of the surveyor, the location of the site surveyed, the number and locations of any nests, nesting colonies or chicks found and a summary of any mitigation measures recommended. Each pre-works survey report should be a maximum of 1-2 pages in length.

Justification

HBRC doesn't currently have a standard pre-works shorebird survey methodology or reporting template, nor an electronic archive for storing pre-works survey reports. The results of pre-works surveys associated with beach raking activities are carried out by HBRC staff and contractors and are currently reported in email format to relevant Asset Management Group staff (Keiko Hashiba, personal communication). There also appears to be some confusion among HBRC staff regarding whether it is HBRC or commercial gravel extractors who are responsible for undertaking pre-works surveys prior to commercial gravel extraction activities, so this needs urgent clarification. What was clear from this review was that pre-works survey reports associated with gravel extraction activities are not being routinely submitted to and archived by HBRC, as required by the EMEPs (Keiko Hashiba and Luke Davis, personal communication). This lack of reporting means that HBRC has little or no evidence that commercial gravel extractors are complying with the requirements of its EMEPs and related consents, and therefore have little evidence that the potential adverse impacts of this activity on riverbed-nesting shorebirds are being adequately managed. Indeed, it appears that in some instances these pre-works surveys are either not being completed or are not being carried out to the required standard. For example, during HBRC's November 2019 shorebird survey, gravel extraction was observed in progress on a gravel beach on the Ngaruroro River, immediately downstream of the Fernhill Bridge. On inspection, a banded dotterel nest containing three eggs was found within 30m of the edge of the gravel extraction site, and a pair with at least one young chick was also observed within 50m of the site. Neither the nest or the chick had apparently been detected by the gravel extractor in this case, as the nest was un-marked and set-back distances were not being observed (N. McArthur personal observation; Keiko Hashiba personal observation).

The adoption of a standard field methodology and reporting template for pre-works shorebird surveys will likely generate cost savings to both HBRC and commercial gravel extractors, while maximising the efficacy of these surveys. For example, a recent review of 322 pre-works shorebird surveys carried out on Canterbury riverbeds between 2004 and 2018 found that there was considerable variability in the field survey methods used by various surveyors over that time. One consequence of this is that many surveys focused heavily on recording the presence and/or number of adult birds of target species, whereas the key survey and reporting requirement for these surveys is to identify and record shorebird nests and chicks. As a result, Canterbury ratepayers and commercial gravel extractors had been paying for the collection and reporting of bird survey data that was not fit-for-purpose when it comes to managing potential adverse impacts of flood mitigation and gravel extraction activities on riverbed-nesting shorebirds (McArthur et al, 2018).

By creating and maintaining an electronic archive of pre-works survey reports, HBRC will create an accurate record of the measures being taken to manage risks to riverbed-nesting shorebirds.

The Council will also build a body of information that can be used to quantify these potential impacts and how they change over time, and to conduct cost-benefit analyses on the management actions being taken. For example, a quantitative analysis of the 322 pre-works surveys archived by Environment Canterbury between 2004 and 2018 revealed that the potential adverse impacts of commercial gravel extraction activities on Canterbury rivers over this time had been very small, and that an estimated $200,000 had been spent on mitigation over this 14-year period. This result indicated that existing measures to mitigate the potential adverse impacts of commercial gravel extraction activities on riverbed-nesting shorebirds in Canterbury were not cost-effective, so Environment Canterbury and local commercial gravel extractors are now exploring several alternative options to deliver better outcomes for shorebirds, at a lower cost (McArthur et al, 2018).

3.3 Marking nests

Recommendation

It is recommended that any shorebird nests found during pre-works surveys are marked by the surveyors using either a metal or plastic waratah, or a wooden stake. The marker should be at least 1m tall but should not be brightly coloured. The marker should be placed 2m from the nest, immediately downstream of the nest.

When carrying out flood mitigation or gravel extraction activities, staff working on site can improve the conspicuousness of these markers by hanging an orange road cone, or tying a hi-viz vest to the top of the waratah or wooden stake. Care should be taken to ensure any hi-viz items added to the waratah or stake can't blow or fall off, and potentially damage the nearby nest. These 'hi-viz' additions should only be installed when staff are working on site and should be removed at the end of each day, to prevent attracting the attention of predators or other river users. Once the beach ripping or gravel extraction work has been completed, each waratah or wooden stake should be removed prior to leaving the site.

Note: because markers are placed 2m downstream of each nest, anyone approaching these markers must approach these markers from downstream of them to avoid the risk of accidentally trampling the nest.

Justification

A key piece of feedback received from HBRC Asset Management Team staff is that it has proven difficult to re-locate un-marked nests that had previously been located by shorebird surveyors. The locations of nests found by surveyors are not currently marked in the field, due to concerns that these markers may attract predators such as Australasian harriers (*Circus approximans*) or black-backed gulls (*Larus dominicanus*) or attract the attention of other river users. Instead, nest locations are recorded using handheld GPS devices, and nest coordinates or field maps are passed on to HBRC staff carrying out flood mitigation or gravel extraction activities on site.

Due to the difficulty being experienced by HBRC staff attempting to re-locate nests using maps or GPS coordinates, a more pragmatic balance needs to be struck between the risk of attracting predators or other river users to shorebird nests, and the need for HBRC staff to easily re-locate nests prior to carrying out flood mitigation or gravel extraction activities. Requiring shorebird surveyors to both GPS nests, and mark them in a standardised way with relatively unobtrusive metal or wooden stakes should assist HBRC staff to re-locate these nests, without substantially increasing the risk of nests being preyed upon by avian predators, or being disturbed by other river users. Temporarily increasing the conspicuousness of these markers using hi-viz items such as road-cones or safety vests will similarly make it much easier to maintain set-back distances around these nests when HBRC staff and contractors are working on site, and their removal at the end of each working day will minimise the risk of attracting predators or other river users to nests when staff are not working on site.

3.4 Setback distances from nests and chicks

Recommendation

It is recommended that HBRC adopts a standard setback distance of 50m for banded dotterel nests and for shorebird chicks of all species, and 75m for all other shorebird nests, including black-billed gulls and white-fronted terns.

Justification

Set-back distances being used by regional councils throughout New Zealand have largely been based on the opinions of ornithological experts, rather than quantitative data describing the flight initiation distances of the shorebird species in question (McArthur et al, 2018). For this reason, regional councils employ a range of set-back distances on rivers throughout New Zealand, varying from 50 metres employed by Marlborough District Council, to the up to 200m employed by Hawke's Bay Regional Council (Table 3.4.1).

Only one regional council in New Zealand has based their set-back distance on quantitative data describing the distances at which shorebirds flush from their nests when approached by machinery (flight initiation distances). Greater Wellington Regional Council (GWRC) currently uses a set-back distance of 75m for shorebird nests and 50m for chicks, based on a series of trials carried out on the Ruamāhanga River in 1997 (Sim, 1997). More recent trials carried out by GWRC in the Wairarapa identified that the maximum flight initiation distance for incubating banded dotterels was 41m whenever the nest was approached by machinery or on foot, leading to the recommendation that the set-back distance for banded dotterel nests could be safely reduced from 75m to 50m (McVeagh & John, 2020).

Given that these data represent the only quantitative data describing the flight initiation distances for riverbed-nesting shorebirds in New Zealand, it is recommended that set-back distances used on Hawke's Bay rivers be based on these data. For this reason, it is recommended that HBRC

adopts a setback distance of 50m for banded dotterel nests and for chicks of all shorebird species, and 75m for all other shorebird nests.

Table 3.4.1: Summary of key rules and conditions used by regional and district councils in New Zealand to avoid, remedy or mitigate the adverse impacts of river-based gravel extraction activities on riverbed-nesting birds. Adapted from McArthur et al (2018)

Regional or District Council	Rivers	Restriction period (river bird breeding season)	Survey & report by suitably-qualified person?	Max No. days prior to gravel extraction that survey must be carried out	Target species	Specified exclusion zone for nests and chicks	Max No. days gravel extraction work can cease for before a re-survey is required	Other conditions
Hawkes Bay Regional Council	Tutaekuri, Ngaruroro and Tukituki River	Aug-Feb Inclusive	Yes	10 days	Banded dotterel, black-fronted dotterel, SIPO, black-billed gull and other threatened species	100m for any Threatened or At Risk species; 200m for black-billed gulls or white-fronted terns	10 days	No gravel extraction permitted in Ngaruroro River black-billed gull/SIPO management zone during restriction period
Horizons Regional Council	Rivers with significant blue duck habitat	Jul-Feb inclusive	Yes	Not specified	Blue duck	Not specified	7 days, following a flood event	No gravel extraction to occur if blue duck present
	Rivers with significant dotterel habitat	Aug-Dec inclusive	Yes	Not specified	Dotterels and waders	Not specified	7 days after flood	No gravel extraction to occur if dotterels or wader present

Regional or District Council	Rivers	Restriction period (river bird breeding season)	Survey & report by suitably-qualified person?	Max No. days prior to gravel extraction that survey must be carried out	Target species	Specified exclusion zone for nests and chicks	Max No. days gravel extraction work can cease for before a re-survey is required	Other conditions
Greater Wellington Regional Council	Hutt and Otaki Rivers; Ruamahanga River and tributaries	Aug-Feb inclusive	Yes	Not specified	Banded dotterel, black-fronted dotterel, pied stilt and black-billed gull	Continuous disturbance: 75m (nests) & 50m (chicks) Short-term disturbance: 25m (nests & chicks)	Not specified	None
Marlborough District Council	All rivers	Sep-Dec inclusive	Yes	Not specified	Nesting birds	50m	Not specified	None
West Coast Regional Council	All rivers	Aug-Jan inclusive	Not specified	Not specified	Nesting threatened species	100m	Not specified	None

Regional or District Council	Rivers	Restriction period (river bird breeding season)	Survey & report by suitably-qualified person?	Max No. days prior to gravel extraction that survey must be carried out	Target species	Specified exclusion zone for nests and chicks	Max No. days gravel extraction work can cease for before a re-survey is required	Other conditions
Environment Canterbury	All rivers	Sep-Feb inclusive	Yes	8 days	24 taxa listed in Table A of Code of Practice	100m	8 days	None
Otago Regional Council	Rivers of importance for threatened or uncommon species	Not specified	Not mandatory	Not specified	Black-fronted tern, wrybill, banded dotterel and blue duck	Not specified	Not specified	None
Environment Southland	All rivers	Sept-Feb inclusive	Site visit by Environment Southland Catchment Management team member; also Fish and Game, DoC & Te Ao Marama personnel	Not specified	Roosting or nesting black-fronted terns, black-billed gulls, black-fronted dotterels and banded dotterels	None	Not specified	No gravel extraction to occur if species are present

4. Summary of recommended changes to Hawke's Bay river Ecological Management and Enhancement Plans

Based on the results of this review, it is recommended that the following changes and additions be made to the Tutaekuri, Ngaruroro and Tukituki River Ecological Management and Enhancement Plans:

- That **section 2.4 of the Tutaekuri River EMEP** be updated with the bird values summarised in section 2.1 and Appendices 1 and 2 of this report.

- That **section 1.2 of the Ngaruroro River EMEP** be updated with the bird values summarised in section 2.2 and Appendices 3 and 4 of this report.

- That **section 2.4 of the Tukituki River EMEP** be updated with the bird values summarised in section 2.3 and Appendices 5 and 6 of this report.

- That **section 3.3 of the Tutaekuri River EMEP, section 5 of the Ngaruroro River EMEP** and **section 3.3 of the Tukituki River EMEP** be updated with the exclusion period rules outlined in section 3.1 of this report.

- That HBRC and commercial gravel extractors and their contractors adopt the standard pre-works shorebird survey methodology and reporting system outlined in section 3.2 and Appendix 7 of this report.

- That HBRC, commercial gravel extractors and their contractors adopt the nest marking protocol outlined in section 3.3 of this report.

- That **section 3.3 of the Tutaekuri River EMEP, section 5 of the Ngaruroro River EMEP** and **section 3.3 of the Tukituki River EMEP** be updated with the nest and chick setback distances outlined in section 3.4 of this report.

5. Recommendations for further work

The recommended updates to the bird values and management actions relating to riverbed-nesting shorebirds in the Tutaekuri, Ngaruroro and Tukituki River EMEPs included in this review have been heavily informed by the shorebird distribution and abundance data collected during HBRC's November 2019 shorebird survey. This being the case, the accuracy of these bird values summaries, and the efficacy of some of the recommended management actions may be adversely affected by any future changes in shorebird distribution and abundance that occur on these rivers. In recognition of the dynamic nature of shorebird populations on the braided rivers of Hawke's Bay, HBRC has committed to a programme of regular shorebird surveys, conducted on a 3-year on, 3-year off cycle. Two further annual surveys are scheduled for November 2020 and November 2021. Therefore, it is recommended that the next review of the shorebird sections of the EMEPs be scheduled for mid-2022, following the completion of the first 3-year set of annual shorebird surveys on these rivers. Following this, subsequent reviews should be scheduled at six-yearly intervals, at the completion of each 3-year set of annual shorebird surveys, to update bird values summaries and management actions in response to any changes and to create the opportunity to further improve and update our understanding of shorebird distribution and abundance, and how this is changing over time.

The revised set-back distances for shorebird nests and chicks included in this report are based on a set of field trials carried out by Greater Wellington Regional Council (Sim, 1997; McVeagh & John, 2020). These trials were limited to banded dotterel nests, due to a shortage of nests of other riverbed-nesting shorebird species on the Wairarapa rivers on which these trials were carried out (McVeagh & John, 2020). For this reason, the results of these trials can be used to substantially reduce the recommended set-back distance for banded dotterel nests, but due to species-specific differences in shorebird behaviour, the results of these trials cannot be extrapolated to other shorebird species present on Hawke's Bay rivers. It is likely that if similar trials were carried out on these other shorebird species, set-back distances for these species could be similarly reduced, potentially generating cost savings for HBRC and commercial gravel extractors without compromising the outcomes of shorebird mitigation measures. For this reason, we recommend that HBRC funds an investigation to quantify the flight initiation distances of nesting black-fronted dotterels, pied stilts, South Island pied oystercatchers and black-billed gulls, to complement the work already completed by Greater Wellington Regional Council on banded dotterels.

Acknowledgements

This work was instigated by Keiko Hashiba, Terrestrial Ecologist at Hawke's Bay Regional Council, and builds upon the extensive groundwork laid down by Adam Forbes and Brent Stephenson. Keiko Hashiba, Graham (Idi) Edmondson and Luke Davis all generously shared their knowledge of flood mitigation, gravel extraction and shorebird management activities on these rivers and provided useful insights that influenced a number of the recommendations included in this review. Thanks are also due to Hugh Robertson (DOC), Colin O'Donnell (DOC), Joanna McVeagh (GWRC) and Dianne John (GWRC) for useful discussions that informed aspects of this review. Both Keiko Hashiba and Annette Harvey provided useful comments on earlier drafts of this report.

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Appendix One: Bird species of the Tutaekuri River

The following table contains a list of the bird species recorded on the Tutaekuri River. Species names and taxonomic order are those listed in Gill et al, (2010), with additional Māori names sourced from the Māori Dictionary Project (https://maoridictionary.co.nz/). National threat rankings are those listed in Robertson et al., (2017) and regional threat rankings are from HBRC, unpublished data.

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
California quail	koera	*Callipepla californica*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
common pheasant	peihana	*Phasianus colchicus*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
black swan	kakīānau	*Cygnus atratus*	Not Threatened	Not Threatened	Stephenson (2011)
greylag goose		*Anser anser*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011)
Canada goose	kuihi	*Branta canadensis*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
paradise shelduck	pūtangitangi	*Tadorna variegata*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
blue duck	Whio	*Hymenolaimus malacorhychos*	Nationally Vulnerable	Regionally Vulnerable	Stephenson (2011)

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
grey teal	tētē moroiti	*Anas gracilis*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
mallard	rakiraki	*A. platyrhynchos*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
grey duck	pārera	*A. superciliosa*	Nationally Critical	Regionally Critical	Stephenson (2011)
Australasian shoveler	kuruwhengi	*A. rhynchotis*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
New Zealand scaup	pāpango	*Aythya novaeseelandiae*	Not Threatened	Regionally Endangered	Stephenson (2011)
New Zealand dabchick	weweia	*Poliocephalus rufopectus*	At Risk, Recovering	Regionally Endangered	Stephenson (2011)
Australasian gannet	tākupu	*Morus serrator*	Not Threatened	Not Threatened	Stephenson (2011)
little shag	kawau paka	*Phalacrocorax melanoleucos*	Not Threatened	Regionally Endangered	Stephenson (2011); HBRC, unpublished data
black shag	kawau	*P. carbo*	At Risk, Naturally Uncommon	Data Deficient	Stephenson (2011); HBRC, unpublished data
pied shag	kāruhiruhi	*P. varius*	At Risk, Recovering	Vagrant	Stephenson (2011); HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
little black shag	kawau tūī	*P. sulcirostris*	At Risk, Naturally Uncommon	Data Deficient	Stephenson (2011)
spotted shag	kawau tikitiki	*Stictocarbo punctatus*	Not Threatened	Migrant	Stephenson (2011)
white heron	kōtuku	*Ardea modesta*	Nationally Critical	Migrant	Stephenson (2011)
cattle egret		*A. ibis*	Migrant	Migrant	Stephenson (2011)
plumed egret		*A. intermdedia*	Vagrant	Vagrant	Stephenson (2011)
white-faced heron	matuku moana	*Egretta novaehollandiae*	Not Threatened	Regionally Vulnerable	Stephenson (2011); HBRC, unpublished data
little egret		*E. garzetta*	Vagrant	Vagrant	Stephenson (2011)
reef heron	matuku moana	*E. sacra*	Nationally Endangered	Regionally Critical	Stephenson (2011)
Australasian bittern	matuku hūrepo	*Botaurus poiciloptilus*	Nationally Critical	Regionally Critical	Stephenson (2011)
royal spoonbill	kotuku ngutupapa	*Platalea regia*	At Risk, Naturally Uncommon	Regionally Critical	Stephenson (2011)
swamp harrier	kāhu	*Circus approximans*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
New Zealand falcon	kārearea	*Falco novaeseelandiae*	At Risk, Recovering	Regionally Endangered	Stephenson (2011)

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
spotless crake	pūweto	*Porzana tabuensis*	At Risk, Declining	Regionally Endangered	Stephenson (2011)
marsh crake	kotoreke	*P. pusilla*	At Risk, Declining	Regionally Critical	Stephenson (2011)
pukeko	pūkeko	*Porphyrio melanotus*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
lesser knot	huahou	*Calidris canutus*	Nationally Vulnerable	Migrant	Stephenson (2011)
curlew sandpiper		*C. ferruginea*	Vagrant	Vagrant	Stephenson (2011)
sharp-tailed sandpiper		*C. acuminata*	Migrant	Migrant	Stephenson (2011)
pectoral sandpiper		*C. melanotos*	Vagrant	Vagrant	Stephenson (2011)
red-necked stint		*C. ruficollis*	Migrant	Vagrant	Stephenson (2011)
bar-tailed godwit	kuaka	*Limosa lapponica*	At Risk, Declining	Regionally Endangered	Stephenson (2011)
ruddy turnstone		*Arenaria interpres*	Migrant	Migrant	Stephenson (2011)
variable oystercatcher	tōrea pango	*Haematopus unicolor*	At Risk, Recovering	Regionally Critical	Stephenson (2011)
South Island pied oystercatcher	tōrea	*H. finschi*	At Risk, Declining	Regionally Critical	Stephenson (2011)

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
pied stilt	poaka	*Himantopus himantopus*	Not Threatened	Regionally Vulnerable	Stephenson (2011); HBRC, unpublished data
Pacific golden plover		*Pluvialis fulva*	Migrant	Migrant	Stephenson (2011)
New Zealand dotterel	tūturiwhatu	*Charadrius obscurus*	At Risk, Recovering	Regionally Critical	Stephenson (2011)
banded dotterel	pohowera	*C. bicinctus*	Nationally Vulnerable	Regionally Vulnerable	Stephenson (2011); HBRC, unpublished data
wrybill	ngutu pare	*Anarhynchus frontalis*	Nationally Vulnerable	Migrant	Stephenson (2011)
black-fronted dotterel		*Elseyornis melanops*	At Risk, Naturally Uncommon	Coloniser	Stephenson (2011); HBRC, unpublished data
shore plover	tuturuatu	*Thinornis novaeseelandiae*	Nationally Critical	Regionally Critical	Stephenson (2011)
spur-winged plover		*Vanellus miles*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
Arctic skua		*Stercorarius parasiticus*	Migrant	Migrant	Stephenson (2011)
southern black-backed gull	karoro	*Larus dominicanus*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
red-billed gull	tarāpunga	*L. novaehollandiae*	At Risk, Declining	Regionally Vulnerable	Stephenson (2011)
black-billed gull	tarāpuka	*L. bulleri*	Nationally Critical	Regionally Critical	Stephenson (2011)

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
little tern		*Sternula albifrons*	Migrant	Vagrant	Stephenson (2011)
gull-billed tern		*Gelochelidon nilotica*	Vagrant	Vagrant	Stephenson (2011)
Caspian tern	taranui	*Hydroprogne caspia*	Nationally Vulnerable	Regionally Critical	Stephenson (2011)
white-winged black tern		*Chlidonias leucopterus*	Migrant	Vagrant	Stephenson (2011)
black-fronted tern	tarapirohe	*C. albostriatus*	Nationally Endangered	Migrant	Stephenson (2011)
white-fronted tern	tara	*Sterna striata*	At Risk, Declining	Not Threatened	Stephenson (2011)
rock pigeon		*Columba livia*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
New Zealand pigeon (kererū)	kererū	*Hemiphaga novaeseelandiae*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
shining cuckoo	pīpīwharauroa	*Chrysococcyx lucidus*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
long-tailed cuckoo	koekoeā	*Eudynamys taitensis*	At Risk, Naturally Uncommon	Regionally Endangered	Stephenson (2011)
morepork	ruru	*Ninox novaeseelandiae*	Not Threatened	Not Threatened	Stephenson (2011)
New Zealand kingfisher	kōtare	*Todiramphus sanctus*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
grey warbler	riroriro	*Gerygone igata*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
bellbird	korimako	*Anthornis melanura*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
tūī	tūī	*Prosthemadera novaeseelandiae*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
whitehead	pōpokotea	*Mohoua albicilla*	At Risk, Declining	Not Threatened	Stephenson (2011)
Australian magpie	makipai	*Gymnorhina tibicen*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
New Zealand fantail	pīwakawaka	*Rhipidura fuliginosa*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
rook		*Corvus frugilegus*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011)
skylark		*Alauda arvensis*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
fernbird	koroātito	*Bowdleria punctata*	At Risk, Declining	Not Threatened	Stephenson (2011)
silvereye	tauhou	*Zosterops lateralis*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
welcome swallow	warou	*Hirundo neoxena*	Not Threatened	Not Threatened	Stephenson (2011); HBRC, unpublished data
Eurasian blackbird	manu pango	*Turdus merula*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
song thrush		*T. philomelos*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
common starling	tāringi	*Sturnus vulgaris*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
common myna	maina	*Acridotheres tristis*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
house sparrow	tiu	*Passer domesticus*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
New Zealand pipit	pīhoihoi	*Anthus novaeseelandiae*	At Risk, Declining	Not Threatened	Stephenson (2011); HBRC, unpublished data
dunnock		*Prunella modularis*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
chaffinch	pahirini	*Fringilla coelebs*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
greenfinch		*Carduelis chloris*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
goldfinch		*C. carduelis*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
common redpoll		*C. flammea*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data
yellowhammer		*Emberiza citrinella*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2011); HBRC, unpublished data

Appendix Two: Tutaekuri River shorebird risk assessment matrix

The following table provides a spatially- and species-specific shorebird risk assessment matrix for flood mitigation and gravel extraction activities on the Tutaekuri River. This matrix provides an indication of the risk of disturbing nests or chicks of each shorebird species present on each section of the Tutaekuri River during the breeding season, based on shorebird densities mapped during the November 2019 survey. River sections designated "High" risk for a particular species supported above average densities of that particular species during November 2019. River sections designated "Medium" risk for a particular species supported below average densities of that particular species during November 2019. River sections on which a particular species was absent during the November 2019 survey are designated as "Low" risk for that species. This matrix can be used as a decision-making tool to plan the timing and extent of flood mitigation and gravel extraction activities in unvegetated gravel habitats, and to determine whether or not a pre-works shorebird survey is required.

River section	Risk assessment				
	Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
XS01 to XS03	Low	Medium	Low	Low	Low
XS03 to XS05	Low	High	Low	Low	Low
XS05 to XS07	Low	High	Low	Low	Low
XS07 to XS09	Low	Low	Low	Low	Low
XS09 to XS11	Low	Medium	Low	Low	Low
XS11 to XS14	Medium	High	Medium	Low	Low
XS14 to XS15	Low	High	Medium	Low	Low
XS15 to XS17	Medium	High	Medium	Low	Low
XS17 to XS18	High	Medium	High	Low	Low
XS18 to XS20	Medium	Medium	Medium	Low	Low
XS20 to XS22a	High	Medium	Medium	Low	Low
XS22a to XS23a	High	High	High	Low	Low
XS23a to XS25	High	Medium	High	Low	Low
XS25 to XS27	High	Medium	High	Low	Low
XS27 to XS29	High	High	High	Low	Low
XS29 to XS31	Medium	High	High	Low	Low
XS31 to XS33	Medium	Medium	Medium	Low	Low
XS33 to XS35	High	Medium	High	Low	Low
XS35 to XS37	High	Medium	High	Low	Low
XS37 to XS39	High	Medium	High	Low	Low
XS39 to XS41	Medium	Medium	High	Low	Low

River section	Risk assessment				
	Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
XS41 to XS42b	High	High	Medium	Low	Low
XS42b to XS43c	Low	Low	Low	Low	Low
XS43c to XS44	High	High	High	Low	Low
XS44 to XS45	High	High	High	Low	Low
XS45 to XS46	High	Low	High	Low	Low
XS46 to XS47	Medium	High	Medium	Low	Low
XS47 to XS48	High	Medium	Medium	Low	Low
XS48 to XS49	High	High	Medium	Low	Low
XS49 to XS50	Medium	Medium	Low	Low	Low
XS50 to XS51	High	Medium	Medium	Low	Low
XS51 to XS52	Medium	High	Medium	Low	Low
XS52 to XS53	Medium	Medium	Medium	Low	Low
XS53 to XS54	Medium	High	Medium	Low	Low
XS54 to XS55	Low	Medium	Medium	Low	Low

Appendix Three: Bird species of the Ngaruroro River

The following table contains a list of the bird species recorded on the Ngaruroro River. Species names and taxonomic order are those listed in Gill et al, (2010), with additional Māori names sourced from the Māori Dictionary Project (https://maoridictionary.co.nz/). National threat rankings are those listed in Robertson et al., (2017) and regional threat rankings are from HBRC, unpublished data.

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
California quail	koera	*Callipepla californica*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
common pheasant	peihana	*Phasianus colchicus*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
peafowl	pīkau	*Pavo cristatus*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
black swan	kakīānau	*Cygnus atratus*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
greylag goose		*Anser anser*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
Canada goose	kuihi	*Branta canadensis*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
paradise shelduck	pūtangitangi	*Tadorna variegata*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
grey teal	tētē moroiti	*Anas gracilis*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
mallard	rakiraki	*A. platyrhynchos*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
grey duck	pārera	*A. superciliosa*	Nationally Critical	Regionally Critical	Stephenson (2010)
Australasian shoveler	kuruwhengi	*A. rhynchotis*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
New Zealand dabchick	weweia	*Poliocephalus rufopectus*	At Risk, Recovering	Regionally Endangered	Stephenson (2010)
Australasian gannet	tākupu	*Morus serrator*	Not Threatened	Not Threatened	Stephenson (2010)
little shag	kawau paka	*Phalacrocorax melanoleucos*	Not Threatened	Regionally Endangered	Stephenson (2010); HBRC, unpublished data
black shag	kawau	*P. carbo*	At Risk, Naturally Uncommon	Data Deficient	Stephenson (2010); HBRC, unpublished data
little black shag	kawau tūī	*P. sulcirostris*	At Risk, Naturally Uncommon	Data Deficient	Stephenson (2010)
spotted shag	kawau tikitiki	*Stictocarbo punctatus*	Not Threatened	Migrant	Stephenson (2010)
white heron	kōtuku	*Ardea modesta*	Nationally Critical	Migrant	Stephenson (2010)

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
cattle egret		*A. ibis*	Migrant	Migrant	Stephenson (2010)
plumed egret		*A. intermedia*	Vagrant	Vagrant	Stephenson (2010)
white-faced heron	matuku moana	*Egretta novaehollandiae*	Not Threatened	Regionally Vulnerable	Stephenson (2010); HBRC, unpublished data
little egret		*E. garzetta*	Vagrant	Vagrant	Stephenson (2010)
reef heron	matuku moana	*E. sacra*	Nationally Endangered	Regionally Critical	Stephenson (2010)
Australasian bittern	matuku hūrepo	*Botaurus poiciloptilus*	Nationally Critical	Regionally Critical	Stephenson (2010)
royal spoonbill	kotuku ngutupapa	*Platalea regia*	At Risk, Naturally Uncommon	Regionally Critical	Stephenson (2010); HBRC, unpublished data
swamp harrier	kāhu	*Circus approximans*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
New Zealand falcon	kārearea	*Falco novaeseelandiae*	At Risk, Recovering	Regionally Endangered	Stephenson (2010); HBRC, unpublished data
spotless crake	pūweto	*Porzana tabuensis*	At Risk, Declining	Regionally Endangered	Stephenson (2010)
marsh crake	kotoreke	*P. pusilla*	At Risk, Declining	Regionally Critical	Stephenson (2010)
pukeko	pūkeko	*Porphyrio melanotus*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
lesser knot	huahou	*Calidris canutus*	Nationally Vulnerable	Migrant	Stephenson (2010)
curlew sandpiper		*C. ferruginea*	Vagrant	Vagrant	Stephenson (2010)
sharp-tailed sandpiper		*C. acuminata*	Migrant	Migrant	Stephenson (2010)
pectoral sandpiper		*C. melanotos*	Vagrant	Vagrant	Stephenson (2010)
red-necked stint		*C. ruficollis*	Migrant	Vagrant	Stephenson (2010)
bar-tailed godwit	kuaka	*Limosa lapponica*	At Risk, Declining	Regionally Endangered	Stephenson (2010); HBRC, unpublished data
ruddy turnstone		*Arenaria interpres*	Migrant	Migrant	Stephenson (2010); HBRC, unpublished data
variable oystercatcher	tōrea pango	*Haematopus unicolor*	At Risk, Recovering	Regionally Critical	Stephenson (2010); HBRC, unpublished data
South Island pied oystercatcher	tōrea	*H. finschi*	At Risk, Declining	Regionally Critical	Stephenson (2010); HBRC, unpublished data
pied stilt	poaka	*Himantopus himantopus*	Not Threatened	Regionally Vulnerable	Stephenson (2010); HBRC, unpublished data
Pacific golden plover		*Pluvialis fulva*	Migrant	Migrant	Stephenson (2010)
New Zealand dotterel	tūturiwhatu	*Charadrius obscurus*	At Risk, Recovering	Regionally Critical	Stephenson (2010); HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
banded dotterel	pohowera	*C. bicinctus*	Nationally Vulnerable	Regionally Vulnerable	Stephenson (2010); HBRC, unpublished data
wrybill	ngutu pare	*Anarhynchus frontalis*	Nationally Vulnerable	Migrant	Stephenson (2010)
black-fronted dotterel		*Elseyornis melanops*	At Risk, Naturally Uncommon	Coloniser	Stephenson (2010); HBRC, unpublished data
shore plover	tuturuatu	*Thinornis novaeseelandiae*	Nationally Critical	Regionally Critical	Stephenson (2010)
spur-winged plover		*Vanellus miles*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
Arctic skua		*Stercorarius parasiticus*	Migrant	Migrant	Stephenson (2010)
southern black-backed gull	karoro	*Larus dominicanus*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
red-billed gull	tarāpunga	*L. novaehollandiae*	At Risk, Declining	Regionally Vulnerable	Stephenson (2010); HBRC, unpublished data
black-billed gull	tarāpuka	*L. bulleri*	Nationally Critical	Regionally Critical	Stephenson (2010); HBRC, unpublished data
little tern		*Sternula albifrons*	Migrant	Vagrant	Stephenson (2010)
gull-billed tern		*Gelochelidon nilotica*	Vagrant	Vagrant	Stephenson (2010)

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
Caspian tern	taranui	*Hydroprogne caspia*	Nationally Vulnerable	Regionally Critical	Stephenson (2010); HBRC, unpublished data
white-winged black tern		*Chlidonias leucopterus*	Migrant	Vagrant	Stephenson (2010)
black-fronted tern	tarapirohe	*C. albostriatus*	Nationally Endangered	Migrant	Stephenson (2010)
white-fronted tern	tara	*Sterna striata*	At Risk, Declining	Not Threatened	Stephenson (2010); HBRC, unpublished data
rock pigeon		*Columba livia*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
New Zealand pigeon (kererū)	kererū	*Hemiphaga novaeseelandiae*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
eastern rosella		*Platycercus eximius*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
shining cuckoo	pīpīwharauroa	*Chrysococcyx lucidus*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
morepork	ruru	*Ninox novaeseelandiae*	Not Threatened	Not Threatened	Stephenson (2010)
New Zealand kingfisher	kōtare	*Todiramphus sanctus*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
grey warbler	riroriro	*Gerygone igata*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
bellbird	korimako	*Anthornis melanura*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
tūī	tūī	*Prosthemadera novaeseelandiae*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
Australian magpie	makipai	*Gymnorhina tibicen*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
New Zealand fantail	pīwakawaka	*Rhipidura fuliginosa*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
rook		*Corvus frugilegus*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
skylark		*Alauda arvensis*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
fernbird	koroātito	*Bowdleria punctata*	At Risk, Declining	Not Threatened	Stephenson (2010)
silvereye	tauhou	*Zosterops lateralis*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
welcome swallow	warou	*Hirundo neoxena*	Not Threatened	Not Threatened	Stephenson (2010); HBRC, unpublished data
Eurasian blackbird	manu pango	*Turdus merula*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
song thrush		*T. philomelos*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
common starling	tāringi	*Sturnus vulgaris*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
common myna	maina	*Acridotheres tristis*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
house sparrow	tiu	*Passer domesticus*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
New Zealand pipit	pīhoihoi	*Anthus novaeseelandiae*	At Risk, Declining	Not Threatened	Stephenson (2010); HBRC, unpublished data
dunnock		*Prunella modularis*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
chaffinch	pahirini	*Fringilla coelebs*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
greenfinch		*Carduelis chloris*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
goldfinch		*C. carduelis*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data
common redpoll		*C. flammea*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
yellowhammer		*Emberiza citrinella*	Introduced and Naturalised	Introduced and Naturalised	Stephenson (2010); HBRC, unpublished data

Appendix Four: Ngaruroro River shorebird risk assessment matrix

The following table provides a spatially- and species-specific shorebird risk assessment matrix for flood mitigation and gravel extraction activities on the Ngaruroro River. This matrix provides an indication of the risk of disturbing nests or chicks of each shorebird species present on each section of the Ngaruroro River during the breeding season, based on shorebird densities mapped during the November 2019 survey. River sections designated "High" risk for a particular species supported above average densities of that particular species during November 2019. River sections designated "Medium" risk for a particular species supported below average densities of that particular species during November 2019. River sections on which a particular species was absent during the November 2019 survey are designated as "Low" risk for that species. This matrix can be used as a decision-making tool to plan the timing and extent of flood mitigation and gravel extraction activities in unvegetated gravel habitats, and to determine whether or not a pre-works shorebird survey is required.

River section	Risk assessment				
	Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
XS00 to XS01	Medium	Low	Medium	Low	High
XS01 to XS03	Low	High	High	Low	Low
XS03 to XS05	Low	Low	Low	Low	Low
XS05 to XS07	Low	Medium	High	Low	Low
XS07 to XS09	Low	High	Low	Low	Low
XS09 to XS11	Low	Low	Low	Low	Low
XS11 to XS13	High	High	Low	Low	Low
XS13 to XS15	High	High	High	Low	Medium
XS15 to XS16	High	High	High	Low	Low
XS16 to XS18	Medium	High	Low	Low	Low
XS18 to XS20	High	High	Low	Low	Low
XS20 to XS22	High	High	High	Low	Low
XS22 to XS24	High	Medium	Low	Low	Low
XS24 to XS25	High	Medium	Low	Low	Low
XS25 to XS27	High	High	Low	Low	Low
XS27 to XS29	High	High	Low	Low	Low
XS29 to XS31	High	High	High	Low	Low
XS31 to XS32	High	High	High	Low	Low
XS32 to XS33	High	High	Medium	Low	Low
XS33 to XS34	High	Medium	Medium	Low	Low

River section	Risk assessment				
	Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
XS34 to XS35	Medium	High	High	Low	Low
XS35 to XS36	High	High	High	Low	Low
XS36 to XS37	High	High	High	Low	Low
XS37 to XS38a	Medium	High	Medium	Low	Low
XS38a to XS40	High	Medium	High	Low	Low
XS40 to XS41	High	Medium	Medium	Low	Low
XS41 to XS42	Medium	Medium	Low	Low	Low
XS42 to XS43	High	Medium	Medium	Low	Low
XS43 to XS44	High	Medium	Low	Low	Low
XS44 to XS45	High	Medium	Medium	Low	Low
XS45 to XS46	High	High	Medium	Low	Low
XS46 to XS46a	High	High	Medium	Low	Low
XS46a to XS48	High	High	Low	Low	Low
XS48 to XS49	High	High	High	Low	Low
XS49 to XS50	High	Medium	Medium	Low	Low
XS50 to XS51	Medium	Medium	Medium	Low	Low
XS51 to XS52	Medium	Medium	Medium	High	Low
XS52 to XS53	Medium	Medium	Medium	Low	Low
XS53 to XS54	High	Medium	Medium	High	Low
XS54 to XS55	Medium	Medium	High	High	Low
XS55 to XS56	High	Low	High	High	Low
XS56 to XS57	High	Medium	Low	Low	Low
XS57 to XS58	High	Medium	Medium	High	Low
XS58 to XS59	High	Medium	High	High	Low
XS59 to XS60	Medium	Medium	Medium	High	Low
XS60 to XS61	Medium	High	High	High	Low
XS61 to XS62	Medium	Medium	Low	Low	Low
XS62 to XS63	Low	Medium	Medium	Low	Low
XS63 to XS64	Medium	Medium	Low	Low	Low
XS64 to XS65	High	Medium	Medium	Low	Low
XS65 to XS66	High	Medium	Medium	High	Medium
XS66 to XS67	High	Medium	Medium	High	Low

River section	Risk assessment				
	Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
XS67 to XS68	High	Low	High	High	Medium
XS68 to XS69	Medium	Low	High	High	Medium
XS69 to Cableway	High	Medium	Medium	High	Medium

Appendix Five: Bird species of the Tukituki River

The following table contains a list of the bird species recorded on the Tukituki River. Species names and taxonomic order are those listed in Gill et al, (2010), with additional Māori names sourced from the Māori Dictionary Project (https://maoridictionary.co.nz/). National threat rankings are those listed in Robertson et al., (2017) and regional threat rankings are from HBRC, unpublished data.

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
California quail	koera	*Callipepla californica*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
common pheasant	peihana	*Phasianus colchicus*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
peafowl	pīkau	*Pavo cristatus*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
feral turkey	korukoru	*Meleagris gallopavo*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
black swan	kakīānau	*Cygnus atratus*	Not Threatened	Not Threatened	HBRC, unpublished data
greylag goose		*Anser anser*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
Canada goose	kuihi	*Branta canadensis*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
paradise shelduck	pūtangitangi	*Tadorna variegata*	Not Threatened	Not Threatened	HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
grey teal	tētē moroiti	*Anas gracilis*	Not Threatened	Not Threatened	HBRC, unpublished data
mallard	rakiraki	*A. platyrhynchos*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
grey duck	pārera	*A. superciliosa*	Nationally Critical	Regionally Critical	HBRC, unpublished data
Australasian shoveler	kuruwhengi	*A. rhynchotis*	Not Threatened	Not Threatened	HBRC, unpublished data
Australasian gannet	tākupu	*Morus serrator*	Not Threatened	Not Threatened	HBRC, unpublished data
little shag	kawau paka	*Phalacrocorax melanoleucos*	Not Threatened	Regionally Endangered	HBRC, unpublished data
black shag	kawau	*P. carbo*	At Risk, Naturally Uncommon	Data Deficient	HBRC, unpublished data
little black shag	kawau tūī	*P. sulcirostris*	At Risk, Naturally Uncommon	Data Deficient	HBRC, unpublished data
white-faced heron	matuku moana	*Egretta novaehollandiae*	Not Threatened	Regionally Vulnerable	HBRC, unpublished data
royal spoonbill	kotuku ngutupapa	*Platalea regia*	At Risk, Naturally Uncommon	Regionally Critical	HBRC, unpublished data
swamp harrier	kāhu	*Circus approximans*	Not Threatened	Not Threatened	HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
New Zealand falcon	kārearea	*Falco novaeseelandiae*	At Risk, Recovering	Regionally Endangered	HBRC, unpublished data
pukeko	pūkeko	*Porphyrio melanotus*	Not Threatened	Not Threatened	HBRC, unpublished data
bar-tailed godwit	kuaka	*Limosa lapponica*	At Risk, Declining	Regionally Endangered	HBRC, unpublished data
ruddy turnstone		*Arenaria interpres*	Migrant	Migrant	HBRC, unpublished data
variable oystercatcher	tōrea pango	*Haematopus unicolor*	At Risk, Recovering	Regionally Critical	HBRC, unpublished data
South Island pied oystercatcher	tōrea	*H. finschi*	At Risk, Declining	Regionally Critical	HBRC, unpublished data
pied stilt	poaka	*Himantopus himantopus*	Not Threatened	Regionally Vulnerable	HBRC, unpublished data
New Zealand dotterel	tūturiwhatu	*Charadrius obscurus*	At Risk, Recovering	Regionally Critical	HBRC, unpublished data
banded dotterel	pohowera	*C. bicinctus*	Nationally Vulnerable	Regionally Vulnerable	HBRC, unpublished data
black-fronted dotterel		*Elseyornis melanops*	At Risk, Naturally Uncommon	Coloniser	HBRC, unpublished data
spur-winged plover		*Vanellus miles*	Not Threatened	Not Threatened	HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
southern black-backed gull	karoro	*Larus dominicanus*	Not Threatened	Not Threatened	HBRC, unpublished data
red-billed gull	tarāpunga	*L. novaehollandiae*	At Risk, Declining	Regionally Vulnerable	HBRC, unpublished data
black-billed gull	tarāpuka	*L. bulleri*	Nationally Critical	Regionally Critical	HBRC, unpublished data
Caspian tern	taranui	*Hydroprogne caspia*	Nationally Vulnerable	Regionally Critical	HBRC, unpublished data
white-fronted tern	tara	*Sterna striata*	At Risk, Declining	Not Threatened	HBRC, unpublished data
rock pigeon		*Columba livia*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
New Zealand pigeon (kererū)	kererū	*Hemiphaga novaeseelandiae*	Not Threatened	Not Threatened	HBRC, unpublished data
eastern rosella		*Platycercus eximius*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
shining cuckoo	pīpīwharauroa	*Chrysococcyx lucidus*	Not Threatened	Not Threatened	HBRC, unpublished data
morepork	ruru	*Ninox novaeseelandiae*	Not Threatened	Not Threatened	HBRC, unpublished data
New Zealand kingfisher	kōtare	*Todiramphus sanctus*	Not Threatened	Not Threatened	HBRC, unpublished data
grey warbler	riroriro	*Gerygone igata*	Not Threatened	Not Threatened	HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
bellbird	korimako	*Anthornis melanura*	Not Threatened	Not Threatened	HBRC, unpublished data
tūī	tūī	*Prosthemadera novaeseelandiae*	Not Threatened	Not Threatened	HBRC, unpublished data
Australian magpie	makipai	*Gymnorhina tibicen*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
New Zealand fantail	pīwakawaka	*Rhipidura fuliginosa*	Not Threatened	Not Threatened	HBRC, unpublished data
rook		*Corvus frugilegus*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
skylark		*Alauda arvensis*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
silvereye	tauhou	*Zosterops lateralis*	Not Threatened	Not Threatened	HBRC, unpublished data
welcome swallow	warou	*Hirundo neoxena*	Not Threatened	Not Threatened	HBRC, unpublished data
Eurasian blackbird	manu pango	*Turdus merula*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
song thrush		*T. philomelos*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
common starling	tāringi	*Sturnus vulgaris*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data

Common name	Māori name	Scientific name	National threat ranking	Regional threat ranking	Data source(s)
common myna	maina	*Acridotheres tristis*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
house sparrow	tiu	*Passer domesticus*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
New Zealand pipit	pīhoihoi	*Anthus novaeseelandiae*	At Risk, Declining	Not Threatened	HBRC, unpublished data
dunnock		*Prunella modularis*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
chaffinch	pahirini	*Fringilla coelebs*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
greenfinch		*Carduelis chloris*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
goldfinch		*C. carduelis*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
common redpoll		*C. flammea*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data
yellowhammer		*Emberiza citrinella*	Introduced and Naturalised	Introduced and Naturalised	HBRC, unpublished data

Appendix Six: Tukituki River shorebird risk assessment matrix

The following table provides a spatially- and species-specific shorebird risk assessment matrix for flood mitigation and gravel extraction activities on the Tukituki River and its tributaries. This matrix provides an indication of the risk of disturbing nests or chicks of each shorebird species present on each section of the Tukituki River and its tributaries during the breeding season, based on shorebird densities mapped during the November 2019 survey. River sections designated "High" risk for a particular species supported above average densities of that particular species during November 2019. River sections designated "Medium" risk for a particular species supported below average densities of that particular species during November 2019. River sections on which a particular species was absent during the November 2019 survey are designated as "Low" risk for that species. This matrix can be used as a decision-making tool to plan the timing and extent of flood mitigation and gravel extraction activities in unvegetated gravel habitats, and to determine whether or not a pre-works shorebird survey is required.

River	River section	Risk assessment				
		Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
Makaretu	XS01 to XS03	Low	Medium	Low	Low	Low
Makaretu	XS03 to XS05	Low	High	Low	Low	Low
Makaretu	XS05 to XS07	Low	High	Low	Low	Low
Makaretu	XS07 to XS09	Low	High	Low	Low	Low
Makaretu	XS09 to XS11	Low	Low	Low	Low	Low
Makaretu	XS11 to XS12	Low	Low	Low	Low	Low
Makaretu	XS12 to XS13	Low	Low	Low	Low	Low
Makaretu	XS13 to XS14	Low	Low	Low	Low	Low
Makaretu	XS14 to XS16	Low	High	Low	Low	Low
Makaretu	XS16 to XS17	Low	Low	Low	Low	Low
Makaretu	XS17 to XS19	Low	High	Low	Low	Low
Makaretu	XS19 to XS20	Low	High	High	Low	Low
Makaretu	XS20 to XS21	Low	High	Low	Low	Low
Makaretu	XS21 to XS22	Low	High	Low	Low	Low
Makaretu	XS22 to XS23	Low	High	Low	Low	Low
Makaretu	XS23 to XS24	Low	High	Low	Low	Low
Makaretu	XS24 to XS25	Low	Low	Low	Low	Low
Makaretu	XS25 to XS26	Low	Low	Low	Low	Low
Makaretu	XS26 to XS28	Low	Low	Low	Low	Low
Makaretu	XS28 to XS29	Low	Low	Low	Low	Low

River	River section	Risk assessment				
		Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
Makaretu	(TUK)XS04 to (MAK)XS01	Low	High	Low	Low	Low
Makaroro	XS02 to 06	Low	Low	Low	Low	Low
Makaroro	(WAI)XS65 to (MRO)XS02	Low	Low	Low	Low	Low
Mangaonuku	XS01 to XS03	Low	Medium	High	Low	Low
Mangaonuku	XS03 to XS05	Low	High	Low	Low	Low
Mangaonuku	XS05 to XS07	High	Low	High	Low	Low
Mangaonuku	XS07 to XS09	Low	High	High	Low	Low
Mangaonuku	XS09 to XS11	Low	Medium	Low	Low	Low
Mangaonuku	XS11 to XS13	Low	Medium	Low	Low	Low
Mangaonuku	XS13 to XS14	Low	Medium	High	Low	Low
Mangaonuku	XS14 to XS15	Low	High	Low	Low	Low
Mangaonuku	XS15 to XS17	Low	High	High	Low	Low
Mangaonuku	XS17 to XS18	Low	High	Low	Low	Low
Mangaonuku	XS18 to XS19	Low	High	Low	Low	Low
Mangaonuku	XS19 to XS20	Low	Low	Low	Low	Low
Mangaonuku	XS20 to XS21	Low	High	Low	Low	Low
Mangaonuku	XS21 to XS23	Low	High	Low	Low	Low
Mangaonuku	XS23 to XS24	High	Low	High	Low	Low
Mangaonuku	XS24 to XS26	Low	High	Low	Low	Low
Mangaonuku	XS26 to XS28	Low	High	Low	Low	Low
Mangaonuku	XS28 to XS29	Low	High	Low	Low	Low
Mangaonuku	XS29 to XS30	Low	High	Low	Low	Low
Mangaonuku	XS30 to XS32	Low	Low	Low	Low	Low
Mangaonuku	XS32 to XS33	Low	High	Low	Low	Low
Mangaonuku	(WAI)XS25 to (MAN)XS01	Medium	High	High	Low	Low
Tukipo	(TTU)XS45 to (TUK)XS01	Low	High	High	Low	Low
Tukipo	XS01 to XS02	Low	High	Low	Low	Low
Tukipo	XS02 to XS04	Low	High	Low	Low	Low
Tukipo	XS04 to XS06	Low	High	Low	Low	Low
Tukipo	XS06 to XS08	Low	High	Low	Low	Low
Tukipo	XS08 to XS10	Low	Low	Low	Low	Low

River	River section	Risk assessment				
		Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
Tukipo	XS10 to XS12	Low	High	Low	Low	Low
Tukipo	XS12 to XS14	Low	High	Low	Low	Low
Tukipo	XS14 to XS16	Low	High	Low	Low	Low
Tukipo	XS16 to XS18	Low	High	High	Low	Low
Tukipo	XS18 to XS20	Low	High	Low	Low	Low
Tukipo	XS20 to XS23	Low	High	Low	Low	Low
Tukipo	XS23 to XS25	Low	High	Low	Low	Low
Tukipo	XS25 to XS28	Low	High	Low	Low	Low
Tukipo	XS28 to XS30	Low	Medium	Low	Low	Low
Tukipo	XS30 to XS32	Low	High	High	Low	Low
Tukipo	XS32 to XS34	Low	High	Low	Low	Low
Tukipo	XS34 to XS37	High	Medium	High	Low	Low
Tukipo	XS37 to XS39	Low	Medium	Low	Low	Low
Tukipo	XS39 to XS41	Low	High	High	Low	Low
Tukipo	XS41 to XS44	Low	Medium	Low	Low	Low
Tukipo	XS44 to XS46	Low	Low	Low	Low	Low
Tukipo	XS46 to XS47	Low	High	Low	Low	Low
Tukipo	XS47 to XS49	Low	Low	Low	Low	Low
Tukipo	XS49 to XS51	Low	Low	Low	Low	Low
Tukipo	XS51 to XS52	Low	Low	Low	Low	Low
Tukituki lower	XS00 to XS03	Medium	Medium	High	Low	High
Tukituki lower	XS03 to XS05	High	Medium	Low	Low	High
Tukituki lower	XS05 to XS07	High	Medium	High	Low	Low
Tukituki lower	XS07 to XS09	High	Medium	High	Low	Low
Tukituki lower	XS09 to XS11	High	High	High	Low	Low
Tukituki lower	XS11 to XS13	High	Medium	High	Low	Low
Tukituki lower	XS13 to XS15	High	High	High	Low	Low
Tukituki lower	XS15 to XS16	High	Medium	High	Low	Low
Tukituki lower	XS16 to XS18	High	Medium	High	Low	Low

River	River section	Risk assessment				
		Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
Tukituki lower	XS18 to XS20	High	High	High	Low	Low
Tukituki lower	XS20 to XS22	High	High	High	Low	Low
Tukituki lower	XS22 to XS23	High	Medium	High	Low	High
Tukituki lower	XS23 to XS24	High	High	High	Low	Low
Tukituki lower	XS24 to XS26	High	High	High	Low	Low
Tukituki lower	XS26 to XS27	High	Medium	Medium	Low	Low
Tukituki lower	XS27 to XS28	Medium	Medium	High	Low	Low
Tukituki lower	(TTL)XS28 to (TTM)XS01	Medium	Medium	Medium	Low	Low
Tukituki mid	XS01 to XS02	Medium	Medium	Medium	Low	Low
Tukituki mid	XS02 to XS03	Medium	Medium	Low	Low	Low
Tukituki mid	XS03 to XS04	High	Medium	Medium	Low	Low
Tukituki mid	XS04 to XS06	High	Medium	Medium	Low	Low
Tukituki mid	XS06 to XS07	High	Medium	High	Low	Low
Tukituki mid	XS07 to XS08	High	Medium	Medium	Low	Low
Tukituki mid	XS08 to XS10	High	High	High	Low	Low
Tukituki mid	XS10 to XS11	High	Medium	Medium	Low	Low
Tukituki mid	XS11 to XS12	Medium	High	High	Low	Low
Tukituki mid	XS12 to XS14	Medium	High	Medium	Low	High
Tukituki mid	XS14 to XS15	Low	Medium	Low	Low	Low
Tukituki mid	XS15 to XS16	Low	Medium	Low	Low	Low
Tukituki mid	XS16 to XS17	High	Medium	High	Low	Low
Tukituki mid	XS17 to XS19	Low	Low	Medium	Low	Low
Tukituki mid	XS19 to XS20	Medium	High	Medium	Low	Low
Tukituki mid	XS20 to XS21	High	Medium	High	Low	Low
Tukituki mid	XS21 to XS23	High	Medium	High	Low	Low
Tukituki mid	XS23 to XS24	High	Medium	Medium	Low	Low
Tukituki mid	XS24 to XS25	High	Medium	High	Low	Low
Tukituki mid	XS25 to XS26	High	High	Medium	Low	Low
Tukituki mid	XS26 to XS27	Medium	Medium	High	Low	Low

River	River section	Risk assessment				
		Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
Tukituki mid	XS27 to XS29	High	Medium	High	Low	Low
Tukituki mid	XS29 to XS30	High	Medium	Low	Low	Low
Tukituki mid	XS30 to XS31	Medium	Medium	Low	Low	Low
Tukituki mid	XS31 to XS32	High	Medium	High	Low	Low
Tukituki mid	XS32 to XS34	Medium	Medium	Medium	Low	Low
Tukituki mid	XS34 to XS35	Medium	High	Medium	Low	Low
Tukituki mid	XS35 to XS36	High	Medium	High	Low	Low
Tukituki mid	XS36 to XS37	Medium	Medium	High	Low	Low
Tukituki mid	XS37 to XS38	High	Medium	High	Low	Low
Tukituki mid	XS38 to XS39	High	Medium	Low	Low	Low
Tukituki mid	XS39 to XS40	Medium	Medium	Medium	Low	Low
Tukituki mid	XS40 to XS41	High	Medium	Medium	High	Low
Tukituki mid	XS41 to XS42	Medium	Medium	Medium	Low	Low
Tukituki mid	XS42 to XS43	High	Medium	High	Low	Low
Tukituki mid	XS43 to XS44	High	Medium	Medium	High	Low
Tukituki mid	XS44 to XS45	High	Medium	Medium	Low	Low
Tukituki mid	XS45 to XS46	High	High	High	High	Low
Tukituki mid	XS46 to XS48	High	High	Medium	Low	Low
Tukituki mid	XS48 to XS49	High	Low	Low	Low	Low
Tukituki mid	XS49 to XS50	High	High	Low	Low	Low
Tukituki mid	XS50 to XS51	High	High	High	Low	Low
Tukituki mid	XS51 to XS52	High	Medium	High	Low	Low
Tukituki mid	XS52 to XS53	High	Medium	High	Low	Low
Tukituki mid	XS53 to XS55	High	High	High	Low	Low
Tukituki mid	XS55 to XS57	High	High	High	Low	Low
Tukituki mid	(TTM)XS57 to (TTU)XS01	High	High	High	Low	Low
Tukituki upper	XS01 to XS02	High	High	Medium	Low	Low
Tukituki upper	XS02 to XS03	High	High	Low	Low	Low
Tukituki upper	XS03 to XS04	High	Medium	Medium	Low	Low
Tukituki upper	XS04 to XS05	Medium	Medium	Low	Low	Low

River	River section	Risk assessment				
		Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
Tukituki upper	XS05 to XS06	Medium	Medium	Low	Low	Low
Tukituki upper	XS06 to XS08	High	Medium	Low	Low	Low
Tukituki upper	XS08 to XS09	High	High	High	Low	Low
Tukituki upper	XS09 to XS11	Low	High	Low	Low	Low
Tukituki upper	XS11 to XS13	Low	High	Low	Low	Low
Tukituki upper	XS13 to XS15	High	High	Low	Low	Low
Tukituki upper	XS15 to XS17	Low	High	Low	Low	Low
Tukituki upper	XS17 to XS19	Low	High	Low	Low	Low
Tukituki upper	XS19 to XS21	Low	High	Low	Low	Low
Tukituki upper	XS21 to XS23	High	High	Low	Low	Low
Tukituki upper	XS23 to XS25	High	High	Medium	Low	Low
Tukituki upper	XS25 to XS27	High	High	High	Low	Low
Tukituki upper	XS27 to XS29	High	Medium	High	Low	Low
Tukituki upper	XS29 to XS31	High	High	Low	Low	Low
Tukituki upper	XS31 to XS33	High	Medium	Low	Low	Low
Tukituki upper	XS33 to XS35	High	High	Medium	Low	Low
Tukituki upper	XS35 to XS37	High	High	Low	Low	Low
Tukituki upper	XS37 to XS39	High	High	Low	Low	Low
Tukituki upper	XS39 to XS41	High	High	Low	Low	Low
Tukituki upper	XS41 to XS43	High	High	Low	Low	Low
Tukituki upper	XS43 to XS45	High	High	High	Low	Low
Tukituki upper	XS45 to XS48	High	Medium	Low	Low	Low
Tukituki upper	XS48 to XS50	Low	High	Low	Low	Low
Tukituki upper	XS50 to XS52	Low	Medium	Low	Low	Low

River	River section	Risk assessment				
		Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
Tukituki upper	XS52 to XS53	Low	High	Low	Low	Low
Tukituki upper	XS53 to XS55	Low	High	Low	Low	Low
Tukituki upper	XS55 to XS56	Low	Low	Low	Low	Low
Tukituki upper	XS56 to XS59	Low	Medium	Low	Low	Low
Tukituki upper	XS59 to XS61	Low	Low	Low	Low	Low
Tukituki upper	XS61 to XS62	Low	Medium	Low	Low	Low
Tukituki upper	XS62 to XS63	Low	High	Low	Low	Low
Tukituki upper	XS63 to XS64	Low	Medium	Low	Low	Low
Tukituki upper	XS64 to XS65	Low	Low	Low	Low	Low
Tukituki upper	XS65 to XS66	Low	Low	Low	Low	Low
Tukituki upper	XS66 to XS67	Low	Low	Low	Low	Low
Tukituki upper	XS67 to XS68	Low	Low	Low	Low	Low
Tukituki upper	XS68 to XS69	Low	Low	Low	Low	Low
Tukituki upper	XS69 to XS70	Low	Medium	Low	Low	Low
Tukituki upper	XS70 to XS71	Low	Medium	Low	Low	Low
Tukituki upper	XS71 to XS73	Low	Medium	Low	Low	Low
Tukituki upper	(TTU)XS09 to (WAI)XS01	Medium	Medium	Low	Low	Low
Waipawa	XS01 to XS02	High	Medium	Low	Low	Low
Waipawa	XS02 to XS04	Low	High	Low	Low	Low
Waipawa	XS04 to XS06	Medium	Low	Low	Low	Low
Waipawa	XS06 to XS08	High	High	Medium	Low	Low
Waipawa	XS08 to XS10	Medium	Medium	Medium	Low	Low
Waipawa	XS10 to XS12	High	High	Low	Low	Low
Waipawa	XS12 to XS13	High	Medium	Low	Low	Low
Waipawa	XS13 to XS14	Medium	Low	Low	Low	Low
Waipawa	XS14 to XS16	Medium	High	Low	Low	Low

River	River section	Risk assessment				
		Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
Waipawa	XS16 to XS18	High	High	Low	Low	Low
Waipawa	XS18 to XS20	High	Medium	High	Low	Low
Waipawa	XS20 to XS21	High	High	High	Low	Low
Waipawa	XS21 to XS22	High	Medium	High	Low	Low
Waipawa	XS22 to XS23	Medium	High	Low	Low	High
Waipawa	XS23 to XS24	Low	High	Low	Low	Low
Waipawa	XS24 to XS25	Low	Medium	Low	Low	Low
Waipawa	XS25 to XS27	High	Low	Low	Low	Low
Waipawa	XS27 to XS27b	High	Medium	Low	Low	Low
Waipawa	XS27b to XS28	Medium	Low	Low	Low	Low
Waipawa	XS28 to XS30	High	Medium	Low	Low	Low
Waipawa	XS30 to XS31	High	Medium	High	Low	Low
Waipawa	XS31 to XS33	Medium	Low	Low	Low	Low
Waipawa	XS33 to XS34	High	Medium	Low	Low	Low
Waipawa	XS34 to XS36	Low	Medium	Low	Low	Low
Waipawa	XS36 to XS38	High	Medium	High	Low	Low
Waipawa	XS38 to XS39	High	Medium	High	Low	Low
Waipawa	XS39 to XS40	High	Medium	Low	Low	Low
Waipawa	XS40 to XS42	High	Medium	High	Low	Low
Waipawa	XS42 to XS43	High	Medium	Low	Low	Low
Waipawa	XS43 to XS45	High	Medium	Low	Low	Low
Waipawa	XS45 to XS47	High	Low	High	Low	Low
Waipawa	XS47 to XS48	High	Low	High	Low	Low
Waipawa	XS48 to XS49	High	Medium	Medium	Low	Low
Waipawa	XS49 to XS50	High	Low	Low	Low	Low
Waipawa	XS50 to XS51	High	Medium	High	Low	Low
Waipawa	XS51 to XS52	High	Medium	Low	High	Low
Waipawa	XS52 to XS53	High	Medium	Low	Low	Low
Waipawa	XS53 to XS54	High	Low	Low	Low	Low
Waipawa	XS54 to XS56	High	Medium	Medium	Low	Low
Waipawa	XS56 to XS57	Low	Medium	Low	Low	Low

River	River section	Risk assessment				
		Banded dotterel	Black-fronted dotterel	Pied stilt	SI pied oystercatcher	Black-billed gull
Waipawa	XS57 to XS58	Low	Medium	Low	Low	Low
Waipawa	XS58 to XS59	Medium	Low	Low	Low	Low
Waipawa	XS59 to XS60	Low	Low	Low	Low	Low
Waipawa	XS60 to XS62	Low	Medium	Low	Low	Low
Waipawa	XS62 to XS64	Low	Medium	High	Low	Low
Waipawa	XS64 to XS65	Low	Medium	Low	Low	Low
Waipawa	XS65 to XS66	Medium	High	High	Low	Low
Waipawa	XS66 to XS68	Low	Low	Low	Low	Low

Appendix 7: Standard pre-works shorebird survey report template

Pre-works shorebird survey, [*Insert river name, date*]

A report for [*Insert name, company, resource consent or gravel authorisation number*]

1 Surveyor's Qualifications and Experience:

The survey was undertaken by **[*Insert name, relevant qualifications*]**

[*Insert brief description of relevant experience, including a summary of previous experience locating and monitoring shorebird nests and/or carrying our shorebird census counts on rivers*]

2 Search Effort

A survey was carried out in the proposed work area (including 100m buffer zones) using the standard survey methodology provided by Hawke's Bay Regional Council

[*Insert map or an accurate description of the survey area*]

The length of riverbed surveyed was **[*Insert length of riverbed surveyed in metres*]** and was **[*Insert area of riverbed surveyed in hectares*]** in area.

3 Results

There were [**XX**] instances of a nest, chicks or colonies being detected within the proposed extraction area:

[Example table:]

Species	Nest, chick(s) or colony	GPS coordinates (NZTM)	
Banded dotterel	Nest (3 eggs)	E1557844	N5190014
Banded dotterel	Chick (1 small)	E1558364	N5190064

[*Insert a locality map clearly delimiting the survey area and showing locations of nests or chicks or colonies, recommended setback distances and alternative accessways or trackways, if needed*].

4 Discussion and Recommendations

[Example discussion & recommendations:]
A banded dotterel nest and an adult with a chick were detected within the proposed extraction area. I recommend that a 50m exclusion zone be maintained around the nest and a 50m exclusion zone around the location where the chick was sighted. The location of the banded dotterel chick prevents operating along the planned accessway. Therefore, access will now be gained from another track, 250m east of the previously planned track.

The locations of the nest and chick, the required setback distances and new accessway have been communicated to staff working onsite.

Gravel extraction work can proceed in the proposed extraction area, provided the abovementioned recommendations are implemented.