GODWITS AND WORM MOUNDS: SUCCESSFUL PIPELINE CONSENTING

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ABSTRACT

The Nelson Regional Sewerage Business Unit's (NRSBU's) decision to proceed with a 2.6km, 800mm diameter HDPE pipeline crossing the Waimea Inlet to their Bell Island wastewater treatment plant faced significant consenting hurdles due to the sensitive estuarine environment and cultural concerns for the estuary crossing. This paper describes the consultative approach taken to accommodate these issues and concerns, to achieve a pragmatic and cost effective consent outcome. Technical aspects of the project are also described.

Submissions to the consent application covered a wide range of issues. Key concerns included Iwi cultural objections to the laying of a sewer pipeline under the estuary, the potential disturbance to five bird species of international importance and ecologically significant areas of worm mounds, eel grass and sponge gardens traversed by the pipeline. Submissions sought to restrict the construction season from May through to August to avoid disruption to the bird's breeding season and the Summer/Autumn fattening of the Bar-tailed Godwit, before its annual migration to Alaska. Submitters expressed a strong desire for trenchless construction, by directional drilling, as this was perceived to present the lowest environmental impact. The studies and technical considerations that lead to acceptance by all of the NRSBU's preferred and lower cost open trenching methodology are described.

KEYWORDS

Estuary, Pipeline, Consents; Sensitive Receiving Environment; Directional Drilling

1 INTRODUCTION

The Nelson Regional Sewerage Business Unit (NRSBU) is a joint committee of the Tasman District Council (TDC) and the Nelson City Council (NCC), with some industrial contributor representation, and was set up in 1998 to provide an improved governance structure for the owners of the assets.

The Nelson Regional Sewerage Scheme (NRSS), commissioned in 1983, comprises 4 pump stations, 11 kilometres of rising mains located around the perimeter of the Waimea Estuary and has a sewage treatment plant (STP) located on Bell Island, in the Waimea Estuary. Treated effluent is discharged into the Estuary on the outgoing tide and stabilised sludge (biosolids) is beneficially applied to forests on Bell Island and Rabbit Island.

The NRSBU reticulation network had been upgraded in stages over the past decade to replace pipes at risk of failure. The only part of the pipeline still at risk of failure was the 2.6km 600mm diameter section across the Waimea Estuary, between Monaco and Bell Island, which had been in place for nearly 30 years. This section also had flow capacity limitations that caused pump station overflows under heavy rainfall conditions. Severe corrosion of critical joints on the existing pipeline was identified as likely, despite the past installation of cathodic protection. These joints could not be inspected, let alone repaired, without a back-up pipeline being in place.

Duplication of the pipeline across the estuary would address the immediate risk issues and provide immediate additional flow capacity while investigations into long-term strategies to accommodate future growth were undertaken. With the risk of pipeline failure considered extreme, the NRSBU's initial reaction was to proceed with the pipeline duplication as a matter of urgency. However, in discussions with Iwi, it was made clear that Iwi did not approve of sewer pipes in the estuary and if a duplicate pipe was installed it should be removed within 10 years of being constructed.

NRSBU, conscious of the environmental, cultural and economic sensitivity of the project, therefore decided to embark on an in-depth consultation process covering eight Regional Scheme upgrade options. This early and openly consultative approach was a key step towards the eventual success of the subsequent consenting process. In the meantime, a Contingency Plan was developed to manage risk in the case of a pipeline failure.

Submitters to the consultation process were asked to rate and comment on the relative importance of the environmental, economic, social and cultural concerns for the various options. Sixty written submissions were received, twelve of which requested to be heard. Issues raised were wide ranging, from energy efficiency, sustainability and global warming considerations, to risk management, environmental, cultural and economic considerations.

A hearing of submissions was held on 3 April 2009, at which Iwi explained their position to now be that, yes NRSBU should install a new duplicate pipeline to protect the estuary from failure of the existing pipe, but must then look seriously at other alternatives (which could include further estuary crossings) for the long-term solution. Iwi offered a significant compromise by agreeing to allow the installation of the duplicate main and associated works and by not requiring the decommissioning or removal of these pipes after 10 years. They, along with other submitters, did however make a strong plea that direction drilling of the pipeline be undertaken to mitigate environmental risks.

The estuary duplication option, with a new 800mm OD HDPE pipeline was selected as NRSBU's preferred option, with the installation methodology and management of environmental impacts to be further studied.

The compromise by Iwi meant that the NRSBU could proceed with the resource consent application and the installation of the duplicate pipeline. A decision on the longer-term pipeline upgrade strategy could therefore be deferred. The request for directional drilling, however, added many millions of dollars to the project cost, and resulted in a significantly longer construction period. As directional drilling would not necessarily achieve a better environmental outcome, it needed to be studied in much greater detail.

2 PROJECT DESCRIPTION

The project submitted for consent comprised two pipelines laid across the estuary, the main pipeline being the 2.6km, 800mm outside diameter high density polyethylene (OD HDPE) duplicate pipeline. The second pipe was a smaller 250mm outside diameter pipeline laid next to the larger pipe, which was being installed to convey treated wastewater from the Bell Island wastewater treatment plant to the Nelson golf course for irrigation purposes.

The route of the two pipelines, shown relative to the existing pipeline, along with associated environmental detail, is shown on the drawing (in two parts) in Appendix A. The dual pipeline route leaves Bell Island and first traverses a tidal channel across to the western tip of Saxton Island, where it then traverses the shallow tidal flat to the eastern extremity of Saxton Island. From there the pipelines traverse another tidal channel (Photograph 1) across to the end of the Monaco Peninsula where the duplicate line joins the existing 600mm concrete pipeline at a fully valved connection point.

The pipelines were to be welded into long strings at a worksite on Bell Island prior to being floated into position for installation. The pipe strings once in place were to be joined using stainless steel flanged joints, further welded joints, and other approved joining technology. The length of pipe strings was a matter to be determined by the contractor ultimately selected to undertake the work to suit his work practices, but typically likely to be around 200m or more.

3 CONSULTATION AND COLLABORATION THE KEY

In November 2009, a notified consent application was lodged for a number of consents for restricted coastal activities and non-complying activities in terms of the Transitional Regional Coastal Plan for the Tasman District and the Nelson Resource Management Plan. This covered a description of the environment, the existing

regional wastewater scheme, the need for the two pipelines, a description of the project, and alternatives. To support the application NRSBU commissioned a Cultural Impact Assessment, an Archaeological Assessment, an Assessment of Environmental Effects, an assessment of potential landscape, visual, and social effects, and a detailed evaluation of the directional drilling installation method. An ornithologist was later engaged following receipt of eight submissions from Iwi, Department of Conservation (DOC), Ornithological Society of NZ, Forest & Bird Society, Nelson Airport and a number of private submitters.

Photograph 1: Monaco Peninsula to Saxton Island at high tide

Close liaison was also maintained with the Saxton family who owned Saxton Island. While construction was to avoid the island, as it was very sensitive to environmental damage, it was important that good working relations were maintained with the island's owners.

The foregoing studies provided the basis on which preliminary design was initially undertaken. However, following receipt of submissions, further amendments were made to the proposed design and installation methodology in order to address, where possible and practicable, the matters raised in these submissions.

A key part of this review process was the genuine desire by NRSBU to listen to submitters concerns and collaboratively work towards the mitigation of those concerns. In this way submitters became part of the solution, as opposed to taking on an adversarial role. By the time of the Hearing (in July 2010), all submitters now supported the proposed works and the focus of the Hearing became just one of identifying consent conditions that were acceptable to all parties.

The following sections now describe the issues faced in the design and installation of the two pipelines, and how these were addressed. Technical aspects of the design are also discussed.

4 TECHNICAL CONSIDERATIONS

4.1 INTRODUCTION

Before considering the environmental issues faced, it is pertinent to first review some of the technical aspects of the project, particularly the study into trenchless construction (horizontal directional drilling - HDD) that lead to it being rejected in favour of the open trenching method on which the consent application was made. The investigations in the estuary are then briefly described, as are some of the technical considerations for jointing the pipeline.

4.2 TRENCHLESS CONSTRUCTION STUDY

The environmental issues faced are described shortly. However it is first pertinent to review the study into trenchless construction (horizontal directional drilling - HDD) that lead to it being rejected in favour of the open trenching method on which the consent application was made.

In the early stages of consultation, it is fair to say that the notion of trenchless construction appealed to many submitters as a way of mitigating most if not all environmental effects, and there was a strong push for NRSBU to adopt this methodology. The reality, however, was far from perception.

HDD is a trenchless method whereby the ground is first pre-drilled and the pipe is then pulled into place. There was, however, limited experience by New Zealand contractors capable of constructing large diameter pipes over long distances, in estuarine conditions, by trenchless directional drilling methods. The 2.6km Monaco to Bell Island pipeline would be beyond the scope of any such work undertaken to date in New Zealand. For that reason, the NRSBU commissioned one of New Zealand's leading specialists in trenchless construction methods to assess the feasibility of using HDD to install the duplicate pipeline, and to identify the works and timeline needed to carry this work out.

This study allowed a more detailed comparative assessment of the open trenching and directional drilling options to be carried out, considering in particular a range of technical, social, economic and environmental aspects. The outcome of the study was to identify that for the following reasons, the impacts and risks associated with directional drilling were so much greater than those for open trenching that directional drilling had to be ruled out as a feasible option for installing the pipeline. Key considerations which lead to the determination ruling out HDD included:

1 The length and diameter of the proposed duplicate pipeline would be at the limit of NZ contractor's HDD experience and probably beyond the capacity of any HDD equipment presently available in New Zealand.

2 An extensive and detailed geotechnical investigation would first be required in order to confirm the feasibility of HDD. The estuary was known to comprise a mix of gravels, sands and muds, as well as cobbles - that can disrupt the HDD process, causing the drill head to deviate, or collapse into the tunnel, increasing the risk of a pipe jam during the "pullback" operation.

3 The required geotechnical investigations would result in substantial disturbance to the estuary bed, which would negate many of the benefits of using the HDD method to reduce disturbance of the estuary in the first place. The investigations required were extensive and would involve the use of excavators to dig test pits and auger boring machines to take core samples every 50m and 100m respectively along the route of the proposed pipeline.

4 Installation by HDD would involve the construction of a drill platform at either end of the pipeline, at Bell Island and Monaco Peninsula, as well as at three 'intermediate stations' within the estuary. These intermediate stations would comprise temporary bunded platforms for pipe launching and drill fluid collection ponds. While construction, use and removal of these stations could be managed effectively to minimise environmental effects, the risks associated with these activities were much higher than for open trenching. Risks include fuel spillage while refuelling pump equipment located within the estuary and the escape of drilling fluid to the estuary.

5 The construction and subsequent removal of the five bunded platforms in the estuary would create greater sediment dispersion effects than that from the open trenching methodology.

6 The projected construction timeframe for installation by HDD was 11 months in comparison to a projected less than 6 month construction timeframe for installation by open trenching.

7 Installation by HDD would require the location of a drill rig at Monaco Peninsula for a period of approximately 23 weeks. While noise levels could be appropriately controlled, there would generally be a much greater level of disruption to Monaco peninsula residents over this time, with traffic being restricted to a single lane for much of this period. Open trenching, by comparison, would involve a moving work site progressing away from residential properties at a rate of approximately 30 metres per day, meaning open trenching would inconvenience local residents for a relatively short period of time.

8 Installation by HDD would require a second tunnel to be drilled to install the return pipeline from the Bell Island treatment plant to the Nelson Golf Course. The additional time and cost associated with constructing a second tunnel would make this element of the proposal unviable. The return pipeline would, then, not be able to be constructed meaning the additional benefits associated with this proposal would be lost.

9 Finally, costs associated with HDD were likely to be significantly higher than for the open trenching approach, and had the potential to escalate during the course of the project to a much greater extent than that for open trenching.

4.3 ESTUARY INVESTIGATIONS

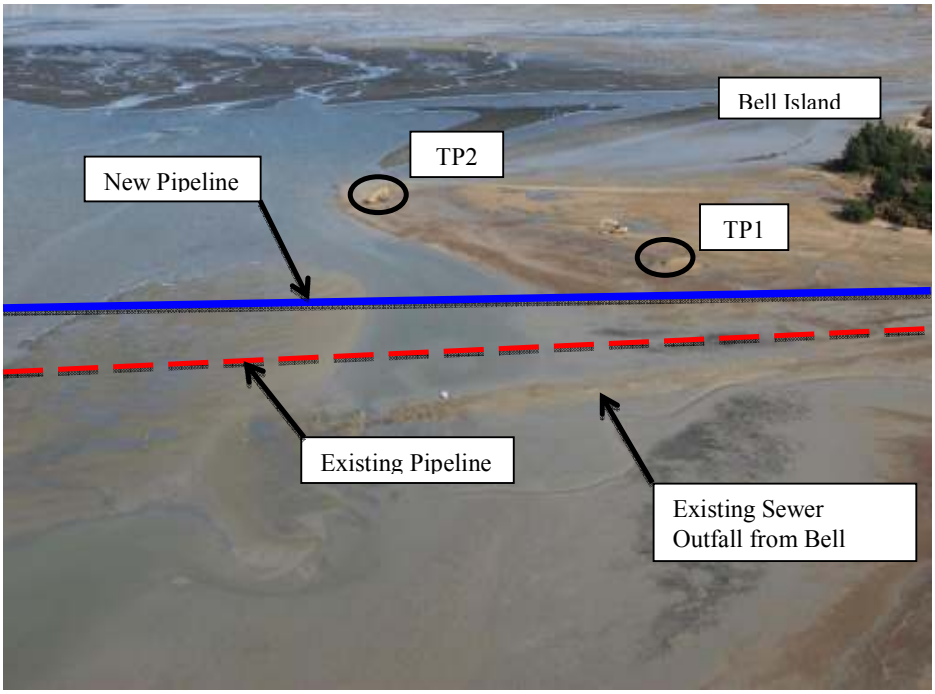
With open trenching selected as the preferred construction methodology, estuary investigations (Photograph 2) were then undertaken to investigate the degree of sedimentation caused by open trenching methods and assess the stability of the resulting stockpiles over subsequent tidal cycles. This was not so much for technical considerations, but more to provide information to the submitters with whom NRSBU were consulting. These investigations comprised the excavation of four test trenches to about 2 metres depth, one each within the inter-tidal zones and one each just within the sub-tidal zones at the Monaco and Bell Island ends of the pipeline. A helicopter was used to fly over the trials and take photographs. In addition, a track mounted scala penetrometer rig was used to investigate the resistance (firmness) of the intertidal sea bed.

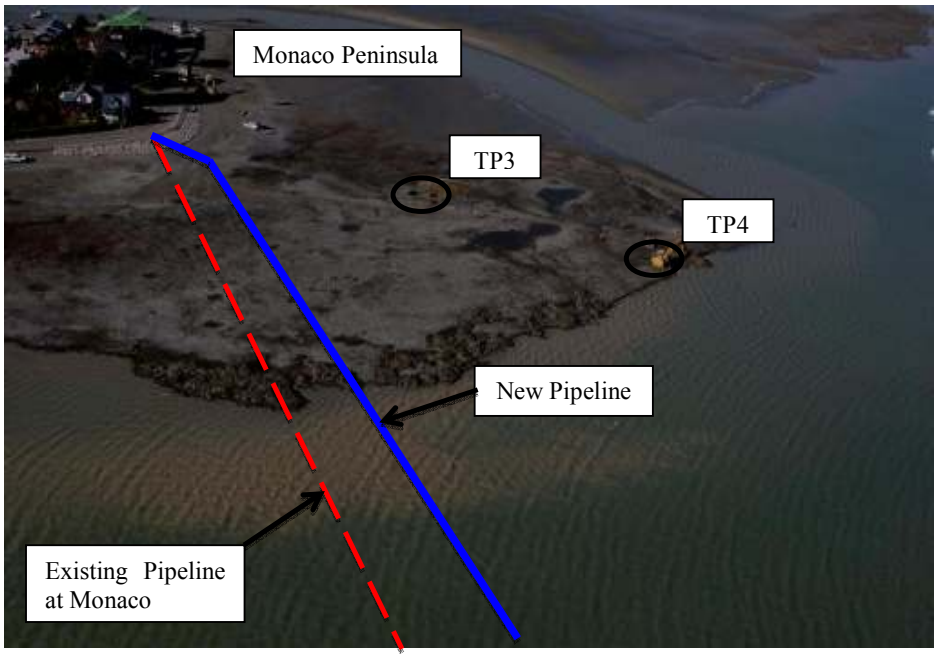
The trials indicated localised sedimentation, as expected, that cleared reasonably quickly. Interestingly, natural sedimentation caused by tidal flows created similar levels of water discolouration – see plume above TP4 in Photograph 2.

4.4 PIPELINE JOINTING

Given that imminent joint failure on the existing pipeline was one reason for the duplication of the existing pipeline, it was crucial that jointing methods on the new line were carefully considered. The original line comprised a 600mm diameter concrete pipeline, with 630 OD HDPE sections through the two subtidal channels, and air valve installations at either end of Saxton Island. Original jointing methods between the concrete/HDPE pipe and the air valve fittings comprised mild steel gibault joints wrapped in a Denso paste wrapping system. A cathodic protection system was retrofitted in the early 1990s through concern over likely longer term corrosion issues. However, one joint was never found and over time the cathodic protection on several other joints was believed to be suspect. An inspection of one joint showed severely corroded bolts, which lead to increasing concern for the security of the pipeline.

For the new HDPE pipeline, most joints would comprise butt-welded joints made on land under carefully controlled conditions. However, the length of the resulting pipe strings, were unlikely to be much longer than 200 - 300m, so some 10 to 12 joints would still need to be made out in the estuarine environment. The decision was taken then to allow only flanged couplings or HDPE electrofusion couplers or butt weld joints carried out under very strict and controlled conditions. For the flanged option, 316 Stainless Steel bolting and backing rings were to be used with HDPE stub flanges. These were to then be wrapped in a Denso paste system to exclude air from all areas of the joint, to reduce the risk of crevice corrosion occurring. HDPE jointing methods were only allowed to be made above surface on a barge sitting firmly on the tidal flats for a sufficient time for the welded joint to properly cool and gain full strength.





Photograph 2: Estuary investigations at low tide; Note Worm Mounds at tidal interface (lower photograph)

5 ENVIRONMENTAL ISSUES AND THEIR MITIGATION

5.1 Introduction

The pipeline route traversed areas of important estuarine ecology and passed close to the breeding grounds of 5 bird species held to be of international importance. On Saxton Island, very close to the pipeline route grew a small rare plant (Peppercress; *Lepidium Bankskii*) protected by DOC, and across the tidal flats of Saxton Island crossed by the pipeline grew an exotic invasive weed that DOC were trying to eradicate and was at risk of being spread to the wider Waimea Inlet by the proposed construction works. Three registered archaeological sites near the pipeline route raised the likelihood of encountering other as yet unidentified sites.

On the more practical side, disruption to the residents of Monaco Peninsula and a café opposite the end of the works had to be mitigated, as did impacts on the nearby Nelson Airport - as a result of bird displacement and night time work lighting effects.

The plan in Appendix A (presented in two parts for better legibility) shows the areas of ecological significance and archaeological sites in relation to the dual pipeline route, along with other construction detail developed through the consultation process.

5.2 Ecology

The composition of estuary substrates varies as the pipeline route crosses from the hard-packed beach and intertidal areas of Monaco Peninsula, Saxton Island and Bell Island through the softer sediments of the estuary channels. The ecological assessment of effects, undertaken by the Cawthron Institute (Nelson), identified that in the wider context of the Waimea Inlet, subtidal and intertidal habitats were not considered of special scientific or conservation value and were not particularly sensitive to disturbance by sedimentation from construction activities. There were, however, specific areas of ecological significance crossed by the two pipelines, which included:

- areas of sabellarid worm mounds within intertidal and subtidal habitats (Photograph 3),
- "sponge gardens" within a proportion of the benthic areas of the two main tidal channels, (Photograph 4)
- areas of Eelgrass (*Zostera*) beds within intertidal habitats (Photograph 5)

Photograph 3: Worm Mounds

Forest and Bird submitted that the tubeworm mounds, the eelgrass and the sponge gardens should not be impacted upon in any way. However some disturbance was inevitable. Cawthron concluded, however, that as long as construction activities were limited to a corridor of 20 to 30m, less than 6% of the eelgrass beds would be impacted. The loss of some worm mound was unavoidable, but these were expected to rebuild once the disturbance was ended. Complete intertidal habitat recovery was expected in the long term based on evidence from the original pipeline construction. In those parts of the estuary likely to be affected by sedimentation, fauna communities are particularly used to dynamic flow regimes and as a result are inherently tolerant of turbidity.

Photograph 4: Sample from "Sponge gardens"

Photograph 5: Eel Grass

Mitigating practices adopted to assist in the re-establishment of damaged habitats was the restriction to a 21m construction corridor through the sensitive areas, and the separate stockpiling of the top 300mm of excavated material and subsequent replacement in the top of the trench. Also, any bedding or fill material imported to site had to be verified as clean and free of contaminating vegetation and weeds.

Management of the foregoing requirements had to be addressed by the Contractor in an *Estuary Pipeline Plan*, which was to include a *Sediment Control Plan* to show how impacts to habitats beyond the project's physical foot-print were to be avoided and mitigated.

5.3 BIRDS

The potential effects on avifauna (birds) was the focus of five of the eight submission received. Of international importance were the Pied Oystercatcher, Variable Oystercatcher, Wrybill, Black-fronted Tern and Bar-tailed Godwit that nested on nearby shell banks. Construction and helicopter activity had the potential to disturb nesting birds and cause displacement of birds to other areas such as the Nelson Airport.

The Bar-tailed Godwits were perhaps the most prominent species of bird on which attention was placed. These birds arrive in New Zealand in September/October after a ~11,500km non-stop flight from Alaska. Records indicate that approximately 3000 arctic migrants residing on the Waimea Estuary are on their final "tank up" (fattening) from February to mid April for their 10,500km flight to the Yellow Sea in China. During this time they cannot afford to waste the energy being stored by being unnecessarily disturbed.

Initially, submitters wished to restrict the construction period to between May and August. This was clearly impracticable and mitigating measures needed to be identified to the satisfaction of all parties. With the assistance of NRSBU's ornithologist, a compromise was developed whereby Construction Exclusion and Construction Restriction zones were identified – as marked on the plan in Appendix A – to provide sufficient buffer protection to the birds.. For the **Construction Exclusion Zone**, no construction activity or vehicle

movements associated with the Contract Works were to take place within this zone. For the **Construction Restriction Zone**, particular restrictions were placed on the Contractor's activities for the periods:

1. between 15 September and 15 April; and

2. within 2.5 hours either side of high tide.

In addition, an ornithologist "observer" was to be employed by the NRSBU to monitor the level of disturbance to birds (if any) and to require suspension of activities if a particular construction activity was, in his opinion, causing a significant level of stress to birds on the nearby shell banks. An *Avifauna Management Plan* had to be prepared by the Contractor to demonstrate how his activities would be managed to work within these constraints.

5.4 INVASIVE WEED

The Department of Conservation had identified the presence of an invasive succulent plant species along the proposed pipeline route which could potentially spread to other locations in the estuary as a result of disturbance during construction work. The extent of this weed is shown as green areas on the plan appended in Appendix A. The Department had recently obtained a resource consent to eradicate this plant through a spraying programme, the first stage of which had already commenced. This first round of spraying has achieved some success, but evidence remained that a further round of spraying would be necessary.

As a precautionary measure against the potential spread of the weed, mitigating measures required the development of a *Weed Management Plan*, including such measures as scraping the surface prior to construction and removal of this material from the estuary, or the burying of the material at depth to prevent grow-back. This would include other measure such as requiring machinery to be washed and cleaned on land at least 10 metres from MHWS (mean high water spring) before being transported away from the work site to prevent the spread of weed to other areas in the region. Effects on Saxton Island and Bell Island Vegetation

5.5 HAZARDOUS MATERIALS MANAGEMENT AND SPILL CONTINGENCY PLANS

The management of hazardous materials on the estuary was clearly a major concern and had to be strictly managed. All vehicle or machinery refuelling, servicing, repairs, washing and cleaning (with the exception of those associated directly with marine vessels) were to be undertaken at least 30 metres inland from MHWS and all fuel stored in a secure, sealed area with suitable bunding to contain the fuel in the event of a spill. Particular measures for spill prevention, containment and contingency planning for fuels, lubricants and hydraulic fluids associated with machinery operation, refuelling and servicing had to be identified. All such measures were to be documented in a *Hazardous Materials Management Plan* and a *Spill Contingency Plan.*

5.6 CULTURAL, SPIRITUAL AND ARCHAEOLOGICAL MATTERS

With a number of registered archaeological sites in the vicinity of the works, monitoring of excavation for possible signs of new sites was important to a number of submitters. Here the agreement was made that an Iwi representative and (at times) an archaeologist appointed and engaged by the NRSBU would monitor any earthworks carried out on the foreshore of Saxton Island and Bell Island and when any works were undertaken within 20 metres of the nearby archaeological sites. The Contractor had to co-operate with and liaise with the Iwi Monitor and Archaeologist, and allow to generally facilitate on-going inspections of the trench as work proceeded. An *Iwi, Archaeological and Community Liaison Plan* setting out all Iwi liaison and public/private liaison protocols, including all contact details, was to be a further requirement.

5.7 SOCIAL AND ECONOMIC EFFECTS

The effects of construction activities on the Monaco Peninsula had the potential to cause adverse social and economic environmental effects to the Monaco Peninsula residents and the public, including effects relating to logistical distribution, noise generation, the generation of dust, materials mobilisation and storage, and increased traffic. One of the key actions taken to mitigate potential disruption and inconvenience to Monaco Peninsula residents was the establishment of the Contractor's work site on Bell Island, adjacent to the existing wastewater

treatment plant. While this increased access and travel distances to the work site, the impact of the contractor's activities on Monaco residents and the general public was minimised to the maximum extent.

6 CONSTRUCTION MANAGEMENT PLAN APPROACH

A key factor for the success of the consenting process, that addressed submitter's concerns whilst at the same time avoided onerous, prescriptive conditions on the Contractor, was the embodiment in the consent conditions of an interactive Construction Management Plan (CMP) approach. This Plan effectively became the cornerstone of the consent conditions and its preparation and approval was to be an interactive exercise between the contractor, the NRSBU, submitters, and the two Regional Councils (Tasman and Nelson) under whose jurisdiction the work was occurring.

The consent conditions simply required: *"The Consent Holder shall, at least 20 day prior to the intended commencement date of the activities authorised by these consents submit to the Tasman District Council's Co-ordinator Compliance monitoring and the Nelson City Council's Monitoring Officer for approval a Construction Management Plan outlining the order of construction activities and all practices and procedures to be adopted in order that compliance with the conditions of this consent can be achieved and the effects of construction activities are minimised to the greatest extent practicable".*

The CMP was to comprise a raft of 'sub-plans', such as those previously mentioned, plus many others covering Emergency Procedures, Noise, Traffic Management, Restoration, Temporary Works and Work Site management. The consent went on to identify particular aspects of work that needed to be addressed in these plans.

7 CONCLUSIONS

At an early stage the Nelson Regional Sewerage Business Unit identified that the proposed construction of a 2.6km, 800mm OD wastewater pipeline across the Waimea Estuary had particular environmental, cultural and economic sensitivities, and embarked on an in-depth consultation process covering eight Regional Scheme upgrade options. This early and openly consultative approach was a key step towards the eventual success of the subsequent consenting process.

The genuine desire by NRSBU to listen to submitters concerns and collaboratively work towards the mitigation of those concerns continued into the consenting process. In this way, submitters became part of the solution, as opposed to taking on an adversarial role. By the time of the Hearing all submitters now supported the proposed works and the focus of the Hearing became just one of identifying consent conditions that were acceptable to all parties.

A further outcome of this consultative approach was the achievement of significant cost savings through the development of a set of consent conditions that mitigated submitter's concerns and whilst still accommodating a workable, cost effective construction approach.

ACKNOWLEDGEMENTS

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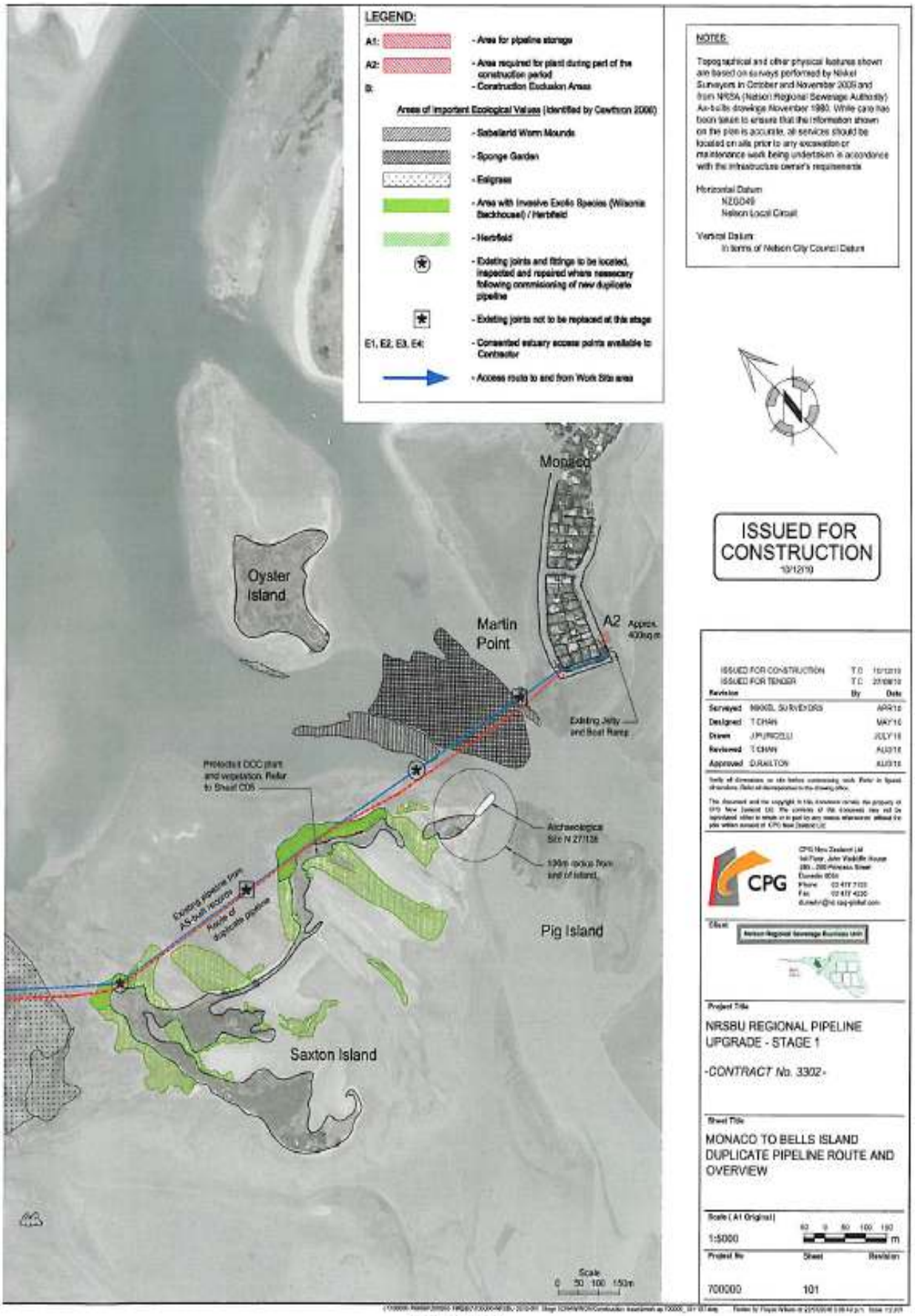

PART 1 OF 2
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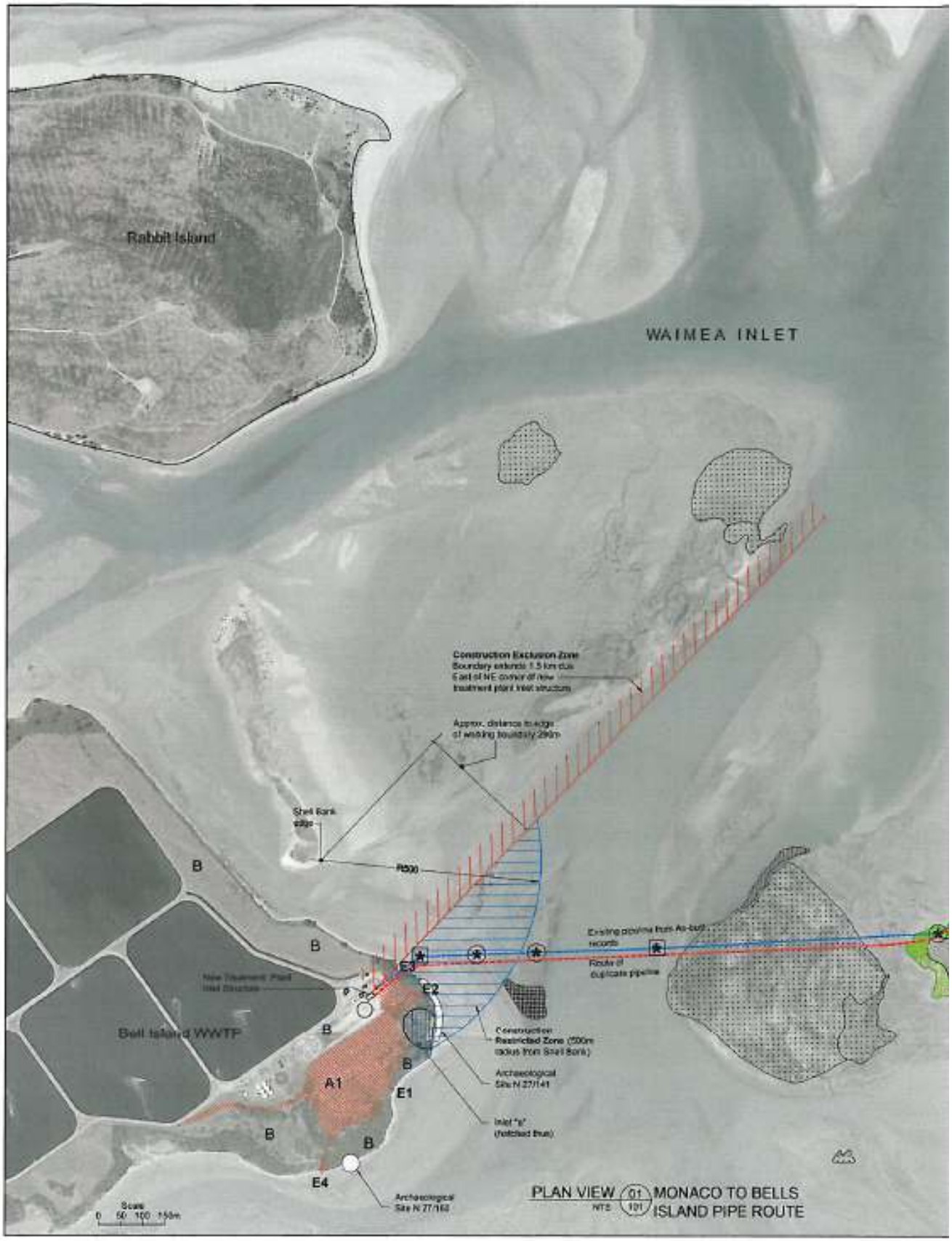
APPENDIX A



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APPENDIX A